EFFECT OF EARLY LACTATION EWE NUTRITION ON LAMB GROWTH

An Honors Thesis Presented to
the Faculty of the Department of Animal Science
in Partial Fulfillment of the Requirements
for a Bachelor's Degree with Distinction in Research

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Abstract

In today's market, it is important that livestock farmers feed their animals less expensive, efficient feedstuffs to remain profitable in the face of decreasing meat prices and increasing feed prices. This study looks at the use of okara, a waste product from the production of tofu and soymilk, as a protein supplement for lactating ewes. In a replicated four-by-four Latin square trial, eight ewes and their twin lambs were fed four different diets. The four diets were: Diet A, a wheat middling and corn concentrate fed with a mixed grass hay; Diet B, an okara and corn concentrate fed with mixed grass hay; Diet C, a soybean meal and wheat middling concentrate fed with haylage; and Diet D an okara and corn concentrate fed with haylage. Ewe weights, lamb weights and daily feed intakes were recorded and milk samples were taken to determine the effect of the diets on the growth and feed intake of the animals and milk composition. The diets had no statistically significant impact on ewe or lamb growth, overall dry matter intake or growth efficiency, but there was significant difference in the amount of different diet forage and concentrate consumed. There was also no effect on milk composition, though there were some trends observed. Based on these findings, okara is a viable source of protein for lactating ewes and can be used as a supplement without any adverse effects on growth or milk composition.

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Introduction

As animal feed prices increase and the prices of the food produced by farmers stay relatively constant or even decrease, it is increasingly important for farmers to feed animals as economically as possible. Waste products from food production and other food and feed processing are likely to be inexpensive sources of animal feed. One such example is okara, or soy pulp. Okara is a waste product in the production of soy milk and tofu, and is high in protein. While it is part of the cuisine in several Asian countries, the production of okara far exceeds demand for human consumption (O'Toole, 1999).

This study investigated the use of okara as a protein supplement in lactating ewe diets. The objective of this study was to determine the effect of okara as a protein supplement on ewe and lamb feed intake, milk composition and lamb growth. Four diets were fed to lactating ewes raising twin lambs. Two diets used a conventional protein supplement while two others used okara as the protein supplement. Two forages were also fed in conjunction with the supplements: Haylage was fed with one okara supplement and one conventional protein supplement, while grass hay was fed with the other two supplements. Milk samples, animal weights and feed intakes were recorded and the results for the four diets were compared.

Literature Review

<u>Farm Economics</u>

For farmers raising meat sheep, one of the most important factors in maintaining economic viability is how quickly and efficiently their lambs grow. High growth rate and efficiency decreases the time that it takes the lambs to reach market weight, which in turn decreases the labor involved with raising lambs and the feed costs associated with the growth of the lambs. Nursing lambs receive their nutrition from two different sources: their mothers' milk and solid feed. As lambs age and near weaning, the percentage of the nutrition they receive from their mothers' milk decreases, and the amount of solid feed they consume increases substantially. This can be demonstrated by the change in the relative size of the stomach compartments as lambs age. In newborn suckling lambs, the rumen and reticulum are non-functional and the milk consumed by the lamb is shunted via the esophageal groove into the abomasum, the glandular stomach compartment. Thus newborn lambs are digestively monogastric. At birth, the abomasum accounts for 60% of the capacity of the lamb's stomach compartments, whereas the rumen accounts for only 25% of the capacity. By four months of age, the rumen accounts for 75% of stomach compartment capacity while the abomasum accounts for a mere 11% (Sheep Production Handbook, 2003). Rumen size increases as the lamb begins to consume solid feedstuffs, inoculating the rumen with microbes and initiating the foregut fermentation processes that define ruminants.

Milk Production

Because milk supplies the majority of the nutrients needed by suckling lambs, milk composition and quantity are incredibly important to suckling lamb growth (Hegarty et al, 2006). If the ewe diet can be manipulated to increase the quantity or nutritive properties of the milk, growth rates of the suckling lambs should also increase. If suckling lambs grow to heavier weights before weaning, they have to spend less time on the farm consuming feed that could be used to feed pregnant and lactating ewes. If it is possible to manipulate lactating ewe diets to increase the volume of nutrients produced in the milk without increasing the cost of feeding those lactating ewes, the profit margin could potentially increase.

Increasing the nutrient content and/or volume of milk produced by lactating ewes could potentially have other benefits besides increased lamb weights at weaning. On occasion, ewes have been known to produce more lambs than they are capable of nursing. In such situations, farmers are often able to recognize this problem early on and will remove one or more lambs from a ewe's care to be raised artificially on milk replacer. This ensures that the other lambs left in the ewe's care have enough milk to thrive without much assistance. While this is typically the case, it is possible that such a situation might escape a farm manager's eye, and more lambs than can be fed by the ewe's milk supply remain with the ewe. In such a situation, it is likely that one or more of the lambs will grow poorly and possibly even starve to death if the situation is severe (Sheep Production Handbook, 2003). Either situation results in a loss of profit for the farmers: lambs that grow slowly must stay on the farm longer to reach market weight, while lambs that are raised artificially have the expense of milk replacer plus the cost of extra labor to feed the lambs. If it is possible to increase the quantity and quality of milk produced by lactating ewes, the likelihood of either situation occurring should decrease. Gardner and Hogue found that an increase in ewe energy intake caused increased milk production (1963).

<u>Alternative Feeds</u>

As the world population increases, so does the competition for agricultural resources. When a feedstuff that is commonly fed to animals is consumable by humans, the price of the feedstuff increases rapidly, causing it to become less economical as a source of nutrients for animal agriculture operations. As the world population continues to increase, the price for human-consumable feedstuffs might also increase. Because of this, it is becoming more and more economical to feed waste products from the processing of plants for human consumption. One such waste product is okara, the residue from the production of soy milk and tofu.

Okara is an off-white pulp that consists of the insoluble parts of soybeans and contains approximately 20 percent dry matter. On a dry matter basis, okara contains 25 to 29 percent crude protein, 75 percent total digestible nutrients, and 30 percent neutral detergent fiber (O'Toole, 1999). While okara is consumable by humans, the demand for human consumption is far less than the quantity that is produced. The consumption of okara by humans is further confounded by the high fiber content of okara, which makes it much less able to be consumed in mass quantities by humans. Okara is often used as animal feed, but in some areas it is also burned as fuel or even dumped in landfills (O'Toole, 1999). Okara was fed to larval silkworms to decrease cost with good results (Sumida et al, 1995). While there has not been an outpouring of research studying the use of okara as a ruminant protein supplement, Takahashi et al, 1992, found that the pH of cecal contents of rats fed fermented okara were depressed and therefore more acidic. This in turn caused an increase in the production of acetate and butyrate, two volatile fatty acids that are also produced in foregut fermentation by ruminants.

Materials & Methods

Eight ewes and their twin lambs from the Sheep Unit of the Cornell Teaching and Research Center, Harford, NY were housed in the Large Animal Research and Teaching Unit (LARTU). Temperature humidity logs were maintained daily (Appendix 1). The ewes were dewormed with 25 cc Ivomectin, vaccinated against rabies and received health checks from a Cornell Ambulatory Clinic veterinarian prior to arrival at LARTU, as well as CD+T (*Clostridium perfringens* type C & D and tetanus) vaccination on December 28, 2008. The lambs averaged 9.39 kg body weight (ranging between 6.96 kg and 12.11 kg) and were between 9 and 16 days old. They were not vaccinated prior to arrival as they relied on passive immunity from their dam's colostrum (De La Rosa et al, 1997).

The ewes had lambed and were raising twins, were in their second or later lactation and weighed between 55.6 and 74.8 kg. The ewes, in early lactation (12.5±3.5 days in milk), were randomly assigned to four dietary treatments (Tables 1 to 4): a wheat middling and corn concentrate fed with a mixed grass hay (Diet TSH), an okara and corn concentrate fed with mixed grass hay (Diet OSH), a soybean meal and wheat middling concentrate fed with hay crop silage (Diet TSS), and an okara and corn concentrate fed with hay crop silage (Diet OSS).

Diets were formulated with the Small Ruminant Nutrition System for a theoretical 50 kg lactating ewe producing 1.5 kg of milk a day at 6.5% milk fat and 5.2% true protein. Daily dry matter intake was estimated to be about 3 kg. Diets were formulated to satisfy the National Resource Council (NRC; 2007) recommendations.

Dietary treatments were rotated every 14 days, following a 7 day adjustment period and a 7 day data collection period. Ewes were offered *ad lib.*

Table 1. Concentrate Compositions (% As Fed)

	Grass hay		Hay crop silage		
	Diet TSH	Diet OSH	Diet TSS	Diet OSS	Creep
Soybean meal	-	-	22.0	-	24.8
Wheat middlings	30.8	-	51.7	-	-
Corn (ground)	50.0	-	-	-	-
Corn (cracked)	-	41.5	-	10.9	43.1
Okara	-	54.5	-	86.0	-
Soy hulls	-	-	-	-	23.0
Molasses	14.8	-	17.8	-	-
Ammonium chloride	1.6	1.0	1.9	0.7	-
Vitamin-mineral premix[b]	2.7	1.5	3.3	1.2	1.0
Calcium carbonate	-	1.5	3.3	1.2	0.8
CSF vitamin E premix[c]	-	-	-	-	0.25
Deccox, 6% concentrate	-	-	-	-	0.05
Water	-	-	-	-	7.00

[b]Composition of pre-mix in Table 2.

[c]Contains 19,075 ppm (DM basis) and 17,011 ppm (air dry basis) of vitamin E.

Table 2. Vitamin-mineral premix compositions

	Amount in premix	Units
Salt	50	%
Deccox, 6% premix	5.0	%
Mineral Oil	0.5	%
Manganese	2500	ppm
Vitamin E	4250	IU/lb
Selenium	30	ppm
Zinc	2000	ppm
Iodine	80	ppm
Vitamin A	120000	IU/lb
Vitamin D	15000	IU/lb
Cobalt	20	ppm
Molybdenum	20	ppm

The first three items are ingredients that make up 55.5% of the premix. The other items are nutrients to be supplied by ingredients that make up the other 44.5% of the premix and/or a filler like distillers grains.

Table 3. Nutrient composition of forages consumed as analyzed by Dairy One

	Diet TSH	Diet OSH	Diet TSS	Diet OSS
DM %	91.6	90.7	38.6	38.0
CP (% DM)	13.2	13.5	18.5	19.4
NEL (Mcal/lb)	0.46	0.44	0.51	0.53
ADF (% DM)	41.5	45.6	40.0	40.6
NDF (% DM)	65.5	63.6	51.8	51.0
TDN (% DM)	54.9	50.8	52.9	53.6
Lignin (% DM)	7.28	8.93	7.29	9.00
Ca (% DM)	0.81	0.92	1.35	1.31
P (% DM)	0.32	0.26	0.25	0.27

Table 4. Nutrient composition of concentrates consumed as analyzed by Dairy One

	Diet TSH	Diet OSH	Diet TSS	Diet OSS	Creep Feed[1]
DM %	85.5	83.2	88.5	25.5	89.5
CP (% DM)	14.5	29.1	26.1	29.4	21.0
NEL (Mcal/lb)	0.87	0.86	0.61	0.88	1.08[2]
ADF (% DM)	6.98	9.80	10.9	10.7	-
NDF (% DM)	17.6	20.2	41.6	15.9	24.7
TDN (% DM)	81.0	80.4	58.9	82.2	-
Ca (% DM)	0.40	1.62	1.32	1.79	0.58
P (% DM)	0.54	0.71	0.80	0.37	0.38

[1] values based on calculations, not feed analysis.

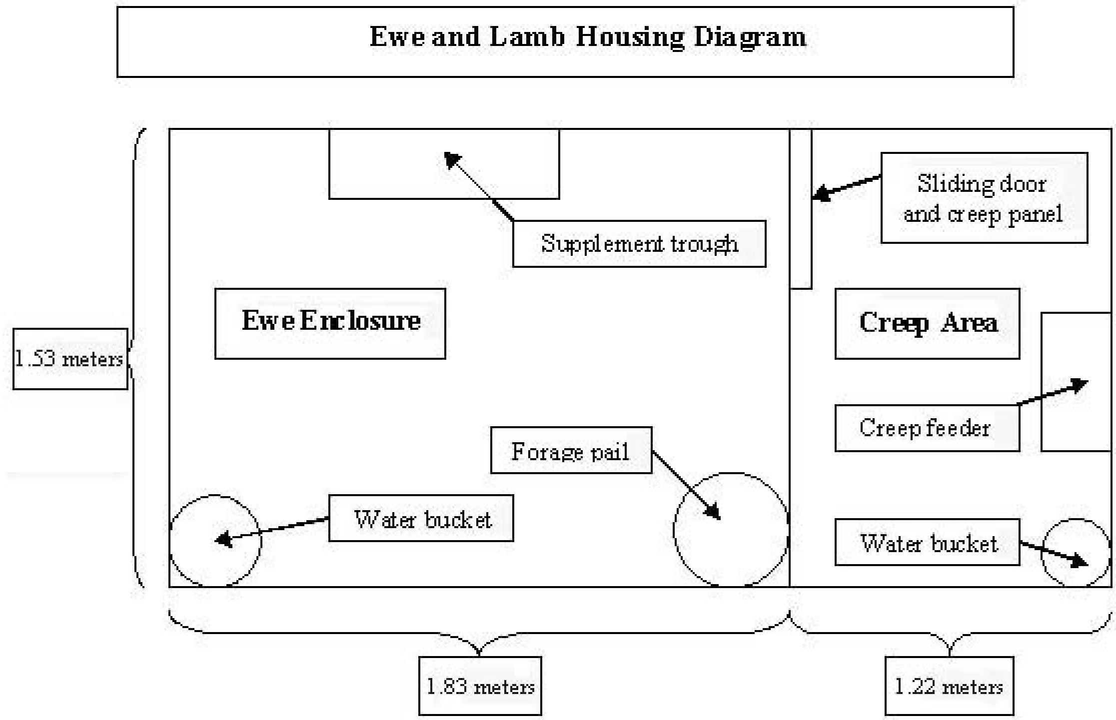
[2] ME (Mcal/lb)

forage and concentrate daily at 800 h, using the previous day's intake to estimate the day's intake to allow for 10% refusals. Forages and concentrate were offered in separate feeders. Additional feed was added in the evening at about 1730 h. Water was offered *ad lib*. Creep feed was offered to lambs at the beginning of each week, with extra added as necessary during the week to allow for *ad lib*. intake.

Ewes and their own lambs were housed in eight separate pens measuring 1.53 meters by 1.83 meters with an attached creep area measuring 1.22 meters by 1.53 meters (Fig. 1). The creep area and ewe enclosure were connected by a sliding door that served as the creep panel and access to the pen. Water buckets were located in a back corner of the pen, concentrate feeders were hung on the chain link walls of the pen and the forage pail was located in a front corner of the pen. In the creep area, water buckets were located in a front corner and the creep feed trough was hung on the front or side of the fence panels.

The replicated study was divided into four periods, each period having a seven day adjustment time and seven days of data collection. Feed intake data was collected on a daily basis and samples of 10 g were taken out of each ewe's refusals each day. These weigh-back samples were stored and analyzed at the end of each period. Samples of the feed offered were also analyzed to determine the actual nutrient composition of the feed consumed. Creep feed was recorded on a weekly basis. Ewe and lamb weights were recorded once a week using a Tru-Test AG350 Indicator animal scale (Tru-Test Distributors Limited, Pakuranga, New Zealand) for ewes and lambs weighing over 10 kg and using a OHAUS ES Series data ranger scale (Ohaus Corp., Pine Brook, NJ) for lambs weighing less than 10 kg. Milk samples were also taken once a week, stripping the teats

Figure 1. Ewe and lamb housing diagram and photograph.



before taking the sample. The feed and milk samples were analyzed by Dairy One Cooperative Inc. in Ithaca, NY. Milk samples were analyzed for percent fat, true protein, lactose and total solids.

Data were analyzed using repeated measures analysis models in the PROC MIXED procedure in SAS, version 7.0 software (SAS, 1998) according to Templeman and Douglass (1999). Class variables were period diet and sheep. The covariance structure was assumed to be first order autoregressive, and degrees of freedom were calculated using the Satterthwaite method. Period is repeated with the subject being sheep. There were seven days per period for each sheep. Statistical design was a 4 X 4 Latin square with two sheep per treatment so no interactions could be obtained. Treatments consisted of two types of concentrate and two types of forage for four treatments. Differences among diets were determined using Tukey's test for all comparisons. Significance was $P < 0.05$ unless otherwise stated.

The study had Institutional Care and Committee Use approval, ensuring that all current standard operating practices for the health and welfare of the sheep were followed.

Results & Discussion

At the beginning of period three, a ewe whose diet had changed from an okara and corn supplement to a wheat middling and corn supplement became acidotic and required treatment, prompting a change in procedure. For periods three and four, ewes switching to diets A or C were given limited quantities of concentrate to help facilitate transition without causing acidosis. On the first day of the transition period, approximately 0.5 kg was offered, then 1 kg, then 2 kg and then *ad lib.* consumption was allowed. The ewe with acidosis was treated with an oral dose of sodium bicarbonate and 2.5 cc Oxytetracycline, 8 cc subcutaneous Oxytetracycline (once a day for three days), 60 cc intravenous calcium and 6 cc subcutaneous B vitamins (twice a day for one day). She responded quickly, so that it was not necessary to exclude her from the trial. During the trial, two ewes on diet OSS had mastitis and were treated with 8 cc subcutaneous Oxytetracycline for four days.

During the adjustment time of period two, one lamb became very ill and was diagnosed by a Cornell Ambulatory Clinic veterinarian as having *Polioencephalomalacia*, a deficiency in vitamin B_1. The lamb was treated with 0.5 L intravenous electrolytes, 4 mL intravenous dextrose in solution, 0.5 cc intramuscular thiamin and oral sodium bicarbonate. The lamb responded to treatment and was subsequently treated with 1 cc subcutaneous Oxytetracycline every other day for three treatments and 0.5 cc intramuscular thiamin three times a day for six days. The lamb was weak for several days, necessitating his being bottle-fed ewe's milk for the first two days, with his mother being held to facilitate nursing for several days thereafter. Two other

Table 5. Ewe daily gain (g) by period*

	Period			
Diet Treatment[1]	1	2	3	4
Diet TSH	170	270	360	-10
Diet OSH	490	70	-100	-140
Diet TSS	130	300	510	110
Diet OSS	-40	0	-560	60

*Proc mixed calculates standard error as the same for all diets when there are no missing values= Standard error = 791

[1]Diet TSH= a wheat middling and corn concentrate fed with a mixed grass hay; Diet OSH= an okara and corn concentrate fed with mixed grass hay; Diet TSS= a soybean meal and wheat middling concentrate fed with hay crop silage; and Diet OSS= an okara and corn concentrate fed with hay crop silage.

Table 6. Lamb daily gain (g) by period*

	Period			
Diet Treatment[1]	1	2	3	4
Diet TSH	290	-70	510	60
Diet OSH	200	300	-560	-10
Diet TSS	200	0	360	-140
Diet OSS	130	270	-100	110

* Proc mixed calculates standard error as the same for all diets when there are no missing values= Standard error = 32

[1]Diet TSH= a wheat middling and corn concentrate fed with a mixed grass hay; Diet OSH= an okara and corn concentrate fed with mixed grass hay; Diet TSS= a soybean meal and wheat middling concentrate fed with hay crop silage; and Diet OSS= an okara and corn concentrate fed with hay crop silage.

lambs were found to have mild scours during the first period, and were treated with 1.3 cc subcutaneous Oxytetracycline.

There were no significant differences (P>0.05) among ewe average weekly gains or rate of gain by period (Table 5). This indicates that the diets had no effect on the ewe's plane of nutrition. There was also no difference (P>0.05) among the diets across the periods or trends across the periods or between the diets. This lack of significant difference was also seen in the lamb average weekly gains and average rate of gain at P>0.05 (Table 6). There were also no discernable trends between the diets or across the periods. This suggests that the ewes and the lambs on one diet gained just as well as the ewes and lambs on any other diet. Each diet was equally effective at producing growth in lambs and maintaining plane of nutrition in the lactating ewes.

Ewe average daily dry matter intake was not significant between periods or between diets, but there were differences between the daily dry matter intakes of supplement and of forages (P<0.05). The amount of okara supplement consumed by ewes fed hay was larger than the amount of okara supplement consumed by ewes fed hay crop silage (P=0.07). There was no significant difference between the traditional concentrate consumption levels or between the traditional concentrate and the okara (P>0.07). The lower intake of the okara-based supplement for the ewes fed hay crop silage as forage could possibly be accounted for by the very high moisture content of the supplement, which contained less corn than the okara-based supplement for the ewes fed grass hay (Table 4). The high moisture content of the combine hay crop silage and okara could decrease the palatability of the feed, thus limiting intake by the ewes. It could also be an attempt by the ewes to moderate their rumen pH level. There was

Table 7. Average daily dry matter intake (kg/day)

	Diet[1]				
Intake Component	TSH	OSH	TSS	OSS	SE*
Forage[3]	0.62[a]	0.61[a]	1.65[b]	1.59[b]	0.180
Supplement[3]	2.88[ab]	3.64[b]	2.57[ab]	1.70[a]	0.470
Creep[2,4]	0.47	0.42	0.45	0.36	0.060
Ewe[4]	3.50	4.25	4.21	3.29	0.392
Total[4]	3.97	4.67	4.66	3.64	0.416

*Standard error

[1]Diet TSH= a wheat middling and corn concentrate fed with a mixed grass hay; Diet OSH= an okara and corn concentrate fed with mixed grass hay; Diet TSS= a soybean meal and wheat middling concentrate fed with hay crop silage; and Diet OSS= an okara and corn concentrate fed with hay crop silage.

[2]Consumed only by lambs.

[3]Means within a row followed by the same letter were not different (P>0.05).

[4]Means within a row were not different (P>0.05).

inevitably some fermentation of the okara, because the supplements were not mixed on a daily basis. In addition, both the okara and the hay crop silage have a low pH (Takahashi et al, 1992). Consuming too much of the feeds could have caused the ewes to become acidotic, and so the ewes limited their intakes. There was also a difference between the dry matter intakes of forages: There was significantly higher intake of hay crop silage than of hay ($P<0.05$), but there was no difference in the intake of hay crop silage between diets C and D or of hay between diets A and B ($P>0.05$). The higher intakes of silage could be explained by the fact that these ewes were consuming hay crop silage as the main part of their diet at the Sheep Unit before becoming part of this study; the ewes being pre-exposed to the hay crop silage could sway their preference towards the hay crop silage. It is also possible that the hay crop silage was more palatable than the grass hay.

There was no difference in creep feed consumption among lambs fed from ewes fed the different diets ($P>0.05$), but there was a periodic difference in consumption at $P<0.01$. Because the lambs were eating essentially the same diets throughout the periods (consisting of milk and creep feed), there was no difference expected. The periodic difference is explained by the fact that the lambs eat more creep feed as they become older and near weaning and as their rumen function develops (Sheep Production Handbook, 2003). There was no significant difference among the growth efficiencies of lambs from ewes fed the different diets at $P>0.05$ with an average growth efficiency of 170 g gain/g feed with a standard error of 30. This data accounts for the gains in lambs and ewes and the total amount of feed consumed. Each diet was just as efficient at producing growth in the nursing lambs, suggesting that the okara is effective as a protein supplement in ruminant diets.

While there was not a significant difference between milk fat percentage among the four diets (P>0.05), there was a trend towards higher milk fat percentage in diets with hay crop silage fed as the forage versus diets with grass hay (Table 8). Percentage of protein in milk did not, however, follow this trend and were also not significantly different among the four diets. Milk protein content is not affected by crude protein concentration in the feed consumed by ewes (Roy et al, 1999). Somatic cell count was different between the Diet OSH (fed grass hay) and Diet TSS (fed hay crop silage) at P<0.05. While this is the only significant difference in somatic cell count, there is a distinct trend toward higher somatic cell counts in diets fed hay versus those fed hay crop silage. This could possibly be due to increased milk production in the ewes fed the grass hay, but could also be caused by instances of mastitis (Bencini and Pulina, 1997). There was not a significant difference in milk urea nitrogen concentration among the different diets (P>0.05), but there was a trend for diets fed grass hay as a forage to have higher MUN. This was especially true for the MUN concentration of Diet OSH, the diet fed okara as a supplement with hay as the forage. There was also no difference in the concentration of lactose in the milk between the different diets (P>0.05), which was expected because of lactose's role as the osmotic regulator in milk production. The difference in total solids among diets was not statistically significant (P>0.05), though there was a trend toward higher solids in the diets fed hay crop silage. This can be explained by the trend towards higher milk fat percentages in the diets fed hay crop silage as the forage.

Table 8. Ewe milk composition as influenced by diet.

	Diet[1]				
Component	TSH	OSH	TSS	OSS	SE*
Fat, % of milk	6.02[a]	6.10[a]	6.85[a]	7.20[a]	0.516
Total Protein, % of milk	4.64[a]	4.81[a]	4.5[a]	4.64[a]	0.165
SCC[2]	1273[abc]	4228[c]	0[a]	472[ab]	125
MUN[3]	57.0[a]	89.3[a]	48.1[a]	51.9[a]	12.0
Lactose, % of milk	4.98[a]	4.92[a]	5.12[a]	5.00[a]	0.493
Total Solids, % of milk	16.46[a]	16.82[a]	17.55[a]	17.94[a]	0.060

*Standard error

[1]Diet TSH= a wheat middling and corn concentrate fed with a mixed grass hay; Diet OSH= an okara and corn concentrate fed with mixed grass hay; Diet TSS= a soybean meal and wheat middling concentrate fed with hay crop silage; and Diet OSS= an okara and corn concentrate fed with hay crop silage

[2]SCC=Somatic Cell Count=(x*1,000)

[3]MUN=Milk Urea Nitrogen= mg/dL

Summary and Conclusion

The main objective of this study was to determine whether okara was an effective protein source for lactating ewes. Using okara as a protein supplement would be beneficial to farmers and tofu or soymilk producers because it would provide an inexpensive source of protein for animal consumption and also eliminate the disposal problems faced by tofu and soymilk producers. Based on these data, we cannot conclusively state that any diet caused a significant increase in milk quantity or quality. We can assume, however, based upon the similar growth efficiencies and average weekly gains of lambs, that at the very least, the okara supplement is just as effective at providing a source of protein for lactating ewes as wheat middlings, corn and soybean meal. Thus, there is a definite possibility that a mutually beneficial relationship could be formed between farmers and tofu and soymilk producers.

There is still plenty of research to be done to further investigate okara as a livestock protein supplement. In the 20 percent dry matter form, okara can be difficult to handle, which poses a problem for many livestock producers. Investigating the drying of okara for use as an animal feed would be beneficial. It would also be interesting to look further into the fermentation of 20 percent dry matter okara and its effects on rumen digestibility. Future research could also examine whether okara is equally effective as a feed for growing weaned lambs as it is for lactating ewes.

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Appendix

Table 1. Temperature and humidity logs

	Temp			Humidity		
Date	Minimum	Maximum	Average	Minimum	Maximum	Average
12-Feb-09	51.4	60.0	55.7	46	64	55.0
13-Feb-09	49.6	52.8	51.2	30	47	38.5
14-Feb-09	50.2	54.2	52.2	24	31	27.5
15-Feb-09	51.4	54.0	52.7	22	27	24.5
16-Feb-09	51.4	54.0	52.7	21	25	23.0
17-Feb-09	49.2	54.2	51.7	21	24	22.5
18-Feb-09	51.6	54.0	52.8	21	22	21.5
19-Feb-09	54.0	51.0	52.5	21	43	32.0
20-Feb-09	49.8	54.0	51.9	21	41	31.0
21-Feb-09	50.2	55.4	52.8	20	24	22.0
22-Feb-09	51.8	54.0	52.9	20	27	23.5
23-Feb-09	49.6	54.0	51.8	21	28	24.5
24-Feb-09	49.0	53.8	51.4	<15	<15	<15
25-Feb-09	49.4	54.8	52.1	<15	<15	<15
26-Feb-09	52.2	60.6	56.4	20	35	27.5
27-Feb-09	53.4	60.8	57.1	22	55	38.5
28-Feb-09	50.4	57.4	53.9	26	68	47.0
29-Feb-09	50.0	54.0	52.0	20	26	23.0
1-Mar-09	50.0	54.0	52.0	20	26	23.0
2-Mar-09	49.6	53.6	51.6	21	23	22.0
3-Mar-09	48.6	51.4	50.0	21	27	24.0
4-Mar-09	48.8	54.2	51.5	<15	<15	<15
5-Mar-09	49.6	55.4	52.5	<15	<15	<15
6-Mar-09	51.8	61.0	56.4	21	40	30.5
7-Mar-09	53.6	62.0	57.8	38	57	47.5
8-Mar-09	53.4	61.8	57.6	47	69	58.0
9-Mar-09	52.4	54.0	53.2	57	66	61.5
10-Mar-09	50.0	53.6	51.8	37	58	47.5
11-Mar-09	50.0	59.6	54.8	37	66	51.5
12-Mar-09	50.0	67.8	58.9	32	39	35.5
13-Mar-09	50.8	54.8	52.8	17	25	21.0
14-Mar-09	52.8	58.8	55.8	20	26	23.0
15-Mar-09	55.0	62.6	58.8	23	26	24.5
16-Mar-09	58.8	63.2	61.0	19	34	26.5
17-Mar-09	54.6	64.4	59.5	22	31	26.5
18-Mar-09	55.6	65.6	60.6	28	51	39.5
19-Mar-09	53.8	61.8	57.8	44	63	53.5
20-Mar-09	53.4	61.2	57.3	22	45	33.5
21-Mar-09	54.8	60.0	57.4	20	24	22.0
22-Mar-09	58.2	62.6	60.4	18	24	21.0

23-Mar-09	53.0	60.8	56.9	19	33	26.0
24-Mar-09	53.0	60.0	56.5	19	20	19.5
25-Mar-09	56.4	61.8	59.1	18	20	19.0
26-Mar-09	57.2	62.6	59.9	19	56	37.5
27-Mar-09	58.2	62.2	60.2	38	57	47.5
28-Mar-09	57.2	63.4	60.3	26	45	35.5
29-Mar-09	60.4	66.8	63.6	41	58	49.5
30-Mar-09	52.8	62.8	57.8	37	68	52.5
31-Mar-09	52.8	61.0	56.9	38	45	41.5
1-Apr-09	57.0	63.0	60.0	34	44	39.0
2-Apr-09	59.0	61.8	60.4	43	54	48.5
3-Apr-09	55.4	64.4	59.9	28	58	43.0
4-Apr-09	54.4	67.4	60.9	46	71	58.5
5-Apr-09	51.8	55.8	53.8	41	51	46.0
6-Apr-09	54.8	63.6	59.2	42	54	48.0
7-Apr-09	50.0	62.2	56.1	36	59	47.5
8-Apr-09	50.4	53.0	51.7	32	39	35.5
9-Apr-09	52.2	62.2	57.2	23	37	30.0
10-Apr-09	56.4	62.4	59.4	22	30	26.0