Grassfed Beef in the Southeast

TRAINING MANUAL FOR PARTICIPANTS

MISSISSIPPI STATE UNIVERSITY EXTENSION

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SOUTHERN SARE
Sustainable Agriculture Research & Education

Forage Module Part I: Pasture Management

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GRASSFED BEEF IN THE SOUTHEAST: FROM SEED TO PLATE

Pasture Improvement

GRASSFED BEEF IN THE SOUTHEAST: FROM SEED TO PLATE

Pasture Improvement Steps

- Soil test
- Weed control
- pH amendment
- Land preparation
- Fertilizer application
- Building organic matter
- Selecting forages
- Seed calculation
- Legume seed inoculation
- Planting
- After planting

Find Out About Your Soil

- NRCS Web soil survey - https://drive.google.com/file/d/0Byo0fBSnPCfjUHVZSl9EY19XM1k/edit
  - Use this tool to identify soil and other aspects of your pastureland
    - Soil type
    - Slope
    - Other properties
  - Step by step procedure to use this site is available at this link https://drive.google.com/file/d/0Byo0fBSnPCfjUHVZSl9EY19XM1k/edit

Soil Test

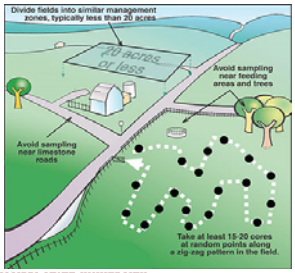
- Very important and the very first step
- Regular soil test evaluates major nutrient contents and pH
  - Nutrients – plants need different nutrients for growth
    - Major nutrients - Nitrogen, Phosphorus, Potassium
  - pH – Right pH is necessary for nutrient availability for plants
    - 5.8 – 6.5 pH suitable for most Southern forages
    - Legumes require higher pH than grasses - ≥6 - 7

Soil Test..

- Collect representative samples - 15-20 random sub-samples in a zigzag manner from a plot (20 acres maximum area - one composite sample) with uniform soil having same forage and topography
- Sample collection depth - 0-4 inches depth for perennial pastures, 0-6 inches or to the depth of tillage for annual pastures
- Avoid areas such as shade, watering and feeding facilities, and manure piles. Do not collect samples from within 150 ft. radius of these areas (see next slide)

Soil Sampling Pattern

- Not within 150 ft
  - Shade
  - Feeding
  - Water



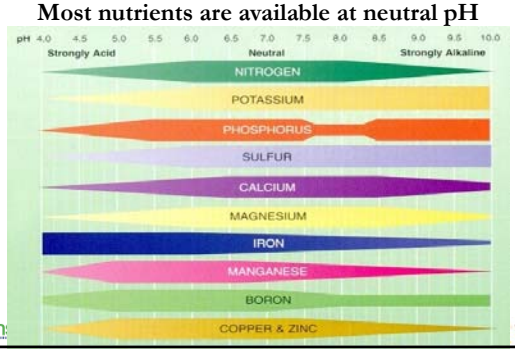
Soil Sample Collection

- Materials:
  - Soil core sampler, shovel, or trowel
  - Bucket
  - Sample bag

Soil Test..

- Collect all the sub-samples into a clean bucket and mix thoroughly
- Remove any non-soil materials from the sample
- Take a pint of composite soil sample and put in a sample bag, close it, label it with your name, address, sample name, and forage species that are growing or to be planted
- Mail the sample with required payment to the nearest Soil Testing Laboratory
- Use the soil test results for applying required lime and fertilizers

Most nutrients are available at neutral pH



Mineral Nutrients

Macro-nutrients

- **Nitrogen**
  - Required for photosynthesis (component of chlorophyll) and green leafy growth.
  - Legumes – they fix nitrogen into the soil and make available for plant. Pastures containing 33% or more legumes do not require the addition nitrogen
  - Application – This nutrient is unstable. Therefore, need to be used in divided doses:
    - First dose – after planting when all forages (grass and forbs) are germinated well and field looks green
    - Subsequent doses: After the first and subsequent grazing

Mineral Nutrients..

- **Macro-nutrients..**
  - Phosphorus
    - Necessary for root growth and development, growth and survival of seedlings, and fruit and seed formation
    - Stays in soil for a long time
    - Apply few weeks before planting (or at the time of planting if prior application is not possible)

Mineral Nutrients..

- **Macro-nutrients..**
  - Potassium
    - Necessary for maintaining cold hardiness, disease resistance, and root growth and development
    - Intermediate between phosphorus and nitrogen in terms of stability in soil
    - Apply few weeks before planting (or at the time of planting if not possible to apply before planting), second application may be required to meet the crop demand

Mineral Nutrients..

- **Other nutrients**: Other fertilizers including the micronutrients may be required for your pastures depending on the type of forages grown and their performance
  - **Secondary nutrients**
    - **Calcium**
    - **Magnesium**
    - **Sulfur**
  - **Micro-nutrients**
    - **Boron, manganese, copper, iron, molybdenum, chloride, zinc, nickel**
  - **Animal manure**

WEED CONTROL IS IMPORTANT

GRASSFED BEEF IN THE SOUTHEAST: FROM SEED TO PLATE

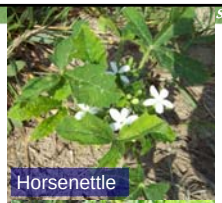
Weed Control – Why?

- Weeds compete with forages for nutrients, space, sunlight, and moisture, and reduce the productivity and quality of forages
- Some weeds can be poisonous to livestock
- Weeds must be controlled before applying any lime or fertilizer
- There are different methods of weed control

GRASSFED BEEF IN THE SOUTHEAST: FROM SEED TO PLATE

Steps of Weed Control

- Walk your pasture regularly
- Identify weeds



Weed Control Methods

- Close grazing with small ruminants
- Then bottom plowing at the beginning, and repeated tilling of the soil if still weeds or other plant persist
- If close grazing and soil tillage is not good enough to control the weeds, use of a suitable herbicide will be necessary. To decide which herbicide to use, visit this link and read the weed control chapter: http://www.tuskegee.edu/sites/www/Uploads/files/About%20US/TUCEP/Livestock%20Program/WeedProceedings.pdf
- Control weeds before they flower and produce viable seeds

Manage Weeds on Time

This stage is already too late!

Weed-Seed Spread - Minimize

- Weed seeds can spread through
  - Mower, chopper, or other farm equipment
  - Manure containing weed seed
  - Weed-contaminated hay
  - Grazing animals
  - Operators' shoes and clothing
- Minimize this possibility
  - Clean equipment, shoes, and clothes
  - Do not use contaminated hay or manure
  - Give rest to livestock for 3-5 days before bringing to clean pastures

Methods of Weed Control

- Cultural
- Mechanical
- Grazing/Biological
- Chemical
- Integrated

⟷ **PROPER TIMING**

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APPLY LIME AND FERTILIZER BASED ON SOIL-TEST RECOMMENDATION

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Soil pH Correction

- **Apply lime to the acidic soil to increase the pH**
  - 6 months to one year prior to targeted results in the permanent pastures where no tillage is applied
  - At least three months before planting in the annual pastures
- **Apply any of the following to lower the pH in alkaline soil**
  - Sphagnum peat, elemental sulfur, aluminum sulfate, iron sulfate, acidifying nitrogen, and organic mulches

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Fertilizer Application

- **Calculate the required amount**
  - **Calculate on your own**
    - **Use the fertilizer calculation sheet**
  - **Use online calculator**
    http://www.aces.edu/anr/soillab/chemfertilizercalc.php
  - **Do cost calculation and select the most economical fertilizer (nutrient vs. filler)**

Organic Matter for Improving Soil

- Add organic matter and build your soil
  - Compost, plant residues (shoots and roots), and animal wastes are the sources of organic matter
- Organic matter function
  - Holds the soil particles together forming aggregates, thereby reducing the risk of soil erosion
  - Maintains soil porosity and facilitates air and water movement through the soil as well as nutrient uptake by the plant roots

Organic Matter ..

- Organic matter..
  - Increases the nutrient retention and water holding capacity of soil
  - Facilitates the survival and growth of various flora and fauna (earthworms, microbes) and enhances the microbial activity and overall soil health
- Organic matter itself serves as a source of various nutrients required for plants

Organic Matter ..

Factors that promote gains of soil organic matter
Green manures or cover crops
Conservation tillage
Return of plant residues into the soil
Low temperatures and shading
Controlled grazing
High soil moisture
Surface mulches
Application of compost and manures
Appropriate nitrogen levels
High plant productivity
High plant root:shoot ratio

Source: Brady and Weil, 2002.

Organic Matter ..

Factors that promote losses of soil organic matter
Erosion
Intensive tillage
Whole plant removal
High temperatures and exposure to sun
Overgrazing
Low soil moisture
Fire
Application of only inorganic materials
Excessive mineral nitrogen
Low plant productivity
Low plant root:shoot ratio

Source: Brady and Weil, 2002.

PREPARE LAND WELL FOR SUCCESSFUL FORAGE ESTABLISHMENT

Land Preparation

- No-till drill
  - Drills seeds into the soil without opening much of the ground surface.
  - Very little or no soil erosion risk.
  - Can be rented or borrowed from most of the soil conservation districts or private companies.
  - Suitable to overseed annual or perennial forages into the existing pastures.

Land Preparation

- Light harrowing
  - If no-till drill is not available, then existing pasture ground can be slightly opened up with light harrowing so that planted seeds can be in close contact with open soil, without much damage to the existing stand

Harrowed field

Land Preparation

- Prepared seedbed
  - Prepared seedbed is necessary for establishing some of the forages, which have poorly competitive seedlings and take a long time for establishing, such as sericea lespedeza, bahiagrass, and perennial peanuts.
  - Seedbeds are prepared by disking, leveling, and cultipacking the soil, which should be left for about a month for developing firmness. Step depth of ¼ of an inch is a good indication of required firmness for a prepared seedbed

Disked and cultipacked seedbed

Select Suitable Forages

Warm-season Perennial grass	Soil type	Region
Bahiagrass	Sandy	Coastal plain
Bermudagrass	Wide range, but sandy is the best	Warm climate with mild winter
Dallisgrass	Loam and clay	Southern coastal plain
Johnsongrass	Clay	Most of the Southeast

Select Suitable Forages..

Warm-season annual grasses	Soil type	Region
Crabgrass	Wide range	Most of the Southeast; best in Gulf Coast area
Browntop & Pearl millet	Non-calcareous	Most of the Southeast
Foxtail millet	Well-drained soil	Most of the Southeast
Sorghum, Sorghum-Sudan hybrids, & sudangrass	Wide range	Most of the Southeast

Select Suitable Forages..

Cool-season perennial grasses	Soil type	Region
Tall fescue (MaxQ) & Orchardgrass	Clay and loam	Humid temperate areas (mid to upper Southeast)
Cool-season annual grasses	**Soil type**	**Region**
Annual ryegrass	Wide range	Most of the Southeast
Small grains (Oats, rye, triticale, wheat)	Wide range	All states

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Select Suitable Forages..

Warm-season perennial legumes	Soil type	Region
Sericea lespedeza	Clay and loam	Humid region (most of the Southeast)
Perennial peanut	Sandy, well-drained	South Alabama, Mississippi
Warm-season annual legumes	**Soil type**	**Region**
Cowpea & soybeans	Well-drained	Most of the Southeast

GRASSFED BEEF IN THE SOUTHEAST: FROM SEED TO PLATE

Select Suitable Forages..

Cool-season perennial legumes	Soil type	Region
White clover	Clay and loam	Humid temperate areas (most of the Southeast)
Alfalfa	Well-drained clay and loam	All States
Red clover*	Well-drained clay and loam	Humid region (all Southeast States)

*Biennial or annual in the South

GRASSFED BEEF IN THE SOUTHEAST: FROM SEED TO PLATE

Select Suitable Forages..

Cool-season annual legumes	Soil type	Region
Arrowleaf & Crimson clover	Well drained	Humid areas with mild weather
Hairy vetch	Wide range; sandy is the best	Most of the Southeast
Forb	**Soil type**	**Region**
Brassicas (kale, rape, turnip)	Moderately to well-drained	All states

Source: Ball et al., 2007

Calculation of Required Seed

- Calculate the required seed amount taking into account the germination percentage and seed purity

Seed calculation formula
Assume following values for this calculation:
Pasture area to be planted (A) = 1 acre
Recommended seed rate for selected forage species (B) = 25 lbs./acre
Seed purity = 98%
Germination rate = 90%

Source: Karki, 2015

Calculation of Required Seed

Seed calculation formula..
Actual amount of seed required per acre = recommended seeding rate ÷ (Purity% x germination %)
When the assumed values are put in the formula, following value is obtained:
Required seed amount (lbs./acre) = 25 ÷ (0.98 x 0.90)
= 28.34 lbs./acre

Source: Karki, 2015

Inoculation of Legume Seeds

- Inoculums contain certain *Rhizobium* bacteria that colonize legume roots, form nodules in the roots, and fix atmospheric nitrogen into the soil by functioning within the root nodules. This nitrogen is available to the plant.
- Legume seeds must be inoculated before planting to a new field; otherwise, legumes cannot perform well.
- Inoculums must be fresh and stored refrigerated until used.
- Inoculation process has to be completed in a cool, dry, and shaded place.
- Pre-inoculated seeds do not require inoculation. Inquire with the seed supplier whether the seeds are pre-inoculated.

Source: Karki, 2015

Inoculation

- Inoculate the legume seeds just before planting

Root nodules on inoculated winter peas (look at the arrow).

Source: Karki, 2015

Planting Forages


Using no-till drill

- Calculate the required amount of seed
- Plant seed at a proper depth
  - Planting depth for small seeds: Bahiagrass, sericea lespedeza, tall fescue, crimson clover, and berseem clover – ¼ to ½ inch
  - Planting depth for larger seeds: hairy vetch, rye, wheat, and cowpea – 1- 2 inches
  - Useful guides for selecting and planting forages:
    - Alabama planting guide for forage legumes: http://www.aces.edu/pubs/docs/A/ANR-0150/ANR-0150.pdf
    - Alabama planting guide for forage grasses: http://www.aces.edu/pubs/docs/A/ANR-0149/ANR-0149.pdf
- Planting too deep is the number one cause of the stand failure

Forage Plantation

- Make sure planted seeds have a good contact with soil.
- The poor seed-soil contact is the number two cause of stand failure.
- Plant forages at the right time. Late planting will reduce competitiveness as weeds and other seasonal plants will be favored by the weather conditions. As a result, the growth of target forage will be dominated by the weeds at an early growth stage and forage establishment will be affected.

Forage Plantation

- Using seed spreader

Photo curtsey: U. Karki

Forage Plantation..

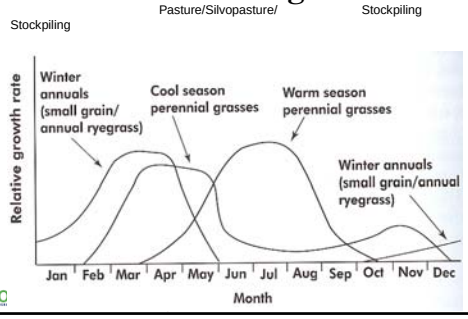
Using a hand spreader in a harrowed field

Spreading with hands on in a small acreage

After Planting

- Cultipack – if planted on a firm, leveled bed
- Irrigate if required
- Take animals off until forages are ready for grazing
- Overseed if required (forage coverage <80%) in the subsequent seasons
- Start grazing when forages are ready following the sustainable grazing practice

Year-Round Grazing is Possible



Useful Resources

- Year-round pasture production and management
  http://www.tuskegee.edu/sites/www/Uploads/files/About%20US/TUCEP/Livestock%20Program/YearRoundPasture_ProductionManagement.pdf
- Pasture weed identification and management
  http://www.tuskegee.edu/sites/www/Uploads/files/About%20US/TUCEP/Livestock%20Program/WeedProceedings.pdf
- Year-round pasture and grazing calendar
  http://www.tuskegee.edu/sites/www/Uploads/Users/732/Files/tucep/Livestok%20Program/Year-round%20Pasture%20Calendar.pdf

GRASSFED BEEF IN THE SOUTHEAST: FROM SEED TO PLATE

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Forage Module Part II: Forage Management

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GRASSFED BEEF IN THE SOUTHEAST: FROM SEED TO PLATE

Outline

- Getting to Year Round Grazing
- Grazing Management
  - Quantity
  - Quality
  - Methods
- Stocking Rate
  - Tools for Management
  - Putting it All Together

GRASSFED BEEF IN THE SOUTHEAST: FROM SEED TO PLATE

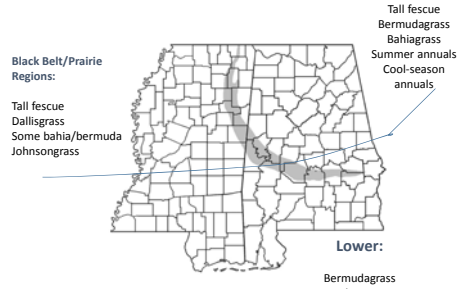
Getting to Year Round Grazing

GRASSFED BEEF IN THE SOUTHEAST: FROM SEED TO PLATE

How can we work towards year round grazing in grass-fed systems?

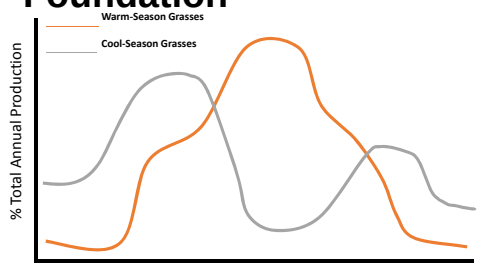
- **Match** quality with needs
- **Perennial forages** provide the base
- **Annual forages** as a supplement – to fill in production gaps and/or provide higher quality

GRASSFED BEEF IN THE SOUTHEAST: FROM SEED TO PLATE

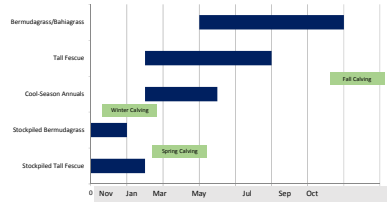


GRASSFED BEEF IN THE SOUTHEAST: FROM SEED TO PLATE

Forages as the Foundation



Forage Growth Distribution and Calving Season



Steps to Increasing the Number of Grazing Days Per Year

- Know your starting point
  - What do I currently have?
- Identify forages to fill in the gaps
- Manage, manage, manage

Increasing the number of grazing days

- Know your starting point
- Take a walk!
- Actual vs. perceived

Increasing the number of grazing days

Evaluate:

1. What is the forage base I am working with?
2. What is the percent of desirable species in the stand?
   - Grass
   - Legumes
   - Weeds
   - Bare ground
3. Based on this, what can be done to improve the stand?

Steps to Increasing the Number of Grazing Days Per Year

- Know your starting point
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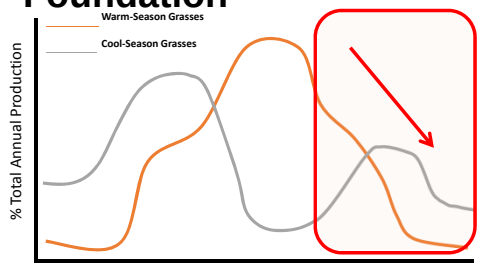
Forages as the Foundation



Extending the grazing season Alternatives for Winter

- Opportunity to reduce production costs associated with winter feeding
- Feed costs can account for 40 to 75% of the cost of production for brood cows
- **Investment** in stockpiling, winter annuals, and legumes where possible reduces the amount of harvested forage needed to maintain cow performance

Stockpiling - Defined

A forage management practice in which forage is allowed to accumulate for grazing at a later time

Candidates for Stockpiling in the Southeast

Bermudagrass — Most success
Tall Fescue

Bahiagrass — Some success
Dallisgrass

Stockpiling - Process

In late summer/early fall:

- Graze/Clip
  - 2" stubble height
- Fertilize
  - 60 to 80 lb N per acre (on average)
- Wait
  - Allow forage to accumulate for 8 to 12 wk

Stockpiled bermudagrass

Usually sufficient for dry, pregnant cows

May be sufficient for lactating cows and growing calves*

- Dependent on stage of production
- Forage variety and management
- Some supplementation may be required later in season

Lalman et al., 2000

Table 1. Nutritive value of stockpiled Tifton 85 bermudagrass receiving different rates of N fertilization – 2 year summary.

Sampling Date	CP, %	TDN, %
Early-Nov	17	73
Late-Nov	12	64
Dec	11	58
Early-Jan	11	53
Late-Jan	10	53
Average	12	60

Holland et al., 2014

Economics - Stockpiling

Table 2. Estimated costs ($ per cow) associated with stockpiled Tifton 85 bermudagrass pastures or hay plus supplement.

Input†	Treatment			
	50 lb N per acre	100 lb N per acre	150 lb N per acre	Hay + 6 lb whole cottonseed daily
Nitrogen, lb	$23.91	$47.81	$71.72	0
Grazing cost	$108.80	$108.80	$108.80	0
Hay	0	0	0	$237.27
Labor	$16.97	$16.97	$16.97	$32.50
Supplement	0	0	0	$146.16
Fixed costs of machinery	$24.50	$24.50	$24.50	$90.63
Cost per cow	$174.18	$198.08	$221.99	$506.53

†Variables included cost of N (ammonium nitrate). Grazing cost includes forage establishment and herbicide. Labor, hay harvest, supplement, and machinery costs were also considered.

Holland et al., 2014

Stockpiling tall fescue

- Maintains high digestibility and palatability
- Leaves do not deteriorate as quickly as other stockpiled forages
- Good sod former

Available forage (lb DM /acre)	Rotational stocking	Strip grazing
	-------steer days/acre-------	
1500	30-40	50-60
2000	40-50	60-65
2500	50-60	65-70

Adapted from Hancock and Gadsey (2010); Assumes growing steer, 700 lb, Expected intake = 2.5% body weight

Why cool-season annuals?

- Extending the grazing season
- Reduce feed costs
- Supplement to tall fescue systems
- Staple forage for winter where fescue is not adapted
- High potential quality and quantity

Extending the grazing season with overseeding

Overseeded Coastal bermudagrass in southeastern Alabama

		Cows	Calves	
Species overseeded	Dates on pasture	Average daily gain, lb	Average daily gain, lb	Gain, lb/acre
Rye, arrowleaf and crimson clover	Jan-Oct	0.90	1.91	511
Arrowleaf and crimson clovers	Mar-Oct	1.37	1.94	410
Ryegrass	Feb-Oct	0.81	1.76	422
None	April-Oct	0.49	1.57	293

Source: Hoveland, C.S. Auburn Univ. Agron. Soils Dept. Exp. Stn. Bull. 496

Animal Performance – Stockers on Cool-Season Annuals

	Grazing days	Stocking rate, animals/acre	ADG, lb/d	Gain per acre	Variable Pasture Cost of Gain ($/lb gain)	Total Pasture Cost of Gain ($/lb of gain)
Trical 2700 triticale	119	1.4	2.5	417	0.74	0.81
SS8641 wheat	123	1.6	3.0	590	0.45	0.50
Marshall ryegrass	126	1.3	3.0	490	0.51	0.56

Source: Lemus et al., 2014

Steps to Increasing the Number of Grazing Days Per Year

- Know your starting point
  - What do I currently have?
- Identify forages to fill in the gaps
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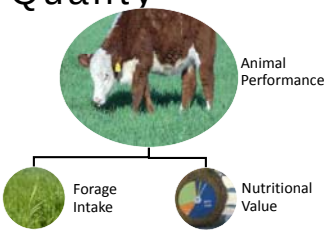
Forage quality and quantity

Animal Performance and Forage Quality



Intake

- Intake = consumption
- Influenced by:
  - Bite size
  - Bite rate
  - Grazing time/time spent eating

Intake and Animal Selectivity

- Ability to select the highest quality in the sward first
- Livestock have preferred plants in the system
  - "Ice Cream Plants"
  - These areas are visited the most often
- Legumes > Grasses

Intake and Animal Selectivity

- Cattle prefer less mature plant tissue over stemmy material
- Prefer leaves over stems and infloresences specifically
- Preferences shift over the grazing season according to 1) plant availability and 2) changing maturity

Intake – Grazed Tall Fescue

150 d grazing

	High Quality (+ Legumes, Mowed periodically)	Low Quality (Mowed once)
Intake, lb/hd/d	24 a	18 b
Digestible DM Intake, lb/hd/d	14 a	11 b
Cow Weight, Final	1070 a	1015 b
Calf Weaning Weight	508 a	470 b

Holloway et al., 1979

Forage Demand – Animal Considerations

Type, livestock	Approximate lb hay/animal/day	Approximate fresh forage/animal/day†
Cows with calves	25-28	80-90
Replacement heifers (550 lb)	10-15	30-40
Growing steer (650 lb)	15-20	40-50
Finishing steer (900 lb)	25-30	80-90

Adapted from Ball et al., 2015 – A.46 – Estimating Hay Needs
†Assumes 70% moisture, 30% dry matter in forage

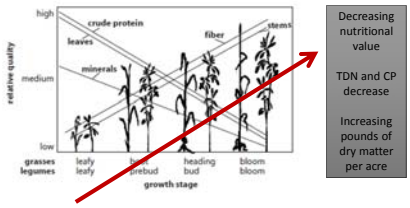
Forage nutritional value

The available energy (total digestibility) and concentration of crude protein

Largely influenced by stage of maturity

With increasing maturity, increasing fiber

Fiber = cellulose, hemicellulose, and lignin



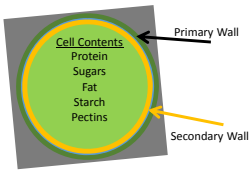
Decreasing nutritional value

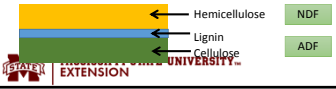
TDN and CP decrease

Increasing pounds of dry matter per acre

Source: Understanding forage quality, Ball

Understanding fiber





NDF

ADF

Fiber Digestion by Rumen Microbes

fiber

intake

digestibility

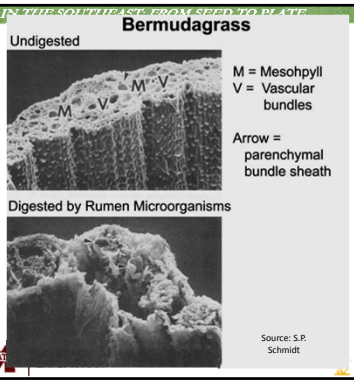


Table 3. Crude protein, ADF, NDF, and TDN of various forage crops

Forage	CP, %	ADF, %	TDN, %	NDF, %	Intake, % BW
Alfalfa					
Bud	24	30	65	43	2.8
Early flower	20	34	63	45	2.6
Mid-bloom	16	38	60	50	2.4
Full-bloom	12	42	55	58	2.1
Ryegrass					
Vegetative- boot	14	30	65	50	2.4
Boot-head	10	35	60	55	2.2
Bermudagrass					
4-week old	12	35	55	65	1.8
8-week old	7	43	47	73	1.6

Adapted from Henning and Lacefield, 2008, Southern Forages Pocket Guide

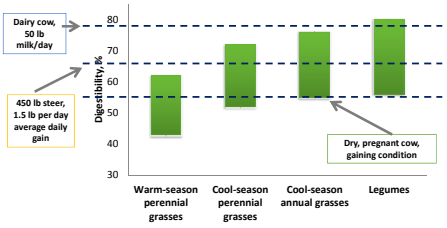
Forage Quality Factors
Forage Species

Generally:

Legumes > Grasses

Cool-season grasses > Warm-season grasses

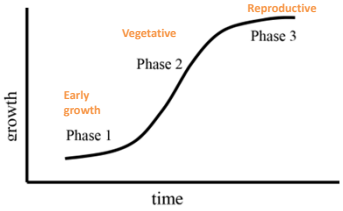
Forage Species



Forage Quality Factors Environment and Others

- Weather
  - Rainfall – frequency and amount
- Temperature
  - Greater temperature – accelerated process
- Pests
  - Weeds, insects, disease, etc.

Managing for Quality – Plant Growth Curve



Grazing methods

Overall Goal

Efficient production and utilization of a forage base that is able to meet the needs of the livestock herd.

Can be achieved through:
Implementing **grazing methods** within a grazing system

Grazing Methods: Goals

1. Improved grazing efficiency
2. Reduce pasture waste
3. Conserve surplus forage (hay or silage)
4. Increased animal performance
5. Improved forage quality at time of use

Methods Matter

Grazing Method	Estimated Typical Efficiency
Continuous stocking	30-40%
Slow rotation (3-4 paddocks)	50-60%
Moderate rotation (6-8 paddocks)	60-70%
Strip grazing	70-80%

Source: Forage Pocket Guide, Ball et al., 2015

Continuous stocking

"Animals stocked on single pasture unit for duration of grazing season"

Pros	Cons
• Simple • Animals are allowed to selectively graze • May result in overall high individual animal performance	• May lead to overstocking, overgrazing, decreased forage production • Lowers overall potential for herd performance • Least efficient

Rotational stocking

"A grazing method in which the grazed area is divided into a given number of smaller paddocks"

Pros	Cons
• Potential increase in forage utilization compared to continuous • Flexibility in managing excess • Better match nutrient requirements of animals with forage nutritional value • Improves pasture management skills	• Initial investment on fences, water, feed bunks • Labor availability • More ma… decisions

Limit Grazing

Allow access to pasture for a short period of time to stretch available grazing

Graze until cattle lay down – then move back

Usually 5 to 8 hours per day

May decrease hay needs by 30%

Source: Gunter et al., 2002; Lang and Broome, 2002

Using a strip grazing approach

Strip-grazing tall fescue

Bale-grazing to spread nutrients

Strip Grazing/Frontal Grazing

Pros	Cons

• Another form of rotational stocking
• Efficient use of forage
  • Animals graze area for a period of a few days before fence is moved forward
  • Especially good in stockpiled forage systems
  • Decreases animal selectivity in pastures
	• Labor – medium to high
	• Adaptability to large operations – need to broken into manageable land units

Grazing Management - applications

Forage Supply and Demand

Scenario #1

Good Nutritional Value: Forage is 62% TDN, 14% CP

Low Forage Quantity: Overgrazed, intake is limited

Supply
- Short, closely grazed pastures

Demand
- Intake continues regardless of if plants continue to grow
- Especially depends on animal requirements

Bottom line: Overgrazing

"The Golf Course"

GRASSFED BEEF IN THE SOUTHEAST: FROM SEED TO PLATE

Forage Supply and Demand

Good Nutritional Value: Forage is 58% TDN, 12% CP

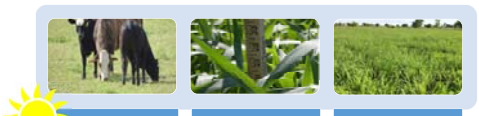
Adequate Forage Quantity: Intake needs are met

GRASSFED BEEF IN THE SOUTHEAST: FROM SEED TO PLATE

Canopy Height and Grazing of Various Forage Crops

Crop	Begin Grazing (in.)	End Grazing (in.)
Alfalfa	10 to 16	3 to 4
Bahiagrass	6 to 10	1 to 2
Bermudagrass	4 to 8	1 to 2
Clover, white	6 to 8	1 to 3
Dallisgrass	6 to 8	3 to 4
Tall fescue	8 to 12	4 to 8
Annual ryegrass	6 to 12	3 to 4
Small grains (rye, wheat, oats)	8 to 12	3 to 4

The Three R's



Residual

Stubble height remaining impacts stand regrowth potential. Min. of 2" for bermudagrass and 4" for tall fescue stands.

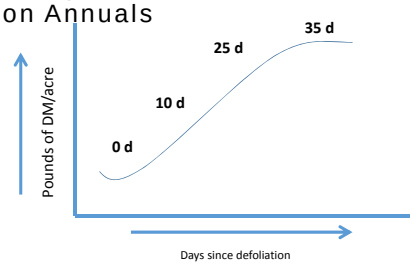
Rest

Remove cattle from grazed area. Rotate to new pasture or feed cattle in designated "sacrifice" area to allow for pasture rest.

Recovery

The combination of adequate residual and rest leads to recovery...plant regrowth occurs more rapidly when grazing intensity and frequency are managed.

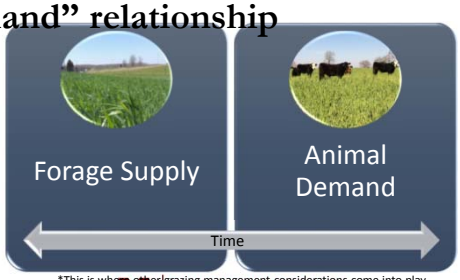
Plant Responses to Defoliation – Cool-Season Annuals



Adapted from Hodges et al., 2007

Stocking rate

Stocking rate is a "supply and demand" relationship



*This is where other grazing management considerations come into play (i.e. stocking method, time on paddock)

What we need to know:

- Forage Supply – Plant Considerations
  - Forage mass
  - % Forage Utilization
  - Number of Acres to be Grazed

Forage Supply Considerations

- Conditions for adequate forage mass
  - Fertility – soil and added amendments
  - Improved forage species – potential to respond
  - Total area planted
  - Expected utilization

Methods for Estimating Forage Mass in Pastures

- Forage height estimation
  - Fast, easy estimates
  - Grazing stick
    - Relates the height to pounds per acre
  - Ultimately, visual estimates can be accurate after practice

What we need to know:

- Forage Demand – Animal Considerations
  - Average weight of animals to be grazed
  - Dry matter consumed per animal (% of body weight per day)
  - Number of animals

What we need to know:

- Time – Days on Pasture

Putting it all together

Scenario:

Starting weaned calves on a forage finishing program

Growing steers – 550 lb,Cool-season forage system

	Forage Utilization (%)			
Forage DM Production Per Season (lb/acre)	20	40	60	80
	----------steers/acre†----------			
2,000	0.1	0.2	0.4	0.6
4,000	0.2	0.3	0.5	0.7
6,000	0.3	0.4	0.6	0.8

†Assumes 550 lb steers, 15 lbs dry matter intake per steer

Establish a grazing management plan

- Estimate supply and demand with available resources
- Make adjustments to the system to improve grazing efficiency
- Maintain pastures in adequate condition

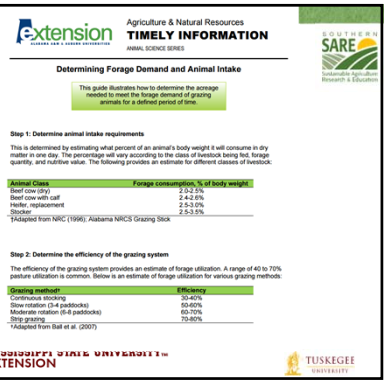
Resources and additional information

Understanding Stocking Rates in Grazing Systems

Agriculture & Natural Resources
TIMELY INFORMATION
ANIMAL SCIENCE SERIES

Understanding Stocking Rates in Grazing Systems

Determining Forage Demand and Animal Intake



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Determining Forage Demand and Animal Intake

This guide illustrates how to determine the acreage needed to meet the forage demand of grazing animals for a defined period of time.

Step 1: Determine animal intake requirements

This is determined by estimating what percent of an animal's body weight it will consume in dry matter in one day. The percentage will vary according to the class of livestock being fed, forage quantity, and nutritive value. The following provides an estimate for different classes of livestock:

Animal Class	Forage consumption, % of body weight
Beef cow (dry)	2.0-2.5%
Beef cow with calf	2.4-2.6%
Heifer, replacement	2.5-3.0%
Stocker	2.5-3.5%

†Adapted from NRC (1996); Alabama NRCS Grazing Stick

Step 2: Determine the efficiency of the grazing system

The efficiency of the grazing system provides an estimate of forage utilization. A range of 40 to 70% pasture utilization is common. Below is an estimate of forage utilization for various grazing methods:

Grazing method†	Efficiency
Continuous stocking	30-40%
Slow rotation (3-4 paddocks)	50-60%
Moderate rotation (5-8 paddocks)	60-70%
Strip grazing	70-80%

†Adapted from Ball et al. (2007)

Cattle Module

Dr. Brandi Karisch and Cobie Rutherford
Mississippi State University

Start with the Goal in Mind

- Goal: Have cattle the are well managed and genetically adapted to produce high quality beef in forage systems
- Start with selection of good genetics
- Manage them well and provide good nutrition

Genetics

Start by asking questions…

1. How are you going to offer your customers a consistent and quality beef product?

$$P = G + E$$

Defining 'E'

- Everything that is non-genetic.
  - Nutrition
  - Health
  - Pasture/Forages
  - Weather
  - Etc.
- Optimize environment to reach full genetic potential

Table 1. Heritability estimates for some common beef traits.

Trait	h^2
Calving Interval	.05
Female Fertility	.04
Weaning Weight	.35
Milking Ability	.35
Marbling	.45
Mature Weight	.50

Selectin 'G'

2. How are you going to offer your customers consistent and quality beef products?
   - What do consumers want?
   - What is our endpoint?
     - Age in days?
     - Backfat thickness?
     - Weight?

Achieving Uniformity

- Consistent beef begins with a uniform cow herd
- Producers should set targets for:
  - Mature Weight
  - Frame size
  - Body type
- Select bulls that complement cows and will allow breeding goals to be met.

Genetic Selection for consistency

- **Genetic Selection is important for consistency**
  - Cow Herd
    - Uniformity
  - Bull Battery
    - Avoid extremes
  - Replacement Females
    - Maternal traits
    - Performance
  - Manage calving intervals

End Point Goals – Carcass

Standard Industry Targets for Carcass Traits

- Carcass Weight: 650 to 850 lbs
- Back fat: 0.25 to 0.49 in
- Rib Eye Area: 11 to 15 in^2
- Yield Grade: less than 3.0
- Quality Grade: Select + to Choice +

End Point Goals – Live Animal

- "Marketing Window of Acceptability"
- Optimal Live Cattle Characteristics
  - Live animal weight at maturity 1000-1350 lbs
  - Classified with a USDA muscling score of 1 or 2
  - Maximum backfat thickness over 12th and 13th rib of 0.30 to 0.45 inches

Muscle Score Feeder Calf Grades

- Muscle thickness refers to the development of the muscle system in relation to skeletal size
  - varies with bone structure, muscling and degree of fatness
- Scored 1(moderate thickness) to 4 (unthrifty or disease)

Muscle Score Feeder Calf Grades

- No. 1-Moderately thick throughout- showing a well rounded appearance through the back and loin with moderate width between the legs
- No. 2-Slightly thick throughout- rounded through back and loin with slight width between legs
- No. 3-Thin throughout Legs are close together- Some dairy breeding. Sunken appearance to back and loin
- No. 4-Less thickness than No. 3 – (dairy)

How to select for muscle?

- Muscle scores can be visually determined.
- For herd sire prospects producers can use a number of tools to make a selection decision:
  - EPDs, Genomic tests, and Ultrasound data

Frame Scores

- Large Frame
  - Tall and long for age Half inch of fat-12th rib
  - Steers, 1200 lbs or more
  - Heifers, 1000 lbs or more
- Medium Frame
  - Slightly tall and slightly long for age Half inch of fat-12th rib
  - Steers, 1000-1200 lbs
  - Heifers, 850-1000 lbs
- Small Frame
  - Small frame and shorter-bodied for age Half inch of fat-12th rib
  - Steers, less than 1000 lbs
  - Heifers, less than 850 lbs

Calculating Frame Score

- 1-3: Small Frame
- 4-6: Moderate Frame
- 7-10: Large

What is the ideal cow?

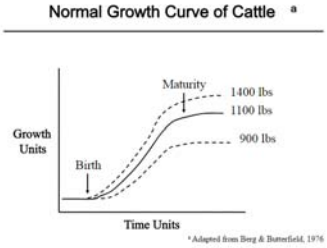
- A cow that will raise a nice calf, can maintain her body condition, will re-breed, and be profitable!
- Select for type: the characters that contribute to an animal's usefulness for a specific purpose (Ensminger 1951).
  - The presumed relationship between the animal's body conformation and its ability to perform a function (Cole, 1966)

Cattle Type

- Frame size
  - Larger framed cattle will finish at a heavier weight, and produce more beef, but require more time on feed
- Fleshing ability
  - Ability of an animal to put on fat or finish
- Muscling
  - More muscle means more beef to an extent.
  - Consider portion size.

Cattle Growth Curve

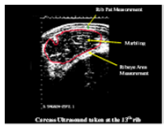
- When cattle are finished/mature, their skeletal and muscular growth are almost complete.
  - Where the line begins to flatten
- Mature cattle increase in weight by the accumulation of fat.



Fleshing Ability

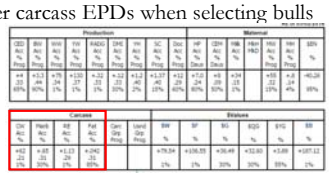
- **Genetic Selection**
  - Which cows maintain flesh while lactating?
  - Tools
    - Expected Progeny Differences (EPDs)
    - Ultrasound
    - Carcass performance data

CW Acc %	Marb Acc %	RE Acc %	Fat Acc %
+.31 .29 65%	+.45 .25 60%	+.51 .28 45%	+.038 .25 90%



Cattle type

- Will you current genetic base work?
  - Consider your cows and bulls
  - Consider carcass EPDs when selecting bulls



Using Carcass EPDs

Percentile Breakdown Non-Parent Bulls											
	Production							Carcass			
Top Pct	CED	BW	WW	YW	RADG	DMI	YH	CW	Marb	RE	Fat
1%	16	-2.8	77	135	0.36	-0.7	1.2	66	1.36	1.02	-0.049
5%	13	-1.4	69	121	0.31	-0.41	1	57	1.06	0.85	-0.031
10%	12	-0.8	65	113	0.29	-0.26	0.8	52	0.92	0.76	-0.021
25%	9	0.3	58	101	0.25	-0.01	0.6	44	0.7	0.62	-0.006
50%	6	1.4	50	89	0.2	0.27	0.4	35	0.5	0.46	0.011
75%	3	2.5	43	75	0.16	0.55	0.2	26	0.33	0.31	0.027
95%	-2	4.2	30	53	0.09	0.99	-0.1	13	0.11	0.1	0.052

Reminder…

The best genetics on the planet will not perform if their nutritional and health needs are not met!

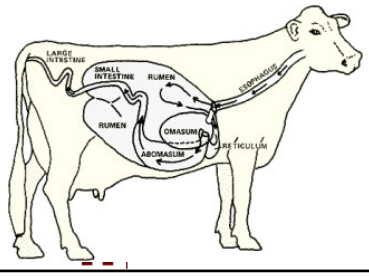
Nutrition

Ruminant Digestive System

- Beef cattle can better use energy from fibrous plant materials that monogastrics (swine, people, poultry) or other herbivores could not utilize.
- Digestive system designed to work symbiotically with microbes to obtain nutrients

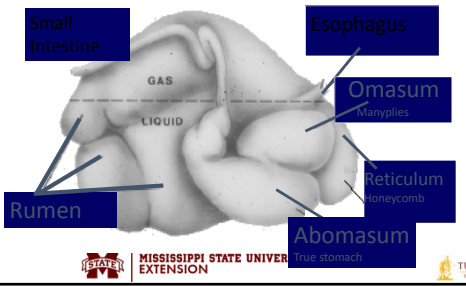
GRASSFED BEEF IN THE SOUTHEAST: FROM SEED TO PLATE

Ruminant Digestive Tract



GRASSFED BEEF IN THE SOUTHEAST: FROM SEED TO PLATE

What is the ruminant stomach?



GRASSFED BEEF IN THE SOUTHEAST: FROM SEED TO PLATE

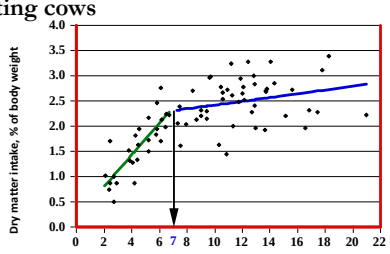
Digestion

- Ruminants have a 4 compartment stomach vs monograstrics who only have 1 compartment
- Rumen, Reticulum (honeycomb), Omasum (manyplies), Abomasum (true stomach)

Ruminal Microbes Vs. Cattle

- Rumen microbes:
  - Bacteria, protozoa, yeast
  - Nitrogen and protein
    - Amino acids and proteins
    - NPN: Ammonia, urea, etc.
  - Energy
    - carbohydrates
  - Minerals
  - Other nutrients
- Cattle

Impact of forage CP level on DMI in beef cattle--nonlactating cows



Protein Supplementation

- Protein supplementation stimulates the intake of low quality forage:
  - Nitrogen from protein increases microbial population in the rumen
  - Increased microbes = increased digestion = increased intake

Feed the microbes!

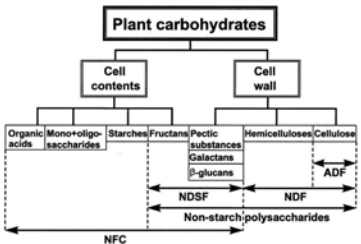
Major Nutrient Groups

- **Water**
- **Carbohydrates**
- **Proteins**
- Lipids
- Vitamins
- Minerals

Water

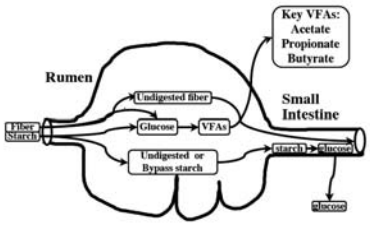
- Often overlooked, but the most important nutrient
- Sources include:
  - Drinking water
  - Water contained in forages and feedstuffs
  - Metabolic Water

Carbohydrates



Source: Hall, 2002 Journal of Animal Science

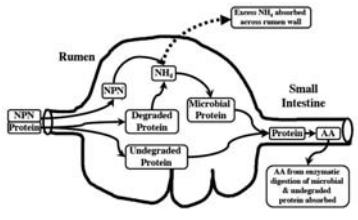
Carbohydrate digestion



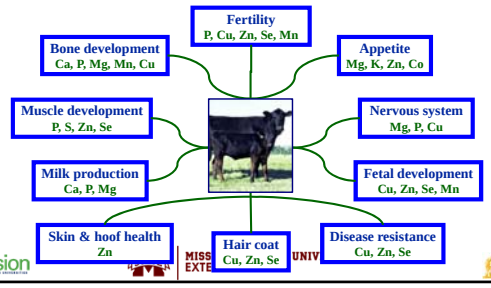
Protein

- true protein: protein composed only of amino acids
- nonprotein nitrogen (NPN): compounds that are not true protein in nature but contain N and can be converted to protein by bacterial action
- digestible protein: portion of protein that an animal can digest
- essential amino acids: AA's that are not synthesized in animal tissues in sufficient amounts to meet metabolic needs
- bypass protein: protein that escapes rumen digestion

Protein Digestion in the Rumen



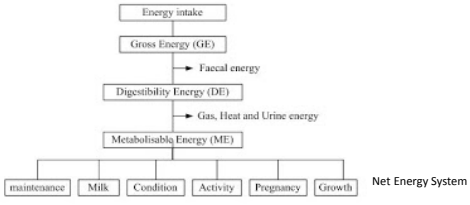
Why are minerals important?



Growing and Finishing Nutrition

- Each forage may supply different proportions of total digestible nutrients (TDN).
- Nutrient requirements in beef cattle vary due to sex, age, weight, performance expected and stage of production.
- For optimum production and profits, match livestock nutrient requirements with forage nutrient levels.

Measuring energy



Net Energy System

Factors Affecting Maintenance Requirements

- Weight
- Breed
- Weather
- Activity
- Genetics
- Physiological Status
- Fetal size
- Milk production
- Sex
- Age
- Previous nutrition
- Body composition
- Hair, Hide, etc
- Management strategies
  - Implants, ionophores, etc.
- Diet composition
- Others

Growing Cattle Requirements

- Net energy system (requirements for maintenance, growth, and other physiological processes).
- Daily NEg requirements are dependent upon:
  - **Weight**
  - **Average daily gain**
  - **Frame size**
  - **Sex**
  - **Age**
  - **Compensatory growth**

Factors which cause the proportion of FAT in gain to increase will increase NEg requirements

Nutrient Requirements

- The National Research Council (NRC) published Nutrient Requirements of Cattle. Last updated in 2016.
- Accompanied by a model that allows you to plug in specific animals and determine requirements based on environmental conditions
- https://www.nap.edu/catalog/19014/nutrient-requirements-of-beef-cattle-eighth-revised-edition

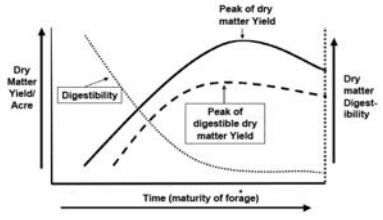
Nutrient Requirements

Body weight, lb	ADG, lb	Dry matter intake, lb/day	Diet Nutrient Density		Daily Nutrients / Animal	
			TDN, % dry matter	CP, % dry matter	TDN, lb	CP, lb
300	0.5	7.8	54	9.4	4.2	0.73
	1.0	8.3	58	11.5	4.8	0.95
	1.5	8.6	63	13.7	5.4	1.17
	2.0	8.6	68	16.2	5.8	1.40
	2.5	8.6	73	18.7	6.3	1.61
	3.0	8.3	80	22.0	6.6	1.83
400	0.5	9.7	54	8.8	5.2	0.85
	1.0	10.3	58	10.4	6.0	1.07
	1.5	10.6	63	12.2	6.7	1.30
	2.0	10.7	68	14.1	7.3	1.51
	2.5	10.7	73	16.1	7.8	1.72
	3.0	10.4	80	18.7	8.3	1.94
500	0.5	11.5	54	8.4	6.2	0.97
	1.0	12.2	58	9.8	7.1	1.19
	1.5	12.6	63	11.2	7.9	1.41
	2.0	12.6	68	12.9	8.6	1.63
	2.5	12.6	73	14.6	9.2	1.84
	3.0	12.2	80	16.8	9.8	2.05

Nutritional Quality of Forages

- Generally, the rank of quality by species:
  - Legumes>Cool-season grasses>Warm-season grasses
  - Annual>Perennials
- As plant maturity ↑ forage quality ↓
  - Leaf: stem ratio ↓
  - Cell wall (NDF) content ↑
  - DM digestibility ↓
  - Protein content ↓
- As plant maturity ↑ forage quantity ↑

Impact of maturity on quality and digestibility



Management

- Weaning Management
- Castration, de-horning
- Vaccination and Deworming schedule
- Determining when cattle are finished

Proper Management =

- *Less sick cattle, fewer treatments, fewer residues*

✓ Provide proper nutrition
✓ Reduce animal stress
✓ Vaccinate for best protection window
✓ Control internal and external parasites
  - Both can affect growth
  - External parasites reduce hide quality
  - Internal parasites lower immune function

- Castration
  - Producers should be experienced and competent in castration procedures, and know how to monitor for problems
  - Castrate young calves
    - A castrated young calf is healed by weaning
    - Performed preferably at less than 3 mos. of age
    - Veterinarians may be consulted regarding analgesia and anesthesia for procedures in older animals
  - Several options available

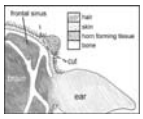
Emasculator
Newberry knife

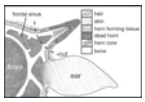
Burdizzo

Elastic bander
(Callicrate,
California, etc)

Dehorning

- Operators performing dehorning of cattle should be trained and competent in the procedure, and be able to recognize the signs of complications
- Dehorning is less stressful on baby calves
  - Performed at early horn development stage (bud)
  - Veterinarians may be consulted regarding analgesia and anesthesia for procedures in older animals
- Several options available, including genetics





Tube dehorner
Electric dehorner
Barnes dehorner

Health

- Consult your veterinarian
- Develop a herd health plan
- Vaccinate your cattle
  - Respiratory disease
  - Reproductive disease
  - Establishing immunity is important (stress)
- Deworm
- Fly control

Preconditioning Programs

Management strategies:

- Dehorning and castrating at a young age instead of near weaning
- Minimize weaning stress (low-stress weaning)
- Get calves onto feed and water rapidly
- Implement effective and economical nutrition and herd health programs
- May require at least 45 days weaned
  - feed bunk and water trough acclimation
  - can add value to calves

Preconditioning Programs

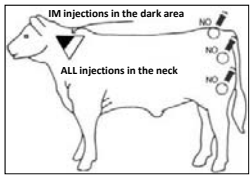
- Develop a nutritional program based around on farm forage resources targeting a desired rate of gain at a sensible cost.
- Implement proper vaccination and other herd health management practices.
  - Work closely with your veterinarian

- **Processing and Treatments**
  - Design a vaccination program with a veterinarian to prevent disease
  - Practice proper vaccine handling
    - Once vaccine is purchased, transport it in a cooler
    - Safeguard vaccines to maintain their effectiveness
    - Use modified-live vaccines properly
      - Only mix what you would use in 2 hours
      - Avoid using disinfectants

Practice Proper Injection Site Management

- Use proper restraint and facilities
- Administer no more than 10 cc/site – less for calves
- Give injections at least 4 inches apart
- All injections should be given in front of the shoulder

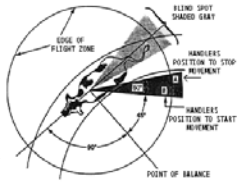
BQA Guidelines require all injections be given in the neck region, unless product is labeled otherwise.



Always Practice Low-Stress Cattle Handling

- Understand how cattle see and hear things
- Avoid visual distractions
- Use light to help (move cattle from dark to light areas)
- Understand herd behavior
- Work in a curve
- Use their flight zone
- Consider working surface (footing)
- Prudent use of prods, other assists

Flight Zones



Sources of Cattle Stress

Stress impacts health and cattle handling

- climate extremes
- climate changes
- disease
- parasites
- injuries
- mud
- noise
- predators
- poor nutrition
- calving
- handling
- weaning
- castration
- dehorning
- hauling
- commingling
- isolation

➢Some stressors are difficult to avoid or control.
➢Others are easily controlled with proper management.

Sources of stress at weaning

- When calves are weaned on the trailer:
  - Stress from weaning trauma
  - Stress from new location
    - Hauling stress
    - New surroundings
    - New diet
    - New diseases

Weaning Stress

- Weaning = one of the most stressful periods
  - separation from dam, new environment, new diet, transportation, commingling
  - increased risk of respiratory infections
- Use low-stress weaning techniques
  - fenceline weaning
  - anti-suckling devices

Determining when Cattle are Finished

- Visual Appraisal
  - Expect grass finished cattle to take longer and be older when they are finished. They will have less overall fat than a grain finished steer, but should still display characteristics of a fattened animal
- Ultrasound

Expected Carcass Value

- Potential to combine quality grade (fat) and yield grade (muscle) into a desirable package
- Areas to evaluate muscle are:
  - down the top (behind their shoulders, over their rib and loin)
  - from behind (hip, round, lower quarter, and stifle).

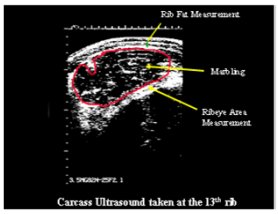
Finish

- Cattle put on fat from front to rear and top to bottom.
- Ideally market steers should possess somewhere between 0.3 and 0.5 inches of fat thickness over their 12th and13th ribs
- Hopefully at the mean (0.4) of the range, cattle have the opportunity to reach the Choice grade

Fleshing Ability

- The ease at which an animal gains weight and accumulates finish and muscle.
- Evaluating feed ability occurs at different viewpoints:
  - from the profile (depth of body),
    - need to display a deep rib design that is uniform from chest to flank.
  - from the front (chest width)
    - need to be optimally wide chested and come out of their spine with spring and outward curvature to their rib cage, both of which facilitate weight gain and, in turn, fat deposition.
  - at a ¾ rear view (rib shape).
    - We consider flat, shallow ribbed cattle as "hard doing" or "hard feeding" because, typically, this type has proven to limit a steer's finishing ability.

Carcass Ultrasound



Carcass Ultrasound taken at the 13th rib

Questions?

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Harvest and Meat Quality

Alex Tigue
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Harvest

Harvest

- What is your target market?
- Selecting a processor
- Delivering an animal to the processor
- Picking up your beef

What is your target market?

First and most important question

- Individual Consumers
- Farmers' Markets
- Grocery Stores
- Online Sales, On-farm markets, etc.

Individual Consumers

Advantages

- Pre-sale
- Sell one animal to 1-4 individuals
- Sell "live animal"
- Can use "custom" processors

Disadvantages

- Lead time on processing
- Customer backing out
- Volume for consumer

Farmers' Markets

Advantages

- Existing market
- Gap in the market
- Market to fit your production
- Sell cuts of meat, consumer preference

Disadvantages

- Lead time on processing
- Seasonality
- Weather dependent
- Farmer's Market req.
- Must use inspected processor
- Setting up at market
- Left-over meat, ground beef
- More

Grocery Stores

Advantages
- Once setup, easy
- Convenient for consumers
- Existing market
- Market to fit your production
- Sell cuts of meat, consumer preference

Disadvantages
- Lead time on processing
- Must use inspected processor
- Left-over meat, ground beef
- Paying store to carry product

MARKETING IS KEY

If you aren't interested in ***selling*** your product, do something else.

- Be creative
- Sell a good product
- Know your market

Select a processor

Considerations
- Location
- Reputation
- Cleanliness
- Services offered
  - Inspection
  - Aging
  - Fabrication
  - Packaging
- Price

Levels of Inspection

Custom
- Basic Sanitation Records
- **State Inspection Service is aware of their operation**
- Product can not be sold

State-Inspected
- Processor must have HACCP Plan
- Animals Inspected Ante-, Postmortem for signs of disease
- Product can be sold **within the state**, if properly labeled

Federally-Inspected
- Processor must have HACCP Plan
- Animals Inspected Ante-, Postmortem for signs of disease
- Product can be sold **across state lines**, if properly labeled

Aging

The process of allowing naturally-occurring enzymes to breakdown muscle fibers, increasing tenderness

- Research shows that majority of this occurs in the first 10 days
- Most processors will offer to hang carcasses 14 days
- After that, tenderness change is small
- Flavor will change dramatically
- Yield loss is significant after long aging periods

Packaging Types

Packaging Should
- Protect Product
- Display Product
- Increase Shelf-life

Overwrap Packaging

Oxygen-Permeable Film
- Keeps bright red color
- Short shelf-life
- Prone to freezerburn

Consumers are used to seeing this
- Common in grocery stores
- Good product visibility

Cheap


Courtesy of AU Lambert-Powell Meat Lab

Butcher Paper Wrapping

Wax-coated paper
- Great product protection
- Moderate Shelf-life
- Easy labeling

Tradition "butcher" packaging
- Nostalgic feel?
- Zero Product visibility
- Most processors use this

Cheap


Courtesy of Univ. of Nevada-Reno Meats

Vacuum Packaging

Oxygen-Impermeable Bag
- Excellent Shelf-life
- No freezer-burn

Consumers are becoming more accepting
- Becoming common in grocery stores
- Good product visibility
- Lack of oxygen creates purple color

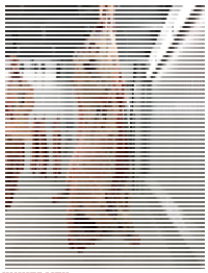
EXPENSIVE
- Equipment cost
- Some processors have not invested


Courtesy of AU Lambert-Powell Meat Lab

Pricing

Most processors use a similar pricing model

- "Kill" Fee
  - $25-75/Head
- Processing Fee
  - $0.45-0.70/lb. of carcass weight
- Further Processing
  - Additional fees for sausage, jerky, etc.



Delivering your animal to the processor

Considerations:

- SCHEDULE IN ADVANCE
- Communicate with the processor
- Use low stress-handling
- Withhold feed 24-hr
- Check withdrawal times on animal health products
- Process at under 30 months of age
- **Make sure calf is healthy**
- Be clear on ownership

Post-Processing handling

Remember 40-140 Rule!

- Keep refrigerated/frozen products under 40°F
- Keep warm foods above 140°F
- Transportation from the processor
  - Freezer with a generator in the bed of a pick-up works, as long as it can stay cold
- Freezer space at home
  - ~1 cubic foot of space per 35-40 lbs. of beef

Meat Quality

GRASSFED BEEF IN THE SOUTHEAST: FROM SEED TO PLATE

Meat Quality

- What can you expect from a grass-fed animal?
- How much meat will I get?
- Basics of carcass fabrication

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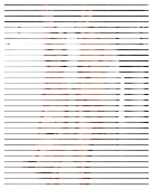
GRASSFED BEEF IN THE SOUTHEAST: FROM SEED TO PLATE

What is *possible* with grass-fed?

Kerth, C. L., K.W. Braden, R. Cox, L.K. Kerth, D.L. Rankins, Jr. *Carcass, sensory, fat color, and consumer acceptance characteristics of Angus-cross steers finished on ryegrass (Lolium multiflorum) forage or on a high-concentrate diet.* Meat Science, Volume 75, Issue 2, February 2007, Pages 324-331

- Compared 30 Angus-sired steers split onto 3 diets:
  100% Ryegrass, Ryegrass + Grain Supplement, and Corn-based finishing diet
- Ryegrass finished calves had lower USDA Yield Grade (leaner carcass)
- No differences in Quality Grade or Marbling Score



IT IS POSSIBLE TO TRULY FINISH CATTLE ON FORAGE!!!

*Under very specific conditions….

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What is realistic with grass-fed?

Vast majority of research paints a different picture

- Leaner Carcasses
- Lower Marbling Scores
- Slower Growth
- Smaller Carcasses/More Days on Feed
- Potential Consumer Sensory Issues

Yield Calculations

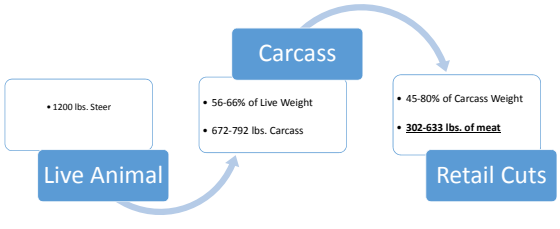
Typical Carcass Yield

- 56-66% of Live Weight
  - Breed, Sex, Degree of Finish, Gut fill, Diet, Feed Additives, etc.

Typical Yield of Retail Cuts

- Varies greatly
  - Fabrication Style, Leanness of Carcass
- Bone-In Fabrication
  - 60-80% of Carcass Weight
- Bone-less Fabrication
  - 45-55% of Carcass Weight

Yield Calculations: Conventional

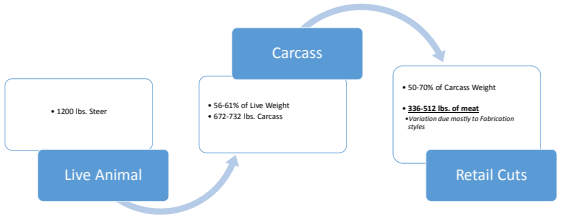


Yield Expectations for Grass-fed

Carcass Yield
- 56-66% of Live Weight Typical
- 56-61% for Grass-fed
  - Relatively Low Energy Diet, Few extremely fat cattle, Dairy-influence?, No Beta-Agonists

Yield of Retail Cuts
- Bone-In Fabrication
  - 60-80% of Carcass Weight
- Bone-less Fabrication
  - 45-55% of Carcass Weight
- Lean Carcasses and Hybrid Fabrication
  - 50-70% of Carcass Weight

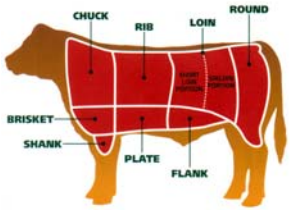
Yield Calculations – Grass-Fed



Carcass Fabrication

The process of breaking the carcass down into Primals, wholesale cuts, and/or retail cuts of beef
- Each processor/butcher has their own variation
- Understand the basic options
- Work with your processor for specifics

Primal Cuts of Beef

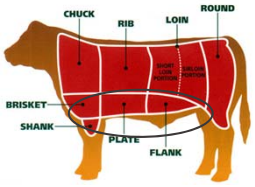


Iowa Beef Industry Council. 4-H Cook This Sirloin Steak. Retrieved online 7/1/15. http://www.iabeef.org/4-hcookthis.aspx

Breaking down the Primal Cuts

Plate, Flank, Brisket, and Shank

- Very few large muscle groups
- Flank Steak, Skirt Steak, Short Ribs, and Brisket
- Majority is ground
- ~19% of Carcass Weight
- ~13% of Carcass Value



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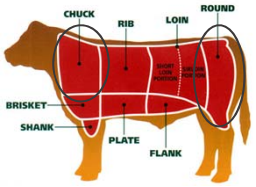
USDA-Agricultural Marketing Service. National Daily Boxed Beef Cutout and Boxed Beef Cuts. Retrieved 7/1/15. http://www.ams.usda.gov/mnreports/lm_xb402.txt

Breaking down the Primal Cuts

Chuck and Round

- Muscles of locomotion
- Tough as compared to "middle meats"
- Roasts and Ground Beef
- ~51% of Carcass Weight
- ~49% of Carcass Value



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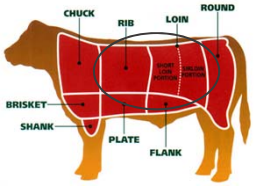
USDA-Agricultural Marketing Service. National Daily Boxed Beef Cutout and Boxed Beef Cuts. Retrieved 7/1/15. http://www.ams.usda.gov/mnreports/lm_xb402.txt

Breaking down the Primal Cuts

Rib and Loin

- Majority of steaks
- Ribeye, Strip, Filet, T-Bone
- Rib Roast, Prime Rib
- ***~25% of Carcass Weight***
- ~38% of Carcass Value



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GRASSFED BEEF IN THE SOUTHEAST: FROM SEED TO PLATE

Where can I get more steak?

Cuts that can work

- Flank Steak
- Skirt Steak
- Flat Iron Steak
- Petite Tender
- Chuck-eye Steak
- Sirloin Cap Steak (Picanha)

Cuts that will disappoint

- Eye of the Round Steak
- Mock Tender Steak
- Any "Round" Steak

Most of these look great
EXTREMELY TOUGH!!!

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GRASSFED BEEF IN THE SOUTHEAST: FROM SEED TO PLATE

Ground Beef

Large portion of retail weight

- Fat Content will vary
  - Fatness of the animal
  - Cuts that are/aren't ground
- Total volume will vary
  - Primals that are/aren't ground
- Consider cull breeding stock if ground beef is a large market


Courtesy of AU Lambert-Powell Meat Lab

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You can't have EVERYTHING

Some cuts come at the expense of others

- T-Bone/Porterhouse vs. Strip and Filet Steaks
- Prime Rib vs. Ribeye Steaks
- Eye of Round Roast vs. Steak
- Top Blade Roast vs. Flat Iron Steak

Further Processed Options

Depending on the processor

- Pre-formed Ground Beef Patties
- Bologna*
- Hotdogs*
- Kiebasa*
- Summer Sausage*

*Will need fat

- Jerky
- Snack Sticks
- Precooked BBQ/Brisket

Other opportunities to add value

Organ Meats

- Liver
- Kidneys
- Oxtail
- Heads
- Etc.

Offal

- Hides
- Horns
- Hooves
- Bones
- Blood

Conclusions

This phase is the sum total of months of hard work

- Select Processor wisely
- Communicate with customers and processor
- Understand your market and work to meet their needs
- Deliver a high quality product

Questions?

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References

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Food Safety and Legal Module

Courtney Crist, PhD
Mississippi State University

Overview

1. Importance of Food Safety
2. Pathogens Associated with Beef
3. Prevention of Contamination
4. Industry Food Safety Practices
5. Food Regulations and Laws
6. Meat Inspection Requirements
7. Meat Inspection and Processing
8. Choosing a Processing Facility
9. Labeling Products
10. Packaging
11. Selling Beef
12. References
13. Additional Information/ Appendix

Importance of Food Safety

- Food safety is essential from FARM to FORK
  - Grower, Processor, Retailer, Consumer
- Reduce risk of foodborne illnesses
  - Multi-hurdle effect
  - Final preparation by consumer most important
  - Safe handling instructions
- Focus on unintentional contamination
  - New emphasis on intentional contamination
    - Food Defense
- USDA, HACCP, FDA and FSMA

Pathogens Associated with Beef

- Potential biological hazards in meat include bacteria, toxins, viruses, protozoa, and parasites
- Bacteria cause a large proportion (approximately 90%) of all foodborne illnesses
- Pathogens are bacteria that can cause harm to humans if consumed
- Sampling plans ensure confidence product is not contaminated
- Proper cooking, fermentation, cooling, and storage of food can destroy and/or prevent growth of these bacteria

Pathogens Associated with Beef

Bacteria
- *E. coli* O157:H7
- *Salmonella*
- *Campylobacter*
- *Listeria monocytogenes*
  - Widespread in the environment and is often present in soil, water, and silage

- Toxins
  - *Clostridium botulinum*
  - *Clostridium perfringens*
  - *Bacillus cereus*
  - *Staphylococcus aureus*
- Parasites
  - *Taenia saginata*

Prevention of Contamination

"Cross-contamination" generally refers to the transfer of organisms from a contaminated source to a previously uncontaminated surface

Example
- Healthy animals may have bacteria in their feces
- While dressing the carcasses during the slaughter process, these bacteria may be transferred from the hide and offal to the carcass causing contamination

Prevention of Contamination

- Contamination can be minimized or avoided altogether by following appropriate
  - Sanitation procedures
  - Good manufacturing practices
  - Procedures for employee hygiene
- Maintaining proper temperatures, good sanitation, and protection from foreign elements (indoors and out) are all important aspects of regulatory compliance and contamination prevention

Food Safety Practices

- Hazard Analysis and Critical Control Point (HACCP)
  - Best tool for producing safe meat
  - HACCP considers hazards from production to consumption
    - Three categories of hazards:
      - Biological
        - Pathogens
      - Chemical
        - Detergents; Nitrite when used in excess
      - Physical
        - Metal; Glass; Bone fragments
  - Requires Sanitation Standard Operating Procedures (SSOPs) and Good Manufacturing Practices (GMPs)

Food Safety Practices

- Seven Principles of HACCP
  - 1. Conduct a hazard analysis
  - 2. Identify critical control points
  - 3. Establish critical limits for each critical control point
  - 4. Establish critical control point monitoring requirements
  - 5. Establish corrective actions
  - 6. Establish record keeping procedures
  - 7. Establish procedures for verifying the HACCP system is working as intended

Food Defense

- Protect your food supply
- Intentional vs. unintentional contamination
- Everything is a target
- Motives for intentional contamination
  - Dissatisfaction, stress, economic gain
- Why target food?
- Basic steps to protection
  - Assess, develop, implement, test, review, maintain

USDA defines a Food Defense Plan as functional if measures are in place to **address outside security, inside security, personnel security and incident response.**

Recordkeeping and Traceability

- Keep and maintain records of your animals and products
- Maintain records of all ingredients from origin to final consumer
- All primary and secondary containers should include traceability measure

"One step forward and one step backward"

- Coding system
- Utilized for recalls

Sanitation

- Must develop, implement, and maintain written SOP for sanitation (SSOP)
- Generally includes provisions for pre-operational, operational, and cleaning and sanitation of all food contact surfaces
- Maintain records

Sanitation

- Written procedures should describe:
  - Cleaning schedules
  - Methods, equipment, and materials to be used in cleaning the buildings and facilities
- Provide for monitoring:
  - Condition and cleanliness of food contact surfaces, including gloves, utensils, and outer garments
  - Maintenance of hand washing, hand sanitizing, and toilet facilities
  - Control of employee health conditions

Regulatory

- Food Code
  - Mississippi State Health Department has adopted Federal Food Code (Food and Drug Administration (FDA))
  - Mississippi Inspection Division (MID) has additional requirements under Mississippi Department of Agriculture & Commerce (MDAC)
- Code of Federal Regulations
  - United States Department of Agriculture (USDA)
  - Must meet minimum federal requirements (USDA)
  - Mississippi (and other states) can be more stringent

Jurisdiction for Inspection

- Wholesome Meat Act (1967) -- Federal Meat Inspection
  - Also called *"Equal To"* law.
    - Required that states have inspection programs *"equal to"* that of the federal government administered by United States Department of Agriculture (USDA), Food Safety and Inspection Service (FSIS), Washington, DC.
  - Today, it is called the **Federal Meat Inspection Act (FMIA).**
- USDA-FSIS jurisdiction
  - Titles 7, 9 and some 21 CFR
    - Agriculture; Animals and Animal Products; Food and Drugs
      - Reference: http://www.access.gpo.gov/nara/cfr/cfr-table-search.html#page1

Functions of Meat Inspection

- Detection and destruction of diseased animals offered for harvest/ meat and/or contaminated meat (ante mortem & post mortem inspection)
- Assurance of clean and sanitary handling and preparation
- Minimization of microbiological contamination of meat
  - Lab testing and sampling programs
- Prevention of adulteration and the presence of chemical or drug residues
- Prevention of false labeling
- Application of inspection insignia

Processing

- Federal government (if meat is to be sold in *interstate* or foreign commerce)
- State government (if meat is to be sold only in *intrastate* commerce).
- Types of Processors
  - Custom
  - State
  - Talmadge-Aiken Act (TA)
  - Federal
- Meat and Poultry products produced for resale into commerce **MUST** bear the mark of inspection

Custom Processing – Plant Categories

- Plant processes animals for **individual owner for personal use only**
- Finished packaging product is stamped **"Not For Sale"**
- Facilities must be sanitary and use non-adulterated products
- Owner can specify how carcass is processed into cuts, packaging, etc.
- No prior approved labels required
- No testing or HACCP plans required
- **No comingling of custom and public or for sale products allowed**
- Facilities will still be subject to periodic, risk-based inspection by USDA FSIS and/or state authorities.

Custom Processing – Plant Categories

- **Pros:**
- Individual sales, price arrangement
- Customer relations
- Individualized cutting and wrapping
- Multiple customers per animal
- No left over cuts, etc.
- Available custom processors
- Independent
- Inspection issues – not as involved

Cons:

Sales arrangements (individual)

Advertisement

Consistency

Timing

Amount of money at one time

Storage volume

Retail Sales – Plant Categories

- Carcass and facility inspection
  - Limitation - end customer sales only -- no resale
  - Volume limits ½ beef carcass
- Fully inspected (pros and cons)
- Other inspection/testing issues (cons)
- Producer to processor requirements
  - Labeling
  - Other marketing slogans
  - Quality product

State Inspected – Plant Categories

- Collaborative effort between state and federal government
  - Full regulations and testing requirements *"equal to"* federal
  - May exceed federal requirements
- Sell and ship into commerce only *intrastate* where the meat was inspected
  - Intrastate within state borders
- Bears marks of *state* inspection
- Sanitation and labeling requirements
- Cattle age requirements
- All labeling, packaging, testing requirements at least equal to federal
  - i.e. Carcass, *Salmonella* and *E. coli*

Talmadge-Aiken (TA) Plants – Plant Categories

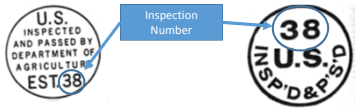
- Same as federal inspection except:
  - Inspection is contracted to and carried out by state meat inspection personnel
  - Federal oversight
  - Periodic strict reviews by federal reviewers
  - Allows interstate and export shipment

Federal Plants – Plant Categories

- Inspection carried out by Federal employees
- All requirements as per Code of Federal Regulations (CFR)
- Have all same requirements as state plants
- Same testing and other inspection standards
- Must have HACCP Plan
- Selling
  - Can sell across state lines
  - Can export
  - Can resell into wholesale, retail, HRI
  - Other means (online, express ship)

Federal Inspection and Processing

- Mark of Inspection
  - Applied to Beef
    - Carcasses
    - Printe



Printed Material: Boxes, Labels, etc.

Individual Carcasses and Cuts

State Inspection and Processing

- Insignia of geographic outline of Mississippi or other state that has a state inspection system
- Contains same verbiage as Federal Stamps
  - i.e.. Inspected and Passed, Mississippi Department of Agriculture and Commerce
- Contains State Establishment N[illegible] tead of Federal

Tips for Finding a Harvesting and/or Processing Facility

- Check your state Department of Agriculture for a list of facilities in your state
- A harvest plant actually harvests the animals, hangs and chills them
- A processing plant cuts up the carcasses
- Target only the ones that do both harvesting and processing
- Call the plant and visit the plant
  - Determine their facility type/specialty/requirements
  - Pay attention to details when visiting
    - Cleanliness, organization, talk to employees
    - Determine costs and pricing to use their facility
- Restaurant and stores might only allow federally inspected products
- Think ahead about the clients and businesses you want to sell your meat to

Tips to Consider When Choosing a Processor

- Critical Factors
  - Due diligence about the operation and facility
  - Slaughter method and animal handling practices.
  - Types of packaging.
  - Labeling capabilities and willingness of the processor to work with individual labels.
  - Length of time the processor will allow the carcasses to hang.
  - Primal and retail cuts with which the processors are familiar.
  - Ability and/or willingness of a processor to work with fresh versus frozen product.
  - Applicable fees and processing prices.
  - Animal drop-off/product pick-up times.

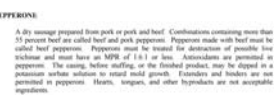
Labeling

- USDA **requires** preapproval of all labels
  - Few exceptions such as small modifications to pre-existing labels
  - Many minor modifications and single ingredient product labels can be *generically approved* by local inspectors
- Accurate portrayal of the product and contents

1. Product name
2. Inspection legend and establishment number
3. Handling statement (Keep Frozen, Keep Refrigerated)
4. Net weight statement
5. Ingredients statement*
6. Address line*
7. Nutrition facts*
8. Safe handling instructions for **raw, not ready to eat products**

* May be placed on information panel

Labeling


PEPPERONI

A dry sausage prepared from pork or pork and beef. Combinations containing more than 55 percent beef are called beef and pork pepperoni. Pepperoni made with beef must be called beef pepperoni. Pepperoni must be treated for destruction of possible live trichinae and must have an MPR of 1.0:1 or less. Antioxidants are permitted in pepperoni. The casing, before stuffing, or the finished product, may be dipped in a potassium sorbate solution to retard mold growth. Extenders and binders are not permitted in pepperoni. Hearts, tongues, and other byproducts are not acceptable ingredients.

- Standards of Identity
  - Most cuts and products have a defined standard of identity
- Standard of identity or common or usual name ("Lamb Chop" or other meat primals or subprimals)
- The Policy Book is intended to be guidance to help manufacturers and prepare product labels that are truthful and not misleading.

https://www.fsis.usda.gov/OPPDE/larc/Policies/Labeling_Policy_Book_082005.pdf

Label Distinctions (Grass Fed Beef)

- Claims found in the Policy Book may be approved generically
  - **EXCEPT**: natural claims, negative claims, etc.
- **Examples that require Label Preapproval**
  - Grass Fed
  - Natural claims, e.g. "All Natural", "100% Natural"
  - Negative claims or "free" claims (no MSG, no MSG added, no preservatives)
  - Statements that identify a product as "organic" or containing organic ingredients
  - 3rd party raising claims or programs
  - Claims regarding meat and poultry production practices (i.e. claims regarding the raising of animals such as "no antibiotics administered" or "vegetarian fed")
  - Breed claims (Berkshire, Angus, Hereford, etc.)
  - Certified claims, Certified Halal
  - Gluten free: both certified and non certified

http://www.fsis.usda.gov/wps/wcm/connect/bf170764-33e3-4a2d-8f86-940c2698e2c5/Comp-Guide-Labeling-Evaluation-Approval.pdf?MOD=AJPERES

Packaging Beef

- Most consumers will not buy a product that they cannot see
- Package your beef in convenient sizes
- Distribution source (restaurant, natural foods distribution company, or a retail store) will inquire about case sizes
- Some retailers may want a bar coding or a Universal Product Code (UPC)
  - Further processed products might require a UP
  - One-time fee for a UPC
  - Visit The Universal Product Code Association www.uc-council.org for more information or www.buyabarcode.com

Selling Beef

- Restaurants
  - Usually want fresh, not frozen, beef and a uniform product.
    - Some variability is acceptable
  - Generally local restaurants and chefs will work with small producers
- Stores
  - More economically focused
  - Markup costs
  - Delivery details
  - Go in with a game plan with knowledge of your costs
    - Transportation, storage, delivery, pallet

Selling Beef

- Distributors
  - Similar to stores with increased volume
  - As a start-up business not the best route
  - Requires more research to find the niche consumer
- Farmers Markets
  - Minimal investment, paid immediately
  - Market regulations may vary from state to state, city to city
    - Check the regulations
    - Contact the Market Manager
    - May require food safety trainings or licenses

References

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- eXtension.org. Meat Processing Rules and Regulations. 2015. Retrieved from: http://articles.extension.org/pages/17170/meat-processing-rules-regulations
- eXtension.org. Meat Inspection. 2015. Retrieved from: http://articles.extension.org/pages/15944/meat-inspection
- Holder, J. How to direct market your beef. Sustainable Agriculture Network (SAN) and Sustainable Agriculture Research and Education (SARE) program. Retrieved from: www.sare.org/content/download/29726/.../How_to_Direct_Market_Your_Beef.pdf
- McMillan, J. Direct Market Guidelines. Farmers Market Authority – Alabama Department of Agriculture and Industries. Retrieved from: http://fma.alabama.gov/pdfs/Brochure_DirectMarketGuidelines.pdf
- NCSU. Choosing your abattoir. Farm to Fork: Direct to the Consumer Beef Marketing Handbook. Retrieved from: https://www.ncsu.edu/fvs/beefhandbook/abattoir_1.php
- USDA FSIS. Microbiological Hazard Identification Guide for Meat and Poultry Components of Products Produced by Very Small Plants. 1999. Developed in Consultation with the Meat and Poultry Subcommittee of the National Advisory Committee on Microbiological Criteria for Foods. Retrieved from: https://www.fsis.usda.gov/Oa/haccp/haguide.pdf?redirectHttp=true
- USDA FSIS. Ground Beef and Food Safety. 2016. Retrieved from: https://www.fsis.usda.gov/wps/portal/fsis/topics/food-safety-education/get-answers/food-safety-fact-sheets/meat-preparation/ground-beef-and-food-safety/CT_Index
- USDA FSIS. Ask Karen. What bacteria are associated with beef? Retrieved from: https://askkaren.custhelp.com/app/answers/detail/a_id/645/~/what-bacteria-are-associated-with-beef%3F
- USDA FSIS. Labeling Policies. Retrieved from: https://www.fsis.usda.gov/wps/portal/fsis/topics/regulatory-compliance/labeling/Labeling-Policies
- USDA FSIS LPDS. Generic Label Approval. Retrieved from: https://www.fsis.usda.gov/wps/wcm/connect/1364c48d-214b-41bf-bab8-6289f951cb31/Generic-Final-Rule-Overview-Industry.pdf?MOD=AJPERES

Additional Information

Useful Resources

- Niche Processing
  - http://www.nichemeatprocessing.org/
- eXtension
  - www.extension.org
- USDA FISIS Small Plant Help Desk
  - https://www.fsis.usda.gov/wps/portal/fsis/topics/regulatory-compliance/svsp/sphelpdesk
- State Department of Agriculture
  - https://www.mdac.ms.gov/bureaus-departments/regulatory-services/meat-inspection/
- State Department of Health
  - http://msdh.ms.gov/msdhsite/_static/30,0,77.html
- State Extension Service
  - http://extension.msstate.edu/

Useful Resources

- Federal Food Code
  - https://www.fda.gov/Food/GuidanceRegulation/RetailFoodProtection/FoodCode/ucm374275.htm
- Basic Regulatory Considerations for Retail and Non-retail Meat Sales in Tennessee.
  - https://ag.tennessee.edu/foodscience/Documents/Basic%20regulatory%20considerations%20for%20retail%20and%20non-retail%20meat%20sales%20in%20Tennessee.pdf
- USDA FSIS Compliance Guidance for Label Approval. November 2015:
  - http://www.fsis.usda.gov/wps/wcm/connect/bf170761-33e3-4a2d-8f86-940c2698e2e5/Comp-Guide-Labeling-Evaluation-Approval.pdf?MOD=AJPERES
- USDA Food Standards and Labeling Policy Book:
  - http://www.fsis.usda.gov/OPPDE/larc/Policies/Labeling_Policy_Book_082005.pdf
- USDA Food Safety and Inspection Service Labeling Guideline on Documentation Needed to Substantiate Animal Raising Claims for Label Submissions. September 2016.
  - https://www.fsis.usda.gov/wps/wcm/connect/6fc3ed56-6809-4239-b7a2-bee6b82a0588/RaisingClaims.pdf?MOD=AJPERES
- USDA Label and Label Approval
  - https://www.fsis.usda.gov/wps/portal/fsis/topics/regulatory-compliance/labeling
- University of Tennessee Farm to Fork A Direct to the Consumer Beef Marketing Handbook
  - http://www.agmrc.org/media/cms/NCSUBeefHandbook_0510_ECD46F82E2D00.pdf
- University of Tennessee. General Overview of the History, Regulations, and Inspection Information for Direct Meat Marketing in Tennessee
  - https://ag.tennessee.edu/cpa/CPA%20Publications/PB1819%20%20FINAL%20CPA.pdf

Mississippi

Mississippi Farmers Market Regulations

Meat must be from an approved facility
- Slaughtering facility that is licensed and inspected by the MDAC Meat Inspection Division or has a grant of inspection from the (USDA)

- Must obtain a mobile retail food establishment license from the department
- Must have a refrigerated mobile vehicle that the department approves before using
  - Commercially approved modes of refrigeration
- For food safety, cold foods must stay at or below 41˚F at all times and frozen foods must remain entirely in a frozen state at all times.
- Most meat has to be sold by net weight
  - All other meat must be weighed on a scale that is approved for commercial use and labeled with a net weight declaration on the package.
- Safe Handling Instructions

Northern MS Plants

- Attala Frozen Meats — Kosciusko
- Clyde & Calvin's Custom Meats — Rienzi
- The Front Porch — Bruce
- MSU Meat Lab — Starkville
- Pitcock Processing — Pope
- Rickman's Meat Market — Corinth
- Sansing Meat Service — Maben
- Smokehouse Meats, Inc. — Pontotoc
- Spencer Meats — Mooreville
- Sullivan's Custom Meat — Preston

Southern MS Plants

- Country Meat Market — Brookhaven
- Al Cascio, Inc. — Hattiesburg
- Forbes Meat Processing — Sandy Hook
- John Fortenberry's — Sandy Hook
- Fortenberry Slgt. House — Carriere
- Houston Processing — Laurel
- Kased Brothers — Summit
- Myers Meat Market & Proc. — Newton
- Parker Processing Plant — Stringer
- Steven's Packing Co. — Poplarville
- Wilson's Meat House — Crystal Springs

Mississippi Resources

- FAQS on Getting Beef From Farm to Market
  - http://www.mdac.ms.gov/wp-content/uploads/Beef-FarmToMarket.pdf
- Department of Agriculture and Commerce
  - https://www.mdac.ms.gov/bureaus-departments/regulatory-services/meat-inspection/
- Mississippi State Department of Health
  - http://msdh.ms.gov/msdhsite/_static/30,0,77.html
- Mississippi State University Extension Service
  - http://extension.msstate.edu/

Alabama

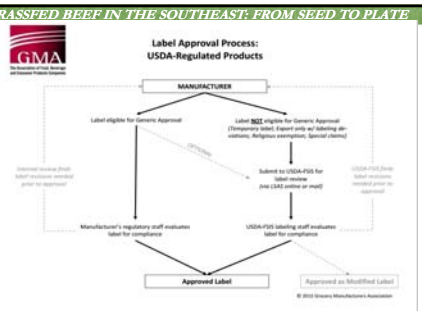
Alabama Farmers Market Regulations

- Only raw meats, including fish and seafood, processed, packaged, and labeled at an inspected facility may be sold
- All processed meat sold in Alabama must be processed by a USDA certified processor
- Beef products sold at farmers markets must originate from livestock slaughtered in a government (federal or state) inspected facility
- All meat products must be wrapped and labeled with the seal of inspection on the package
- Meat products must be brought to the market in frozen condition and kept frozen until sold
  - Selling packaged meat at the farmers market requires
    - Sanitary handling
    - Temperature Control
    - Recommended to use a mechanical unit capable of maintaining meat in a frozen state
- Live animals are prohibited for sale at Alabama Farmers Markets.

Alabama Resources

- The Food Safety and Inspection Service in Alabama
  - https://www.fsis.usda.gov/wps/wcm/connect/660a4d3e-71cb-4086-9ac3-66b2a8b3e807/AL.pdf?MOD=AJPERES
- Alabama Farmers Market Information
  - http://www.fma.alabama.gov/pdfs/STCertFarmersMrkts05-12.pdf
  - http://www.fma.alabama.gov/faq.aspx
  - http://fma.alabama.gov/pdfs/Brochure_DirectMarketGuidelines.pdf

Labeling Guidance



- http://wwwgmaonline.org/file-manager/2015-06-02%20Quick%20Reference%20Guide%20-%20USDA%20Label%20Approval%20Process.PDF

Labeling Approval

- Federal Meat Inspection Act (FMIA) and Poultry Products Inspection Act (PPIA) require food manufacturers to obtain prior approval for labels of meat and poultry products before products may be marketed
- Prior approval is granted one of two ways:
  - Sketch approval which is approved by the Labeling and Program Delivery Staff (LPDS)
  - Generic approval which is approved by being in compliance with applicable regulations

Labeling Approval

Sketch

- Label review process by LPDS
- Printer's proof or equivalent that is sufficiently legible to clearly show all labeling features, size, and location
- May be hand drawn, computer generated or other reasonable facsimile
- Must clearly reflect and project the final version of the label
- Specific categories of labels require sketch approval
- Sketch approved labels reviewed by LPDS are either "approved" or "approved as modified"
- A "Sketch" label is the concept of a label while "Final" label is the label that is applied to product before distribution in commerce

NOTE: Establishments are responsible for ensuring final labels applied to product are in compliance with FSIS regulations, including making modifications noted by LPDS during sketch

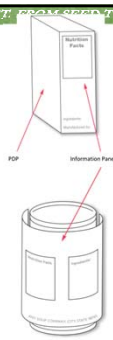
Generic

- The approval of labeling or modifications to labeling prior approved by the Agency without submitting such labeling to FSIS for sketch approval
- Requires that all mandatory labeling features are in conformance with FSIS regulations
- Although not submitted to FSIS for approval, generically approved labels are approved by being in compliance with applicable regulations

NOTE: FSIS Inspectors do not generically approve labels. Establishments do not generically approve labels. FSIS approves labels through generic labeling regulations.

Labeling

- Principal Display Panel (PDP)
- Information Panel
  - Placed to the right of the PDP



Basic Label Requirements

- Clearly legible and conspicuous
  - No intervening material between required label features
  - Name must comply with standards of identity or common names
  - Text size at least 1/16" based on height of lower case "o". 21 CFR 101
  - If foreign language included, must be in English and foreign language
  - Artwork must accurately depict product

Ingredient Labeling

- Listed in order of predominance
- Common or usual name of ingredient required
- Chemical preservative must include a purpose statement
  - "a mold inhibitor" "to help protect flavor"
- Spices may be declared as "spices"; "flavor" or "natural flavor"; or "artificial flavor"
- Sub ingredients of products must be listed in parentheses behind ingredient
- Allergen statement

Allergens

1. Milk
2. Egg
3. Fish
4. Crustacean shellfish
5. Tree nuts
6. Wheat
7. Peanuts
8. Soybeans

Responsible for 90% of food allergies

Allergens

- Majority of recalls are due to mislabeled allergens
- Labeling Statements:
  - "This item may contain…"
  - "This item is produced in a facility that also processes…"
  - "Contains: soy, eggs…"

Allergen Labeling

- All allergens and ingredients derived from allergen proteins must be labeled
- Sources of protein must be identified
  - "hydrolyzed plant protein (soy)"
- **Thoroughly scrutinize** all ingredients to ensure allergen labeling
  - Cause of many recalls
- Must be addressed in Standard Operating Procedures (SOP's) or Hazard Analysis and Critical Control Points (HACCP) program

Net Quantity

- Metric and US Customary System Terms
- Only the quantity of the food
  - Does not include packaging
- Size based upon area of PDP

Manufacturer Name

- Name of manufacturer, packer, or distributor
- If manufacturer is not applicable must include:
  - "Manufactured for" or "Distributed by"
- Full address is required unless listed in city directory/phone book
  - Otherwise city, state, and zip code required

Safe Handling

Labeling Resources

- USDA FSIS A Guide to Federal Food Labeling Requirements for Meat, Poultry, and Egg Products
  - https://www.fsis.usda.gov/wps/wcm/connect/f4af7c74-2b9f-4484-bb16-fd8f9820012d/Labeling_Requirements_Guide.pdf?MOD=AJPERES
- Food Marketing Institute
  - www.fmi.org/consumer/nutrifacts/
- FSIS point-of-purchase (POP) materials
  - https://www.fsis.usda.gov/wps/wcm/connect/fsis-content/internet/main/topics/regulatory-compliance/labeling/labeling-policies/nutrition-labeling-policies/nutrition-labeling
  - https://www.fsis.usda.gov/wps/portal/fsis/topics/regulatory-compliance/labeling
- The National Cattlemen's Beef Association
  - www.beefretail.org/nutritionlabeler/
- Agricultural Research Service at the Nutrient Database for Standard Reference
  - www.ars.usda.gov/nutrientdata

Other Food Safety Information

Beef Slaughter

- Requirements for product sales
  - BSE animal age and specified risks materials
  - Antimicrobial intervention steps prior to chilling
  - Carcass testing for *E. coli* and *Salmonella*
  - Product testing on various products for *E. coli* 0157:H7
  - Costs of testing
  - Testing and Holding of product/traceability

Recordkeeping

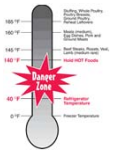
- Records are vital to food safety and the success of business
- Consider creating a system that works for your business
  - Master Form
  - Job Order
  - Lot numbers
  - Invoices
  - Relevant Dates

Insurance

- Some of your customers (retail stores, restaurants and some farmers markets) will require you to carry product liability insurance.
- This is a separate policy from your normal ranch or farm insurance.
- Most places require $1 million in liability.

Safe Handling

- Avoid Cross-Contamination
  - Before, during, and after preparation/cooking
- DANGER ZONE
  - 40-140°F
  - Max 2 hour holding period
- Cook meat to minimum internal temperature
  - Ground meat – 160°F
  - Fresh Beef – 145°F & 3 minutes rest
  - Poultry – 165°F
  - Pork – 145°F & 3 minutes rest
  - Leftovers and casseroles – 165°F



Recalls

- Class I: potential to cause serious health problems or death
  - Ex: Undeclared allergen
- Class II: may cause temporary health problem
  - Ex: Undeclared non-allergen ingredient, foreign matter (hair)
- Class III: unlikely to cause any adverse health reaction
  - Ex: lack of English label on retail food
- New regulations will give FDA and USDA mandatory recall authority **(FSMA)**
  - **(Proposed for USDA)**

Economics and Marketing Module

Josh Maples, Ph.D.
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Livestock Extension Economist

Overview

- Know your costs
- Understand state laws on beef sales
- Identify your customers
- Selling the whole carcass
- Marketing your beef!

Understanding Costs

- Accurate record keeping is key
- Know your break-even cost
- How much do you have to earn from each animal to make a profit?
- Keep track of all expenses in a budget

Possible Expenses

- Cost of cattle
- Labor
- Land
- Feed/Hay
- Transportation
- Processing fees
- Packaging
- Storage
- Promotion/Marketing
- Interest

Opportunity Costs

- One cost that doesn't always get considered is opportunity cost
- This is the value of your next best alternative use for your resources (e.g. time, land, labor, etc.)
- For grass-fed cattle, an alternative is conventional
- Compare profits from grass-fed beef program to what your profits could be in a conventional program and choose the most profitable

Understand State Laws

- Do you have access to a licensed and inspected slaughter facility?
- Many local processors do not have the inspection credentials needed to sell beef per cut
- If you intend to sell beef across state lines, you will need a federally inspected facility

Identify Your Customer

- Friends and neighbors
- Local restaurants
- Grocery stores
- Farmers markets
- Fresh vs. Frozen?

Production and the Customer

- What type of customers can you realistically support?
- How much beef will you have available each year?
- When will your beef be ready to sell?
- Answering these questions will help narrow down your target customer

Is Your Beef Seasonal?

- Most operations are seasonal with finished beef ready a few times per year
- Restaurants (and others) may require a consistent supply throughout the year
- Producing beef through the winter can be more expensive and should be considered in costs

Pricing Your Beef

- A good place to start is your break-even cost
- Determine how much you *have* to make from each animal
- Add what you think is a fair profit
- Compare to prices for grass-fed beef in your area (e.g. grocery stores, farmers' markets)

Per Cut or in Bulk Pricing

- It is much more costly to sell individual cuts than it is to sell in bulk
- Increased handling, packaging, promotion, etc.
- Your pricing should reflect this
- You should mark per cut prices well above your bulk prices

Selling the Whole Carcass

- Relatively easy to sell the high-end cuts (e.g. tenderloin and ribeye steaks)
- More difficult to sell the low-end cuts (e.g. chucks, rounds, hamburger)
- For every 100 pounds of tenderloin, you also have about 2000 pounds of hamburger to sell to someone

Selling the Whole Carcass

- Lower value cuts are less likely to earn large premiums over conventional beef
- The higher value cuts are where you must earn your profit
- Can partially avoid these issues by selling at the carcass level (i.e. half or a quarter of a calf)

Marketing Your Beef

- Focus on the positive attributes that YOUR customers value
- Avoid negative advertising about conventional beef – you are hoping to earn a premium over conventional, not replace it
- Be consistent with branding so that customers recognize your products

Branding

- Be consistent and keep it simple
- The quality of your promotion signals customers about the quality of your product
- Make sure branding reflects what your customers want – not necessarily what you like

Conclusion

- Make sure your operation is profitable
- Keep track of your costs and price above your break-even point
- Identify customers that you can support
- Build a brand for your beef that customers recognize and want!

GRASSFED BEEF IN THE SOUTHEAST: FROM SEED TO PLATE

Questions?

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Determining Forage Demand and Animal Intake

This guide illustrates how to determine the acreage needed to meet the forage demand of grazing animals for a defined period of time.

Step 1: Determine animal intake requirements

This is determined by estimating what percent of an animal's body weight it will consume in dry matter in one day. The percentage will vary according to the class of livestock being fed, forage quantity, and nutritive value. The following provides an estimate for different classes of livestock:

Animal Class	Forage consumption, % of body weight
Beef cow (dry)	2.0-2.5%
Beef cow with calf	2.4-2.6%
Heifer, replacement	2.5-3.0%
Stocker	2.5-3.5%

†Adapted from NRC (1996); Alabama NRCS Grazing Stick

Step 2: Determine the efficiency of the grazing system

The efficiency of the grazing system provides an estimate of forage utilization. A range of 40 to 70% pasture utilization is common. Below is an estimate of forage utilization for various grazing methods:

Grazing method†	Efficiency
Continuous stocking	30-40%
Slow rotation (3-4 paddocks)	50-60%
Moderate rotation (6-8 paddocks)	60-70%
Strip grazing	70-80%

†Adapted from Ball et al. (2007)

Step 3: Putting it all together

Calculate the area required per paddock to provide adequate forage intake for a defined number of days.

$$\text{Acres required per paddock} = \frac{\text{Avg. weight of animals to be grazed} \times \text{Dry matter intake, \% of animal body weight} \times \text{Number of animals} \times \text{Days on pasture}}{\text{Available forage mass}^{\ddagger} \times \text{\% Forage utilization}^{\dagger}}$$

*Adapted from IPNI: Forage Crop Pocket Guide (2012)

Where:

‡Available forage mass is the amount of dry matter available in the area to be grazed. (See Using a Grazing Stick for Pasture Evaluation).

†% Forage utilization (See Step 2 above).

Example:

Twenty 1,200 pound (lb) dry, pregnant brood cows
1,200 lb x 2.5% body weight in dry matter intake = 30 lb dry matter needed per day
Days on pasture before rotating = 7 days
Slow rotation, 50% grazing efficiency
Available forage mass = 2,000 lb of dry matter per acre

$$\text{Acres required per paddock} = \frac{\text{1,200 lb} \times \text{2.5\%} \times \text{20 animals} \times \text{7 days}}{\text{2,000 lb dry matter per acre} \times \text{50\% utilization}}$$

= 4.2 acres required for 7 days

Now determine the total acres needed based on the number of paddocks in your system:

Total Acres Required = Number of Paddocks x Acres Required Per Paddock
= 4 paddocks x 4.2 acres
= 16.8 acres

Stocking rate = $\frac{\text{Number of animals grazing}}{\text{Total acres grazed}} = \frac{\text{20 animals}}{\text{16.8 acres}} =$ 1.2 animals per acre

Prepared by Kim Mullenix, Ph.D., Extension Beef Cattle Systems Specialist, and Jennifer Johnson, Ph.D., Extension Forage Specialist, Auburn University, Auburn, AL. MKM-15-4. May 2015.

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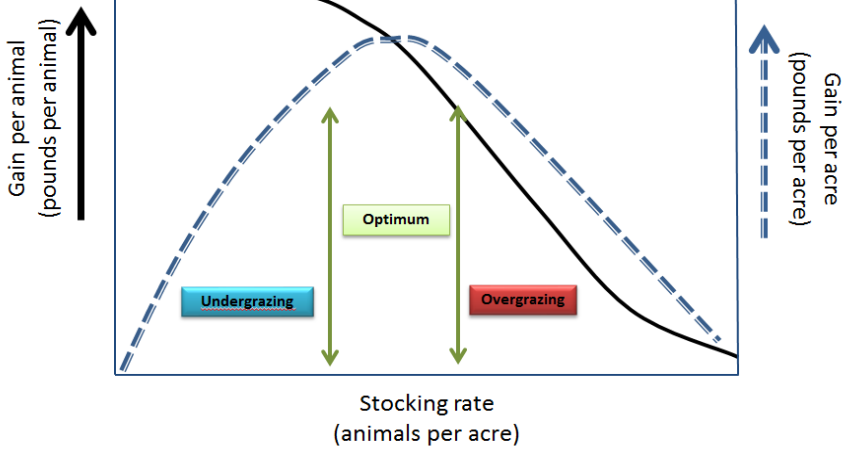
Understanding Stocking Rates in Grazing Systems

What is stocking rate?

Stocking rate is defined as the total amount of land allotted to each grazing animal during the grazing season. Establishing stocking rate is the most critical management decision for the grazier, and it enables animal requirements to be more closely matched with forage production potential. Stocking rate has a large impact on both plant and animal production over time. The amount of available forage declines under a high stocking rate or overgrazing situation, and may negatively affect stand persistence.

In this situation, animal forage intake declines, and animals are less able to select plants or plant parts that are high in nutritive value, decreasing individual animal performance. The amount of gain per acre may still be high due to a large number of animals per unit land area; however, this is a less-than-optimum use of land because both plant and animal performance are compromised. Undergrazing will likely reduce total animal performance per acre, but forage production per acre may be increased. Individual animal performance may be improved because animals have the potential to select an adequate quantity of forage relatively high in nutritive value. However, as the number of animals per acre is lowered, potential animal gain on a per-acre basis also decreases, and excess forage is available that is underutilized. Proper stocking rates more closely optimize forage production, persistence, and animal performance on a per-acre basis.

Figure 1. Relationship between stocking rate and animal performance (pounds of gain).



Adapted from Mott et al., 1973

How do I determine my stocking rate?

Stocking rate is calculated as the number of animals to be grazed divided by the total acreage available for grazing. The amount of acreage needed depends on the following factors influencing forage supply and demand:

- **Forage Supply - Plant Considerations**
  - Forage mass [Pounds (lb) of forage dry matter (DM) per acre]
  - % of the DM utilized by grazing

    - Number of acres to be grazed
- **Forage Demand - Animal Considerations**
    - Average weight of animals to be grazed
    - Dry matter consumed per animal (% of body weight per day)
    - Number of animals
- **Time**
    - Days on pasture

The following scenarios illustrate potential stocking rates in a cow/calf production system using the information above:

Scenario 1

Cow-calf pairs, 1,200 lb cow + growing calf (300 lb)*
Cool-season forage system
130 grazing days
Fall-calving system

	Forage Utilization Rate (%)			
	20	40	60	80
Forage DM (lb/ac/yr*)	Stocking Rate (cow-calf pairs/acre)			
2,000	0.1	0.2	0.3	0.4
4,000	0.2	0.4	0.6	0.8
6,000	0.3	0.6	0.9	1.2
8,000	0.4	0.8	1.2	1.6

*Assume 27 lb DM (65% TDN, 14% CP) per day for 1,200 lb cow producing 20 lb milk/day (2.25% of BW)
Assume 4 lb DM per day for growing calf (average 1.5% BW across grazing season) – Boggs et al. (1980)

Scenario 2

Dry, pregnant cows – 1,200 lb
Warm-season forage system
150 grazing days
Fall-calving system

	Forage Utilization Rate (%)			
	20	40	60	80
Forage DM (lb/ac/yr*)	Stocking Rate (animals/acre)			
6,000	0.3	0.6	0.9	1.2
8,000	0.4	0.8	1.2	1.6
10,000	0.5	1.0	1.5	2.0
12,000	0.6	1.2	1.8	2.4

*Assume 24 lb DM (55% TDN, 12% CP) per day for 1,200 lb dry, pregnant cow (2.0% of BW)

Prepared by: Kim Mullenix, Extension Beef Cattle Systems Specialist, and Jennifer Johnson, Extension Forage Specialist, Auburn University. MKM-15-3. May 2015.

Understanding the Ruminant Animal Digestive System

Ruminant livestock include cattle, sheep, and goats. Ruminants are hoofed mammals that have a unique digestive system that allows them to better use energy from fibrous plant material than other herbivores. Unlike monogastrics such as swine and poultry, ruminants have a digestive system designed to ferment feedstuffs and provide precursors for energy for the animal to use. By better understanding how the digestive system of the ruminant works, livestock producers can better understand how to care for and feed ruminant animals.

Ruminant Digestive Anatomy and Function

The ruminant digestive system uniquely qualifies ruminant animals such as cattle to efficiently use high roughage feedstuffs, including forages. Anatomy of the ruminant digestive system includes the mouth, tongue, salivary glands (producing saliva for buffering rumen pH), esophagus, four-compartment stomach (rumen, reticulum, omasum, and abomasum), pancreas, gall bladder, small intestine (duodenum, jejunum, and ileum), and large intestine (cecum, colon, and rectum).

A ruminant uses its mouth (oral cavity) and tongue to harvest forages during grazing or to consume harvested feedstuffs. Cattle harvest forages during grazing by wrapping their tongues around the plants and then pulling to tear the forage for consumption. On average, cattle take from 25,000 to more than 40,000 prehensile bites to harvest forage while grazing each day. They typically spend more than one-third of their time grazing, one-third of their time ruminating (cud chewing), and slightly less than one-third of their time idling where they are, neither grazing nor ruminating.

The roof of the ruminant mouth is a hard/soft palate without incisors. The lower jaw incisors work against this hard dental pad. The incisors of grass/roughage selectors are wide with a shovel-shaped crown, while those of concentrate selectors are narrower and chisel-shaped. Premolars and molars match between upper and lower jaws. These teeth crush and grind plant material during initial chewing and rumination.

Saliva aids in chewing and swallowing, contains enzymes for breakdown of fat (salivary lipase) and starch (salivary amylase), and is involved in nitrogen recycling to the rumen. Saliva's most important function is to buffer pH levels in the reticulum and rumen. A mature cow produces up to 50 quarts of saliva per day, but this varies, depending on the amount of time spent chewing feed, because that stimulates saliva production.

Forage and feed mixes with saliva containing sodium, potassium, phosphate, bicarbonate, and urea when consumed, to form a bolus. That bolus then moves from the mouth to the reticulum through a tube-like passage called the esophagus. Muscle contractions and pressure differences carry these substances down the esophagus to the reticulum.

Ruminants eat rapidly, swallowing much of their feedstuffs without chewing it sufficiently (< 1.5 inches). The esophagus functions bidirectionally in ruminants, allowing them to regurgitate their cud for further chewing, if necessary. The process of rumination or "chewing the cud" is where forage and other feedstuffs are

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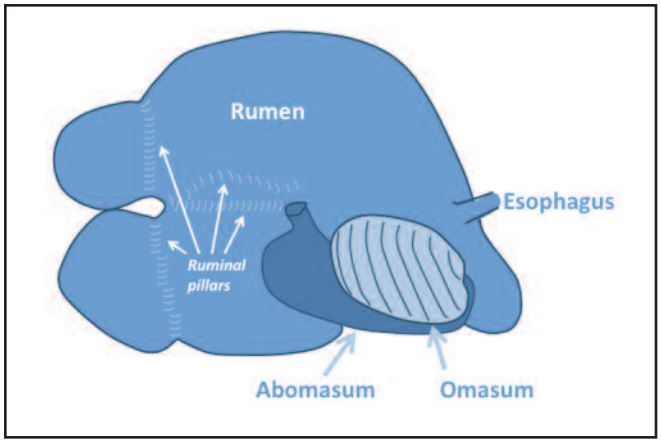
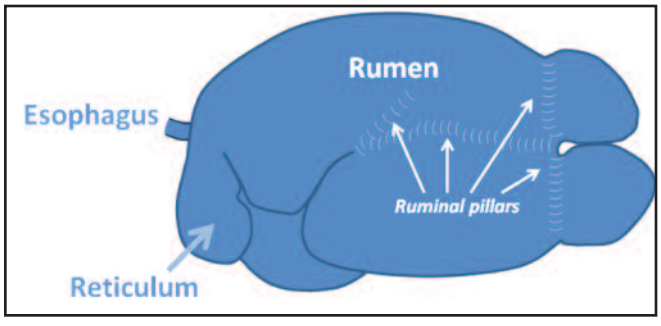
forced back to the mouth for further chewing and mixing with saliva. This cud is then swallowed again and passed into the reticulum. Then the solid portion slowly moves into the rumen for fermentation, while most of the liquid portion rapidly moves from the reticulorumen into the omasum and then abomasum. The solid portion left behind in the rumen typically remains for up to 48 hours and forms a dense mat in the rumen, where microbes can use the fibrous feedstuffs to make precursors for energy.

True ruminants, such as cattle, sheep, goats, deer, and antelope, have one stomach with four compartments: the rumen, reticulum, omasum, and abomasums. The ruminant stomach occupies almost 75 percent of the abdominal cavity, filling nearly all of the left side and extending significantly into the right side. The relative size of the four compartments is as follows: the rumen and reticulum comprise 84 percent of the volume of the total stomach, the omasum 12 percent, and the abomasum 4 percent. The rumen is the largest stomach compartment, holding up to 40 gallons in a mature cow.

The reticulum holds approximately 5 gallons in the mature cow. Typically, the rumen and reticulum are considered one organ because they have similar functions and are separated only by a small muscular fold of tissue. They are collectively referred to as the reticulorumen. The omasum and abomasum hold up to 15 and 7 gallons, respectively, in the mature cow.



Right-sided view of ruminant digestive tract



Left-sided view of ruminant digestive tract

The reticulorumen is home to a population of microorganisms (microbes or "rumen bugs") that include bacteria, protozoa, and fungi. These microbes ferment and break down plant cell walls into their carbohydrate fractions and produce volatile fatty acids (VFAs), such as acetate (used for fat synthesis), priopionate (used for glucose synthesis), and butyrate from these carbohydrates. The animal later uses these VFAs for energy.

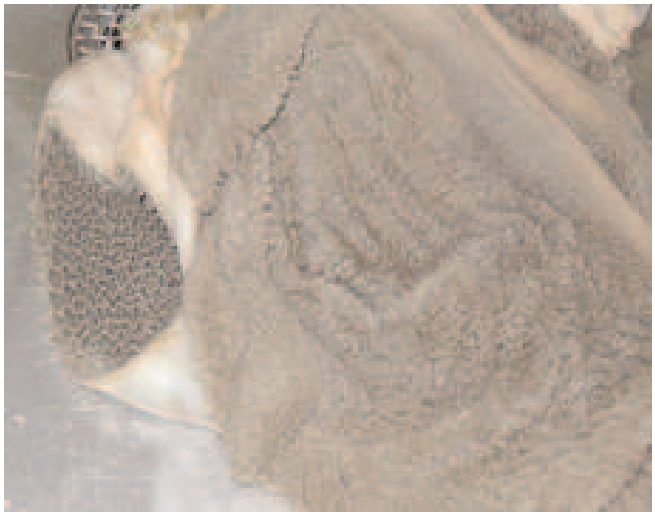
The reticulum is called the "honeycomb" because of the honeycomb appearance of its lining. It sits underneath and toward the front of the rumen, lying against the diaphragm. Ingesta flow freely between the reticulum and rumen. The main function of the reticulum is to collect smaller digesta particles and move them into the omasum, while the larger particles remain in the rumen for further digestion.

"Honeycomb" interior lining of the reticulum in an 8-week old calf

The reticulum also traps and collects heavy/dense objects the animal consumes. When a ruminant consumes a nail, wire, or other sharp heavy object, it is very likely the object will be caught in the reticulum. During normal digestive tract contractions, this object can penetrate the reticulum wall and make its way to the heart, where it can lead to hardware disease. The reticulum is sometimes referred to as the "hardware stomach." Hardware disease is discussed in detail in Mississippi State University Extension Service Publication 2519, "Beef Cattle Nutritional Disorders."

The rumen is sometimes called the "paunch." It is lined with papillae for nutrient absorption and divided by muscular pillars into the dorsal, ventral, caudodorsal, and caudoventral sacs. The rumen acts as a fermentation vat by hosting microbial fermentation. About 50 to 65 percent of starch and soluble sugar consumed is digested in the rumen. Rumen microorganisms (primarily bacteria) digest cellulose from plant cell walls, digest complex starch, synthesize protein from nonprotein nitrogen, and synthesize B vitamins and vitamin

K. Rumen pH typically ranges from 6.5 to 6.8. The rumen environment is anaerobic (without oxygen). Gases produced in the rumen include carbon dioxide, methane, and hydrogen sulfide. The gas fraction rises to the top of the rumen above the liquid fraction.



Interior lining of the rumen, revealing papillae in an 8-week old calf

The omasum is spherical and connected to the reticulum by a short tunnel. It is called the "many piles" or the "butcher's bible" in reference to the many folds or leaves that resemble pages of a book. These folds increase the surface area, which increases the area that absorbs nutrients from feed and water. Water absorption occurs in the omasum. Cattle have a highly developed, large omasum.

Interior lining of the omasum, revealing the "many piles" tissue folds in an 8-week old calf

The abomasum is the "true stomach" of a ruminant. It is the compartment that is most similar to a stomach in a nonruminant. The abomasum produces hydrochloric acid and digestive enzymes, such as pepsin (breaks down proteins), and receives digestive enzymes secreted from the pancreas, such as pancreatic lipase (breaks down fats). These secretions help prepare proteins for absorption in the intestines. The pH in the abomasum generally ranges from 3.5 to 4.0. The chief cells in the abomasum secrete mucous to protect the abomasal wall from acid damage.

Interior lining of the abomasum, the "true stomach," in an 8-week old calf

The small and large intestines follow the abomasum as further sites of nutrient absorption. The small intestine is a tube up to 150 feet long with a 20-gallon capacity in a mature cow. Digesta entering the small intestine mix with secretions from the pancreas and liver, which elevate the pH from 2.5 to between 7 and 8. This higher pH is needed for enzymes in the small intestine to work properly. Bile from the gall bladder is secreted into the first section of the small intestine, the duodenum, to aid in digestion. Active nutrient absorption occurs throughout the small intestine, including rumen bypass protein absorption. The intestinal wall contains numerous "finger-like" projections called villi that increase intestinal surface area to aid in nutrient absorption. Muscular contractions aid in mixing digesta and moving it to the next section.

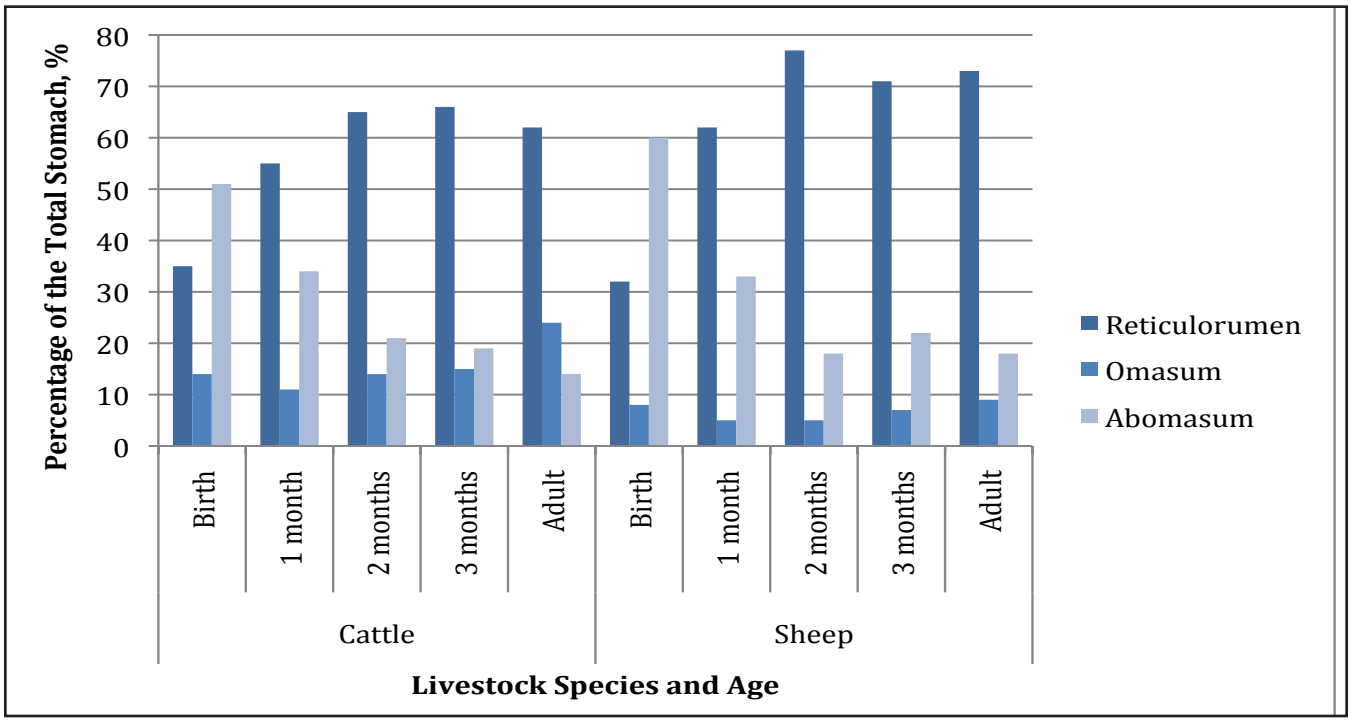
The large intestine absorbs water from material passing through it and then excretes the remaining material as feces from the rectum. The cecum is a large blind pouch at the beginning of the large intestine, approximately 3 feet long with a 2-gallon capacity in the mature cow. The cecum serves little function in a ruminant, unlike its role in horses. The colon is the site of most of the water absorption in the large intestine.

Ruminant Digestive Development

Immature ruminants, such as young, growing calves from birth to about 2 to 3 months of age, are functionally nonruminants. The reticular groove (sometimes referred to as esophageal groove) in these young animals is formed by muscular folds of the reticulum. It shunts milk directly to the omasum and then aboma-

sum, bypassing the reticulorumen. The rumen in these animals must be inoculated with rumen microorganisms, including bacteria, fungi, and protozoa. This is thought to be accomplished through mature ruminants licking calves and environmental contact with these microorganisms.

Immature ruminants must undergo reticulorumen-omasal growth, including increases in volume and muscle. In a calf at birth, the abomasum is the largest compartment of the stomach, making up more than 50 percent of the total stomach area. The reticulorumen and omasum account for 35 percent and 14 percent of the total stomach area in the newborn calf. As ruminants develop, the reticulorumen and omasum grow rapidly and account for increasing proportions of the total stomach area. In mature cattle, the abomasum encompasses only 21 percent of the total stomach capacity, whereas the reticulorumen and omasum make up 62 and 24 percent, respectively, of the total stomach area. Rumen papillae (sites of nutrient absorption) lengthen and decrease in numbers as part of rumen development.



Relative proportions of stomach compartments in cattle and sheep at various ages

Because immature ruminants do not have a functional rumen, feeding recommendations differ for developing ruminants compared with adult ruminants. For instance, it is recommended immature ruminants are not allowed access to feeds containing non-protein nitrogen such as urea. Developing ruminants are also more sensitive to gossypol and dietary fat levels than mature ruminants. Design nutritional programs for ruminants considering animal age.

Ruminant Feeding Types

Based on the diets they prefer, ruminants can be classified into distinct feeding types: concentrate selectors, grass/roughage eaters, and intermediate types. The relative sizes of various digestive system organs differ by ruminant feeding type, creating differences in feeding adaptations. Knowledge of grazing preferences and adaptations amongst ruminant livestock species helps in planning grazing systems for each individual species and also for multiple species grazed together or on the same acreage.

Concentrate selectors have a small reticulorumen in relation to body size and selectively browse trees and shrubs. Deer and giraffes are examples of concentrate selectors. Animals in this group of ruminants select plants and plant parts high in easily digestible, nutrient dense substances such as plant starch, protein, and fat. For example, deer prefer legumes over grasses. Concentrate selectors are very limited in their ability to digest the fibers and cellulose in plant cell walls.

Grass/roughage eaters (bulk and roughage eaters) include cattle and sheep. These ruminants depend on diets of grasses and other fibrous plant material. They prefer diets of fresh grasses over legumes but can adequately manage rapidly fermenting feedstuffs. Grass/roughage eaters have much longer intestines relative to body length and a shorter proportion of large intestine to small intestine as compared with concentrate selectors.

Goats are classified as intermediate types and prefer forbs and browse such as woody, shrubby type plants. This group of ruminants has adaptations of both concentrate selectors and grass/roughage eaters. They have a fair though limited capacity to digest cellulose in plant cell walls.

Carbohydrate Digestion

Forages

On high-forage diets ruminants often ruminate or regurgitate ingested forage. This allows them to "chew their cud" to reduce particle size and improve digestibility. As ruminants are transitioned to higher concentrate (grain-based) diets, they ruminate less.

Once inside the reticulorumen, forage is exposed to a unique population of microbes that begin to ferment and digest the plant cell wall components and break these components down into carbohydrates and sugars. Rumen microbes use carbohydrates along with ammonia and amino acids to grow. The microbes ferment sugars to produce VFAs (acetate, propionate, butyrate), methane, hydrogen sulfide, and carbon dioxide. The VFAs are then absorbed across the rumen wall, where they go to the liver.

Once at the liver, the VFAs are converted to glucose via gluconeogenesis. Because plant cell walls are slow to digest, this acid production is very slow. Coupled with routine rumination (chewing and rechewing of the cud) that increases salivary flow, this makes for a rather stable pH environment (around 6.0).

High-Concentrate Feedstuffs (Grains)

When ruminants are fed high-grain or concentrate rations, the digestion process is similar to forage digestion, with a few exceptions. Typically, on a high-grain diet, there is less chewing and ruminating, which leads to less salivary production and buffering agents' being produced. Additionally, most grains have a high concentration of readily digestible carbohydrates, unlike the more structural carbohydrates found in plant cell walls. This readily digestible carbohydrate is rapidly digested, resulting in an increase in VFA production.

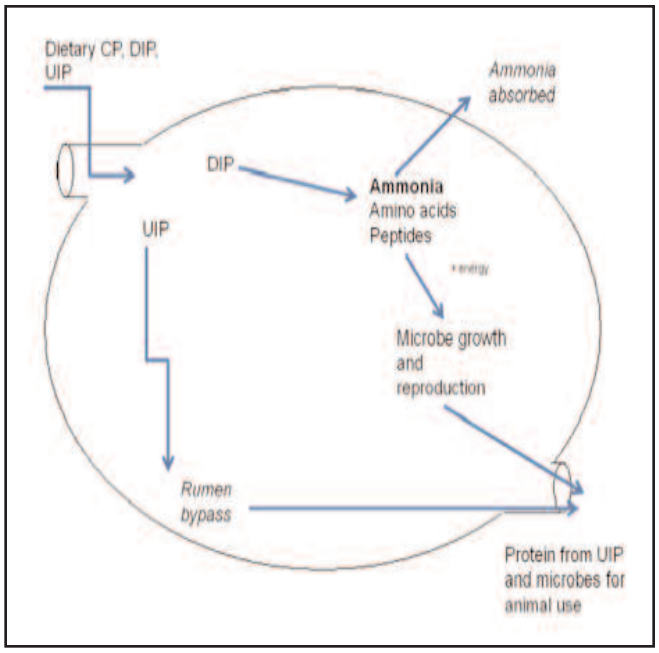
The relative concentrations of the VFAs are also changed, with propionate being produced in the greatest quantity, followed by acetate and butyrate. Less methane and heat are produced as well. The increase in VFA production leads to a more acidic environment (pH 5.5). It also causes a shift in the microbial population by decreasing the forage using microbial population and potentially leading to a decrease in digestibility of forages.

Lactic acid, a strong acid, is a byproduct of starch fermentation. Lactic acid production, coupled with the increased VFA production, can overwhelm the ruminant's ability to buffer and absorb these acids and lead to metabolic acidosis. The acidic environment leads to tissue damage within the rumen and can lead to ulcerations of the rumen wall. Take care to provide adequate forage and avoid situations that might lead to acidosis when feeding ruminants high-concentrate diets. Acidosis is discussed in detail in Mississippi State University Extension Service Publication 2519, "Beef Cattle Nutritional Disorders." In addition, energy as a nutrient in ruminant diets is discussed in detail in Mississippi State University Extension Service Publication 2504, "Energy in Beef Cattle Diets."

Protein Digestion

Two sources of protein are available for the ruminant to use: protein from feed and microbial protein from the microbes that inhabit its rumen. A ruminant is unique in that it has a symbiotic relationship with these microbes. Like other living creatures, these microbes have requirements for protein and energy to facilitate growth and reproduction. During digestive contractions, some of these microorganisms are "washed" out of the rumen into the abomasum where they are digested like other proteins, thereby creating a source of protein for the animal.

All crude protein (CP) the animal ingests is divided into two fractions, degradable intake protein (DIP) and undegradable intake protein (UIP, also called "rumen bypass protein"). Each feedstuff (such as cottonseed meal, soybean hulls, and annual ryegrass forage) has different proportions of each protein type. Rumen microbes break down the DIP into ammonia (NH_3) amino acids, and peptides, which are used by the microbes along with energy from carbohydrate digestion for growth and reproduction.



Protein digestion in the ruminant

Excess ammonia is absorbed via the rumen wall and

converted into urea in the liver, where it returns in the blood to the saliva or is excreted by the body. Urea toxicity comes from overfeeding urea to ruminants. Ingested urea is immediately degraded to ammonia in the rumen.

When more ammonia than energy is available for building protein from the nitrogen supplied by urea, the excess ammonia is absorbed through the rumen wall. Toxicity occurs when the excess ammonia overwhelms the liver's ability to detoxify it into urea. This can kill the animal. However, with sufficient energy, microbes use ammonia and amino acids to grow and reproduce.

The rumen does not degrade the UIP component of feedstuffs. The UIP "bypasses" the rumen and makes its way from the omasum to the abomasum. In the abomasum, the ruminant uses UIP along with microorganisms washed out of the rumen as a protein source. Protein as a nutrient in ruminant diets is discussed in detail in Mississippi State University Extension Service Publication 2499, "Protein in Beef Cattle Diets."

Importance of Ruminant Livestock

The digestive system of ruminants optimizes use of rumen microbe fermentation products. This adaptation lets ruminants use resources (such as high-fiber forage) that cannot be used by or are not available to other animals. Ruminants are in a unique position of being able to use such resources that are not in demand by humans but in turn provide man with a vital food source. Ruminants are also useful in converting vast renewable resources from pasture into other products for human use such as hides, fertilizer, and other inedible products (such as horns and bone).

One of the best ways to improve agricultural sustainability is by developing and using effective ruminant livestock grazing systems. More than 60 percent of the land area in the world is too poor or erodible for cultivation but can become productive when used for ruminant grazing. Ruminant livestock can use land for grazing that would otherwise not be suitable for crop production. Ruminant livestock production also complements crop production, because ruminants can use the byproducts of these crop systems that are not in demand for human use or consumption. Developing a good understanding of ruminant digestive anatomy and function can help livestock producers better plan appropriate nutritional programs and properly manage ruminant animals in various production systems.

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Photographs of the ruminant digestive system are courtesy of Dr. Stephanie R. Hill, assistant research professor, Animal and Dairy Sciences, Mississippi State University.

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Beef Cattle Nutrient Requirements

Nutrients Required by Beef Cattle

Beef cattle require nutrients to support body maintenance, reproduction, lactation, and growth. The nutritional needs of beef cattle vary by age, class, stage of production, performance level, and weight. Physiological and environmental stressors, such as sickness and weather, can also impact nutritional requirements.

Beef cattle need water, protein, carbohydrates, fats, minerals, and vitamins. Of these nutrients, they require water in the greatest amounts daily. For more information on beef cattle water requirements, refer to Mississippi State University Extension Service Publication 2490, "Beef Cattle Water Requirements and Source Management."

The second greatest need is energy, which is supplied by carbohydrates, fats, and protein. This publication reports energy values for total digestible nutrients, net energy for maintenance, and net energy for gain. Mississippi State University Extension Service Publication 2504, "Energy in Beef Cattle Diets," contains a detailed discussion of beef cattle energy needs.

Protein is essential in beef cattle diets. This publication contains a table of crude protein values. Refer to Mississippi State University Extension Service Publication 2499, "Protein in Beef Cattle Diets," for information on the role of protein in beef cattle diets.

Of the nutrients listed above, beef cattle need minerals and vitamins in the smallest quantities, but they are essential to health and productivity. Mineral requirement values for calcium and phosphorus appear in this publication. Mississippi State University Extension Service Publication 2484, "Mineral and Vitamin Nutrition for Beef Cattle," outlines in detail calcium and phosphorus as well as other mineral and vitamin nutritional requirements of beef cattle.

Dry Matter Intake

While specific requirements for forage or feed intake do not exist, estimates of how much forage or feed animals will consume is needed for diet formulation and prediction of animal performance. This publication includes nutrient requirement tables that report dry matter intake and average daily gain values. Daily dry matter intake of forage and feed is the amount of forage and feed (excluding the moisture content) consumed in a day. Cattle require certain amounts of certain nutrients every day, such as protein, calcium, and vitamin A. To meet specific nutrient requirements, the percentage of nutrients in the diet for cattle is based on the quantities of forages and feeds consumed daily.

Many factors affect dry matter intake, including animal weight, condition, stage of production, milk production level, environmental conditions, forage quality, and amount and type of forage or feed offered. Forages typically make up the majority of cattle diets on both cow-calf and stocker cattle operations in Mississippi. Forage intake capacity is affected by stage of production and forage type and maturity (Table 1).

Table 1. Forage Intake Capacity of Beef Cows[1]

Forage Type and Maturity	Stage of Production	Forage Dry Matter Intake Capacity (% of body weight)
Low quality forage (< 52% total digestible nutrients)	Non-lactating	1.8
	Lactating	2.2
Average quality forage (52 to 59% total digestible nutrients)	Non-lactating	2.2
	Lactating	2.5
High quality forage (> 59% total digestible nutrients)	Non-lactating	2.5
	Lactating	2.7
Lush, growing pasture	Non-lactating	2.5
	Lactating	2.7
Silage	Non-lactating	2.5
	Lactating	2.7

[1] Intake estimates assume that protein requirements are met in the total diet. When protein requirements are not met, forage intake will be lower than the values in the table. Source: Hibbard and Thrift, 1992.

Forage Availability

Forage availability is the most important factor affecting forage intake on pasture. Insufficient available forage restricts intake. On high quality pasture, intake is typically adequate when available forage dry matter is at least 1000 to 1500 pounds per acre. Cattle harvest forages with their tongues, so very short forage can limit the amount of forage intake per bite (bite size). The animal has to walk farther and take more bites to consume an adequate level of forage. The extra walking allows less time for chewing and ruminating. When cattle are grazing short pasture, increased grazing time is often not enough to compensate for reduced bite size on forage intake.

The proportion of leaf to stem can greatly affect the bite size, as cattle prefer leaves. Higher proportions of stems effectively reduce bite size even if total forage available is adequate. When stocking rate is high, cattle on rotationally stocked pastures may be forced to consume more stem or low quality forage, which can reduce intake. In contrast, cattle on a continuously grazed pasture can be more selective unless the pasture is overstocked and has low forage availability. Warm-season perennial grasses, such as bermudagrass, bahiagrass, and dallisgrass, with a higher proportion of stem may require the animal to harvest more but in smaller bites to obtain the desired amount of forage. Cattle avoid dead material if green leaf is available, and bite size may be restricted as the grazing animal seeks out green leaves.

Palatability

Palatability refers to how acceptable a forage or feed is to an animal. Animals may spend time seeking out certain forage species and avoiding others, which affects bite size and effective forage availability. Cattle generally prefer grasses over clover and alfalfa. The tannins found in forages such as arrowleaf clover can reduce palatability. Nitrogen fertilization will generally increase forage protein content and can increase forage palatability. Cattle prefer certain feed ingredients as well. For example, newly arrived stocker calves usually prefer dry feeds to wet feeds, such as silages. Cattle may even refuse extremely moldy or otherwise unpalatable feeds. Palatability problems with hay or feed can increase feed waste.

Feeding Drive

If adequate forage is available, increased feeding drive usually increases forage intake. Body size, lactation level, growth rate, age, sex, and environmental factors all affect an animal's demand for nutrients. Lactating beef cattle can consume 35 to 50 percent more dry matter than nonlactating cattle of the same size on the same diet. Cattle with greater milk-producing ability often also have increased feed intake needs. Body composition, particularly the amount of body fat, can impact feed intake. Dry matter intake decreases once cattle exceed a certain degree of condition. Specifically, there is about a 2.7 percent decrease in dry matter intake for each 1 percent increase in body fat past the range of 21.3 to 31.5 percent body fat. Diligent feed intake monitoring can help determine when cattle have reached appropriate finish condition.

Physical Satiety

Physical satiety is the degree of "fullness" or distention of the digestive tract or abdomen caused by the volume of digesta in the tract. It is affected by forage quality, which determines how rapidly forage moves through the digestive tract. For example, intake on low quality bermudagrass will typically be lower than on annual ryegrass or white clover because bermudagrass remains in the rumen much longer. The beef animal's digestive tract breaks down annual ryegrass and white clover quickly, absorbs the nutrients, and rapidly passes the small amount of residue through the digestive tract. Forage intake can be limited by the capacity of the digestive tract because receptors in the rumen wall are sensitive to stretch. Yet factors other than gut capacity may

influence rate of digestion and intake.

Intake by beef cattle fed high-concentrate, grain-based diets is likely controlled by metabolic factors, not bulk fill. Feedlot cattle may increase their dry matter intake in response to a change in the level of bulky roughage (by as little as 5 percent or less of dry matter) or a shift to a more fibrous roughage. Percentage of dietary neutral detergent fiber (NDF) supplied by roughage appears to be useful for predicting effects of roughage quantity and source on dry matter intake. In general, as NDF levels increase, dry matter intake decreases.

Toxic Factors

There is considerable evidence that cattle can learn to avoid toxic or imbalanced feeds and to choose between two feeds of different nutritional value in order to avoid nutrient excesses or deficiencies. For example, cattle will graze a shorter time without changing bite size on toxic endophyte-infected tall fescue than on endophyte-free or nontoxic endophyte infected tall fescue. Selenium, cyanide (from prussic acid), or an alkaloid (for example, from toxic endophyte-infected tall fescue) can severely reduce intake.

Nutrient Deficiencies

Intake can be depressed whenever feed is deficient in essential nutrients, particularly protein. Nitrogen deficiency is common in cattle consuming low-nitrogen, high-fiber forage. Correcting this deficiency with supplemental nitrogen (protein) can increase dry matter intake substantially. Supplementing with protein helps increase intake when forage crude protein levels fall below 6 to 8 percent. Low protein levels are most commonly seen in poor quality forage with inadequate nitrogen fertilization. Supplementing with grain-based concentrate feeds tends to decrease forage intake, and forage intake drops more with high-quality forages than with low-quality forages.

Feed Physical Form

The physical form of feeds and forages can impact feed intake. With forage, fine grinding can improve intake, possibly by allowing it to pass through the digestive tract more rapidly. However, fine grinding of concentrate feeds can decrease feed intake.

Ionophore Use

Monensin is an ionophore used in beef cattle diets that helps improve cattle growth and efficiency. Beef cattle may drop dry matter intake by approximately 4 to 6 percent when fed monensin at recommended levels. Monensin can be added to receiving rations at levels required for coccidiosis control without affecting feed intake of lightweight calves. Monensin can reduce feed intake variation among individuals in group-fed cattle. Other ionophores, such as lasalocid, have limited effects on feed intake.

Implant Use

Growth-promoting implants tend to increase feed intake by 4 to 16 percent. The actual increase in feed intake may depend upon the animal's stage of growth at the time the implant is administered. Dry matter intake predictions should be decreased by about 8 percent for non-implanted cattle.

Environment

Extreme temperatures and weather can impact feed intake. The thermal neutral zone is the effective temperature range within which performance rate and efficiency are maximized. As temperatures rise above the animal's thermal neutral zone upper critical temperature, the point at which heat stress begins, dry matter intake falls (Figure 1). As temperatures drop below the animal's thermal neutral zone lower critical temperature, the point at which cold stress begins, dry matter intake increases. Temperature-based stress on cattle impacts energetic efficiency.

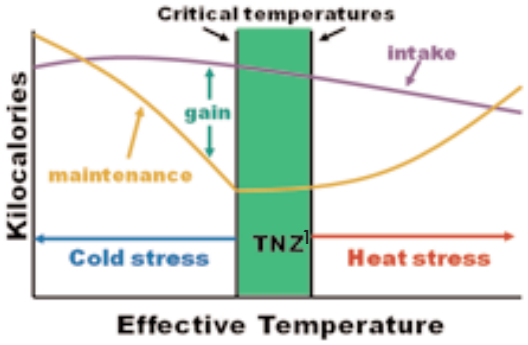

Figure 1. Effects of Temperature on Beef Cattle Maintenance, Gain, and Intake

[1]TNZ = Thermal Neutral Zone

Source: Adapted from Taylor, 1994.

The effects of temperature on feed intake depend upon the animal's thermal susceptibility, acclimation to the conditions, and diet. Mud, precipitation, humidity, and wind heighten temperature effects on feed intake (Table 2). The duration of these adverse conditions and the photoperiod, or length of daylight, may also influence feed intake. Breed also strongly influences how environmental conditions affect feed intake. Adaptability of cattle to the environment can impact feed intake and cattle productivity.

Table 2. Dry Matter Intake Adjustment Factors for Specific Environmental Conditions[1]

Environmental Condition	Dry Matter Intake Adjustment Factor[1]
Temperature, degrees Fahrenheit	
> 95 with no night cooling	.65
> 95 with night cooling	.90
77 to 95	.90
59 to 77	1.00
41 to 59	1.03
23 to 41	1.05
5 to 23	1.07
< 5	1.16
Mud, inches	
None	1.00
Mild, 3.9 to 7.9	.85
Severe, 11.8 to 23.6	.70

[1] Multiply this factor by predicted dry matter intake to determine adjusted dry matter intake for the specific environmental condition.

Source: NRC, 1987. Adapted from Predicting Feed Intake of Food-Producing Animals.

Management

Management can impact feed intake levels in beef cattle. Commingled newly weaned calves tend to consume more dry matter in the first weeks after weaning. Management practices such as programmed feeding, multiple feed deliveries per day, and consistent timing of feed delivery help regulate feeding behavior and reduce variations in feed intake by penned cattle. However, the effectiveness of these practices is typically evaluated by the pen and does not usually account for individual variation.

Individual Animal Variation

There is considerable individual animal variation in feed intake beyond what would be predicted based on size and growth rate. This difference in intake is called net or residual feed intake (RFI). Genetic variation in RFI of beef cattle exists both during growth and in adult cattle. Residual feed intake is moderately heritable, indicating that genetic improvement can be made through selection. From a cost production standpoint, a lower RFI value is more desirable. An animal with a negative RFI is more efficient because it consumes less feed than expected, while a positive-RFI animal is less efficient because it consumes more feed than expected.

Nutrient Requirement Tables

Data provided in the following nutrient requirement tables can assist producers in determining specific beef cattle nutrient requirements (Tables 3 through 9). The values listed in the tables serve as a general guide for matching forage and feeding programs to cattle nutrient needs. Actual nutrient requirements vary depending on many animal and environmental factors. Monitor body condition and weight in mature cattle and growth rates of growing cattle to make adjustments to cattle diets to achieve desired performance results.

Dry matter intake values are estimates based on published prediction equations. These predictions assume that adequate protein is supplied in the diet for maximum rumen fermentation. If the diet is deficient in protein, the dry matter intake values will overestimate actual cattle consumption.

Tabular values are intended for healthy, unstressed cattle in good body condition. Thin cattle need additional nutrients to improve body condition. Cattle under stresses, such as weather extremes or physical exertion, also require extra energy for maintenance.

Table 3. Nutrient Requirements of Mature Beef Cows[1,2]

Animal Description			Dry Matter Intake (DMI)		Diet Nutrient Density					Daily Nutrients per Animal				
Months since calving	Milk, lb/day	Body weight, lb	DMI, lb/day	DMI, % of BW	TDN, % DM	NE_m, Mcal/lb	CP, % DM	Ca, % DM	P, % DM	TDN, lb	NE_m, Mcal	CP, lb	Ca, lb	P, lb
900 lb mature weight														
10 lb peak milk														
1	8.3	900	20.2	2.2	56.4	.55	8.9	.24	.16	11.4	11.1	1.79	.049	.033
2	10.0	900	20.6	2.3	56.8	.57	9.3	.26	.17	11.7	11.7	1.92	.053	.035
3	9.0	901	21.4	2.4	54.7	.53	8.6	.24	.16	11.7	11.3	1.84	.051	.035
4	7.2	902	21.0	2.3	53.8	.51	8.1	.22	.15	11.3	10.8	1.70	.046	.031
5	5.4	904	20.5	2.3	52.7	.50	7.7	.20	.14	10.8	10.2	1.57	.042	.029
6	3.9	907	20.2	2.2	52.0	.49	7.2	.18	.13	10.5	9.8	1.45	.037	.026
20 lb peak milk														
1	16.7	900	22.6	2.5	60.2	.61	10.8	.30	.19	13.6	13.8	2.44	.068	.044
2	20.0	900	23.5	2.6	61.7	.63	11.5	.33	.22	14.5	14.9	2.70	.077	.051
3	18.0	901	23.8	2.6	59.2	.60	10.7	.31	.19	14.1	14.3	2.54	.073	.046
4	14.4	902	22.9	2.5	57.6	.57	9.9	.28	.18	13.2	13.1	2.26	.064	.042
5	10.8	904	21.9	2.4	55.7	.55	9.1	.25	.17	12.2	12.0	1.99	.055	.037
6	7.8	907	21.1	2.3	54.5	.52	8.3	.22	.16	11.5	11.0	1.76	.046	.033
30 lb peak milk														
1	25.0	900	24.9	2.8	63.5	.66	12.4	.35	.23	15.8	16.5	3.09	.088	.057
2	30.0	900	26.3	2.9	65.4	.69	13.2	.38	.24	17.2	18.2	3.48	.101	.064
3	27.0	901	26.3	2.9	62.7	.65	12.3	.36	.23	16.5	17.2	3.24	.095	.060
4	21.6	902	24.8	2.7	60.9	.63	11.4	.33	.21	15.1	15.5	2.83	.082	.053
5	16.2	904	23.4	2.6	58.5	.59	10.3	.29	.19	13.7	13.7	2.41	.068	.044
6	11.7	907	22.2	2.4	56.3	.55	9.3	.26	.17	12.5	12.3	2.06	.057	.037
10, 20, 30 lb peak milk														
7	0.0	911	18.0	2.0	46.7	.40	6.5	.16	.12	8.4	7.2	1.17	.029	.022
8	0.0	918	18.3	2.0	47.0	.40	6.6	.16	.12	8.6	7.4	1.20	.029	.022
9	0.0	929	18.7	2.0	47.6	.42	6.7	.16	.12	8.9	7.8	1.25	.029	.022
10	0.0	944	19.4	2.1	49.0	.43	6.9	.24	.15	9.5	8.4	1.33	.046	.029
11	0.0	966	19.4	2.0	51.5	.48	7.6	.24	.15	10.0	9.3	1.47	.046	.029
12	0.0	997	19.7	2.0	55.3	.54	8.6	.23	.15	10.9	10.7	1.70	.046	.029
1,000 lb mature weight														
10 lb peak milk														
1	8.2	1,000	21.6	2.2	55.8	.55	8.7	.24	.17	12.1	11.9	1.88	.052	.037
2	10.0	1,000	22.1	2.2	56.6	.56	9.1	.25	.17	12.5	12.4	2.01	.055	.038
3	9.0	1,002	23.0	2.3	54.3	.52	8.4	.23	.16	12.5	12.0	1.93	.053	.037
4	7.2	1,003	22.5	2.2	53.4	.51	8.0	.22	.15	12.0	11.5	1.79	.050	.034
5	5.4	1,005	22.1	2.2	52.5	.49	7.5	.20	.14	11.6	10.8	1.66	.044	.031
6	3.9	1,009	21.7	2.2	51.8	.48	7.1	.19	.14	11.2	10.4	1.55	.041	.030
20 lb peak milk														
1	16.7	1,000	24.0	2.4	59.6	.60	10.5	.30	.20	14.3	14.4	2.53	.072	.048
2	20.0	1,000	25.0	2.5	60.9	.62	11.2	.32	.21	15.2	15.5	2.80	.080	.053
3	18.0	1,002	25.4	2.5	58.6	.59	10.4	.30	.19	14.9	15.0	2.64	.076	.048
4	14.4	1,003	24.4	2.4	57.0	.56	9.7	.27	.18	13.9	13.7	2.35	.066	.044
5	10.8	1,005	23.5	2.3	55.4	.54	8.9	.24	.17	13.0	12.7	2.08	.056	.040
6	7.8	1,009	22.7	2.3	54.0	.52	8.2	.22	.15	12.3	11.8	1.85	.050	.034
30 lb peak milk														
1	25.0	1,000	26.4	2.6	62.8	.65	12.1	.35	.22	16.6	17.2	3.18	.092	.058
2	30.0	1,000	27.8	2.8	64.5	.68	12.9	.38	.24	17.9	18.9	3.58	.106	.067
3	27.0	1,002	27.8	2.8	62.1	.64	12.0	.35	.22	17.3	17.8	3.34	.097	.061
4	21.6	1,003	26.4	2.6	60.1	.61	11.1	.32	.21	15.9	16.1	2.92	.084	.055
5	16.2	1,005	24.9	2.5	57.9	.58	10.0	.28	.19	14.4	14.4	2.50	.070	.047
6	11.7	1,009	23.7	2.3	55.9	.55	9.1	.25	.17	13.2	13.0	2.15	.059	.040
10, 20, 30 lb peak milk														
7	0.0	1,015	21.1	2.1	44.9	.37	6.0	.15	.11	9.5	7.8	1.26	.032	.023
8	0.0	1,024	21.0	2.1	45.7	.38	6.2	.15	.11	9.6	8.0	1.29	.032	.023
9	0.0	1,038	20.9	2.0	47.0	.40	6.5	.15	.11	9.8	8.4	1.35	.031	.023
10	0.0	1,059	20.8	2.0	49.1	.44	7.0	.24	.15	9.8	9.2	1.45	.050	.031
11	0.0	1,088	21.0	1.9	52.0	.49	7.7	.24	.15	10.9	10.3	1.61	.050	.032
12	0.0	1,129	21.4	1.9	55.7	.54	8.7	.24	.15	11.9	11.6	1.86	.051	.032

[1] To maintain moderate body condition

[2] BW = total body weight = shrunk body weight or 96% full body weight, TDN = total digestible nutrients, NE_m = net energy for maintenance, CP = crude protein, Ca = calcium, P = phosphorus

Source: NRC, 2000. Adapted from NRC Nutrient Requirements of Beef Cattle, 7th revised edition.

Table 3 (Continued). Nutrient Requirements of Mature Beef Cows[1,2]

Animal Description			Dry Matter Intake (DMI)		Diet Nutrient Density					Daily Nutrients per Animal				
Months since calving	Milk, lb/day	Body weight, lb	DMI, lb/day	DMI, % of BW	TDN, % DM	NE_m, Mcal/lb	CP, % DM	Ca, % DM	P, % DM	TDN, lb	NE_m, Mcal	CP, lb	Ca, lb	P, lb
1,100 lb mature weight														
10 lb peak milk														
1	8.3	1,100	23.1	2.1	55.6	.54	8.5	.24	.16	12.8	12.5	1.97	.055	.037
2	10.0	1,100	23.5	2.1	56.3	.55	8.9	.26	.17	13.2	13.0	2.10	.060	.040
3	9.0	1,102	24.5	2.2	54.1	.52	8.2	.22	.16	13.3	12.7	2.02	.055	.040
4	7.2	1,103	24.1	2.2	53.2	.50	7.8	.21	.15	12.8	12.1	1.89	.051	.037
5	5.4	1,105	23.6	2.1	52.3	.49	7.4	.19	.14	12.3	11.6	1.75	.046	.033
6	3.9	1,108	23.3	2.1	51.6	.48	7.0	.19	.13	12.0	11.2	1.64	.044	.031
20 lb peak milk														
1	16.7	1,100	25.4	2.3	59.1	.60	10.3	.30	.20	15.0	15.2	2.62	.075	.051
2	20.0	1,100	26.4	2.4	60.4	.62	10.9	.32	.21	15.9	16.3	2.88	.084	.055
3	18.0	1,102	26.9	2.4	58.1	.58	10.1	.29	.19	15.6	15.6	2.73	.077	.051
4	14.4	1,103	26.0	2.4	56.6	.56	9.4	.26	.18	14.7	14.5	2.45	.068	.046
5	10.8	1,105	25.0	2.3	55.0	.53	8.7	.24	.17	13.8	13.3	2.17	.060	.042
6	7.8	1,108	24.2	2.2	53.7	.51	8.1	.22	.15	13.0	12.4	1.95	.053	.037
30 lb peak milk														
1	25.0	1,100	27.8	2.5	62.2	.64	11.8	.34	.22	17.3	17.9	3.27	.095	.062
2	30.0	1,100	29.2	2.7	63.9	.67	12.5	.37	.23	18.7	19.5	3.66	.108	.068
3	27.0	1,102	29.4	2.7	61.5	.63	11.7	.34	.22	18.1	18.6	3.43	.099	.064
4	21.6	1,103	27.9	2.5	59.5	.60	10.8	.31	.20	16.6	16.8	3.01	.086	.057
5	16.2	1,105	26.4	2.4	57.4	.57	9.8	.28	.19	15.2	15.1	2.59	.073	.049
6	11.7	1,108	25.3	2.3	55.6	.54	8.9	.25	.17	14.1	13.7	2.25	.062	.042
10, 20, 30 lb peak milk														
7	0.0	1,114	20.9	1.9	46.8	.40	6.5	.16	.12	9.8	8.4	1.36	.033	.026
8	0.0	1,122	21.2	1.9	47.2	.41	6.6	.16	.12	10.0	8.7	1.40	.033	.026
9	0.0	1,135	21.8	1.9	47.9	.42	6.7	.15	.12	10.4	9.1	1.45	.033	.026
10	0.0	1,154	22.6	2.0	48.9	.44	6.9	.24	.15	11.1	9.9	1.56	.055	.035
11	0.0	1,181	22.5	1.9	52.1	.49	7.7	.24	.16	11.7	11.0	1.73	.055	.035
12	0.0	1,218	23.0	1.9	56.0	.55	8.7	.24	.15	12.9	12.6	2.00	.055	.035
1,200 lb mature weight														
10 lb peak milk														
1	8.3	1,200	24.4	2.0	55.3	.54	8.4	.24	.17	13.5	13.2	2.06	.059	.041
2	10.0	1,200	24.9	2.1	56.0	.55	8.8	.25	.17	13.9	13.7	2.19	.062	.042
3	9.0	1,202	26.0	2.2	53.7	.51	8.1	.23	.16	14.0	13.3	2.11	.060	.042
4	7.2	1,203	25.6	2.1	52.9	.50	7.7	.21	.15	13.5	12.8	1.98	.054	.038
5	5.4	1,205	25.1	2.1	52.1	.49	7.3	.20	.14	13.1	12.3	1.84	.050	.035
6	3.9	1,209	24.8	2.1	51.5	.48	7.0	.19	.14	12.8	11.9	1.74	.047	.035
20 lb peak milk														
1	16.7	1,200	26.8	2.2	58.7	.59	10.1	.29	.19	15.7	15.8	2.71	.078	.051
2	20.0	1,200	27.8	2.3	59.9	.61	10.7	.31	.21	16.7	17.0	2.97	.086	.058
3	18.0	1,202	28.4	2.4	57.6	.57	9.9	.29	.19	16.4	16.2	2.82	.082	.054
4	14.4	1,203	27.4	2.3	56.2	.55	9.3	.26	.18	15.4	15.1	2.53	.071	.049
5	10.8	1,205	26.5	2.2	54.7	.53	8.5	.24	.17	14.5	14.0	2.26	.064	.045
6	7.8	1,209	25.7	2.1	53.4	.51	7.9	.22	.15	13.7	13.1	2.04	.057	.039
30 lb peak milk														
1	25.0	1,200	29.2	2.4	61.6	.64	11.5	.34	.22	18.0	18.7	3.36	.099	.064
2	30.0	1,200	30.6	2.6	63.2	.66	12.3	.36	.23	19.3	20.2	3.75	.110	.070
3	27.0	1,202	30.8	2.6	60.8	.62	11.4	.34	.22	18.7	19.1	3.51	.105	.068
4	21.6	1,203	29.4	2.4	59.0	.59	10.6	.31	.20	17.3	17.3	3.10	.091	.059
5	16.2	1,205	27.9	2.3	57.0	.56	9.6	.27	.18	15.9	15.6	2.68	.075	.050
6	11.7	1,209	26.7	2.2	55.2	.54	8.8	.25	.17	14.7	14.4	2.34	.067	.045
10, 20, 30 lb peak milk														
7	0.0	1,215	24.2	2.0	44.9	.37	6.0	.15	.12	10.9	9.0	1.45	.036	.029
8	0.0	1,224	24.1	2.0	45.8	.38	6.2	.15	.12	11.0	9.2	1.49	.036	.029
9	0.0	1,238	24.0	1.9	47.1	.41	6.5	.15	.12	11.3	9.8	1.56	.036	.029
10	0.0	1,259	23.9	1.9	49.3	.44	7.0	.26	.16	11.8	10.5	1.67	.062	.038
11	0.0	1,288	24.1	1.9	52.3	.49	7.7	.25	.16	12.6	11.8	1.86	.060	.039
12	0.0	1,329	24.6	1.9	56.2	.55	8.8	.25	.16	13.8	13.5	2.16	.062	.039

[1] To maintain moderate body condition

[2] BW = total body weight = shrunk body weight or 96% full body weight, TDN = total digestible nutrients, NE_m = net energy for maintenance, CP = crude protein, Ca = calcium, P = phosphorus

Source: NRC, 2000. Adapted from NRC Nutrient Requirements of Beef Cattle, 7th revised edition.

Table 3 (Continued). Nutrient Requirements of Mature Beef Cows[1,2]

Animal Description			Dry Matter Intake (DMI)		Diet Nutrient Density					Daily Nutrients per Animal				
Months since calving	Milk, lb/day	Body weight, lb	DMI, lb/day	DMI, % of BW	TDN, % DM	NE_m, Mcal/lb	CP, % DM	Ca, % DM	P, % DM	TDN, lb	NE_m, Mcal	CP, lb	Ca, lb	P, lb
1,300 lb mature weight														
10 lb peak milk														
1	8.3	1,300	25.8	2.0	55.0	.53	8.3	.23	.16	14.2	13.8	2.15	.060	.042
2	10.0	1,300	26.3	2.0	55.9	.54	8.7	.24	.17	14.7	14.3	2.28	.064	.046
3	9.0	1,302	27.5	2.1	53.5	.51	8.0	.23	.16	14.7	14.0	2.20	.062	.044
4	7.2	1,303	27.0	2.1	52.6	.50	7.6	.21	.16	14.2	13.4	2.06	.057	.042
5	5.4	1,306	26.6	2.0	51.9	.48	7.3	.20	.15	13.8	12.9	1.93	.053	.040
6	3.9	1,310	26.3	2.0	51.3	.48	6.9	.19	.14	13.5	12.5	1.82	.051	.037
20 lb peak milk														
1	16.7	1,300	28.2	2.2	58.5	.59	9.9	.29	.20	16.5	16.5	2.80	.082	.055
2	20.0	1,300	29.1	2.2	59.5	.60	10.5	.30	.21	17.3	17.6	3.06	.088	.060
3	18.0	1,302	29.9	2.3	57.2	.57	9.7	.28	.19	17.1	16.9	2.91	.084	.057
4	14.4	1,303	28.9	2.2	56.1	.55	9.1	.26	.18	16.2	15.8	2.63	.075	.051
5	10.8	1,306	28.0	2.1	54.3	.52	8.4	.24	.16	15.2	14.6	2.35	.066	.046
6	7.8	1,310	27.2	2.1	53.3	.50	7.8	.22	.15	14.5	13.7	2.13	.060	.042
30 lb peak milk														
1	25.0	1,300	30.6	2.4	61.1	.63	11.3	.33	.22	18.7	19.2	3.45	.101	.066
2	30.0	1,300	32.0	2.5	62.8	.65	12.0	.36	.23	20.1	20.8	3.84	.115	.073
3	27.0	1,302	32.3	2.5	60.4	.62	11.2	.33	.21	19.5	19.9	3.61	.106	.068
4	21.6	1,303	30.8	2.4	58.8	.59	10.4	.30	.20	18.1	18.1	3.19	.093	.062
5	16.2	1,306	29.4	2.3	56.5	.56	9.4	.27	.19	16.6	16.4	2.77	.079	.055
6	11.7	1,310	28.2	2.2	55.0	.53	8.6	.24	.17	15.5	15.0	2.43	.068	.049
10, 20, 30 lb peak milk														
7	0.0	1,316	23.8	1.8	47.1	.40	6.5	.17	.13	11.2	9.5	1.54	.040	.031
8	0.0	1,326	24.2	1.8	47.1	.40	6.4	.17	.13	11.4	9.8	1.58	.040	.031
9	0.0	1,342	24.8	1.8	48.0	.42	6.7	.16	.13	11.9	10.4	1.66	.040	.031
10	0.0	1,364	25.8	1.9	48.8	.44	6.9	.26	.16	12.6	11.3	1.78	.066	.042
11	0.0	1,396	25.6	1.8	52.3	.49	7.8	.26	.16	13.4	12.6	1.99	.066	.042
12	0.0	1,440	26.1	1.8	56.3	.56	8.9	.25	.16	14.7	14.5	2.31	.066	.042
1,400 lb mature weight														
10 lb peak milk														
1	8.3	1,400	27.1	1.9	54.9	.53	8.2	.23	.17	14.9	14.4	2.23	.062	.046
2	10.0	1,400	27.6	2.0	55.5	.54	8.6	.25	.17	15.3	14.9	2.36	.069	.047
3	9.0	1,402	28.9	2.1	53.3	.51	7.9	.23	.16	15.4	14.7	2.29	.066	.046
4	7.2	1,403	28.5	2.0	52.5	.49	7.6	.21	.15	15.0	14.0	2.15	.060	.043
5	5.4	1,406	28.0	2.0	51.8	.48	7.2	.20	.15	14.5	13.4	2.01	.056	.042
6	3.9	1,410	27.7	2.0	51.2	.47	6.9	.19	.14	14.2	13.0	1.91	.053	.039
20 lb peak milk														
1	16.7	1,400	29.5	2.1	58.0	.58	9.8	.28	.19	17.1	17.1	2.88	.083	.056
2	20.0	1,400	30.5	2.2	59.1	.60	10.3	.30	.20	18.0	18.3	3.14	.092	.061
3	18.0	1,402	31.3	2.2	56.8	.56	9.6	.28	.19	17.8	17.5	2.99	.088	.059
4	14.4	1,403	30.3	2.2	55.5	.54	8.9	.26	.18	16.8	16.4	2.71	.079	.055
5	10.8	1,406	29.4	2.1	54.1	.52	8.3	.24	.17	15.9	15.3	2.44	.071	.050
6	7.8	1,410	28.6	2.0	53.0	.50	7.7	.22	.16	15.2	14.3	2.21	.063	.046
30 lb peak milk														
1	25.0	1,400	31.9	2.3	60.7	.62	11.1	.33	.22	19.4	19.8	3.53	.105	.070
2	30.0	1,400	33.3	2.4	62.2	.64	11.8	.35	.23	20.7	21.3	3.92	.117	.077
3	27.0	1,402	33.7	2.4	59.8	.61	11.0	.32	.21	20.2	20.6	3.69	.108	.071
4	21.6	1,403	32.3	2.3	58.1	.58	10.2	.30	.20	18.8	18.7	3.28	.097	.065
5	16.2	1,406	30.8	2.2	56.2	.55	9.3	.27	.18	17.3	16.9	2.86	.083	.055
6	11.7	1,410	29.6	2.1	54.7	.53	8.5	.24	.17	16.2	15.7	2.51	.071	.050
10, 20, 30 lb peak milk														
7	0.0	1,417	27.2	1.9	45.0	.37	6.0	.16	.12	12.2	10.1	1.63	.044	.033
8	0.0	1,428	27.0	1.9	45.8	.39	6.2	.16	.12	12.4	10.5	1.67	.043	.032
9	0.0	1,445	26.9	1.9	47.3	.41	6.5	.16	.12	12.7	11.0	1.76	.043	.032
10	0.0	1,469	26.8	1.8	49.5	.44	7.0	.27	.17	13.3	11.8	1.89	.072	.046
11	0.0	1,503	27.0	1.8	52.6	.49	7.8	.26	.17	14.2	13.2	2.11	.070	.046
12	0.0	1,550	27.6	1.8	56.6	.56	8.9	.26	.16	15.6	15.5	2.45	.072	.044

[1] To maintain moderate body condition

[2] BW = total body weight = shrunk body weight or 96% full body weight, TDN = total digestible nutrients, NE_m = net energy for maintenance, CP = crude protein, Ca = calcium, P = phosphorus

Source: NRC, 2000. Adapted from NRC Nutrient Requirements of Beef Cattle, 7th revised edition.

Table 4. Nutrient Requirements of Two-Year-Old Heifers[1,2]

Animal Description			Dry Matter Intake (DMI)		Diet Nutrient Density					Daily Nutrients per Animal				
Months since calving	Milk, lb/day	Body weight, lb	DMI, lb/day	DMI, % of BW	TDN, % DM	NE_m, Mcal/lb	CP, % DM	Ca, % DM	P, % DM	TDN, lb	NE_m, Mcal	CP, lb	Ca, lb	P, lb
900 lb mature weight														
1	12.3	729	19.1	2.6	61.4	.63	10.8	.31	.20	11.7	12.1	2.07	.060	.037
2	14.8	738	19.9	2.7	62.6	.65	11.4	.33	.21	12.5	12.9	2.27	.066	.042
3	13.3	748	20.4	2.7	60.3	.61	10.6	.30	.19	12.3	12.5	2.16	.062	.040
4	10.7	758	19.8	2.6	58.8	.60	9.9	.28	.18	11.6	11.8	1.96	.055	.035
5	8.0	769	19.3	2.5	57.4	.57	9.2	.25	.17	11.1	11.0	1.77	.049	.033
6	5.8	781	18.8	2.4	56.2	.55	8.6	.23	.15	10.6	10.4	1.61	.044	.029
7	0.0	794	17.4	2.2	48.5	.43	6.8	.18	.13	8.4	7.4	1.18	.031	.022
8	0.0	810	17.5	2.2	49.2	.44	7.0	.18	.13	8.6	7.7	1.22	.031	.022
9	0.0	830	17.7	2.1	50.5	.46	7.2	.17	.12	8.9	8.2	1.28	.031	.022
10	0.0	854	17.9	2.1	52.4	.49	7.7	.27	.16	9.4	8.8	1.38	.049	.029
11	0.0	885	18.3	2.1	55.2	.54	8.3	.27	.16	10.1	9.8	1.52	.049	.029
12	0.0	825	18.9	2.3	58.7	.59	9.3	.27	.15	11.1	11.2	1.75	.051	.029
1,000 lb mature weight														
1	12.3	810	20.4	2.5	61.0	.63	10.6	.30	.19	12.4	12.8	2.16	.062	.040
2	14.8	820	21.2	2.6	62.1	.64	11.1	.32	.21	13.2	13.6	2.36	.068	.044
3	13.3	831	21.8	2.6	59.8	.61	10.4	.30	.19	13.0	13.2	2.26	.066	.042
4	10.7	843	21.2	2.5	58.5	.59	9.7	.28	.18	12.4	12.5	2.06	.060	.037
5	8.0	854	20.7	2.4	57.1	.57	9.0	.26	.17	11.8	11.7	1.87	.053	.035
6	5.8	868	20.3	2.3	56.0	.55	8.4	.23	.15	11.4	11.1	1.71	.046	.031
7	0.0	883	18.8	2.1	48.6	.43	6.8	.18	.13	9.1	8.1	1.29	.033	.024
8	0.0	900	18.9	2.1	49.4	.44	7.0	.17	.13	9.3	8.4	1.33	.033	.024
9	0.0	922	19.1	2.1	50.7	.47	7.3	.17	.13	9.7	8.9	1.39	.033	.024
10	0.0	949	19.4	2.0	52.7	.49	7.7	.28	.17	10.2	9.6	1.50	.055	.033
11	0.0	984	19.9	2.0	55.5	.54	8.4	.28	.17	11.0	10.7	1.66	.055	.033
12	0.0	1,028	20.6	2.0	59.1	.60	9.3	.27	.16	12.2	12.3	1.92	.055	.033
1,100 lb mature weight														
1	12.3	891	21.6	2.4	60.7	.62	10.4	.31	.19	13.1	13.4	2.25	.066	.042
2	14.8	902	22.5	2.5	61.7	.64	10.9	.32	.21	13.9	14.3	2.45	.073	.046
3	13.3	915	23.2	2.5	59.5	.60	10.1	.29	.19	13.8	13.9	2.35	.068	.044
4	10.7	927	22.6	2.4	58.2	.58	9.5	.27	.18	13.2	13.2	2.16	.062	.040
5	8.0	940	22.1	2.4	56.9	.56	8.9	.25	.17	12.6	12.4	1.96	.055	.037
6	5.8	954	21.7	2.3	55.9	.55	8.3	.23	.15	12.1	11.9	1.81	.051	.033
7	0.0	971	20.2	2.1	48.8	.43	6.9	.19	.13	9.9	8.7	1.39	.037	.026
8	0.0	990	20.4	2.1	49.5	.45	7.0	.18	.13	10.1	9.1	1.43	.037	.026
9	0.0	1,014	20.6	2.0	50.8	.47	7.3	.18	.13	10.5	9.6	1.50	.037	.026
10	0.0	1,044	20.9	2.0	52.8	.50	7.7	.28	.17	11.0	10.4	1.61	.060	.035
11	0.0	1,082	21.4	2.0	55.7	.54	8.4	.28	.16	11.9	11.6	1.79	.060	.035
12	0.0	1,130	22.1	2.0	59.4	.60	9.4	.27	.16	13.1	13.3	2.07	.060	.035

[1] 20 lb peak milk production

[2] BW = total body weight = shrunk body weight or 96% full body weight, TDN = total digestible nutrients, NE_m = net energy for maintenance, CP = crude protein, Ca = calcium, P = phosphorus

Source: NRC, 2000. Adapted from NRC Nutrient Requirements of Beef Cattle, 7th revised edition.

Table 4 (Continued). Nutrient Requirements of Two-Year-Old Heifers[1,2]

Animal Description			Dry Matter Intake (DMI)		Diet Nutrient Density					Daily Nutrients per Animal				
Months since calving	Milk, lb/day	Body weight, lb	DMI, lb/day	DMI, % of BW	TDN, % DM	NE_m, Mcal/lb	CP, % DM	Ca, % DM	P, % DM	TDN, lb	NE_m, Mcal	CP, lb	Ca, lb	P, lb
1,200 lb mature weight														
1	12.3	972	22.9	2.4	60.4	.62	10.2	.30	.19	13.8	14.1	2.34	.068	.044
2	14.8	984	23.8	2.4	61.4	.63	10.7	.31	.20	14.6	15.0	2.55	.075	.049
3	13.3	998	24.5	2.5	59.2	.60	10.0	.29	.19	14.5	14.6	2.44	.071	.046
4	10.7	1,011	24.0	2.4	58.0	.58	9.4	.28	.17	13.9	13.9	2.25	.066	.042
5	8.0	1,025	23.4	2.3	56.8	.56	8.8	.25	.17	13.3	13.1	2.05	.060	.040
6	5.8	1,041	23.0	2.2	55.8	.55	8.3	.23	.15	12.8	12.6	1.90	.053	.035
7	0.0	1,059	21.5	2.0	48.9	.44	6.9	.18	.13	10.5	9.4	1.48	.040	.029
8	0.0	1,080	21.7	2.0	49.7	.45	7.1	.18	.13	10.8	9.7	1.53	.040	.029
9	0.0	1,106	22.0	2.0	51.0	.47	7.3	.18	.13	11.2	10.3	1.61	.040	.029
10	0.0	1,139	22.3	2.0	53.1	.50	7.8	.30	.18	11.8	11.2	1.73	.066	.040
11	0.0	1,180	22.8	1.9	55.9	.55	8.5	.29	.17	12.7	12.5	1.93	.066	.040
12	0.0	1,233	23.7	1.9	59.7	.60	9.4	.28	.17	14.1	14.3	2.23	.066	.040
1,300 lb mature weight														
1	12.3	1,053	24.1	2.3	60.2	.61	10.1	.30	.19	14.5	14.8	2.43	.073	.046
2	14.8	1,066	25.0	2.3	61.1	.63	10.5	.31	.20	15.3	15.7	2.63	.077	.051
3	13.3	1,081	25.8	2.4	58.9	.59	9.8	.29	.19	15.2	15.3	2.53	.075	.049
4	10.7	1,095	25.3	2.3	57.8	.57	9.2	.27	.17	14.6	14.5	2.34	.068	.044
5	8.0	1,111	24.8	2.2	56.6	.56	8.7	.25	.17	14.0	13.8	2.15	.062	.042
6	5.8	1,128	24.4	2.2	55.7	.55	8.2	.23	.15	13.6	13.3	1.99	.057	.037
7	0.0	1,147	22.9	2.0	49.0	.44	6.9	.19	.13	11.2	10.0	1.58	.044	.031
8	0.0	1,170	23.1	2.0	49.8	.45	7.1	.19	.13	11.5	10.4	1.63	.044	.031
9	0.0	1,199	23.3	1.9	51.2	.47	7.3	.19	.13	11.9	11.0	1.71	.044	.031
10	0.0	1,234	23.7	1.9	53.3	.51	7.8	.30	.18	12.6	12.0	1.85	.071	.042
11	0.0	1,279	24.3	1.9	56.2	.55	8.5	.29	.17	13.7	13.4	2.06	.071	.042
12	0.0	1,336	25.2	1.9	60.0	.61	9.5	.28	.17	15.1	15.4	2.40	.071	.042
1,400 lb mature weight														
1	12.3	1,134	25.3	2.2	60.0	.61	9.9	.30	.19	15.2	15.4	2.52	.075	.049
2	14.8	1,148	26.2	2.3	60.9	.62	10.4	.31	.20	16.0	16.3	2.72	.082	.053
3	13.3	1,164	27.1	2.3	58.7	.59	9.7	.28	.19	15.9	16.0	2.62	.077	.051
4	10.7	1,179	26.6	2.3	57.6	.57	9.1	.27	.17	15.3	15.2	2.43	.073	.046
5	8.0	1,196	26.1	2.2	56.5	.56	8.6	.25	.17	14.7	14.5	2.23	.066	.044
6	5.8	1,214	25.7	2.1	55.7	.54	8.1	.23	.15	14.3	14.0	2.08	.060	.040
7	0.0	1,235	24.2	2.0	49.1	.44	6.9	.19	.14	11.9	10.6	1.67	.046	.033
8	0.0	1,260	24.4	1.9	49.9	.45	7.1	.19	.14	12.2	11.0	1.72	.046	.033
9	0.0	1,291	24.7	1.9	51.3	.47	7.3	.19	.13	12.7	11.7	1.81	.046	.033
10	0.0	1,329	25.1	1.9	53.4	.51	7.8	.30	.18	13.4	12.7	1.96	.075	.046
11	0.0	1,377	25.7	1.9	56.4	.56	8.5	.30	.18	14.5	14.3	2.19	.077	.046
12	0.0	1,438	26.7	1.9	60.2	.61	9.5	.29	.17	16.1	16.4	2.54	.077	.046

[1] 20 lb peak milk production

[2] BW = total body weight = shrunk body weight or 96% full body weight, TDN = total digestible nutrients, NE_m = net energy for maintenance, CP = crude protein, Ca = calcium, P = phosphorus

Source: NRC, 2000. Adapted from NRC Nutrient Requirements of Beef Cattle, 7th revised edition.

Table 5. Nutrient Requirements of Pregnant Replacement Heifers[1]

Animal Description			Dry Matter Intake (DMI)		Diet Nutrient Density						Daily Nutrients per Animal					
Months since conception	Body weight, lb	ADG, lb	DMI, lb/day	DMI, % of BW	TDN, % DM	NE_m, Mcal/lb	NE_g, Mcal/lb	CP, % DM	Ca, % DM	P, % DM	TDN, lb	NE_m, Mcal	NE_g, Mcal	CP, lb	Ca, lb	P, lb
900 lb mature weight																
1	562	0.70	15.5	2.8	50.2	.46	.21	7.1	.21	.13	7.8	7.1	3.3	1.10	.033	.020
2	584	0.73	15.9	2.7	50.3	.46	.21	7.1	.21	.13	8.0	7.3	3.3	1.13	.033	.020
3	607	0.77	16.3	2.7	50.4	.46	.21	7.1	.20	.12	8.2	7.5	3.4	1.16	.033	.020
4	631	0.84	16.8	2.7	50.7	.46	.21	7.1	.20	.12	8.5	7.7	3.5	1.20	.033	.020
5	658	0.94	17.3	2.6	51.3	.47	.22	7.2	.19	.12	8.9	8.1	3.8	1.25	.033	.020
6	689	1.08	17.8	2.6	52.3	.49	.24	7.4	.20	.12	9.3	8.7	4.3	1.31	.035	.022
7	724	1.26	18.4	2.5	54.1	.51	.26	7.7	.29	.16	10.0	9.4	4.8	1.41	.053	.029
8	766	1.51	19.1	2.5	57.1	.56	.30	8.2	.28	.15	10.9	10.7	5.7	1.57	.053	.029
9	817	1.82	19.7	2.4	62.0	.63	.37	9.2	.27	.16	12.2	12.4	7.3	1.81	.053	.031
1,000 lb mature weight																
1	625	0.78	16.7	2.7	50.1	.46	.21	7.2	.22	.17	8.4	7.7	3.5	1.20	.036	.028
2	649	0.81	17.2	2.7	50.2	.46	.21	7.2	.22	.17	8.6	7.9	3.6	1.24	.038	.029
3	674	0.86	17.7	2.6	50.4	.46	.21	7.2	.22	.17	8.9	8.1	3.7	1.27	.039	.030
4	701	0.94	18.2	2.6	50.7	.46	.21	7.2	.21	.17	9.2	8.4	3.8	1.31	.038	.031
5	731	1.05	18.7	2.6	51.3	.47	.22	7.3	.21	.17	9.6	8.8	4.1	1.37	.039	.032
6	765	1.20	19.4	2.5	52.3	.49	.24	7.6	.20	.16	10.1	9.5	4.7	1.47	.039	.031
7	805	1.41	20.0	2.5	54.0	.52	.26	8.0	.32	.23	10.8	10.4	5.2	1.60	.064	.046
8	852	1.68	20.7	2.4	56.8	.56	.30	8.7	.31	.23	11.8	11.6	6.2	1.80	.064	.048
9	908	2.02	21.3	2.3	61.3	.63	.37	10.0	.31	.22	13.1	13.4	7.9	2.13	.066	.047
1,100 lb mature weight																
1	687	.86	18.0	2.6	50.3	.46	.21	7.2	.23	.18	9.1	8.3	3.8	1.30	.041	.032
2	714	.89	18.5	2.6	50.4	.46	.21	7.2	.22	.17	9.3	8.5	3.9	1.33	.041	.031
3	742	.95	19.0	2.6	50.5	.46	.21	7.2	.22	.17	9.6	8.7	4.0	1.37	.042	.032
4	771	1.03	19.5	2.5	50.8	.47	.22	7.2	.22	.17	9.9	9.2	4.3	1.40	.043	.033
5	804	1.15	20.1	2.5	51.3	.48	.22	7.3	.21	.17	10.3	9.6	4.4	1.47	.042	.034
6	842	1.31	20.8	2.5	52.3	.49	.24	7.5	.21	.17	10.9	10.2	5.0	1.56	.044	.035
7	885	1.54	21.5	2.4	53.9	.52	.26	7.9	.32	.23	11.6	11.2	5.6	1.70	.069	.049
8	936	1.84	22.3	2.4	56.5	.56	.30	8.6	.31	.22	12.6	12.5	6.7	1.92	.069	.049
9	998	2.21	22.9	2.3	60.6	.62	.36	9.8	.30	.22	13.9	14.2	8.2	2.24	.069	.050
1,200 lb mature weight																
1	750	.93	19.3	2.6	50.5	.46	.21	7.2	.23	.18	9.7	8.9	4.1	1.39	.044	.035
2	779	.97	19.8	2.5	50.5	.46	.21	7.2	.23	.18	10.0	9.1	4.2	1.43	.046	.036
3	809	1.03	20.3	2.5	50.7	.46	.21	7.2	.22	.18	10.3	9.3	4.3	1.46	.045	.035
4	842	1.12	20.9	2.5	50.9	.47	.22	7.2	.22	.17	10.6	9.8	4.6	1.50	.046	.036
5	878	1.25	21.5	2.4	51.4	.48	.23	7.3	.22	.17	11.1	10.3	4.9	1.57	.047	.037
6	918	1.44	22.2	2.4	52.3	.49	.24	7.5	.21	.17	11.6	10.9	5.3	1.67	.047	.038
7	966	1.69	23.0	2.4	53.8	.51	.26	7.9	.31	.23	12.4	11.7	6.0	1.82	.071	.053
8	1,022	2.01	23.7	2.3	56.2	.55	.30	8.5	.31	.22	13.3	13.0	7.1	2.01	.073	.052
9	1,089	2.42	24.4	2.2	59.9	.61	.35	9.6	.30	.22	14.6	14.9	8.5	2.34	.073	.054
1,300 lb mature weight																
1	812	1.01	20.5	2.5	50.6	.46	.21	7.2	.24	.18	10.4	9.4	4.3	1.48	.049	.037
2	843	1.05	21.0	2.5	50.7	.46	.21	7.2	.23	.18	10.6	9.7	4.4	1.51	.048	.038
3	876	1.12	21.6	2.5	50.8	.47	.22	7.2	.23	.18	11.0	10.2	4.8	1.56	.050	.039
4	912	1.22	22.2	2.4	51.0	.47	.22	7.2	.22	.18	11.3	10.4	4.9	1.60	.049	.040
5	951	1.36	22.9	2.4	51.5	.48	.23	7.3	.22	.18	11.8	11.0	5.3	1.67	.050	.041
6	995	1.56	23.6	2.4	52.4	.49	.24	7.5	.22	.17	12.4	11.6	5.7	1.77	.052	.040
7	1,046	1.83	24.4	2.3	53.7	.51	.26	7.9	.31	.23	13.1	12.4	6.3	1.93	.076	.056
8	1,107	2.19	25.2	2.3	56.0	.55	.29	8.5	.30	.22	14.1	13.9	7.3	2.14	.076	.055
9	1,180	2.63	25.9	2.2	59.5	.60	.34	9.5	.30	.22	15.4	15.5	8.8	2.46	.078	.057
1,400 lb mature weight																
1	875	1.09	21.7	2.5	50.7	.47	.22	7.3	.24	.18	11.0	10.2	4.8	1.58	.052	.039
2	908	1.13	22.3	2.5	50.8	.47	.22	7.2	.24	.18	11.3	10.5	4.9	1.61	.054	.040
3	944	1.20	22.9	2.4	50.9	.47	.22	7.2	.23	.18	11.7	10.8	5.0	1.65	.053	.041
4	982	1.31	23.5	2.4	51.2	.47	.22	7.2	.23	.18	12.0	11.0	5.2	1.69	.054	.042
5	1,024	1.46	24.2	2.4	51.6	.48	.23	7.3	.22	.18	12.5	11.6	5.6	1.77	.053	.044
6	1,071	1.67	24.9	2.3	52.4	.49	.24	7.5	.22	.18	13.0	12.2	6.0	1.82	.055	.045
7	1,126	1.96	25.8	2.3	53.7	.51	.26	7.8	.31	.23	13.9	13.2	6.7	2.01	.080	.059
8	1,192	2.34	26.6	2.2	55.8	.55	.29	8.4	.30	.22	14.8	14.6	7.7	2.23	.080	.059
9	1,270	2.82	27.4	2.2	59.0	.60	.34	9.3	.30	.22	16.2	16.4	9.3	2.55	.082	.060

[1] BW = total body weight = shrunk body weight or 96% full body weight, ADG = average daily gain, TDN = total digestible nutrients, NE_m = net energy for maintenance, NE_g = net energy for gain, CP = crude protein, Ca = calcium, P = phosphorus

Source: NRC, 2000. Adapted from NRC Nutrient Requirements of Beef Cattle, 7th revised edition.

Table 6. Nutrient Requirements of Growing Steer and Heifer Calves[1,2]

Animal Description		Dry Matter Intake (DMI)		Diet Nutrient Density						Daily Nutrients per Animal					
Body weight, lb	ADG, lb	DMI, lb/day	DMI, % of BW	TDN, % DM	NE_m, Mcal/lb	NE_g, Mcal/lb	CP, % DM	Ca, % DM	P, % DM	TDN, lb	NE_m, Mcal	NE_g, Mcal	CP, lb	Ca, lb	P, lb
1,100 lb at finishing															
300	0.5	7.9	2.6	54	.50	.24	9.2	.30	.16	4.3	3.1	.4	.73	.024	.013
	1.0	8.4	2.8	59	.57	.31	11.4	.46	.23	5.0	3.1	.9	.95	.039	.019
	1.5	8.6	2.9	64	.64	.37	13.6	.62	.29	5.5	3.1	1.4	1.17	.053	.025
	2.0	8.6	2.9	69	.72	.44	16.2	.79	.36	5.9	3.1	1.9	1.39	.068	.031
	2.5	8.5	2.8	75	.81	.52	18.9	.96	.40	6.4	3.1	2.5	1.61	.082	.034
	3.0	8.2	2.7	83	.92	.62	22.2	1.17	.51	6.8	3.1	3.0	1.83	.096	.042
400	0.5	9.8	2.5	54	.50	.24	8.7	.27	.15	5.3	3.8	.5	.85	.026	.015
	1.0	10.4	2.6	59	.57	.31	10.4	.39	.20	6.1	3.8	1.1	1.08	.040	.021
	1.5	10.7	2.7	64	.64	.37	12.1	.50	.24	6.8	3.8	1.7	1.30	.053	.026
	2.0	10.7	2.7	69	.72	.44	14.1	.62	.29	7.4	3.8	2.4	1.51	.066	.031
	2.5	10.6	2.7	75	.81	.52	16.3	.75	.34	8.0	3.8	3.1	1.72	.079	.036
	3.0	10.2	2.6	83	.92	.62	19.0	.90	.41	8.5	3.8	3.7	1.94	.092	.042
500	0.5	11.6	2.3	54	.50	.24	8.4	.25	.15	6.3	4.5	.6	.97	.029	.017
	1.0	12.2	2.4	59	.57	.31	9.8	.34	.18	7.2	4.5	1.3	1.19	.041	.022
	1.5	12.6	2.5	64	.64	.37	11.2	.42	.22	8.1	4.5	2.1	1.41	.054	.027
	2.0	12.7	2.5	69	.72	.44	12.8	.52	.25	8.8	4.5	2.8	1.63	.066	.032
	2.5	12.5	2.5	75	.81	.52	14.7	.62	.30	9.4	4.5	3.6	1.84	.077	.037
	3.0	12.1	2.4	83	.92	.62	16.9	.74	.35	10.0	4.5	4.4	2.05	.089	.042
600	0.5	13.2	2.2	54	.50	.24	8.2	.23	.14	7.1	5.2	.7	1.08	.031	.019
	1.0	14.0	2.3	59	.57	.31	9.4	.30	.17	8.3	5.2	1.5	1.31	.043	.024
	1.5	14.4	2.4	64	.64	.37	10.6	.38	.20	9.2	5.2	2.4	1.53	.054	.028
	2.0	14.6	2.4	69	.72	.44	11.9	.44	.22	10.1	5.2	3.2	1.74	.065	.033
	2.5	14.4	2.4	75	.81	.52	13.6	.52	.26	10.8	5.2	4.1	1.95	.075	.037
	3.0	13.8	2.3	83	.92	.62	15.7	.62	.30	11.5	5.2	5.0	2.17	.086	.041
700	0.5	14.9	2.1	54	.50	.24	8.0	.22	.14	8.0	5.8	.8	1.19	.033	.021
	1.0	15.8	2.3	59	.57	.31	9.0	.28	.16	9.3	5.8	1.7	1.42	.044	.026
	1.5	16.2	2.3	64	.64	.37	10.1	.33	.19	10.4	5.8	2.7	1.64	.054	.030
	2.0	16.3	2.3	69	.72	.44	11.4	.39	.21	11.2	5.8	3.6	1.85	.064	.034
	2.5	16.1	2.3	75	.81	.52	12.8	.46	.24	12.1	5.8	4.6	2.06	.074	.038
	3.0	15.5	2.2	83	.92	.62	14.6	.54	.27	12.9	5.8	5.7	2.27	.084	.042

[1] 1,100 or 1,200 lb at finishing (28 percent body fat) or maturity (replacement heifers)

[2] BW = total body weight = shrunk body weight or 96% full body weight, ADG = average daily gain, TDN = total digestible nutrients, NE_m = net energy for maintenance, NE_g = net energy for gain, CP = crude protein, Ca = calcium, P = phosphorus

Source: NRC, 2000. Adapted from NRC Nutrient Requirements of Beef Cattle, 7th revised edition.

Table 6 (Continued). Nutrient Requirements of Growing Steer and Heifer Calves[1,2]

Animal Description		Dry Matter Intake (DMI)		Diet Nutrient Density						Daily Nutrients per Animal					
Body weight, lb	ADG, lb	DMI, lb/day	DMI, % of BW	TDN, % DM	NE_m, Mcal/lb	NE_g, Mcal/lb	CP, % DM	Ca, % DM	P, % DM	TDN, lb	NE_m, Mcal	NE_g, Mcal	CP, lb	Ca, lb	P, lb
1,200 lb at finishing															
300	0.5	7.8	2.6	54	.49	.24	9.4	.31	.17	4.2	3.1	.4	.73	.025	.013
	1.0	8.3	2.8	58	.56	.30	11.5	.48	.23	4.8	3.1	.8	.95	.040	.019
	1.5	8.6	2.9	63	.63	.36	13.7	.63	.29	5.4	3.1	1.3	1.17	.054	.025
	2.0	8.6	2.9	68	.70	.42	16.2	.80	.36	5.8	3.1	1.8	1.40	.069	.031
	2.5	8.6	2.9	73	.78	.50	18.7	.96	.43	6.3	3.1	2.3	1.61	.083	.037
	3.0	8.3	2.8	80	.88	.58	22.0	1.18	.52	6.6	3.1	2.8	1.83	.098	.043
400	0.5	9.7	2.4	54	.49	.24	8.8	.28	.16	5.2	3.8	.5	.85	.027	.015
	1.0	10.3	2.6	58	.56	.30	10.4	.39	.20	6.0	3.8	1.0	1.07	.041	.021
	1.5	10.6	2.7	63	.63	.36	12.2	.51	.25	6.7	3.8	1.6	1.30	.054	.026
	2.0	10.7	2.7	68	.70	.42	14.1	.63	.30	7.3	3.8	2.2	1.51	.068	.032
	2.5	10.7	2.7	73	.78	.50	16.1	.76	.35	7.8	3.8	2.9	1.72	.081	.037
	3.0	10.4	2.6	80	.88	.58	18.7	.90	.41	8.3	3.8	3.5	1.94	.094	.043
500	0.5	11.5	2.3	54	.49	.24	8.4	.25	.15	6.2	4.5	.6	.97	.029	.017
	1.0	12.2	2.4	58	.56	.30	9.8	.34	.18	7.1	4.5	1.2	1.19	.042	.022
	1.5	12.6	2.5	63	.63	.36	11.2	.43	.22	7.9	4.5	1.9	1.41	.055	.028
	2.0	12.6	2.5	68	.70	.42	12.9	.53	.26	8.6	4.5	2.6	1.63	.067	.033
	2.5	12.6	2.5	73	.78	.50	14.6	.63	.30	9.2	4.5	3.4	1.84	.079	.038
	3.0	12.2	2.4	80	.88	.58	16.8	.75	.35	9.8	4.5	4.1	2.05	.092	.043
600	0.5	13.2	2.2	54	.49	.24	8.2	.24	.15	7.1	5.2	.7	1.08	.031	.019
	1.0	14.0	2.3	58	.56	.30	9.3	.31	.17	8.1	5.2	1.4	1.31	.043	.024
	1.5	14.4	2.4	63	.63	.36	10.6	.38	.20	9.1	5.2	2.2	1.52	.055	.029
	2.0	14.4	2.4	68	.70	.42	12.1	.46	.23	9.8	5.2	3.0	1.74	.067	.034
	2.5	14.4	2.4	73	.78	.50	13.5	.54	.26	10.5	5.2	3.9	1.95	.078	.038
	3.0	14.0	2.3	80	.88	.58	15.4	.64	.31	11.2	5.2	4.7	2.16	.089	.043
700	0.5	14.8	2.1	54	.49	.24	8.0	.23	.14	8.0	5.8	.7	1.18	.034	.021
	1.0	15.7	2.2	58	.56	.30	9.0	.29	.17	9.1	5.8	1.6	1.42	.045	.026
	1.5	16.2	2.3	63	.63	.36	10.1	.34	.19	10.2	5.8	2.5	1.64	.056	.030
	2.0	16.3	2.3	68	.70	.42	11.3	.41	.21	11.1	5.8	3.4	1.85	.067	.035
	2.5	16.2	2.3	73	.78	.50	12.7	.47	.24	11.8	5.8	4.3	2.05	.077	.039
	3.0	15.8	2.3	80	.88	.58	14.4	.55	.27	12.6	5.8	5.3	2.27	.087	.043

[1] 1,100 or 1,200 lb at finishing (28 percent body fat) or maturity (replacement heifers)

[2] BW = total body weight = shrunk body weight or 96% full body weight, ADG = average daily gain, TDN = total digestible nutrients, NE_m = net energy for maintenance, NE_g = net energy for gain, CP = crude protein, Ca = calcium, P = phosphorus

Source: NRC, 2000. Adapted from NRC Nutrient Requirements of Beef Cattle, 7th revised edition.

Table 6 (Continued). Nutrient Requirements of Growing Steer and Heifer Calves[1,2]

Animal Description		Dry Matter Intake (DMI)		Diet Nutrient Density						Daily Nutrients per Animal					
Body weight, lb	ADG, lb	DMI, lb/day	DMI, % of BW	TDN, % DM	NE_m, Mcal/lb	NEg, Mcal/lb	CP, % DM	Ca, % DM	P, % DM	TDN, lb	NE_m, Mcal	NE_g, Mcal	CP, lb	Ca, lb	P, lb
1,200 lb at finishing															
300	0.5	7.8	2.6	54	.49	.24	9.4	.31	.17	4.2	3.1	.4	.73	.025	.013
	1.0	8.3	2.8	58	.56	.30	11.5	.48	.23	4.8	3.1	.8	.95	.040	.019
	1.5	8.6	2.9	63	.63	.36	13.7	.63	.29	5.4	3.1	1.3	1.17	.054	.025
	2.0	8.6	2.9	68	.70	.42	16.2	.80	.36	5.8	3.1	1.8	1.40	.069	.031
	2.5	8.6	2.9	73	.78	.50	18.7	.96	.43	6.3	3.1	2.3	1.61	.083	.037
	3.0	8.3	2.8	80	.88	.58	22.0	1.18	.52	6.6	3.1	2.8	1.83	.098	.043
400	0.5	9.7	2.4	54	.49	.24	8.8	.28	.16	5.2	3.8	.5	.85	.027	.015
	1.0	10.3	2.6	58	.56	.30	10.4	.39	.20	6.0	3.8	1.0	1.07	.041	.021
	1.5	10.6	2.7	63	.63	.36	12.2	.51	.25	6.7	3.8	1.6	1.30	.054	.026
	2.0	10.7	2.7	68	.70	.42	14.1	.63	.30	7.3	3.8	2.2	1.51	.068	.032
	2.5	10.7	2.7	73	.78	.50	16.1	.76	.35	7.8	3.8	2.9	1.72	.081	.037
	3.0	10.4	2.6	80	.88	.58	18.7	.90	.41	8.3	3.8	3.5	1.94	.094	.043
500	0.5	11.5	2.3	54	.49	.24	8.4	.25	.15	6.2	4.5	.6	.97	.029	.017
	1.0	12.2	2.4	58	.56	.30	9.8	.34	.18	7.1	4.5	1.2	1.19	.042	.022
	1.5	12.6	2.5	63	.63	.36	11.2	.43	.22	7.9	4.5	1.9	1.41	.055	.028
	2.0	12.6	2.5	68	.70	.42	12.9	.53	.26	8.6	4.5	2.6	1.63	.067	.033
	2.5	12.6	2.5	73	.78	.50	14.6	.63	.30	9.2	4.5	3.4	1.84	.079	.038
	3.0	12.2	2.4	80	.88	.58	16.8	.75	.35	9.8	4.5	4.1	2.05	.092	.043
600	0.5	13.2	2.2	54	.49	.24	8.2	.24	.15	7.1	5.2	.7	1.08	.031	.019
	1.0	14.0	2.3	58	.56	.30	9.3	.31	.17	8.1	5.2	1.4	1.31	.043	.024
	1.5	14.4	2.4	63	.63	.36	10.6	.38	.20	9.1	5.2	2.2	1.52	.055	.029
	2.0	14.4	2.4	68	.70	.42	12.1	.46	.23	9.8	5.2	3.0	1.74	.067	.034
	2.5	14.4	2.4	73	.78	.50	13.5	.54	.26	10.5	5.2	3.9	1.95	.078	.038
	3.0	14.0	2.3	80	.88	.58	15.4	.64	.31	11.2	5.2	4.7	2.16	.089	.043
700	0.5	14.8	2.1	54	.49	.24	8.0	.23	.14	8.0	5.8	.7	1.18	.034	.021
	1.0	15.7	2.2	58	.56	.30	9.0	.29	.17	9.1	5.8	1.6	1.42	.045	.026
	1.5	16.2	2.3	63	.63	.36	10.1	.34	.19	10.2	5.8	2.5	1.64	.056	.030
	2.0	16.3	2.3	68	.70	.42	11.3	.41	.21	11.1	5.8	3.4	1.85	.067	.035
	2.5	16.2	2.3	73	.78	.50	12.7	.47	.24	11.8	5.8	4.3	2.05	.077	.039
	3.0	15.8	2.3	80	.88	.58	14.4	.55	.27	12.6	5.8	5.3	2.27	.087	.043

[1] 1,100 or 1,200 lb at finishing (28 percent body fat) or maturity (replacement heifers)

[2] BW = total body weight = shrunk body weight or 96% full body weight, ADG = average daily gain, TDN = total digestible nutrients, NE_m = net energy for maintenance, NE_g = net energy for gain, CP = crude protein, Ca = calcium, P = phosphorus

Source: NRC, 2000. Adapted from NRC Nutrient Requirements of Beef Cattle, 7th revised edition.

Table 7. Nutrient Requirements of Growing Bull Calves[1,2]

Animal Description		Dry Matter Intake (DMI)		Diet Nutrient Density						Daily Nutrients per Animal					
Body weight, lb	ADG, lb	DMI, lb/day	DMI, % of BW	TDN, % DM	NE_m, Mcal/lb	NE_g, Mcal/lb	CP, % DM	Ca, % DM	P, % DM	TDN, lb	NE_m, Mcal	NE_g, Mcal	CP, lb	Ca, lb	P, lb
2,000 lb mature weight															
300	0.5	8.0	2.7	55	.51	.25	9.1	.31	.16	4.4	3.5	.4	.73	.025	.013
	1.0	8.3	2.8	58	.56	.30	11.4	.48	.23	4.8	3.5	.8	.95	.040	.019
	1.5	8.5	2.8	61	.60	.34	13.8	.64	.29	5.2	3.5	1.3	1.17	.054	.025
	2.0	8.6	2.9	65	.65	.38	16.3	.80	.36	5.6	3.5	1.8	1.40	.069	.031
	2.5	8.7	2.9	68	.71	.43	18.5	.95	.43	5.9	3.5	2.3	1.61	.083	.037
	3.0	8.6	2.9	72	.76	.48	21.3	1.14	.50	6.2	3.5	2.8	1.83	.098	.043
400	0.5	9.9	2.5	55	.51	.25	8.6	.27	.15	5.4	4.4	.5	.85	.027	.015
	1.0	10.3	2.6	58	.56	.30	10.5	.40	.20	6.0	4.4	1.0	1.08	.041	.021
	1.5	10.5	2.6	61	.60	.34	12.4	.51	.25	6.4	4.4	1.6	1.30	.054	.026
	2.0	10.7	2.7	65	.65	.38	14.1	.64	.30	7.0	4.4	2.2	1.51	.068	.032
	2.5	10.7	2.7	68	.71	.43	16.2	.76	.35	7.3	4.4	2.9	1.73	.081	.037
	3.0	10.7	2.7	72	.76	.48	18.1	.88	.40	7.7	4.4	3.5	1.94	.094	.043
500	0.5	11.7	2.3	55	.51	.25	8.3	.25	.15	6.4	5.2	.6	.97	.029	.017
	1.0	12.2	2.4	58	.56	.30	9.8	.34	.18	7.1	5.2	1.2	1.19	.042	.022
	1.5	12.5	2.5	61	.60	.34	11.3	.44	.22	7.6	5.2	1.9	1.41	.055	.028
	2.0	12.6	2.5	65	.65	.38	12.9	.53	.26	8.2	5.2	2.6	1.63	.067	.033
	2.5	12.7	2.5	68	.71	.43	14.5	.63	.29	8.6	5.2	3.4	1.84	.080	.037
	3.0	12.6	2.5	72	.76	.48	16.3	.73	.34	9.1	5.2	4.1	2.05	.092	.043
600	0.5	13.4	2.2	55	.51	.25	8.1	.24	.14	7.4	5.9	.7	1.08	.032	.019
	1.0	13.9	2.3	58	.56	.30	9.4	.32	.17	8.1	5.9	1.4	1.31	.044	.024
	1.5	14.3	2.4	61	.60	.34	10.7	.38	.20	8.7	5.9	2.2	1.53	.055	.029
	2.0	14.5	2.4	65	.65	.38	12.0	.46	.23	9.4	5.9	3.0	1.74	.067	.034
	2.5	14.5	2.4	68	.71	.43	13.4	.54	.26	9.9	5.9	3.9	1.95	.078	.038
	3.0	14.5	2.4	72	.76	.48	14.9	.61	.30	10.4	5.9	4.7	2.16	.089	.043
700	0.5	15.1	2.2	55	.51	.25	7.9	.23	.14	8.3	6.7	.7	1.19	.034	.021
	1.0	15.6	2.2	58	.56	.30	9.1	.29	.17	9.0	6.7	1.6	1.42	.045	.026
	1.5	16.0	2.3	61	.60	.34	10.3	.35	.19	9.8	6.7	2.5	1.64	.056	.030
	2.0	16.3	2.3	65	.65	.38	11.4	.40	.21	10.6	6.7	3.4	1.86	.066	.035
	2.5	16.3	2.3	68	.71	.43	12.7	.47	.24	11.1	6.7	4.3	2.07	.077	.039
	3.0	15.3	2.2	72	.76	.48	13.9	.53	.26	11.7	6.7	5.3	2.27	.087	.043
800	0.5	16.7	2.1	55	.51	.25	7.7	.22	.14	9.2	7.4	.8	1.28	.036	.023
	1.0	17.3	2.2	58	.56	.30	8.7	.27	.16	10.0	7.4	1.8	1.51	.047	.028
	1.5	17.7	2.2	61	.60	.34	9.7	.32	.18	10.8	7.4	2.7	1.72	.057	.032
	2.0	18.0	2.3	65	.65	.38	10.7	.37	.19	11.7	7.4	3.8	1.93	.066	.035
	2.5	18.1	2.3	68	.71	.43	11.8	.42	.22	12.3	7.4	4.8	2.13	.076	.039
	3.0	18.0	2.3	72	.76	.48	12.9	.47	.24	13.0	7.4	5.9	2.33	.085	.043
900	0.5	18.2	2.0	55	.51	.25	7.5	.21	.14	10.0	8.0	.9	1.37	.039	.026
	1.0	18.9	2.1	58	.56	.30	8.3	.25	.15	11.0	8.0	1.9	1.57	.048	.029
	1.5	19.4	2.2	61	.60	.34	9.1	.29	.17	11.8	8.0	3.0	1.77	.057	.033
	2.0	19.6	2.2	65	.65	.38	9.9	.34	.19	12.7	8.0	4.1	1.95	.066	.037
	2.5	19.7	2.2	68	.71	.43	10.9	.38	.20	13.4	8.0	5.2	2.14	.075	.040
	3.0	19.6	2.2	72	.76	.48	11.9	.42	.22	14.1	8.0	6.4	2.33	.083	.043

[1] For bulls less than 12 months of age

[2] BW = total body weight = shrunk body weight or 96% full body weight, ADG = average daily gain, TDN = total digestible nutrients, NE_m = net energy for maintenance, NE_g = net energy for gain, CP = crude protein, Ca = calcium, P = phosphorus

Source: NRC, 2000. Adapted from NRC Nutrient Requirements of Beef Cattle, 7th revised edition.

Table 8. Nutrient Requirements of Growing Yearlings[1,2,3]

Animal Description		Dry Matter Intake (DMI)		Diet Nutrient Density						Daily Nutrients per Animal					
Body weight, lb	ADG, lb	DMI, lb/day	DMI, % of BW	TDN, % DM	NE_m, Mcal/lb	NE_g, Mcal/lb	CP, % DM	Ca, % DM	P, % DM	TDN, lb	NE_m, Mcal	NEg, Mcal	CP, lb	Ca, lb	P, lb
1,000 lb at finishing															
550	0.6	15.2	2.8	50	.45	.20	7.1	.21	.13	7.6	4.8	.9	1.08	.032	.020
	1.8	16.1	2.9	60	.61	.35	9.8	.36	.19	9.7	4.8	2.9	1.58	.058	.031
	2.7	15.7	2.9	70	.76	.48	12.4	.49	.24	11.0	4.8	4.5	1.95	.077	.038
	3.3	14.8	2.7	80	.90	.61	14.9	.61	.29	11.8	4.8	5.7	2.21	.090	.043
	3.8	13.7	2.5	90	1.04	.72	17.3	.73	.34	12.3	4.8	6.5	2.37	.100	.047
600	0.6	16.2	2.7	50	.45	.20	7.0	.21	.13	8.1	5.2	1.0	1.13	.034	.021
	1.8	17.2	2.9	60	.61	.35	9.5	.34	.18	10.3	5.2	3.0	1.63	.058	.031
	2.7	16.8	2.8	70	.76	.48	11.9	.45	.23	11.8	5.2	4.8	2.00	.076	.039
	3.3	15.8	2.6	80	.90	.61	14.3	.56	.27	12.6	5.2	6.1	2.26	.088	.043
	3.8	14.6	2.4	90	1.04	.72	16.5	.66	.32	13.1	5.2	6.9	2.41	.096	.047
650	0.6	17.3	2.7	50	.45	.20	6.9	.20	.12	8.7	5.5	1.1	1.19	.035	.021
	1.8	18.2	2.8	60	.61	.35	9.2	.32	.17	10.9	5.5	3.2	1.67	.058	.031
	2.7	17.8	2.7	70	.76	.48	11.5	.42	.21	12.5	5.5	5.1	2.05	.075	.037
	3.3	16.8	2.6	80	.90	.61	13.7	.52	.26	13.4	5.5	6.5	2.30	.087	.044
	3.8	15.5	2.4	90	1.04	.72	15.9	.61	.30	14.0	5.5	7.4	2.46	.095	.047
700	0.6	18.2	2.6	50	.45	.20	6.8	.19	.12	9.1	5.8	1.1	1.24	.035	.022
	1.8	19.3	2.8	60	.61	.35	8.8	.30	.16	11.6	5.8	3.4	1.70	.058	.031
	2.7	18.8	2.7	70	.76	.48	10.9	.39	.20	13.2	5.8	5.4	2.05	.073	.037
	3.3	17.8	2.5	80	.90	.61	13.0	.48	.24	14.2	5.8	6.8	2.31	.085	.044
	3.8	16.4	2.3	90	1.04	.72	15.0	.56	.28	14.8	5.8	7.8	2.46	.092	.047
750	0.6	19.2	2.6	50	.45	.20	6.7	.19	.12	9.6	6.1	1.2	1.29	.036	.022
	1.8	20.3	2.7	60	.61	.35	8.5	.28	.16	12.2	6.1	3.6	1.73	.057	.031
	2.7	19.8	2.6	70	.76	.48	10.3	.37	.19	13.9	6.1	5.7	2.04	.073	.038
	3.3	18.7	2.5	80	.90	.61	12.2	.45	.23	15.0	6.1	7.2	2.28	.084	.043
	3.8	17.3	2.3	90	1.04	.72	14.0	.52	.26	15.6	6.1	8.2	2.42	.090	.046
800	0.6	20.2	2.5	50	.45	.20	6.5	.19	.12	10.1	6.4	1.2	1.31	.038	.024
	1.8	21.3	2.7	60	.61	.35	8.1	.27	.15	12.8	6.4	3.8	1.73	.058	.032
	2.7	20.8	2.6	70	.76	.48	9.8	.34	.18	14.6	6.4	5.9	2.04	.071	.037
	3.3	19.6	2.5	80	.90	.61	11.5	.42	.22	15.7	6.4	7.6	2.25	.082	.043
	3.8	18.1	2.3	90	1.04	.72	13.2	.48	.25	16.3	6.4	8.6	2.39	.087	.045

[1] Multiply expected mature bull weight by 0.60 for weight to use for growing yearling bulls

[2] 1,000 to 1,400 lb at finishing (28 percent body fat) or maturity (replacement heifers)

[3] BW = total body weight = shrunk body weight or 96% full body weight, ADG = average daily gain, TDN = total digestible nutrients, NE_m = net energy for maintenance, NE_g = net energy for gain, CP = crude protein, Ca = calcium, P = phosphorus

Source: NRC, 2000. Adapted from NRC Nutrient Requirements of Beef Cattle, 7th revised edition.

Table 8 (Continued). Nutrient Requirements of Growing Yearlings[1,2,3]

Animal Description		Dry Matter Intake (DMI)		Diet Nutrient Density						Daily Nutrients per Animal					
Body weight, lb	ADG, lb	DMI, b/day	DMI, % of BW	TDN, DM	NE_m, Mcal/lb	NE_g, Mcal/lb	CP, % DM	Ca, % DM	P, % DM	TDN, lb	NE_m, Mcal	NE_g, Mcal	CP, lb	Ca, lb	P, lb
1,100 lb at finishing															
605	0.7	16.3	2.7	50	.45	.20	7.2	.22	.13	8.2	5.2	1.0	1.17	.036	.021
	1.9	17.3	2.9	60	.61	.35	10.0	.36	.19	10.4	5.2	3.0	1.73	.062	.033
	2.9	16.9	2.8	70	.76	.48	12.7	.49	.24	11.8	5.2	4.8	2.15	.083	.041
	3.6	15.9	2.6	80	.90	.61	15.3	.61	.29	12.7	5.2	6.1	2.43	.097	.046
	4.0	14.7	2.4	90	1.04	.72	17.8	.72	.34	13.2	5.2	7.0	2.62	.106	.050
660	0.7	17.5	2.7	50	.45	.20	7.1	.21	.13	8.8	5.5	1.1	1.24	.037	.023
	1.9	18.4	2.8	60	.61	.35	9.7	.34	.18	11.0	5.5	3.2	1.78	.063	.033
	2.9	18.0	2.7	70	.76	.48	12.3	.45	.23	12.6	5.5	5.1	2.21	.081	.041
	3.6	17.0	2.6	80	.90	.61	14.7	.56	.27	13.6	5.5	6.5	2.50	.095	.046
	4.0	15.7	2.4	90	1.04	.72	17.1	.66	.32	14.1	5.5	7.4	2.68	.104	.050
715	0.7	18.5	2.6	50	.45	.20	6.9	.20	.13	9.3	5.9	1.1	1.28	.037	.024
	1.9	19.6	2.7	60	.61	.35	9.2	.32	.17	11.8	5.9	3.5	1.80	.063	.033
	2.9	19.1	2.7	70	.76	.48	11.5	.42	.21	13.4	5.9	5.5	2.20	.080	.040
	3.6	18.1	2.5	80	.90	.61	13.7	.52	.26	14.5	5.9	6.9	2.48	.094	.047
	4.0	16.7	2.3	90	1.04	.72	15.9	.61	.30	15.0	5.9	7.9	2.66	.102	.050
770	0.7	19.6	2.5	50	.45	.20	6.8	.20	.12	9.8	6.2	1.2	1.33	.039	.024
	1.9	20.7	2.7	60	.61	.35	8.8	.30	.16	12.4	6.2	3.6	1.82	.062	.033
	2.9	20.2	2.6	70	.76	.48	10.9	.39	.20	14.1	6.2	5.8	2.20	.079	.040
	3.6	19.1	2.5	80	.90	.61	12.9	.48	.24	15.3	6.2	7.3	2.46	.092	.046
	4.0	17.6	2.3	90	1.04	.72	14.8	.56	.28	15.8	6.2	8.3	2.60	.099	.049
825	0.7	20.6	2.5	50	.45	.20	6.6	.19	.12	10.3	6.6	1.3	1.36	.039	.025
	1.9	21.8	2.6	60	.61	.35	8.4	.28	.16	13.1	6.6	3.8	1.83	.061	.035
	2.9	21.3	2.6	70	.76	.48	10.3	.37	.19	14.9	6.6	6.1	2.19	.079	.040
	3.6	20.1	2.4	80	.90	.61	12.1	.44	.23	16.1	6.6	7.7	2.43	.088	.046
	4.0	18.6	2.3	90	1.04	.72	13.9	.52	.26	16.7	6.6	8.8	2.59	.097	.048
880	0.7	21.7	2.5	50	.45	.20	6.5	.19	.12	10.9	6.9	1.3	1.41	.041	.026
	1.9	22.9	2.6	60	.61	.35	8.1	.27	.15	13.7	6.9	4.0	1.85	.062	.034
	2.9	22.4	2.5	70	.76	.48	9.8	.34	.18	15.7	6.9	6.4	2.20	.076	.040
	3.6	21.1	2.4	80	.90	.61	11.4	.42	.22	16.9	6.9	8.1	2.41	.089	.046
	4.0	19.5	2.2	90	1.04	.72	13.1	.48	.25	17.6	6.9	9.2	2.55	.094	.049

1Multiply expected mature bull weight by 0.60 for weight to use for growing yearling bulls
2 1,000 to 1,400 lb at finishing (28 percent body fat) or maturity (replacement heifers)
3 BW = total body weight = shrunk body weight or 96% full body weight, ADG = average daily gain, TDN = total digestible nutrients, NE_m = net energy for maintenance, NE_g = net energy for gain, CP = crude protein, Ca = calcium, P = phosphorus

Source: NRC, 2000. Adapted from NRC Nutrient Requirements of Beef Cattle, 7th revised edition.

Table 8 (Continued). Nutrient Requirements of Growing Yearlings[1,2,3]

Animal Description		Dry Matter Intake (DMI)		Diet Nutrient Density						Daily Nutrients per Animal					
Body weight, lb	ADG, lb	DMI, lb/day	DMI, % of BW	TDN, % DM	NE_m, Mcal/lb	NE_g, Mcal/lb	CP, % DM	Ca, % DM	P, % DM	TDN, lb	NE_m, Mcal	NE_g, Mcal	CP, lb	Ca, lb	P, lb
1,200 lb at finishing															
660	0.7	17.5	2.7	50	.45	.20	7.3	.22	.13	8.8	5.5	1.1	1.28	.039	.023
	1.9	18.4	2.8	60	.61	.35	10.2	.36	.19	11.0	5.5	3.3	1.88	.066	.035
	2.9	18.0	2.7	70	.76	.48	13.0	.49	.24	12.6	5.5	5.2	2.34	.088	.043
	3.6	17.0	2.6	80	.90	.61	15.8	.61	.29	13.6	5.5	6.5	2.69	.104	.049
	4.0	15.7	2.4	90	1.04	.72	18.4	.72	.34	14.1	5.5	7.4	2.89	.113	.053
720	0.7	18.6	2.6	50	.45	.20	7.1	.21	.13	9.3	5.9	1.1	1.32	.039	.024
	2.0	19.7	2.7	60	.61	.35	9.7	.34	.18	11.8	5.9	3.5	1.91	.067	.035
	3.0	19.2	2.7	70	.76	.48	12.2	.45	.23	13.4	5.9	5.5	2.34	.086	.044
	3.8	18.2	2.5	80	.90	.61	14.6	.56	.27	14.6	5.9	7.0	2.66	.102	.049
	4.2	16.8	2.3	90	1.04	.72	17.0	.66	.32	15.1	5.9	7.9	2.86	.111	.054
780	0.7	19.8	2.5	50	.45	.20	6.9	.20	.13	9.9	6.3	1.2	1.37	.040	.026
	2.0	20.9	2.7	60	.61	.35	9.2	.32	.17	12.5	6.3	3.7	1.92	.067	.036
	3.0	20.4	2.6	70	.76	.48	11.4	.42	.21	14.3	6.3	5.8	2.33	.086	.043
	3.8	19.3	2.5	80	.90	.61	13.6	.52	.26	15.4	6.3	7.4	2.62	.100	.050
	4.2	17.8	2.3	90	1.04	.72	15.8	.61	.30	16.0	6.3	8.4	2.81	.109	.053
840	0.7	20.9	2.5	50	.45	.20	6.8	.20	.13	10.5	6.6	1.3	1.42	.042	.027
	2.0	22.1	2.6	60	.61	.35	8.8	.30	.16	13.3	6.6	3.9	1.94	.071	.035
	3.0	21.6	2.6	70	.76	.48	10.8	.39	.20	15.1	6.6	6.2	2.33	.091	.043
	3.8	20.4	2.4	80	.90	.61	12.8	.48	.24	16.3	6.6	7.8	2.61	.106	.049
	4.2	18.8	2.2	90	1.04	.72	14.7	.56	.28	16.9	6.6	8.9	2.76	.115	.053
900	0.7	22.0	2.4	50	.45	.20	6.6	.19	.12	11.0	7.0	1.3	1.45	.042	.026
	2.0	23.3	2.6	60	.61	.35	8.4	.28	.16	14.0	7.0	4.1	1.96	.065	.037
	3.0	22.7	2.5	70	.76	.48	10.2	.37	.19	15.9	7.0	6.5	2.32	.084	.043
	3.8	21.5	2.4	80	.90	.61	12.0	.44	.23	17.2	7.0	8.3	2.58	.095	.049
	4.2	19.8	2.2	90	1.04	.72	13.8	.52	.26	17.8	7.0	9.4	2.73	.103	.051
960	0.7	23.1	2.4	50	.45	.20	6.5	.19	.12	11.6	7.3	1.4	1.50	.044	.028
	2.0	24.4	2.5	60	.61	.35	8.1	.27	.15	14.6	7.3	4.3	1.98	.066	.037
	3.0	23.9	2.5	70	.76	.48	9.7	.34	.19	16.7	7.3	6.8	2.32	.081	.045
	3.8	22.5	2.3	80	.90	.61	11.3	.41	.22	18.0	7.3	8.7	2.54	.092	.050
	4.2	20.8	2.2	90	1.04	.72	13.0	.48	.25	18.7	7.3	9.9	2.70	.100	.052

[1] Multiply expected mature bull weight by 0.60 for weight to use for growing yearling bulls

[2] 1,000 to 1,400 lb at finishing (28 percent body fat) or maturity (replacement heifers)

[3] BW = total body weight = shrunk body weight or 96% full body weight, ADG = average daily gain, TDN = total digestible nutrients, NE_m = net energy for maintenance, NE_g = net energy for gain, CP = crude protein, Ca = calcium, P = phosphorus

Source: NRC, 2000. Adapted from NRC Nutrient Requirements of Beef Cattle, 7th revised edition.

Table 8 (Continued). Nutrient Requirements of Growing Yearlings[1,2,3]

Animal Description		Dry Matter Intake (DMI)		Diet Nutrient Density						Daily Nutrients per Animal					
Body weight, lb	ADG, lb	DMI, lb/day	DMI, % of BW	TDN, % DM	NE_m, Mcal/lb	NE_g, Mcal/lb	CP, % DM	Ca, % DM	P, % DM	TDN, lb	NE_m, Mcal	NE_g, Mcal	CP, lb	Ca, lb	P, lb
1,300 lb at finishing															
715	0.8	18.5	2.6	50	.45	.20	7.3	.22	.13	9.3	5.9	1.1	1.35	.041	.024
	2.1	19.6	2.7	60	.61	.35	10.2	.36	.19	11.8	5.9	3.5	2.00	.071	.037
	3.2	19.1	2.7	70	.76	.48	13.0	.49	.24	13.4	5.9	5.5	2.48	.094	.046
	4.0	18.1	2.5	80	.90	.61	15.7	.61	.29	14.5	5.9	6.9	2.84	.110	.052
	4.5	16.7	2.3	90	1.04	.72	18.3	.72	.34	15.0	5.9	7.9	3.06	.120	.057
780	0.8	19.8	2.5	50	.45	.20	7.1	.21	.13	9.9	6.3	1.2	1.41	.042	.026
	2.1	20.9	2.7	60	.61	.35	9.6	.34	.18	12.5	6.3	3.7	2.01	.071	.038
	3.2	20.4	2.6	70	.76	.48	12.1	.45	.23	14.3	6.3	5.8	2.47	.092	.047
	4.0	19.3	2.5	80	.90	.61	14.5	.56	.27	15.4	6.3	7.4	2.80	.108	.052
	4.5	17.8	2.3	90	1.04	.72	16.9	.66	.32	16.0	6.3	8.4	3.01	.117	.057
845	0.8	21.0	2.5	50	.45	.20	6.9	.21	.13	10.5	6.7	1.3	1.45	.044	.027
	2.1	22.2	2.6	60	.61	.35	9.1	.32	.17	13.3	6.7	3.9	2.02	.071	.038
	3.2	21.7	2.6	70	.76	.48	11.4	.42	.22	15.2	6.7	6.2	2.47	.091	.048
	4.0	20.5	2.4	80	.90	.61	13.6	.51	.26	16.4	6.7	7.9	2.79	.105	.053
	4.5	18.9	2.2	90	1.04	.72	15.7	.60	.30	17.0	6.7	8.9	2.97	.113	.057
910	0.8	22.2	2.4	50	.45	.20	6.7	.20	.13	11.1	7.1	1.4	1.49	.044	.029
	2.1	23.5	2.6	60	.61	.35	8.7	.30	.17	14.1	7.1	4.1	2.04	.071	.040
	3.2	22.9	2.5	70	.76	.48	10.7	.39	.20	16.0	7.1	6.6	2.45	.089	.046
	4.0	21.6	2.4	80	.90	.61	12.7	.48	.24	17.3	7.1	8.3	2.74	.104	.052
	4.5	20.0	2.2	90	1.04	.72	14.6	.56	.28	18.0	7.1	9.4	2.92	.112	.056
975	0.8	23.4	2.4	50	.45	.20	6.6	.20	.13	11.7	7.4	1.4	1.54	.047	.030
	2.1	24.7	2.5	60	.61	.35	8.3	.28	.16	14.8	7.4	4.4	2.05	.069	.040
	3.2	24.1	2.5	70	.76	.48	10.2	.37	.19	16.9	7.4	6.9	2.46	.089	.046
	4.0	22.8	2.3	80	.90	.61	11.9	.44	.23	18.2	7.4	8.8	2.71	.100	.052
	4.5	21.0	2.2	90	1.04	.72	13.7	.52	.26	18.9	7.4	9.9	2.88	.109	.055
1,040	0.8	24.5	2.4	50	.45	.20	6.5	.19	.13	12.3	7.8	1.5	1.59	.047	.032
	2.1	25.9	2.5	60	.61	.35	8.0	.27	.15	15.5	7.8	4.6	2.07	.070	.039
	3.2	25.3	2.4	70	.76	.48	9.6	.34	.19	17.7	7.8	7.2	2.43	.086	.048
	4.0	23.9	2.3	80	.90	.61	11.3	.41	.22	19.1	7.8	9.2	2.70	.098	.053
	4.5	22.1	2.1	90	1.04	.72	12.9	.48	.25	19.9	7.8	10.4	2.85	.106	.055

[1] Multiply expected mature bull weight by 0.60 for weight to use for growing yearling bulls

[2] 1,000 to 1,400 lb at finishing (28 percent body fat) or maturity (replacement heifers)

[3] BW = total body weight = shrunk body weight or 96% full body weight, ADG = average daily gain, TDN = total digestible nutrients, NE_m = net energy for maintenance, NE_g = net energy for gain, CP = crude protein, Ca = calcium, P = phosphorus

Source: NRC, 2000. Adapted from NRC Nutrient Requirements of Beef Cattle, 7th revised edition.

Table 8 (Continued). Nutrient Requirements of Growing Yearlings[1,2,3]

Animal Description		Dry Matter Intake (DMI)		Diet Nutrient Density						Daily Nutrients per Animal					
Body weight, lb	ADG, lb	DMI, lb/day	DMI, % of BW	TDN, % DM	NE_m, Mcal/lb	NE_g, Mcal/lb	CP, % DM	Ca, % DM	P, % DM	TDN, lb	NE_m, Mcal	NE_g, Mcal	CP, lb	Ca, lb	P, lb
1,400 lb at finishing															
770	0.8	19.6	2.5	50	.45	.20	7.3	.22	.13	9.9	6.2	1.2	1.43	.043	.025
	2.2	20.7	2.7	60	.61	.35	10.1	.36	.19	12.4	6.2	3.7	2.09	.075	.039
	3.4	20.2	2.6	70	.76	.48	12.9	.49	.24	14.1	6.2	5.8	2.61	.099	.048
	4.2	19.1	2.5	80	.90	.61	15.6	.61	.29	15.3	6.2	7.3	2.98	.117	.055
	4.7	17.6	2.3	90	1.04	.72	18.1	.72	.34	15.8	6.2	8.3	3.19	.127	.060
840	0.8	20.9	2.5	50	.45	.20	7.1	.21	.13	10.5	6.6	1.3	1.48	.044	.027
	2.2	22.1	2.6	60	.61	.35	9.6	.34	.18	13.3	6.6	3.9	2.12	.075	.040
	3.4	21.6	2.6	70	.76	.48	12.1	.45	.23	15.1	6.6	6.2	2.61	.097	.050
	4.2	20.4	2.4	80	.90	.61	14.5	.56	.27	16.3	6.6	7.8	2.96	.114	.055
	4.7	18.8	2.2	90	1.04	.72	16.8	.65	.32	16.9	6.6	8.9	3.16	.122	.060
910	0.8	22.2	2.4	50	.45	.20	6.9	.21	.13	11.1	7.1	1.4	1.53	.047	.029
	2.2	23.5	2.6	60	.61	.35	9.1	.32	.17	14.1	7.1	4.1	2.14	.075	.040
	3.4	22.9	2.5	70	.76	.48	11.3	.42	.22	16.0	7.1	6.6	2.59	.096	.050
	4.2	21.6	2.4	80	.90	.61	13.5	.51	.26	17.3	7.1	8.3	2.92	.110	.056
	4.7	20.0	2.2	90	1.04	.72	15.6	.60	.30	18.0	7.1	9.5	3.12	.120	.060
980	0.8	23.5	2.4	50	.45	.20	6.7	.20	.13	11.8	7.5	1.4	1.57	.047	.031
	2.2	24.8	2.5	60	.61	.35	8.7	.30	.17	14.9	7.5	4.4	2.16	.074	.042
	3.4	24.2	2.5	70	.76	.48	10.7	.39	.20	16.9	7.5	6.9	2.59	.094	.048
	4.2	22.9	2.3	80	.90	.61	12.6	.47	.24	18.3	7.5	8.8	2.89	.108	.055
	4.7	21.1	2.2	90	1.04	.72	14.5	.56	.28	19.0	7.5	10.0	3.06	.118	.059
1,050	0.8	24.7	2.4	50	.45	.20	6.6	.20	.13	12.4	7.9	1.5	1.63	.049	.032
	2.2	26.1	2.5	60	.61	.35	8.3	.28	.16	15.7	7.9	4.6	2.17	.073	.042
	3.4	25.5	2.4	70	.76	.48	10.1	.37	.20	17.9	7.9	7.3	2.58	.094	.051
	4.2	24.1	2.3	80	.90	.61	11.9	.44	.23	19.3	7.9	9.3	2.87	.106	.055
	4.7	22.2	2.1	90	1.04	.72	13.6	.51	.26	20.0	7.9	10.5	3.02	.113	.058
1,120	0.8	25.9	2.3	50	.45	.20	6.5	.19	.13	13.0	8.2	1.6	1.68	.049	.034
	2.2	27.4	2.4	60	.61	.35	8.0	.27	.16	16.4	8.2	4.8	2.19	.074	.044
	3.4	26.8	2.4	70	.76	.48	9.6	.34	.19	18.8	8.2	7.7	2.57	.091	.051
	4.2	25.3	2.3	80	.90	.61	11.2	.41	.22	20.2	8.2	9.7	2.83	.104	.056
	4.7	23.3	2.1	90	1.04	.72	12.8	.48	.25	21.0	8.2	11.1	2.98	.112	.058

[1] Multiply expected mature bull weight by 0.60 for weight to use for growing yearling bull

[2] 1,000 to 1,400 lb at finishing (28 percent body fat) or maturity (replacement heifers)

[3] BW = total body weight = shrunk body weight or 96% full body weight, ADG = average daily gain, TDN = total digestible nutrients, NE_m = net energy for maintenance, NE_g = net energy for gain, CP = crude protein, Ca = calcium, P = phosphorus

Source: NRC, 2000. Adapted from NRC Nutrient Requirements of Beef Cattle, 7th revised edition.

Table 9. Nutrient Requirements of Growing and Mature Bulls[1,2]

Animal Description		Dry Matter Intake (DMI)		Diet Nutrient Density						Daily Nutrients per Animal					
Body weight, lb	ADG, lb	DMI, lb/day	DMI, % of BW	TDN, % DM	NE_m, Mcal/lb	NE_g, Mcal/lb	CP, % DM	Ca, % DM	P, % DM	TDN, lb	NE_m, Mcal	NE_g, Mcal	CP, lb	Ca, lb	P, lb
1,700 lb mature weight															
900	0.4	22.0	2.4	50	.45	.20	6.0	.16	.11	11.0	8.0	0.9	1.32	.036	.025
	1.6	23.3	2.6	60	.61	.35	7.3	.23	.14	14.0	8.0	3.5	1.71	.054	.032
	2.5	22.7	2.5	70	.76	.48	8.8	.30	.16	15.9	8.0	5.8	1.99	.068	.037
	3.1	21.5	2.4	80	.90	.61	10.2	.36	.19	17.2	8.0	7.6	2.19	.077	.041
1,000	0.4	23.8	2.4	50	.45	.20	5.9	.16	.11	11.9	8.7	1.0	1.40	.039	.027
	1.6	25.2	2.5	60	.61	.35	6.9	.22	.13	15.1	8.7	3.8	1.74	.055	.033
	2.5	24.6	2.5	70	.76	.48	8.1	.27	.15	17.2	8.7	6.3	1.99	.067	.038
	3.1	23.2	2.3	80	.90	.61	9.3	.32	.18	18.6	8.7	8.2	2.16	.074	.041
1,100	0.4	25.6	2.3	50	.45	.20	5.8	.16	.11	12.8	9.4	1.0	1.48	.041	.029
	1.6	27.0	2.5	60	.61	.35	6.6	.20	.13	16.2	9.4	4.1	1.78	.055	.034
	2.5	26.4	2.4	70	.76	.48	7.5	.25	.14	18.5	9.4	6.8	1.99	.065	.038
	3.1	24.9	2.3	80	.90	.61	8.6	.29	.16	19.9	9.4	8.8	2.13	.072	.041
1,200	0.4	27.3	2.3	50	.45	.20	5.7	.16	.11	13.7	10.0	1.1	1.55	.044	.031
	1.6	28.9	2.4	60	.61	.35	6.3	.19	.12	17.3	10.0	4.4	1.81	.056	.036
	2.5	28.2	2.4	70	.76	.48	7.1	.23	.14	19.7	10.0	7.2	1.99	.064	.039
	3.1	26.6	2.2	80	.90	.61	7.9	.26	.15	21.3	10.0	9.4	2.10	.069	.041
1,300	0.4	29.0	2.2	50	.45	.20	5.6	.16	.11	14.5	10.6	1.2	1.63	.046	.033
	1.6	30.7	2.4	60	.61	.35	6.0	.19	.12	18.4	10.6	4.6	1.85	.057	.037
1,400	0.4	30.7	2.2	50	.45	.20	5.5	.16	.11	15.4	11.2	1.2	1.70	.049	.035
	1.6	32.4	2.3	60	.61	.35	5.8	.18	.12	19.4	11.2	4.9	1.88	.057	.039
1,500	0.4	32.3	2.2	50	.45	.20	5.5	.16	.11	16.2	11.8	1.3	1.77	.051	.037
	1.6	34.1	2.3	60	.61	.35	5.6	.17	.12	20.5	11.8	5.1	1.92	.058	.040
1,600	0.4	33.9	2.1	50	.45	.20	5.4	.16	.12	17.0	12.4	1.4	1.84	.054	.039
	1.6	35.8	2.2	60	.61	.35	5.4	.16	.11	21.5	12.4	5.4	1.95	.059	.041
1,700	0.0	32.9	1.9	46	.39	.00	5.6	.16	.12	15.1	13.0	0.0	1.83	.052	.040
	1.6	35.5	2.1	50	.45	.20	5.4	.16	.12	17.8	13.0	1.4	1.91	.056	.041

[1] For bulls that are at least 12 months of age and weigh more than 50 percent of their mature weight

[2] BW = total body weight = shrunk body weight or 96% full body weight, ADG = average daily gain, TDN = total digestible nutrients, NE_m = net energy for maintenance, NE_g = net energy for gain, CP = crude protein, Ca = calcium, P = phosphorus

Source: NRC, 2000. Adapted from NRC Nutrient Requirements of Beef Cattle, 7th revised edition.

Table 9 (Continued). Nutrient Requirements of Growing and Mature Bulls[1,2]

Animal Description		Dry Matter Intake (DMI)		Diet Nutrient Density						Daily Nutrients per Animal					
Body weight, lb	ADG, lb	DMI, lb/day	DMI, % of BW	TDN, % DM	NE_m, Mcal/lb	NE_g, Mcal/lb	CP, % DM	Ca, % DM	P, % DM	TDN, lb	NE_m, Mcal	NE_g, Mcal	CP, lb	Ca, lb	P, lb
2,000 lb mature weight															
1,000	0.5	23.8	2.4	50	.45	.20	6.1	.17	.12	11.9	8.7	1.0	1.44	.041	.028
	1.7	25.2	2.5	60	.61	.35	7.5	.25	.14	15.1	8.7	3.8	1.89	.062	.036
	2.8	24.6	2.5	70	.76	.48	9.1	.32	.17	17.2	8.7	6.3	2.23	.078	.043
	3.5	23.2	2.3	80	.90	.61	10.5	.38	.20	18.6	8.7	8.2	2.46	.088	.047
1,100	0.5	25.6	2.3	50	.45	.20	5.9	.17	.12	12.8	9.4	1.0	1.52	.043	.030
	1.7	27.0	2.5	60	.61	.35	7.1	.23	.14	16.2	9.4	4.1	1.92	.062	.037
	2.8	26.4	2.4	70	.76	.48	8.4	.29	.16	18.5	9.4	6.8	2.22	.076	.043
	3.5	24.9	2.3	80	.90	.61	9.8	.35	.19	19.9	9.4	8.8	2.43	.086	.047
1,200	0.5	27.3	2.3	50	.45	.20	5.8	.17	.12	13.7	10.0	1.1	1.59	.046	.032
	1.7	28.9	2.4	60	.61	.35	6.8	.22	.13	17.3	10.0	4.3	1.96	.063	.039
	2.8	28.2	2.4	70	.76	.48	7.9	.27	.16	19.7	10.0	7.2	2.22	.075	.044
	3.5	26.6	2.2	80	.90	.61	9.0	.32	.18	21.3	10.0	9.4	2.40	.084	.047
1,300	0.5	29.0	2.2	50	.45	.20	5.8	.17	.12	14.5	10.6	1.2	1.67	.048	.034
	1.7	30.7	2.4	60	.61	.35	6.5	.21	.13	18.4	10.6	4.6	2.00	.063	.040
	2.8	30.0	2.3	70	.76	.48	7.4	.25	.15	21.0	10.6	7.7	2.22	.074	.044
	3.5	28.3	2.2	80	.90	.61	8.4	.29	.17	22.6	10.6	10.0	2.38	.081	.047
1,400	0.5	30.7	2.2	50	.45	.20	5.7	.16	.12	15.4	11.2	1.2	1.74	.051	.036
	1.7	32.4	2.3	60	.61	.35	6.3	.20	.13	19.4	11.2	4.9	2.03	.064	.041
1,500	0.5	32.3	2.2	50	.45	.20	5.6	.16	.12	16.2	11.8	1.3	1.81	.053	.038
	1.7	34.1	2.3	60	.61	.35	6.0	.19	.13	20.5	11.8	5.1	2.06	.065	.043
1,600	0.5	33.9	2.1	50	.45	.20	5.5	.17	.12	17.0	12.4	1.4	1.88	.056	.040
	1.7	35.8	2.2	60	.61	.35	5.8	.18	.12	21.5	12.4	5.4	2.09	.066	.044
1,700	0.5	35.5	2.1	50	.45	.20	5.5	.16	.12	17.8	13.0	1.4	1.95	.058	.042
	1.7	37.5	2.2	60	.61	.35	5.7	.18	.12	22.5	13.0	5.6	2.13	.066	.046
1,800	0.5	37.0	2.1	50	.45	.20	5.5	.16	.12	18.5	13.5	1.5	2.02	.061	.044
	1.7	39.1	2.2	60	.61	.35	5.5	.17	.12	23.5	13.5	5.9	2.16	.067	.047
1,900	0.5	38.6	2.0	50	.45	.20	5.4	.16	.12	19.3	14.1	1.5	2.09	.063	.047
	1.7	40.8	2.1	60	.61	.35	5.4	.17	.12	24.5	14.1	6.1	2.19	.068	.049
2,000	0.0	37.2	1.9	46	.39	.00	5.6	.17	.13	17.1	14.6	0.0	2.07	.062	.047
	0.5	40.1	2.0	50	.45	.20	5.2	.16	.12	20.1	14.6	1.6	2.15	.065	.049

[1]For bulls that are at least 12 months of age and weigh more than 50 percent of their mature weight

[2] BW = total body weight = shrunk body weight or 96% full body weight, ADG = average daily gain, TDN = total digestible nutrients, NE_m = net energy for maintenance, NE_g = net energy for gain, CP = crude protein, Ca = calcium, P = phosphorus

Source: NRC, 2000. Adapted from NRC Nutrient Requirements of Beef Cattle, 7th revised edition.

Table 9 (Continued). Nutrient Requirements of Growing and Mature Bulls[1,2]

Animal Description		Dry Matter Intake (DMI)		Diet Nutrient Density						Daily Nutrients per Animal					
Body weight, lb	ADG, lb	DMI, lb/day	DMI, % of BW	TDN, % DM	NE_m, Mcal/lb	NE_g, Mcal/lb	CP, % DM	Ca, % DM	P, % DM	TDN, lb	NE_m, Mcal	NE_g, Mcal	CP, lb	Ca, lb	P, lb
2,300 lb mature weight															
1,200	0.5	27.3	2.3	50	.45	.20	6.0	.18	.12	13.7	10.0	1.1	1.63	.048	.032
	1.9	28.9	2.4	60	.61	.35	7.3	.24	.14	17.3	10.0	4.4	2.10	.070	.041
	3.0	28.2	2.4	70	.76	.48	8.7	.30	.17	19.7	10.0	7.2	2.45	.086	.048
	3.8	26.6	2.2	80	.90	.61	10.1	.36	.20	21.3	10.0	9.4	2.68	.097	.052
1,300	0.5	29.0	2.2	50	.45	.20	5.9	.17	.12	14.5	10.6	1.2	1.71	.050	.035
	1.9	30.7	2.4	60	.61	.35	7.0	.23	.14	18.4	10.6	4.6	2.14	.070	.043
	3.0	30.0	2.3	70	.76	.48	8.2	.28	.16	21.0	10.6	7.7	2.45	.085	.049
	3.8	28.3	2.2	80	.90	.61	9.4	.34	.19	22.6	10.6	10.0	2.66	.095	.053
1,400	0.5	30.7	2.2	50	.45	.20	5.8	.17	.12	15.4	11.2	1.2	1.78	.052	.037
	1.9	32.4	2.3	60	.61	.35	6.7	.22	.14	19.4	11.2	4.9	2.17	.071	.044
	3.0	31.7	2.3	70	.76	.48	7.7	.26	.15	22.2	11.2	8.1	2.45	.084	.049
	3.8	29.9	2.1	80	.90	.61	8.8	.31	.18	23.9	11.2	12.5	2.64	.092	.053
1,500	0.5	32.3	2.2	50	.45	.20	5.7	.17	.12	16.2	11.8	1.3	1.85	.055	.039
	1.9	34.1	2.3	60	.61	.35	6.5	.21	.13	20.5	11.8	5.2	2.20	.072	.045
1,600	0.5	33.9	2.1	50	.45	.20	5.7	.17	.12	17.0	12.4	1.4	1.92	.058	.041
	1.9	35.8	2.2	60	.61	.35	6.3	.20	.13	21.5	12.4	5.4	2.24	.072	.047
1,700	0.5	35.5	2.1	50	.45	.20	5.6	.17	.12	17.8	13.0	1.4	1.99	.060	.043
	1.9	37.5	2.2	60	.61	.35	6.1	.19	.13	22.5	13.0	5.7	2.27	.073	.048
1,800	0.5	37.0	2.1	50	.45	.20	5.6	.17	.12	18.5	13.5	1.5	2.06	.063	.045
	1.9	39.1	2.2	60	.61	.35	5.9	.19	.13	23.5	13.5	5.9	2.30	.074	.050
1,900	0.5	38.6	2.0	50	.45	.20	5.5	.17	.12	19.3	14.1	1.5	2.13	.065	.047
	1.9	40.8	2.1	60	.61	.35	5.7	.18	.13	24.5	14.1	6.2	2.33	.075	.051
2,000	0.5	40.1	2.0	50	.45	.20	5.5	.17	.12	20.1	14.6	1.6	2.19	.067	.050
	1.9	42.3	2.1	60	.61	.35	5.6	.18	.13	25.4	14.6	6.4	2.36	.075	.053
2,100	0.5	41.6	2.0	50	.45	.20	5.4	.17	.13	20.8	15.2	1.7	2.26	.070	.052
	1.9	43.9	2.1	60	.61	.35	5.5	.17	.12	26.3	15.2	6.6	2.40	.076	.054
2,200	0.5	43.1	2.0	50	.45	.20	5.4	.17	.13	21.6	15.7	1.7	2.32	.072	.054
	1.9	45.5	2.1	60	.61	.35	5.3	.17	.12	27.3	15.7	6.9	2.42	.077	.056
2,300	0.0	44.5	1.9	46	.39	.00	5.2	.16	.12	20.5	16.3	0.0	2.30	.071	.054
	0.5	47.0	2.0	50	.45	.20	5.1	.16	.12	23.5	16.3	1.8	2.39	.075	.056

[1] For bulls that are at least 12 months of age and weigh more than 50 percent of their mature weight

[2] BW = total body weight = shrunk body weight or 96% full body weight, ADG = average daily gain, TDN = total digestible nutrients, NEm = net energy for maintenance, NEg = net energy for gain, CP = crude protein, Ca = calcium, P = phosphorus

Source: NRC, 2000. Adapted from NRC Nutrient Requirements of Beef Cattle, 7th revised edition.

For more information on beef cattle nutrient requirements, contact an office of the Mississippi State University Extension Service.

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Mineral and Vitamin Nutrition for Beef Cattle

MISSISSIPPI STATE UNIVERSITY EXTENSION

Minerals and vitamins account for a very small proportion of daily dry matter intake in beef cattle diets and can sometimes be overlooked in a herd nutritional program. Although minerals and vitamins are needed as a very small percentage of dietary nutrients, they are very important in beef cattle nutritional programs for proper animal function, such as bone development, immune function, muscle contractions, and nervous system function. Cattle growth and reproductive performance can be compromised if a good mineral program is not in place.

A good mineral and vitamin supplementation program costs approximately $30 to $55 per head per year. With annual cost of production per cow generally being several hundred dollars, the cost of a high-quality mineral and vitamin supplement program is a relatively small investment. Many free-choice mineral and vitamin mixes are formulated for 2- or 4-ounce daily consumption rates. For illustration purposes, if a beef cow consumes 4 ounces (1/4 pound) of a supplement per day for 365 days, then she consumes 91.25 pounds of the supplement in a year. Many mineral and vitamin supplements are packaged in 50-pound bags, so a beef cow consumes almost two 50-pound bags of this supplement annually at the 4-ounce daily consumption rate. Doubling the price of one of these bags of mineral and vitamin supplement approximates the annual cost of the supplement on a per-head basis.

Macrominerals and Microminerals

Beef cattle require at least 17 different mineral elements in their diets. Required minerals are classified as either macrominerals (major minerals) or microminerals (trace minerals), based on the quantities required in beef cattle diets. Macrominerals are required in larger quantities (grams per day) than microminerals (milligrams or micrograms per day).

Macrominerals required by beef cattle include calcium, magnesium, phosphorus, potassium, sodium, chlorine, and sulfur. Required microminerals include chromium, cobalt, copper, iodine, iron, manganese, molybdenum, nickel, selenium, and zinc. Nutrient requirements of specific mineral elements vary, depending on animal age, weight, stage of production, lactation status, breed, stress, and mineral bioavailability (the degree to which a mineral becomes available to the target tissue after administration) from the diet.

Macromineral requirements are typically expressed as a percentage (%) of the total diet, while micromineral requirements are generally expressed as milligrams per kilogram (mg/kg), which is the equivalent of parts per million (ppm). To convert percent to ppm, move the decimal four places to the right (for example 0.2500% = 2500 ppm).

Macromineral Requirements in Beef Cattle

Mineral*, %	Requirement			
	Growing and Finishing Cattle	Stressed Calves**	Dry, Gestating Cows	Lactating Cows
Calcium	0.31	0.6-0.8	0.18	0.58
Magnesium	0.10	0.2-0.3	0.12	0.20
Phosphorus	0.21	0.4-0.5	0.16	0.26
Potassium	0.60	1.2-1.4	0.60	0.70
Sodium	0.06-0.08	0.2-0.3	0.06-0.08	0.10
Sulfur	0.15	0.15	0.15	0.15

*Research data are inadequate to determine chlorine requirements.
**Suggested range.

Source: NRC, 2000. Adapted from NRC Nutrient Requirements of Beef Cattle, 7th revised edition.

Micromineral Requirements in Beef Cattle

Mineral*, ppm	Requirement			
	Growing and Finishing Cattle	Stressed Calves**	Dry, Gestating Cows	Lactating Cows
Cobalt	0.10	0.1-0.2	0.10	0.10
Copper	10.00	10.0-15.0	10.00	10.00
Iodine	0.50	0.3-0.6	0.50	0.50
Iron 50.00	100.0-200.0	50.00	50.00	
Manganese	20.00	40.0-70.0	40.00	40.00
Selenium	0.10	0.1-0.2	0.10	0.10
Zinc 30.00	75.0-100.0	30.00	30.00	

*Research data are inadequate to determine chromium, molybdenum, and nickel requirements.
**Suggested range.

Source: NRC, 2000. Adapted from NRC Nutrient Requirements of Beef Cattle, 7th revised edition.

Dietary mineral sources include forages, concentrate feedstuffs, mineral supplements, and water.

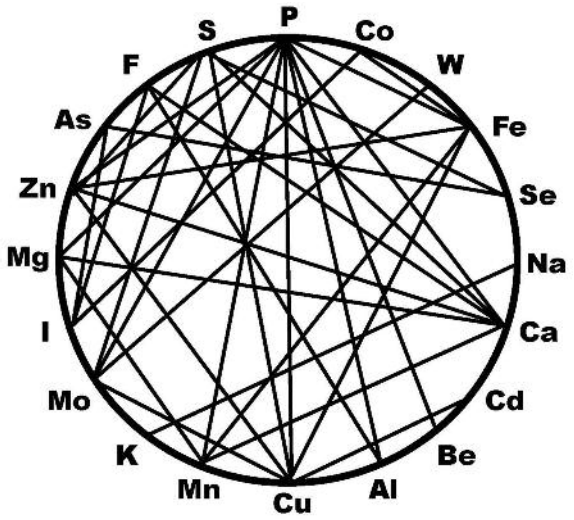
Mineral and Vitamin Levels of Feedstuffs Commonly Utilized in Mississippi

Feedstuff	Calcium, %	Phosphorus, %	Magnesium, %	Potassium, %	Sulfur, %	Copper, ppm	Zinc, ppm	Vitamin A, 1000 IU/kg
Bahiagrass pasture	0.46	0.22	0.25	1.45	0.00	0.00	0.00	304.20
Bahiagrass hay	0.50	0.22	0.19	0.00	0.00	0.00	0.00	0.00
Bermudagrass pasture	0.26	0.18	0.13	1.30	0.21	9.00	20.00	136.20
Ladino clover hay	1.45	0.33	0.47	2.44	0.21	9.41	17.00	33.00
Tall fescue hay	0.51	0.37	0.27	2.30	0.18	0.00	22.00	0.00
Corn silage	0.25	0.22	0.18	1.14	0.12	4.18	17.70	18.00
Cracked corn	0.03	0.32	0.12	0.44	0.11	2.51	24.20	1.00
Corn gluten feed	0.07	0.95	0.40	1.40	0.47	6.98	73.30	1.00
Cottonseed meal, 41% CP	0.20	1.16	0.65	1.65	0.42	16.50	74.00	0.00
Cottonseed hulls	0.15	0.09	0.14	0.87	0.09	13.00	22.00	0.00
Dried distillers grains with solubles	0.32	1.40	0.65	1.83	0.40	83.90	94.80	1.20
Soybean hulls	0.53	0.18	0.22	1.29	0.11	17.80	48.00	0.00
Soybean meal, 44% CP	0.40	0.71	0.31	2.22	0.46	22.40	57.00	0.00
Whole cottonseed	0.16	0.62	0.35	1.22	0.26	7.90	37.70	0.00

Source: NRC, 2000. Adapted from NRC Nutrient Requirements of Beef Cattle, 7th revised edition.

Mineral Interactions

Minerals interact with each other in the body. The many interactions can result in mineral elements' tying up or making other mineral elements unavailable for essential body functions. In practical beef cattle nutrition programs, the interaction between calcium and phosphorus is the classic example of two minerals that affect the required levels of each other in the diet. Calcium and phosphorus recommendations are commonly expressed as a ratio (Ca:P) of calcium to phosphorus.



Potential Mineral Element Interactions

Macrominerals

Calcium (Ca)

Calcium is the most abundant mineral in the body and is involved in many vital body functions, including bone formation and maintenance, development and maintenance of teeth, blood clotting, membrane permeability, muscle contraction, nerve impulse transmission, heart regulation, milk secretion, hormone secretion, and enzyme activation and function.

Most calcium supplies in the body are found in the bones and teeth. Bones can supply short-term dietary deficiencies of calcium. However, long-term dietary calcium deficiencies can cause severe production problems. Vitamin D is required for calcium absorption. Diets high in fat can reduce calcium absorption.

Calcium deficiency interferes with normal bone growth in young cattle and can cause rickets (weak, soft bones that are easily fractured) and retarded growth and development. In adult cattle, calcium deficiency can cause osteomalacia, a condition characterized by weak and brittle bones. Milk fever, a condition usually associated with dairy cattle, can also occur in beef cattle as a result of calcium deficiency and leads to cows that go down soon after calving. Milk fever is described in detail in the nutritional disorders section of this publication.

Forages are generally higher in calcium concentrations than concentrate (grain-based) feedstuffs, with legumes (such as clovers and alfalfa) typically providing higher calcium levels than grasses. Calcium content in forages varies with species, plant part, maturity, quantity of calcium available in the soil for plant uptake, and climate.

Cattle can tolerate high concentrations of dietary calcium if other mineral levels are adequate in the diet. Calcium recommendations are expressed in terms of a calcium to phosphorus ratio (Ca:P), where approximately 1.6:1 is ideal, with a range of 1:1 to 4:1 being acceptable.

Supplemental calcium sources include calcium carbonate, feed-grade limestone, dicalcium phosphate, defluorinated phosphate, monocalcium phosphate, and calcium sulfate. Feed-grade limestone is approximately 34 percent calcium and is commonly added to beef cattle diets to increase the calcium levels of the diet. Dicalcium phosphate is approximately 22 percent calcium and 19.3 percent phosphorus and is added to beef cattle diets to help balance the calcium to phosphorus ratio. It adds both calcium and phosphorus to the diet.

Phosphorus (P)

Similar to calcium, most phosphorus is in the bones and teeth, but some phosphorus is in soft tissues as well. Phosphorus is required for skeletal development and maintenance, normal milk secretion, muscle tissue building, cell growth and differentiation, energy use and transfer, efficient food use, membrane formation, function of many enzyme systems, osmotic and acid-base balance maintenance, and rumen microorganism growth and metabolism. Most phosphorus losses are through the feces, while urinary phosphorus losses are lower but increase on high-concentrate diets.

Phosphorus requirements are often presented in terms of the calcium to phosphorus ratio described earlier. The most critical aspect is that phosphorus

levels meet cattle requirements. Most phosphorus losses are through the feces, while urinary phosphorus losses are lower but increase on high-concentrate diets. Excessive phosphorus intake can lead to increased fecal output of phosphorus into the environment and have environmental implications. Too much phosphorus in the diet can also result in urinary calculi, a condition detailed in the nutritional disorders section of this publication.

Phosphorus deficiency has tremendous implications for beef cattle performance. Not meeting animal phosphorus requirements reduces growth and feed efficiency, decreases dry matter intake, lowers reproductive performance, depresses milk production, and causes weak and fragile bones. Mature cattle can draw on phosphorus reserves in bones when needed, but skeletal phosphorus supplies must be replenished to avoid a phosphorus deficiency situation.

Forages are generally low in phosphorus as compared to concentrate feedstuffs such as cereal grains and oilseed meals (cottonseed meal, soybean meal). Drought conditions and increased forage maturity further deplete forage phosphorus concentrations. This suggests that higher phosphorus supplementation may be needed to supply increased dietary phosphorus levels when grazing or feeding stored mature forages or during periods of drought. Dicalcium phosphate, defluorinated phosphate, monoammonium phosphate, and phytate phosphate are sources of supplemental phosphorus for ruminants. Recommended phosphorus levels in a mineral supplement are generally from 4 to 8 percent, largely depending on forage conditions and other levels of dietary sources of phosphorus.

Magnesium (Mg)

Approximately 65 to 70 percent of magnesium in the body is found in bone, 15 percent in muscle, 15 percent in other soft tissues, and 1 percent in extracellular fluid. Magnesium is important for enzyme activation, glucose breakdown, genetic code transmission, membrane transport, nerve impulse transmission, and skeletal development.

In general, magnesium toxicity is not a problem in beef cattle, with concentrations up to 0.4 percent being tolerated. Yet excessive magnesium intake can result in severe diarrhea, sluggish appearance, and reduced dry matter digestibility.

Magnesium deficiency, on the other hand, can be severe in beef cattle. Signs of magnesium deficiency include excitability, anorexia, increased blood flow, convulsions, frothing at the mouth, prolific salivation, and soft tissue calcification. Young cattle can mobilize large amounts of magnesium from bone, but mature cattle are unable to do this, and they must receive regular and adequate magnesium supplies from the diet. Grass tetany, a condition common among lactating beef cows grazing lush forages, is characterized by low magnesium levels. Grass tetany is discussed in detail in the nutrition disorders section later in this publication.

Forage magnesium concentrations depend on plant species, soil magnesium levels, plant growth stage, season, and environmental temperature. Legumes usually contain higher magnesium levels than grasses. Cereal grains contain approximately 0.11 to 0.17 percent magnesium, and plant protein sources contain roughly double these amounts. Magnesium sulfate and magnesium oxide serve as good supplemental sources of magnesium. Recommendations for magnesium supplementation are magnesium offered at 2 to 4 percent of the supplement when cattle consume low and intermediate forages, respectively. Raise this level to at least 10 percent of the supplement to avoid grass tetany on lush forages.

The USDA's National Animal Health Monitoring System (NAHMS) reported in a 1996 survey that, by U.S. geographic region, beef cattle operators in the southeastern U.S. were most likely to supplement magnesium to their beef cattle herds than any other region. Seventy-four and a half percent of southeastern beef cattle operators reported supplementing magnesium compared to the U.S. average of 63.5 percent. The production of lush forages in the southeast coincides with calving season on many southeastern U.S. cattle operations, and many producers recognize these conditions as increasing grass tetany risk. Increasing magnesium supplementation is a common producer action to prevent grass tetany.

Potassium (K)

The third most abundant mineral in the body is potassium. Potassium is in intracellular fluid and is involved in acid-base balance, osmotic pressure regulation, water balance, muscle contractions, nerve impulse transmission, oxygen and carbon dioxide transport in the blood, and enzyme reactions. Potassium prevents tetany, convulsions, and unsteady gait.

Potassium deficiency is indicated by reduced feed intake, depraved appetite, lowered weight gains, rough hair coat, and muscle weakness. Body stores of potassium are low, so potassium deficiency can

begin quickly. Potassium is mainly excreted in the urine of cattle, and potassium secretion in milk is relatively high.

Forages are good sources of this mineral, often ranging from 1 to 4 percent potassium. Potassium content can be very high in lush pasture, potentially contributing to grass tetany onset. Mature and stockpiled forage contain lowered concentrations of potassium.

Cereal grains are typically low in potassium content, while oilseed meals are generally good sources. High-concentrate diets likely require potassium supplementation if forage or protein sources containing adequate potassium levels are not provided. Generally, potassium supplementation on pasture is not critical. Supplemental potassium sources include potassium chloride, potassium bicarbonate, potassium sulfate, and potassium carbonate, which are all readily available dietary forms for beef cattle.

Sodium (Na) and Chlorine (Cl)

Sodium and chlorine are components of common white salt. Sodium and chlorine are each in the body in extracellular fluid. They are important for maintaining osmotic pressure, controlling water balance, regulating acid-base balance, contracting muscles, transmitting nerve impulses, and carrying glucose and amino acids. Sodium is necessary for the operation of some enzyme systems. Heart action and nerve impulse transmission depend on some sodium and potassium. Chlorine is needed for hydrochloric acid production in the abomasum (true ruminant stomach) and activation of amylase, an enzyme critical for normal starch digestion. Chlorine also aids in respiratory gas exchange.

Cattle crave sodium and will consume more salt than needed when it is supplied free choice. High concentrations of salt are sometimes used to regulate feed intake. Cattle consume approximately 0.1 pound salt per 100 pounds of body weight in salt-limited feeds (0.5 pounds per day for a 500 lb. calf; 1.1 pounds per day for a 1100 lb. cow). These high dietary intake levels of salt are generally tolerated by cattle when adequate water is available. Dietary salt levels of 6.5 percent have been shown to reduce feed intake and growth. The maximum tolerable concentration for total dietary salt is estimated at 9 percent. Recommended salt content of a mineral and vitamin supplement is in the range of 10 to 25 percent of the supplement.

When salt is present in the drinking water of cattle, salt toxicity risk increases. Salt concentrations in drinking water of 1.25 to 2.0 percent can result in anorexia, reduced weight gain or increased weight loss, lowered water intake, and collapse. Even lower levels of salt in drinking water can result in reduced feed and water intake, decreased cattle growth, digestive disturbances, and diarrhea.
In Mississippi, beef cattle producers in coastal regions should be particularly cautious of fresh water supplies for cattle that may become contaminated with salt in the aftermath of a tropical storm or hurricane.

A chlorine deficiency is not probable under most production conditions. Sodium deficiency signs include reduced and abnormal feed intake, retarded growth, and decreased milk production.

Forage sodium content varies considerably, and cereal grains and oilseed meals are typically not good sources of sodium. Sodium can be supplemented as sodium chloride or sodium bicarbonate, both of which are highly available forms for beef cattle.

Sulfur (S)

Sulfur is a building block in several amino acids (methoinine, cysteine, and cystine) and B vitamins (thiamin and biotin) along with other organic compounds. Sulfur functions in the body in detoxification reactions and is required by ruminal microorganisms for growth and normal cell function.

Sulfur toxicity is characterized by restlessness, diarrhea, muscle twitching, and labored breathing. In protracted cases, inactivity and death may follow. High sulfur levels are associated with polioencephalomalacia, a condition discussed in detail in the nutritional disorders section of this publication.

Lower sulfur intakes can reduce feed intake, depress growth, and decrease copper levels. Lowered feed and water intake can occur when high levels of sulfur are consumed in drinking water. Reported sulfur deficiency signs are anorexia, weight loss, weakness, emaciation, profuse salivation, and death. Less severe sulfur deficiencies can reduce feed intake, digestibility, rumen microorganism numbers, and microbial protein synthesis. Lactate accumulation in the rumen and blood can then develop with disruption of rumen microbe populations.

Sulfur in feedstuffs is found largely as a component of protein. In diets containing high levels of sorghum forages, mature forages, forages produced in sulfur-deficient soils, corn silage, rumen-bypass proteins, or where urea or other non-protein nitrogen sources replace plant protein sources, dietary sulfur requirements or supplementation needs may be increased. Potential sulfur supplements include sodium sulfate, ammonium sulfate, calcium sulfate, potassium sulfate, magnesium sulfate, or elemental sulfur.

Microminerals

Chromium (Cr)

Chromium is a trace mineral involved in glucose clearance. Immune response and growth rate in stressed cattle has been shown to improve with chromium supplementation. Chromium can be supplemented as chromium picolinate or chromium polynicotinate. However, beef cattle producers do not need to be concerned about chromium supplementation under normal circumstances.

Cobalt (Co)

Cobalt functions as a component of vitamin B12 (cobalamin). The microbes of ruminants are able to synthesize vitamin B12 if cobalt is present.

Cattle can tolerate approximately 100 times their dietary requirement for cobalt, so cobalt toxicity is not likely unless a mineral supplement formulation error is made. Cobalt toxicity signs include decreased feed intake, reduced weight gain, anemia, emaciation, abnormal increase in the hemoglobin content of red blood cells, and weakness.

Young, growing cattle appear to be more sensitive to cobalt deficiency than mature cattle. Initial cobalt deficiency signs are depressed appetite and reduced growth performance or weight loss. In cases of severe cobalt deficiency, cattle display severe unthriftiness, swift weight loss, liver breakdown, and anemia. Cobalt deficiency has also been demonstrated to compromise immune system problems and disruption of microorganism production of propionate (a volatile fatty acid important for glucose production).

Legumes are usually higher in cobalt than grasses. Soil pH is a major determinant of cobalt availability in the soil. Cobalt sulfate and cobalt carbonate are examples of supplemental cobalt sources for beef cattle diets. For a mineral supplement with an expected 4-ounce daily intake, the supplement should include 15 ppm cobalt.

Copper (Cu)

Copper is an essential component of many enzymes including lysyl oxidase, cytochrome oxidase, superoxide dismutase, ceruloplasmin, and tyrosinase.

Supplementing with too much copper or contaminating feeds with copper could result in copper toxicity. Copper accumulates in the liver before toxicity occurs. Large releases of copper from the liver cause red blood cell breakage; elevated methemoglobin levels in the blood, impairing oxygen transport; abnormally high hemoglobin content in the urine; jaundice; widespread tissue death; and, finally, death. Young cattle are more susceptible to copper toxicity than older cattle. Cattle with a mature rumen do not absorb copper well, but the liver can store significant quantities of copper. Molybdenum, sulfur, and iron levels in the diet affect copper levels required to induce toxicity.

Copper deficiency is a widespread problem in U.S. beef cattle herds. Cattle experiencing copper deficiency exhibit anemia, reduced growth, loss of pigmentation in hair, changes in hair growth and appearance, heart failure, easily fractured bones, diarrhea, compromised immune system function, and impaired reproduction, particularly estrous cycle disruption. Breed composition of cattle also affects copper requirements. For example, Simmental and Charolais require more copper than Angus, and copper supplement levels may need to be increased by as much as 25 to 50 percent for these breeds. In cattle grazing toxic endophyte-infected tall fescue, tall fescue toxicosis may be confused for copper deficiency, based on hair coat changes. In some cases, these conditions can occur together.

Copper is more available in concentrate diets than in forage diets. Forages vary greatly in copper content and may contain variable levels of molybdenum, sulfur, and iron, which reduce usable copper levels. Molybdenum, sulfur, iron, and zinc reduce copper status in the body can impact copper requirements. Legumes typically contain higher copper concentrations compared to grasses. In addition, oilseed meals generally contain higher levels of copper than cereal grains. Copper supplements include sulfate, carbonate, oxide, and organic forms. Copper oxide is poorly available compared with other the copper forms listed. General copper supplementation recommendations are 1250 ppm copper for a supplement consumed at a rate of four ounces per day.

Iodine (I)

Iodine is a key component of thyroid hormones involved in energy metabolism rate regulation in the body. Iodine is rarely deficient in cow herds in the Southeast U.S. Calves born hairless, weak, or dead; irregular cycling, reduced conception rate, and retained placenta in breeding age beef females; and depressed libido and semen quality in bulls are classic iodine deficiency signs. Onset of deficiency signs may be delayed well beyond the actual initial period of iodine deficiency.

Iodine deficiency is characterized by enlargement of the thyroid (goiter). Goitrogenic substances in feeds suppress thyroid function and can affect iodine requirements. In white clover, thiocyanate is derived from cyanate and impairs iodine uptake by the thyroid. Some Brassica forages, such as kale, turnips, and rape, contain glucosinolates with goitrogenic effects, but most reports of problems are in sheep and goats. Soybean meal and cottonseed meal are also reported to have goitrogenic effects.

Iodine toxicity affects cattle by reducing weight gain, lowering feed intake, and causing coughing and undue nasal discharge.

Dietary iodine supplement sources include calcium iodate, ethylenediamine dihydroiodide (EDDI), potassium iodide, and sodium iodide. The calcium iodate and EDDI forms of iodine are very stable and have high bioavailability in cattle, while the potassium and sodium iodide forms are relatively unstable and can break down when exposed to other minerals, heat, light, or moisture. A supplementation rate of 50 ppm iodine in a 4-ounce per day intake mineral supplement is recommended.

The EDDI form is an organic form that has been used for foot rot prevention. Levels of EDDI necessary for foot rot control are much higher than nutrient requirement levels. Currently, the maximum legal supplementation rate of EDDI is 50 mg per head per day. This level is not effective for foot rot control, and the Food and Drug Administration (FDA) does not allow claims of EDDI supplements to treat or prevent any animal disease.

Iron (Fe)

Iron is a critical component of hemoglobin and myoglobin, two proteins involved in oxygen transport and use. More than half of the iron in the body is in hemoglobin. This element is also an essential component of several cytochromes and iron-sulfur proteins involved in the electron transport chain. In addition, some enzymes either contain or are activated by iron.

Iron toxicity manifests as diarrhea, acidosis (digestive tract disturbance), hypothermia (lower than normal core body temperature), reduced weight gain, and depressed feed intake. Iron depletes copper in cattle and can contribute to copper deficiency if copper supplementation levels are not adjusted to compensate for copper losses. Iron deficiency causes anemia, lethargy, lowered feed intake, reduced weight gain, pale mucous membranes, and shriveling of the raised tissue structures on the tongue. Conditions that cause chronic blood loss, such as severe parasite infestations, can lead to iron deficiency. Evidence suggests iron requirements are higher for young cattle than for mature cattle. Calves raised in confinement exclusively on milk diets are more prone to iron deficiency.

Iron sources include forages, cereal grains, oilseed meals, water, and soil ingestion. However, forage iron content varies greatly, and bioavailability of iron from forages is low relative to supplemental sources. Common supplemental sources include ferrous sulfate (iron sulfate), ferrous carbonate (iron carbonate), and ferric oxide (iron oxide or "rust"). Bioavailability rank of these iron sources from most to least available is sulfate, carbonate, and then oxide form. Iron oxide has very little nutritional value. Iron is generally not needed from sources other than those provided by other mineral compounds commonly found in complete mineral supplements.

Manganese (Mn)

Manganese usefulness in the body is as a constituent of the enzymes pyruvate carboxylase, arginase, and superoxide dismutase and as an activator for many other enzymes, including hydrolases, kinases, transferases, and decarboxylases. Manganese is important for normal skeletal development, growth, and reproductive function.

At extremely high levels of manganese intake, growth performance and feed intake are reduced. Cattle deficient in manganese exhibit skeletal abnormalities, including stiffness, twisted legs, joint enlargement, and weak bones in young cattle. Older cattle display depressed or irregular estrus, low conception rate, abortion, stillbirths, and light birth weights when manganese intake is inadequate.

Forage manganese levels vary with plant species, soil pH, and soil drainage, but forages usually contain adequate manganese levels. Corn silage manganese content is generally low. Feed-grade manganese forms include manganese sulfate, manganese oxide, manganese methionine, manganese proteinate, manganese polysaccharide complex, and manganese amino acid chelate. Bioavailability ranking from most to least available is manganese methionine, manganese sulfate, and, lastly, manganese oxide. A recommended manganese level is 2000 ppm in a 4-ounce daily intake mineral supplement.

Molybdenum (Mo)

The enzymes xanthine oxidase, sulfite oxidase, and aldehyde oxidase contain molybdenum. This element may improve microbial activity in the rumen under certain conditions.

There is no proof cattle experience molybdenum deficiency under normal production circumstances, so molybdenum supplementation is not a practical concern. Molybdenum toxicity, on the other hand, results in diarrhea, anorexia, weight loss, stiffness, and hair color alterations. Other potential effects of molybdenum toxicity include increased heifer age at puberty, decreased weight of heifers at puberty, and reduced conception rate. Calf growth performance is also slowed by excessive molybdenum levels. Copper and sulfur work against molybdenum in the body. Molybdenum contributes to copper deficiency, and copper can reduce molybdenum toxicity.

Forage molybdenum concentrates fluctuate with soil type and soil pH. Increased soil moisture, organic matter, and pH improve forage molybdenum levels. Molybdenum content in cereal grains and protein sources is more consistent.

Nickel (Ni)

The function of nickel in cattle is unknown. Yet nickel deficiency has been experimentally induced in animals. Nickel plays a role in ureolytic bacteria function as an essential component of the urease enzyme that breaks down urea (a common nonprotein nitrogen source in cattle diets). In general, nickel supplementation is not a concern on beef cattle operations under normal circumstances.

Selenium (Se)

Selenium is an important part of the enzymes glutathione peroxidase and iodothyronine 5′-deiodinase. Glutathione peroxidase helps prevent oxidative damage to tissues. The latter enzyme is involved in thyroid hormone metabolism. The functions of vitamin E and selenium are interrelated. Diets low in vitamin E may require selenium supplementation.

Signs of chronic selenium toxicosis include lameness, anorexia, emaciation, sore feet, cracked and deformed hooves, liver cirrhosis, kidney inflammation, and tail hair loss. In severe toxicity cases, difficulty breathing, diarrhea, muscle incoordination, abnormal posture, and death from respiratory failure are observed.

Selenium deficiency can lead to white muscle disease, a condition discussed in detail later in the nutritional disorders section of this publication. Calves may experience compromised immune response even when no other clinical signs of selenium deficiency are present. Unthriftiness, weight loss, and diarrhea are other deficiency signs.

Feed-grade selenium is often supplied as sodium selenite or sodium selenate, while selenomethionine is the common form in most feedstuffs. Selenium yeast is also a selenium source approved for use in cattle feed. Because of the high toxicity of selenium, it should be supplemented in a premixed form only. The FDA allows sodium selenate or sodium selenite as sources of selenium for selenium supplementation of complete feeds at a level not more than 0.3 ppm. The FDA permits up to 120 ppm selenium to be included in a salt-mineral mixture for free-choice feeding. Selenium injections are another way to provide selenium.

In some regions of the U.S., chronic selenium toxicity (alkali disease) occurs as a result of cattle's consuming forages grown on high selenium soils. Other regions of the U.S., including the southeastern U.S., are predisposed to selenium deficiency risk based on low soil and forage selenium content. In selenium-deficiency-prone areas, use the maximum legal selenium supplement level in the feed and note that when purchasing feedstuffs from areas known to be deficient in selenium, selenium supplementation may need to be considered.

Zinc (Zn)

Zinc is a crucial component of many important enzymes and is also needed to activate other enzymes. These enzymes function in nucleic acid, protein, and carbohydrate metabolism. Zinc plays an important role in immune system development and function as well.

Quantities of zinc needed to cause toxicity are much greater than animal requirements. Signs of zinc toxicity include reduced weight gain, feed intake, and feed efficiency. Severe cases of zinc deficiency include listlessness, excessive salivation, testicular growth reduction, swollen feet, scaly lesions on feet, tissue lesions (most often on the legs, neck, head, and around the nostrils), slow healing of wounds, and hair loss. Less dramatic zinc deficiencies can cause decreased growth and lower reproductive performance.

Similar to several other minerals, zinc concentrations in forages depend on many factors, and zinc concentration in legumes is greater than in grasses. Plant proteins are typically higher in zinc levels than cereal grains. Supplemental sources of zinc include oxide, sulfate, methionine, and proteinate forms. The oxide and sulfate forms appear to have similar bioavailabilities, indicating no advantage to using zinc sulfate over zinc oxide. Zinc should be supplemented at a rate of 4000 ppm in a supplement designed for 4 ounces of intake per head per day.

Nutritional Disorders Related to Mineral Imbalances

Mineral imbalances (toxicities or deficiencies) can trigger nutritional disorders such as grass tetany, urinary calculi, polioencephalomalacia, white muscle disease, and milk fever in cattle. While these disorders can produce dramatic signs in affected cattle, mineral imbalances are often overlooked because only subclinical signs are present.

In the NAHMS 1996 survey, relatively few operations (5.2 percent) reported any known mineral deficiencies in the previous five years. However, these percentages likely severely underestimate the true magnitude of mineral deficiencies in cow-calf herds. A 1993 cow-calf study indicated that the extent of marginal and severe deficiency for copper and selenium is much more widespread.

In the absence of clinical signs, a mineral imbalance may be suspected if blood and tissue sample analysis or forage and diet mineral analysis suggests a problem. Compare levels of dietary mineral sources with cattle requirements detailed earlier in this publication to identify significant potential mineral imbalance problems. These are not always definitive for identifying mineral imbalances, though. It is important to be alert for "red flags" in animal behavior and appearance to catch a problem early and minimize losses. Veterinarians should be familiar with mineral-related disorders common in their areas and can assist with prevention and treatment. Reduced cattle performance from mineral imbalances is preventable with a good mineral nutrition program.

Grass Tetany

Cause. Grass tetany is associated with low levels of magnesium or calcium in cattle grazing annual ryegrass, small grains (such as oats, rye, wheat), and cool-season perennial grasses (such as tall fescue) in late winter and early spring. Grass tetany in Mississippi usually occurs February through April, when spring-calving cows graze on lush annual ryegrass or tall fescue. During this time of the year, there is often a flush of new forage growth. This is also the time of year many spring calves are born and nursing. Grass tetany most commonly affects lactating cattle, particularly the highest-milking animals in the herd. Magnesium and calcium requirements of lactating cattle are far greater than those of nonlactating cattle. This predisposes cattle to grass tetany during lactation. Grass tetany results when magnesium and calcium levels in forages are too low to meet the requirements of cattle and cattle do not get enough magnesium and calcium supplementation. Clinical signs of grass tetany include nervousness, muscle twitching around the face and ears, staggering, and reduced feed intake. An affected animal may go down on its side, experience muscle spasms and convulsions, and die if not treated.

Prevention. Forages grown on soils deficient in magnesium, wet soils, or soils low in phosphorus but high in potassium and nitrogen may contain very low levels of magnesium and calcium. Lime magnesium-deficient pastures with dolomitic lime, which contains magnesium. This may not prevent grass tetany on waterlogged soils, because plants may not be able to take up enough magnesium under wet conditions.

Phosphorus fertilization may also improve forage magnesium levels. However, environmental concerns associated with excessive soil phosphorus levels should be considered. High levels of nitrogen and potassium fertilization are associated with increased grass tetany, so fertilization plans should consider this. Legumes are often high in magnesium and may help reduce the risk of grass tetany when included in the forage program. The most reliable method of grass tetany prevention is supplemental feeding of magnesium and calcium during the grass tetany season. Both can be included in a mineral mix as part of a mineral supplementation program. Initiate high-magnesium (at least 10 percent Mg and preferably 13 to 14 percent Mg) mineral feeding at least one month before grass tetany season.

Urinary Calculi or "Water Belly"

Cause. Urinary calculi (kidney stones) are hard mineral deposits in the urinary tracts of cattle. Affected cattle may experience chronic bladder infection from tissue damage produced by the calculi. In more serious cases, calculi may block the flow of urine, particularly in male animals. The urinary bladder or urethra may rupture from prolonged urinary tract blockage, resulting in release of urine into the surrounding tissues. The collection of urine under the skin or in the abdominal cavity is referred to as "water belly." Death from toxemia may result within 48 hours of bladder rupture. Signs of urinary calculi include straining to urinate, dribbling urine, blood-tinged urine, and indications of extreme discomfort, such as tail wringing, foot stamping, and kicking at the abdomen. Phosphate urinary calculi form in cattle on high grain diets, while silicate urinary calculi typically develop in cattle on rangeland.

Prevention. Strategies to prevent problems with urinary calculi in cattle include lowering urinary phosphorus levels, acidifying the urine, and increasing urine volume. To lower urinary phosphorus levels, avoid diets high in phosphorus. Maintain a dietary calcium-to-phosphorus ratio of 2:1. This ratio is preferred over the previously mentioned 1.6:1 ratio in situations where urinary calculi risk is of concern. Acid-forming salts such as ammonium chloride may be fed to acidify the urine. Ammonium chloride may be fed at a rate of 1.0 to 1.5 ounces per head per day. Urine volume may be increased by feeding salt at 1 to 4 percent of the diet while providing enough water.

Polioencephalomalacia

Cause. Polioencephalomalacia is caused by a disturbance in thiamine metabolism. Thiamine is required for a number of important nervous system functions. This disease most commonly affects young, fast-growing cattle on a high concentrate diet and may result from a thiamine-deficient diet, an increase in thiaminase (an enzyme that breaks down thiamine) in the rumen, or an increase in dietary sulfates.

A thiamine-deficient diet is usually associated with an increase in the dietary-concentrate-to-roughage ratio. When concentrates (feed grains such as corn) are increased and roughage (forage, cottonseed hulls, etc.) are decreased in the diet, rumen pH drops. This increases the numbers of thiaminase-producing bacteria in the rumen. Thiaminase breaks down the form of thiamine the animal normally could use. Some species of plants produce thiaminase and can cause a decrease in the useable amount of thiamine when consumed. Examples of these plants include kochia, bracken fern, and equisetum.

A high sulfate diet can also inhibit an animal's ability to properly use thiamine. Feeds such as molasses, corn gluten feed, and dried distillers grains are often high in dietary sulfates. Some water sources can also contain a high amount of sulfur (such as "gyp" water). When these are consumed in excessive amounts, clinical signs of polioencephalomalacia can occur.

Affected cattle usually show several signs of generalized neurological disease. These signs can include but are not limited to blindness, inconsistent and uncoordinated movements, head pressing, "goose" stepping, lying with full body contact with the ground with the head and legs extended, tetany (muscle spasms), convulsions with paddling motions, and death. These signs usually begin suddenly, with the animals typically having normal temperatures and rumen function.

Prevention. Preventative strategies should focus on the diet. Avoid risk factors such as high concentrate diets or high sulfate diets, if possible. Thiamine can also be added to a feed ration or a free-choice mineral supplement at 3 to 10 ppm, but this may not be cost effective.

White Muscle Disease

Cause. "White muscle disease" (enzootic nutritional muscular dystrophy) most commonly affects cardiac or skeletal muscle of rapidly growing calves. It results from vitamin E and/or selenium deficiency and causes muscle breakdown. This metabolic imbalance can be because of dietary deficiency or because of calves' being born to dams that consumed selenium-deficient diets during gestation.

Two distinct conditions of this disease are a cardiac form and a skeletal form. The cardiac form of the disease usually comes on quickly, with the most common clinical sign's being sudden death. At first, animals may exhibit an increased heart rate and respiratory distress, but they usually die within 24 hours. The skeletal form of the disease generally has a slower onset. Calves affected by the skeletal form exhibit stiffness and muscle weakness. Although these animals usually have normal appetites, they may not be able to stand for long periods and have trouble breathing if their diaphragm or chest muscles are involved. Some animals may show signs of difficulty swallowing and possible pain while swallowing if the muscles of the tongue are also affected.

Necropsy of an affected animal often reveals pale discoloration of the affected muscle. The texture of the muscle is dry with white, chalky, streaked sections representing the fibrosis and calcification of the diseased tissue. Hence, the name "white muscle disease."

Prevention. Supplementing vitamin E and selenium controls this disease. Salt/mineral mixtures can supplement the deficiencies. A free-choice mineral supplement with an expected intake of four ounces/head/day should contain 27 ppm of selenium. In known selenium deficient areas, it is recommended to administer 25 mg of selenium and 340 IU of vitamin E intramuscularly approximately four weeks before calving.

Milk Fever

Cause. Milk fever (parturient paresis or hypocalcemia) is generally associated with older, high-producing dairy cattle, but it may also occur with beef cattle. Milk fever occurs shortly after calving and the onset of milk production. Milk fever occurs when the lactating cow

cannot absorb enough calcium from the diet or has not started mobilizing bone calcium to meet the increased calcium demand of lactation. Calcium losses from lactation coupled with inadequate supply results in a drop in blood calcium level. Because calcium is needed for muscle contraction, cows suffering from milk fever often lose their ability to stand.

Prevention. Numerous steps can be taken to prevent milk fever. The first is to raise the calcium and phosphorus levels of the diet. Too much dietary calcium in late pregnancy could leave the cow unprepared to absorb or mobilize enough calcium from bone to meet elevated requirements when lactation starts. This sometimes occurs with feeding poultry litter because of the high calcium content of the litter.

Feeding low calcium diets a month or two before calving was once thought to be the best prevention because the body would be geared to mobilizing bone calcium. This approach has had limited success and is difficult with high forage diets.

If milk fever is a common problem in the herd, feeding an anionic pre-partum diet (a negative dietary cation-anion difference, DCAD) helps prevent milk fever. Adequate vitamin D is also important in preventing milk fever but is not typically a problem with beef cattle on pasture.

Mineral Elements and Levels Toxic to Cattle

Some minerals beef cattle do not require or require only in very small quantities can be toxic when consumed above threshold toxicity levels. The National Research Council defines the maximum tolerable concentration for a mineral as "that dietary level that, when fed for a limited period, will not impair animal performance and should not produce unsafe residues in human food derived from the animal."

Mineral Maximum Tolerable Concentrations in Beef Cattle Diets

Mineral Element	Maximum Tolerable Concentration
Aluminum	1000 ppm
Arsenic	50 ppm (100 ppm for organic forms)
Bromine	200 ppm
Cadmium	0.5 ppm
Chromium	1000 ppm
Cobalt	10 ppm
Copper	100 ppm
Fluorine	40 to 100 ppm
Iodine	50 ppm
Iron	1000 ppm
Lead	30 ppm
Magnesium	0.4%
Manganese	1000 ppm
Mercury	2 ppm
Molybdenum	5 ppm
Nickel	50 ppm
Potassium	3%
Selenium	2 ppm
Strontium	2000 ppm
Sulfur	0.4%
Zinc	500 ppm

Source: NRC, 2000. Adapted from NRC Nutrient Requirements of Beef Cattle, 7th revised edition.

Vitamin Nutrition

Vitamins are classified as either water soluble or fat soluble. Water soluble vitamins include the B complex and vitamin C. Fat soluble vitamins include A, D, E, and K. Rumen bacteria can produce the B complex vitamins and vitamin K in cattle. Vitamin supplementation is generally not as critical as mineral supplementation for beef cattle grazing actively growing forages. However, increased rates of vitamin A and E supplementation may be necessary when feeding dormant pastures or stored forages. For practical purposes, vitamins A and E should receive the most attention when planning cattle vitamin nutritional programs.

Fat Soluble Vitamins

Vitamin A

Vitamin A (retinol) is the vitamin most likely to be deficient in beef cattle diets. It is essential for normal vision, growth, reproduction, skin tissue and body cavity lining cell maintenance, and bone development. It is not in plant material, but its precursors (alpha carotene, beta carotene, gamma carotene, and cryptoxanthin) are present. These cartotene and carotenoid precursors are converted to vitamin A in

the animal. Vitamin A and beta carotene play a role in disease protection and immune system function.

Exposure to sunlight, air, and high temperatures destroys carotene. Ensiling can help preserve carotene supplies. Corn is one of the few grains that contains appreciable amounts of carotene. High quality forages, on the other hand, contain large amounts of vitamin A precursors. When forage supplies are limited or low quality, vitamin A supplementation becomes critical. While the liver can store vitamin A, at most two to four months of reliance on these stored liver supplies can ward off vitamin A deficiency.

In practical production scenarios, vitamin A toxicity is rare. Rumen microorganisms can break down vitamin A, and this helps prevent vitamin A toxicity. Vitamin A deficiency is more probable when cattle are fed high concentrate diets; bleached pasture or hay during drought conditions; feeds excessively exposed to sunlight, heat, and air; heavily processed feeds; feeds mixed with oxidizing materials such as minerals; or feeds stored for long periods. Calves not receiving adequate colostrum and stressed calves are at highest risk of vitamin A deficiency.

Vitamin A deficiency shows up as reduced feed intake, rough hair coat, fluid accumulation in joints and brisket, excessive tear production, night blindness, slow growth, diarrhea, seizures, poor skeletal growth, blindness, low conception rates, abortion, stillbirths, blind calves, low quality semen and infections in cattle. Night blindness is unique to vitamin A deficiency. Vitamin A can be supplied by injection or through the consumption of vitamin A precursors in green, leafy forages. In deficiency situations, injections may be more effective.

Vitamin D

Vitamin D forms include ergocalciferol (vitamin D2) found in plants and cholecalciferol (vitamin D3) found in animals. Vitamin D is needed for calcium and phosphorus absorption, normal bone mineralization, and calcium mobilization from bone. It may also function in immune response. Toxicity signs include calcification of soft tissues, bone demineralization, decreased appetite, and weight loss. Vitamin D deficiency causes rickets where bones do not use calcium and phosphorus normally. Stiff joints, irritability, anorexia, convulsions, brittle bones, decreased appetite, digestive problems, labored breathing, and weakness are deficiency signs. Cattle do not maintain body reserves of vitamin D. Yet cattle rarely require vitamin D supplementation because vitamin D is made by cattle exposed to sunlight or fed sun-cured forages.

Vitamin E

Vitamin E is in feedstuffs as alpha-tocophorol. It serves as an antioxidant in the body and is important in membrane formation, muscle structure, and muscle function. Disease resistance is tied to Vitamin E levels. Selenium is closely linked with this vitamin. Vitamin E requirements depend on concentrations of antioxidants, sulfur-containing amino acids, and selenium in the diet. And high dietary concentrations of polyunsaturated fatty acids found in corn oil and soybean oil can dramatically increase vitamin E requirements. High moisture feeds lose vitamin E quicker than drier feeds, and many other factors contribute to vitamin E breakdown in feeds.

There is less toxicity risk with vitamin E than with vitamins A and D. The margin of safety with vitamin E appears to be great. Signs of vitamin E deficiency, however, are characteristic of white muscle disease described earlier. Cattle displaying deficiency signs often respond to either vitamin E or selenium supplementation. Both may be needed in some instances.

Vitamin Supplementation

Vitamins A, D, and E are often added to mineral mixes or feed supplements as an A-D-E premix package. Many commercial mineral mixes have vitamins A, D, and E added at sufficient levels. However, it is important to review the mineral tag to be sure, particularly when actively growing forage is not available to cattle. Vitamin quantities are expressed as International Units (IU), which are set amounts defined for each specific vitamin form. Reasonable rates of vitamin supplementation for cattle consuming a 4-ounce daily intake vitamin supplement are: Vitamin A, 100,000 to 200,000 IU; Vitamin D, 7,500 to 20,000 IU; and Vitamin E, 50 to 100 IU. Vitamins can degrade over time, so supplements purchased and stored for several months before being used may not supply adequate vitamin levels.

Vitamin Requirements in Beef Cattle

Mineral	Requirement			
	Growing and Finishing Cattle	Stressed Calves*	Dry, Gestating Cows	Lactating Cows
Vitamin A, IU/kg	2200	4000-6000	2800	3900
Vitamin D, IU/kg	275	275	275	275
Vitamin E, IU/kg**	15-60	75-100	–	–

**Vitamin E requirements depend upon concentrations of antioxidants, sulfur-containing amino acids, and selenium in the diet. The growing and finishing cattle requirement presented here is an estimate.

Source: NRC, 2000. Adapted from NRC Nutrient Requirements of Beef Cattle, 7th revised edition.

Interpreting Mineral and Vitamin Tags

Though the amount of information on a mineral and vitamin supplement tag may seem overwhelming at first, the tag contains valuable information about a mineral mix. There are several common sections on most mineral tags.

1. Product name – When a single number is present in the product name, the number represents the phosphorus content. For example, "Pro 8" would contain 8 percent phosphorus. When two numbers are present in the name, the first number typically represents the calcium content, while the second number represents the phosphorus content. In most cases, if the calcium to phosphorus ratio is higher than 3:1, cattle will have to eat an excessive amount to get the phosphorus they need. Phosphorus is usually the most expensive component of a mineral supplement. Phosphorus is also very important in beef cattle diets, particularly when grazing low quality pastures. Instead of purchasing a supplement based on price alone, try to buy a reasonably-priced supplement that provides adequate levels of phosphorus and other important minerals.

2. Approved animals – This indicates the species and classes of livestock for which the product is intended.

3. Drug claim – Some labels describe the purpose of any drugs in the product. Consider whether or not the drug is needed and if it is the right time of year to use it. For instance, it may not be worthwhile to include fly control compounds in a mineral mix outside of fly season.

4. Active drug ingredient statement – This tells the name of the drug and the level added to the product.

5. Guaranteed analysis – This lists the amounts of individual minerals and vitamins in the supplement. These levels can be compared to cattle requirements to determine if the product matches up well with animal needs. Remember that the percentage or amounts of minerals and vitamins listed on a supplement tag indicate the quantities in the supplement. To compare mineral requirements with supplement amounts effectively, consider the total dietary mineral and vitamin intake. For example, while the phosphorus requirement of lactating cows is listed as 0.26 percent in the table at the top of page 2, low quanlity forage may need to be supplemented with a mineral mix containing 6 percent phosphorus at 4-ounce daily supplement intake rate to achieve the required phosphorus level in the total diet. Make sure the mineral supplement contains enough macrominerals (calcium, phosphorus, magnesium, potassium, sodium, chlorine, sulfur), trace minerals (chromium, cobalt, copper, iodine, iron, manganese, molybdenum, nickel, selenium, and zinc), and vitamins A and E.

6. Ingredients – This lists product ingredients in order from the highest to lowest amounts. Look for specific ingredients. For instance, copper oxide is not an ideal copper source, but copper sulfate and copper chloride are typically better sources for copper supplementation. As a general rule, the bioavailability (nutritional value considering the degree of availability to the body tissues) of inorganic mineral sources follows this order: sulfates = chlorides > carbonates > oxides. Organic mineral sources include chelated minerals. Chelated minerals are minerals bound to amino acids. Some researchers have reported greater bioavailability of organic mineral sources as compared to inorganic forms. However variable bioavailability values have been reported with the trace mineral chelates and complexes, suggesting no advantages in using organic forms.

7. Feeding directions – This lists expected intake, feeding instructions, and the length of any required withdrawal times for specific livestock classes. The mineral and vitamin concentrations in a 2-ounce daily intake rate supplement should be double those in a 4-ounce daily intake rate supplement to achieve the same intake of specific minerals and vitamins from the supplement.

8. Caution – This warning indicates potential problems, such as feeding an ionophore to horses, a high copper level to sheep, or selenium levels over legal limits.

Mineral and Vitamin Supplement Feeding Problems and Solutions

Fine particle size and the need to mix small quantities into bulk feed supplies make mixing a mineral and vitamin supplement with commodity-based feedstuffs difficult or impractical in some feed mixing scenarios. Unless feed mixing equipment can create a consistent mix and there is not a significant likelihood of the smaller particles in the mineral and vitamin supplement settling out of the finished feed, then consistently supplying a separate free-choice loose mineral mix or top-dressing feed may be more practical for mineral and vitamin supplement delivery in cattle diets.

Excessive intake can be a problem with mineral and vitamin supplements and can be an unnecessary expense. Cattle sometimes over consume a mineral and vitamin mix when they are first exposed to it but then drop supplement intake to appropriate levels after an adjustment period. Also, if cattle are allowed to run out of mineral and vitamin supplement, they may over compensate by increasing consumption when it is put out again. If intake does not drop to recommended levels after a month of feeding a continuous supply of mineral and vitamin supplement, try adding salt to the mineral and vitamin mix or moving the supplement feeder farther away from water sources.

Inadequate mineral and vitamin intake, on the other hand, can be addressed by adding dry molasses to the mineral and vitamin mix or by moving the supplement feeder closer to a water source or area where cattle congregate. Make sure not to provide salt separately from a free-choice mineral supplement, because cattle may consume the salt supplement and avoid the complete mineral and vitamin mix. Changing mineral mixes is another option that sometimes corrects excessive or inadequate mineral consumption.

One mineral and vitamin supplement formulation may not be ideal year-round. Mineral and vitamin supplements can be used to deliver beneficial drugs, antibiotics, and parasite control ingredients to cattle diets. Adding these products may increase the price of the mineral and vitamin supplement. In addition, these products may need only to be supplied to cattle for defined periods of time or during certain times of year. It is advisable to reformulate the mineral and vitamin supplement to remove these products when they are not needed. Mineral and vitamin composition of supplements should also be adjusted for forage conditions. For example, increased magnesium supplementation is justified during grass tetany season but should be reduced during other periods to match cattle nutrient needs better and avoid unnecessary reductions in supplement palatability often associated with high levels of magnesium.

Many mineral supplements cake and harden when allowed to get wet, causing mineral intake to drop. Magnesium supplements are particularly prone to this problem. Using covered feeders that protect from rain can help minimize mineral hardening. Commercial mineral supplements are available that better withstand rain damage and wind losses. Mineral and vitamin supplement selection should consider mineral and vitamin composition and price of the supplement as first priorities over weather protection. It is a good idea to check the mineral and vitamin supplement supply at least weekly. Break up hardened mineral as much as possible. Checking the mineral supply on a regular basis is also important in monitoring consumption and making sure cattle do not run out.

Many different mineral and vitamin supplement feeder designs are available. Examples are shown below. Consider differences in protection of the supplement from the environment, quantity of supplement the feeder can contain, ease of moving the feeder, and feeder durability. Strategic placement and positioning of open-sided mineral and vitamin supplement feeders can lessen weather effects on the supplement. For illustration, if precipitation most often falls and blows from one direction, then turning open sides of mineral and vitamin supplement feeders away from this direction is warranted.

Examples of mineral and vitamin supplement feeder designs.

Mineral and Vitamin Supplementation Summary

Appropriate intake of key minerals and vitamins is essential for beef cattle productivity and health. Many different commercially available mineral and vitamin supplements are marketed to beef cattle producers. Custom blends of minerals and vitamins are another option for mineral and vitamin supplementation. Not all available mineral and vitamin supplements contain enough of the minerals and vitamins beef cattle need. In selecting a mineral and vitamin supplement, consider the class of cattle being supplemented; forage conditions; mineral and vitamin levels in feedstuff and water sources; and expected intake levels of forages, feeds, and mineral and vitamin supplements. Investing in a good mineral and vitamin nutrition program and properly managing mineral and vitamin feeding is highly recommended for both beef cow-calf and stocker operations. For more information on mineral and vitamin nutrition for beef cattle, contact an office of the Mississippi State University Extension Service.

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By **Dr. Jane Parish**, Associate Extension/Research Professor; and **Dr. Justin Rhinehart**, former Assistant Extension Professor; Animal and Dairy Sciences.

Frequently Asked Questions about

Processing and Marketing Beef, Pork, Lamb and Goat Meats

In North Carolina and South Carolina

Photo: Robert Campbell

HEIFER INTERNATIONAL

Carolina Farm Stewardship Association
Working to create a sustainable food system in the Carolinas

NC Choices

Frequently Asked Questions about

Processing and Marketing Beef, Pork, Lamb and Goat Meats

In North Carolina and South Carolina

Susan Jelinek Mellage

October 2006

About Heifer International

Founded in 1944, Heifer International is a humanitarian assistance organization that works to end world hunger and protect the earth. Through livestock, training and "passing on the gift," Heifer has helped seven million families in more than 125 countries improve their quality of life and move toward greater self-reliance. The Appalachian-Southeastern Region works to promote a just food system throughout Appalachia and the southeastern United States.

Heifer International
Appalachian-Southeastern Office
212 South Broad St., Ste C
Brevard, NC 28712
(828) 862-5534

About CFSA

The Carolina Farm Stewardship Association is a membership-based organization of more than 900 farmers, processors, gardeners, businesses and individuals in North and South Carolina who are committed to sustainable agriculture and the development of locally-based, organic food systems. For 25 years, CFSA has provided support of local and organic food systems through promotion and marketing assistance; education and advocacy efforts; and information sharing/networking. They can be reached online at www.carolinafarmstewards.org or through their state office.

CFSA North Carolina
P.O. Box 448
Pittsboro, NC 27312
(919) 542-2402

About NC Choices

NC Choices (www.ncchoices.com) is a project of the Center for Environmental Farming Systems (www.cefs.ncsu.edu) and is funded by the W.K. Kellogg Foundation. NC Choices brings together a variety of partners, including farmers, meat processors, environmental organizations and research and extension personnel to promote local, sustainable and compassionate pork production. NC Choices is dedicated to educating consumers, providing technical information and resources for outdoor, pasture-based pork producers, enhancing opportunities for small-scale value-added meat processing, and developing direct market opportunities.

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This document is available online at www.carolinafarmstewards.org and at www.ncchoices.com.

Table of Contents

Introduction

With a background in Horticulture, I was surprised to find myself working with livestock farmers just after graduate school as the project manager for NC Choices at the Center for Environmental Farming Systems at NC State University. The sale of meats brings a new level of regulatory oversight and red tape that is just not found in the produce marketplace. I was met with many specific questions from farmers regarding what was allowed and what was not when it came to selling their meats. I quickly realized I needed a crash course on the world of meat regulation. Thanks to many progressive farmers and the helpful staff of the NC Meat and Poultry Inspection Office, I was soon able to tackle most of the questions thrown my way. When Heifer International and the Carolina Farm Stewardship Association expressed their interest in developing a manual for farmers, I jumped at the chance.

This document is intended to act as a guide for farmers who want to begin selling their own red meats. Red meats are considered to include pork, beef, lamb, and goat's meat. The guide may also be used as a general reference for poultry and rabbits slaughtered and processed at a federally– or state-inspected slaughter facility, but not for products from poultry or rabbits slaughtered on-farm. Please reference the poultry resource section on page 29 for more information regarding on-farm poultry and rabbit slaughter and sale.

The frequently-asked-question format was chosen to give accurate and straightforward answers to the most common questions farmers have, but it is also meant to be a starting point. Develop good relationships with your state and federal meat regulators and your processor. They will be your best guide as you start to sell meats from your farm.

Raleigh, NC
October 2006

Notice of Disclaimer

All efforts were made to provide accurate and precise information pertaining to the laws and regulations surrounding the sale of red meats in NC and SC. Due to the changing nature of the regulatory system, it is important to verify the accuracy of these statements with the responsible regulatory agency.

Production

What are the rules about bringing live animals in and out of the state?

Farmers may want to bring in livestock or breeding stock to their farm from another state. Regulation of the movement of live animals in and out of the state is controlled by the Office of the State Veterinarian. In general, to bring livestock into or out of the state, the animal(s) must have a valid health certificate which shows that the animal has been inspected by a permitted vet and is not infected with nor has come into contact with animals carrying a communicable disease. Contact your local large animal vet or the Office of the State Veterinarian for more information on how to obtain a certificate of vet inspection.

Need to Contact your State Veterinarian?

In NC: (919) 733-7601 **In SC: (803) 788-8747**

If I am taking my animals across state lines to a processor, do I need to get a certificate of veterinary inspection?

No. If you are taking animals across state lines for immediate slaughter (or to visit a veterinarian), you are not required to get a certificate of veterinary inspection.

What environmental programs are available to me from Natural Resources Conservation Service (NRCS) or Soil and Water Conservation Districts (SWCD)?

To encourage farmers to use best management practices on their farms, local offices of the NRCS and SWCD offer many types of environmental programs that provide cost-sharing or training opportunities. Many farmers have been provided with financial assistance to fence livestock out of waterways and to dig wells for watering systems. Others have expanded buffer strips around waterways, adopted controlled rotational grazing systems, and provided more wildlife habitat through these programs. Call your local county or regional offices to learn more about these opportunities. Don't forget! Your customers care about your environmental stewardship - be sure to let them know that you participate in these programs!

What is the National Animal Identification System (NAIS)?

NAIS is a state-federal-industry partnership that aims to expand animal identification throughout the country in order to find and track animals or farms that have come into direct contact with a livestock disease. The program works by identifying premises with livestock, identifying individual animals , and tracking these animals from location to location. As of Fall 2006, the program is voluntary; however the USDA is moving to make this program mandatory in the future.

Want to Learn More about NAIS?
Visit http://animalid.aphis.usda.gov/nais
Or Call (301) 734-7255
or visit
http://www.attra.org/attra-pub/nais.html

What are animal welfare and environmental certification programs? What are their benefits?

There are several organizations around the country who provide guidelines on how animals should be raised to maximize animal welfare and protect the environment. Guidelines can range from how the animals are fed and sheltered to how they are transported or slaughtered. Some also include guidelines on how animals are grazed or how streams and ponds are buffered from run-off. Some farmers choose to certify with these organizations in order to more easily explain how their animals are raised and to give their customers confidence that they are raising animals humanely or in ways that protect the environment. Some organizations provide certification for free, but others charge a fee. Organizations will require a visit to your farm on a regular basis to verify your practices. To find out more about these organizations, turn to the Animal Welfare and Environmental Certification Agencies Resource Section on page 30 .

Photo: Robert Campbell

How can I improve my production and utilize best management practices on my farm?

Your local county livestock extension agent is your best resource when it comes to improving your production and utilizing best management practices on your land. Develop a good relationship with your agent. Invite them to your farm for a tour. Talk with them about your future plans. Work together through on-farm demonstrations or research projects. See the Livestock Production Resources section on page 28 for more information.

How can I find organic feeds? If I want to raise my own organic feeds, where can I find more information?

The demand for certified organic feeds in NC and SC has grown over recent years, as more farmers are looking to feed them to their livestock. Many choose organic feeds because they want to support other farmers using sustainable practices and because they want to be able to further differentiate their product in the marketplace. Luckily, more NC and SC farmers are choosing to raise feed grains organically and larger quantities are available in the marketplace. The price of these feeds can be significantly more than conventional feed grains, so many farmers are also looking to grow their own.

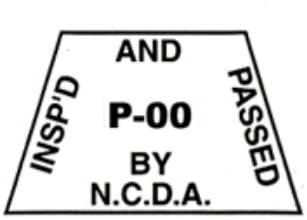
Since 2004, the North Carolina Organic Grain Project has worked to support organic grain farmers with production and marketing support. They also link livestock producers with grain farmers and feed mills who sell organic grains. Some information may be available for SC farmers who live near the NC border.

Want to raise organic grains or
find an organic grains distributor?
Visit the North Carolina Organic Grains Project
www.cropsci.ncsu.edu/organicgrains
or call (828) 628-2675.

USDA vs. State Meat Inspection

What is the difference between a federally- and state-inspected plant? How does the inspection affect where and to whom I sell meats?

State and federally inspected processing plants follow the same guidelines to ensure that meat is wholesome and safe for consumption. The main difference is that, by law, state-inspected meats can only be sold within the state. This means that you may not cross state lines, sell these meats online, mail or in any other way ship them out of state. State inspected meat and poultry products bear a state inspection legend and federally-inspected meat bears a USDA inspection legend.



The North Carolina State Inspection Legend (left) and the USDA Inspection Legend. The numbers indicate which processing plant was used.

Legislation Update

As of Fall 2006, lawmakers in the US Congress are working to allow the sale of state-inspected meats over state lines, but this law has not been passed. To read more about this effort, call the Offices of Senator Orrin Hatch (Utah) or Senator Kent Conrad (North Dakota) at (202) 224-3121 or visit:
http://hatch.senate.gov/index.cfm?FuseAction=PressReleases.Detail&PressRelease_id=1595

What is a TA plant?

"TA" refers to the Talmadge-Aiken Act of 1962, a law passed to help coordinate state and federal food safety guidelines. This law allows trained inspectors that are state employees to staff meat packing plants with USDA inspection privileges. A "TA plant" is a "federally-inspected" plant, which means that meats from this facility bear the USDA Inspection Legend and can be sold across state lines.

Will my customers care if it is federally-inspected or state-inspected meat?

Your customers might ask what the difference is between state- and federally-inspected meats. You can confidently tell them that the safety standards are the same and that they can be sure that the meats they are buying are safe to eat. The kind of plant you use only affects where you can sell or ship your meats.

What is a "custom slaughter" facility?

A custom slaughter facility is a slaughter and processing facility that does not have a state or federally inspector on duty and therefore the meats from these facilities are not considered state- or federally-inspected meats. These establishments are regularly inspected for overall sanitation, but the animals themselves are not inspected for disease. Custom slaughter operations are typically thought to process deer meat for hunters, but they offer services for people who want any animal slaughtered or processed for their own personal use. The meat is cut, packaged, and labeled "not for sale." These meats are returned to the owner of the animal and cannot be sold.

Want to find a processor near you?

See Find a Processor Near You on Page 32

On-farm Animal Slaughter and Processing

Can I slaughter my animals myself?

Yes. You can slaughter animals that you have raised on your farm as long as the meat is for your family's own personal use or the use of non-paying guests. You may not sell meat from animals you have slaughtered on your farm. You must use a state– or federally- inspected slaughter facility to sell meats.

You may sell meats from rabbits or poultry that you have slaughtered, processed, packaged, and labeled yourself. There are specific rules and guidelines that need to be followed in order to process and sell your own poultry. Please Poultry Resources on page 29 for more information.

Can I sell a live animal to a customer and slaughter "their animal" myself as a service on my farm?

No! Some farmers have attempted to go around laws about selling meats from animals they have slaughtered themselves by "selling a customer a live animal" and then slaughtering that animal "as a service." If you slaughter animals for other individuals on your property, without first building an inspected slaughter facility, you are in violation of state and federal meat inspection laws. Not only is this against the law, it can put your farm and livelihood at risk. Compliance officers in both NC and SC have been cracking down on these unlawful practices and individuals found in violation could be assessed a civil money penalty or prosecuted. You are also putting yourself and your customer at risk. If a customer gets sick, you could be held responsible. It is not worth this risk.

Only slaughter animals for your own personal use. Always use a state- or federally-inspected facility to slaughter and process meats you sell to the general public. If they want to have the animal slaughtered and/or processed for their personal use, they must take it to a custom slaughtering facility or a state– or federally-inspected slaughter facility which conducts custom slaughter. The animal will be slaughtered, processed to their specifications, and marked and labeled as "NOT FOR SALE".

Can I sell a live animal off the farm and allow the customer to slaughter "their animal" on my farm?

No! If you provide a location, service or facility for the slaughter of animals by an individual, without first building an inspected slaughter facility, you are in violation of state and federal meat inspection laws. Again, you are putting yourself and your farm at risk by allowing this to happen on your property. If they want to have the animal slaughtered, they must take it to a custom slaughtering facility or an inspected slaughtering facility which conducts custom slaughtering activity where the animal will be slaughtered, processed to their specifications, and marked and labeled as "NOT FOR SALE". Have the animal leave your property alive.

Working with a Processor for the First Time

Meat quality is affected by how the animals are raised, transported, killed, and processed. It is important to know how your processor operates to get the best meat quality from your animals as well as a finished product your customers will be happy with. Get to know your processor. Respect his knowledge and advice regarding how to get the best from your animals. Talk with him about your farm, your business, and your customers.

What should I ask a processor about bringing my animals to the processing facility?

What animals do you slaughter and process?

Most processors do either red meats (beef, pork, lamb, goat) or poultry and rabbits. Some processors may only deal with certain animals, so be sure to ask.

Do I need to make an appointment to have animals processed? If so, how much notice do you need?

Most processors want to know ahead of time that you are coming with a load of animals to be processed. Ask them how much notice they will need. Certain times of year can be busier than others (for example, many hogs are slaughtered right before the 4th of July) so make sure you have scheduled an appointment far enough in advance.

Is there a minimum number of animals I need to bring?

Some processors will only work with farmers who can bring a minimum number of animals each time they come. Some will take as little as one animal at a time, others require more.

What should I ask about how the animals are handled and slaughtered?

Where are the animals kept until they are killed?

Meat quality is affected by the stress level of the animal at the time of slaughter. Many believe it best to transport your animals to the plant and allow them time to “rest” before being slaughtered. Make sure your processor has a secure, comfortable place for your animals to be kept until they are brought in the plant for slaughter.

How are the animals killed?

The more quickly the animal is killed reduces stress and can lead to higher quality meats. The Humane Slaughter Act of 1978 requires all animals to be rendered unconscious in a swift and accurate manner prior to being bled. Most slaughter establishments use gunshot, captive bolt pistols, or electricity to render the animals unconscious. After rendering the animal insensitive to pain, the animal's throat is slit to bleed out the carcass. Done properly, the animal should only have to be stunned once to be knocked out, killing the animal quickly and not diminishing meat quality. As part of their daily procedures, meat inspectors enforce regulations regarding stunning effectiveness and other rules governing humane handling of livestock. If an establishment is not stunning properly, the meat inspector will not allow slaughtering to continue until the problem is corrected. You should note that if the animal is shot in the head, no part from the head may be saved for human consumption.

Another method of killing is with carbon dioxide gas. The animal is rendered unconscious and then bled as described above. Most small plants cannot afford the equipment to offer gas stunning, but some are opting for this method.

Are the carcasses skinned?

Some processors must skin the animal to be able to remove the hair. This will determine the outcome of some of your products. For example, if hogs are skinned, pork roasts will not have the skin (also called "the rind") left on them.

What parts of the animal do you keep? Can I get paid for parts I do not want?

Based on how the animal is slaughtered or processed, state and federal meat regulations require certain by-products to be disposed of as inedible (e.g. lungs, chitterlings, hooves etc.) Be sure to ask what the processor will dispose of so that there are no surprises at pick-up time. A processor may also pay you for parts or cuts that you don't want or don't have room to store. Be sure to ask if this arrangement is possible and how much you can be paid for this.

What should I ask about how the meat is processed, cut and packaged?

How are the meats packaged?

Generally, meats are either wrapped in freezer paper or vacuum-packaged in heavy plastic wrap. Some farmers prefer the vacuum-packing because customers can see the meats before they buy them. Also, vacuum-packing may better protect the quality of the meat while in the freezer. Most federally-inspected plants offer vacuum-packing. Many small, state-inspected plants only offer paper wrapping of meats.

How do you label the meats? What information is put on the label? Can I have my farm name on the label?

Ask what information the processor can put on the label. Be sure to ask specifically if the weight of the package will be noted on each label. Also ask if they can put your farm name and logo on the label. For more about label requirements, see Proper Meat Labeling Section on page 12.

Do you offer any value-added processing like sausage making, smoking, or curing?

To maximize the use of all the meat from the animals and to provide a wide variety of products to your customers, ask what kinds of value-added processing is available to you. Most smaller processors offer sausage making (country style and specialty link sausages), but few can provide smoking and curing. Talk with your processor about offering these services in the future.

How long do you allow beef to age (or "hang")?

For highest quality, beef must be aged. Different processors allow different amounts of time to let beef hang. Most usually allow 2-3 weeks, but if you are interested in a longer amount of time, be sure to ask.

What is the fee to have animals slaughtered and processed? Is there an extra fee for packaging and labeling?

Be sure to ask what fees are involved in having your meats processed and packaged. The processor usually charges a flat fee for the slaughter and an additional price per pound of meat processed. There may be an additional fee for a certain type of packaging or labeling or a value-added service, so be sure to ask. Ask if there are any taxes. Most processors require payment when you come to pick up the meat.

What else should I ask?

What other farms do you slaughter and process for?

Ask for names of other farmers who use them. Speak with these farmers about working with this processor. Buy some of their product to see how it is cut and packaged. Most farmers are very willing to give you "the inside story" about the processor they use and how to get the best meats from your animals.

Can I take a tour of your facility?

There is no better way to get to know your processor than to take a tour of his facility. It will also give them a chance to get to know you and your business. It is also a good way to determine how long it will take to get to the processor. Typically for the comfort of the animals and to keep the meats fully frozen on the return trip, most farmers go to processors less than two hours away. Be sure to wear close-toed shoes.

Want to find a processor near you?

See Finding a Processor on Page 32

Proper Meat Labeling

Do all my meats need to be labeled?

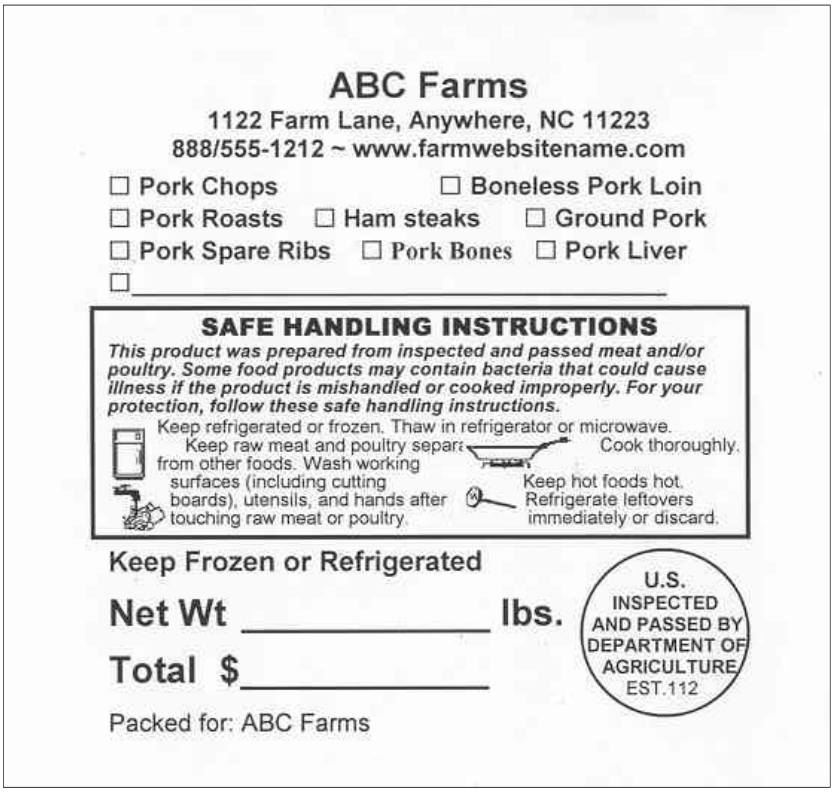
Yes. All of your meats must be properly packaged and labeled. See below for what is required on the label.

What information do the labels need?

All meats must be labeled with the following information:

- The contents of the package (name of the product) (e.g. “lamb chops”, “ground beef”, or “pork sausage”)
- If the contents have other ingredients (like spices in sausage), those ingredients must be listed (e.g. ground pork, salt, red pepper, sage, and black pepper”)
- Safe handling instructions, including “Keep refrigerated or frozen”.
- The mark of inspection with processing plant number
- The net weight of the package
- The name and address of the processing plant, or if the name and address are other than the producer, (such as the name and address of a farm) it must be qualified by a statement identifying the person or firm associated with the product (e.g. “Packed for___” or “Distributed by ___.”

Example of a "generic" label with only the processor's name and contact information included. Many farmers use generic labels first and then work with their processor to get their farm name and logo added. The processor would mark the net weight of the package. Because the product has more than one ingredient, all ingredients are listed.



Example of a label with the farm name and contact information included. The processor will mark the correct box for the contents and will mark the weight of the package. The label does not necessarily need to have the price marked, but some processors can offer this as an added service.

Can I label my meats myself at my farm?

No. All required labeling must be done at the processor. You may not change the original label or add any other labels to the meat, which could be viewed as a misrepresentation of the product once it has left the processor. This includes applying the net weight of the meat package. Adding your farm name, contact information and sale price is acceptable as long as it is applied separately from and does not obscure the original label.

Does the processor supply the labels for me or do I supply them? How can I get my farm name on the labels?

Ask your processor if he is able to print labels with your farm name and logo on it. Some have labeling machines where they can load your farm name and logo into a computer so it will be printed on the label when he is processing your meats.

It is also possible to supply your processor with labels. The labels must have all the required information on them. Some farmers have made their own labels on their computer, printed them at home and given them to their processor to use. Others have used label suppliers who can ship your farm labels directly to the processor. If you do print your own labels, be sure the ink is resistant to moisture and that the label can stick to a frozen surface. Be sure that the labels have been approved either by the state meat inspection office or the USDA meat inspection office before ordering labels.

Some processors may not be willing to use labels with your farm name on them unless they have an established relationship with you. You may have to use the processor's generic labels first.

I want my labels to say that the meat is raised without antibiotics, certified organic, or grass fed. Is this allowed? What words or phrases can I use?

Yes, as long as the claims can be substantiated by and the labels are approved by the state Meat and Poultry Inspection office for state-inspected plants or the USDA office in Washington, DC for federally-inspected plants. Labeling your meat with phrases that explain how the animals were raised is called "making claims". Label approvals are actually granted only to the inspected establishment (i.e. the processor) that is doing the meat processing, not you or your farm. This is because they have been assigned a unique inspection legend number, and are responsible for all labels with that inspection legend number.

The USDA only accepts certain phrases when making claims. For example, you may not label meats as "antibiotic-free" but you may label them as "raised without antibiotics" if you can provide sufficient proof to substantiate these claims to either the state Meat and Poultry Inspection or the USDA.

Commonly Approved Claims (Can Be Used)	Non-approved Claims (Cannot Be Used)
Raised without added hormones*	Antibiotic free
Raised without antibiotics	Hormone free
Not fed animal by-products	Residue free
Free range	Residue tested
Free roaming	Naturally raised
Grass fed	Naturally grown
Corn fed	Drug free
Grain fed	Chemical free
Certified Organic by (Certifying Agency)	Organic

* Hormones are only approved for use in beef cattle and lamb production. They are not approved for use in poultry, hogs, veal calves or exotic species. Therefore, the phrase "no hormones administered" on a chicken label cannot be approved unless it is followed (directly) with the statement "Federal regulations prohibit the use of hormones in poultry."

How do I get my claims approved?

As stated previously, label approvals are granted only to the inspected establishment (i.e. your processor) not to you or your farm. Your state or the federal Meat and Poultry Inspection office will have paperwork for the processor to fill out to get your claims and label approved.

You will need to work closely with your processor to get these labels approved, so let them know you are planning to do this. For federally-inspected plants, contact the USDA Food Safety and Inspection Service at (202) 205-0623 or (202) 205-0279.
Your processor will need to fill out the FSIS Form 7234-1 available at:
www.fsis.usda.gov/fsisforms/7234-1.pdf

What if I don't want to deal with all this paperwork, but still want my customers to know how I raise my animals?

You are still allowed to tell your customers how you raise your animals. You just can't have these claims on the physical label of the meats unless they are approved.

My farm is certified organic, but the processor I use is not. Can I still label my meats "organic"?

No. In order to be "certified organic", the processing plant must be certified organic as well. If you are interested in becoming certified organic, talk to your processor about considering organic certification.

How does my processor become certified organic? Can they still process non-organic meats?

Certified organic processing facilities are still allowed to process non-organic meats. There are only a few key requirements for meat processors to become certified organic.

First, they must be able to ensure that organic meats and non-organic meats do not "co-mingle", in other words, they won't get mixed up or come into contact with each other. They must be able to ensure that the meats in the package came from your organic animals. This is usually achieved by processing organic meats all at once at a certain time of the day or on a certain day of the week.

The equipment must be thoroughly cleaned after processing non-organic meat and before processing organic meats. Usually processors go through a thorough cleaning and hot wash at the end of the day, so this requirement is easily accomplished by processing organic meats first thing in the morning and then processing non-organic meats the rest of the day.

The processor must use proper vermin and pest control that is acceptable to organic standards. Certifying agencies can give specific pest control recommendations.
The facility will need to be inspected by an organic certification agency and fees do apply to become certified.

For resources on organic livestock production,

see Livestock Production Resources Section on page 28

To find a certifying agent that works in your state

see the Organic Certifiers

Resource Section on Page 31

Value-added Processing

What is required on the label for value-added products?

Value-added products (like ham, sausage, bacon, etc) require the same labeling information as other meats. For products that have more than one ingredient (like sausage), the ingredients must be listed on the label. Work with your processor to make sure all ingredients are listed properly.

Can I take meat that has been processed in an inspected facility and further process it myself? For example, can I cure my own hams and then sell them?

No. Once the meat has left the inspected processing facility, you may not further process it. This includes curing ham or bacon, making sausage, or handling the meats in any way other than storing it and selling it in its original packaging.

Generic packing label for goat sausage with ingredients listed.

Meat Handler's Registration and Proper Meat Storage

What is a Meat Handler's Registration?

In NC and SC any person, firm or corporation that stores, transports, or otherwise handles meat products, must obtain a Meat Handler's Registration. This Registration process includes reviews by compliance officer personnel to verify that your meat products are properly marked, labeled and wholesome and are being stored and transported under conditions which will not lead to misbranding and/or adulteration.

Who do I contact to get a Meat Handler's Registration?

To obtain a Meat Handler's Registration, contact the NC Meat and Poultry Inspection Service office in Raleigh at (919) 733-4136 or the SC Meat and Poultry Inspection office at (803) 788-2260. Say that you are inquiring about a Meat Handler's Registration and would like to make an appointment with your local compliance officer. There are several compliance officers in the state, and yours will depend on what county you live in. The receptionist will give you the name of your compliance officer, but may take your information and have the compliance officer call you back to make an appointment. Because compliance officers travel throughout the state, it is often difficult to reach them in the office.

When you are able to speak to the compliance officer, there are a few things you can ask him beforehand to help with the inspection. Ask about what he will be looking for when they arrive. Do they want you to have your own meats in the freezer to inspect? How long will his visit last? Do they need directions to the farm? If your meats are stored off-farm, does he still want to meet you at the farm?

What will the compliance officer look for when she comes to my farm?

When the compliance officer arrives at your farm, she will usually sit down with you first and go over what she will be doing that day at your farm. She will want to see your freezers (with meats in them) to make sure they are working properly and that the inside temperature is acceptable. She will inspect the labels for accuracy (see Proper Meat Labeling Section on page 12 for more information). She will look to make sure the storage area is clean and there are no rodent or pest issues. She will also likely ask you how you transport your meats to/from the processor and to/from the market.

What kind of freezer do I need?

Any kind of freezer that is in good repair and kept clean can be acceptable as long as it keeps the meats frozen at an acceptable temperature. The freezer must be used for the storage of inspected meat products only – no personal use or NOT FOR SALE meat products can be stored in the freezer. You will also have to put a thermometer inside the freezer (if there is not one built in) that shows the temperature inside the freezer is acceptable. Compliance officers also look to make sure there is no rusting, exposed insulation, excessive ice build up and that vermin cannot get into the freezer. They will also inspect for general housekeeping, sanitation practices, possible cross contamination issues, rodent/pest activity and preventive measures for rodents/pests in the area where the freezer is located. Most farmers prefer chest freezers because they can be opened and closed easily without raising the temperature inside. They are also very economical and ads for used chest freezers can be found in many local papers.

Can I store my meats off-farm?

Some farmers choose to store their meats off-farm in cold storage facilities. There are a few benefits to this. Firstly, these freezers are often much larger than home chest freezers which is very convenient to farmers who store large quantities of meat year round. Secondly, these facilities are more likely to have back-up generators in case of power outage. The drawback is that farmers will often have to pay a rental fee to use these facilities; however, some farmers use the barter system, trading produce and meats for use of the space. Farmers using off-farm meat storage still need to obtain a meat handler's registration, and the compliance officer will want to visit the off-site storage to inspect the meat and freezers.

Selling Meats

Can I sell fresh meats?

Yes, you may sell fresh (not frozen) meats if the meat was not frozen when you picked it up at the processor. You must be extra careful in the transporting and storage of fresh meat products in order to prevent temperature abuse (i.e. letting the temperature get too high or fluctuating) and maintain optimum shelf life. Meat that has been frozen may not be thawed and then sold. If you plan to sell fresh meats at a farmers' market, make sure you tell the market manager, as there may be market rules against this.

Can I freeze fresh meats and then sell them?

If you receive processed meat already frozen from the plant, then it must remain frozen through the sale to the customer. If the product is not yet frozen, it can be sold fresh or frozen. Farmers selling at farmers' markets should check the market's rules governing the sale of meat and poultry, as some may only allow frozen product.

Can I sell meat directly off my farm?

Yes, many farmers sell meats directly off their farm. These meats are still required to be processed in a state– or federally-inspected facility and must be labeled properly just as if you were selling the meats any where else. It is also a good idea to recommend that customers bring their own coolers to transport the meat home safely.

Can I sell meat at the farmers market?

Yes, you may sell meats at a farmers market, if the market rules allow it. Tell the Market Manager you want to start selling meats, and ask what kind of storage is required by market rules. Most of the time, chest coolers are acceptable, however some markets require that you store meats in a small chest freezer run by electrical power. There may be fees associated with using electrical power at the market. If you want to sell fresh meats, be sure to ask if this is allowed as some markets only allow frozen meats to be sold.
As with all meat sales, the meat must be processed at a state– or federally-inspected facility and must be properly labeled by the processor. It is also a good idea to recommend that customers bring their own coolers to transport the meat home safely.

Eliza McLean of Cane Creek Farm takes out an order for a customer at the Carrboro Farmers' Market (left). Elise Margolis of Elysian Fields Farm displays her cooler full of pasture-raised pork (above).

Can I offer free cooked samples at the market?

One of the best ways to sell your farm products is to let customers have a taste! Some farmers set up small grills or electric skillets to cook up samples. Hot country sausage on a Saturday morning at the market can be a great way to gather crowds! It is very important to speak with your market manager before you offer cooked samples. There may be market rules against this, or you may need to speak or work with a local health inspector before this is allowed. Your market manager or your county health department will have more information on how to go about this safely and legally.

How do I store my frozen meats while at the market?

Most farmers store meats in large chest coolers while at the market. If kept closed properly, meats should stay frozen for several hours. Alternative refrigeration methods such as ice packs, etc. are highly recommended when using a chest cooler. Chest coolers are an acceptable means of temporary storage by state Meat and Poultry Inspection as long as the meat products do not become unwholesome due to temperature abuse, however, some markets require that farmers store meats in small chest freezers that can be plugged in. The market may charge an extra rental fee to use electrical power. Speak to your market manager about acceptable meat storage.

How can I transport my frozen meats safely to/from the processor or the market?

Most farmers transport their frozen meats in chest coolers. Again alternative refrigeration such as ice packs, etc. are highly recommended. The chest coolers must be clean along with the transport vehicle. The inspector at the slaughtering facility may inspect the transport vehicle and chest coolers. Unacceptable findings could result in the inspector not allowing the inspected product to be loaded. The chest coolers are inexpensive and can keep the meats frozen until you are able to store them in your on-farm or off-farm freezer space provided you do not encounter any unforeseen problems during transport such as a vehicle breakdown or an accident. Again, another reason for alternative refrigeration. Some farmers use small chest freezers they can power through their car battery. This alternative is more expensive than chest coolers, and may not be necessary for most trips from the processor. Some farmers use small chest type freezers that are plugged in overnight where temperatures are consistently maintained at zero degrees or below. The farmers unplug the freezer and in turn pick up their meat products from the inspected facility. The freezer is already cold and maintains better temperature control than the chest coolers.

Left: Cooler of meats ready to travel to the farmers market.

Can I sell meat at local grocery stores or co-ops?

Yes. Many farmers supply their meats to locally-owned grocery stores or co-ops. The meat must still be processed at a state– or federally-inspected facility and properly labeled for sale. The store may also have rules as to if the meat is state- or federally-inspected so check with the store manager or meat buyer. Some stores may require proof of liability insurance. See Product Liability Insurance section on page 24 for more information.

Can I sell meats to local restaurants?

Yes. Locally-owned restaurants are some of the best customers for local meats. The meat must still be processed in an inspected facility and the carcass must bear the stamp of inspection, however individual packaging and labeling of the cuts of meat may not be required. Check with the restaurant as to how they prefer to receive their meat shipments. Some restaurants may require proof of liability insurance. See Product Liability Insurance section on page 24 for more information.

Can I sell meats outside the state?

You can sell and ship meats out of the state if your meats are processed in a federally-inspected plant. You cannot ship or sell meats outside the state if your meats are processed at a state-inspected facility.

Can I ship meats? How? Where can I find packing materials to ship meats?

You can ship or mail meats out of the state if your meats are processed in a federally-inspected plant. You cannot ship or mail meats outside the state if your meats are processed at a state-inspected facility.

Frozen meats can be safely shipped by US Mail, UPS, FedEx and other private carriers by using overnight or 2nd Day shipping. Meats must be packed in a Styrofoam cooler to keep meats frozen. They must also be packed with dry ice to keep the inside of the shipment cold. You cannot ship meats using regular ice! The package must also be properly labeled as "Perishable" and "Keep Frozen". For more details on how to properly pack perishable shipments, contact the United States Postal Service or the shipping company directly.

You can arrange pick-up services with most private shipping companies like UPS or FedEx. They may be able to provide you with shipping materials, but you will need to supply your own dry ice which can be purchased from local suppliers. They can likely be found under "dry ice" in the phone book.

More Information on How to Pack Your Perishable Shipments

United States Postal Service 1-800-275-8777
http://pe.usps.com/text/pub52/welcome.htm

FedEx 1-800-463-3339
http://www.fedex.com/us/services/pdf/PKG_Pointers_Perishable.pdf

UPS 1-800-742-5877
http://www.ups.com/content/us/en/resources/prepare/materials/coolants.html

Product Liability Insurance

Do I need product liability insurance?

Any time you sell a new product or offer a new service as part of your farm business, you should contact your insurance agent to make sure you have proper insurance coverage. Be honest with your agent and answer all of his questions regarding your farm business. This is simply good common sense to protect your business and your family's livelihood.

Some restaurants or grocery stores might require you to have product liability insurance (sometimes up to a certain amount of coverage) in order to sell to them or through their stores. Speak with the restaurant or store manager about what they require, then contact your agent to make sure you meet this requirement. The restaurant or store manager may require you to show proof of this insurance before they will take your product.

How much does product liability insurance cost?

Rates vary by company, what kind of coverage you need, and how much coverage you need. Speak with several companies to compare rates. Often you can reduce your overall insurance costs by carrying all your policies with one company. By combining your home, car, business and liability insurance under one policy, it may help reduce your overall costs.

Marketing Meats

What are some local and national directories where consumers can find information about my farm?

There are many ways to let consumers know what you have and how to buy it! There are several state- and nationwide directories both in print and online.

National Online Directories

Local Harvest
www.localharvest.com
Allows you to list your farm, what you sell, and how to reach you for free. Customers can search by zip code.

Eat Wild
www.eatwild.com
Information for consumers on natural meats and their benefits. Free listing of farm information.

Sustainable Table Eat Well Guide
www.eatwellguide.org
From the folks who brought you the Meatrix! Free farm listing for producers of sustainably-raised meats, eggs, and dairy. Customers can search by zip code.

Robyn Van En Center for CSA Resources
www.wilson.edu/wilson/asp/content.asp?id=804
National directory of farms with Community Supported Agriculture (CSA) programs. Free listing, but donations are appreciated.

The New Farm
www.thenewfarm.org/farmlocator
A publication of the Rodale Institute, The New Farm online magazine also connects customers and farmers through their Farm Locator. Listing is free.

In North Carolina

NC Choices
(919) 515-2390 & (919) 967-0014
www.ncchoices.com
Online guide linking customers to NC farmers producing pasture-raised and antibiotic-free pork. Contact for more information on listing opportunities.

Carolina Farm Stewardship Association
(919) 542-2402
www.carolinafarmstewards.org
Free farm listing for CFSA members.

NC Farm Fresh
(919) 733-7887
www.ncfarmfresh.com
Free farm listing from the NC Department of Agriculture.

Buy Appalachian Guide
by Appalachian Sustainable Agriculture Project (ASAP)
(828) 236-1282
www.buyappalachian.org
Free listing of Appalachian region farms

In South Carolina

Carolina Farm Stewardship Association
(803) 779-1124
www.carolinafarmstewards.org
Free farm listing for CFSA members.

South Carolina Specialty Food Producers Association
(803) 734-2200
www.scsfa.org
Listing of all registered members in membership directory. Members are also listed on SC Department of Agriculture website.

Resources

Livestock Production Resources

***NCAT's Organic Livestock Workbook– A Guide to Sustainable and Allowed Practices*. National Center for Appropriate Technology. 2004.**
http://attra.ncat.org/attra-pub/PDF/livestockworkbook.pdf
Workbook and guide for farmers who produce organic livestock. Includes information on certified organic production practices as well as a "check-off" sheet for determining if practices are allowable under federal organic rules.

Appropriate Technology for Rural Areas (ATTRA)'s Livestock Resource Center.
www.attra.org/livestock.html or by calling 1-800-346-9140.
Resources on the sustainable production of beef, dairy, hogs, sheep, goats, and poultry. Special publications on pasture management, watering systems, and fencing.

NC Cooperative Extension Service
To contact your local county office, visit www.ces.ncsu.edu
To find livestock production publications online, visit
http://www.ces.ncsu.edu/index.php?page=animalagriculture

SC Cooperative Extension Service
To find your local county office, visit www.clemson.edu/extension
To find livestock production publications online, visit
http://dprod4.clemson.edu/olos/asp/searchresults.asp?s=Animal

Poultry Resources

Selling Meat and Eggs: What farmers Need to Know
Growing Small Farms Website, Debbie Roos, Chatham County Extension
www.ces.ncsu.edu/chatham/ag/SustAg/meatandeggs.html
Information regarding sales of meat, poultry, and eggs in NC. Covers meat handler's registration and basic labeling regulations. Contact information for NC meat regulators and inspectors.

Inspection Requirements for Meat and Poultry Businesses.
NC Department of Agriculture.
www.ncagr.com/vet/meat_poultry/pdf/InspRequireM&PBusinesses.pdf
or call (919) 733-4136

Guidance for Determining Whether a Poultry Slaughter or Processing Operation is Exempt from Inspection Requirements of the Poultry Products Inspection Act. United States Department of Agriculture. Food Safety and Inspection Service. Inspection & Enforcement Initiatives Staff. April 2006.
www.fsis.usda.gov/OPPDE/rdad/FSISNotices/Poultry_Slaughter_Exemption_0406.pdf
User-friendly guide to understanding the federal poultry slaughter exemption act.

Legal Issues for Small-scale Poultry Processors
Federal and State Inspection Requirements For On-Farm Poultry Production and Processing. Compiled by Janie Hipp. December 2001.
Information for all states on poultry slaughter and processing regulations.
http://www.apppa.org/legalstates.pdf

Animal Welfare / Environmental Certification Agencies

Animal Welfare Institute
PO Box 3650
Washington, DC 20027
(703) 836-4300
www.awionline.org

Free Farmed Certification Program
American Humane Association (AHA)
63 Inverness Drive East
Englewood, Colorado 80112
(303) 792-9900 X613
www.americanhumane.org/freefarmed

Humane Farm Animal Care
PO Box 727
Herndon, VA 20172
Phone: 703-435-3883
www.certifiedhumane.org

River Friendly Farm Program
Contact your local Soil and Water Conservation District for more information

Organic Certifying Agencies that Service NC and SC

North Carolina Crop Improvement Association
3709 Hillsborough St.
Raleigh, NC 27607-5464
(919) 513-3444
www.nccia.ncsu.edu

Department of Plant Industry
Clemson University
511 Westinghouse Rd.
Pendleton, SC 29670
(864) 646-2140

Quality Certification Services
P.O. Box 12311
Gainesville, FL 32604
(352) 377-0133
www.QCSinfo.org

For Organic Certification Agencies throughout the United States, call the National Organic Program at (202) 720-3252 or visit
www.ams.usda.gov/nop/CertifyingAgents/Accredited.html

Label Suppliers

Growers Discount Labels
PO Box 70
Tunnel, NY 13848
1-800-693-1572
growersdiscountlabels@tds.net

Find a Processor Near You

North Carolina

Independent Farmers' Directory of Slaughter Facilities in North Carolina NC Cooperative Extension. 2004.

Edited by Mike Lanier, Orange County Extension
A directory of slaughter facilities in NC that will work with independent producers. Organized by county, the directory lists contact information, species of animals slaughtered, packaging type and other services such as value-added. Also includes basic information on retailing meats like labeling and the meat handler's registration. Available by calling (919) 245-2050 or online at:
www.ces.ncsu.edu/chatham/ag/SustAg/Slaughter Directory Introduction.pdf

Processing Plant Directory. NC Department of Agriculture. 2006.

http://www.ncagr.com/vet/meat%5Fpoultry/directory.htm
Online directory of custom, state, and federal processing plants. Searchable by name and plant number. Information includes contact information and species processed, but no information of whether these plants are open for independent farmers.

South Carolina

Processing Plant Directory. SC Meat and Poultry Inspection, Clemson University Livestock and Poultry Health. 2006.

http://www.clemson.edu/lph/meatinspection.htm#directory
Online directory of custom, state, and federal processing plants. Information includes contact information and services (slaughter and processing) but no information of whether these plants are open for independent farmers.

Marketing Resources

Selling to Institutions: An Iowa Farmer's Guide. By Robert Luedeman and Neil D. Hamilton, Drake University Agricultural Law Center. January 2003.
http://www.iowafoodpolicy.org/selling.pdf
Farmers' guide about selling farm products (including meats) to institutions. Written in FAQ format. Special attention is paid to legal and financial considerations.

Selling to Restaurants. By Janet Bachmann, Agriculture Specialist. National Center for Appropriate Technology (NCAT). August 2004. ATTRA Publication #IP255.
http://www.attra.org/attra-pub/sellingtorestaurants.html
Farmers guide to selling farm products (including meats) to local restaurants. Profiles several farms and restaurants. Written in news article style.

Other Guides to Understanding Meat Regulations

North Carolina

Producer Managed Marketing of Livestock and Livestock Products
NC A&T State University Cooperative Extension Program
Southern Region SARE PDP Project, 2005

Handbook to the training series offered at NCA&TSU to extension agents in the SARE Southern region. Meant to be a guide for agents who work with farmers who direct-market meat and other livestock products. Organized in a way to walk agents through the process farmers will go through and educates them on how to find out information pertinent their home state. Guide covers red meats, poultry, dairy, and eggs. Processing regulations sections outlines process by which farmers can sell meats.

Selling Meat and Eggs: What farmers Need to Know
Growing Small Farms Website, Debbie Roos, Chatham County Extension

http://www.ces.ncsu.edu/chatham/ag/SustAg/meatandeggs.html
Information regarding sales of meat, poultry, and eggs in NC. Covers meat handler's registration and basic labeling regulations. Contact information for NC meat regulators and inspectors.

NC Department of Agriculture, Department of Meat and Poultry Inspection
Meat Processing and Inspection Laws. 2006.

http://www.ncagr.com/vet/meat%5Fpoultry/pdf/NC%20Compulsory%20Meat%20Inspection%20Law.pdf
Laws of the State of North Carolina concerning the slaughter, processing, packaging, and sale of meats and meat products.

South Carolina

SC Meat Processing and Inspection Regulations. SC Meat and Poultry Inspection, Clemson University Livestock and Poultry Health. 2006.

http://www.clemson.edu/lph/meatinspection.htm#regs
Laws of the State of South Carolina concerning the slaughter, processing, packaging, and sale of meats and meat products.

Outside North and South Carolina

Farmer's Guide to Processing and Selling Meat or Poultry. Penn State College of Agriculture Sciences and Cooperative Extension. 2000.

http://lehigh.extension.psu.edu/Agriculture/Farmers_Guide.pdf
Guide for Pennsylvania farmers who retail their own meats. Includes information for red meats and poultry with attention to processing, labeling, shipping, and retailing. Pennsylvania doesn't not have state inspection, so federal guidelines are followed.

Consumer Information on Buying Meat Direct From Farmers. Jenifer Buckley, Northeast Minnesota Chapter of the Sustainable Farming Association.

http://www.misa.umn.edu/Consumer_Guide.html
Intended for consumers, this guide outlines regulations regarding the sale of meat and live animals in MN. Great outline of what to ask a farmer before buying meats or live animals for slaughter.

Marketing Strategies for Farmers and Ranchers. Sustainable Agriculture Research and Education (SARE) Program.

http://www.sare.org/publications/marketing/market07.htm
General guide to marketing of farm products. Specific sections regarding meats and regulation, legal, and risk management concerns that farmers should consider before retailing. Written in news article format.

Specialty Livestock Processing in Illinois. 2000. University of Illinois at Urbana-Champaign. College of Agricultural, Consumer and Environmental Sciences. Department of Agricultural and Consumer Economics.

Authors surveyed processing facilities on types of slaughter, processing services, and involvement in specialty markets. Includes resources and contact information.

A Basic Guide To Selling Meat In Vermont

By Curtis J. Stasheski, Vermont Dept. of Agriculture, Food & Markets
http://www.vermontbeefproducers.org/sellguide.htm
Short leaflet on the slaughter and processing of meats with suggestions on what to do if farmers want to sell the meats.

Direct Meat Marketing: An Alternative for Farmers. By Lisa Solomon, K-State Research & Extension News. 2002.
http://www.oznet.ksu.edu/news/sty/2002/meat_marketing120502.htm
Cooperative extension leaflet outlining basic rules and considerations farmers will face in retailing their own meats in Kansas.

Direct Marketing Meat — Is It An Option for You? By Anastasia Becker, Community Food Systems and Sustainable Agriculture, University of Missouri Outreach and Extension
http://aes.missouri.edu/swcenter/sustain/Marketing%20Meats%20-%20is%20it%20for%20you.pdf
Extension bulletin on marketing meats, including benefits, challenges and considerations before beginning your meat business. Tips on "getting the word out" and building customer loyalty.

Direct Market Meats: A Resource for Direct Market Meat Producers in Wisconsin. Edited by: Greg Lawless, Extension Outreach Specialist, UW Center for Cooperatives
http://s142412519.onlinehome.us/uw/pdfs/A3809_WEB.PDF
Comprehensive manual on marketing of meats including processing regulations, tips for marketing, and working with a processor. Also includes processing plant directory.

Direct Marketing of Meat and Meat Products. University of California Cooperative Extension
http://ucce.ucdavis.edu/files/filelibrary/1271/18808.pdf
PowerPoint presentation on the marketing of meats in California. Particularly good slide on how animals are sold and processed and what is legal under California and federal law.

***Farm Direct Marketing- Meat and Poutlry*. Oregon Department of Agriculture. 2006.**
http://www.oregon.gov/ODA/pub_fd_commodities.shtml#Meat_and_poultry
Extension directory outlining regulations concerning meat and poultry sales. Basics of custom slaughter and processing of wild game included.

Feasibility Studies of Building or Providing Meat Processing Centers

Cost Analysis: A Meat processing Facility in Western Massachusetts. Massachusetts Farm Bureau Federation, Inc., Ashland 2002.

http://www.mass.gov/agr/programs/agroenviro/grantreport_openfields_meatproc_final.pdf

Feasibility Study for establishing a shared-use value adding agricultural processing/commercial kitchen facility. Smithson Mills, NCDA Agribusiness Development Representative. 2002.

Study that led to the Blue Ridge Food Ventures facility. Small section of the study looked into meat processing, but due to lack of interest by users and cost of building, was not included in the first phase.

FAQS ON GETTING BEEF FROM FARM TO MARKET

Where do meat inspection requirements come from? The requirements for meat inspection come from the Federal Meat Inspection Act (FMIA) and the Mississippi Meat Inspection Act (MMIA) and the regulations adopted thereto.

What are the requirements for selling meat products in Mississippi? All beef, pork, sheep, goat, horse and other equine products sold to consumers must be from animals that have been slaughtered, processed and accurately labeled in an approved facility and have passed ante mortem and post mortem inspections.

What is an "approved facility?" An approved facility is a slaughtering facility that is licensed and inspected by the Mississippi Department of Agriculture & Commerce's (MDAC) Meat Inspection Division or has a grant of inspection from the United States Department of Agriculture (USDA) and meets the applicable requirements set forth in the FMIA, which have been adopted by the Department.

Are there any approved facilities for beef inspection in Mississippi?
Yes, one USDA facility and one MDAC inspected facility. Beef is slaughtered and processed under USDA inspection at Kased Brothers in Summit. Beef processed here may move in interstate commerce, i.e. sold across state lines. The contact number for Kased Brothers is 601-684-0319. Attala Frozen Foods in Kosciusko is a MDAC inspected facility. Beef processed here may only be sold within borders of Mississippi. The contact information is 662-289-2561.

Are there any approved facilities in surrounding states where I can have beef processed and bring it back to Mississippi. Yes. HOPCO in Headland, Alabama slaughters and processes beef under USDA inspection. Hopco's contact number is 334-693-9299. Cox Butcher Shop in Florence, Alabama slaughters and processes beef under USDA inspection. Cox's contact number is 256-766-2051. McNeese State University in Lake Charles, Louisiana slaughter and process beef into retail cuts of meat under USDA inspection but they do not produce non-intact products (ground beef or tenderized steak). McNeese State University's contact number is 337-588-5008.

What is an antemortem inspection? This is an examination and inspection of the animal by a federal or state inspector before it enters the slaughtering facility. The purpose is to separate an animal that shows symptoms of disease from animals that are healthy.

What is a postmortem inspection? This is an examination and inspection of the carcass of the animal by a government inspector done for the purpose of detecting disease and/or adulteration.

Will my animal undergo any type of testing at the slaughter plant? Possibly. Any animal presented for slaughter at an approved facility is subject to all testing (microbiological, residue) the same as any other carcass. The fact that it is farmer owned has no bearing on the inspection process if the farmer plans for the product to enter commerce.

What happens when an animal passes inspection? The product is stamped or labeled "Inspected" with the appropriate government agency's mark of inspection and can enter into interstate commerce if it has the USDA mark and intrastate commerce if it has the MDAC mark.

Can I sell my "Inspected" product at wholesale? Yes**.** Your product is legal for sale anywhere in Mississippi once inspected. You may wholesale the product, i.e. sell it to a retail outlet or restaurant for resale.

Can I sell my product at retail? Yes. The product can be sold by you at retail but you must obtain a retail food license from the department and your establishment must be inspected and meet sanitation requirements.

Can I sell my product at a farmers market? Yes, but because almost all of the farmers markets in Mississippi are outdoors markets, you must obtain a mobile retail food establishment license from the department and you must have a refrigerated mobile vehicle that the department approves before using.

Can I put a cooler in the back of my truck and drive up to the farmers market? No. In order to ensure food safety, cold foods must stay at or below 41˚F at all times and frozen foods must remain entirely in a frozen state at all times. Chest coolers and household devices do not guarantee the same level of safety as commercially approved modes of refrigeration. With chest coolers, cold ambient temperature is guaranteed for only a short time, and with household coolers/freezers/refrigerators, cold temperature cannot be maintained outside in summer heat in a household styled cooler that is not intended to be opened and closed continuously throughout the day, as would happen at a market.

Pictures of approved trucks and trailers:


27 1:06 AM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Why can't I use a refrigerator or freezer in the back of my truck or on a trailer?
Before MDAC adopted regulations requiring commercially approved refrigerated trucks or trailers, it allowed the use of inverters to power household coolers. Inspectors often found that the inverters would not be strong enough to power the refrigerators or freezers. Although the use of inverters and household coolers allowed more people to sell meat, the lack of investment and food safety experience on the part of many vendors led to many sanitation and food safety violations. Therefore, the Department had to adopt regulations to maintain an acceptable level of food safety.

Can I use a rented refrigerated trailer or vehicle? The Department has approved rented refrigerated trailers or vehicles as long as they are presented to the Department for approval prior to use.

Who should I contact to approve my refrigerated vehicle? Once a truck or trailer is selected, the vendor should contact the Consumer Protection office at 601-359-1148 to schedule an inspection of the truck. The inspectors will check the temperature and any products inside the truck. (If the vendor has not filled out a Mobile Vehicle Application, one will be given to him onsite. The cost is $10/year.) The inspector will also make sure that the vendor has the proper labeling on the truck. Even if the truck or trailer is a rental, the name, address, and telephone number of the vendor should be conspicuously posted.

Is there any requirement for the method of sale of my inspected and packaged meat? Yes. Most meat has to be sold by net weight. Only certain and particular types of meat do not have to be sold by weight, such as offal (e.g., brains, feet, heads, and hearts) and meat that has been processed so much that it is no longer considered meat (e.g., hamburgers, pastrami, sausages, chicken nuggets, and bologna). All other meat must be weighed on a scale that is approved for commercial use and labeled with a net weight declaration on the package. "Net weight" means that the packaging, or tare weight, cannot be counted toward the weight and price of the product.

What is a "scale that is approved for commercial use?" All scales used for commerce in Mississippi must be approved by the National Type Evaluation Program (NTEP) within the National Institute of Standards and Technology (NIST). The following links can guide vendors when making a scale purchase:

http://www.ncwm.net/resource/consumer-information
(Then click on "Buying Commercial Scales on the Internet.")

https://www.ncwm.net/ntep/cert_search

Are there any other labeling requirements for beef products? Yes. The identity of the product and the processor's name and address. Beef products must be labeled with safe handling instructions as follows:

SAFE HANDLING INSTRUCTIONS

Some food products may contain bacteria that could cause illness if the product is mishandled or cooked improperly. For your protection, follow these safe handling instructions

- Keep refrigerated or frozen. Thaw in refrigerator or microwave.
- Keep raw meat and poultry separate from other foods. Wash working surfaces (including cutting boards), utensils, and hands after touching raw meat or poultry.
- Cook thoroughly.
- Keep hot foods hot. Refrigerate leftovers immediately or discard.

Basic Labeling Requirements for Food Products Entering Commerce

MISSISSIPPI STATE UNIVERSITY EXTENSION

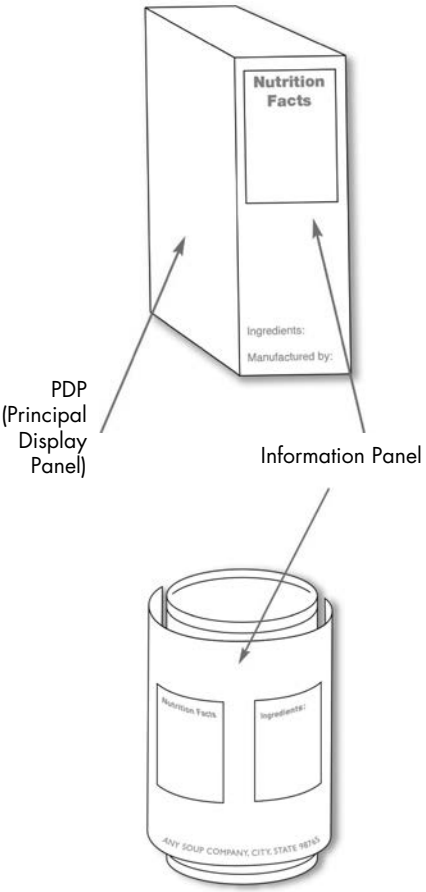
A food label is often a consumer's closest contact to a food manufacturer and only source of knowledge of the product. A label offers assurance of what the product is and some information of how it was produced. Just as a company is represented by the name, it is also represented by the label on its product. Whether FDA or USDA regulates a product, the fundamentals are similar.

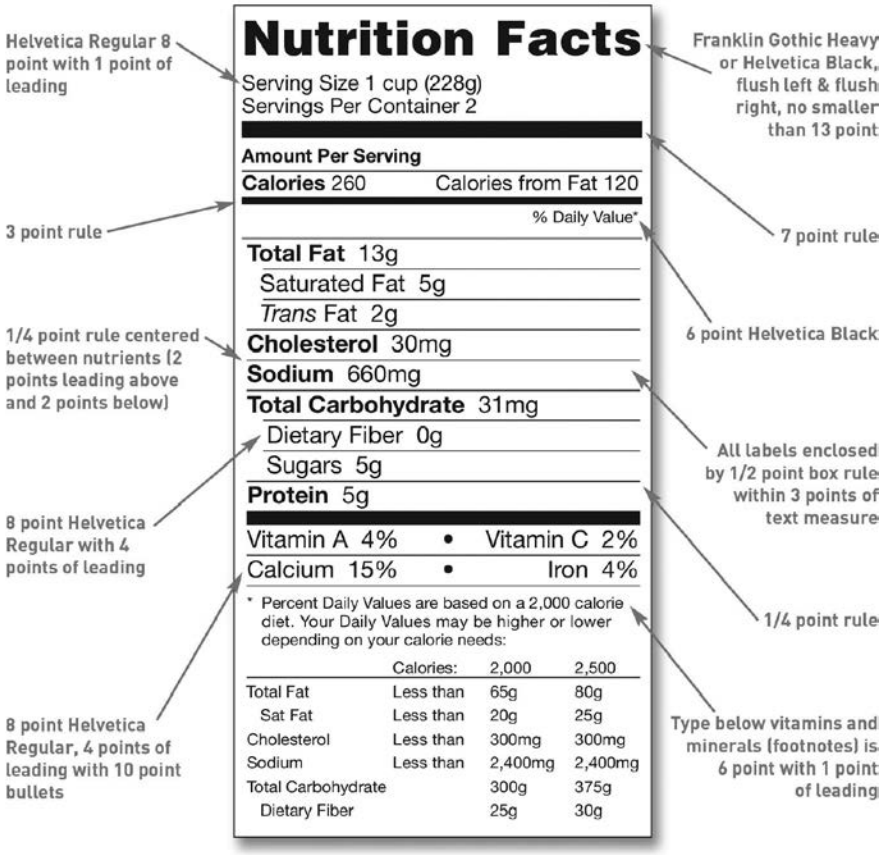
Regulation and labeling of food products are handled through two organizations, the United States Department of Agriculture Food Safety Inspection Service (USDA FSIS) and the Food and Drug Administration (FDA). In general, USDA FSIS regulates most meat, poultry, and processed eggs (broken whole eggs, egg whites, egg yolks, dried, etc.), while FDA handles all other food products.

Food labels may have two formats: a principal display panel (PDP) only or a principal display panel and an information panel. If an information panel is used, it is placed to the right of the PDP. See the examples below and on the next page. Nutrition panel examples of various formats with specifics of formatting are also included in this publication.

Nutritional information is a required feature on all products unless exempt from the requirement as outlined in Title 21 of the Code of Federal Regulations (21 CFR 101.9 j).

All required labeling must be clearly legible and easily seen. Intervening material that is not required by regulation must not be placed between required labeling features. The name of a product must be in compliance with any standards of identity or common names associated with the product and must be prominent on the label. If the product is not included in either of these standards, then the name must adequately describe and represent the product. Text size must be at least one-sixteenth of an inch, based on the height of the lowercase "o." For specific text size requirements, see Title 21 of the Code of Federal Regulations (21 CFR 101). If a label includes a foreign language, all required statements must be given in both English and the foreign language. Artwork must accurately depict the product inside the packaging and may not detract from the required label features.





Ingredients are listed in order by weight with the ingredient that weighs the most listed first, followed by the next in descending order, and so forth. The common or usual name of the ingredient must be used unless there is another term given by regulation. If an approved chemical preservative is used in a product, it must be listed in the ingredient statement and followed by the purpose of the preservative such as "mold inhibitor," "to help protect flavor," or similar. Spices added to a product may be declared as "spices," "flavor" or "natural flavor," or "artificial flavor." If an ingredient used in a product includes other ingredients, the sub-ingredients must be listed in parentheses behind the ingredient used in the product, or the sub-ingredients may be listed in order of descending predominance without the name of the ingredient used in the product. An allergen statement must be included if any of the eight major allergens are included in the product ingredients. More information on allergens is presented below.

The net quantity statement must be given in both metric and U.S. Customary System terms. The size of the statement depends on the size of the principal display panel. The quantity stated is the quantity of only the food (not including the packaging), so it should be given in net weight or net volume depending on the type of product.

The name of the manufacturer, packer, or distributor must be clearly defined. If the actual manufacturer is not applicable to the product, a statement such as "manufactured for" or "distributed by" must be used. The street address must be given if the name and address of the business is not listed in a current city directory or phone book. The city, state, and zip code must be included (21 CFR 101.5).

Labeling FDA-Regulated Products

FDA does not require preapproval of food labels. Product labels are monitored through post-marketing checks. A manufacturer, competitor, or customer may request a label review by FDA. In general, FDA regulates all foods other than those containing a significant portion of meat or poultry or 100 percent processed egg products. FDA also has authority over exotic species of livestock and poultry, such as deer, elk, and pheasant. The following outlines products that qualify for FDA regulation:

- 3 percent or less raw meat or less than 2 percent cooked meat
- Less than 2 percent cooked poultry [9 C.F.R. § 381.15(a)(1) (poultry)]
- All other food products other than processed eggs
- Seek clarification from FSIS to determine exact legal responsibility.

Nutrition Facts

Serving Size 1 Cup (35g)
Servings Per Container 10

Amount Per Serving	Cereal	with 1/2 cup Skim milk
Calories	130	170
Calories from Fat	0	0
	% Daily Value**	
Total Fat 0g*	**0%**	**0%**
Saturated Fat 0g	**0%**	**0%**
Trans Fat 0g		
Cholesterol 0mg	**0%**	**0%**
Sodium 200mg	**8%**	**11%**
Total Carbohydrate 30g	**10%**	**12%**
Dietary Fiber 4g	**16%**	**16%**
Sugars 18g		
Protein 3g		
Vitamin A	25%	25%
Vitamin C	25%	25%
Calcium	0%	15%
Iron	10%	10%

* Amount in cereal. One half cup skim milk contributes an additional 40 calories, 65mg sodium, 6g total carbohydrate (6g sugars), and 4g protein.
**Percent Daily Values are based on a 2,000 calorie diet. Your Daily Values may be higher or lower depending on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

Nutrition Facts

Serving Size 1 cup (228g)
Servings Per Container 12

Amount Per Serving

Calories 260	Calories from Fat 120
	% Daily Value
Total Fat 13g	**20%**
Saturated Fat 5g	**25%**
Trans Fat 2g	
Cholesterol 30mg	**10%**
Sodium 660mg	**28%**
Total Carbohydrate 31g	**10%**
Dietary Fiber 0g	**0%**
Sugars 5g	
Protein 5g	

Vitamin A 4% • Vitamin C 2%
Calcium 15% • Iron 4%

*Percent Daily Values are based on a 2,000 calorie diet. Your Daily Values may be higher or lower depending on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

Nutrition Facts

Serving Size 1 Tbsp (14 g)
Servings Per Container 64

Amount Per Serving

Calories 130	Calories from Fat 130
	% Daily Value*
Total Fat 14g	**22%**
Saturated Fat 2g	**10%**
Trans Fat 2g	
Polyunsaturated Fat 4g	
Monounsaturated Fat 6g	
Sodium 0mg	**0%**
Total Carbohydrate 0g	**0%**
Protein 0g	

Not a significant source of cholesterol, dietary fiber, sugars, vitamin A, vitamin C, calcium, and iron.

* Percent Daily Values are based on a 2,000 calorie diet.

There are six requirements for an FDA-labeled product:

1. Product name
2. Ingredient list*
3. Allergen labeling* (if applicable)
4. Net quantity
5. Manufacturer name and address*
6. Nutrition labeling*

Items denoted by an asterisk (*) may be placed on the information panel. If there is not a separate information panel, then all information must be displayed on the principle display panel. Products that consumers expect to contain juice must contain a "percent juice" declaration near the top of the information panel.

Labeling USDA FSIS-Regulated Products

FSIS mandates the preapproval of all labels before the product enters the market. FSIS receives approximately 130,000 labels for review and approval annually. There are a few specific circumstances when a preapproved label may be modified and the resulting new label not be resubmitted for approval. Many minor modifications and single-ingredient product labels can be approved by local inspectors and/or through the new generic approval process. However, any type of claim made on the label requires USDA FSIS prior approval. There are eight requirements for an FSIS-labeled product:

1. Product name
2. Inspection legend and establishment number
3. Handling statement
4. Net weight statement
5. Ingredients statement and allergen statement (if applicable)
6. Address
7. Nutrition facts
8. Safe handling instructions for raw products

The principal display panel, the area most likely to be read or viewed on the package, must include the product name, net quantity, inspection legend and establishment number, and handling statement (when applicable). The required area of the principal display panel can be found at 9 CFR 317.2 for meat and 9 CFR 381.116 for poultry (see references section for direct links to these regulations). The information panel may be located next to the principal display panel and may include information such as the ingredients statement, nutrition statement, and manufacturer or distributor name and address. Each of these items must be easily read and understood by the average consumer.

The product name must be prominent and easily seen on the principal display panel. All foods that fall under a standard of identity as stated in 9 CFR 319 (meat) and 9 CFR 381 (poultry) must be clearly labeled as the given name by regulation. In any case, when there is a common or usual name for a product, it must be used to avoid misbranding or misrepresenting the product. Names that include a geographic origin or significance may be included in the product name only when the product is made in the same geographic region. If the product is not made in the geographic area stated on the label, it must include a qualifying statement such as "style" or "type," as well as a statement clarifying where the product was made ("Made in …").

Allergens

There are eight major food allergens that are responsible for 90 percent of food allergies. All allergens and ingredients derived from allergen proteins must be labeled on the food product. Sources of protein must be identified, such as "hydrolyzed plant protein (soy)." All ingredients used in a product formulation must be thoroughly scrutinized, and all ingredients, including allergens, must be listed on the product label. Allergen statements must be addressed in the standard operating procedures (SOPs) or hazard analysis and critical control points (HACCP) program.

1. Milk
2. Eggs
3. Fish
4. Crustacean shellfish
5. Tree nuts
6. Wheat
7. Peanuts
8. Soy

Traceability

All labels/products should include a traceability measure in order to keep record of where each ingredient originated and where the finished product has been shipped. A "one step forward and one step backward" approach has been used in the industry, but with new regulations, such as the Food Safety Modernization Act, and the potential for recalls, it is suggested that food producers and processors maintain records of all ingredients from origin to final consumer sale if possible. A coding system is typically used to verify these traceability records in the case of a recall. FDA has defined three classes of recalls:

- Class I: potential to cause serious health problems or death

  Example: undeclared allergen, pathogen

- Class II: may cause temporary health problem

  Example: non-pathogen, low-risk undeclared ingredient, very small foreign particles

- Class III: unlikely to cause any adverse health reaction

  Example: lack of English language on retail food label, incorrect order of ingredients

Foodsafety.gov includes an updated list of all food-related recalls from FDA and USDA. Media outlets may be used to inform the public of a recall if it is deemed necessary. The role of the governmental agencies during recalls is to oversee the process and verify the adequacy of the recall. Most recalls are voluntary. It is in the producer's best interest to recall all products that could be affected in order to ensure the safety of consumers as well as the financial stability and reputation of the business. New regulations will give FDA and USDA mandatory recall authority.

References

9 CFR 317: http://www.gpo.gov/fdsys/pkg/CFR-2011-title9-vol2/pdf/CFR-2011-title9-vol2-part317.pdf

9 CFR 319: http://www.gpo.gov/fdsys/pkg/CFR-2011-title9-vol2/pdf/CFR-2011-title9-vol2-part319.pdf

9 CFR 381: http://www.gpo.gov/fdsys/pkg/CFR-2011-title9-vol2/pdf/CFR-2011-title9-vol2-part381.pdf

21 CFR 101: http://www.gpo.gov/fdsys/pkg/CFR-2011-title21-vol2/pdf/CFR-2011-title21-vol2-part101.pdf

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Hartson & Hogan. (2007). A Guide to Federal Food Labeling Requirements for Meat, Poultry, and Egg Products, 1–117. Retrieved from http://www.fsis.usda.gov/wps/wcm/connect/f4af7c74-2b9f-4484-bb16-fd8f9820012d/Labeling_Requirements_Guide.pdf?MOD=AJPERES

U.S. Department of Health and Human Services. (2013). Food Labeling Guide. Retrieved from www.fda.gov/FoodLabelingGuide

Other Resources

AOAC-Approved Labs

Eurofins Labs

Intertek USA Food Testing Services

Mississippi State Chemical Laboratory

Schawk.com

Center for Food Safety and Applied Nutrition. (n.d.). Labeling & Nutrition Guidance Documents & Regulatory Information. Center for Food Safety and Applied Nutrition. Retrieved from http://www.fda.gov/food/guidanceregulation/guidancedocumentsregulatoryinformation/labelingnutrition/

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By **Dr. J. Byron Williams**, Associate Extension Professor, and **Elizabeth L. Griswold**, Graduate Assistant, Food Science, Nutrition, & Health Promotion.

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Food Defense and Biosecurity

Elements and Guidelines for a Defense Plan

In recent years, biosecurity and bioterrorism awareness in the industry has become more critical. Since the attacks of September 11, 2001, terrorists are becoming more creative in their attack methods and targets.

Due to the complacency of businesses, especially in the food industry, many believe such attacks are possible if companies do not reevaluate their biosecurity defense. Threats to the system can occur in a number of ways: biological, physical, radiological/chemical, or nuclear. Food defense plans are essential to protect the food supply from intentional threats, which may lead to serious outcomes.

The agriculture and food industries operate in a global market, so a successful terrorist act would be felt around the world. Food and water sources are a concern because they are a means by which a very small amount of a causative agent can affect large numbers of people.

Not only is international terrorism a concern, but one disgruntled employee could harm or even kill consumers and result in a company's bankruptcy.

The goal of governmental agencies, such as the Food and Drug Administration (FDA), the Centers for Disease Control and Prevention (CDC), and the U.S. Department of Agriculture (USDA), is to ensure the food industry is prepared for such attacks by outlining potential risk areas. In particular, the USDA Food Safety and Inspection Service (FSIS) and FDA have developed surveys, strategies, and guidelines that outline, in detail, potential vulnerabilities within a food company's infrastructure.

A food defense plan needs to be efficient and functional. Most companies have implemented a Hazard Analysis and Critical Control Points (HACCP) plan to ensure the production of safe food. But a food defense plan is one that evaluates all of a plant's security points: personnel, incoming ingredients and supplies procedure, transportation, processing, and product tracking. Most of a plant's security measures are common sense but often overlooked.

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Areas to Evaluate

Following is a list of some of the areas to evaluate when making a food defense plan. Some examples of how to ensure security in each area also are provided.

- Personnel (internal and/or external)
  - Background checks (employees, contractors, temporary workers)
  - Security training
  - Controlled access
  - Identification
  - Restrictions to access areas
- Outside security
  - Secured grounds (perimeter fencing)
  - Enough lighting for proper monitoring
  - Emergency exits that are self-locking and/or set with alarms
  - Working locks on outside doors, windows, gates, roof openings, storage tanks, vents, trucks, rail cars, etc.
  - Guard entrance
  - Employee identification for access to the grounds
- Inside security
  - Emergency lighting
  - Security cameras
  - Restricted access areas (cleared employee accompaniment of all non-approved personnel)
  - Updated facility layout to local law enforcement agencies
  - Regular inventory of employee issued keys
  - Procedures for checking suspicious packages, lockers, closets, storage areas, maintenance areas
  - Visitor policy (access, identification, accompaniment by a responsible employee, exit accountability)
  - Restricted access for:
    1. HVAC systems
    2. Ventilation ducts
    3. Water systems
    4. Electricity
    5. Disinfection systems (tanks, supplies, hoses, etc.)
    6. CIP systems
    7. Other closed systems
    8. Lab areas (chemicals, reagents, disposal procedures)
    9. Chemical storage areas (cleaning compounds, refrigerant, etc.)
    10. Restricted ingredients storage areas (secured/limited access)
- Slaughter and processing areas
  - Holding pens
  - Flow line integrity
  - Incoming ingredient and packaging integrity
  - Trace back records (COOL, lot numbers, affidavits, animal ID)
  - Trace forward records (recalls and procedures)
- Computer system
  - Firewalls
  - Backup system
  - Password-protected computer entry
  - Activity monitoring
- Storage security
  - Restricted access to product and material storage areas
  - Inventory of ingredients
  - Inventory of restricted ingredients (checked and monitored frequently and compared to production volume)
  - Inventory of hazardous chemicals (periodic and systematic)
  - Procedures for storage and disposal of chemicals
- Shipping and receiving
  - Inspection of trailers
  - Check on trailer's seals and locks (inbound and outbound)
  - Monitoring and testing of incoming ingredients
  - Records of inspections
  - Usage of tamper-evident seals on trucks and products
  - Check deliveries of all materials
  - Notification of deliveries
  - Proper authority notification when abnormalities exist
  - Returned goods policies and procedures
- Water and ice supply
  - Restricted access to the water supply (especially wells)
  - Restricted access to ice machines
  - Restricted access to storage tanks
  - Monitor water line integrity
  - Prompt communication with local health officials if there is any suspected compromise of public water potability
- Mail handling
  - Separate facility and/or room away from food areas
  - Training for handlers of mail (suspicious packages)
  - If handled by an outside agency, knowledge of that agency's security procedures
- Security throughout the line
  - Knowledge of suppliers' defense plans
  - Reliability of suppliers
  - Certificates of analysis on incoming raw materials
  - Adequate tracking system of products
- Emergency preparedness
  - Contacts in the event of an emergency
  - Evacuation routes
  - Recall plan

Elements of a Functional Food Defense Plan

- Develop a functional food defense plan based on the vulnerabilities revealed during the evaluation.
- Implement the food defense plan by using the defense measures identified.
- Test the written plan by periodically monitoring the effectiveness of the defense measures. For example:
  - Make unannounced entrances at random perimeter checkpoints
  - Check plant employee ID badges
  - Check locks on doors, storage areas, bulk tanks, water/ice supplies, windows, offices, one-way exit doors, etc.
  - Perform a mock recall
  - Test lab or storeroom inventory procedures
  - Test security cameras in strategic locations
- Assess the food defense plan periodically, especially if new risk areas are discovered, to ensure the security of the establishment. Do this at least yearly or when changes occur in the plant, similar to HACCP plan reviews.
- Maintain the plans to ensure that defense measures are being implemented and are effective.

For More Information

http://www.usda.gov/wps/portal/!ut/p/_s.7_0_A/7_0_1OB?navid=FOOD_SECURITY&parentnav=FOOD_NUTRITION&navtype=RT

http://www.fsis.usda.gov/pdf/Elements_of_a_Food_Defense_Plan.pdf

http://www.fsis.usda.gov/Food_Defense_&_Emergency_Response/Guidance_Materials/index.asp

http://www.fsis.usda.gov/News_&_Events/Food_Safety_Inspection_Podcasts/index.asp

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By **J. Byron Williams**, Ph.D., PAS, Assistant Extension/Research Professor, Food Science, Nutrition, and Health Promotion, and Courtney A. Crist, undergraduate research laboratory assistant.

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Extension Service of Mississippi State University, cooperating with U.S. Department of Agriculture. Published in furtherance of Acts of Congress, May 8 and June 30, 1914. MELISSA J. MIXON, Interim Director (POD-01-10)

How to direct market your beef

By Jan Holder

About this Book

How to Direct Market Your Beef portrays how one couple used their family's ranch to launch a profitable, grass-based beef operation focused on direct market sales. Jan and Will Holders' compelling real-life experiences, with numerous instructional guideposts along the way, provide valuable tips for direct marketing beef from slaughtering to sales.

A special **Entrepreneurs** section features farmers and ranchers – four of whom received or benefited from Sustainable Agriculture Research and Education (SARE) program grants – who demonstrate real-life successes in direct marketing sustainably raised food in innovative ways.

How to Direct Market Your Beef is not a book about market analysis and theory. See the **Resources** section for a list of such materials.

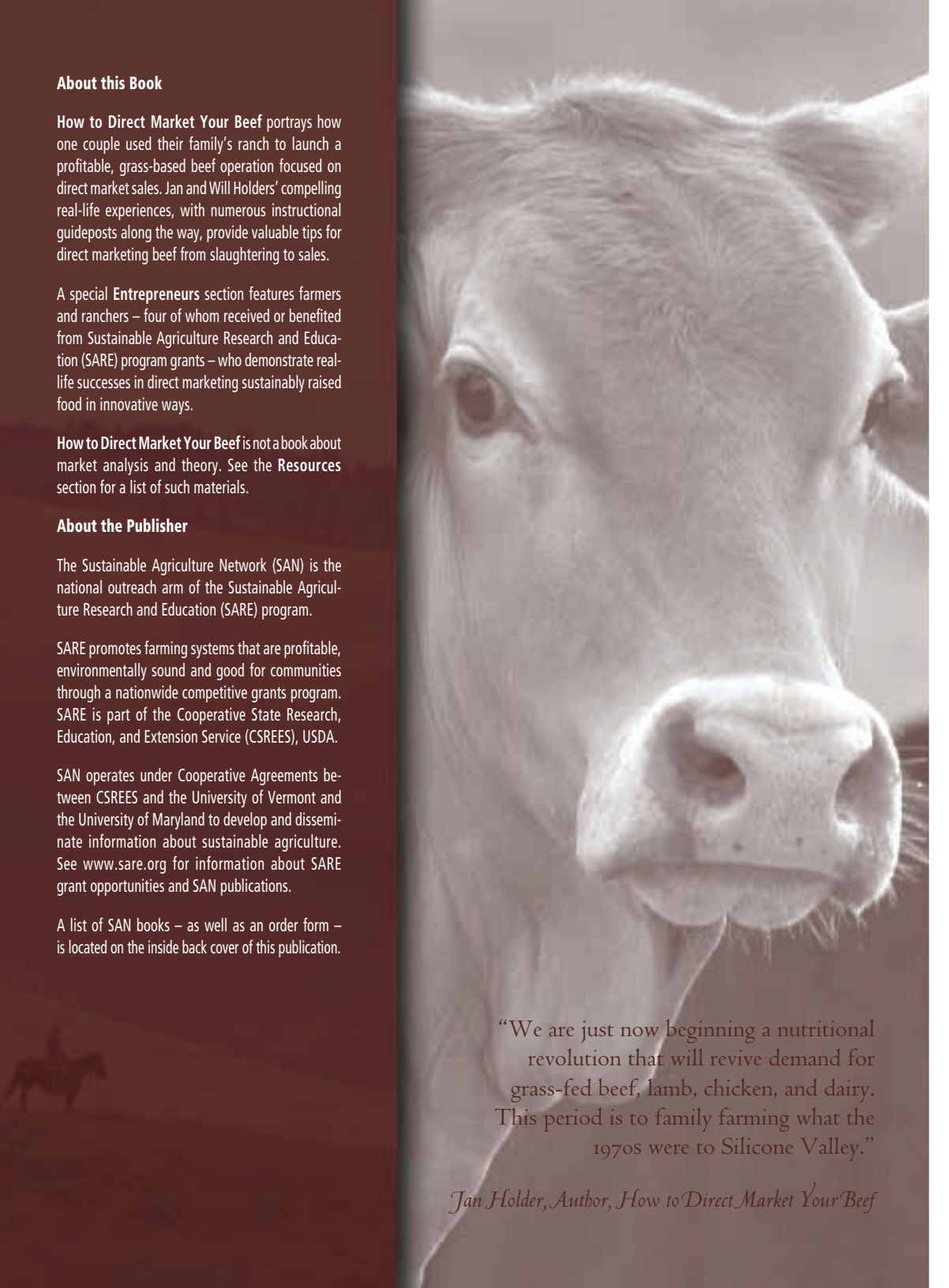
About the Publisher

The Sustainable Agriculture Network (SAN) is the national outreach arm of the Sustainable Agriculture Research and Education (SARE) program.

SARE promotes farming systems that are profitable, environmentally sound and good for communities through a nationwide competitive grants program. SARE is part of the Cooperative State Research, Education, and Extension Service (CSREES), USDA.

SAN operates under Cooperative Agreements between CSREES and the University of Vermont and the University of Maryland to develop and disseminate information about sustainable agriculture. See www.sare.org for information about SARE grant opportunities and SAN publications.

A list of SAN books – as well as an order form – is located on the inside back cover of this publication.



"We are just now beginning a nutritional revolution that will revive demand for grass-fed beef, lamb, chicken, and dairy. This period is to family farming what the 1970s were to Silicone Valley."

Jan Holder, Author, How to Direct Market Your Beef

How to Direct Market Your Beef

By Jan Holder

SUSTAINABLE AGRICULTURE NETWORK
THE NATIONAL OUTREACH ARM OF USDA-SARE

Handbook Series Book 8
Published by the Sustainable Agriculture Network, Beltsville, MD

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The book was reviewed by SARE staff as well as Jim Goodman, beef producer, Wonewoc, Wis., A. Lee Meyer, University of Kentucky Extension, Peggy Sechrist, beef producer, Fredericksburg, Texas, and Michael A. Smith, University of Wyoming. Every effort has been made to make this book as accurate as possible and to educate the reader. This text is only a guide, however, and should be used in conjunction with other information sources on direct marketing. The editor, author and publisher disclaim any liability, loss or risk, personal or otherwise, which is incurred as a consequence, directly or indirectly, of the use and application of any of the contents of this book.

This book was published by the Sustainable Agriculture Network (SAN) under cooperative agreements with the Cooperative State Research, Education, and Extension Service, USDA, the University of Maryland and the University of Vermont. SARE works to increase knowledge about – and help farmers and ranchers adopt – practices that are profitable, environmentally sound and good for communities. For more information about SARE grant opportunities, go to www.sare.org. SAN is the national outreach arm of SARE.

To order copies of this book ($14.95 + $5.95 s/h), contact (301) 374-9696, sanpubs@sare.org or www.sare.org/WebStore.

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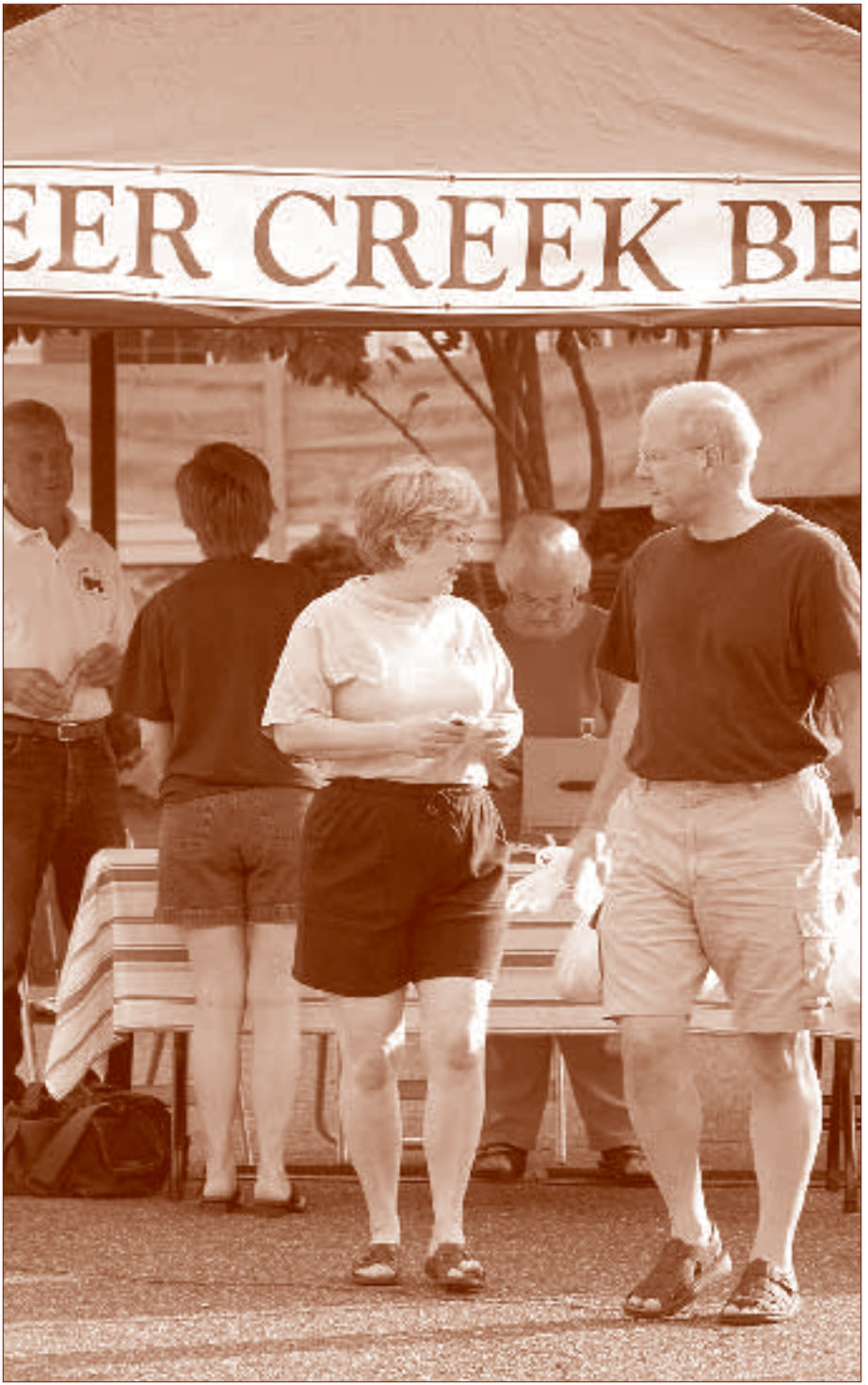

PHOTO BY EDWIN REMSBERG

introduction

When my husband and I took over the management of the family ranch in 1992, we thought that it was going to be an idyllic life. We were going to whip the ranch into shape in a few months and then spend the next 20 years canning vegetables and writing the great American novel. We thought that if we just ran things a little more efficiently, the ranch would instantly be profitable.

It took us a couple of years to learn what was really wrong with the ranch. Sure, the place was a little rundown. The houses were in need of repair. The corrals were held together with more baling wire than wood. The land was overgrazed. But we didn't mind hard work, so everything was going to be fine.

Then, slowly, the realization hit us. No matter how hard we worked, no matter what building we repaired or pastures we improved, the ranch was still never going to make it on its own. The beef industry had changed. Just a few generations ago, you could support your family with a herd of 25. Today, with our commodity-based cattle industry, a small cattle rancher was increasingly challenged just to make a living.

After asking around, I found that the only ranchers who were solvent were the ones who had other income. Either the wife or husband worked in town, or in our case, we had a father who was an eye doctor with deep enough pockets to subsidize the ranch. Sure, the really big ranches, the huge ranches, were making it. They could make 3 cents on a carcass and still come out okay. But they were running many thousands of animals. We had a herd of 200. How could we possibly compete?

It was clear that we couldn't. We had to figure out how to sell our beef in a new way. We decided to try to take it from the pasture to the plate without all the middlemen in between. But after contacting an old advertising client in Phoenix who ran a chain of restaurants, I found that we could barely compete with his prices, even after cutting out all those middlemen. So, we decided that we had to make our beef different and better. Then folks would be willing to pay more for it.

To differentiate our product, we thought we could highlight our pesticide-free beef, our range-protection strategies, our "gentle" approach to raising our animals, and our acceptance of predators on the land. After all, we were considered radical, weird and strange for our tree-hugger mentality.

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Most other cattle ranchers thought that we were nuts. We didn't use pesticides. We treated our cattle as gently as possible. We constantly took classes on ways to use cattle to improve the land. We didn't kill predators. All we had to do was tell people how wonderful we were and they would flock to us in droves and buy our beef! This was going to be so easy. I really couldn't believe that all small producers weren't marketing their own beef.

After reading both of Joel Salatin's books (*Salad Bar Beef* and *Pasture Profits*), we felt that between his ranch-direct program and selling in the nearest local towns, we could market all of our beef. Soon we found that we were too far out in the boonies for ranch-direct selling, the nearest tiny hamlet being 1 ½ hours away. People in the nearest sizeable town 2 ½ hours away weren't going to pay a premium for beef. Many of the residents of those towns seem more impressed with 60-cent-a-pound hamburger than anything that we could come up with. So we decided that we were going to have to sell in Phoenix or Tucson.

We still believed in Joel Salatin's idea of relationship marketing, but realized that our relationships were going to take a slightly different form. Even though people seemed to like the idea of ecologically sensitive ranching, not that many were willing to put their money where their mouths were. Suddenly, what looked like a huge demand turned out to be a few committed people.

We did sell to a local organic buying club (and still do), but to really make it we were going to have to hit the big cities.

Back at the ranch, we asked ourselves, "How are we going to sell beef five and six hours away?" We decided to target stores, restaurants and natural foods distributors.

Years later, it still seems too early to rest on our laurels (is there ever a time when we can rest on our laurels?), but we are very happy with the choices we have made, and sales have gone very well. In 2004, the grass-fed beef industry was estimated to be worth around $5 billion, and growing at a rate of 20 percent per year.

Our Ervin's Grassfed Beef now sells throughout 11 western states through natural food distribution companies, as well as at farmers markets in Arizona. In addition to ground beef, ground beef patties, steaks and roasts, we now also sell pre-cooked marinated roasts and pre-cooked sliced roast beef.

Even though direct selling our beef has increased our bottom line, our company also has helped us to live the life we want, a life on a family ranch.

JAN AND WILL HOLDER ON THEIR ARIZONA RANCH

starting out

Find a Niche

To successfully direct market your beef, you must do something no one else is doing. With conventional beef sales, large companies can produce hamburger for about 60 cents a pound. If you can figure out how to do it for 59 cents a pound and remain profitable, you will be very successful. Obviously we can't do this. So you have to look for other ways of differing yourself from the competition.

Bill Niman, founder of Niman Ranch, is a good example of an entrepreneur finding a niche. He recognized that the products in conventional beef sales varied quite a bit. One day you might get a good steak, another day you won't. (If you are the only game in town, you don't have to care.) All Bill Niman did was offer a consistent product. If you buy a Niman steak, you know it will be good. Hence, you can charge more.

A niche also can be something that is non-tangible. Many of our customers buy our product because we don't kill wolves. That does not make the beef taste any better, but it is a difference that people are willing to pay for. The difference doesn't have to be a real thing, it can also be a perceived thing. For instance, which is better: Coke or Pepsi? They are essentially the same product with different packaging. Remember, if folks can find different niches for sugar water, surely you can find one for beef.

There are lots of these sorts of niches. You just need to be creative to see them. To help you get your juices flowing, here's a list of possible niches:

- Slaughter procedures (for those who want beef slaughtered a certain way)
- Choice-grade grass-fed beef
- Organic
- Corn fed
- Grass fed
- Angus
- Longhorn
- Prime
- Lean
- Guaranteed tender
- From a family farm
- Locally produced
- Humane handling
- Nebraska beef
- Argentina beef
- Ethnic markets

The emergence of e-coli outbreaks, salmonella, lysteria, mad-cow disease, and hoof-and-mouth disease has opened the door for another marketing opportunity: clean, safe beef.

The emergence of e-coli outbreaks, salmonella, lysteria, mad cow disease, and hoof-and-mouth disease has opened the door for another marketing opportunity: clean, safe beef. Many people are very worried about those problems and are willing to pay more for the peace of mind, knowing the beef they feed their families is safer from contamination. As a small producer, this is one way you can compete and win against the big guys.

The sheer volume of beef and the speed at which they have to process cattle makes it impossible for large producers to provide beef free of contamination. Being small, you have the ability to literally monitor every carcass you sell. You can be much more certain of the safety of your product.

Most niche producers today also are certifying the source of their cattle's feed. This was brought on by concerns that cattle fed rendered animals could cause mad cow disease. It's another way you can differentiate yourself from the pack.

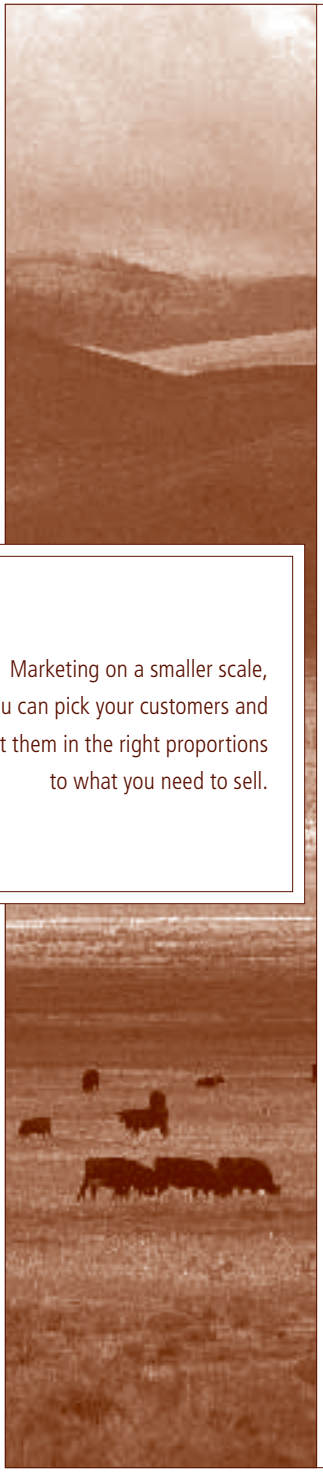
The beef industry needs to make some major structural changes to deal with customer perceptions that beef isn't healthy. Until they do, selling clean, healthy beef is one of the best niche-market opportunities you have as a small producer.

Selling the Whole Carcass

When first starting out to market your own beef, one of the first problems you will face is that it is easy to sell the high-end cuts and hard to sell the low-end cuts.

Restaurants love buying steaks from local ranchers, but steaks only make up about 10 percent of the carcass. You still have a lot of beef to sell.

Conventional beef marketing deals with this problem by using price. That's why chucks, hamburger and rounds are cheap, and loin steaks and tenderloin are expensive, because



everyone wants steaks and tenders. Every day, they have so much beef to sell, and they get on the phone (just like the trading floor of the stock exchange) and sell their beef. Because fresh beef has a limited shelf life, they have to sell it before it spoils. As the industry saying goes, "You have to sell it before you smell it." They just keep going down in price until all their beef is sold.

Marketing on a smaller scale, you can pick your customers and select them in the right proportions to what you need to sell. For example, if a restaurant wants 50 pounds of tenderloin a week, you will have to match that demand with customers who are willing to buy 1,000 pounds of hamburger a week.

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Of course, you can always sell your other cuts on the conventional market, but you'll have to accept a very low price. Most big meat distributors only deal in huge quantities, which makes it hard for small marketers to "dump" what they can't sell.

You'll also find that the low-end cuts are much more price sensitive than the high-end cuts. You might be able to charge double or triple market price for your tenderloin, but you may have to settle with just 10 to 20 percent more for your ground beef.

Initially, you will probably sell out of steaks and be left with ground beef, limiting your overall sales. People seem ready to pay for a premium steak but balk at $3-a-pound ground beef.

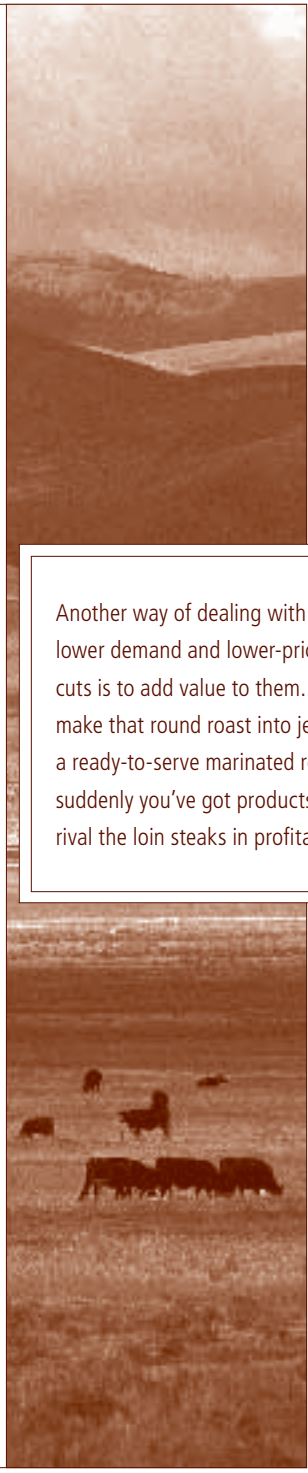
They may not realize there is a difference between yours and the 60-cent-a-pound supermarket version. Once they are hooked on your steak, give them a free pound of ground beef. One pound will usually convince them to buy a balance of all of your cuts.

To make things even more difficult, there are a few cuts in the middle that no one really knows about. People know what a steak is and what hamburger is, but what's a tri tip? What's the difference between a flank and skirt? Being small, you will have a lot of face-to-face interaction with your customers, so you can educate them on how to cook the different cuts.

I've found that with a little planning you can proportion your customers to match how you cut up the carcass and not be forced to sell for a lower price just to get rid of all your beef. You will want to find a lot of hamburger buyers, because about 50 percent of your carcass will be hamburger.

Another way of dealing with the lower demand and lower-priced cuts is to add value to them. The margins on a round roast are not very large, but if you make that round roast into jerky or a ready-to-serve marinated roast, suddenly you've got products that rival the loin steaks in profitability. So if you can't sell it, rather than take a lower price, be creative and think what you could turn it into.

There are also several other parts of the carcass that can become more profitable.



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Your creativity is the only boundary:

- Tongue, livers and kidneys can be mixed with fat, hamburger and vitamins for premium dog food.
- Hides, tendons and "pizzles" can be turned into dog chews.
- Bones can be used for dogs, zoos or wildlife rehabilitation centers.
- Marrow bones are seeing a comeback at high-end restaurants, health food stores and hospitals.
- Ground and dried liver and glands are used as supplements in health food stores.
- Trim can be dried and turned into dog chews.
- Consider these specialties: summer sausage, beef bacon, jerky, deli meats, hot dogs and marinated roasts.

I have had good luck with selling cuts at farmers markets that I can't seem to move elsewhere. Usually, I have had to be a little creative. For instance, I once had a lot of skirt steak that wasn't moving. I added spices, rolled them up, sliced them and labeled them "spiced pinwheel steaks." I sold out in one hour – at $4.50 a pound. These were skirt steaks that we couldn't sell at $1.50 a pound. The secret was that I set up a grill and let people taste samples. I handed out a recipe and cooking instructions for the item with each sale.

At this same farmers market, I sold 32 pounds of flank steak that I had to move. I marinated it in a very simple marinade for an hour

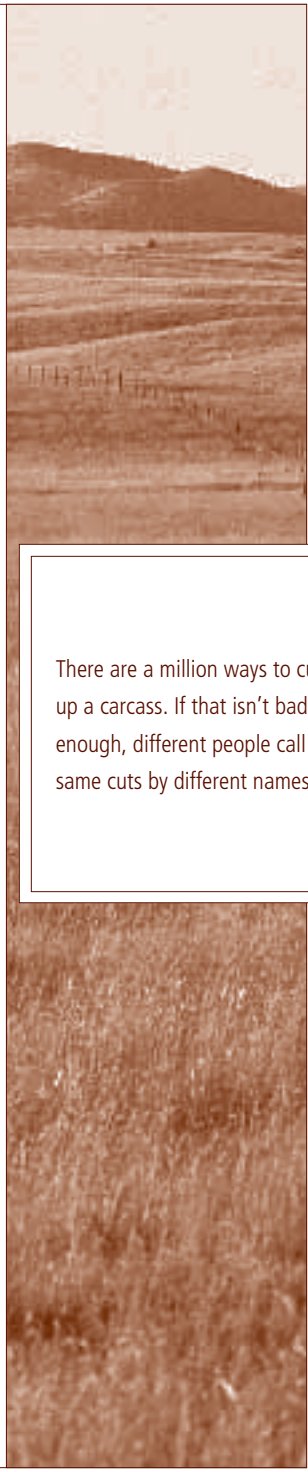
and cut it up and stuck it on skewers. I had 10 people buy the whole skewer for $3 apiece. That comes to about $30 a pound.

However, make sure that you check your local, county and state regulations concerning sampling products and selling value-added products such as spiced pinwheel steaks and marinated cuts. Depending on the laws in your area, they may not be allowed at farmers markets. If you alter a cut after it has been inspected (by adding other ingredients) and labeled, you may void that inspection. Cooking and giving away samples may require you to be inspected and licensed as a restaurant.

How to Cut up a Carcass And How Much You'll Get of Each Cut After You Do

No doubt if you're looking into direct marketing your own beef you've talked to a butcher about how a carcass is cut up, and how much of what cut you can expect from a carcass. If you have and walked away feeling totally mystified, join the club. There are a million ways to cut up a carcass. If that isn't bad enough, different people call the same cuts by different names.

What's the difference between a top sirloin and a T-bone? Or a Kansas City strip steak and a New York strip steak? Or a breakfast steak and a cube steak?



There are a million ways to cut up a carcass. If that isn't bad enough, different people call the same cuts by different names.

I even went in and watched them cut up the carcass, thinking it might help to visualize all this stuff. Actually, it did and I would recommend it highly. Even more, the biggest help to me was a book called *The Beef Buyers Guide.* This is a secret club kind of thing. Everybody in the industry pretends that this is a holy writ, but you won't find it in a bookstore (although you can order it online). This book breaks down the carcass into different pages, tells you all the cuts you can make from a certain section and provides helpful pictures.

For instance, with the rib section you can make a rib steak/bone in/tail on, or rib steak/bone in/tail off, or boneless rib steak, or tied rib roast, and so on. It is a bit of overkill, but it will give you a working knowledge. Plus, it contains the codes that restaurants use, so you'll know when someone calls and says he wants a 1139a (whole tenderloin, ¼-inch trim, lip on).

Beef showing various cuts

In actual practice, it turns out no one really knows all of those codes. There are regional differences in what meat people will call the same cut, both in name and in code (a New York strip and a Kansas City strip are the same thing). But if you know them, it will make you look smarter than the conventional meat salesperson.

As I mentioned, you can cut up a carcass many ways. It all depends how much, and of what, you are selling. If you're just starting out and aren't that sure of your quality, start with cull cows. They'll give you excellent hamburger and store-quality tenderloin. The next step up is young cows and steers, which give you tenderloin, stew beef, marinated roasts, jerky and hamburgers. If you're really good, you have the slaughter steer or heifer, which gives you everything.

As a rule of thumb, a 1,000-pound live animal will give you about 300 pounds of saleable beef or, in industry lingo, your "boxed weight." You might hear people talk about getting 50 percent yields (versus your 30 percent). What they are talking about is the "cold carcass" weight, or how much your carcass weighs on the rail. This weight

is meaningless; what counts is the weight of the beef you sell. If you are cutting steaks or making hamburger for people, there is a lot of bone you don't get paid for.

Of course, you can divide a carcass into many different cuts (*right*), each of which contributes to your bottom line. Your actual weights may vary 5 percent each way depending upon your genetics and slaughter weight, but this is generally about average.

Make $10, Not $1,000 Mistakes

Once you have decided to market your own beef, it won't take long before you figure out that things would be easier if your marketing effort were bigger. That's because conventional beef marketing is set up to move huge quantities of beef very cheaply. Unfortunately, there are a lot of people who have lost an awful lot of money trying to do this.

Large beef processing and distribution companies can move huge quantities of meat very cheaply because they've been at it awhile. Although we dislike the dominating corporate nature of their business, we have a great deal of respect for what they have been able to accomplish. They do what they do very well.

When we first started out, we made a presentation to a very kind individual with a natural foods distribution company. He informed us that we were not experienced enough or large enough to service them properly. He also suggested that we sell directly to our area's small natural food buying clubs, which were

Tenderloin
12 pounds/carcass
$9.60 per pound
$115.20 gross

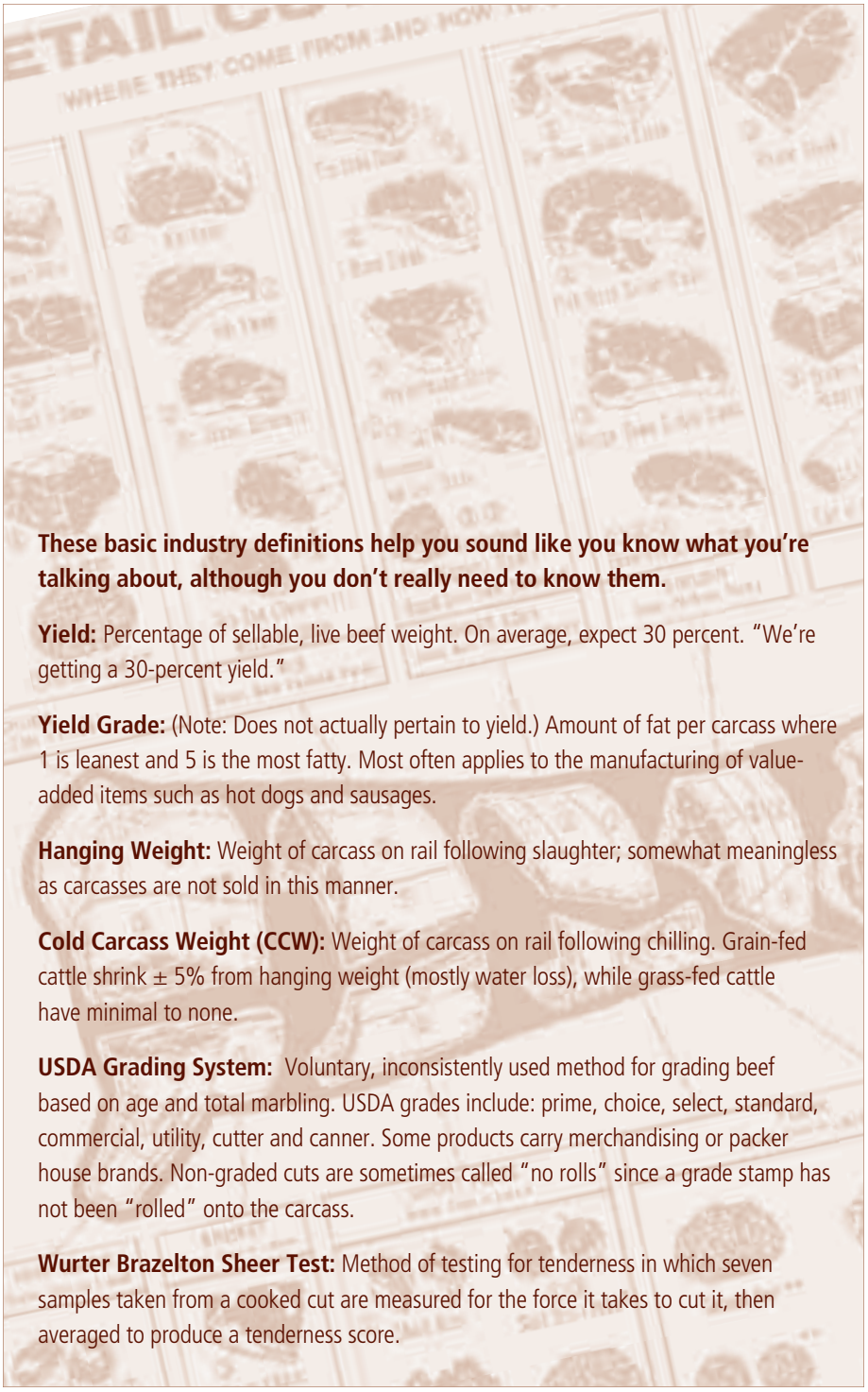
New York Strip Steak
14 pounds/carcass
$6.40 per pound
$89.00 gross

Ribeye Steak
24 pounds/carcass
$5.33 per pound
$127.00 gross

Fajita/Stir Fry
6 pounds/carcass
$3.20 per pound
$19.00 gross

Round Roast
67 pounds/carcass
$2.76 per pound
$184.00 gross

Ground Beef
170 pounds/carcass
$1.75 per pound
$297.00 gross



These basic industry definitions help you sound like you know what you're talking about, although you don't really need to know them.

Yield: Percentage of sellable, live beef weight. On average, expect 30 percent. "We're getting a 30-percent yield."

Yield Grade: (Note: Does not actually pertain to yield.) Amount of fat per carcass where 1 is leanest and 5 is the most fatty. Most often applies to the manufacturing of value-added items such as hot dogs and sausages.

Hanging Weight: Weight of carcass on rail following slaughter; somewhat meaningless as carcasses are not sold in this manner.

Cold Carcass Weight (CCW): Weight of carcass on rail following chilling. Grain-fed cattle shrink ± 5% from hanging weight (mostly water loss), while grass-fed cattle have minimal to none.

USDA Grading System: Voluntary, inconsistently used method for grading beef based on age and total marbling. USDA grades include: prime, choice, select, standard, commercial, utility, cutter and canner. Some products carry merchandising or packer house brands. Non-graded cuts are sometimes called "no rolls" since a grade stamp has not been "rolled" onto the carcass.

Wurter Brazelton Sheer Test: Method of testing for tenderness in which seven samples taken from a cooked cut are measured for the force it takes to cut it, then averaged to produce a tenderness score.

his customers. Even though we were a trifle (okay, maybe a lot) peeved at his suggestion, it turned out to be some of the best advice we have gotten.

We learned what cuts the customers want, how they want it packaged, and how many pounds to put in each package – as well as a myriad of other details we hadn't even thought about. For example, we found out that customers liked beef in see-through fresh food packages better than if it was wrapped in butcher paper, because they could see the meat.

Moreover, we found out that our customers like 1-pound packages of ground beef more than 2-pound packages (2 pounds was too much for most families).

If you are just starting out, sell to your friends or to groups. Sell sides of beef using an ad in the local paper. Call up local groups – like the Elks – and ask if you can sell them the beef for their next big barbecue. Invite comments and criticism. You need all these experiences.

If people criticize your beef – rightly or wrongly – the natural thing to do is defend yourself. Try not to. It will only create ill will between you and your customers. Just be gracious and thank them for their comments. Offer their money back.

When first starting out, you will need to restrain yourself from being big. Start small and stay small until you have worked your way through all the surprises. Then take on some more demand. Do it incrementally,

do it slowly. No one gets everything right. There are too many things to go wrong. The mistake that gets you won't be one you know, it'll be one you hadn't even considered. Your margins won't be as big when you are small. By the same token, a mistake won't kill you either. Take it slow, work your way through mistakes, and be creative. There is always more than one way to skin a cat.

Don't buy a refrigerated truck. Don't buy any processing equipment. Don't buy a processing facility. Lease or hire it until you are a few years down the road.

Jim Goodman of Wonewoc, Wis., bought a walk-in freezer as his only initial start-up equipment. He says his business would have been impossible without it. "It allows us to sell on the farm, makes getting ready for the farmers market, where all meat must be sold frozen, quick and easy, with no running to rented freezer sites," he says.

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Stand By Your Price

The easiest way to determine your price is to start with the cow and work your way to the consumer. It costs you x to make a 500-pound calf, x to finish it, x to process it, and x to store, transport, package and distribute it. Once you know all that, you can simply add what you think is a fair profit. You may end up having to revise it, but at least you will know where your break-even point is. The point is to create a price and

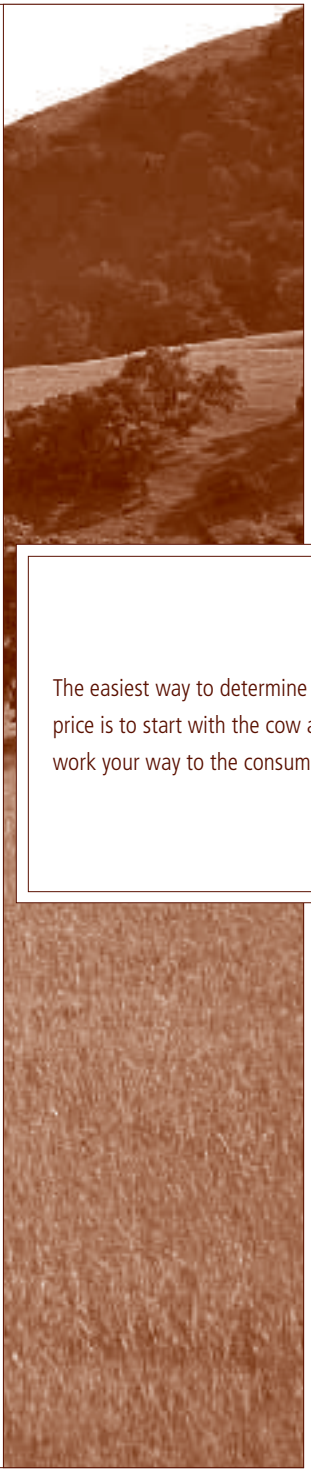
stick to it. You can count on folks trying to talk you down. Don't take it personally. This is how the commodity game is played. However, don't be afraid to turn some folks down because of price. You can't be all things to all people, and there are plenty of other places a person can find cheap beef.

Items to be worked into your price:

- Cost of creating a saleable animal (labor, supplement, replacement cost, etc.)
- Land
- Finishing
- Transportation to slaughter facility
- Slaughter fee
- Processing
- Packaging
- Storage
- Transportation to retail
- Promotion

If you are still not sure that your prices are in line with what the customer will pay, go to a big natural foods store in the nearest thriving metropolis, and check out the prices. Write down the price of each cut, per pound, and compare them with yours. Figure that the retail price is about 30 percent higher than what the wholesaler sold it for. If they ask what the heck you're doing, you can always say that you are planning a big shindig and are on a tight budget.

One mistake we made early on was not pricing our beef high enough. People didn't perceive this as a bargain. They perceived



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our beef as inferior to beef that sold for a higher price. So we simply priced ourselves higher and made everyone happy.

Refer to ***Factors that Impact Your Bottom Line*** (p. 84) for more tips on pricing.

Expect to Reinvent the Wheel

Author Allan Nation's view of the learning curve shows the potential downside to being too ambitious without doing your research first. In his version, naive enthusiasm leads to total despair. In other words, take a good look before you leap into marketing your own beef.

As stated earlier, the conventional beef marketing system is not set up to deal with small producers. So even though this country has an excellent infrastructure for transporting, processing, packaging and distributing beef, it means nothing to you. It costs almost as much to ship 100 pounds of beef across town as it does to ship 1 ton across the country. These are frustrating, but important facts. You will need to get used to reinventing the wheel, because, at least in this case, the wheel wasn't designed for you.

Actually it's even harder than that. Not only do you have to reinvent something, but you also are challenging the status quo.

As in all industries, there are good people and bad people. You will probably run into a few of these bad apples along the way.

They'll probably be rude; they might laugh at you, or act condescending and tell you that you will never make it. Try not to take it personally, and don't let their negativity rub off on you.

The majority of folks who try to market their own beef run into a few of these obstacles, get frustrated and quit because "it's impossible." It's not impossible. It might be crazy, it might be work, and it might ruffle someone's feathers. But it's not impossible. What it will be is creative. Just plan on having to customize every little step, from pasture to plate, and take nothing for granted.

Frozen vs. Fresh

There is an age-old debate among meat scientists that asks the question, "Which is better: fresh or frozen?" Our experience has been that there is no difference in quality. In fact, our frozen beef may be more tender because fresh, conventionally marketed beef goes through its aging process during transport. So if you happen to be first on the delivery that week, your beef hasn't aged enough. There is a discoloration of the beef when you freeze it, from a cherry red color when it's fresh, to more of a rose color when it's frozen. After it's cooked, it looks the same as fresh beef.

However, there is a perceived difference. We have yet to meet a chef who will accept a frozen product. We've tried blind taste tests and the whole shebang, but they just

want a fresh product, it's just their deal. There are also some retail customers who feel the same way, but it's even sillier with them. Of course, the first thing they do with the beef when they get home is throw it in the freezer.

Organic vs. Natural

Until the summer of 1999, the USDA would not recognize, nor issue labels, that made any kind of claim to being organic (at least as far as beef was concerned). That's how *natural* beef got started. Legally, the USDA use of *natural* only meant that your beef had no artificial additives and was minimally processed. So unless you injected your sirloin with Red Dye No. 5 or ground it and reformed it into steak nuggets, you could qualify as *natural.*

However, some folks felt they could offer more and strove for an "organic" label. The USDA has since finalized its organic label, including one for beef. As part of that, USDA recognizes third-party private certifiers. To learn more about organic livestock production, see the online *Organic Livestock Workbook* produced by NCAT. (***Resources,*** p. 88.)

USDA Legal Definitions

- ***Natural beef:*** No artificial additives, minimally processed.
- ***Organic beef:*** No hormones, antibiotics, pesticides, and fed only organically raised feed. For beef to be certified organic, the processor who renders it needs to be certified as well.

What makes this issue confusing is that customers have differing perceptions on what these terms mean. For instance, natural beef is considered by most people to be beef with no antibiotics and no steroids. Using the USDA definition, that isn't necessarily true.

Although most people can tell you what the term *free range* means, there is a great deal of confusion among consumers between *organic* and *natural*. You should be aware of how educated your customers are before going through all the trouble and cost of being organic.

Personally, I feel this will be the final chapter for the vague natural label. I predict that the term *natural* will start to fade away, as beef companies develop their specific certification programs.

Scheduling

Unlike marketing your cattle conventionally and selling everything on one day, direct marketing your beef will cause you to have to deliver cattle several times a year (***Entrepreneurs***, p. 44).

It can be trickier than you might think. If you are doing farmers markets, it is not so critical if you don't have beef to sell at every market (other than lost opportunity). However, if you are selling to stores and restaurants, you cannot ever run short. They will be willing to work with you from time to time, but if it becomes a habit, they'll stop buying from you. In fact, that will probably

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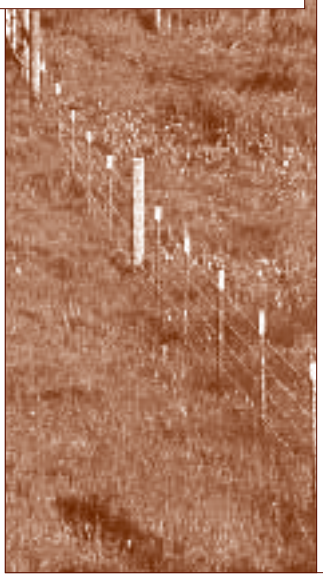


be your biggest stumbling block to selling to restaurants and stores – earning their trust that you won't ever come up short.

If you've done your planning homework, you should be able to predict your demand close enough not to cause any major problems. Stores and restaurants have a very good idea of how your product will do with their customers. Be sure to flat out ask them what your sales volume might be, listen and respect their advice. We also make it a rule to have a major new client one full year before adding additional clients, so that we get a good feel for their demand cycles.

Choosing how to schedule your cattle production is important from a marketing perspective. Most urban customers are conditioned for convenience – they are used to buying tomatoes 365 days per year, rather than late summer when the tomatoes are ripe on the vine in our part of the world. This same thinking applies to cattle as well. Most urban customers do not realize that it takes two years to grow out beef, or that cattle only finish well during a certain part of the year.

It will be your job to either educate your customers about time and seasonal restraints, or develop a "pipeline" that will satisfy their need for the convenience of having grass-fed beef available 24/7.

There are basically only three ways to sell beef: 1) feedlot, 2) seasonally, and 3) frozen. Of course there could even be variations or

combinations of these three ways, but how you schedule your cattle will depend a lot on which way you choose.

The most forgiving of these three is frozen. Your frozen storage is your pipeline. You can theoretically finish all your beef in three months, throw it all in a freezer, and then sell it all year long. Of course there is some cost with this, and that needs to be figured into the equation. It also allows you to keep a cushion that will smooth out the bumps between supply and demand, or when bringing on a new customer.

We've never run a feedlot, but it seems to be the second easiest way. A lot is also a pipeline. The hard part is buying the right weights at the right time of year to feed your demand. To do this, you will either have to develop multiple breeding seasons, or buy from a large geographical area where folks don't all calve at the same time. You also don't have to plan so far in advance with a feedlot. Because more of your cattle will finish within a year, you can move and make changes faster. In a grass-fed program, it takes two years to finish an animal.

Finally, a seasonal product is hardest, at least from a scheduling point of view. It also has a lot of advantages in that your cattle are out on the pasture earning you money, instead of taking money eating bought feed or paying rent for frozen storage. However, you will have to stair-step your cattle to finish throughout the season. It's a pretty hard task in itself, not even considering all the other

Most urban customers do not realize that it takes two years to grow out beef, or that cattle only finish well during a certain part of the year.

elements that can frustrate you: differing rates of gain, sickness, drought, demand surges, predator kills, carcass variability and mechanical breakdowns at the slaughter house (even though the processing has stopped, your cattle are still going). With a seasonal program, once you get behind, things snowball fast and it's almost impossible to catch up.

To help us plan for the un-plannable, we forward contract our cattle as much as two years in advance. You can do this with direct marketing because you are in control of the carcass price and therefore also control the live price. See ***Factors that Affect Your Bottom Line*** (p. 84).

Learn How to Cook Your Beef

Since starting this business, we've found that we are an endangered species – people who cook and eat their own food! At first we took it for granted that people would know how to cook a variety of dishes, and would know the appropriate cut of beef for that dish. It's not true.

I can't tell you the number of times that we've had a customer call and complain about the toughness of their steak. After a little questioning, it usually turns out that they took a round steak, plunked it under the broiler and turned it into a hockey puck. Then they think our meat is tough. They usually try to tell us that they always cook round steak this way.

I think what really happens is that they go to the market, buy a slab of something red and do the easiest possible thing – broil the crud out of it. We bet that they never have any idea what cut they bought.

We have found that this is even more true for grass-fed beef. You don't have to apologize for anything, just tell them what to cook with what. Tell people specifically what cuts are good for what kinds of dishes. We even give away a little booklet, the *Holder Family's Favorite Recipes.* I thought that the recipes in there are just regular stuff, but people rave about them.

Cooking really comes in handy at farmers markets. Keep in mind that you will have to check the local, county and state regulations to see what they will allow. In one county where I sell and pass out samples at farmers markets, I don't need any kind of permit at all. In another county, I need a $15 permit. In yet another, it isn't allowed unless I am preparing the samples in a county-certified mobile kitchen. Make sure you check it out.

Anything you have a hard time moving can be sold at farmers markets – just cook samples and hand out recipe cards for the dish. When we do sampling in supermarkets (again, check regulations), we ask that the manager have pre-made ingredient kits available – people are thrilled to be able to just pick up a packet and go. Similarly, request that store managers stock extra of any ingredient found in your recipe. One day, we made fajitas for sampling. Even though we had asked the store manager

PHOTO BY EDWIN REMSBERG

to stock extra tortillas, peppers, etc., they sold out within an hour. The store not only lost a lot of sales but also had to contend with dozens of irritated customers.

Processing

Finding a processing facility can be really hard or really easy, depending where you live and what your needs are. Processing plants vary enormously in the types of processing they do. You need to have a pretty good idea of what your needs are before you go looking for a plant because the evaluation and site visits you'll need to do are very time-consuming.

Check your state Department of Agriculture for a list of facilities in your state. This list will tell you if the plant is state or federally inspected and whether it is a kill plant, a processing plant, or both. A kill plant actually kills the animals, hangs and chills them. A processing plant cuts up the carcasses.

First, target only the ones that do both killing and processing. You don't want to truck your meat from one plant to another if you can avoid it. Then call them up and find out exactly what they do. A lot of plants are very specialized and only serve a particular market.

Then go visit them. No matter what they tell you on the phone, nothing replaces a site inspection. Pay attention to the details. Are their offices clean? Are the employees happy? Strike up conversations with everyone you can. Ask them how long they have worked there, what they do, and how they like their

jobs. Write down the names of their equipment; ask them about the throughput per hour, day and week in every area of the operation. Ask them who their customers are. Ask for references. Ask to meet their inspector.

The good plants will be very open. They will show you everything; they will be proud of their plant. The bad ones will be obvious after just the first few minutes. They won't want you talking to anyone. They will ask you why you need that information. They won't give you specifics. They will act insulted that you questioned their integrity.

Run away as fast as you can.

Once you have it narrowed down, get pricing on the work you want them to do. Be very specific. Tell them what products you want, exactly how you want them cut, how each cut is to be packaged, boxed and labeled, and where and when your shipment will be delivered.

For us, it was pretty hard. We needed a federally inspected plant (because our products cross state lines, and our client's insurance demanded federal, not state inspection), that could kill and custom-process. It also had to be able to separate our beef from other beef, because of our grass-fed label. We found only three federally inspected killing and processing facilities in the state that would custom-process for us. So keep in mind that even if your product doesn't cross state lines, you may still need a federally inspected plant.

We have found that with increasing frequency, a restaurant or store's insurance carrier requires them to only sell federally inspected products.

So don't assume that state inspection is acceptable unless you ask your potential client.

Most large federal plants will not deal with you. They aren't interested in cleaning their machines so that their meat does not contaminate yours. They do not want the hassle of having to keep your meat in a separate area from the conventional beef. They do not want your few animals gumming up their massive assembly line.

We now have most of our processing done at the University of Arizona Meat Science Lab. The plant is sparkling clean, it has great equipment, and the person who runs it has been very helpful to us.

Our jerky and marinated roasts are processed at another plant. We have to truck the meat in refrigerated vehicles. We are using a sausage and hot dog plant in Phoenix that does a great job and has a wonderful little old man offering you great samples.

However, the plants we use are okay for now, but not perfect. We cannot serve many clients because we do not have the right kind of processing available to us.

MAKING SURE YOU GET IT DONE RIGHT

Keeping an inventory of processed beef is next to impossible. The yield of every carcass is a little different, and you might cut up different carcasses differently. However, keeping good records keeps meat from disappearing.

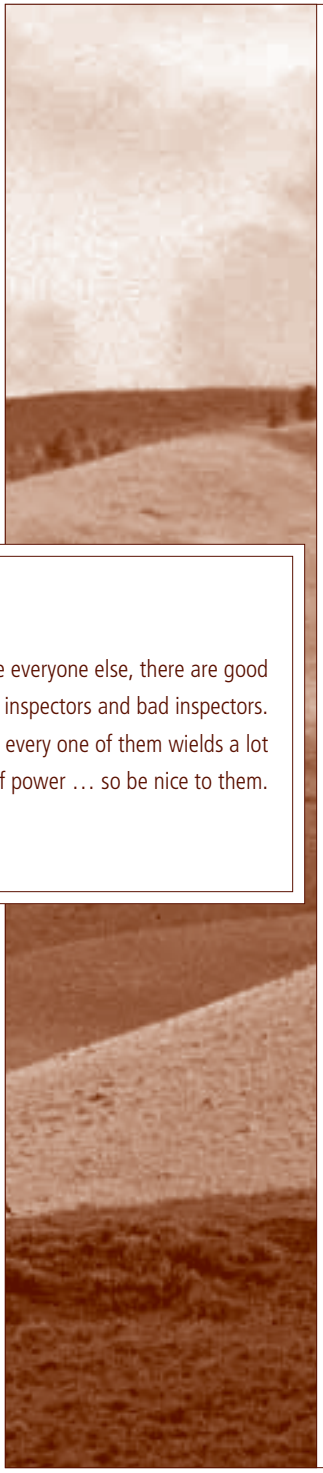
We've created a form that helps us:

- Communicate with the processing plant about how we want our carcass cut.
- Create a visual check list to make sure we've accounted for the whole carcass.
- Inventory cut beef.
- Keep the processing plant honest.
- See trends to predict yields of certain cuts.
- Access written records if there is a problem.
- Create carcass performance data that can be taken to a breeder.

You may want to consider having your carcasses graded, at least occasionally, to help you learn more about your cattle. Our processor will do it for free on an unofficial basis. An official USDA grader charges a fee.

FEDERAL INSPECTORS

All federally inspected processing facilities will have a federal inspector who maintains a permanent office within the facility. They are always present when the slaughter is done and they regulate the way the meat is handled within the facility. They also enforce the rules concerning the transfer of meat between



Like everyone else, there are good inspectors and bad inspectors. Yet, every one of them wields a lot of power … so be nice to them.

facilities. For instance, if you transfer meat from a federally inspected facility to a state-inspected facility, it is then considered only state-inspected.

Like everyone else, there are good inspectors and bad inspectors. Yet, every one of them wields a lot of power. Most of their interaction will be with the operators of the processing plant, but you will need to deal with them a little. Be nice to them. They can be a great help, or they can make your life miserable. For instance, the amount of meat that you can give away is actually regulated. Samples are all supposed to be marked "sample," and the amount may not exceed 2,000 pounds per year. Now, if you have a good relationship with your inspector, he probably is not going to inspect and count each and every sample that you take from the processing plant, but he certainly has the power to do so.

Getting a Label

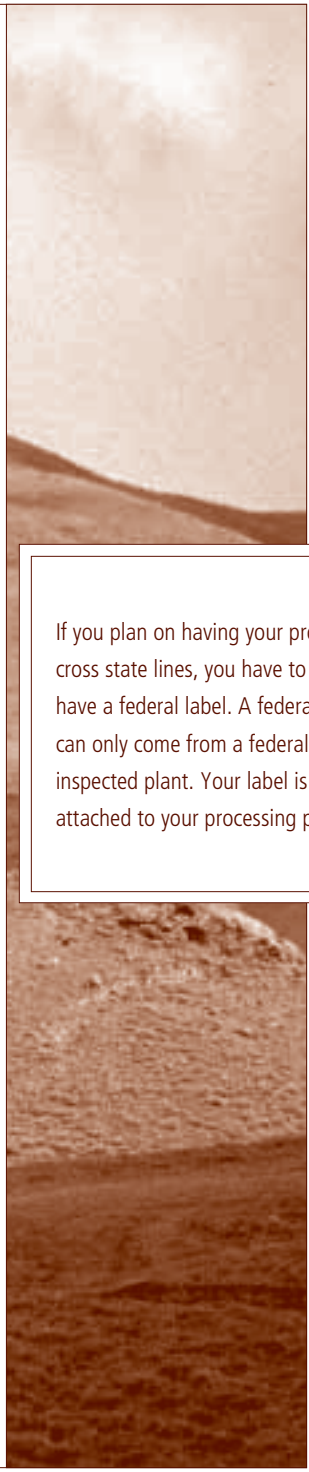
If you plan on having your product cross state lines, you have to have a federal label. A federal label can only come from a federally inspected plant. Your label is attached to your processing plant. For instance, we have a separate label for our jerky and marinated roasts than for our other beef products. They look almost the same. The only difference is the establishment number in the circle in the lower-right corner. That's it. The plant that does your processing will apply to the

federal government for your label. You need to have the artwork created – preferably on a computer, so that changes can be made easily – then give it to your processing house to have it approved. Some plants will provide this service for you, usually at no charge.

Obtaining approval on your label can take as little as 10 days, or many months, depending on how out of the ordinary your label is and the experience of the processing company.

When we applied for our first federal label, it took quite a while. Our processing house had never applied for a label with anything strange like natural on it. Even adding that fairly innocuous word apparently makes the feds nervous. Our label kept being rejected over and over, and we couldn't figure out why.

Finally, out of desperation, we hired a label expediter to help get our label through. An expediter is a person who knows all the guys in Washington who fret over the terms like natural and organic and hormone-free. He gets paid a lot of money for knowing where their offices are and what questions to ask when they tell him that your label was rejected. And, most amazing, he can tell you exactly what to change so that the label will pass. After months and months of going around and around with our label, it turned out that what was wrong was frustratingly simple. We stated on the label – "Keep Refrigerated or Frozen." It turns out that we can say, "Keep Refrigerated" or "Keep Frozen," but not both. How could we have



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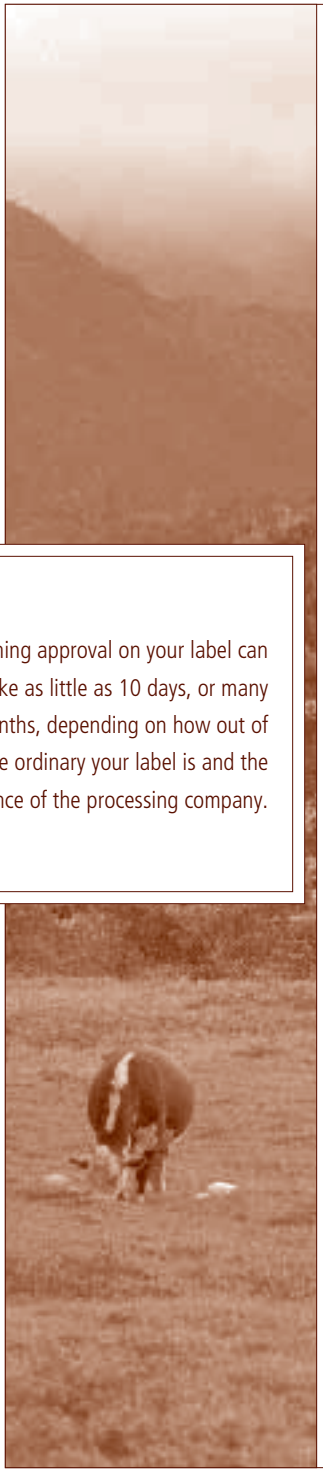


Obtaining approval on your label can take as little as 10 days, or many months, depending on how out of the ordinary your label is and the experience of the processing company.

been so misinformed? Actually, in the end it was not really very expensive (a couple hundred dollars), and we should have hired the expediter a lot sooner.

While I would never claim to entirely understand the label approval office, they seem to be getting more user-friendly. You can find out more about labels and getting your approval at www.fsis.usda.gov/home. If you want to sell your product as certified organic, your label as well as your processing plant also will have to be approved by your state or third party certifier.

The easy thing to do is to team up with a processing house with experience dealing with natural or organic labels or copy one that has already been approved. Don't try to do your advertising with your product label. You will never win in a battle with federal regulators. Make all your claims on your point-of-purchase material or your product literature, not on your federal label. Anything that you say on your federal label has to be approved by the feds. That is time-consuming, at best.

If you want to say that your beef is better for you, say it in your brochures. If you want to say that your beef is tender, say it in your brochures. If you put it in your brochures, it's just your business. If it's on your federal label, it's the feds' business.

LABEL SOURCES

When you're first starting out, especially when you are still deciding what your product mix will be, go to a small printing company for your labels. You want to order pressure-sensitive labels that come on continuous-feed rolls. Your quantities will be too small for a regular label company to be cost-effective. Most small printing companies sub-contract with a to-the-trade-only label printer.

Make all your labels the same color (although you can create screens of one color for more visual interest) and try to do them all at once. You may have different quantities of each – 1,000 stew beef labels, 500 sirloin steak labels, 500 tenderloin steak labels, and 3,000 ground beef labels. Go with a standard size, as custom sizes are a lot more expensive. Sizes usually run in 1-inch increments.

When your volume is higher (such as 10,000 labels or more), deal directly with a label printing company. Most major metropolitan areas have one or two. Look in the yellow pages. Get bids from two or three if possible. Make sure to give them the following information: quantity of each label, total quantity, size, ink color, color of stock (the paper that the labels are printed on), whether the labels need to be waterproof, and delivery location. Expect a four-week turnaround time.

Packaging Your Product

Bulk ground beef is most economically packaged in small bags, usually referred to as chubb bags. They come in 1-, 2- and 5-pound sizes, and you can select from different thicknesses of plastic. You can buy them pre-printed with some standard design, and then have your label affixed when they are filled at the processing plant. When your quantities are higher (5,000 and above), you can have your label pre-printed on the bag. There are only a few chubb bag companies around. Don't purchase really cheap bags, as cheap bags tend to get holes during the filling process. Seek food service equipment and supplies sources online.

Recently, we have changed our ground beef packaging to a Styrofoam tray with a perishable food wrapping. Our processor still occasionally had trouble with pin holes in the chubb bags. Even though it is more expensive, in the end it made our customers and us happier, not to have packages that had to be returned due to defects.

Most consumers will not buy a product that they cannot see, especially if they've never bought it before. So package your beef in clear plastic perishable food wrapping, vacuum packed. It is more expensive, but important not only so the consumer can see what he or she is getting, but also so the product stays fresh longer. Food wrapping, such as Cryovac®, gives meat a longer shelf life than paper-wrapped meat. The higher cost is offset by these benefits.

Package your beef in convenient sizes. We have found that the person who typically buys our product tends to eat smaller portions than your average meat consumer. At the supermarket, ground beef is usually sold in 1 ½- to 2-pound packages. Our customers complained that that was too large. So now we sell our ground beef, ground beef patties, stew beef, and fajita beef in 1-pound packages, steaks two-to-a-package, tenderloin at ¾ of a pound per package, New York strips at 1 pound per package, rib eyes at 1 pound, 3 ounces per package, roasts at 3 pounds each and beef jerky at 1 ounce per package.

If you wind up selling to a distribution source – such as a restaurant, natural foods distribution company, or a retail store – instead of directly to a consumer, they will inquire about case sizes. Generally we have found it is best to have a case big enough that the cost of cardboard doesn't kill you, but it won't mean too large of an investment in one order.

Also, weight is a factor. A lot of women are employed as warehouse workers these days. Don't make up cases weighing over 35 or 40 pounds. Our cases are usually 24 pounds. You need to label all cases with the product codes (we use the standard codes listed in the beef buyers guide unless we have come up with a cut that is not listed – then we make up our own).

PHOTO BY BOB CUNNINGHAM

UPC CODES

Some retailers want you to include bar coding or a Universal Product Code (UPC). That is the little code on your product that identifies your company and its location to the store, and may contain other information including the product price. Bar coding is new for meat products. We have never had a client insist upon it, which is good, as it does add cost to the bottom line.

There are many websites that detail how to get a bar code onto your label. Any processed product (such as hot dogs, jerky, etc.) will require a UPC code. Some producers join the Universal Product Code organization, which charges a one-time fee. The Universal Product Code association is on the Internet at www.uc-council.org.

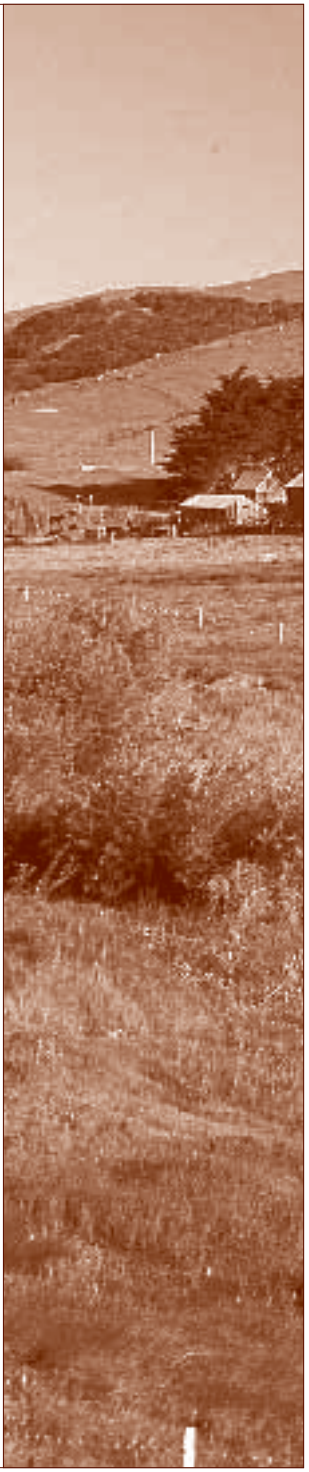
A ranching friend buys all his bar codes from a private company he finds cheaper and faster: www.buyabarcode.com. Their one-time fee of $75 is a bargain compared to the $800 charged by the UPC Council, and the bar codes are only $35 each. Moreover, you don't have to sort through new software to download a code.

Then, consider three ways to get your bar code on your product:

- Contact a printing company that prints UPC bar code labels, which can then be applied to your product.
- Have a UPC bar code printed directly on the package of your product.
- Print UPC bar code labels yourself using off-the-shelf software.

INSURANCE

Some of your customers – mostly retail stores, restaurants and some farmers markets – will require you to carry product liability insurance. This is a separate policy from your normal ranch or farm insurance. It's not all that big of a deal. Most places require $1 million in liability. Present a "certificate of insurance" to your client whenever you meet them for the first time. If they demand it, it will save some time. If they don't, you will look all the more respectable and trustworthy.



Genetics

There are a ton of different breeds of cattle out there. If you read the breeds marketing literature, they all seem to "calve well, gain fast, and do great under range conditions." Of course, if this were true, we'd only need one breed of cow. In reality, we all live in different climates, and we are all looking for certain strengths in our cattle – even more so for you as a niche marketer.

For example, meat marbling is definitely one of those personal preference issues. Some particularly health-conscious customers don't want any marbling in their beef. Others claim their beef isn't tender without a little fat. You'll need to discern what most of your customers like and plan your breeds accordingly.

One more thing you also will hear is, "There are more differences within a breed than between breeds." There is an element of truth to this. By the same token, you will never find a Zebu that marbles as well as a Wygu. The moral here again is only you will know what's best for you. Based on what we learned about genetics and our experiences, we've made some basic conclusions.

Cattle that marble well:

- Angus
- Jersey
- Hereford
- Red Angus
- Highlanders
- Murry Grey
- Tarantaise

I've read that Highlands cattle marble very easily; they have so much hair, they don't need any back fat and put that energy in marbling.

Leaner cattle with less marbling:

- Zebu
- Brahma
- Brangus
- Gelbvieh
- Braunvieh

I have heard that there is a strain of Brahma that is very tender. Personally, I have had very bad luck with them, as tenderness goes. Only about 4 percent have been tender enough.

The longer we are in this business, the more respect we have for genetics. Good genetics has a lot to do with the tenderness of your beef. Angus cattle can make just as many tough steaks as a Brahma. It just depends on the genetics behind them. Good genetics also has a lot to do with profitability. There is a 20-percent difference between our best cattle and our worst in the weight of our high-end cuts.

Another area we are working with is maturity. Maturity is based on frame size, but knowing when an animal has matured (and, more importantly, marbled) is as much of an art as a science. It's just a skill you have to develop. However, there are some basics.

PHOTO BY EDWIN REMSBERG

For a grass-fed product, we are looking at something that will mature in two years or less.

No matter how much you feed your animals or how good the forage is, they will not start to marble until they mature. Currently, the conventional market is looking for animals maturing at 1,200 to 1,300 pounds. This seems ludicrous. The only person to profit on such heavy weights is the feeder (who gets to sell more feed), and the packer (who gets a break by spreading his hard costs over a heavier animal).

For a grass-fed product, we are looking at something that will mature in two years or less. After about 30 months of age, you will start running into tenderness problems related solely to age (this isn't a hard and fast rule, with good genetics we've been able to slaughter open three-year-olds with no tenderness problems). With that in mind, we've been looking to raise an animal that will mature at 800 to 1,000 pounds, a figure sort of pulled out of a hat. Maybe 600 to 800 pounds is the magic figure. We chose 800 to 1,000 pounds because it seemed do-able without getting into an extreme breeding program.

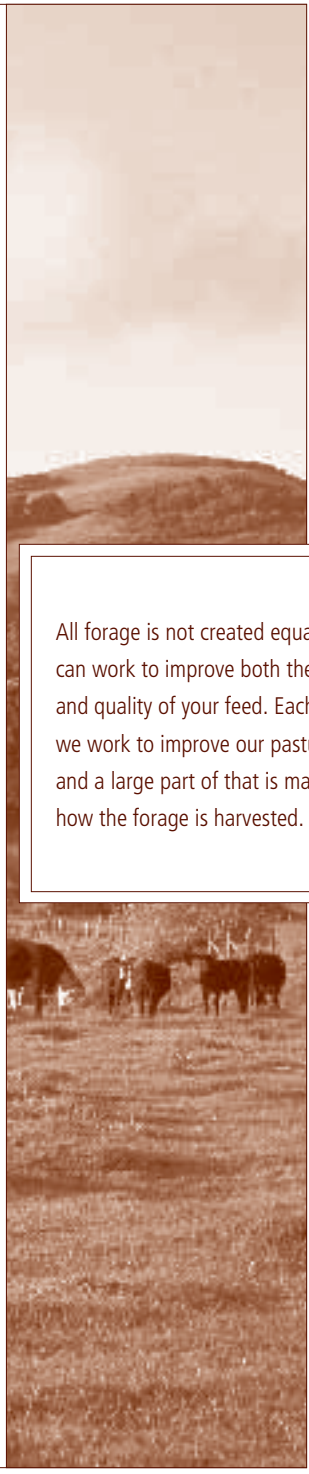
As our genetics and quality of forage improves, we are experimenting with trying to take this weight up to 1,000 to 1,100 pounds. The jury is still out on whether this is economical. If you buy calves instead of producing your own, you may want to choose the shorter frame animals that will mature at your lighter harvest weight.

Ultimately, we believe these new breeding programs will be a spin-off industry of grass-fed beef. Beef that do well in a feedlot don't necessarily do well on grass. Special breeding lines will have to be created. Grass-fed cattle in Minnesota will be very different genetically from Florida, or Arizona, or anywhere else. We all have different situations and needs. We will all need different genetics, and someone, somewhere will supply them.

Forage

All forage is not created equal. You can work to improve both the amount and quality of your feed. Each season, we work to improve our pasture, and a large part of that is managing how the forage is harvested.

You'll want to put your brood cows on your poorest forage. Granted, they will do better on better forage, but to get the biggest bang for your buck, you'll want to save your good forage for your high-value animals, those you are finishing. These animals are gaining in weight and quality, as opposed to your cow herd, which is depreciating and doesn't get as much of a benefit out of good forage. Some intensive graziers even do a leader/follower system.



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In beginning our grass-fed program, we didn't worry too much about forages. We used all native forage that was already in the fields. In fact, some producers report raising great-tasting beef from native grasses, which also saves them money. However, our experience is leading us to believe there may be enough value in planted forages to warrant more research.

We are looking at finishing our animals with high-energy forage. Here is a list, ranked highest to lowest:

- brassicas
- legumes
- cool-season annuals
- perennial ryegrass
- warm-season annuals
- cool-season perennials
- alfalfa

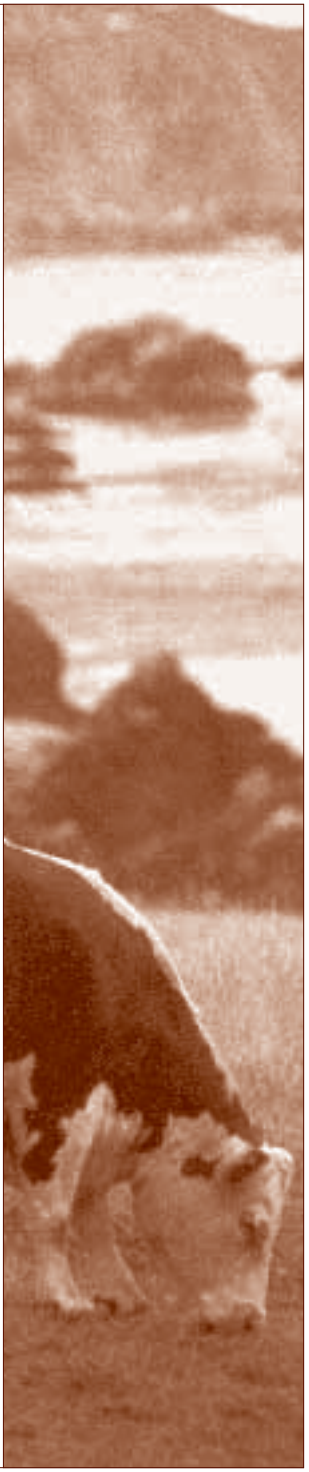
Most of the grass-fed world (Argentina, New Zealand) concentrates on the top four. In taste tests in Alabama, California and England, ryegrass was found to produce a better tasting beef than grain. However, while fescue was almost universally disliked, it can be a useful piece of your system.

No one knows the minimum amount of time an animal has to be finished on high quality forage. There have been some figures thrown about ranging anywhere from

50 to 100 days, but no one really knows. Again, native grasses might prove an attractive, low-cost option.

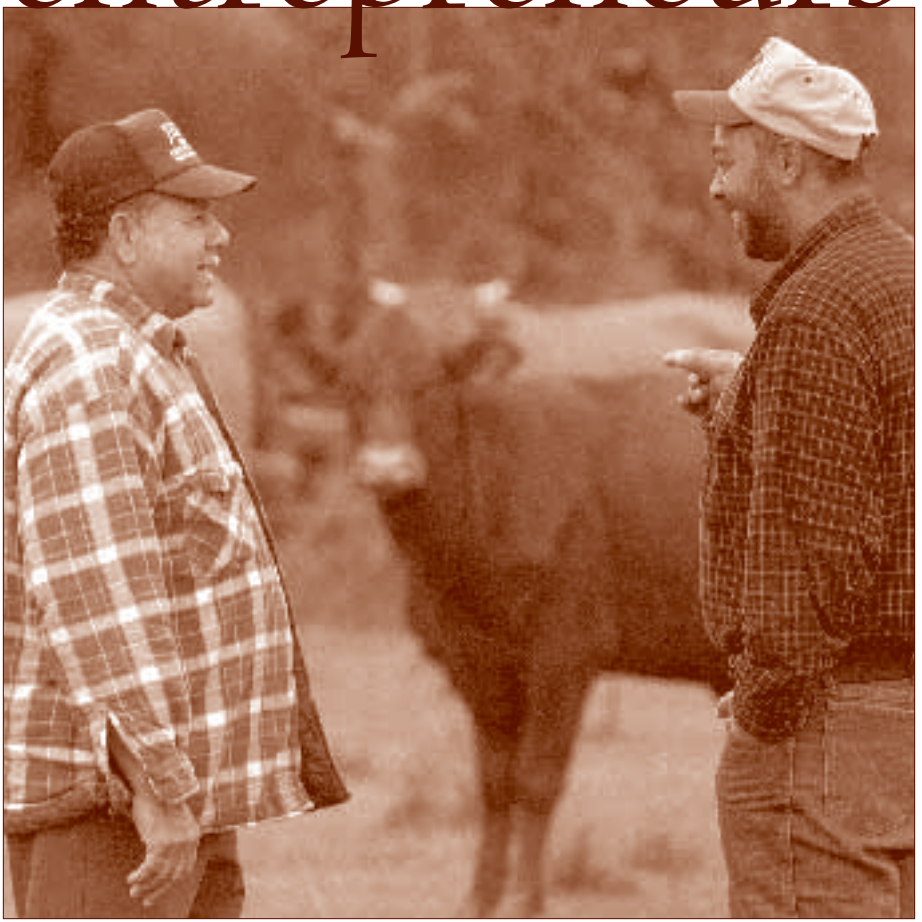
One thing we do know comes from Dr. Dick Diven, of the Low Cost Cow/Calf Production School: When your steer reaches 60 percent of its mature body weight, it will be at a point in its development where it grows intramuscular fat (marbling) cells or connective tissue (gristle). If your steer is on an upward plane of nutrition (gaining weight), it will form marbling cells. If not, it will form connective tissue. This is one reason you can't look at a fat steer ready for slaughter and predict if he'll marble well. Unless you know how he was doing when he hit 60 percent of his mature weight, you can feed him all you want and he still won't marble.

Dr. Diven also has a word of caution if you are using grain to supplement your grass program. Without going into the complex rumen chemistry, oil grains (like cotton seed or soy) will work more efficiently with the rumen, allowing the steer to eat more cheap grass. A starch grain (like corn) will work against the rumen in a grass-based program, making the rumen, in time, more dependent on bought grain for its nutritional needs.



People who market sustainably raised food in innovative ways provide inspirational real-life models. Consider adapting ideas from the approaches that follow.

entrepreneurs



With more than a century of sheep ranching tradition on their 30,000-acre central Oregon ranch, Dan and Jeanne Carver wanted to continue raising sheep despite declining lamb and wool markets. With a grant from the Sustainable Agriculture Research and Education (SARE) program, they researched markets and launched a product line featuring uniqueness and quality.

Today, their sales include lamb for high-end restaurants, wool in yarn-and-pattern kits for hand knitters, and ready-to-wear woolen and lambskin fashions. These sideline enterprises augment the main ranch commodities, which include 800 head of cattle, hay, and 3,000 acres of no-till grain.

With a lack of processors, the Carvers were forced to find custom outfits willing to develop out-of-the-ordinary retail products. They found a small meat processor 80 miles away and attracted restaurants using many messages – fresh, locally grown, "natural" spring lamb from a ranch awarded for its conservation practices. "That's a lot of sizzle," said Jeanne.

Once washed and dyed, the wool becomes yarn for kits featuring the Carvers' knitwear designs and is sold through a dealer who publishes a catalog circulated to 100,000 crafters. Repeated requests for finished garments from their wool encouraged Jeanne to work with area designers and knitters to create handmade woolen clothing sold in resorts and specialty shops. To use the whole animal, they began tanning hides and added lambskin fashion items to their clothing line.

"The marketing project has increased awareness and visibility of what we grow, how we grow it and, most importantly, how we manage the land," said Dan, referring to a bevy of practices to safeguard the environment, such as installing miles of fencing to control grazing impact and building dams to create watering holes for domestic stock and wildlife.

Lamb sales have spurred interest in their beef, which the Carvers primarily sell as 700-pound calves to the generic market. With the new interest from lamb buyers, however, they now direct-market their finished beef to some of their established lamb customers and high-end restaurants dotting the Columbia River Gorge.

Dan said they only direct-market about 50 head of beef a year, but not for lack of interest. "Once the chefs tour the ranch and see the roots of their product, they ask 'How do we get your beef?'" he said. "The demand is there for increased direct-market sales but it will grow only as fast as our processing and distribution will allow."

The Carvers estimate they clear 30 percent over the price

of lamb sold on the generic market, and wool profits are growing even while they keep prices affordable.

"Our customers love the quality of our product, the flavor profile of the meat, the feel of the wool and the message of the land and sense of place," Jeanne said.

THE CARVER FAMILY

2002 SARE PROGRAM GRANT RECIPIENT

Written by Valerie Berton | Image from Dan and Jean Carver

Bill and Di Hodge had raised a small cattle herd in addition to their "day jobs" for decades, but got serious about making the sideline activity a real income-generating enterprise after they saw the potential of marketing grass-fed beef.

"Six to eight years ago, we suddenly came to the realization that a cow was put on this Earth to graze," said Bill Hodge, an extension educator who farms in northwest Georgia. "We wanted to see if we could produce a consumer-acceptable product from pasture."

After four years of forage research, the Hodges had perfected a system of growing cold-season and warm-season grasses that not only performed well in their climate but also produced a good flavor in their beef. They introduced customers to their new product at a nearby farmers market in Carrollton started in 2002 partly with support from a Sustainable Agriculture Research and Education (SARE) program grant.

The Cotton Mill Farmers Market filled a gap in northwest Georgia. As a suburban population drifted west from Atlanta during the 1990s, Carroll County grew. Many of the new residents knew nothing about the local farm products. SARE's grant supported a new market initiated by civic groups, government agencies and farmers committed to bridging that gap.

As Carroll County extension director, Hodge participated in the local effort to launch the market. In 2003, its second year, the market featured 32 producers, the Hodges among them. The market was an ideal venue to test their packaging scheme devised to use the whole animal: 20-, 30- and 40-pound packs of ground beef, steaks and roasts.

That season the farmers market became a primary sales outlet for the Hodges, especially with the opportunity to feature their beef in occasional chef demonstrations prepared on site.

"The farmers market gave us a venue to be in the market and expose the product," Bill said. "It really made a difference [to customers] to have a chef prepare our beef, with the aroma flowing through the market."

Today, the Hodges sell their meat under their "Hodge Common Sense Beef" label directly from their farm or on online at websites like LocalHarvest.org and EatWild.com, where Hodge says they have gained many customers. They still go to the Cotton Mill market sometimes, but say demand now exceeds supply from their herd of 40.

The Hodges have begun marketing meat for several producers under their label. "Others don't want to spend the time dealing with the public," Bill said. "There's a lot of time and energy involved in direct marketing."

Despite that, the Hodges still sell at the market periodically. They expect to diversify and offer lamb from a new flock of sheep and are considering goats as a biological weed control on their land.

THE HODGE FAMILY

BENEFITED FROM A 2002 SARE PROGRAM GRANT

Written by Valerie Berton | Image from Wendy Crager

For eight years, Bill and Denise Brownlee watched feed prices rise and pork prices fall, wondering all the while how they could make their Wil-Den Family Farms in Pennsylvania more profitable. In 2002, they decided to exploit what they saw as a market advantage – for years they have perfected an outdoor production system where their hogs farrow and finish on pasture without growth stimulants and minimal antibiotic use. The Brownlees withdrew their pork from conventional sales and began trying to market their product directly to customers.

Given the time commitment involved in direct marketing, they scaled back their operation from 170 sows to 60 and began focusing on selling 900 to 1,000 animals per year, this time at a premium. Their broad efforts include developing a meat-oriented community agriculture project, running a subscription service, partnering with CSA farmers, selling at farmers markets and grocery stores, selling to institutions, and establishing an on-farm store.

With help from a grant from the Sustainable Agriculture Research and Education (SARE) program to a local non-profit organization that wanted to test the concept of a community-supported agriculture project focused on meat, the Brownlees began hosting meat sampling events. They hoped to capture 100 families interested in buying annual "shares" of their farm product. For between $400 and $800, depending on their choices, each member would receive a mix: bone-in center-cut chops, bacon, ground pork, breakfast sausage, Italian sausage and semi-boneless ham, throughout the year. The concept, however, failed to take hold.

"We tried to pattern it after how people are used to buying from vegetable farmers: paying upfront," Denise said. "For whatever reason, they were hesitant to commit." They changed their strategy to encourage people to buy a month's supply of meat in a subscription service and hope their happy customers will begin buying for a full year. About 40 customers have subscribed for monthly meat deliveries.

Denise and Bill host meat sampling at a variety of venues. Denise's first presentation at a local business gained a handful of customers, who are still receiving meat deliveries.

A local restaurant featured the Brownlees, a beef producer and a poultry farmer in a pastured meat tasting. And at a nearby conservatory, they took part in a "Green Eats" event, distributing tastes of pork to a well-heeled crowd.

Early successes include selling whole hogs, an inexpensive way to move the entire animal, to institutions such as a convent and ground pork to Washington and Jefferson College in Washington, Pa. Selling lower-end cuts remains one of their biggest challenges.

"We've doubled the pigs we slaughter under our label, but it's not enough," Denise said. "We have just 60 sows paying the bills and we need to make more money from those animals."

THE BROWNLEE FAMILY

Benefited from a 2004 SARE program grant

Written by Valerie Berton | Image from Bill & Denise Brownlee

Since 1999, Wende Elliott has raised poultry and lamb in a pasture-based system on her 120-acre central Iowa farm. With her husband, Joe Rude, she gained organic certification for her meat products, as well as alfalfa, oats and corn.

As they fine-tuned their production, Wende and Joe pondered how to get the most from their meat. In 2001, Wende wrote a business plan and successfully

launched a cooperative called Wholesome Harvest. With two grants from the Sustainable Agriculture Research and Education (SARE) program, she began to promote meat sales in five Midwestern states.

Wholesome Harvest is now a thriving, farmer-owned organic business with more than 40 members. The e-commerce site, wholesomeharvest.com, is a successful direct sales mechanism that augments more traditional markets such as grocery stores and restaurants.

The website provides a wealth of information about the Wholesome Harvest cooperative and the group's efforts to promote organic meat grown on pasture with humane handling practices.

Wholesome Harvest's virtual market enables buyers to order meat online for delivery. It evolved from Wende's vision that people who wanted to eat certified organic, independently raised meat from family farms didn't have to go farther than their computer to shop for it.

In an innovative twist on community agriculture projects, people can join Wholesome Harvest's meat-of-the-month club and receive monthly shipments of organic beef, chicken, lamb, duck, goose and turkey, much like a CSA. Frozen meat on dry ice is shipped via two-day express delivery.

In its advertising, the co-op emphasizes that its products are locally grown, farmer-owned, pasture-raised and rendered at custom processors to give them a human edge over the more anonymous industrial model.

"We can't compete on cheap food," Wende said, "but we can compete on quality and freshness and the fact that our product is local."

Growth, the co-op's communications officer says, is steady. For that and other reasons, Wende hopes to form a national coalition of regional organic meat cooperatives.

"Only by working together can farmers protect the added value of organic meat, and capture premium and remote as well as mainstream markets for their products," Wende said. "Otherwise, they will end up being paid what the plant wants to pay them."

To learn more about the national coalition, contact Wende at welliott@wholesomeharvest.com.

THE ELLIOTT/RUDE FAMILY

2000 & 2002 SARE PROGRAM GRANT RECIPIENT

Written by Valerie Berton | Image from Wholesome Harvest

THE HATFIELD FAMILY
OREGON NATURAL BEEF

There were two pioneers in the direct marketing beef business: Mel Coleman of Coleman Beef, and Doc and Connie Hatfield of Oregon Natural Beef. Mel basically modeled his production system after the conventional market and had mixed results (for a more detailed analysis, read his book *Riding the Higher Range*). The Hatfields, however, truly blazed their own trail.

In a nutshell, they created a cooperative of producers who promise a certain number of cattle during different parts of the year. These cattle are then fed out and slaughtered, with the owner retaining ownership. At slaughter, the slaughter house buys the beef for conventional prices, but stores the beef separately from their conventional beef. The Hatfields then get on the phone to their clients and take orders for that week. With orders in hand, they then buy back as much of their beef as demand will allow from the processing facility. Then they pay the producer a premium for the amount of beef they were able to sell.

The nice part of this model is that there is a steady supply of fresh beef and a guaranteed sale. At the very least, you'd get what you would have gotten by selling your cattle conventionally. Finally, it makes producers more conscious of the product they offer.

STRENGTH: *Year-round production, guaranteed sale*

WEAKNESS: *High production/start-up cost*

THE JAMES FAMILY
JAMES RANCH GRASS-FINISHED BEEF

The James family, like the Salatins, has made a nice living doing things on a smaller scale. They slaughter their beef at around 950-1,150 pounds, the majority in the late fall, but also some in the spring. The beef is then frozen and sold throughout the year. Part of their marketing is done through an on-ranch store that is open one day a week. Another part is sold at a local farmers market. They also sell most of their hamburger through some high-end local restaurants who cater to tourists looking for a western experience as well as natural food groceries in and near Durango.

James Ranch beef cattle begin their lives on pastures in Utah and are then moved to the ranch to graze on cool-season grasses and clovers. The Red Angus beef cattle grow quickly on grass and are ready for market between 18 and 30 months of age.

Besides grass-finished beef, the multi-generational family operation also produces artisan cheese and pastured pork.

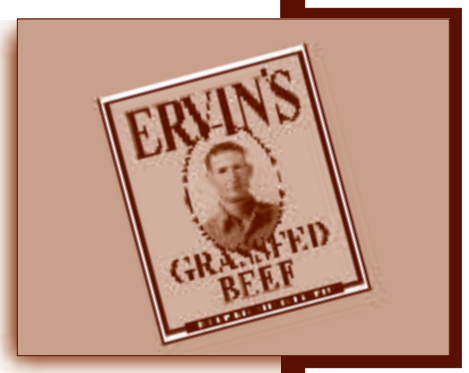
The Jameses advertise their meat online at www.jamesranch.net. There, customers can pre-order beef using an online order form and pick it up in Durango.

STRENGTH: *Low start-up and production cost*

WEAKNESS: *Time spent away from the ranch at store or in market*

THE HOLDER FAMILY
ERVIN'S GRASSFED BEEF

Will and I started Ervin's Grassfed Beef (EGB) in 1997. The company was named after my husband Will's maternal grandfather, Ervin Hicks (***below***), who had a wonderful land ethic and a gentle way with animals. Originally, we tried to form a cooperative, including our neighbors and a few other ranchers who do a great job with their land and their cattle. Unfortunately, even though everyone agreed that it was a great idea, no one but us was willing to spend any money or time developing it. So now, our program is set up like a cooperative, at least in spirit. On paper, EGB is simply a marketing agent that buys cattle from other ranchers who are willing to adhere to the same set of standards that we do. This way, EGB is a pretty lean organization, giving most of the value to the producer and the consumer.



Each rancher with whom we work is certified by EGB to meet the standards we advertise to the consumer. They are responsible for the product and retain ownership until the steer is on the rail. Some producers don't want the responsibility of finishing a steer, so our ranch buys them from the producer (similar to a stocker operation), and sells them to EGB.

EGB offers three prices: hamburger (cull cow), stew beef (tough steer) and steak (tender steer). We only buy what our demand calls for. Originally, we started offering only a frozen product but have since been able to offer fresh as well.

STRENGTH: *Starting with frozen product is very forgiving and maximizes per carcass net*

WEAKNESS: *Frozen product limits marketability*

selling product

Situational Analysis

The first thing that you have to do is to identify your strengths and weaknesses. This sounds really simple, but we've found that it actually takes quite a bit of time. We wasted a lot of time trying to follow the models of some pretty brilliant people, only to get a ways down the road and find out that, given our particular set of circumstances, we couldn't go that route. So first off, do your homework. Make a list of what you have to work with.

Your team:

- Your family's background. This is a group effort.
- Your personality. How do you deal with others? Would you enjoy making a "cold" sales call?
- Your education and experience.

Your physical resources:

- The size of your ranch.
- The number and breed of cattle.
- The ranch's history, layout, elevation and character.
- If pesticides, non-organic fertilizers or herbicides have been used.
- If any part is irrigated or able to be irrigated.
- The condition of the pastures.
- Water availability.
- If you own, or have access to, scales.

Your location:

- The distance to a town.
- The distance to a major metropolitan area.
- The nearest processing facility – and its willingness to train you.

Economics:

- Your economic situation. Do you have savings to support you during transition?
- How much money does the ranch need to produce, both short and long term?
- How much cash reserve do you have?
- What is your available credit?
- Can you afford to break even or even lose money for a few years? The general rule is to expect seven years to establish a profitable direct-market business.

Supporting resources such as:

- Small Business Development Centers. The U.S. Small Business Administration runs these programs to provide management assistance to current and prospective small business owners. www.sba.gov/sbdc/
- Extension staff with experience in direct meat marketing.
- Private consultants.

Answer all of these questions before you proceed. Every factor will play a part in deciding what type of operation is the best for you. For example, if you are located fairly close to a metropolitan area, your family has some experience with direct sales, and you like dealing with people, the Joel Salatin model may be the best for you. Then again, if you don't like direct sales, and you are located way out in the boonies, then you may want to have a distributor sell for you.

You may want to consider writing a business plan. For help, consult *Building a Sustainable Business,* a handbook from the Sustainable Agriculture Network (***Resources,*** p. 89).

Sales Outlets

RESTAURANTS

Restaurants use a lot of beef. It seems, then, that they would be an excellent avenue to market your product. They must have small margins, though, because they are the most price-conscious customers that we have. They also want it in particular ways. It seems that every type of restaurant has its own particular needs.

You are probably wasting your time working with franchise restaurants. Locally owned restaurants are more likely to share your goals.

Mexican restaurants use a lot of beef, but the problem is that they use a lot of very cheap beef – the stew, rounds, brisket, skirt, plate and ground beef. We have found that even the ones who advertise healthy food with low fat still buy 60-cent-a-pound ground beef. You have to look for the kinds of restaurants that offer a healthy, ecologically sensitive and high-ticket menu.

Restaurateurs also usually want fresh, not frozen, beef. That means frequent deliveries and a convenient delivery system. They also want a uniform product. The last thing a restaurant manager wants is a customer complaining that last time he ordered this steak it was a lot bigger (or leaner, or more tender, or whatever). However, things are changing. We have found that some restaurants will accept some product variability. They are the restaurants that already buy organic vegetables and seasonal, locally produced

PHOTO BY EDWIN REMSBERG

wines and breads. The best thing is that they are usually rather expensive, too. They are used to paying extra for what they want.

Search for chefs who will work closely with you. These kinds of chefs can creatively use many different cuts and will probably teach you a lot.

Some restaurants (generally those that specialize in organic and local fare) are willing to work with a number of small producers, but they are few and far between. They generally change their menus daily or weekly. When they get a specialty item like your tenderloin, they may want to feature it that evening while it lasts. So you need to give them notice when you will have high-end cuts so they can plan with the rest of their small suppliers.

Don't forget that high-end restaurants like lots of bones to make stock, generally more than just you can supply. It also is a nice idea to give them a few pounds of burger or roast occasionally that they can use for their staff dinners, which many host prior to serving hours. It always helps to make friends with the general staff.

When restaurants get a specialty item like your tenderloin, they may want to feature it that evening while it lasts. So you need to give them notice when you will have high-end cuts .

STORES

You think the cattle business is tough? Spend an hour with a store buyer. They are thorough, knowledgeable, and so slick with a calculator you'll wonder where all your math education went to. These people are like commodity brokers. They deal in

tenths of percents. They are bottom line kind of people. If you are not completely buttoned up when you go to meet with these guys, they will not only chew you up, but feel angry that they wasted 15 minutes of their day on you.

Actually, they may not be that bad. However, don't go in thinking your sweet picture of a family farm is going to win them over. That picture is very important, but so are economics, margins and markups. Know all your costs going in – transportation, storage, delivery and pallet charges.

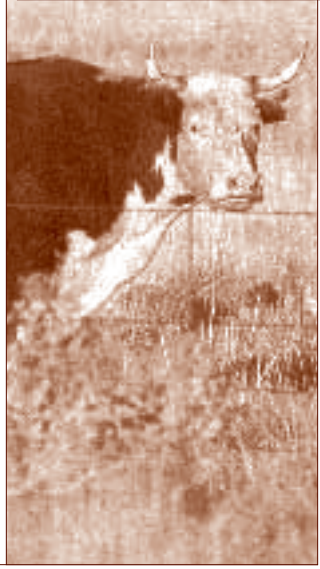
All of this might discourage you. Don't let it. Stores are wonderful in that, instead of having 200 customers, with 200 checks and 200 delivery times every month, you only have one. That decreases the headaches and day-to-day problems quite a bit.

Stores charge a mark up of about 30 percent – less in big supermarkets, more in small specialty stores. They will expect you to ask about their markup, and how and when they want your product delivered (and possibly by whose trucks).

Store buyers will ask you about:

- Customers
- Current gross sales
- When you can start delivery
- Case size
- What your product will look like (label, package, appearance)
- Promotional materials
- Liability insurance

PHOTO BY BOB CUNNINGHAM



Distributors are a lot like stores, but with even bigger volume. For you, they are one customer, requiring one bill and one delivery, that does a ton of volume. The only bad thing is that your product is more costly to the consumer.

DISTRIBUTORS

Distributors are a lot like stores, but with even bigger volume. For you, they are one customer, requiring one bill and one delivery, that does a ton of volume. The only bad thing is that your product is more costly to the consumer. Distributors charge anywhere from 8 to 30 percent, which jacks up your price considerably when you figure the retail store will add another 30 to 40 percent on top of that.

It seems that every major metropolitan area has a host of distributors that could be lumped into one of two categories:

1) big volume/little service, and 2) big service/lower volume. Big volume distributors are companies like Shamrock Foods who will want to deal with thousands of pounds of product at a time. For most family ranches (especially at start up), this is not a viable option.

The big service distributors, which are harder to find, are willing to deal with much smaller quantities (even tens of pounds). These companies are either small Mom-and-Pop operations who have somehow managed to survive from the 1950s, or gourmet-type people. The easiest way to find them is to call the purchaser (they are also sometimes called "foragers" or "buying agents") of very exclusive restaurants and ask them who distributes their gourmet or hard-to-find items. Another nice reason for finding a gourmet distributor is that they are always

looking for something new and novel to sell, such as your locally produced beef. Price isn't nearly as big an issue for them as it is with large-volume distributors. Again, you will have to weigh the good versus the bad and decide based upon your situation.

FARMERS MARKETS

If you live within easy driving distance of a city, farmers markets can be great. The investment is minimal, and you get paid immediately. It's really fun to boot. We always met a lot of nice customers and other vendors with natural products to sell. I would come home after a farmers market with the most wonderful breads, jams, produce and advice on what to do about our dog's arthritis.

The amount of money that you make is largely dependent upon the area you live in. The farmers markets in Phoenix aren't very well established yet. People don't seem to really use them for their regular shopping. We did meet quite a few nice people who became excellent regular customers. We believe that if we wanted to continue with the markets, we would have eventually built up a large amount of business. The amount of money we made in a day would have been fine if it was a half-hour drive for us, but it was more like six hours. Each way. That makes for an exhausting trip. Moreover, it was impossible for us to bring along our toddler son for that many hours, especially in Phoenix's brutal heat.

PHOTO BY EDWIN REMSBERG

Tucson's markets are a lot better. There is one near an affluent area where a friend of ours sells out each week. It's only 45 minutes from her home. There are many other cities with huge, very successful farmers markets, so it's worth investigation.

The laws governing farmers markets vary depending upon where you live. In some areas, the county makes the rules. In some areas it is the state. In some areas you have to comply with the health department's rules and regulations. Some markets have tables and umbrellas for you to use, free of charge. Some don't. Some have access to power, some don't. Some let you sell out of traditional ice chests, some want electric-powered ice chests. They are all different.

We keep it fairly simple at our farmers markets: a folding table (we already had that), a cash box (we bought a plastic one for $6), and two electric ice chests (which we bought at a discount chain for $60 each), that we have used so much that we should have bought them years ago. If you can find them, glass-top ice cream display freezers work very well at farmers markets.

Begin by visiting the markets you are interested in trying. Ask market managers what rules and regulations you need to comply with. The reason for asking the markets and not the government agencies is that every agency always seems to think that they have the authority. I talked to 14 (no, I am not kidding) different people,

each of whom insisted that we had to follow a different set of rules. Some of them were downright ridiculous. One told me that we had to have a refrigerated truck and all people manning the booth had to be cleared by his department.

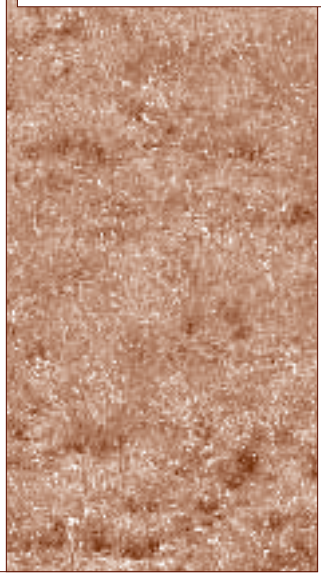
For the real low-down on the rules, ask the market manager or the vendors. They know what works and what doesn't.

Usually, the operators of the market receive a percentage of sales for providing the space setup and power. This percentage varies by market. I have heard that some charge a flat fee. In any case the charge is very small, usually between 3 to 5 percent.

In many areas you'll need a business license (so you'll have the privilege of paying taxes on your sales), and nothing else. We have been told that if we didn't raise the beef ourselves, it would mean that we are distributors, and insurance is more expensive. Most areas require $1 million in liability insurance. Check with your town, county and state authorities for regulations.

Selling products (or even giving away samples), that are cooked will also get you involved in a different set of rules and regulations (all of a sudden you're a restaurant), so stick to selling refrigerated or frozen beef unless the market manager gives his approval.

The opening and closing times vary a lot, too. Some are early markets, open from about six in the morning to about noon,



and some are geared to the business crowd, open for about three hours in the middle of the day. They expect you to be set up one-half hour before opening, and not leave until the official closing time. You need to make your own change, and have your own bags (here's a great use for all those plastic grocery sacks). Bring your brochures and print up a big (hand written) price list, and you are set to go. A few ideas to help sales:

- Display your product
- Display pricing
- Give out samples
- Hang a bright, easy-to-read sign
- Be outgoing

Consider publications like *The New Farmers' Market* and the *Growing for Market* newsletter (***Resources***, p. 88).

MAIL ORDER

We have tried mail order using frozen beef, and it's difficult in the Southwest, especially in the warm months. It requires very expensive special packaging, and either frozen gel packs or dry ice.

We have found that the packaging and shipping (because you have to ship overnight mail) usually far exceeds the value of the product. The small producer will not have the huge volumes that allow you to negotiate less expensive rates with the shipping com-

panies. A large mail order company such as Walnut Creek can ship a package for $4 that would cost you or me $20.

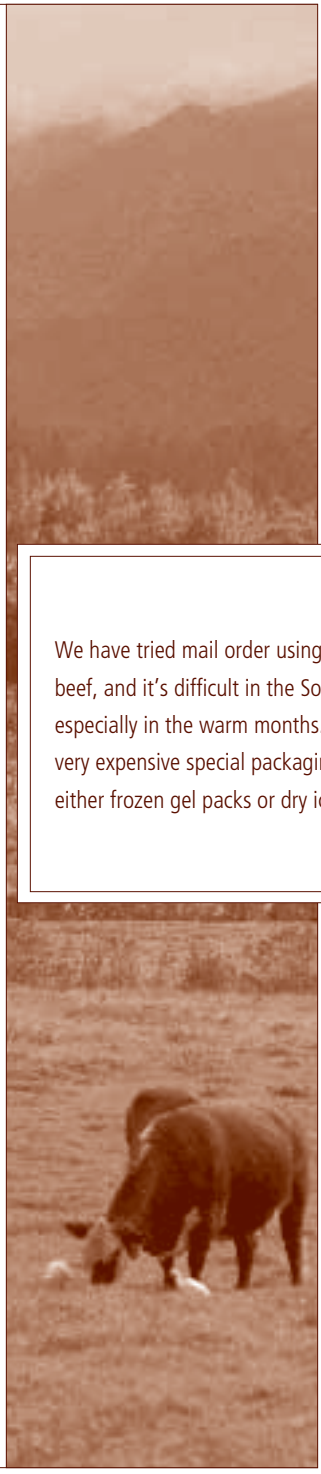
If you want your product to retain its federal-inspection status, you have to package all shipments at a federally inspected plant. We have tried it, but we have not been able to make it work.

If you are going to offer a shelf-stable product, such as beef jerky, mail order can be a viable option. You can go in two different directions – sending out your own catalogs and filling orders directly, or advertising your beef in an already existing catalog and having them fulfill the orders for you.

DIRECT MAIL

If you want to try it yourself, you will need three things: an inexpensive, part-time labor pool, a catalog and a list. The labor pool is usually the easy part. Everyone usually has some teenagers, bored neighbors or someone who would like a little part-time work. It's not hard work, either – it entails placing stickers on envelopes, stuffing envelopes and filling orders.

You will need to invest some cash into self-advertising. While you don't need a glossy, full-color, 24-page catalog, you should consider a one- or two-color direct-mail piece that folds to fit in a regular envelope. (It's a lot cheaper to mail than a larger size.) Include photographs of your products (with food, photos sell better



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than drawings). Usually, it pays to have the photos professionally shot. Again, the graphic design can be done by that same college student or local print shop, but seek a good printer. Looking professional really counts in mail order.

The hardest part is finding a good list. You can locate a list broker through a company that does contract mailings (look up "Mailing" in the yellow pages), who will charge you so much per thousand names and addresses, depending upon the difficulty he has in targeting the audience you want. For instance, if you merely want to mail to a zip code area that you know is relatively upscale, then that will be fairly inexpensive to obtain. Instead, maybe you wish to mail to males, aged between 21 and 45, with an annual income of over $40,000, who participate in outdoor sports and have contributed money to an environmental organization in the last year. It can be done, but it will be a lot more expensive. Your mailings will be more effective, but you have to weigh the effectiveness against the expense.

When you start out, see if you can lay your hands on a free list that contains your target audience. If you or a good friend is a member of a special interest group such as *Californians for the Ferret,* it may be a good bet. Remember to always get permission first. It is illegal to use a list without permission.

Using the Internet to advertise your products can be great, as long as you are very specific about the areas you serve. You want to avoid fielding those endless inquiries from foreign countries that are out of your shipping zones. You can also take orders and process credit cards on the Internet. When we checked into the start-up costs, we couldn't justify the costs with our low volume, but, depending on the scope of your business, it might be worth it for you.

CATALOGS

If you get your product into an existing catalog, they do all the work. However, you only receive a portion of the sales price. Most catalogs retain 50 to 70 percent of the sales price. Granted, they handle the lists, the catalog, the shipping and all the customer-service details, but they also get a great portion of the cash. For that, they reach thousands more people than you can on your own, so you'll have a lot more volume. You'll have to weigh the two factors and see what is best for you.

The big catalogs are notoriously hard to get into. They have huge merchandising departments that receive and analyze hundreds of potential products per day. Even after you convince the merchandising person that your product will sell well, have a decent profit margin, and a low level of customer-service problems, it will be analyzed on a weekly

basis for its profit-per-square-inch performance. In other words, a product must contribute a certain profit for each square inch that it takes up in the catalog. Some excellent products may never make it in a catalog just because it takes too much text to explain it properly. The moment it falls below a pre-determined level, it is dropped. Yet, if you have a hot product in a good catalog, it can mean years of profitability.

It is sometimes advisable to get a sales representative when dealing with catalog companies. They are experienced in negotiating the best deal with the merchandising personnel (who can be ruthless), and with moving you to a different catalog if you are not performing well in a particular one. They charge a percentage of the sale.

Distribution and Trucking

When it comes to transportation, every situation is different. Retail distributors (who wholesale to stores) charge about a 35-percent markup. Restaurant distributors charge about 8 percent. Most other trucking firms charge by weight.

Don't be afraid to dicker over your price or percent with truckers or distributors. They are very supply-and-demand oriented. Being a small customer, you probably won't have the clout to push your weight around, but it doesn't hurt to ask.

With any kind of trucking be very specific:

- Frequency per week, day, month
- Pick up times
- Delivery times
- Who loads and unloads
- Who signs for pick-ups
- Who signs for delivery
- Pallet sizes
- Minimum weights
- Additional costs for unscheduled runs
- Other fees: pallet, lading (freight/cargo)

PHOTO BY EDWIN REMSBERG

Marketing Your Product

Marketing involves two separate, but interrelated areas – sales and advertising. You will need both areas to work together to effectively market your product. It is ideal to have one person be the decision maker for all of marketing. I have seen a lot of large companies flounder simply because their sales and advertising departments were marching to a different drummer.

SALES BASICS

If you decide that restaurants, stores or distributors are the best avenue to sell your product, then you are going to have to make a sales call. If you have had no experience in sales, like most ranchers, here are the basics.

Make a client list that fits your size, marketing goals and so on. Call a potential client on the phone. You will probably get a secretary on the line. Tell him or her that you

are John Smith from John's Natural Beef Company and you are interested in getting your beef into their restaurant or store or catalog and ask to whom you should speak. Be very, very nice to the secretary or receptionist. A secretary or receptionist can be a huge ally or a huge enemy. Thank him or her profusely for the help. Make a note of his or her name, the contact's name, and get the right spellings. Ask for the contact by name after that. You may have to speak with three or four people to get the right one.

Before you go to your appointment, do a little homework. Visit the store or restaurant. Look at their customers. Look at what products they offer and how much space they are given. Find out how long they have been in business. Anything that you learn will help you in your discussion with your potential client.

Practice on an unlikely client. Go in like you expect to do well, but use it as an opportunity to learn how to make a call.

When you get to your appointment, you want to have the following items with you, and four or five sets of each – your brochure, business card, a price list with all items that are available and a proposal. The proposal should state exactly what items you want your client to carry and all pertinent information. This may include delivery information, ordering information, scheduling and sales support material availability.

Bring two sets of product samples. Do not charge them for their samples. The client will expect the samples to appear exactly as the product they will be selling or distributing, down to the last comma on the label. Make sure the samples are perfect. If you are going to sell a frozen product, make sure it is frozen hard. Bring the samples in a pristine ice chest. That one you take to the lake that smells like fish should stay home. Dress like a rancher, but a clean rancher.

Send a thank-you letter to the prospective client a few days later. Say that you will call in a few days to see how he or she liked your product. Then follow up promptly and you are off and running.

If the client is not interested in your product, don't hesitate to ask why. Ask if he or she knows someone who may be interested in what you have to offer. Tell them you respect their opinion. I have received a lot of useful advice and referrals this way. A few times I've gotten some very powerful people to call friends of theirs and set up appointments for me, merely because I told them that I would really appreciate their advice.

Take multiple copies of your brochure, business card, price list and your proposal to every sales appointment; bring two perfect sets of product samples, and do not charge for them.

LOGO & SALES SUPPORT MATERIAL

You will need the following materials when you begin: a logo, stationery and a simple brochure. There are three things to remember:

- Keep it simple.
- Make sure the pieces reflect the taste of the people who will buy your product, not you.
- The quality of your materials directly reflects on the quality of your product.

In my 20-plus years in advertising, I've found that most people, including a lot of seemingly intelligent people, use this opportunity to feed their own egos. I cannot count the number of times that I have had a client insist that their company logo needs to be purple (or whatever) – because it is his wife's favorite color. Name your company something that appeals to your customer, use colors that will appeal to your customer, use language that they can understand. Get your own ego out of it. Your expertise is in beef production, not in design.

Spend time figuring out who wants your product and write it down. Take all this information and create an imaginary perfect customer. Revisit that perfect customer every time you need to make a decision about your sales support material.

Keep your look consistent; it will help people recognize you. Your brochure should be consistent with your label. Your label should be consistent with your business cards.

Now that you know who your target customer is, you can have your material designed. Call a community college with a graphic design department, or try a small printing company. They usually have an on-staff designer and they are very reasonable if you also allow them to print the job.

Do not have it done by a relative, or an old baby sitter, or even your spouse. Also, unless you have recently received a large inheritance, do not go to a professional graphic design company or advertising agency. These types of companies will charge you thousands of dollars more than you need to spend when you are starting out.

Your Logo. Don't rush your name and logo. You don't want to invest a lot of money and time into something only to find it's terribly wrong and you'll have to do it all over. Draw up a few of your favorites and put them up where you and, preferably, your target market can look and comment on them every day for about a week (a refrigerator, office cooler, bathroom mirror). After a while, you will see some definite winners emerging and some definite losers. It will make your decision easy.

First you need a name. Make sure that it is relatively short, and keep in mind your target customer. Alan Nation, editor of the Stockman Grass Farmer, believes that you should name it after yourself or your family. The most important aspect of your product is your credibility – and using your name

reinforces that belief. It gives you leverage when you sell your company to Ted Turner for billions of dollars. Ted will want to keep Fred Smith as a spokesperson on retainer with Fred's Family Beef for at least 10 years. That sounds like a very good reason to us.

Go with simple graphics. Consider a simple type treatment, perhaps an old woodcut or simple drawing. Leave the tricky symbols to professional graphic designers. Unless done extremely well they usually look dated in a few years. Moreover, logo design can be more costly than you think.

Make it one color. Multi-color anything just adds expense to your printing jobs and makes consistency harder to control. And it will not add to your sales. People expect a great deal of sophistication when they see a complex logo, they won't expect it of you. You just need to look professional and credible.

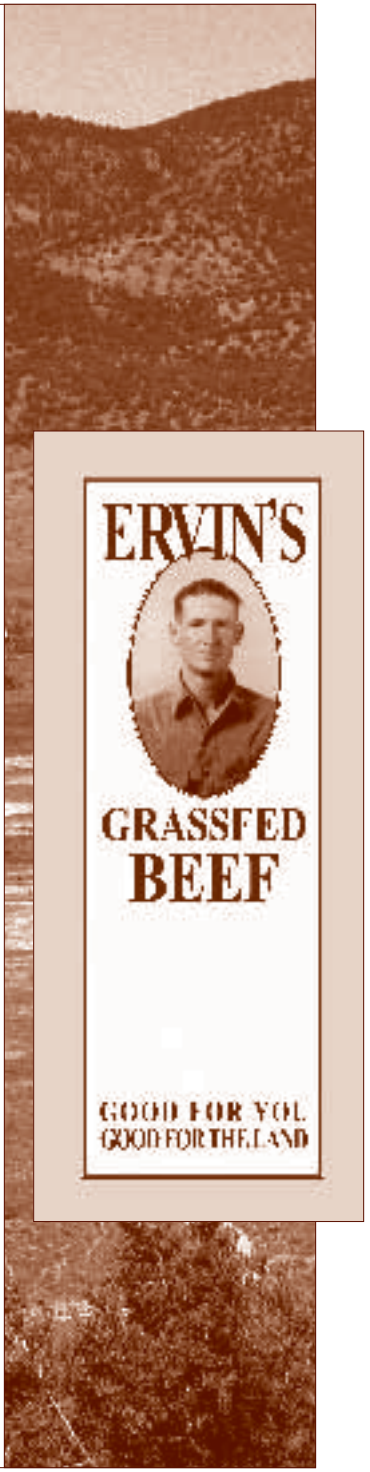
Brochures. You will probably need a small brochure. People want to know something about who they're buying from. If you keep it simple enough, and don't put in pricing (which can change often), you will be able to use your brochure for a lot of things. The most cost-effective size is 8½ x 11 inches, folded twice so that it fits in a number 10, business-sized envelope. Make it one color, but do include a photo of yourself, or the family, if they work in your business at all. It adds little to the cost and it helps people identify with you. Have the photo taken with a digital camera if possible, so that you

can email the photos along with your copy when sending your brochures to a printer, as well as to the media when soliciting coverage.

Have a professional take photos. You probably know someone who has shot some good wedding photos who will trade for some beef. Also, take some extra shots: one of you alone, some with your whole family. Dress in work clothes and pay attention to what is in the background. A horse or a barn and rolling hills is better than your wife's Toyota. You can always use some for your company's holiday cards or send some to *Acres* magazine when they do that article on you being a fabulous success.

Tell a little about yourself in the brochure. The most important thing to talk about is what this product will do for the customer. Mention the health aspects, the food safety issues, and how your product is better for the land. Describe your humane treatment of animals, how your ranching practices benefit endangered and threatened species, or how your customer's purchasing of a local product eliminates petroleum use.

Use recycled paper when you print, and have the printer include the appropriate recycled symbol in the bottom corner. The folks who will pay more for a natural, organic or grass-fed product expect you to have environmentally sensitive stationery, too.



Advertising Basics

The two most important points to include in any advertising are:

- Customer Benefit: What's in it for the consumer? Does it taste better or is it better for the environment?
- Call to Action: After people have seen your ad, what next? Do you want them to call for more information, buy now, or look for you at the store? End every ad with a call to action.

Effective advertising can actually be done in a number of ways. Beyond paid advertising, consider using public relations strategies: having articles written about you in newspapers, magazines, radio and television; product sampling events; or speaking engagements. The most important thing to remember is: Do not spend any time or money promoting your product to people who are not predisposed to buying your product and who do not have an avenue to do so.

We know of one struggling beef co-op that actually provided free samples to a state fair, even though less than 1/10 of 1 percent were potential customers, and even worse, less than 1/30 of 1 percent had an avenue in which to buy their beef. It cost them thousands and thousands of dollars to reach a tiny percentage of their potential target customers.

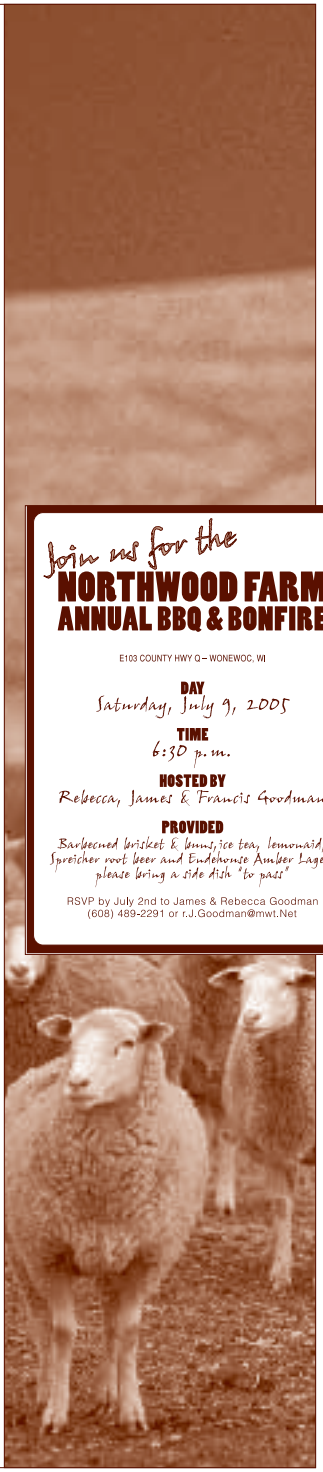
Here is a good rule of thumb regarding advertising: When introducing yourself to a new market, your advertising should

create a 15-percent increase in demand (compounded) with each showing, and plateau after about four showings. The percent varies depending on industry and maturity of market, but it is a good place to start.

Public Relations

You can obtain a lot of free PR, but it usually requires some effort on your part. Are you doing something interesting that could make a news story? If you have a story to tell, the press will probably write about it. Are you raising your beef differently than your neighbors? Are you fencing off areas for a threatened species? Are you providing internships for local kids?

Call the local papers and ask who covers environmental issues, agricultural issues or human interest. Then write a note to the appropriate person and include all the pertinent details. It doesn't have to be too fancy, but make sure it goes to the correct person. Include one of your brochures and the name and number of a contact person, in case they need more information or they want to send out a reporter or photographer. Hit all local TV, radio, newspapers and magazines. When you get a little larger, it will be helpful to make up a press kit. This will contain all the information in your brochure, plus a lot more specific information about yourself, your beliefs, and your operation. Also include any press clippings at the back.



Another way to obtain free exposure is to offer yourself for speaking engagements.

Call local civic clubs if you have an interesting story to tell. Locate the special-interest clubs in your area that might be interested in what you have to say. Maybe it's a story about your efforts to restore health to the rangeland. Again, make sure that these are your target customers. Speaking at a soup kitchen shelter may be a wonderful thing to do, but those people are probably not going to have the discretionary income to purchase your product. Speaking to the local chapter of the Sierra Club, if you are speaking of your ranch's conservation efforts, is probably a better bet.

The same is true for product sampling. It works really well to distribute samples to a pre-qualified group. For instance, we give out product information and samples at our biggest client's yearly new-product fair. We give out jerky samples at farmers markets. We give our beef to a wildlife rehabilitation center's annual fund-raising dinner.

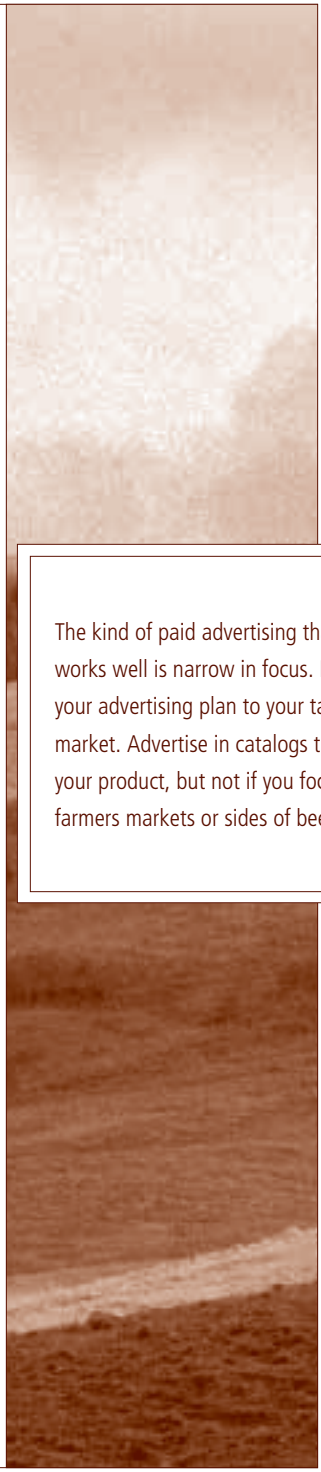
Paid advertising in newspapers, magazines, yellow pages, outdoor boards, radio and television are generally useless to the small beef producer. They are too expensive to cost-effectively reach your narrowly targeted customers. Do not even speak to the advertising salespeople who will contact you. They are armed with a lot of charts, graphs, demographics, psychographics, double-speak, and gobbledygook. Remember: All

advertising salespeople have their agendas. They will do anything to sell a $30 radio spot. That is all you need to know.

The kind of paid advertising that works well is narrow in focus. Match your advertising plan to your target market. Advertise in catalogs that sell your product, but not if you focus on farmers markets or sides of beef. Give away informational flyers in the stores that carry your products. Print up small table tents to place on tables in restaurants that sell your products. These are generally very effective and inexpensive.

Remember to stress the benefits to the consumer. Make it simple. Don't try to say too much in one ad. Make all type at least 12 points in size. Make headlines very short. Always include your logo and where to buy your product. Always include a "call to action." Tell them clearly what you want them to do: "Call 1-928-428-0033 and order today," or "stop by Tucson Cooperative's Cash-and-Carry Outlet and pick up some steaks today!"

The Internet is the hot advertising medium right now. Some producers find that websites – such as LocalHarvest.org and EatWild.com, which maintain directories of direct market farmers – provide good promotional channels. Local Harvest, for example, calls its nationwide directory of local food sources "the no. 1 informational resource for the 'buy local' movement and the top place on the Internet where people find information on direct marketing family



The kind of paid advertising that works well is narrow in focus. Match your advertising plan to your target market. Advertise in catalogs that sell your product, but not if you focus on farmers markets or sides of beef.

farms." You can register yourself for free, and their search engine will help people find you when they're looking for meat produced off the grid.

It may or may not work for you. We found that directory-type websites are an excellent resource for our customers to learn more about us, our company and our standards. Since we developed our own website, our telephone time spent with customers wanting to know if we treat our cattle humanely, or if we feed animal by-products, has been cut almost to nothing. However accepting online orders never worked for us. It is simply impossible in Arizona to ship product even overnight with specialized packaging, and have it arrive intact in the month of August. Even though we were specific about the geographic area that we serve, we continually had to field inquiries from far away spots like Japan. So we use the web as an educational support system for our clients.

Record Keeping

As a cattle rancher, you probably already have a bookkeeping system. It might be a simple manual system or a sophisticated computer program. Whatever it is, separate the books for your beef marketing company from your personal and ranch books. This will enable you to clearly define the performance of your new endeavor. I know that most ranchers just lump all their personal finances in with their ranch finances. Yet, it

is important to at least separate your beef company on paper, or you will never be able to tell exactly how much money you generate.

These simple forms keep us organized:

- Master log-in form: Orders are numbered and logged in. Other forms and invoices pertaining to these orders share the same reference number. This keeps us from mixing up orders.
- Job order form: Contains all ordering information. After the order is paid, we file them by client so that we can refer to them later (***left***).
- A delivery receipt: We use this when we deliver to stores. It is signed and dated by the recipient in a space provided. With small stores, different people may log in deliveries on different days, so getting a signature is crucial.
- Invoice: The original job order form becomes an invoice after the order is delivered. We generate these on the computer and keep them in a separate file until the invoice is paid. We file them by client (***right***).

We also have started keeping records of sales by product and by month. We have found that there is a great deal of variance in sales over the year. For instance, sales tend to plummet during late December and early January. Sales tend to be the highest, especially for steaks, in the summer months. Keeping the numbers and charting them has helped us schedule our cattle more effectively.

growing profit

Many small cattle ranchers are suffering financially these days. With the increased costs of operating a ranch, the decreased returns of commodity beef, the additional scrutiny that faces public land ranchers and the pressure from many environmental groups, it's a wonder that anyone raises cattle at all.

Yet, through direct marketing there is a world of opportunity. Research shows that the organic and grass-fed markets are making huge incremental gains each year. Many people are looking for local products to feed their family. The increase in food safety issues such as BSE (bovine spongiform encephalopathy), or mad cow disease, brings even more opportunities for the small, local producer.

Our Vision of the Future for Small Beef Operations

Many family farms and ranches are simply too small to play the commodity game. Stan Parsons, of the Ranching for Profit School, figures you need a minimum of 1,000 head to be profitable. If you don't, you need to find a new game. Direct marketing is a good game.

Worldwide, the organic market is the fastest-growing segment of the food industry. We are just now beginning a nutritional revolution that will revive demand for grass-fed beef, lamb, chicken and dairy. This period is to family farming what the 1970s were to Silicone Valley, or what the 1940s were to Detroit.

If you have the marketing skills, or the desire to develop them, you will thrive in this demand-driven market segment. This is one of those periods in history when you want to have all your ducks in a row. Ride this wave up and have yourself positioned when the market matures in 15 to 20 years.

Developing Growth

As soon as you have your first client on board, you will be tempted to go out and try to bring on lots more. Since we are selling six head a month with no problems, won't 60 per month just be better? Won't that get the ranch out of our financial hole just that much quicker? Try to calm yourself down and be sensible. Grow slowly. Do not assume that now that you have the first client, the others will be easy. They're not.

Each client is unique and will keep you busy solving all the different problems. Remember, if you disappoint a client once and don't make that delivery, he or she will probably dump you. Very few restaurants, stores and distributors will forgive you. After all, they had to disappoint their customers too. They lost sales. They lost money, and it is your fault.

PHOTO BY EDWIN REMSBERG

As long as you are centering on one type of business, small health food chains, for example, keep adding chains, one by one, making sure that you solve the problems one by one as they come up. Give each new acquisition, no matter how small, to your family of clients a minimum of a month or two to become familiar with your product and your company. Learn their way of doing things.

Say you decide to take on a client in a type of business that is different from anything you've handled before. You have three small chains of health food stores that are doing very nicely. You know the purchasing people now and they ask for you by name. Recently you made a presentation to a new distributor. He wants you. You want him. But take it slow.

Remember, you reinvented the wheel here. Every new type of business has its own set of challenges. Give a major new client six months to work the bugs out. We know that seems like a long time, but it is a lot better to have four happy customers than to take on 10 and lose nine because of problems.

Maximizing Your Performance

You may hear mention of beef "fitting in the box." That means your carcass is generally suited for mass-marketed beef, but it's hard to know what they want.

Each segment of the industry makes its money differently. The calf people make their money off cows that cycle back quickly. The stocker people make their money off fast growth on grass. The feedlot people make their money keeping their lot full. The packers make their money by slaughtering as many animals as they can.

So where does tenderness or marbling come into play? It usually doesn't mean too much if you're selling commodity beef. However, there are some exceptions. Bill Niman (*right*), founder of Niman Ranch, built a reputation for quality. For the rest of us, until the industry vertically integrates, there won't be much additional profit in creating a better product for the commodity markets.

With all that in mind, you can see that most of those cogs in the wheels of big industry don't apply to you. You will have to be your own research agent. There are a lot of folks like you out there doing different things. You will want to network with them and compare results.

What kind of cattle are the best for a grass-fed niche in Alabama? What is the point of diminishing returns with a grain-on-grass program in Utah? If you are lucky, you may find some research, but it's been our experience never to believe anything until you try it yourself.

There is a lot more good information out there than when we started. Most of the organizations and information listed in ***Resources*** (p. 88) are pretty new. With any luck and a lot of planning, you won't make all the mistakes we made. Despite the trials we went through, we are very happy with our choice to direct market our beef. We think you will be, too.

RICHARD AND PEGGY SECHRIST ON THEIR TEXAS RANCH — PHOTO BY PEGGY JONES

Factors that Impact Your Bottom Line

Written by Dan, Peggy & Richard Sechrist

What follows are some of the nitty-gritty details you need to consider in your profit equation. While you probably want to consider these options before launching a direct-marketing strategy, there is always opportunity to revisit these costs at any stage of the game.

Production costs. If you want to truly calculate your profit margin when direct marketing beef, you must include the full cost of production. You may even want to treat production costs as a separate "business" in your bookkeeping. Production costs are the total cost of the raw material needed to create your packaged product. It is essential to know if your gross profit covers the replacement value for the animals you are selling.

Processing costs. Processing costs for individual beef producers can vary a great deal and can take a big chunk out of your bottom line. The easiest way to compute and monitor processing costs is to calculate per head. The difference between your total cost and the total price you receive from the sale of each animal is your profit margin. The retail market price of beef is heavily influenced by the large beef packers who process several thousand head of cattle per day in their own facilities. This volume gives them a competitive edge by lowering their

processing costs per head, and allowing them to set a low market price on beef. By contrast, individual beef producers may pay as much as 800 to 900 percent higher costs for processing and still need to price their beef within a competitive range. So managing your processing costs is very critical to your bottom line.

Market requirements. Who you are processing for is a related cost that requires careful management. When you decide to market your own beef, you may sell to three different markets:

- Distributors, who re-sell your beef to retailers
- Wholesale markets, such as retail food stores and restaurants
- Direct to consumers

The sales price structure for each of these segments is different. You receive the highest price when you sell direct to consumers. You receive a lower price for wholesale, and lower still for distributors.
The requirements for how you cut and package your beef may differ among these market segments, too.

For example, the distributor may want each steak and roast "portion cut," meaning that each cut weighs exactly the same. Portion cutting adds additional cost to your processing fees while generating the lowest price. Wholesale customers may also make special requests that add to your costs. Selling direct to consumers may require you to use a USDA-approved label. You will need to discuss this with the licensed inspector at your processing plant. All these marketing options directly impact your profit margin. It pays to research and analyze your markets before you spend much money on your processing.

Carcass yields. It's important to calculate the percentage of each animal that returns to you as saleable beef after processing. That percentage can either help you achieve your desired profit margin – or wipe it out completely. There are industry averages, but there is so much variance that it behooves a producer who direct markets his own meat to calculate – in pounds – how much beef is available to sell after processing, then calculate what that available beef will return to see if the resulting profit margin is acceptable. Each animal is a bit unique in its capacity to finish.

Collecting data from each animal as it is processed – or averaging each group of animals processed – is vital to determine which slaughter weight leads to the highest yield of meat to sell.

Your yield from live weight to boxed beef is the yield you want to track. If you process 100 animals, all at 1,000 pounds live weight, your yield could vary more than you realize if you don't collect that data. If your yield of meat drops by as little as 3 to 5 percent, you can lose a large portion or even all of your profit. For example, a 5-percent yield deviation on 100 animals processed at 1,000 pounds live weight could reduce your profit margin by $20,000. Tracking this information as it occurs gives you a window of opportunity to strategize how to regain some profit before your product is sold.

Storage and obsolescence risk. There is substantial risk to creating a high number of different cuts to satisfy all the requests you may receive. You could butcher a carcass into 20 or more different cuts in pursuit of different customers. Yet, unless you have a guaranteed commitment for a special cut, you could easily find yourself with a stockpile of those cuts in frozen storage. The revenue that these cuts represent, along with their storage costs, could easily wipe out your profit margin.

A similar risk is to discount cuts that accumulate in storage. Discounting also will reduce your profit. Eight to nine of the most popular cuts give you the greatest flexibility to sell the whole carcass within a reasonable period of time.

Management skills. Managing the sale of several beef cuts as opposed to selling a live animal requires different management methods. You'll find it important to know exactly what your total cost is in each animal as well as knowing exactly what your gross profit is for each animal. Because small deviation in yields or accumulation of a few cuts can so dramatically impact your bottom line, you will want to track your return on each animal and be poised to make adjustments before you find yourself somewhere in the red. ■

resources

Agriculture Marketing Resource Center. A national information center for value-added agriculture. www.agmrc.org. Information on "natural," organic and direct marketing beef. www.agmrc.org/agmrc/commodity/livestock/beef/beef.htm.

Alternative Farming Systems Information Center (AFSIC). Provides free assistance and resources to farmers and agricultural professionals, including information on livestock production and marketing. (301) 504-6559; www.nal.usda.gov/afsic

ATTRA. National information service offers 200+ free publications on farming and marketing, many about livestock production and marketing. (800) 346-9140 / Spanish (800) 411-3222. http://attra.ncat.org/

Direct and Local Meat Marketing Project, University of Kentucky. Online resource for livestock producers includes budget spreadsheets and yield and pricing guides. www.uky.edu/ag/kymeat

Sustainable Agriculture Research and Education (SARE). SARE provides grants to researchers, agricultural educators and producers to study and spread information about sustainable agriculture, including direct marketing, via a nationwide grants program. (301) 504-5230; www.sare.org

Sustainable Agriculture Network (SAN). SAN delivers cutting-edge research results with books, bulletins and electronic resources for producers, educators and researchers. (301) 504-5236; www.sare.org

USDA Small Business Development Centers. Provides management assistance to current and prospective small business owners. 800-8-ask-sba; www.sba.gov/sbdc/

PUBLICATIONS

Adding Value to Beef Production. Assists those beginning a value-added agriculture business venture with tried-and-true methods. Iowa State University Extension. www.ciras.iastate.edu/beefmanual

Alternative Beef Marketing by ATTRA. Explores marketing alternatives for small-scale cattle ranchers who want to add value to their beef. www.attra.org/attra-pub/beefmark.html

Alternative Meat Marketing by ATTRA. Includes production and processing, direct marketing options, legal/regulatory considerations, organic certification and targeting ethnic markets. http://attra.ncat.org/attra-pub/altmeat.html

Building a Sustainable Business: A Guide to Developing a Business Plan for Farms and Rural Businesses. Transform farm-grown inspirations into profitable enterprises with sample worksheets for researching processing options, potential markets and financing. 280 pp. $17 to the Sustainable Agriculture Network, (301) 374-9696, www.sare.org/WebStore

How to Direct Market Meat – Is It An Option for You? by Anastasia Becker, Community Food Systems and Sustainable Agriculture, University of Missouri Outreach and Extension. http://aes.missouri.edu/swcenter/sustain

Direct Sales of Beef. Suggestions for selling beef directly to consumers. Nebraska Cooperative Extension. http://ianrpubs.unl.edu/beef/g1420.htm

The E Myth Revisited by Michael Gerber. Dispels the myths about starting your own business. 288 pp. $16. (866) 201-7601; www.powells.com

Energy-Efficient Grass-Based Meat and Veal Production and Marketing Manual. Center for Agricultural Development & Entrepreneurship, www.cadefarms.org/publications.htm

Grass Productivity by André Voisin. Maximizing productivity in grass and cattle operations from one of the earliest proponents. 370 pp. $30. www.Amazon.com

Holistic Resource Management by Allan Savory. Practical instruction in financial, biological and land planning. Case studies drawn from real-life situations lead the reader through the process. 590 pp. Prices vary. www.Amazon.com

Marketing Grass-fed Beef by the Kansas Rural Center. Marketing pamphlet with gross margin marketing worksheet. kansasruralcenter.org/publications/grassfedbeef.pdf

The Meat Buyers Guide by the North American Meat Processors Association. Meat identification manual, with more than 295 illustrated cuts, buying and ordering procedures, nutrition data, food safety and grading standards. 199 pp. $52, www.Amazon.com

The New Farmers' Market by Eric Gibson. Tips and trends from leading sellers to best display and sell product. 272 pp. $24.95. (301) 374-9696; www.sare.org/WebStore

Organic Livestock Workbook: A Guide to Sustainable and Allowed Practices by ATTRA. http://attra.ncat.org/attra-pub/PDF/livestockworkbook.pdf

Pasture Profits with Stocker Cattle by Allan Nation. How to improve profits with less financial risk. 224 pp. $28.50. Stockman Grass Farmer, (800) 748-9808; www.stockmangrassfarmer.com

Permaculture: A Designer's Manual by Bill Mollison. Philosophies of land use, soil, agricultural and livestock management, irrigation, and more. $75 (hard cover). www.Amazon.com

Salad Bar Beef by Joel Salatin. How to make a good profit with a small beef cattle operation. 368 pp. www.chelseagreen.com/1996/items/516

Shelter & Shade: Creating a Healthy and Profitable Environment for your Livestock with Trees by John & Bunny Mortimer. 160 pp. $20. The Stockman Grass Farmer, (800) 748-9808; www.stockmangrassfarmer.com

MAGAZINES

ACRES USA. A comprehensive guide to sustainable agriculture. (800) 355-5313; www.acresusa.com/magazines/magazine.htm

Small Farmer's Journal. Focuses on livestock breeds, organic farming and equipment. (800) 876-2893; www.smallfarmersjournal.com

Stockman Grass Farmer. Describes grazing technology and pasture management. (800) 748-9808; www.stockmangrassfarmer.com/sgf/

Small Farm Today. Preservation and promotion of small farming, rural living, community and sustainability. (800) 633-2535; www.smallfarmtoday.com

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WEBSITE Log on to www.sare.org/WebStore.
FAX Send form & credit card information to (301) 843-0159.

Contact sanpubs@sare.org or (301) 374-9696 for more information.

ABOUT YOU

☐ Farmer ☐ Rancher ☐ Consumer ☐ Educator

How do you plan to use your SAN resources?

SHIPPING

Full name

Street

City State ZIP

Phone

Email (required for shipping confirmation)

PUBLICATIONS[1]	QTY	COST	TOTAL
Manage Insects on Your Farm		$15.95	$
How to Direct Market Your Beef		$14.95	$
The New American Farmer		$16.95	$
Building a Sustainable Business		$17.00	$
How to Manage the Blue Orchard Bee		$9.95	$
Building Soils for Better Crops		$19.95	$
Managing Cover Crops Profitably		$19.00	$
Steel in the Field		$18.00	$
The New Farmers' Market[2]		$24.95	$
		Your discount[1,2]	– ($)
		Shipping [3]	$
		Subtotal	$
		MD residents please add 5% sales tax	$
		TOTAL PAYMENT DUE	**$**

PAYMENT

☐ Check/money order enclosed (payable to Sustainable Agriculture Publications)

☐ VISA or ☐ MasterCard

Cardholder name

Card number

Cardholder signature

1 25% discount for 10 books or more ; 50% discount for 25 books or more.
2 Sorry, discounts are not available for "The New Farmers' Market."
3 Add $5.95 for the first book and $2.00 for each additional book shipped within the U.S. Call (301) 374-9696 for more information on bulk, rush, or international shipments. Please allow 3 weeks for delivery.

SUSTAINABLE AGRICULTURE NETWORK
publications

Manage Insects on Your Farm: A Guide to Ecological Strategies – Crop diversification, biological control and soil improvement strategies for pest management. 128p.

How to Direct Market Your Beef – A thorough how-to for ranchers interested in direct markets for grass-fed beef. 96p.

The New American Farmer, 2nd Edition – Producer profiles spotlighting profitability, stewardship and community improvement.

Building a Sustainable Business – Follow a farming family as they build and implement a business plan. 280p.

How to Manage the Blue Orchard Bee – Learn how to raise this alternative orchard pollinator. 88p.

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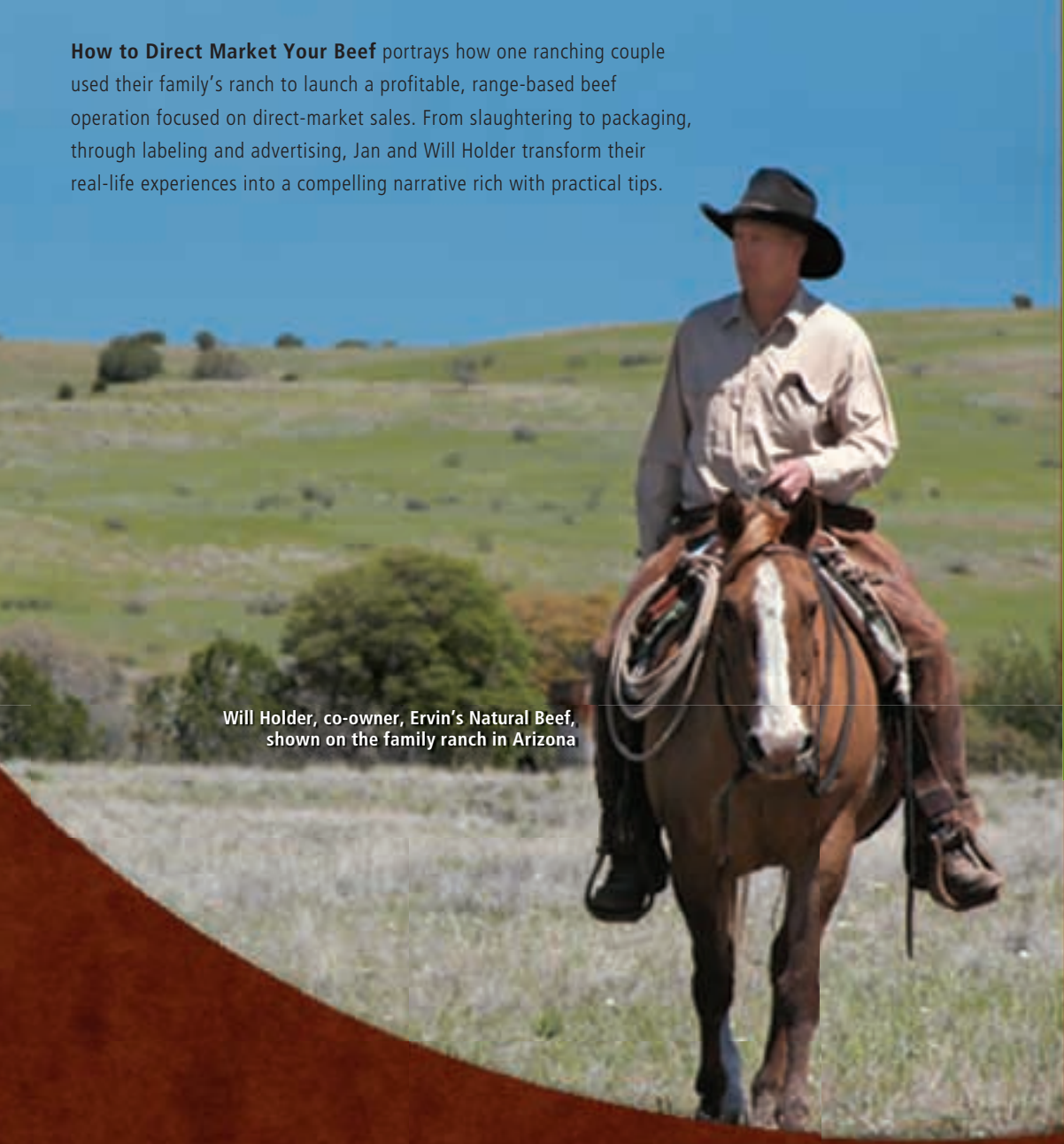
How to Direct Market Your Beef portrays how one ranching couple used their family's ranch to launch a profitable, range-based beef operation focused on direct-market sales. From slaughtering to packaging, through labeling and advertising, Jan and Will Holder transform their real-life experiences into a compelling narrative rich with practical tips.



Will Holder, co-owner, Ervin's Natural Beef, shown on the family ranch in Arizona

"This is an excellent overview and how-to manual for someone interested in starting a direct-market beef operation."
Jim Goodman, Dairy/Beef Producer, Wonewoc, Wis.

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