Sheep

Research Report

Hettinger Research Extension Center

Department of Animal Science

North Dakota State University

Report No. 54

October 2014

NDSU | HETTINGER RESEARCH EXTENSION CENTER

Index

Effects of maternal nutrition and arginine supplementation on characteristics of wool quality in offspring
J. L. Peine, P. B. Borowicz, J. S. Caton, and R. R. Redden 2

Ovine progressive pneumonia virus infection rate and incidence of genetic susceptibility diplotype in North Dakota sheep flocks
R. R. Redden, R. J. Schmidt, and J. D. Kirsch 5

2014 North Dakota 4-H Lamb Ultrasound Carcass Evaluation
A.R. Crane, R.R. Redden, and C.S. Schauer 9

2013 Dakota Ram Test Final Performance Results
A.R. Crane, D. Pearson, D. Ollila, J. Held, and C. S. Schauer 13

Effects of lasalocid and diet particle size on feedlot performance, carcass traits, and nutrient digestibility in feedlot lambs
A. R. Crane, R. R. Redden, P. B. Berg, and C. S. Schauer 18

Mortality Composting: Proper Disposal Methods to Manage Mortalities in the Sheep Flock
M.A. Berg 25

Flock Calendar Outline 28

Rearing Lambs Artificially (Orphans)- Management Tips 30

Effects of maternal nutrition and arginine supplementation on characteristics of wool quality in offspring

J. L. Peine*, P. B. Borowicz*, J. S. Caton*, and R. R. Redden*

*Department of Animal Sciences and Center for Nutrition and Pregnancy, North Dakota State University, Fargo 58108

The objectives of this study were to evaluate effects of maternal nutritional plane and rumen-protected arginine supplementation on postnatal offspring wool quality and follicle development. We hypothesized that lambs from ewes receiving diets fed to nutrient requirements would have a greater density of wool follicles and more improved wool quality than lambs from nutrient restricted ewes; we also hypothesized that lambs from restricted ewes receiving a rumen-protected arginine supplement would present similar wool follicle numbers and quality to those lambs from adequately fed dams. We found that though maternal nutrient restriction did not appear to affect wool quality, maternal rumen-protected arginine supplementation may increase wool follicle density in offspring from nutrient-restricted dams and therefore potentially increase wool production.

INTRODUCTION

The United States' total wool supply has been declining over the last twenty years. In 1990, U.S. wool supply totaled 214.8 million clean pounds, with 131.9 million clean pounds in 2000 and dropping to 56.3 million clean pounds in 2010 (USDA, 2013). Similarly, total yield per head has been decreasing, albeit not as drastically (7.8 lb/head in 1990, 7.6 lb/head in 2000, and 7.3 lb/head in 2010; USDA 2013). These data support a need for improvement in U. S. wool production.

Development of wool follicles occurs during fetal life and plays an important role in postnatal wool output (Magolski et al., 2011). Skin has a defined number of dermal cells in the embryonic stage that will eventually permit postnatal follicle formation, meaning that postnatal wool follicle numbers are pre-determined by fetal development during gestation. Nutrition, especially amino acid availability, impacts wool growth and follicle development (Rogers, 2006). When maternal nutrition, particularly amino acid availability, during pregnancy is restricted, this can result in a decrease in wool follicle development (Schinckel and Short, 1960).

Knowing this, we hypothesize that lambs from ewes receiving diets fed to meet nutrient requirements during gestation will have a greater density of wool follicles and increased wool quality compared to lambs from ewes restricted in nutrients during gestation. We also hypothesize that lambs from ewes restricted in nutrients, but receiving a rumen-protected arginine supplement will present similar wool follicle numbers and quality to those lambs from dams receiving full nutrient requirements during gestation.

PROCEDURES

Ewes were confirmed pregnant and randomly assigned to one of three treatments at day 54 (standard deviation of start date was 3.89 days) of gestation: control (**CON**) receiving 100% NRC (1985, 2007) energy requirements, restricted (**RES**) receiving 60% of CON nutrients, and restricted plus arginine (**RES-ARG**) receiving the restricted diet in addition to a rumen-protected arginine supplement dosed at 81.7 mg/lb (180 mg/kg) body weight. All ewes were receiving a complete pelleted diet once daily containing 34% dehydrated alfalfa meal, 27% dehydrated beet pulp, 25% wheat middlings, 9% ground corn, 5% soybean meal, and a trace mineral premix exchanged for ground corn at the rate of 12 pounds per ton on an as fed basis. Rumen-protected arginine supplements were mixed into 0.11

pounds of corn and fed once a day at 8:00 am, just prior to offering pelleted diet. Ewes were weighed every 14 days, and diets were adjusted as necessary. Ewes were carried through gestational term on these treatments. Immediately post-lambing, lambs were separated from ewes and raised independent of their dam.

Lambs were maintained on a common diet of artificial colostrum for 20 hours after birth, dosed at 8.7 mL/lb body weight 0 and 2 hours post birth, and 11.6 mL/lb body weight 4, 8, 12, 16, and 20 hours post birth. These was followed by ad libitum milk replacer (Super Lamb Milk Replacer, Merrick's Inc., Middleton, WI) and water in addition to long stem mid-bloom alfalfa hay and creep feed for the remainder of the project. At 54 days of age (with a standard deviation of 3 days), lambs were weighed prior to stunning by captive bolt. Following wool collection, the corresponding 3 cm^2 sections of skin were obtained from the side (between 10th and 12th rib) and britch regions of the lamb for further histological analysis.

Skin sections were fixed and stained via a procedure using Mayer's Hematoxylin and Schiff Reagent. Sections were processed, embedded in paraffin blocks, and applied to glass slides for microscopic imaging. Photomicrograph images were analyzed in Image-Pro Plus software to measure two 1 mm^2 sections and count the total number of wool follicles visible in these areas. An average of the follicle counts for each of the two squares was taken for each lamb – one average value for the side and one average value for the britch.

Side and britch wool samples were sent to Montana Wool Laboratory (Bozeman, MT) for analyses of mean fiber diameter, fiber diameter SD, and comfort factor with the Optical Fiber Diameter Analyzer 100.

RESULTS

Birth weight and growth performance of the lambs have been reported previously (Peine et al., 2013). At d 54 of age, there was no difference ($P \geq 0.16$) in lamb body weight due to maternal nutrition treatment, twin status, or fetal sex.

No differences ($P = 0.41$) were observed in follicle numbers between maternal nutrition treatments for skin samples taken from the side of the lamb, however singleton lambs had greater wool ($P = 0.04$) follicle density than twin lambs (87 ± 4.2 vs. 66 ± 9.1 follicles per 1 mm^2, respectively) (Table 1). In samples taken from the britch, lambs from RES-ARG ewes had greater ($P = 0.02$) wool follicle density than lambs from CON ewes, and tended to have greater ($P = 0.13$) wool follicle density than lambs from RES ewes. Singleton lambs also tended to have greater ($P = 0.13$) wool follicle density than twin lambs in samples taken from the britch.

The wool quality data reflected that mean fiber diameter, fiber diameter, and comfort factor all showed no differences between treatment, twin status, or fetal sex ($P \geq 0.15$).

DISCUSSION

Lambs from RES-ARG ewes had greater wool follicle density than lambs from CON ewes, and tended to have more wool follicle density than lambs from RES ewes in skin samples taken from the britch. Arginine is a precursor to synthesis of polyamines, which regulate DNA and protein synthesis, cell proliferation and differentiation, and regulation of gene expression (Kwon et al., 2003). Arginine-induced polyamine synthesis may have permitted differentiation and proliferation of wool follicle cells during fetal development. In addition, arginine is also a precursor to nitric oxide (**NO**) which regulates blood flow (Martin et al., 2001). Increased blood flow due to arginine supplementation and NO regulation may provide more nutrient availability for wool growth.

Twin status may have induced differences in wool follicle numbers in both the side and britch skin. Singleton lambs had greater wool follicle density in skin samples from the side than twin lambs. Similarly, singleton lambs tended to have greater wool follicle density in skin samples from the britch than twin lambs. This is probably due to singleton lambs having less competition for nutrients during fetal development than twin lambs (Freer et al., 1997).

There were no differences in mean fiber diameter, fiber diameter SD, or comfort factor based on maternal treatment, fetal number, or sex of the offspring. These results demonstrate a lack of improvement in wool quality in terms of fiber diameter based on either maternal nutrition or rumen-protected arginine supplementation.

IMPLICATIONS

These data imply that arginine supplementation has the potential to increase wool follicle density in offspring from ewes restricted in nutrients during gestation. However, arginine supplementation did not increase wool quality in those offspring.

LITERATURE CITED

Kwon, H., Wu, G., Bazer, F. W., Spencer, T. E., 2003. Developmental changes in polyamine levels and synthesis in the ovine conceptus. Biol. Reprod. 69, 1626-1634.

Magolski, J. D., Luther, J. S., Neville, T. L., Redmer, D. A., Reynolds, L. P., Caton, J. S., Vonnahme, K.A., 2011. Maternal nutrition during pregnancy influences offspring wool production and wool follicle development. J. Anim. Sci. 89, 3810-3823.

Martin, M. J., Jimenez, M. D., Motilva, V., 2001. New issues about nitric oxide and its effects on the gastrointestinal tract. Curr. Pharm. Des. 7(10), 881-908.

Peine, J. L., Jia, G. Q., Van Emon, M. L., Neville, T. L., Kirsch, J. D., Hammer, C. J., O'Rourke, S. T., Reynolds, L. P., Caton, J. S., 2013. Effects of maternal nutrition and rumen-protected arginine supplementation on ewe and postnatal lamb performance. Proc. Western Section Am. Soc. Anim. Sci. 64, 80-83.

Rogers, G. E., 2006. Biology of the wool follicle: an excursion into a unique tissue interaction system waiting to be re-discovered. 2006. Exp. Dermatol. 15, 931-949.

Schinckel, P. G., Short, B. F., 1960. The influence of nutritional level during pre-natal and early post-natal life on adult fleece and body characters. Aust. J. Agric. Res. 12(1), 176-202.

USDA., 2013. Cotton and wool yearbook: U.S. wool supply and use. http://www.ers.usda.gov/data-products/cotton,-wool,-and-textile-data/cotton-and-wool-yearbook.aspx. (Accessed 29 May 2014).

Table 1. Effect of maternal nutrition and arginine supplementation on wool follicle numbers and various wool quality measurements[1]

	Maternal Treatment[2]				*P* - values		
Item	CON	RES	RES-ARG	SEM	Treatment	Fetal no.	Sex
54 day body weight (lb)	52.6	48.3	52.2	2.27	0.25	0.81	0.16
Follicle No.							
Side	85	74	71	9.5	0.29	0.04	0.29
Britch	86[a]	93[ab]	106[b]	6.3	0.05	0.13	0.97
Mean fiber diameter (µm)							
Side	18.8	18.4	18.3	0.31	0.32	0.33	0.15
Britch	20.9	21.5	20.8	0.43	0.40	0.30	0.45
Fiber diameter SD (µm)							
Side	4.8	4.9	4.9	0.16	0.75	0.37	0.56
Britch	5.6	6.0	5.6	0.29	0.46	0.27	0.65
Comfort factor							
Side	98.5	98.5	98.6	0.37	0.98	0.57	0.13
Britch	94.6	93.1	95.0	1.35	0.47	0.16	0.16

[1]Wool follicle numbers and quality were assessed in offspring from ewes fed complete pelleted diets at varying levels of nutrient requirements with or without rumen-protected arginine (RP-ARG) supplementation.
[2]Treatments were administered to ewes as a complete pelleted diet daily. Rumen-protected arginine supplement was mixed in a 50 g fine ground corn carrier. Treatments were control (CON, 100% NRC requirements, n = 11), restricted (RES, 60% CON nutrients, n = 11), and restricted + arginine (RES-ARG, RES + rumen-protected arginine supplement, n = 10). Rumen-protected arginine was dosed at 81.7 mg/lb (180 mg/kg) BW.
[a,b,c] Means within a row without a common letter superscript differ ($P \leq 0.05$).

Ovine progressive pneumonia virus infection rate and incidence of genetic susceptibility diplotype in North Dakota sheep flocks[1]

R. R. Redden[*], R. J. Schmidt[†], and J. D. Kirsch[*]

[*]Department of Animal Sciences, North Dakota State University, Fargo, ND
[†] Oliver County, North Dakota State University Extension Service, Center, ND

The objectives for the project were to determine the incidence of sheep serologically positive for ovine progressive pneumonia virus (OPPV) and frequency of diplotypes known to affect OPPV susceptibility in sheep. Of the 12 flocks tested, 1/3 had a high incidence of OPPV positive sheep and 2/3 had a low incidence or no sheep test positive for OPPV. Sheep with both copies of the more favorable diplotype "1" had a lower incidence of OPPV positive sheep than sheep with at least one unfavorable haplotype "2 or 3". Younger ewes had a lower OPPV infection rate.

INTRODUCTION

Ovine progressive pneumonia (OPP) is a slowly progressive viral disease of adult sheep. Often, the first sign noticed is a general loss of body condition referred to as "thin ewe syndrome." Another common sign of OPP is an increased breathing effort at rest. Infected ewes can develop "hard bag," an enlarged, firm udder with reduced or no milk flow.

Once infected, animals remain infected for life, although many never show clinical signs of the disease. Flocks infected with OPPV can have lowered production efficiency because higher adult death loss, early culling, decreased milk production and lower weaning weights. Recent research at the U.S. Meat Animal Research Center (US-MARC) in Clay Center, Neb., has discovered a genetic marker that can identify animals that are less susceptible to OPPV infection. This new genetic test, TMEM 154, determines the risk level for infection with OPPV. There are three haplotypes that are most common and they are depicted as 1, 2, and 3. Every animal has two copies of a haplotype, which is referred to as a diplotype.

This disease is transmitted from ewe to lamb at an early age (vertical transmission) or transmitted from sheep to sheep as adults (horizontal transmission) throughout their lifetime. Although, some literature indicates that most transmission is from ewe to lamb, research at US-MARC has shown that horizontal transmission is quite common and typically occurs during the lambing season and/or when sheep are housed in close quarters.

PROCEDURES

We identified 12 different sheep flocks in North Dakota who volunteered to be a part of the project. Each flock was able to test up to 50 adult animals per breed. In total, we sampled 735 adult sheep. Sheep breed and age data were recorded on each animal. Blood samples were taken via jugular venipuncture. Samples were sent to a centralized laboratory (GeneSeek, Lincoln NE) where they were analyzed for OPPV serum antibody and tested with the OPPV genetic susceptibility test (TMEM 154). Serological samples were classified into positive, negative, and questionable categories based on the assay guidelines. Questionable samples were rerun and all sheep were placed into positive or negative categories based on the second assay. If any flock had at least one positive animal they were categorized as an infected flock. Breed, age and diplotype were used as class variables. Animal infection status was analyzed

[1]This project was supported by North Central Sustainable Agriculture Research and Education - Farmer Rancher Grant Program.

using the GLIMMIX procedures of SAS for all sheep and sheep from only infected flocks. Means were considered different at $P \leq 0.10$.

RESULTS AND DISCUSSION

Figure 1 categorizes each flock by the percent flock OPPV infection rate. Eight of the 12 flocks (66 %) had at least one sheep test positive for OPPV, which is considerably higher than what the Animal and Plant Health Inspection Service (APHIS) estimates the US sheep industry's prevalence rate of OPP (36%). This could be due to our relatively small sample size or the difference in flock management in North Dakota compared to the rest of the nation. Within infected flocks, 2 to 76 % of the sheep within each flock tested positive for OPPV. There were only 2 flocks that had a greater than 25% infection rate. The majority of flocks did not have any sheep test positive or had a low OPPV prevalence rate (≤ 25%). The overall OPPV prevalence rate of all sheep tested was 28 %, which is similar to the 24% prevalence rate estimated for the U.S. sheep industry by APHIS.

Diplotype status had an effect ($P < 0.01$) on OPPV infection rate of sheep in all flocks and within infected flocks (Table 1). Across all flocks, sheep with diplotype "1 1" had a lower ($P < 0.10$) infection rate than sheep with less favorable diplotypes ("1 2" "1 3" "1 4" "2 2" and "2 4"). Within infected flock, sheep with the diplotypes "1 1" "1 4" and "4 4" had a lower ($P < 0.10$) OPPV infection rate than sheep with the diplotypes "1 2" or "1 3". Sheep with diplotypes "2 2" "2 3" and "2 4" were not detected to be different ($P > 0.10$) from all there diplotypes, which is likely due to a low number of these diplotypes in the population. This data are consistent with findings from US-MARC that indicate an increase in risk of infection for sheep with at least one of the more undesirable haplotypes (2 or 3). Less is known about haplotype 4 and ongoing investigation of this haplotype is currently being done in collaboration with our lab and US-MARC. This data indicates that haplotype 4 provides some protection from infection; whereas, research from US-MARC indicated that the diplotype "4 4" was fully resistant to OPPV.

We were unable to detect an effect ($P = 0.15$) of age of sheep on OPPV infection rate of sheep within all flocks; however, within infected flocks age of sheep had an effect ($P = 0.02$) on OPPV infection rate (Table 1). Within infected flocks, 1 and 2 year old sheep had a lower ($P \leq 0.10$) OPPV infection rate than 3, 4, 5, 6, and 7 year old sheep. No differences ($P \geq 0.10$) were detected between sheep older than 8 years of age and sheep younger than 8 years of age, which was likely due to a low number of ewes tested beyond 7 year of age. Similarly, research at US-MARC indicates that the sheep with an undesirable diplotype are 3.5 and 7 times more likely to test positive for OPPV at 1 and 2 years of age, respectively. We likely reported a lower level of infection rate per year because many of the flocks had a low level of OPPV infection. Similarly, the disease is also known to increase ewe culling rate, which could skew the data because infected animals that show symptoms would likely have been removed from the flock. However, it does appear that our data is somewhat consistent with US-MARC and adult animals within an infected flock become OPPV positive over many years. Management decisions that reduce the contact between uninfected or younger ewes from contracting the disease from older or infected ewes warrants further investigation.

Breed of sheep had an effect ($P < 0.01$) on OPPV infection rate across all sheep and within infected flocks (Table 1). Within infected flocks, Rambouillet and Montadale sheep had lower OPPV infection rates than all of breeds. Similarly, Polypay and Suffolk sheep had lower ($P < 0.06$) OPPV infection rates than Columbia, Dorset, Hampshire, and Katahdin sheep. Katahdin sheep from infected flocks had the highest ($P < 0.01$) infection rate of all breeds. Frequency of haplotypes varied among breeds (Table 2). Within infected flocks, breeds that had a 90% or higher frequency of the more favorable haplotype "1" were less likely to be infected with OPPV, except for the Columbia breed. Similarly, the breeds that had 60% or lower frequency of the more favorable haplotype "1" were more likely to be infected with OPPV.

IMPLICATIONS

Ovine progressive pneumonia is prevalent in the North Dakota sheep industry. One third of the flocks tested had a high incidence of OPPV positive sheep. The prevalence and impact of the disease in these flocks is likely due to a combination of genetic susceptibility, presence of the virus, and management system. The OPPV genetic susceptibility test (TMEM 154) does not guarantee that sheep will be resistant to

OPPV but those that had more unfavorable at least one of the unfavorable haplotypes were more likely to test serologically positive. Breed of sheep has an impact on OPPV infection rate; however, this is likely a result of frequency of diplotype within breed. Additionally, younger ewes were less likely to be infected with the virus, which indicates that management decisions to isolate young uninfected ewes from older infected ewes could help reduce the impact of this disease on sheep flocks.

LITERATURE CITED

Animal Plant and Health Inspection Service (APHIS). 2003. Info Sheet: Ovine progressive pneumonia awareness, management, and seroprevalence. accessed online:http://www.aphis.usda.gov/animal_health/nahms/sheep/downloads/sheep01/Sheep01_is_OPP.pdf

Leymaster, K.A., C.G. Chitko-McKown, M.L. Lawson, G.P. Harhay, and M.P. Heaton. 2013. Effects of TMEM 154 haplotypes 1 and 3 on susceptibility to ovine progressive pneumonia virus following natural exposure in sheep. J. Anim. Sci. 91: 5114-5121.

Table 1. Number and percent of OPPV infected[1] sheep by diplotype, age, and breed

	All Flocks[2]		Infected Flocks[3]	
Item	OPPV Infection Rate (%)	SE	OPPV Infection Rate (%)	SE
Diplotype[4]				
1,1	21.0[a]	5.8	41.8[a]	7.2
1,2	38.7[b]	7.0	67.3[b]	9.1
1,3	34.6[b]	7.7	74.1[b]	9.8
1,4	43.0[b]	8.2	42.1[a]	10.3
2,2	63.5[b]	24.6	59.5[ab]	31.0
2,3	21.0[ab]	21.6	34.7[ab]	30.6
2,4	52.4[b]	12.3	57.1[ab]	14.4
4,4	34.7[ab]	21.8	27.5[a]	22.7
Age, years				
1	23.0	8.6	23.2[a]	10.0
2	15.0	8.4	22.9 [a]	9.9
3	27.0	8.3	37.3 [b]	9.8
4	23.4	8.7	35.9 [b]	10.0
5	31.7	9.0	42.9 [b]	10.9
6	14.0	9.1	44.8 [b]	11.7
7	25.2	10.3	46.9 [b]	12.5
8	23.1	10.6	42.4 [ab]	13.9
9	22.6	15.3	35.7 [ab]	18.5
10	37.8	30.2	81.8 [ab]	42.8
Breed				
Columbia	54.8[c]	9.6	55.4[c]	11.3
Dorset	46.5[bc]	8.0	60.1[c]	10.0
Hampshire	46.4[bc]	9.3	70.0[cd]	11.0
Katahdin	39.6[b]	7.5	100.3[e]	10.0
Montadale	5.2[a]	13.0	8.2[a]	14.4
Polypay	42.6[bc]	8.5	40.4[b]	10.3
Rambouillet	12.2[a]	7.8	22.6[a]	10.0
Suffolk	11.0[a]	8.2	36.2 [b]	11.2

[1]Infection status was determined by serological analysis for OPPV serum antibody
[2]Sheep were tested on 12 different farms (n = 720)
[3]Sheep from farms that had at least one OPPV positive animal (n = 493)
[4]Diplotypes of sheep tested for OPPV genetic susceptibility (TMEM 154)

Table 2: Haplotype frequency for each breed of sheep

	Haplotype[1]			
Item	1	2	3	4
Breed				
Columbia	0.99			0.01
Dorset	0.88	0.10	0.02	
Hampshire	0.53	0.16		0.31
Katahdin	0.59	0.13	0.17	0.09
Montadale	0.97			0.03
Polypay	0.86	0.04	0.08	0.02
Rambouillet	0.92	0.01	0.06	0.002
Suffolk	0.76	0.16	0.01	0.08

[1]Haplotype of sheep tested for OPPV genetic susceptibility (TMEM 154)

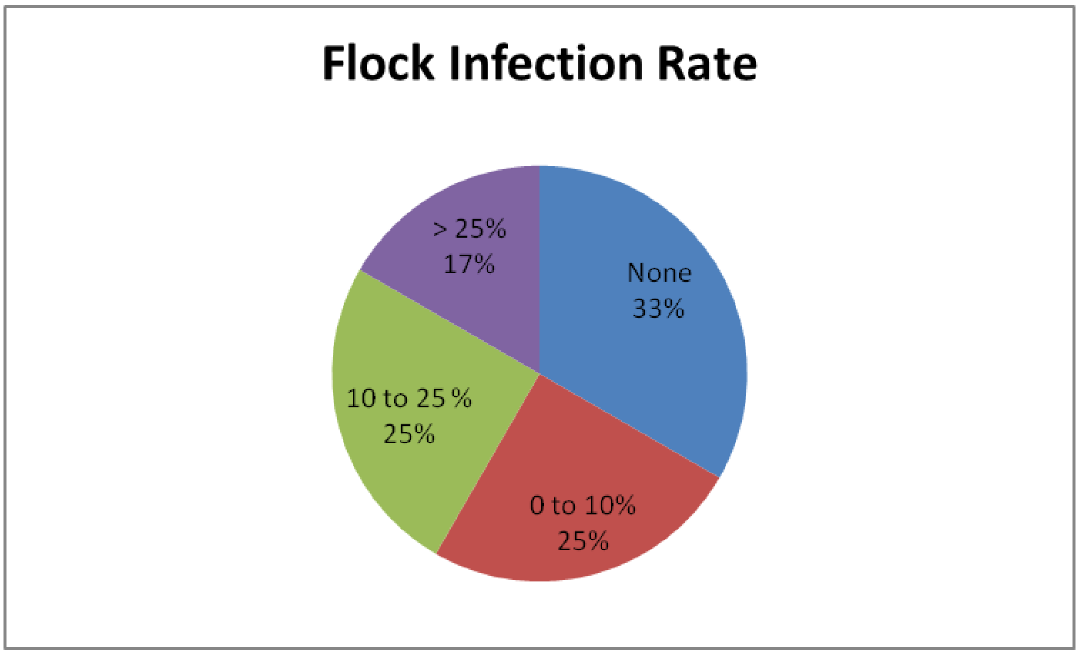

Figure 1. Flocks categorized by percent of sheep testing positive for OPPV as determined by serological testing

2014 North Dakota 4-H Lamb Ultrasound Carcass Evaluation

A.R. Crane[*¶], R.R. Redden[*], and C.S. Schauer[¶]

[*]Department of Animal Sciences, North Dakota State University, Fargo, ND
[¶]Hettinger Research Extension Center, North Dakota State University, Hettinger, ND

Yield and quality of the lamb carcass are what ultimately determine the value of a lamb. The carcass evaluation system is used to evaluate the carcass merit of 4-H club lambs using data from ultrasound scans. Lambs are first weighed, given a leg score, and loin muscle eye area, fat thickness, and body wall thickness. The latter three measurements are determined by ultrasound scanning between the 12th and 13th ribs. All of this data will then be used to evaluate the carcass merit of individual lambs.

INTRODUCTION

The ultimate value of lamb is determined by carcass quality, with many factors playing a part in its evaluation. Ultrasound technology allows for the objective estimation of carcass traits in real-time of live animals (Grainer, 2001). This technology is important for the genetic improvement of carcass merit and is certainly an important tool for outreach to 4-H participants. Ultrasound measurement allows an opportunity to quantify conformation in an objective manner (Greiner, 2001) allowing lambs with superior carcass quality to be recognized through the ND premium lamb certification using the carcass evaluation live lamb index.

PROCEDURES

Determining Carcass Character. Carcass traits used to evaluate lamb carcasses are based on industry standards for dressing percentage and ultrasound measurements of fat and muscling.

<u>Hot carcass weight and dressing percentage:</u> The weight of the carcass after slaughter is referred to as hot carcass weight. The relationship between live weight and hot carcass weight is called dressing percentage, which is figured by dividing hot carcass weight by live weight. For lambs, the dressing percentage can vary between 45 and 57 percent. For this evaluation, we used a value of 54 percent, which is based on research data from club lambs. For example, a 150-pound lamb is estimated to have a hot carcass weight of 81 pounds (150 pounds x 54 percent).

<u>Backfat thickness:</u> This is the thickness of the fat from the ribeye muscle to the outer surface of the carcass measured at the midpoint of the ribeye muscle at the 12th rib location (Figure 1). Backfat thickness is the only factor used in the assignment of yield grades. Figure 1 illustrates the location of the backfat measurement over the center of the ribeye, between the 12th and 13th ribs. Fat thickness may be adjusted up or down to account for unusual fat distribution at the point of measurement. Backfat on carcasses usually ranges from 0.1 to 0.5 inch.

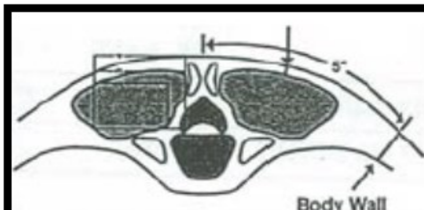

Figure 1. Locations of measurement of ribeye area, backfat thickness and body wall thickness are shown in this figure, which represents a cross section of the lamb carcass at the 12th rib. Ribeye area is the area of the longissimus muscle (ribeye).

Body wall thickness: This is a measurement across the lean, bone and fat of the lower rib 5 inches from the midline of the carcass (Figure 1). This area accumulates excess fat in some animals and is an indicator of expected trimmed cut yield from the carcass. Body wall thickness usually ranges from 0.5 to 1.2 inches.

Ribeye area (REA): This is an objective measure of muscling in lambs and is measured in square inches between the 12th and 13th ribs (Figure 1). REA measurements usually range from 1.5 to 4.0 square inches. REA is affected by the weight and muscularity of the live animal and provides a good estimate of the percentage of lean to bone in the carcass.

USDA yield grade: U.S. Department of Agriculture yield grades are calculated by using the following formula: YG = 0.4 + (10 × adj. fat thickness). USDA yield grades (1, 2, 3, 4, 5) categorize carcasses into groups according to the expected yield of trimmed, retail cuts. Yield grade 1 has the highest expected yield and 5 the lowest. For example, a lamb with 0.15 inch of backfat will have a USDA yield grade of 1.9 (0.4 + (10 x 0.15). Table 1 describes the assignment of yield grades based on backfat ranges and the average yield of semiboneless cuts for each yield grade.

Leg scores (Figure 2): These are used to evaluate muscling subjectively. Variations in leg score do not affect yield grade but are used to evaluate the attractiveness and lean yield of the lamb carcass. Leg scores usually range from 15 (very thick muscling) to 9 (thin muscling). A leg score of 12 is considered average for lamb leg muscling (slightly thick muscling).

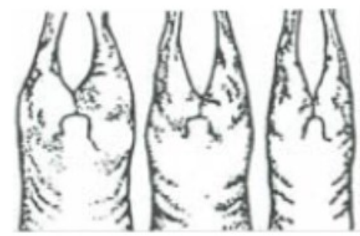

Figure 2. Examples of three leg scores are shown in Figure 2, with the thickest leg being a leg score 14, the middle example being a leg score 12 and the thinnest leg being a leg score 10.

Index System

If lambs make North Dakota premium lamb certification, the index system will rank lambs based on carcass merit. All premium lambs start with a base index value of 80. For each 0.1 inch increase in yield grade above 1.5, 0.25 point is deducted. For each 0.1 inch increase in loin muscle area above the base area for the lamb's weight class, lambs are given 1 point. For each 0.1 inch increase in body wall thickness above 0.8, lambs are deducted 2 points. Conversely, each 0.1 inch decrease in body wall thickness is rewarded with 2 points. Finally, lambs are given 2 additional points for each leg score above 12.

RESULTS

During the North Dakota State Fair, a total of 78 lambs were scanned for the 4-H live lamb carcass evaluation contest, belonging to 48 kids from 21 counties. Forty six percent of the lambs received the certification for ND premium lamb. The tables below list the carcass qualities and indices of the top ten lambs enrolled in the contest.

IMPLICATIONS

The ND live lamb carcass evaluation contest was developed to evaluate the carcass merit of 4H club lambs using data from the ultrasound scans. Through this program children involved have been impacted by being taught the value of ultrasounding sheep and other livestock and the impact it can have on the industry. Scientists explained the process of scanning, the qualities being scanned, and what the measurements can tell us about the individual animals. Through this program, we can positively impact the lamb industry by striving to have a superior product in club lambs.

LITERATURE CITED

Maddock, R., R. R. Redden, and C. S. Schauer. 2013. North Dakota 4-H lamb ultrasound carcass value evaluation. NDSU Extension Bulletin: GBJ09, July.

Greiner, S. P. 2001. Understanding sheep ultrasound measurements for carcass traits. Virginia Cooperative Extension Bulletin: Livestock Update, August

Table 1. Lamb Carcass Yield Grade Information (Maddock et al., 2013)

Yield Grade	Backfat Range	Average Estimated % Semi-boneless Yield
1	0.15 in and less	50.3
2	0.16- 0.25 in	49.0
3	0.26-0.35 in	47.7
4	0.36-0.45 in	46.4
5	0.46 in and greater	45.1

Table 2. North Dakota 4-H Lamb Live Carcass Index (Maddock et al., 2013)

Base Index	Yield Grade	Carcass Weight (lbs.)	Loin Muscle Area (in^2)	Body Wall Thickness (in.)	Leg Score
80	1.5	<50	2.7	Base = 0.8	Base= 12
		50-55	2.8		
		55-60	2.9		
		60-65	3.0		
		65-70	3.1		
		70-75	3.2		
		75-80	3.3		
		80-85	3.4		
		>85 lbs	3.5		
	(+ 0.1 in. = -0.25 units)		(+0.1 in^2 = +1 unit)	(+0.1 in. = -2 units) (-0.1 in. = +2 units)	

Table 3. Carcass data for the top ten lambs entered in the ND State Fair carcass contest

Exhibitor		Lamb Measurement								
First	Last	Lamb ID	Live Wt (#)	LMA (in.)	BF (in.)	BW (in.)	Leg Score	CWT	YG	LMA Class
Hadley	Detienne	280	132	4.24	0.28	0.55	13.5	71.3	3.2	2.7
Sheyenne	Freitag	598	129	3.80	0.20	1.02	13	69.7	2.4	2.6
Dylan	Rue	1431	106	3.52	0.20	0.71	12	57.2	2.4	2.4
Haley	Filipek	390	118	3.54	0.20	0.55	12.5	63.7	2.4	2.5
Lynsey	Schmitz	1417	119	3.69	0.28	0.55	14	64.3	3.2	2.5
Wyatt	Dunlop	404	119	3.57	0.24	0.63	13	64.3	2.8	2.5
Ty	Kulsrud	0037	111	3.31	0.20	0.35	12.5	59.9	2.4	2.4
Jaime	Lundquist	0940	103	3.53	0.28	0.75	12.5	55.6	3.2	2.4
Ashly	Miller	386	134	3.58	0.20	0.55	14	72.4	2.4	2.7
Wyatt	Dunlop	0221	117	3.42	0.28	0.51	12.5	63.2	3.2	2.5

Table 4. Index for the top ten lambs entered in the ND State Fair carcass contest

Exhibitor			Index					
First	Last	Lamb ID	Base	YG	LMA	BW	Leg Score	Final
Hadley	Detienne	280	80	-2.9	15.43	0.50	3	93.04
Sheyenne	Freitag	598	80	-0.9	12.03	-0.45	2	90.66
Dylan	Rue	1431	80	-0.9	11.22	0.18	0	90.49
Haley	Filipek	390	80	-0.9	10.38	0.50	1	89.96
Lynsey	Schmitz	1417	80	-2.9	11.93	0.50	4	89.54
Wyatt	Dunlop	404	80	-1.9	10.67	0.34	2	89.11
Ty	Kulsrud	0037	80	-0.9	9.07	0.89	1	89.04
Jaime	Lundquist	0940	80	-2.9	11.32	0.10	1	88.53
Ashly	Miller	386	80	-0.9	8.80	0.50	4	88.37
Wyatt	Dunlop	0221	80	-2.9	9.25	0.58	1	86.93

Table 5. Top ten lamb's data receiving the ND premium lamb certification

Exhibitor			ND Premium					
First	Last	Lamb ID	Wt	YG	LMA	BW	Leg Score	Final
Hadley	Detienne	280	1	1	1	1	1	5
Sheyenne	Freitag	598	1	1	1	1	1	5
Dylan	Rue	1431	1	1	1	1	1	5
Haley	Filipek	390	1	1	1	1	1	5
Lynsey	Schmitz	1417	1	1	1	1	1	5
Wyatt	Dunlop	404	1	1	1	1	1	5
Ty	Kulsrud	0037	1	1	1	1	1	5
Jaime	Lundquist	0940	1	1	1	1	1	5
Ashly	Miller	386	1	1	1	1	1	5
Wyatt	Dunlop	0221	1	1	1	1	1	5

2013 DAKOTA RAM TEST FINAL PERFORMANCE RESULTS[1]

A.R. Crane[*¶], D. Pearson[*], D. Ollila[§], J. Held[†], and C. S. Schauer[*]

[*]Hettinger Research Extension Center, North Dakota State University, Hettinger, ND
[¶]Department of Animal Sciences, North Dakota State University, Fargo, ND
[§]West River Ag Center, South Dakota State University, Rapid City, SD
[†]Department of Animal and Range Sciences, South Dakota State University, Brookings, SD

The Dakota Performance Ram Testing program was established primarily to identify differences in wool traits for rams managed under the same environmental conditions and plane of nutrition. Secondly, it was established to measure post-weaning growth rate as indicated by weight gain. An added feature is the evaluation of animal carcass merit using real-time ultrasound technology.

INTRODUCTION

The 2013 Dakota Performance Ram Test included 49 rams from 3 breeds. The ram test calendar listed below summarizes the dates on which specific activities were conducted during the test. Results are listed below, ranking indexed rams from high to low, and separates rams eligible for Certificate of Merit. Carcass data results are also included. Financially, it appears expenses exceeded our registration fee by approximately $23/head. Some of the values are estimates, as we do not account for any feed left in the bin. The % of blown legs was 8% (15% last year, 21% in 2011, 10% the 3 years before that). The last couple of years we have increased supplemental Vit D to 360 IU/lb diet, and this year we provided injectable Vitamin D every 28 d in an attempt to further alleviate these "rickets-like" symptoms. Obviously, Vitamin D is not the only problem. Overall, ADG was similar to the past couple of years (0.85 vs. 0.88 and 0.83), but we had no rams with ADG below 0.55 lbs/d, the minimum required for certification.

PROCEDURES

Fleece weight and staple length were calculated on a 365-day basis. Core samples were sent to Texas A&M University to determine fiber diameter, variability, and clean wool yield. Wool measurements for fiber were determined by the OFDA 2000. Average daily gain was calculated based on the total weight gain (including fleece) during the 140 d performance trial.

SCHEDULE 2013 DAKOTA FALL RAM TEST

September 7 - September 25, 2013	Rams to be delivered to the HREC
October 1, 2013	Rams weighed and started on test
October 2, 2013	Rams shorn
October 29, 2013	28 day weighing
November 26, 2013	56 day weighing
December 23, 2013	85 day weighing; trim hooves and re-vaccinate
January 21, 2014	112 day weighing
February 18, 2014	140 day weighing - End of growth test period Bleed B-ovis and DNA, staple length, wrinkle score, scrotal circumference
February 19, 2014	Rams shorn - core sampling, wool weights
March 14, 2014	Ultrasound
March 15, 2014	Field Day and Sale; rams pick up

[1]We would like to extend thanks to the consignors that took part in the Dakota Ram test, along with Dave Pearson, the Ram Test manager, and Dave Ollila for their continued dedication and assistance throughout this program.

Fiber Diameter: Core fiber diameter was determined for each sample using the laserscan technology method. The diameter is estimated by measuring four hundred clean fibers to determine an average (mean). In addition, the variation within a sample is determined. For each individual ram and type of sample, a histogram illustrates the variation. The horizontal axis indicates microns and the vertical axis shows the number of fibers from the total fibers measured which were a specific diameter. A narrow distribution pattern indicates relative fleece uniformity. The standard deviation (std. dev.) and coefficient of variation (CV) are given to provide numerical indications of the variation. A fleece sample with a small CV should be considered more uniform than one with a large CV (CV = std.dev./mean fiber dia.).

Staple Length: Staple length was determined by measuring length at the shoulder, side, and britch. Values were adjusted (less 1/8") for the stubble remaining after the initial shearing and an average calculated from these three sites.

Clean Wool: Clean wool was determined from the laboratory scoured clean yield estimates on side samples. Analytical procedures meet ASTM standards.

Face and Body Skin Fold Scores: Scores were determined by averaging subjective scores from a three person committee selected by the Ram Test committee. Scores were assigned from 1 to 4 for each trait. The lower the value the more open faced or freedom from skin folds.

Average Daily Gain: Average daily gain was calculated by dividing the total gain by the number of days in the test period (140 d).

Index: The index utilized the following formula established by the Texas and Wyoming Ram tests and the approved index for the American Rambouillet Sheep Association's register of merit program (ROM). (Revised July 8, 1993)

Index = 60(Average daily gain in pounds) + 4.0(365-day adjusted staple length in inches up to 5.5 inches) + 4(365-day adjusted clean wool in pounds) ± fiber diameter and variability points according to the following schedule:

Fiber Diameter (micron) of side:

3(22-actual microns) = + points up to 9

3(actual microns-22) = - points up to -6

Variability:

22.0 +/- actual Coefficient Variation x 1.25 up to a maximum of +/- 5 points

Index Ratios: To compare one ram with another an index ration was calculated by the following formula. The average index ratio for all rams is 100; an individual with an index ratio of 130 would be 30% higher than the average.

Actual Ram Index

Ram Index Ratio = 100

X Average Ram Index Value

The top 30% of the registered Rambouillet rams as indicated by index are eligible for the Certified Ram Classification. In addition to the above requirement, a ram must meet acceptable standards from the standpoint of body type, amount of body skin folds, freedom from anatomical weaknesses and wool defects, including extremely hairy britch or excessive amount of belly type wool. All certified rams must have a minimum of 4.0 in staple length, 9 lbs clean wool, a core wool grade of 23.77 microns or less, a maximum of 2.7 face cover score, and must have gained at least 0.55 lbs/d on test.

Carcass Merit: At the end of the test, fat cover and ribeye area were measured at the 12-13th rib by real-time ultrasound. This information is not included in the index. However, these measures may help producers identify rams with superior carcass merit. Ribeye area is a good indicator of overall muscling; rams with larger ribeyes would be expected to be more muscular compared to those with smaller ribeyes. More muscular individuals would be expected to exhibit high growth rate relative to those with less muscularity. Fat cover is an indicator of maturity (i.e. frame size). Those rams carrying less fat (finish) would likely be later maturing, or perhaps younger than those with greater amounts of fat cover.

RESULTS and DISCUSSION

The 2013 Dakota Ram Test proved successful with 49 rams, including 3 breeds, enrolled in the test from 14 producers across the Midwest including: North Dakota, South Dakota, Wyoming, and Minnesota. Below are tables presenting the data from Rambouillet breeders. Other breeds were not included in the index. The final index results table includes rams that are eligible for certificates of merit from the Dakota Ram test. Three rams were in the top 30%, but were not eligible for the certificate of merit. Two of these three rams were too coarse to be eligible and the third had an injured ankle.

IMPLICATIONS

As the 2014 Dakota Ram Test begins, it is showing to be increasingly promising. More producers from outside the region are enrolling in the test and more rams from other breeds are also showing interest. With these new interests in mind, an index for Columbia rams needs to be adapted for their use in the test for adequate comparison among the breed. The National Sheep Improvement Plan along with Ram Tests like this one can have a significant genetic impact on programs throughout the region.

Table 1. Growth and Performance Results

TID	Owner	Breed	FID	Premise ID	Scrapie ID	Reg. #	B Date	BT	H/P	Gene	B Wt	F Wt	Gain	ADG
8	Veit Rambouillet	Ramb	1339	SD2115	0336	996509	4/1/13	S	P	RR	123	271	148	1.06
47	Erk, Paul	Ramb	B0910	SD1257	06274	996488	5/2/13	S	P	RR	123	248	125	0.89
25	McGivney, Ian	Ramb	83	00EDZKF	0083	996322	3/24/13	TW	H	RR	156	275	119	0.85
48	Erk, Paul	Ramb	B0818	SD1257	06272	996483	4/15/13	S	P	RR	138	272	134	0.96
1	Cook Sisters	Ramb	5315	SD1359	0410	996424	4/15/13	S	H	RR	122	263	141	1.01
26	Forbes, Jim	Ramb	2500	WYBT	9621	996408	4/18/13	TW	H	RR	119	244	125	0.89
2	Cook Sisters	Ramb	5304	SD1359	0412	996421	4/12/13	S	H	QR	132	256	124	0.89
28	Forbes, Jim	Ramb	2498	WYBT	9619	996409	4/12/13	TW	H	RR	116	242	126	0.90
9	Veit Rambouillet	Ramb	1280	SD2115	0337	996512	3/22/13	TW	P	QR	121	276	155	1.11
49	Erk, Paul	Ramb	B0759	SD1257	06202	996481	2/14/13	S	P	RR	152	273	121	0.86
29	Forbes, Jim	Ramb	2499	WYBT	9620	996403	4/9/13	TW	H	RR	108	240	132	0.94

Table 2. Wool Performance Results

TID	Owner	GR FL (#)	GR 365-d (#)	Yield CWFP (%)	CL FL 365-d (#)	STL (365-d)	Belly (1,2,3)	Face (1,2,3,4)	Skin (1,2,3,4)	Core micron	Core Spin	Fleece Adj Dia	Fleece Adj Var
8	Veit Rambouillet	10.0	26.1	46.77	12.19	4.52	1.0	2.5	1.0	21.23	64	2.31	1.13
47	Erk, Paul	12.2	31.7	45.20	14.32	5.21	1.0	2.0	1.0	22.25	62	-0.75	0.87
25	McGivney, Ian	12.4	32.3	47.85	15.47	5.48	1.0	1.0	1.0	23.71	60	-5.13	0.38
48	Erk, Paul	10.8	28.2	44.72	12.59	4.43	1.0	2.0	1.0	22.57	62	-1.71	4.75
1	Cook Sisters	9.3	24.2	49.36	11.97	5.21	2.0	1.0	1.0	22.39	62	-1.17	-0.50
26	Forbes, Jim	11.4	29.7	47.59	14.14	4.78	1.0	1.0	1.0	22.69	62	-2.07	0.00
2	Cook Sisters	10.5	27.2	48.70	13.27	4.08	1.0	1.0	1.0	21.17	64	2.49	-0.25
28	Forbes, Jim	9.5	24.6	52.98	13.05	4.69	1.0	1.0	1.0	22.46	62	-1.38	1.13
9	Veit Rambouillet	9.1	23.6	44.16	10.42	4.52	1.0	1.0	1.0	22.45	62	-1.35	-0.13
49	Erk, Paul	11.8	30.8	42.25	13.00	4.95	1.0	1.0	1.0	22.71	62	-2.13	3.13
29	Forbes, Jim	9.2	23.9	49.92	11.91	4.43	1.0	1.0	1.0	21.70	64	0.90	0.38

Table 3. Final Index Results – Certified Rams

TID	Owner	SC (cm)	Index	Ratio
8	Veit Rambouillet	36.0	133.71	116%
47	Erk, Paul	37.0	131.83	115%
25	McGivney, Ian	31.0	130.02	113%
48	Erk, Paul	37.0	128.56	112%
1	Cook Sisters	37.0	127.49	111%
26	Forbes, Jim	31.0	127.20	111%
2	Cook Sisters	33.0	124.79	109%
28	Forbes, Jim	35.0	124.73	109%
9	Veit Rambouillet	38.0	124.71	109%
49	Erk, Paul	40.0	124.66	109%
29	Forbes, Jim	28.0	123.21	107%

Effects of lasalocid and diet particle size on feedlot performance, carcass traits, and nutrient digestibility in feedlot lambs[1]

A. R. Crane[*†], R. R. Redden[*], P. B. Berg[*], and C. S. Schauer[†]

[*]Department of Animal Sciences, North Dakota State University, Fargo, ND 58108;
[†]Hettinger Research Extension Center, North Dakota State University, Hettinger, ND 58639

The objective of this research was to determine the influence of diet particle size and lasalocid on growth performance, carcass characteristics, and N balance in feedlot lambs. Lasalocid fed lambs had an increase in HCW. Additionally, there was an interaction of particle size and use of ionophores for ADG, loin eye area, and % boneless closely trimmed retail cuts (%BCTRC). Loin eye area was greatest for WCL and GCNL. A second study was conducted utilizing the same treatments to evaluate N balance in 16 crossbred wethers. Nitrogen balance was not affected by treatment. Our results indicate that HCW in lambs fed lasalocid was increased while particle size had no major impact on feedlot performance, carcass traits, or N digestibility.

[1]The authors would also like to thank Kelsie Egeland, Dave Pearson, Don Drolc, Don Stecher, and ND SBARE for their support and assistance throughout the project.

INTRODUCTION

In the Northern Great Plains, lambs are commonly fed whole corn accompanied by a market lamb pellet through self-feeders during the growing-finishing phase. However, as evidenced in the cattle industry, when feeding high energy and low roughage diets acidosis can become a health problem resulting in a decrease in performance and an increase in morbidity and mortality (Elam, 1976).

Research in cattle has shown the effectiveness of ionophores for increasing feed efficiency and decreasing the incidence of acidosis in high grain diets (Jacques et al., 1987). Additionally, in sheep, researchers have reported the ability of ionophores to improve rate of gain, organic matter and crude protein digestion, and the absorption of N (Funk et al., 1986; Horton, 1980; Ricke et al., 1984). However, monensin is not currently labeled for use in sheep (FDA, 2005). The ionophore lasalocid is approved for use in sheep (FDA, 2003) and has been shown to increase total tract organic matter digestibility in finishing lambs (80 vs. 76.4%; Funk et al., 1986) fed a 65% concentrate diet. With the exception of the previous trial, little data exists describing the effects of lasalocid in lamb finishing rations.

Grinding the diet can increase digestibility, intake, and performance of livestock (Kerley, et al., 1985). However, in the lamb finishing industry it is generally advised to leave feeds whole, as the cost of grinding usually exceeds the performance benefits of feeding a ground ration (Stanton et al., 2006). Additionally, when feeds are ground lambs tend to select larger particles (Reynolds and Lindahl, 1960), potentially resulting in reduced DM intake and/or failure to eat a complete diet. Grinding feeds can increase the rate of digestion, therefore decreasing total digestibility (Reynolds and Lindahl, 1960) and potentially resulting in more cases of acidosis (Gressley, et al., 2011).

To our knowledge, limited research has evaluated the effects of particle size and ionophores in sheep. Our hypothesis was that lambs fed ground rations and lasalocid would have the greatest performance in the feedlot and improved nutrient digestibility when compared to lambs fed rations that weren't ground or rations without lasalocid. Our specific objectives were to determine the influence of lasalocid and particle size on growth performance, carcass characteristics, and N balance in lambs consuming a finishing ration.

PROCEDURES

All procedures were approved by the Animal Care and Use Committee of North Dakota State University (protocol # A13041). This study was conducted at the NDSU Hettinger Research Extension Center in Hettinger, ND.

Feedlot Study

Animals and Diets. At 2 wk of age, tails were docked, males were castrated, and all lambs were vaccinated for *Clostridium perfringens* types C and D and tetanus (CD-T; Bar Vac CD/T; Boehringer Ingelheim, Ridgefield, CT). Lambs were weaned and vaccinated with CD-T again at approximately 60 d of age and d -1 (4 mo. of age) of the trial. Lambs were allowed free choice access to a commercial lamb creep pellet (16% CP) from birth to weaning. Lambs were adapted to an 80% corn and 20% commercial market lamb pellet diet (DM basis; Table 1) following weaning. One hundred sixty crossbred (Suffolk x Rambouillet) wether and ewe lambs (68 ± 0.2 lb BW; approximate 90 d of age) were stratified by BW and sex (80 wethers and 80 ewes) and randomly assigned to 1 of 16 outdoor pens (10 lambs/pen). Pens were assigned randomly to 1 of 4 treatments, with pen serving as the experimental unit (*n* = 4 pens/treatment). Treatments were: whole corn with lasalocid (**WCL**), whole corn without lasalocid (**WCNL**), ground corn with lasalocid (**GCL**), or ground corn without lasalocid (**GCNL**; Table 1). Lambs receiving lasalocid (20 g/ton of market lamb pellet, Bovatec, Alpharma Inc., Bridgewater, NJ) received the basal feedlot ration with lasalocid included in the market lamb pellet starting on d 0. A factorial arrangement of treatments was applied in a completely randomized design to evaluate the outlined objectives.

Ground diets were ground through a 1.27 cm screen (Gehl Mix-All, Model 170, Gehl, West Bend, WI). Diets were mixed and provided by the same mixer-grinder and offered ad libitum via bulk feeders (48.6-cm bunk space/lamb). Lambs had continuous access to clean, fresh water and shade. Study diets were balanced to be equal to or great than CP and energy (NE) requirements (NRC, 2007). The rations were formulated to have a minimum Ca:P ratio of 2:1. Feeders were checked daily and cleaned of contaminated feed. Lambs were observed daily to monitor health and treated when necessary.

Data Collection Procedures. The study was divided into four periods. Lambs were weighed on 2 consecutive d at the initiation (d -1 and 0) and end (d 111 and 112) of the trial; single day weights were taken on d 33, 57, and 85 and used to assist in evaluation of morbidity. Ration and feed ingredient samples from the bulk feeders were taken at the beginning of each period and dried at 131°F for 48 h to determine DM and ration nutrient composition.

Trained personnel collected carcass data after a 24-h chill (temperature < 35.6°F and humidity near 100%). Carcass data collected included HCW, leg score, conformation score, fat depth (over the 12th rib), body wall thickness, loin eye area, flank streaking, quality grade, and yield grade, and % boneless closely trimmed retail cuts (**%BCTRC**; Savell and Smith, 2000).

Nitrogen Balance Study

Animals and Treatments. Sixteen Suffolk x Rambouillet wethers (88.2 ± 3.7 lbs BW; approximate age = 90 d) were used in completely random design. Wethers were weighed on d 0 and 1, stratified by weight, and allotted randomly to treatments (*n* = 4 wethers/treatment) as described in the feedlot trial. Lambs were assigned randomly to individual metabolism crates on d 1. Wethers were housed in an enclosed room with lighting from approximately 0730 to 2000 h. Lambs were adapted to diets (Table 1) and processed as outlined in the previous study, but lambs were also given an injection of vitamins A, D and E on d 1 of the trial. Rations were provided daily at 0830 h at 130% of the average daily intake for the previous 5 d. Feed refusals from the previous day were determined before feeding. Water troughs were cleaned and refilled daily after feeding.

Data Collection Procedures. The experimental period was 21 d. Dry matter intake was determined on d 14 to 20. Additionally, samples of corn, pellets, and ration were collected on d 14 to 20 and dried at 131°F for 48 h. Wethers were fitted with fecal collection bags on d 11. Total fecal and urine output were collected on d 15 to 21. A subsample of each daily fecal sample (7.5% of total, wet basis) was dried at 131°F for 96 h for calculation of fecal DM. Urine was collected via stainless steel funnel beneath the lamb, with total urine output collected. Sufficient 6 *N* HCL (100 mL) was added daily to urinals to maintain urine pH < 3. Total daily urine output was recorded and urine was composited daily by wether (10% of total; wet basis) and stored at 39°F. Approximately 288 g of urine were collected from each urine subsample and stored at 39°F. On d 15 to 21, 10 mL of blood were collected via jugular venipuncture 4 h after feeding using vaccutainers (VWR International). Blood was cooled at 39°F for 2 h and centrifuged (3,640 × *g*, 59˚F, 20 min), and serum was harvested and stored (-4°F).

Dried fecal samples were ground through a Wiley mill (2-mm screen) and composited by lamb. Daily samples of corn, pellets and ration were composited for the collection period, and orts were composited by lamb on an equal weight basis (20%; as-fed basis). Feed, orts, and fecal samples were analyzed for DM, ash, NDF, and ADF as described previously in the feedlot study. Feed, orts, fecal, and urine samples were analyzed for N as described previously in the feedlot study. Concentration of N in feed, orts, fecal, and urine samples was used to calculate daily N intake and excretion from feed, ort, feces, and urine weights. Nitrogen excretion (fecal N + urinary N) was subtracted from N intake (feed N – ort N) to calculate N balance (g N/lb BW basis).

RESULTS AND DISCUSSION

Feedlot Study

Feedlot Performance. Results for feedlot lamb growth, carcass characteristics and mortality are reported in Table 2. There were no interactions among treatments for final BW, feed offered, G:F, mortality, HCW, leg score, conformation score, fat depth, body wall thickness, flank streaking, quality or yield grade, and dressing percentage ($P \geq 0.06$). However, there was an interaction of particle size and use of ionophores for ADG ($P = 0.05$), loin eye area ($P < 0.001$), and BCTRC ($P = 0.004$). While an interaction was observed for ADG, upon comparison of means no differences were observed among treatments ($P > 0.05$). . Numerically the WCL fed lambs had the highest ADG, and this difference in BW gain could be relevant from a producer standpoint, with a difference of 5.3 lbs over the 120 d finishing period when comparing WCL vs. WCNL or GCL. Lending further evidence to the benefit of whole corn diets including lasalocid, we observed a tendency for an interaction ($P = 0.06$) between particle size and ionophores for final BW, where WCL fed lambs tended to be heavier than the other lambs by up to 0.33 lbs. Erickson et al. (1988 and 1989) conducted two trials in lambs evaluating particle size in finishing rations. Erickson et al. (1989) reported reducing particle size (whole vs. ground in corn-based diets) had no effect on ADG or G:F in feedlot lambs. However, Erickson et al. (1988) also reported a tendency for lambs fed whole grain diets to have heavier final BW, which is similar to the tendencies we observed for final BW.

Erickson et al. (1988 and 1989) conducted two trials in lambs evaluating particle size in finishing rations. Erickson et al. (1989) reported reducing particle size (whole vs. ground in corn-based diets) had no effect on ADG or G:F in feedlot lambs. However, Erickson et al. (1988) also reported a tendency for lambs fed whole grain diets to have heavier final BW, which is similar to the tendencies we observed for final BW.

Carcass Characteristics. There were no interactions among treatments for HCW, leg score, conformation score, fat depth, body wall thickness, flank streaking, quality or yield grade, and dressing percentage ($P \geq 0.06$). However, there was an interaction between particle size and ionophores for loin eye area ($P < 0.001$) and % BCTRC ($P = 0.004$). Loin eye area was greatest ($P < 0.05$) for WCL and GCNL, with GCL intermediate. However, GCNL had the greatest ($P < 0.05$) %BCTRC. Additionally, lambs fed lasalocid had heavier HCW (3%; $P = 0.05$) compared to those fed diets without lasalocid. No additional effects were observed for the rest of the carcass traits in relation to particle size or ionophore inclusion ($P \geq 0.06$). The research that has been conducted evaluating particle size in grain based finishing rations in lambs supports our findings that reducing particle size has minimal effects on carcass traits. Erickson et al. (1988) reported that lambs fed whole vs. ground corn had no difference in HCW and leg score, however lambs had higher yield grades and thicker fat depths when fed whole grains vs. ground. Reynolds and Lindahl (1960) reported that lambs tend to not consume finely ground feeds and sort through feed to select larger particles and secondly, that grinding increases the rate of digestion, therefore decreasing total digestibility. Additionally a previous trial at this lab, similar to our research, fed lambs coarse rolled corn with lasalocid had higher dressing percentage when compared to lambs not receiving lasalocid, however lasalocid did not affect any other carcass characteristics (Rupprecht et al., 1992).

While performance and carcass data evaluating particle size and ionophores is limited, research is available addressing the biological affects of ionophores. Ionophores appear to alter the movement of certain ions across biologic membranes, which, in the rumen, results in an alteration of microflora (NRC, 2007). Feeding lasalocid and monensin may also exert a possible N-sparing effect by inhibition of ruminal amino acid deamination (Schelling et al., 1978; Poos et al., 1979). In vitro production of amino-N decreased linearly with increasing levels of monensin in research reported by Whetstone et al. (1981) which suggests a decrease in rate of proteolysis. In a study by Paterson et al. (1983), rumen propionate was increased and the acetate to propionate ratio was decreased when lasalocid was fed to lambs. The addition of lasalocid to a low ruminal N degradable feed resulted in more rapid weight gain than without lasalocid; however, when lambs were fed soybean meal with or without lasalocid, lasalocid actually slowed the rate of gain (Paterson et al., 1983). These results indicate that lasalocid can effectively increase propionate production in the rumen, which explains the tendency for higher growth performance of the lambs fed WCL diets in the current trial. However, GCNL fed lambs had similar growth performance to WCL fed lambs, which is quite interesting. A possible explanation for the similar performance is due to a smaller particle size which led to an increase in overall digestibility for the GCNL fed lambs; although, this is speculation and was not tested in the current trial. The most interesting note in this trial, is WCNL fed lambs numerical reduction in performance compared to the three other treatments. Lasalocid is most likely needed to increase propionate production with this whole grain diet to attain the increased performance seen in the other treatments. In the current trial, GCNL fed lambs did have greater %BCTRC, however these lambs also had increased loin eye area, although statistically similar to WCL, which could have driven the increase in %BCTRC. Interestingly, the current trial showed that particle size also affected loin eye area ($P = 0.008$), while prior research in ground vs. whole grains has shown no effect of diet processing on loin eye area (Erickson et al., 1988; Erickson et al., 1989).

Nitrogen Balance Study

There were no interactions or main affects among treatments for DMI, N intake, N balance, or serum urea-N concentration (Table 3; $P \geq 0.18$), however, there was a day effect ($P = 0.0018$) for serum urea-N concentration. Days 1, 2, and 3 were generally lower than days 4 to 6 ($P < 0.05$; data not shown). There is conflicting research on particle size and its effects on N digestion, N balance, and serum urea-N concentration. Although there was no particle size affect ($P \geq 0.22$) in the current trial, previous research by Kerley et al. (1985) reported that N digestion was increased in lambs fed 6.5, 5.4 and 0.8 mm particle size corncob diets, while the 1.4 mm diet was decreased. The 1.4 mm diet also had higher fecal N loss when compared to the other diets. Other research by Perez-Torres et al. (2011) reports no differences in DM or OM intake or digestibility in diets that differ in particle size, agreeing with results from the current trial. However, the addition of lasalocid did decrease ($P = 0.01$) fecal N excretion. This is similar to findings by Ricke et al. (1984), in which lasalocid treated lambs also had decreased fecal N excretion when compared to lambs fed monensin or no ionophore. Varying results exist on lasalocid's effects on N digestibility, with some reporting it increases N digestibility (Paterson et al., 1983; Ricke et al., 1984), while other report that it remains unaffected (Funk et al., 1986) with N balance also appearing to remain unaffected (Funk et al., 1986). Ricke et al., (1984) also reports that lasalocid-fed lambs had less fecal N loss and therefore higher N retentions, which could be reflective of increased digestibility. The differences in findings could be due to the different types of collection, ranging from N balance trials, to in situ techniques.

IMPLICATIONS

Grinding lamb finishing rations containing 80% corn and 20% market lamb pellet had no beneficial, or negative, impact on lamb growth performance, mortality, or carcass traits. However, including lasalocid in rations containing whole corn and market lamb pellet may result in an increase in average daily gain, final body weight, and carcass weight. Additional research is needed to further quantify the benefits of grinding rations with feed ingredients of differing particle size (i.e. combing corn and dried distillers grains), as well as the impacts of ionophores in non-traditional feedlot rations.

LITERATURE CITED

AOAC Int. 2010. Official methods of analysis. 18th ed. AOAC Int., Arlington, VA.

Elam, C. J. 1976. Acidosis in feedlot cattle: practical observations. J. Anim. Sci. 43:898-901.

Erickson, D. O., T. C. Faller, K. A. Ringwall, W. D. Slanger, and P. T. Berg. 1988. Comparisons of lambs fed barley or corn diets fed in whole or ground form. Proc. 29th Annual Western Dakota Sheep Day. 23-29.

Erickson, D. O., T. C. Faller, K. A. Ringwall, and P. T. Berg. 1989. Barley or milo fed in whole or ground forms for finishing lambs. Proc. 30th Annual Western Dakota Sheep Day. 1-5.

FDA. 2003. Freedom of information summary: NADA 096-298. http://www.fda.gov/downloads/animalveterinary/products/approvedanimaldrugproducts/foiadrugsummaries/ucm064876.pdf. Accessed: Feb. 27, 2014.

FDA. 2005. Freedom of information summary: NADA 095-735. http://www.fda.gov/downloads/AnimalVeterinary/Products/ApprovedAnimalDrugProducts/FOIADrugSummaries/ucm064847.pdf. Accessed: Feb. 27, 2014.

Funk, M. A., M. L. Galyean, and T. T. Ross. 1986. Potassium and lasalocid effects on performance and digestion in lambs. J. Anim. Sci. 63:685-691.

Goering, H. K., and P. J. Van Soest. 1970. Forage fiber analysis (apparatus, reagents, procedures, and some applications). Agric. Handbook No. 379. ARS-USDA, Washington, DC.

Gressley, T. F., M. B. Hall, and L. E. Armentano. 2011. Ruminant nutrition symposium: Productivity, digestion, and health responses to hindgut acidosis in ruminants. J. Anim. Sci. 89:1120-1130.

Horton, G. M. J. 1980. Effect of monensin and a deaminase prohibitor on feed utilization by lambs. Can. J. Anim. Sci. 60(1): 169-172.

Jacques, K. A., R. C. Cochran, L. R. Corah, T. B. Avery, K. O. Zoellner, and J. F. Higginbotham. 1987. Influence of lasalocid level on forage intake, digestibility, rumen fermentation, liquid flow and performance of beef cattle grazing winter range. J. Anim. Sci. 65:777-785.

Kerley, M. S., A. R. Kinser, J. L. Firkins, G. C. Fahey, Jr. and L. L. Berger. 1985. Effects of roughage particle size on site of nutrient digestion and digesta flow through the gastrointestinal tract of sheep fed corncob-concentrate diets. J. Anim. Sci. 61:504-513.

NRC. 2007. Nutrient requirements of small ruminants. Natl. Acad. Press, Washington, DC.

Paterson, J. A., B. M. Anderson, D. K. Bowman, R. L. Morrison, and J. E. Williams. 1983. Effect of protein source and lasalocid on nitrogen digestibility and growth by ruminants. J. Anim. Sci. 57:1537-1544.

Perez-Torres, A., I. Sierra, A. de Vega, and A. Keli. 2011. Effect of grinding size and sunflower oil addition on intake, digestibility, rumen function and microbial protein synthesis in sheep fed a dry total mixed ration. Span. J. Agric. Res. 9 (4):1186-1196.

Poos, M. I., T. L. Hanson, and T. J. Klopfenstein. 1979. Monensin effects on diet digestibility, ruminal protein bypass and microbial protein synthesis. J. Anim. Sci. 48:1516-1524.

Ricke, S. C., L. L. Berger, P. J. van der Aar, and G. C. Fahey, Jr. 1984. Effects of lasalocid and monensin on nutrient digestion, metabolism and rumen characteristics of sheep. J. Anim. Sci. 58:194-202.

Reynolds, P. J. and I. L. Lindahl. 1960. Effect pelleting on the digestibility of hay by sheep. J. Anim. Sci. 19:873-880.

Rupprecht, D. S., B. L. Moore, and D. O. Erickson. 1992. Effects of lasalocid in barley or corn diets for lambs. Proc. 33rd Annual Western Dakota Sheep Day. 5-9.

Savell, J. W., and G. C. Smith. 200. Laboratory manual for meat science. 7th ed. American Press, Boston, MA.

Schelling, G. T., H. R. Spires, G. E. Mitchell, and R. E. Tucker. 1978. The effect of various antimicrobials on amino acid degradation rates by rumen microbes. Fed. Proc. 37:411.

Stanton, T. L., and S. B. LeValley. Lamb feedlot nutrition. Colorado State University Extension: Livestock Series Management. Fact sheet No.1.613.

Whetstone, H. D., C. L. Davis, and M. P. Bryant. 1981. Effect of monensin on breakdown of protein by ruminal microorganisms in vitro. J. Anim. Sci. 53: 803-809.

Van Soest, P. J., J. B. Robertson, and B. A. Lewis. 1991. Methods for dietary fiber, neutral detergent fiber, and non-starch polysaccharides in relation to animal nutrition. J. Dairy Sci. 74:3583-3597.

Table 1. Ingredient and nutritional composition of diets fed to lambs fed differing particle sizes of corn and market lamb pellets with or without lasalocid (DM basis)

	Treatments[1]			
Item	WCNL	WCL	GCNL	GCL
Ingredient, %				
Corn	80	80	80	80
Market lamb pellet[2]	20	20	20	20
Nutrient composition, %				
DM	96.4	96.3	96.0	96.7
CP	19.6	18.7	17.7	17.2
NDF	16.4	15.4	14.4	15.7
ADF	5.3	4.8	4.5	5.3

[1]Treatments: WCNL= whole corn and market lamb pellet without lasalocid (Bovatec, Alpharma Inc., Bridgewater, NJ); WCL= whole corn and market lamb pellet with lasalocid; GCNL= ground corn and market lamb pellet without lasalocid; GCL= ground corn and market lamb pellet with lasalocid.

[2]Market lamb pellet contained 38% CP, 4.25% Ca, 0.6% P, 3.5% salt, 3.0 ppm Se, 24,000 IU/lb vitamin A, 2,400 IU/lb vitamin D, and 60 IU/lb vitamin E with treatments WCNL and GCNL having no lasalocid and WCL and GCL containing 20 g/ton of lasalocid.

Table 2. Effects of lasalocid and particle size on lamb growth performance, carcass characteristics, and mortality

	Treatment[1]					*P*-value[3]		
Item	WCNL	WCL	GCNL	GCL	SEM[2]	PS	ION	PS*ION
Initial BW, lb	68.78	69.00	67.90	69.00	0.22	---	---	---
Final BW, lb	151.46	157.41	153.44	152.34	1.54	0.34	0.17	0.06
ADG, lb/d	0.57[a]	0.62[a]	0.60[a]	0.57[a]	0.02	0.76	0.73	0.05
Feed offered, lb DM • head^{-1} • d^{-1}	5.56	5.89	5.73	5.89	0.15	0.58	0.14	0.57
G:F	0.10	0.10	0.11	0.10	0.004	0.59	0.47	0.23
Mortality, %	0	5	2.5	5	2.39	0.61	0.14	0.61
HCW, lb	74.3	78.0	75.0	75.6	1.06	0.37	0.05	0.16
Leg score[4]	11.5	11.7	11.5	11.6	0.13	0.06	0.14	0.94
Conformation score[4]	11.7	11.9	11.8	11.8	0.10	0.85	0.24	0.51
Fat depth, cm[5]	0.73	0.61	0.66	0.74	0.06	0.60	0.72	0.11
Body wall thickness, cm	2.53	2.55	2.51	2.63	0.08	0.73	0.42	0.54
Loin eye area, cm^2	19.6[a]	21.1[bc]	22.0[c]	20.7[b]	0.31	0.008	0.79	<0.001
Flank streaking[6]	375	389	366	376	9	0.27	0.22	0.89
Quality grade[4]	11.7	11.8	11.6	11.6	0.09	0.10	0.43	0.88
Yield grade[7]	3.28	2.81	3.01	3.30	0.22	0.61	0.70	0.11
BCTRC, %[8]	46[a]	47[a]	47[b]	46[a]	0.18	0.06	0.24	0.004
Dressing, %	49	50	49	50	0.39	0.80	0.10	0.85

[1]Treatments: WCNL= whole corn and market lamb pellet without lasalocid (Bovatec, Alpharma Inc., Bridgewater, NJ); WCL= whole corn and market lamb pellet with lasalocid; GCNL= ground corn and market lamb pellet without lasalocid; GCL= ground corn and market lamb pellet with lasalocid.

[2]$n = 4$.

[3]PS= particle size of diet and ION= ionophores.

[4]Leg score, conformation score and quality grade: 1= cull to 15= high prime.

[5]Fat depth and yield grades.

[6]Flank streaking: 100 to 199= practically devoid; 200 to 299= traces; 300 to 399= slight; 400 to 499= small; 500 to 599= modest.

[7]Yield grade= 0.4 + (10 × fat depth).

[8] BCTRC= boneless closely trimmed retail cuts, % = [49.936- (0.0848 × HCW, lb) – (4.376 × 0.3937 × fat depth, cm) – (3.53 × 0.3937 × body wall thickness, cm) + (2.456 × 0.155 × loin eye area, cm^2)].

[a,b,c]Means within a row with different superscripts differ ($P < 0.05$).

Table 3. Effects of lasalocid and particle size of feed on N intake, excretion, balance, and serum urea-N concentration in lambs

	Treatment[1]					*P*-value[3]		
Item	WCNL	WCL	GCNL	GCL	SEM[2]	PS	ION	PS*ION
Daily DMI, g/ kg BW	38.43	36.99	66.16	37.97	12.9	0.29	0.28	0.32
Daily N intake, g/ kg BW	1.06	0.94	1.11	1.04	0.06	0.26	0.18	0.69
Daily N excretion, g/ kg BW								
Fecal	0.23	0.14	0.21	0.16	0.01	0.87	0.01	0.45
Urinary	0.05	0.04	0.05	0.05	0.004	0.23	0.97	0.25
Daily N Balance, g/ kg BW	0.78	0.76	0.84	0.83	0.05	0.22	0.76	0.99
Serum urea-N[4], m*M*	10.29	10.11	10.87	10.37	0.53	0.50	0.65	0.77

[1]Treatments: WCNL= whole corn and market lamb pellet without lasalocid (Bovatec, Alpharma Inc., Bridgewater, NJ); WCL= whole corn and market lamb pellet with lasalocid; GCNL= ground corn and market lamb pellet without lasalocid; GCL= ground corn and market lamb pellet with lasalocid.

[2]$n = 4$.

[3]PS= particle size of the diet and ION= ionophores.

[4]*P*-values for serum urea-N: day ($P = 0.0018$) and treatment × day ($P = 0.33$).

Mortality Composting: Proper Disposal Methods to Manage Mortalities in the Sheep Flock

M.A. Berg

Carrington Research Extension Center, North Dakota State University, Carrington, ND

INTRODUCTION

Natural disasters, diseases and accidents can all contribute to livestock death losses. Animal mortalities in North Dakota must be disposed of within 36 hours of death using 1 of the 4 approved methods: rending, incineration, burial or composting. Although historically done, carcass abandonment is strongly discouraged. Proper carcass disposal ensures air, water, and soil quality are maintained and the potential for spreading disease is decreased.

PROCEDURES

Composting mortalities is a relatively simple process that can typically be done with materials that are already present on the farm.

In a typical flock, the majority of sheep mortalities likely occur during lambing. Composting these losses would be an excellent management option. Because lambing mortalities are small in size, a layered pile system is best. Heat will be maintained during cold months and land area will be used effectively. A source of carbon material such as straw or old hay will be needed to create a base layer. Additionally, core material such as manure or spoiled silage, as well as cover material such as straw, old hay or sawdust will be needed. Each farm will have different material sources available, thus there is not a single "recipe" that is best. Use the following guidelines for composting lambing mortalities to get you started.

- Do not place the windrow, pile or bin in a floodplain, in a low area where water gathers during spring's melt or heavy rain, or on a sandy or other porous surface.
- Start with 2 feet of base material in a windrow, pile or bin-type setup (Figure 1).
- Place the carcasses on top of the base. Make sure the carcasses do not touch. Have at least 1 foot of base material between the perimeter of the carcass and the edge of the base.
- Cover the carcasses with 6 to 8 inches of core material.
- Either layer more carcasses on top of the core material or if all of the mortalities fit in one layer, cover the entire pile or windrow with 2 feet of cover material. The cover material should be placed on the top and sides, no part of the carcasses should be showing. A good cap on the pile will keep predators out and seal in heat.
- When additional carcasses need to be added to the windrow, pile, or bin; layer them on top of the cover material, cover with additional core material and add more cover material to the top (Figure 2). calculate application rates.

- During cold weather composting, make sure the completed windrow, pile or bin is at least 4 feet tall. This will maintain proper heating and prevent the pile from freezing.
- Leave the windrow, pile or bin undisturbed to keep heat sealed in during the very cold winter months. Small carcasses will completely breakdown within 2-4 months and temperatures should reach above 130 degrees Fahrenheit. For lamb carcasses even the bones will decay during this process. Note: larger carcasses (ewe) will take longer to decay and may require aeration, after 2-4 months, to reintroduce oxygen for the process to continue properly.
- The final compost product can be used as the core material to start a new mortality composting process or can be used as a fertilizer on crops applied at agronomic rates. A sample should be sent to a commercial laboratory for a nutrient analysis to properly calculate application rates.

More information can be found by watching the eXtension Livestock and Poultry Environmental Learning Center's video series at http://tinyurl.com/ktghhlw or visiting www.ag.ndsu.edu/lem. If you have questions or would like help setting up a windrow, pile or bin-type mortality composting system, please contact Mary.Berg@ndsu.edu or 701-652-2951.

REFERENCES

Bass, T., D. Colburn, J. Davis, J. Deering, M. Fisher, R. Flynn, S. Lupis, J. Norton, N. Schauermann. 2012. Livestock mortality composting for large and small operation in the semi-arid west.

North Dakota Department of Health, Environmental Health Section, Division of Water Quality. 2005. North Dakota livestock program design manual.

Rahman, S., T. Dvorak, C. Stoltenow, S. Mukhtar. 2009. Animal carcass disposal options.NDSU Extension Service publication NM-1422.

Figure 1. Bin-type mortality compost system with a 2-foot carbon base prepared for mortalities.

Figure 2. Bin-type mortality compost system with several layers of moralities and core material.

FLOCK CALENDAR OUTLINE

The following guidelines are neither inclusive nor intended to fit every sheep operation. Each operation is different, therefore, each "calendar event" should be tailored to each flock's needs.

PRIOR TO BREEDING

1. Bag and mouth ewes and cull those that are not sound.
2. Replace culled ewes with top-end yearlings or ewe lambs.
3. Keep replacement ewes lambs on growing rations.
4. Evaluate sires:
   A. Be sure they are vigorous, healthy and in good breeding condition.
   B. Rams should be conditioned at least a month before breeding season. Flush rams in poor condition.
   C. Allow at least two mature rams (preferably three) or four buck lambs per 100 ewes.
5. Flush ewes:
   A. One pound grain/day two to five weeks before breeding (usually 17 days).
   B. If ewes are over-conditioned, the effect of flushing will be lessened.
6. Vaccinate ewes for vibriosis and enzootic abortion (EAE).
7. Identify all ewes and rams with ear tags, paint brands or tattoos.

BREEDING

1. The ovulation rate of a ewe tends to be lower at the first part of the breeding season. Vasectomized or teaser rams run with ewes through the first heat period tend to stimulate then and increase the ovulation rate at the second heat period.
2. Use a ram marking harness or painted brisket to monitor breeding. Soft gun grease with a paint pigment mixed in works well for painting the brisket. A color sequence of orange, red and black is recommended with colors being changed every 17 days.
3. Leave rams in NO LONGER than 51 days (35 days is more desirable).
   A. An exception may be with ewe lambs. Allowing them four cycles or 68 days may be beneficial.
4. Remove rams from ewes after the season (don't winter rams with ewes).

PRIOR TO LAMBING (First 15 weeks)

1. Watch general heath of ewes. If possible sort off thin ewes and give extra feed so they can catch up.
2. Feed the poor quality roughage you have on hand during this period, saving better for lambing.
3. An exception to the above is feeding pregnant ewe lambs. They should receive good quality roughage and grain (about 20 percent of the ration) during this period.

LAST SIX WEEKS BEFORE LAMBING

1. Trim hooves and treat for internal parasites.
2. Six to four weeks before lambing feed 1/4 to 1/3 pound grain/ewe/day.
3. Shear ewe before lambing (with highly prolific ewes at least a month before is preferred). Keep feeding schedule regular and watch weather conditions immediately after shearing (cold).
4. Vaccinate ewe for enterotoxaemia.
5. Control lice and ticks immediately after shearing.
6. Four weeks before lambing increase grain to 1/2 to 3/4 pound/ewe/day (usually done immediately after shearing.
7. Give A-D-E preparations to ewes if pastures and/or roughage are or have been poor quality.
8. Feed selenium-vitamin E or use an injectable product if white muscle is a problem. Caution DO NOT use both.
9. Check facilities and equipment to be sure everything is ready for lambing.
10. Two weeks before lambing increase grain to 1 pound/ewe/day.

LAMBING

1. Be prepared for the first lambs 142 days after turning the rams in with the ewe, even though the average pregnancy period is 148 days.
2. Watch ewes closely. Extra effort will be repaid with more lambs at weaning time. Saving lambs involves a 24-hour surveillance. Additional help at this time is money well spent.
3. Pen a ewe and lambs in lambing pen (jug) after lambing, not before.
4. Grain feeding the ewe during the first three days after lambing is not necessary.
5. Be available to provide assistance if ewes have trouble lambing.
6. Disinfect lamb's naval with iodine as soon after birth as possible.
7. Be sure both teats are functional and lambs nurse as soon as possible.
8. Use additional heat sources (heat lamps, ect) in cold weather.
9. Brand ewes and lambs with identical numbers on same side. Identify lambs with ear tags, tattoos or both.
10. Turn ewes and lambs out of jug as soon as all are doing well (one to three days).
11. Bunch up ewes and lambs in small groups of four to eight ewes and then combine groups until they are a workable size unit.
12. Castrate and dock lambs as soon as they are strong and have a good start (two days to two weeks of age). Use a tetanus toxoid if tetanus has been a problem on the farm (toxoids are not immediate protection, it takes at least ten days for immunity to build).
13. Vaccinate lambs for soremouth at one to two weeks of age if it has been a problem in the flock.
14. Provide a place for orphaned lambs. Make decision on what lambs to orphan as soon after birth as possible for best success. Few ewes can successfully nurse more than two lambs.

END OF LAMBING TO WEANING

1. Feed ewes according to the number of lambs sucking. Ewes with twins and triplets should receive a higher plane of nutrition.
2. Provide creep feed for lambs (especially those born during the winter and early spring).
3. Vaccinate lambs for overeating at five weeks and seven weeks of age.

WEANING

1. Wean ewes from lambs, not lambs from ewes. If possible, remove ewes from pen out of sight and sound of lambs. If lambs have to be moved to new quarters, leave a couple of ewes with them for a few days to lead the lambs to feed and water locations.
2. Lambs should be weaned between 50 and 60 days of age when they weigh at least 40 pounds and are eating creep and drinking water. The advantage of early weaning is that the ewe's milk production drops off to almost nothing after eight weeks of lactation.
2. Grains should be removed from the ewe's diet at least one week prior to weaning and low quality roughage should be fed. Restriction of hay and water to ewes following weaning lessens the chance of mastitis to occur. Poorer quality roughage should be fed to the ewes for at least 10-14 days following weaning.
3. Handle the ewes as little as possible for about 10 days following weaning. Tight udders bruise easily. If possible, bed the area where the ewes will rest heavily with straw to form a soft bed for the ewes to lay on.

WEANING TO PRE-BREEDING

1. If ewes go to pasture, treat for internal parasites.
2. Feed a maintenance ration to the ewes. Put ewe lambs that lambed back on a growing ration once they have quit milking.
3. Adjust ewes condition so they can be effectively flushed for next breeding season. Don't get ewes too fat prior to breeding.

REARING LAMBS ARTIFICIALLY (ORPHANS)- MANAGEMENT TIPS

Within 2 to 4 hours after birth, decide which lambs among those from multiple births you should remove. Look for the weaker, or smaller ones to choose for artificial rearing. It is important to make the decision early. Relatively weak lambs remaining with ewes can experience more stress than those reared artificially. Consider the following tips:

- It is essential that newborn lambs receive colostrums milk. Cow's colostrums will work if ewe's milk is not available. Do not dilute with water or warm too quickly if colostrums is frozen.
- Lambs should be removed from sight and hearing distance of ewes.
- Provide a warm, dry , draft-free area to start lambs.
- Use a good milk replacer that is 30% fat and at least 24% protein. Each lamb will require from 15 to 20 pounds of replacer to weaning.
- Lambs may require some assistance the first day or two to teach them to nurse on whatever feeding device is used.
- Start on nurser quickly, young lambs start easier.
- Self feed cold milk replacer after lambs are started. Milk replacers should be mixed with warm water for best results and then cooled down. Lambs feed cold milk well with less problems from scours and other digestive distrubances. Cold milk keeps better too.
- There is a Formaldehyde solution commercially avaliable that retards bacterial growth in milk (1cc/gallon milk).
- Hang a light over the milk replacer feeding device and dry ration feeder.
- Avoid placing young lambs with older lambs, as they may be pushed aside and may not be able to obtain the milk replacer. Remember that lambs nursing ewes drink 25 to 40 times per 24 hours. Best results have been obtained when lambs are fed in groups of 3 to 4 initially. After lambs are successfully trained, they can be handled in groups of 25.
- Inject lambs in the first few days with Iron Dextran, Vitamin A-D-E, and Selenium-Vitamin E. At 15 days of age, vaccinate for overeating (Colostridum perfringen type C & D).
- Provide lambs with a high-quality creep feed as soon as possible. Provide ample fresh water in front of lambs at all times. Do not feed hay or oats the first three week after weaning, as it encourages bloat. Caution! Do not feed leafy alfalfa until two weeks after weaning, as it encourages bloat.
- Wean lambs abruptly at 21-30 days of age. When to wean depends upon whether lambs are eating creep feed and drinking water. Newly weaned lambs will go back wards for several days. Don't be alarmed, they will make compensating gains later on.