Sustainable year-round sheep milking management

Final report for GNE16-123

Project Type: Graduate Student  
Funds awarded in 2016: $14,994.00  
Projected End Date: 07/31/2018  
Grant Recipient: Cornell University  
Region: Northeast  
State: New York  
Graduate Student: Nikola Kochendoerfer  
Faculty Advisor: Dr. Michael Thonney  
Cornell University

Project Information

Summary:

This project showed that meat breed ewes fed a diet containing with 35% potentially fermentable fiber and milked in short and frequent lactations have potential to thrive as both milk and meat producers. The purpose was to determine the optimum dietary fiber level to improve the sustainability of sheep farming in the Northeast by 1) diluting manure, greenhouse gases, and operation costs over more product; 2) making year-round marketing a possibility to increase milk; and 3) adding a second product: milk or milk products to a traditional meat flock or meat to a traditional dairy operation.

The project also addressed whether more widely available meat breed genetics could be incorporated into the narrow genetic base of the North American dairy sheep breeds to improve flock vigor. It included three 73-day lactations from each of 3 groups of ewes varying in size from 10 to 18 with 219 days between lambings. There were 664 consecutive days of milking 2x daily, 17,749 recorded milk weights, and 285 lambs delivered alive.

The three groups of ewes represented three Latin squares, which removed the effects of the three lactations within groups, and the three pens within each lactation. The experimental design minimized the errors associated with comparing the lactation curves for ewes fed diets containing 30, 35, or 40% potentially-fermentable fiber (pfNDF).

When ewes were fed the 35% pfNDF diet, they had the highest lactation curves with peak yields of about 1.8 kg milk/d and an average lactation yield of 1.5 kg/day in 1.67 lactations (122 days) and 183 kg of milk per year. This compares with research done at the Spooner Agricultural Research Station in Wisconsin with dairy sheep breeds (Thomas et al., 2014), East-Friesian ewes produced 359 kg of milk in 189-day lactations and Lacaune ewes produced 345 kg of milk in 180-day lactations. On a
365-day basis, these milk yields were 1.0 kg/d and 0.95 kg/d, respectively. Ewes fed the 35% pfNDF diet consumed 2.7 kg of dry matter per day, more than the ewes fed the 30% NDF diet (2.5 kg/d), but about the same as the ewes fed the 40% pfNDF diet. Thus, ewes fed the 35% pfNDF diet were more efficient.

Flock health and reproduction was excellent. Conception rates ranged between 75% and 100%. From 69% to 100% of the ewes lambed ~146 days by the end of the first breeding cycle (17 days in sheep). This side result suggests that the days of extra work and stress associated with lambing seasons could be reduced dramatically, to 17 days or less, in accelerated lambing systems. A total of 285 live lambs were delivered from October 2016 and September June 2018. Of these, 6 (2.1%) died. Lambs averaged 299 g/d to 50 days of age.

Although individual meat breed ewes milked on the STAR system produced less milk per year than recorded for dairy ewes in a research flock, three times as many ewes lambed and lactated, for dramatically more lamb production and a constant supply of 1.5 kg daily milk per ewe milked throughout the year. We had no opportunity prior to the start of the experiment to select against poor milking ewes or to cull them after the experiment started. The top half of the lactations for ewes fed the 35% pfNDF diet averaged 2 kg milk/day so doing simple culling could dramatically increase milk production of ewes from non-dairy breeds.

We had hoped to milk the ewes longer than 73 days, but pen size limited our ability to milk more than one group at a time. One group of ewes milked to 80 days or more was successfully bred starting on day 73 of lactation, confirming that lactations could have been longer. We hope to test this in an experiment to milk ⅓ East Friesian ewes for 120 days in a system with 3 lactations in 2 years. Based upon comments from our advisory committee and other small ruminant dairy farmers, this more relaxed accelerated lambing system – with the potential for 4 months off from milking between lactations – would be more appealing.

Project Objectives:

1. Determine optimal dietary levels of fermentable fiber (NDF) for maximum milk production, optimal ewe body condition, fertility, and health. Verify previous observations about the positive effect of fermentable NDF on feed intake and milk production.

2. Record observations on milking behavior of meat breed ewes

3. Record health problems and responses to treatments.

4. Record prolificacy and lamb survival under the STAR accelerated system in a milking sheep environment.

5. Compare published values for 190-day, yearly lactations of traditionally-milked dairy-breed ewes with yield and components of Finnsheep x Dorset ewes milked in 73- to 103-day lactations.

Introduction:

Milking meat sheep that can breed out of season on the STAR Accelerated Lambing System could achieve equal or higher farm milk yields year-round in 365 days than possible with one annual 180-day dairy sheep lactation, utilizing the higher peak milk yields of many meat breed ewes in comparison to dairy breed ewes. Higher litter sizes of traditional meat ewes as well as the ability to lamb up to 1.67 times per year on the STAR management system leads to a higher lamb crop, more
consistent marketing, and subsequent higher profitability. To be able to uphold high productivity, fecundity, and fertility while maintaining optimal health and body condition, elevated levels of dietary nutrients need to be provided.

Goals of this research encompassed: 1) a blueprint for milking sheep in short and frequent lactations on the STAR accelerated management system; 2) the pursuit of a dual-purpose (meat and dairy) system; and 3) The identification of ideal levels of fermentable fiber in diets for high producing milking ewes. With these accomplished, farmers may increase their income by being able to produce and market product year-round, sell more and diversified product (dairy and meat), and feed their animals to maximize health and production.

Cooperators

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Research

Materials and methods:
This study aimed to determine how sustainably and effectively a meat ewe flock may be bred and milked on the STAR Accelerated Lambing System adapted to a total dairy situation. The Cornell University Dorset, and Dorset × Finnsheep flock was managed in three STAR groups (STAR-R, STAR-B, STAR-G). Each group started each of the five yearly 73-day periods either lactating, in mid-gestation and dry, or just dried off and breeding. Each STAR group completed 3 consecutive lactations separated by 219 days in this 2-year research project.

The experiment was designed as a triply replicated 3×3 Latin Square. Each of the 3 STAR groups (STAR-R, STAR-B, STAR-G) was a Latin square containing from 10 to 18 ewes randomly assigned to 3 pens (A, B, C) completing 3 lactations (1, 2, 3). Three diets shown in Table 1 contained 30, 35, or 40% potentially-fermentable fiber (pfNDF) and were allotted orthogonally to pens across each lactation. Variation due to STAR group, pen, and lactation was effectively be removed by this design to maximize the probability of detecting differences among diets. Dietary differences among lactation curves were detected by adding to the statistical model the covariate effect of the diets on the linear, quadratic, and cubic covariates for days in milk (DIM). Covariates that were not significant were removed in a modified step-down procedure starting with the highest order polynomial terms.

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>30% pfNDF</th>
<th>35% pfNDF</th>
<th>40% pfNDF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soy hulls</td>
<td>34.4</td>
<td>42.4</td>
<td>50.9</td>
</tr>
<tr>
<td>Wheat midds</td>
<td>20.1</td>
<td>20.1</td>
<td>20.1</td>
</tr>
<tr>
<td>Corn</td>
<td>31.5</td>
<td>24.1</td>
<td>16.2</td>
</tr>
<tr>
<td>Soybean meal</td>
<td>8.9</td>
<td>8.6</td>
<td>8.2</td>
</tr>
<tr>
<td>Molasses</td>
<td>1.7</td>
<td>1.7</td>
<td>1.7</td>
</tr>
<tr>
<td>Cornell sheep premix</td>
<td>1.06</td>
<td>1.06</td>
<td>1.06</td>
</tr>
<tr>
<td>Ammonium chloride</td>
<td>0.78</td>
<td>0.78</td>
<td>1.68</td>
</tr>
<tr>
<td>Calcium carbonate</td>
<td>1.34</td>
<td>1.12</td>
<td>0.89</td>
</tr>
<tr>
<td>Pellet binder</td>
<td>0.26</td>
<td>0.26</td>
<td>0.26</td>
</tr>
<tr>
<td><strong>Estimated components</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>89.6</td>
<td>89.5</td>
<td>89.4</td>
</tr>
<tr>
<td>----------------</td>
<td>------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>DM (% of feed)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DDM</td>
<td>81.0</td>
<td>80.6</td>
<td>80.3</td>
</tr>
<tr>
<td>CP</td>
<td>17.0</td>
<td>17.0</td>
<td>17.1</td>
</tr>
<tr>
<td>NDF</td>
<td>36.1</td>
<td>41.1</td>
<td>46.5</td>
</tr>
<tr>
<td>pfNDF</td>
<td>30.5</td>
<td>35.1</td>
<td>40.1</td>
</tr>
<tr>
<td>INDF</td>
<td>5.6</td>
<td>6.0</td>
<td>6.4</td>
</tr>
<tr>
<td>NSCHO</td>
<td>38.9</td>
<td>34.0</td>
<td>28.7</td>
</tr>
<tr>
<td>EE</td>
<td>2.7</td>
<td>2.6</td>
<td>2.4</td>
</tr>
<tr>
<td>Ash</td>
<td>5.3</td>
<td>5.3</td>
<td>5.3</td>
</tr>
</tbody>
</table>

1Pelleted diets except for the first lactation of the first STAR group, which had no wheat midds, molasses, or pellet binder, but with 2.2% vegetable oil, more soy hulls, less calcium carbonate, more soybean meal, and 0.22% salt.

Lambs were removed from their dams within 12 hours after birth and reared artificially on the free-choice cold milk lambar system. Ewe milk from the parlor was cooled and fed back to the lambs. Milk yield was recorded for each ewe at the 7 am and 5 pm milking times. Weights of feed offered and refused were recorded for each pen at both milking times. Milking ewes and lambs were weighed weekly. Feed and refusal samples were collected weekly. Milk samples were collected weekly for analysis of components in the laboratory of Dr. Dave Barbano, Department of Food Science at Cornell University. Fecal samples were collected twice per lactation, and feed samples were composited for determination of digestibility using acid insoluble ash as a marker. A device to sample ruminal fluid was developed and used twice in each lactation to acquire samples from individual ewes (3 samples per ewe and lactation period). The fluid was measured for pH and then frozen for later measurement volatile fatty acid composition to complement the nutritional trial of this study.

Research results and discussion:

The last group of ewes in this experiment was milked until late August 2018. Not all samples are analyzed yet, including:

- Feed and fecal samples for determination of digestibility with the AIA acid insoluble ash method (Thonney, 1979),
Ruminal fluid samples for VFA concentration and composition,
Blood NEFA for determination of energy balance,
Video to quantify rumination times,
NIRS milk composition analysis for determination of protein and fat (Woolpert, 2016).

Milk yield, feed intake, weight, lamb survival and growth, and reproduction data for all 9 lactations of the experiment are analyzed and presented in the following report. However, slight changes of the data analysis – with minor effect on the results – may be necessary when all collected samples are processed and all data are available.

**OBJECTIVE 1. DETERMINE OPTIMAL DIETARY LEVELS OF POTENTIALLY FERMENTABLE FIBER (PFNDF) FOR MAXIMUM MILK PRODUCTION, OPTIMAL EWE BODY CONDITION, FERTILITY, AND HEALTH. VERIFY PREVIOUS OBSERVATIONS ABOUT THE POSITIVE EFFECT OF FERMENTABLE NDF ON FEED INTAKE AND MILK PRODUCTION.**

Higher concentrations of pfNDF in the diet resulted in higher feed intakes in two previous experiments (Schotthofer et al., 2007; Hein et al., 2010) at Cornell University with ewes nursing triplets, and growing lambs, respectively. Schotthofer, (2007), found that ewes nursing triplets fed the diet with the highest level (35%) of pfNDF had the highest intake, and – by inference from lamb growth – produced the most milk. The current experiment tested a higher level of 40% pfNDF, but ewes fed the diet with 35% pfNDF had the highest (P < 0.001) peak intake of dry matter from ad libitum fed pellets plus a small amount (~300 g) of hay per ewe/day (Figure 1). The feed intakes had a significant (P < 0.001) impact on milk production curves. Ewes in all three STAR groups fed the 35% pfNDF diet had the highest milk yields. (Figure 2).
As shown in Figure 3, weight gains were inversely related to milk production. Nutrients that were not used for milk production probably accumulated as fat. The slightly lower weight for ewes fed the 35% pfNDF diet may reflect higher milk production and slightly lower feed intake in the first part of lactation.

**OBJECTIVE 2. RECORD OBSERVATIONS ON MILKING BEHAVIOR OF MEAT BREED EWES.**

Milking behavior was scored from 1: No kicking, no skittishness, ease of entering and leaving the platforms, teat cups stay on; to 2: Slightly skittish, needs parlor bait to easily enter platform, nervous, kicks off teat cups occasionally; to 3: Very skittish, kicking, teat cups need to be held in place, no ease of entering the platform and head gate, very nervous. Milking behavior was recorded at the beginning of lactation and at the end of lactation so that improvements could be assessed. Milking behavior scores for lactation 1 (n = 40) were slightly worse (2.0 to 1.4 from beginning to end of lactation), than those for lactation 2 (n = 47), which scored from 1.6 to 1.3. Both scores indicate improvement throughout lactation as well as improvement from the ewe’s first to second lactation. Scores for lactation 3 (n = 42) further improved, with scores going from 1.6 at the beginning of lactation to 1.2 at the end of lactation.

**OBJECTIVE 3. RECORD HEALTH PROBLEMS AND RESPONSES TO TREATMENTS.**

Health conditions (Table 2) were treated by or with the advice of our flock veterinarian, Professor Mary Smith, who also conducted necropsies of animals that died. One lactating ewe was removed from the flock due to sudden milk loss,
diagnosed with Johne’s Disease, and euthanized. Nine ewes, all in the first lactation of the experiment, were successfully treated for mastitis; improved dry-off procedures prevented mastitis in the following 2 lactations. Two ewes were treated for metritis. Three ewes were treated for pregnancy toxemia near the end of gestation; two mistakenly had not been penned with other pregnant ewes and fed concentrate in addition to hay for the three weeks prior to the start of the lambing season. One of those ewes was delivered of a healthy set of twins that may not have received sufficient colostrum to prevent enterotoxaemia, causing one of the twins to die at 25 days. One lamb had unusual symptoms of septicemia during week 7 of age; it was treated successfully but had developed contracted tendons and failed to ambulate after recovery from infection so it was euthanized. Nine lambs developed tail dock infections when the hot tail docker did not work properly; 2 of those died, resulting in a switch to the use of rubber bands for tail docking. Two lambs were treated for symptoms of urinary calculi, which was confirmed by necropsy of the euthanized lambs; in retrospect the lambs in that group had not been drinking sufficient water after weaning. One replacement ewe lamb suddenly displayed jaundice consistent with copper toxicity at seven months of age; however, multiple samples of concentrate feed, minerals, and hay samples did not reveal copper concentrations higher than 10 ppm of the total diet and liver and kidney tissues from the euthanized ewe had normal copper levels. Although list of health conditions may seem long, that is primarily because we are reporting the details. Overall flock health was excellent (Table 3 and Table 4).

**Table 2. Summary of health problems.**

<table>
<thead>
<tr>
<th>Age category</th>
<th>Diagnosis</th>
<th>Number</th>
<th>Age</th>
<th>Deaths</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ewe</td>
<td>Johne's Disease</td>
<td>1</td>
<td>4 years</td>
<td>1</td>
<td>Euthanized.</td>
</tr>
<tr>
<td></td>
<td>Mastitis</td>
<td>9</td>
<td>15 months to 6 years</td>
<td>0</td>
<td>All in lactation 1 of experiment; completely recovered.</td>
</tr>
<tr>
<td></td>
<td>Metritis</td>
<td>2</td>
<td>5 &amp; 6 years</td>
<td>0</td>
<td>Due to dystocias</td>
</tr>
<tr>
<td></td>
<td>Pregnancy toxemia</td>
<td>3</td>
<td>5 years</td>
<td>2</td>
<td>Not fed concentrate before lambing.</td>
</tr>
<tr>
<td>Lamb</td>
<td>Enterotoxaemia</td>
<td>1</td>
<td>25 days</td>
<td>1</td>
<td>No colostrum.</td>
</tr>
<tr>
<td></td>
<td>Septicemia</td>
<td>1</td>
<td>35 days</td>
<td>1</td>
<td>Treated successfully, but failed to ambulate.</td>
</tr>
<tr>
<td></td>
<td>Tail dock infection</td>
<td>9</td>
<td>7 to 16 days</td>
<td>2</td>
<td>Hot tail docker problems.</td>
</tr>
<tr>
<td></td>
<td>Urinary calculi</td>
<td>2</td>
<td>7 weeks</td>
<td>2</td>
<td>Euthanized.</td>
</tr>
<tr>
<td>Replacement</td>
<td>Unknown</td>
<td>1</td>
<td>7 months</td>
<td>1</td>
<td>Jaundice, not Cu toxicity.</td>
</tr>
</tbody>
</table>

**OBJECTIVE 4. RECORD PROLIFICACY AND LAMB SURVIVAL UNDER THE STAR ACCELERATED SYSTEM IN A MILKING SHEEP ENVIRONMENT.**

Conception rates ranged between 75% and 100% (Table 3). Different methods were used to synchronize breeding, ranging from natural breeding (no aid used) in fall breeding seasons to teaser rams (vasectomized rams 10 days prior to start of breeding), to hormonal synchronization (CIDRs, sponges), or a combination. From 69% to 100% of the ewes lambed ~146 days after the beginning of the first
breeding cycle (17 days in sheep). This side result suggests that the days of extra work and stress associated with lambing could be reduced dramatically in accelerated lambing systems.

Table 3. Breeding.

<table>
<thead>
<tr>
<th>Group</th>
<th>Lac.</th>
<th>Ewes</th>
<th>Breeding Method</th>
<th>Scanned positive</th>
<th>First cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAR-R</td>
<td>1</td>
<td>18</td>
<td>6/6/2016 Teaser, CIDR</td>
<td>14 78%</td>
<td>13 93%</td>
</tr>
<tr>
<td>STAR-B</td>
<td>1</td>
<td>16</td>
<td>8/20/2016 Teaser, Sponge</td>
<td>16 100%</td>
<td>11 69%</td>
</tr>
<tr>
<td>STAR-G</td>
<td>1</td>
<td>16 ewe lambs</td>
<td>10/30/2016 Teaser</td>
<td>12 75%</td>
<td>11 92%</td>
</tr>
<tr>
<td>STAR-R</td>
<td>2</td>
<td>18</td>
<td>1/11/2017 Natural</td>
<td>17 94%</td>
<td>13 76%</td>
</tr>
<tr>
<td>STAR-B</td>
<td>2</td>
<td>17</td>
<td>3/3/2017 Teaser, CIDR (13)</td>
<td>13 76%</td>
<td>11 85%</td>
</tr>
<tr>
<td>STAR-G</td>
<td>2</td>
<td>16</td>
<td>6/6/2017 Teaser, CIDR</td>
<td>16 89%</td>
<td>12 75%</td>
</tr>
<tr>
<td>STAR-R</td>
<td>3</td>
<td>19</td>
<td>8/20/2017 Natural</td>
<td>17 89%</td>
<td>15 88%</td>
</tr>
<tr>
<td>STAR-B</td>
<td>3</td>
<td>14</td>
<td>10/30/2017 Natural</td>
<td>13¹ 93%</td>
<td>10² 91%</td>
</tr>
<tr>
<td>STAR-G</td>
<td>3</td>
<td>20</td>
<td>1/7/118 Teaser, CIDR</td>
<td>18 90%</td>
<td>18³ 100%</td>
</tr>
</tbody>
</table>

¹One of these ewes aborted and one died of pregnancy toxemia before lambing.
²Out of the 11 ewes lambing.
³These 18 ewes delivered 42 live lambs in 8 days, including a litter of triplets.

Reproduction data are shown in Table 4. A total of 285 live lambs were delivered from October 2016 and September June 2018. Of these lambs, 6 died. Lambs averaged 299 g/d to 50 days of age, after which weekly weights were no longer recorded.

Table 4. Reproduction.

<table>
<thead>
<tr>
<th>Item</th>
<th>23 Oct 2016 – 16 Jun 2018</th>
<th>Annually</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of ewes lambing</td>
<td>57</td>
<td></td>
</tr>
<tr>
<td>Lamblings</td>
<td>135</td>
<td></td>
</tr>
<tr>
<td>Lamblings per ewe (includes replacements)</td>
<td>2.4</td>
<td>1.3</td>
</tr>
<tr>
<td>Lambs delivered</td>
<td>308</td>
<td>179</td>
</tr>
<tr>
<td>Lambs delivered per lambing</td>
<td>2.3</td>
<td></td>
</tr>
<tr>
<td>Lambs delivered per ewe lambing</td>
<td>5.4</td>
<td>3.0</td>
</tr>
<tr>
<td>Lambs born alive</td>
<td>285</td>
<td>156.7</td>
</tr>
<tr>
<td>Stillborn loss</td>
<td>7.5%</td>
<td></td>
</tr>
</tbody>
</table>
Lambs born alive per ewe lambing | 5.0 | 2.7
---|---|---
Lambs born alive that died | 6 | 
Live lamb loss | 2.1% | 

1Through 16 June 2018.

OBJECTIVE 5. COMPARE PUBLISHED VALUES FOR 190-DAY, YEARLY LACTATIONS OF TRADITIONALLY-MILKED DAIRY-BREED EWES WITH YIELD AND COMPONENTS OF FINNSHEEP X DORSET EWES MILKED IN 73- TO 103-DAY LACTATIONS.

Ewes in this experiment fed the 35% pfNDF diet achieved the highest milk yields. The STAR system program of 5 lactations were achieved each year. The average daily milk yield of ewes fed the most successful diet was 1.5 kg/d in 1.67 lactations per year of 73-days (122 lactation days per year). Based on research done at the Spooner Agricultural Research Station in Wisconsin with dairy sheep breeds (Thomas et al., 2014), East-Friesian ewes produced 359 kg of milk in 189-day lactations and Lacaune ewes produced 345 kg of milk in 180-day lactations. On a 365-day basis, these milk yields were 1.0 kg/d and 0.95 kg/d, respectively.

Although individual meat breed ewes milked on the STAR system produced less milk per year (183 kg), three times as many ewes lambed and lactated for dramatically more lamb production and a constant supply of 1.5 kg daily milk per ewe milked throughout the year. We had no opportunity prior to the start of the experiment to select against poor milking ewes or to cull them after the experiment started. The top half of the lactations for ewes fed the 35% pfNDF diet averaged 2 kg milk/day so doing simple culling would dramatically increase milk production of ewes from non-dairy breeds.

Literature cited


Research conclusions:
The project succeeded in answering two major questions. First, it demonstrated that a system of milking meat breed ewes year-round in an accelerated lambing system could succeed, enabling farmers to exploit year-round expectations of good markets for milk and milk products. There were only a few health issues, and none were related to the system. Unlike common expectations, the ewes gained weight throughout lactation and were remarkably fertile and produced large litters every 219 days, with the potential to increase sheep dairy farm income from lamb sales.
Second, the dietary experiment part of the project narrowed the range of optimum level of fermentable fiber in on-farm diets for lactating ewes to between 30 and 40%, with ewes in this project maximizing milk production when fed the mid-range level of 35% potentially-fermentable fiber. Such a complete, pelleted diet can be formulated to take advantage of low cost, by-product feeds mixed at local feed mills.
Yearly production of milk from the 1.67 lactations/year was lower than that reported in the Wisconsin research flock of dairy ewes. For data collection logistics reasons, however, each lactation period in our project was limited to about 73 days, with evidence from a couple of groups that the ewes could continue to be milked longer and bred during lactation. Additionally, we had no opportunity prior to the start of the experiment to select against poor milking ewes or to cull them after the experiment started. The top half of the lactations for ewes fed the 35% pfNDF diet averaged 2 kg milk/day compared with an average of 1.5 kg/d so doing simple culling would dramatically increase milk for farmers starting with non-dairy breeds.
Most of the ewes lambed during the first 17 days of the lambing season. This unanticipated result means that farmers could minimize the labor and stress associated with lambing season by limiting breeding season to 17 days or fewer.

Participation Summary
1 Farmer participating in research

Education & Outreach Activities and Participation Summary

12 Consultations
1 Curricula, factsheets or educational tools
7 Tours
7 Webinars / talks / presentations
6 Other educational activities
PARTICIPATION SUMMARY:

11 Number of agricultural educator or service providers reached through education and outreach activities

Education/outreach description:

The Cornell Sheep Dairy has been successfully operating for 22 months. It was mainly student operated and was managed by the Niko Kochendoerfer, the graduate student researcher and the PI of the overall project, Dr. Mike Thonney. Over 30 undergraduate students and interns, none specifically recruited, were taught how to milk, feed, handle ewes, and how to process, feed, and handle lambs. New students were continuously trained to ensure staff to operate the dairy.

This research idea was presented at the 22nd Annual Dairy Sheep Association of North America Symposium held at Cornell University, 2 to 4 December 2016, and included in the proceedings (Kochendoerfer, 2016). Preliminary results were presented at the 78th Cornell Nutrition Conference (Kochendoerfer and Thonney, 2017), with additional data to be presented at the Cornell 2018 Nutrition Conference (16 to 18 October) with a conference publication “Fermentable Fiber for Year-Round Ewe Milk Production”, Cornell Nutrition Conference 2018 Proceedings, Syracuse, NY. The project idea and preliminary data were shared at the SARE Our Farms Our Future Conference on 3 April 2018 in Saint Louis, Missouri.

Multiple lab sessions and lectures were taught by the graduate student researcher on this project for Cornell University undergraduate animal science classes ANSC 3800 Sheep, ANSC 2050 Sustainable Animal Agriculture, and ANSC/IARD 4000 Feeding the World. Activities included milking sheep, processing lambs, calculating (ideal) nutrient intake, and assessing system productivity and profitability. Twelve undergraduate pre-veterinary students from the City University of Hong-Kong were taught an intense 3-week 2018 summer class on handling, feeding, milking, and breeding sheep.

There are 761 followers of the Cornell Sheep Dairy Instagram @cornellsheepdairy since April 2017 that are mainly small-scale dairy and meat sheep farmers around the country. Lamb growth curves during this project were posted on the Cornell Sheep Program Facebook page, which has 1,027 followers.

A comprehensive class curriculum was written for a potential small-ruminant dairying class as well as a small-ruminant dairying internship at Cornell University. Prospectively, the dairy will be Grade A and able to sell milk for processing. A 30-gallon bulk-tank was purchased recently, with a metal milking parlor to be newly fabricated for the next group of ewes to be milked by students starting in February 2019.

Project Outcomes

3 Grants applied for that built upon this project

3 New working collaborations
Project outcomes:

This project evolved as research into a dual-purpose system, where emphasis was placed on both, highly productive, milk and meat production. Sheep farmers, regardless of producing milk or lamb may benefit from the two main areas of gained understanding of on farm sustainability, nutrition and reproduction.

Potentially fermentable fiber (pfNDF), as it was used in this experiment as a concept to formulate diets with, is an effective, telling, easily accomplished and successful strategy for feeding animals for high production and reproductive success. The required levels of pfNDF in diets for high producing ewes were verified and refined from previous research (Schotthofer, 2007), and can be used to advise farmer. These recommendations offer the formulation of optimal diets utilizing feeds high in fermentable fiber, low price by-products like soyhulls, citrus pulp or beet pulp, as well as pasture. These feeding strategies may have a direct and high impact on on-farm financial sustainability due to the purchase of low-price by-product feed generating higher production. The translation of feeds high in fermentable fiber from by-products to pasture may lead to increased environmental sustainability. Pastures high in pfNDF throughout the grazing seasons can only be achieved through optimal pasture management and refined, rotational, grazing strategies. This may lead to a decrease of overgrazing resulting in lower erosion damage, soil compaction, and parasite load, as well as an increase in overall productivity from pastures.

The outcome of this project, that high levels of fermentable fiber, weight gain in early lactation and high body condition scores lead to increased litter sizes and high conception rates may also have a direct impact on on-farm financial viability. Higher litter sizes result in increased milk production, and additional sold lamb increases farm income.

Considering the impact and connections that the Cornell Sheep Program has on sheep farmers in the US North-East these results will be distributed widely and find application in numerous farms. The first presentation of select nutritional results will be held at the 2018 Sheep and Goat Symposium on October 13, 2018 at Cornell University for ~85 sheep farmers that so far signed up for the conference.

Knowledge Gained:

Knowledge was gained during this project in the following areas:

1. Management of a small ruminant dairy, and training of students for milking, feeding, caretaking of a milking flock
2. Grade-A certification of the milking parlor, creamery equipment, sheep cheese making, and sheep milk properties
3. Reproductive techniques, both nutritionally and hormonally
4. Optimal levels of dietary fermentable fibers were established

The management of the dairy was in the hands of the graduate student and PI. This task included the operation of the dairy, all aspects of labor, supplies, cost, flock health and lambing management. A curriculum was developed encompassing all relevant areas of small-ruminant dairying, and best practices to convey this knowledge were tested throughout the project in numerous labs, internship and volunteer orientations, as well as lectures.

Throughout the project we explore a variety of ways to best make use of the milk generated in the Cornell Sheep Dairy, which resulted in purchasing a 30-gallon bulk tank and pursuing the Grade-A certification of the milking parlor. Throughout this
process knowledge about sheep milk and its properties and usage for sheep milk products as well as equipment and storage were acquired.

Optimal dietary fiber levels for both, optimal reproductive success and high milk productivity were established. A variety of breeding techniques were explored. The best breeding schedule was deemed 10-day introduction of a vasectomized teaser ram, followed by a 7-day period with inserted estrogen CIDRs (Controlled Intravaginal Drug Releasing device) for breeding synchronization, followed by the introduction of the breeding ram (Inskeep, 2011).

Additionally, while surveying the landscape of the US sheep dairy industry the following conclusion may be reached: Vertically integrated, seasonal, sheep diary production with on-farm creameries may be a sustainable system for small-scale family businesses with a long-standing tradition, and a solid customer base. For new farm operations, non-family businesses or larger scale sheep milk producers this system may be labor intensive while not being cost-effective or productive. For these farms year-round production at a high level, hired labor, and the establishment of markets selling liquid milk to processors – disconnecting production and processing – is advisable.

Inskeep, K. K., Marlon; Ramboldt, Todd. 2011. Out-Of-Season breeding Using the EAZI Breed CIDR-G in Ewes. In: Shepherds Symposium, Virginia Tech

Information Products

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US Department of Agriculture
This site is maintained by SARE Outreach for the SARE program and is based upon work supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under award No. 2019-38640-29881. SARE Outreach operates under cooperative agreements with the University of Maryland to develop and disseminate information about sustainable agriculture. USDA is an equal opportunity provider and employer.

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