Evaluating Grains Grown in Aroostook County, Maine to Determine the Feasibility of Producing a Locally Grown Poultry Feed -- FNE02-400

Final Report

Presented by:

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Background

Northern Aroostook County, Maine has one of the shortest growing seasons in the nation. Due to cold wintertime soil temperatures and late springs, the soil temperature does not allow planting of most crops until the middle of May. Many other crops, such as field corn, cannot be planted until June. Frosts in late August and early September keep our growing season short. The few attempts at growing field corn have netted poor yields and have required harvesting after snowfall.

Aroostook county is primarily "potato country." Grains are considered to be a secondary crop. The markets for these grains are poor. Recently, a small portion of Aroostook farmers have started growing organic wheat for a Maine organic bread company. Farmers need to find economically viable organic rotation crops. The markets for unprocessed organic grains are a long distance from northern Maine.

Concurrently, there is a definite lack of organic poultry feeds in the state of Maine. Feeds are available from Pennsylvania, Vermont, and Quebec. The shipping makes purchasing these grains unfeasible for most small organic farmers. I have not yet found any organic poultry feeds offered for sale in Aroostook County, Maine.

Corn is the primary ingredient in most poultry feeds. As previously stated, it is not feasible to grow field corn in northern Aroostook County. Other grains, such as barley, have similar energy and protein values as corn. Soybean meal is the primary source of protein in poultry feed. Short season varieties of Soybean can be grown here. Since soybean is a legume, it is an ideal rotation crop for the wheat farmers. Additionally, a soybean extruder has recently been set up in Aroostook County. All of these facts combined suggest that it may be possible to make a local organic poultry feed. Doing so would provide a boost to struggling small farmers in northern Maine.

All poultry, but especially turkeys, have very specific dietary needs. Failure to meet all dietary requirements leads to diseases such as Rickets or conditions such as stunted growth. Therefore, any grains used to make poultry feed needed to be tested for dietary properties. Sources for organic vitamin supplements needed to be found.

My project determined whether a local poultry feed could be made. Some book values could be used. However, values vary based on land quality. For example, the book value for Buckwheat Middlings is 29% protein. The actual value in Aroostook County is 17%. Since most grains are vitamin deficient, I already knew that I needed to use vitamin supplements.

I tested grains grown in different parts of Aroostook County to determine average feed values. Once test results were obtained, I had a poultry nutritionist analyze them with a computer to determine the most nutritionally complete formula using just grains. Then, I researched and obtained suitable organic vitamin supplements.

Goals

The original goals of the project were as follows:

A. Research the dietary requirements for laying hens, broilers, and turkeys. Since the field research has already been done, I only need to find the results of previously done experiments.

B. Obtain grain samples from organic farmers throughout Aroostook County, Maine. Hulled oats, hull-less oats, barley, wheat, and soybean will be tested. I will take samples from Southern Aroostook, Central Aroostook, and Northern Aroostook to attempt to attain a regional average. I will only take samples from organic farmers because organically grown grain could possibly have different properties than non-organically grown grain. I will also obtain samples of fish meal (not an Aroostook County product, but important to the feed).

C. Send all samples to Midwest Forage Analysis Lab in Omaha, Nebraska to be nutritionally analyzed. Due to the high cost of feed analysis, I will premix the samples and only analyze one sample per grain type. For example, I will mix together all barley samples in my grain mixer. I will then take a sample of the mixed barley to send to the lab.

   Since the high amino acid concentrations are only found in the soy and the fish, I will only sample these products for amino acids. Amino acid testing is very expensive. It is important to have correct amino acid levels in chicken feed.

D. Create a spreadsheet. The spreadsheet will have columns for grain type, cost, amino acids, vitamins, fiber, protein, and minerals. It will also have a column for ration %, so I can change the ration on the computer to determine the dietary values in the final product.

E. Compute the values of amino acids. Amino acid concentrations can be computed from the other analysis.

F. Compare the nutritional values of Part D with the dietary requirements of poultry. Several rations will be reviewed. I will find the best ration for layers, broilers, and turkey; and locate any deficiencies.

G. Locate organic sources for vitamin and mineral supplements. I will research sources for both synthetic and organic vitamins and minerals, but will give preference to organic.

H. Find the most complete feed for layers, broilers, and turkeys.

J. If feed is deemed acceptable, research licensing requirements.

Farm History

We (my husband and I) currently operate a 214 acre farm, plus rent 80 additional tillable acres. We raise beef, laying hens, turkeys, organic grains, timber, and operate a portable sawmill. We are in the process of converting our entire farm to organic production. Even though we both have other jobs, we spend enough time working on the farm to consider it another full time job.

The farm has been in operation for well over 20 years by family. We have only been managing the farm for the past 5 years. Eventually, we hope to rely on the farm for 100% of our income. We are well on our way of making this dream a reality. We recently received two grants from Coastal Enterprises, Inc (CEI). The first provided assistance in writing our business plan. The second is providing financial assistance to upgrade some of our equipment and help with other startup costs. Due to the generous help from SARE and CEI, we are increasing our beef herd size and opening a mill which processes a new line of organic poultry feed.

Cooperators

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Linda Kling served as project nutritionist. She drafted the feed formulas that I used in my feeding trials. She was a superb resource, and made many excellent suggestions on my formulas. Russel Libby and his staff at MOFGA, my organic certifiers, served as brainstormers whenever I was stuck on a problem. Dr Mike Opitz kept me in touch with MAPA, the Maine Alternative Poultry Association. Deena Potter helped with brainstorming and with disseminating project materials.

Project Portfolio

In the fall of 2002, I visited seven organic grain farmers in Aroostook County. Each farmer provided a small sample of grain crops grown in 2002. Grains collected were barley, oats, hull-less oats, and wheat. I mixed equal portions of like grains together (oats with oats, wheat with wheat, etc). From these conglomerate samples, I packaged a single sample of each grain type for analysis. A complete proximate analysis with minerals was completed for each sample. Copies of the proximate analyses were forwarded to Linda Kling, project nutritionist. Results from the proximate analyses are outlined in table 1 at the end of this report.

Concurrently, I researched sources for organic vitamins and minerals. I obtained a list of organic feed suppliers from ATTRA (Appropriate Technology Transfer for Rural Areas). I contacted all listed producers of organic poultry feed or minerals. I obtained the analyses of all available vitamin and mineral premixes. Through queries, I pinpointed which companies were updating their mixes to stay current with the updated organic regulations. I forwarded copies of the premix analysis to Kling. She eliminated all but two of the premixes, citing them as not being complete. I picked the final premix to use in this study based on the company's dedication to staying organic.

Linda Kling used the premix analysis and the grain analyses to create rough draft feed rations. Kling computed amino acid values using data from the grain analyses. She then used these values in a computer program to compute formulas nutritionally complete diets. Kling indicated that barley could only be used in poultry feed if a digestive enzyme was added to the feed rations. Poultry are lacking the enzyme needed to break down barley. She also indicated that, without corn in the rations, egg yolks and poultry skin would be pale. Feed rations are nutritionally complete without the pigments found in corn. The pigments simply make the end product more desirable. Synthetic pigments for darkening yolks are available, but these are not organically certifiable. I needed to research a similar source of organic pigments.

Rations were tested for palatability on my own flocks of laying hens and turkeys. While conducting palatability trials, I tested various organic pigments. I used paint chips to record egg yolk colors pre-trial and using different pigments. Organic pigments tested included spinach powder, duckweed, spirulina, and calendula. These all had varying degrees of effectiveness. The most potent was spirulina, followed by calendula, duckweed, and spinach powder.

I had some unexpected results concerning grain palatability. Young poultry (< 4 weeks old) will not eat oat hulls. They also will not eat whole or coarsely ground hull-less oats. This means that starter feeds must be made, in entire, of finely ground hull-less oats and soya. Growing pullets also cannot be fed whole hull-less oats. They cause uneven growth rates in the flock. Flocks fed only ground hull-less oats had uniform growth rates. Adult layers will not eat finely ground hull-less oats; they must be coarsely ground or whole. Fat added to the ration makes ground hull-less oats more palatable. Adult layers like the whole hull-less oats, assumedly because they look like maggots. Turkeys were not fed any oats, only hull-less oats and soy. Turkeys will not eat whole hull-less oats until they are 6 weeks old. After that age, they will eat them but do not seem to prefer them. They do not have a preference between coarsely ground and finely ground hull-less oats. Ground wheat was palatable. Barley was not used in tests, as it is not digestible by poultry.

In summary, it is possible to make a nutritionally complete poultry feed using entirely Maine-grown grains. While it is possible to use barley in the rations, an enzyme must be added to aid in digestion. The growing season in Maine is too short to raise dry field corn. An organic feed would be restricted to soya, wheat, oats, and hull-less oats. Due to availability, organic vitamins and minerals must be imported from out-of-state.

There is a licensing fee for feed rations in the State of Maine. A copy of the guaranteed analysis, the feed label, and an $80 fee per product must be sent to the Maine Department of Agriculture, Food, and Rural Resources Division of Quality Assurance and Regulations in Augusta, Maine.

Miscellaneous Info

The short growing season in Maine was the primary reason for this SARE project. Most poultry feeds are corn based. We cannot grow dry field corn in Maine. Therefore, alternative grains needed to be identified.

This SARE project triggered a wealth of new ideas, and will result in an increase in our farm income. The preliminary results from the SARE grant indicate that making an organic Maine based poultry feed is possible. As a result of our positive findings, we have invested in some farm machinery that will make this idea a reality. We plan to capitalize on this information by actually opening an organic feed mill. We have enlisted the help of Coastal Enterprises Inc, based in Portland, ME, to fund part of the start-up costs. The product, organic Maine-grown poultry feed, will be sold throughout the state. Production is expected to begin in October or November of 2003.

Public Outreach

I designed and created a brochure that outlines the findings from this SARE project. I disseminated these brochures at a booth at the Common Ground Country Fair in Unity, Maine on September 19, 20, and 21 2003. I also gave a presentation at the fair on Sunday, September 21. Approximately 25 people attended my presentation. A few thousand people attended the fair. A copy of this brochure is included with this final report.

Catherine Albert

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Date

Oct 3, 2003

Table 1 Grain analysis results for organic grains sampled from Aroostock County, Maine.

	Wheat		Soybeans		Oats		Barley		Hull-less Oats	
Component	As Sent	Dry	As Sent	Dry	As Sent	Dry	As Sent	Dry	As Sent	Dry
Moisture %	12.02		12.85		10.14		12.22		10.57	
Dry Matter %	87.98		87.15		89.86		87.78		89.43	
Crude Protein%	13.4	15.3	40.3	46.3	12.4	13.8	13.2	15.1	15.9	17.8
Crude Fat %	1.87	2.13	16.7	19.2	4.14	4.61	1.9	2.16	6.23	6.97
Acid Detergent Fiber %	2.56	2.91	5.68	6.52	12.2	13.6	5.87	6.69	4.04	4.52
Ash %	1.54	1.75	4.04	4.64	1.93	2.15	1.84	2.09	1.71	1.91
Total digestible nutrients %	76.8	87.2	84.5	97	77.7	86.4	75.3	85.8	81.8	91.5
Net energy lactation (Mcal/lb)	0.81	0.92	0.89	1.02	0.81	0.91	0.79	0.9	0.86	0.96
Net energy maint (Mcal.lb)	0.84	0.96	0.95	1.09	0.85	0.95	0.82	0.94	0.91	1.01
Net energy gain (Mcal/lb)	0.56	0.63	0.62	0.71	0.56	0.63	0.55	0.62	0.6	0.67
Digestible energy (Mcal/lb)	1.54	1.74	1.69	1.94	1.55	1.73	1.51	1.72	1.64	1.83
Metabolizable energy (Mcal/lb)	1.43	1.62	1.46	1.68	1.45	1.61	1.4	1.59	1.51	1.69
Sulfur %	0.17	0.19	0.32	0.37	0.17	0.18	0.16	0.18	0.22	0.25
Phosphorus %	0.48	0.54	0.67	0.77	0.42	0.47	0.45	0.51	0.51	0.57
Potassium %	0.38	0.43	1.62	1.86	0.4	0.47	0.44	0.51	0.36	0.4
Magnesium %	0.16	0.18	0.25	0.28	0.15	0.17	0.13	0.15	0.16	0.18
Calcium %	0.05	0.06	0.22	0.25	0.09	0.1	0.08	0.09	0.07	0.08
Sodium %	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Iron ppm	42	48	79	91	53	59	54	62	47	52
Manganese ppm	57	65	30	34	52	58	19	22	77	83
copper ppm	6	7	18	21	9	10	11	13	10	11
Zinc ppm	41	47	44	51	32	35	33	38	42	47

Table 1. Feed Formulas for Brown-egg Type Pullets, Layers, Broiler Starter, and Broilers.

	Brown Egg Pullets	Brown Egg Layers	Broiler Starter	Broiler Finisher
Salt	0.15%	0.00%	0.20%	0.20%
Oyster Shell	1.00%	7.00%	1.40%	1.00%
Fertrell Vitamin Pre-Mix	3.00%	3.00%	3.00%	3.00%
Full fat Soybeans	10.00%	13.00%	30.00%	19.00%
Oat Groats	60.85%	37.00%	65.40%	76.80%
Oats	25.00%	40.00%	0.00%	0.00%

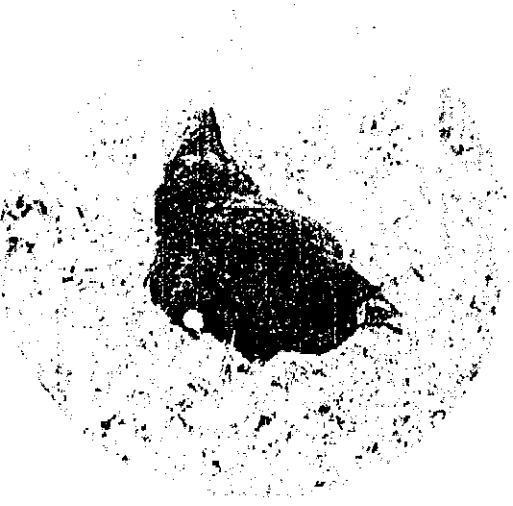
Table 2. Comparison of required nutrients vs. nutrients contained in feed formulas.

	Brown Egg Pullets		Brown Egg Layer		Broiler Starter		Broiler Finisher	
	Required	Present	Required	Present	Required	Present	Required	Present
Energy	1100.000	1259.775	1100.000	1276.500	1450.000	1522.560	1450.000	1544.520
Fiber		7.833		5.762		3.150		2.986
Calcium	0.900	0.847	3.250	3.122	1.000	1.010	0.800	0.849
Available Phosphorous	0.400	0.445	0.250	0.425	0.450	0.416	0.300	0.409
Fat		6.324		6.802		9.913		8.719
Linoelic Acid	1.000	1.509	1.000	1.540	1.000	2.700	1.000	1.710
Protein	15.000	14.719	15.000	15.830	20.000	22.376	18.000	20.434
Lysine	0.560	0.621	0.690	0.683	1.100	1.076	0.850	0.890
Methionine	0.230	0.294	0.300	0.298	0.380	0.375	0.320	0.341
Meth + Cyst	0.490	0.527	0.580	0.534	0.720	0.688	0.600	0.620
Tryptophan	0.130	0.204	0.160	0.213	0.200	0.299	0.160	0.260
Isoleucine	0.470	0.666	0.650	0.688	0.800	0.972	0.620	0.831
Leucine	0.800	1.111	0.820	1.152	1.200	1.578	0.930	1.410
Theronine	0.530	0.538	0.470	0.551	0.740	0.762	0.680	0.659
Arginine	0.780	1.007	0.700	1.044	1.100	1.468	1.000	1.269
Valine	0.490	0.800	0.700	0.816	0.820	1.077	0.700	0.980
Sodium	0.150	0.255	0.150	0.184	0.150	0.254	0.120	0.256
Choline	900.000	724.395	1000.000	700.080	1000.000	691.230	750.000	749.400

Addendum to NE SARE # **FNE02-400**

One important thing we learned from this SARE project is that there is no one perfect formula for poultry feed. You can use oats, or wheat, or barley as a base, or a combination of the three. Soybeans are an essential component to the diet. Without the soy, certain amino acids are lacking. Protein requirements can be met by using hull-less grains, but the amino acid requirements cannot be met without the soy. The feed formulas provided use roasted soy. Either roasted soy or soy meal may be used. However, extra fat must be added if soy meal is used.

Tables 1 gives feed formulas for pullets, layers, and broilers, and starter. No formulas for turkeys were created. The nutritionist that aided in this study does not have turkey expertise and was not comfortable making turkey recommendations. However, turkeys may be raised on broiler rations. If this is done, expect slower growth rates. Table 2 compares the feed formulas with the nutrient requirements of the poultry.



Northeast SARE Grant
FNE02 - 400

Evaluating Grains Grown in Aroostook County, ME To Determine the Feasibility of Producing A Locally Grown Poultry Feed

Pamphlet and Photography by:
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Project Background:

The short growing season in Maine was the primary reason for this SARE project. Most poultry feeds are corn based. We cannot grow dry field corn in Maine. Therefore, alternative grains needed to be identified.

Other grains can be grown in Maine, such as barley, oats, hull-less oats, and short season soybeans. This suggests that it may be possible to make a local organic poultry feed. Doing so would provide a boost to struggling organic farmers in northern Maine.

My project determined whether a local poultry feed could be made. I was hesitant about using book feed values for my calculations. Feed values of grain vary enormously depending on location. For example, book value for Buckwheat Middlings is 29% protein. The actual value in Aroostook County is 17%.

Grain Testing

I tested grains grown in different parts of Aroostook County to determine average feed values. Once test results were obtained, I had a poultry nutritionist analyze them with a computer to determine the most nutritionally complete formula using just grains. Test results are found on the back of this sheet (Table 1).

Vitamins

All poultry, but especially turkeys, have very specific dietary needs. Failure to meet all dietary requirements leads to diseases such as Rickets or conditions such as stunted growth. I knew that grains alone could not supply the vitamins poultry need. Sources for organic vitamin supplements needed to be found.

I obtained a list of organic feed suppliers from ATTRA (Appropriate Technology Transfer for Rural Areas, www.attra.org). I contacted all listed producers of organic poultry feed or minerals. From these contacts, I received the analyses' of several organic vitamin and mineral premixes. There are several acceptable premixes available on the ATTRA list.

Conclusions

We determined that, regardless of the base grain used, soya must be used to raise the protein value of the poultry feed. It also adds important amino acids not found in other grains. If soy meal is used (as opposed to roasted soy), a small amount of fat must be added to replace the fatty amino acids lost in the extruding process.

The poultry nutritionist immediately ruled out barley as a candidate for organic poultry feed. Poultry are lacking an

enzyme that is needed in order to digest barley. This enzyme is not available for use in organic feeds.

There is no specific advantage to using wheat in feed rations. In large quantities, the fine texture of ground wheat may lead to gizzard compaction. It may be used if coarsely ground or in small quantities.

Oats by themselves cannot be use to create a complete feed: they simply have too little protein and too much fiber. The fiber is beneficial in smaller amounts; it helps curb cannibalism.

The poultry nutritionist deemed hull-less oats (naked oats) to be "better than corn" for poultry. They are highly digestible, and have appropriate levels of the needed amino acids. They have the highest protein (besides soya) of all grains tested. Studies have shown that a hull-less oat diet may result in larger eggs.

The one downfall of a hull-less oat based diet is the lack of carotene (coloring pigments). I located several potential sources of organic carotene: marigold (*Taggett spp.*), duckweed, and *Spirulina* (a blue-green algae). One of these products must be used if deeply colored yolks and skin are desired.

Table 1. Grain analysis results for organic grains sampled from Aroostook County, Maine.

	Wheat		Soybeans		Oats		Barley		Hull-less Oats	
Component	As Sent	Dry	As Sent	Dry	As Sent	Dry	As Sent	Dry	As Sent	Dry
Moisture %	12.02		12.85		10.14		12.22		10.57	
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Crude Fat %	1.87	2.13	16.7	19.2	4.14	4.61	1.9	2.16	6.23	6.97
Acid Detergent Fiber %	2.56	2.91	5.68	6.52	12.2	13.6	5.87	6.69	4.04	4.52
Ash %	1.54	1.75	4.04	4.64	1.93	2.15	1.84	2.09	1.71	1.91
Total digestible nutrients %	76.8	87.2	84.5	97	77.7	86.4	75.3	85.8	81.8	91.5
Net energy lactation (Mcal/lb)	0.81	0.92	0.89	1.02	0.81	0.91	0.79	0.9	0.86	0.96
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Net energy gain (Mcal/lb)	0.56	0.63	0.62	0.71	0.56	0.63	0.55	0.62	0.6	0.67
Digestible energy (Mcal/lb)	1.54	1.74	1.69	1.94	1.55	1.73	1.51	1.72	1.64	1.83
Metabolizable energy (Mcal/lb)	1.43	1.62	1.46	1.68	1.45	1.61	1.4	1.59	1.51	1.69
Sulfur %	0.17	0.19	0.32	0.37	0.17	0.18	0.16	0.18	0.22	0.25
Phosphorus %	0.48	0.54	0.67	0.77	0.42	0.47	0.45	0.51	0.51	0.57
Potassium %	0.38	0.43	1.62	1.86	0.4	0.47	0.44	0.51	0.36	0.4
Magnesium %	0.16	0.18	0.25	0.28	0.15	0.17	0.13	0.15	0.16	0.18
Calcium %	0.05	0.06	0.22	0.25	0.09	0.1	0.08	0.09	0.07	0.08
Sodium %	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Iron ppm	42	48	79	91	53	59	54	62	47	52
Manganese ppm	57	65	30	34	52	58	19	22	77	83
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