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Growth and Carcass Characteristics of Conventionally Raised Lambs Versus Naturally Raised Lambs[1]

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Summary

This study compared growth and carcass quality of conventionally and naturally raised lambs. The hypothesis tested was conventionally raised lambs would have increased growth, but conventional management would not affect carcass characteristics. Two hundred eighty-eight Rambouillet x blackface (Suffolk and Hampshire) lambs (34.1 kg ± 0.13 kg) were randomly assigned to conventional (CONV) or naturally raised (NAT) treatments (6 pens/treatment; 24 lambs/pen) and fed ad libitum via self feeders for 112 d. The NAT lamb diet was 80 percent corn and 20 percent commercial supplement (DM basis; 87.9 percent TDN and 15.8 percent CP) with decoquinate. The NAT lambs were not given antibiotics or growth promoting implants. Conventionally raised lambs were fed a similar diet, with decoquinate, chlortetracycline, and lasalocid included, and were implanted with 36 mg zeranol on d 28. Lambs were weighed and feed refusals collected every 28 d. Lambs were harvested and carcass data collected 24 h post chill. Overall, CONV lambs had increased ADG (0.35 kg vs 0.33 kg ± 0.006 kg; $P = 0.03$) and final BW (73.3 kg vs. 71.3 kg ± 0.71 kg; $P = 0.07$) compared to NAT lambs, but DMI (1.64 kg/d vs 1.58 kg/d ± 0.04 kg/d; $P = 0.55$) and G:F (0.22 vs 0.21 ± 0.004; $P = 0.32$) were not different between treatments. Naturally raised lambs had greater rib eye area ($P = 0.03$), decreased body wall thickness ($P = 0.05$), and increased percentage boneless, closely trimmed retail cuts ($P = 0.05$). More CONV lambs prolapsed (8.3 percent vs 0 percent; $P = 0.001$) which increased mortality (2.8 percent vs 0 percent; $P = 0.01$). In the current trial, naturally raised lambs had decreased growth, marginal increases in carcass quality, and were less susceptible to prolapse and mortality than conventionally raised lambs.

Key Words: Antibiotic, Carcass Traits, Feedlot Performance, Lamb, Naturally Raised, Zeranol

Introduction

Consumer demand for natural food products has caused substantial increases in natural food sales (Davis and Stewart, 2002). However, there is a large disconnect between consumer perception of natural meat production and actual management practices of natural producers. Until recently, federal regulations have not addressed this disconnect. In January, 2009, the USDA released the Naturally Raised Marketing Claim, which provides voluntary guidelines for production of naturally raised products. According to the standards, naturally raised animals should be raised "…without growth promotants and antibiotics and that have never been fed mammalian or avian by-products…" (Agricultural Marketing Service, 2009). Adhering to, and marketing under the Naturally Raised Marketing Claim, affords producers the opportunity to offer a lamb product as raised "natural".

Growth promotants and antibiotics offer a considerable performance advantage in conventional-management systems. Administration of antibiotics, such as chlortetracycline (Bridges et al., 1953; Johnson et al., 1956; Kunkel et al., 1956), the ionophore lasalocid (Schwulst et al., 1991), and zeranol (Hufstedler et al., 1996; Hutcheson et al., 1992; Salisbury et al., 2007), improve growth in lambs. Numerous studies report improved growth and carcass characteristics in conventionally raised cattle compared to naturally raised cattle (Sawyer et al., 2003; Thompson et al., 2010). The advantages in growth and carcass characteristics in conventional-production systems suggest natural-meat products need a premium for natural-production systems to be economically viable. The objective of the present study was to determine the effects of naturally raised and conventional-management practices on growth and carcass quality in finishing lambs.

Materials and Methods

Animals and Treatments

All experimental protocols were approved by the North Dakota State University Animal Care and Use Committee. Tails were docked, males castrated, and all lambs vaccinated for *Clostridium perfringens* types C and D and tetanus (CD-T; Bar Vac CD-T, Boehringer Ingelhein, Ridgefield, Conn.) at two wks of age. Lambs were weaned and vaccinated with CD-T again at 60 d of age and d -1 (4 mo of age) of the trial. Two hundred eighty-eight, spring-born, Rambouillet x black-face (Suffolk and Hampshire) wether and ewe lambs (BW ± SD; 34.0 kg ± 0.13 kg) were stratified by BW, sex, and breed and randomly assigned to 12 outdoor feedlot pens (24 lambs/pen) on May 20, 2009. Pens were randomly assigned to treatment, conventionally raised (CONV) or naturally raised (NAT), with pen serving as the experimental unit. Treatments were applied in a completely randomized design to evaluate lamb growth and carcass characteristics under conventional- and natural-management practices.

Lambs were adapted to a concentrate diet from a creep pellet following weaning. Treatment diets were balanced to meet or exceed CP and energy (NE) requirements (NRC, 2007). The dietary treatments were formulated to have a minimum Ca to P ratio of 2:1. Conventional lambs were raised using best-management practices, including supplementation with lasalocid (0.15 g lasalocid/kg CONV market lamb pellet; 90 percent DM basis), decoquinate (1.25 g/kg; Dekade Krumbles; 90 percent DM basis, CHS Nutrition, Sioux Falls, S.D.), and chlortetracycline (CTC; 8.82 g/kg; CTC 4G; 90 percent DM basis, CHS Nutrition, Sioux Falls, S.D.), and implantation with zeranol (Ralgro, Schering-Plough Animal Health Corp., Union, N.J.). The CONV diet was 78.6 percent whole, shelled corn, 19.8 percent medicated, market-lamb pellet (Market Lamb 38-10 Supplement, CHS Nutrition, Sioux Falls, S.D.), 1.2 percent supplement containing decoquinate, and 0.4 percent supplement containing CTC

Table 1. Ingredient and nutritional composition of diets fed to feedlot lambs

	Diets[1]	
Item	CONV	NAT
Ingredient, %	DM basis	
Whole Corn	78.6	80.0
CONV Market Lamb Pellet[2]	19.8	-
NAT Market Lamb Pellet[3]	-	20.0
Decoquinate[4]	1.2	-
Chlortetracycline[5]	0.4	-
Nutrient concentration		
CP, %	15.7	15.8
TDN, %	87.5	87.9
NEm, Mcal/kg[6]	2.12	2.13
NEg, Mcal/kg[7]	1.36	1.39
Crude Fat, %	3.80	3.83
ADF, %	3.63	3.13
Ash, %	4.59	4.43
Ca, %	1.11	0.95
P, %	0.40	0.40

[1] Treatments: CONV (conventional) and NAT (naturally raised).
[2] Conventional Market Lamb Pellet contained: 0.15 g/kg lasalocid, 38% CP, 4.25% Ca, 0.6% P, 3.5% salt, 1.2 mg/kg Se, 52.920 IU/kg Vitamin A, 5.292 IU/kg Vitamin D, and 154 IU/kg Vitamin E (90% DM basis).
[3] Naturally raised Market Lamb Pellet contained: 0.1432 g/kg decoquinate, 38% CP, 4.25% Ca, 0.6% P, 3.5% salt, 1.2 mg/kg Se, 52,920 IU/kg Vitamin A, 5,292 IU/kg Vitamin D, and 154 IU/kg Vitamin E.
[4] Dekade Krumbles contained 1.25 g/kg decoquinate (90% DM basis).
[5] CTC 4G contained 8.8 g/kg chlortetracycline (90% DM basis).
[6] Net energy for maintenance; calculated analysis.
[7] Net energy for gain; calculated analysis.

(DM basis; Table 1). Conventional lambs (as defined in this study) were implanted in the ear with three, 12 mg zeranol pellets on d 28. Conventional lambs were treated with antibiotics as necessary and remained in the study (12 lambs treated for prolapse, 1 lamb treated for cystic infection). The NAT diet was 80 percent whole, shelled corn and 20 percent non-medicated, commercial pellet (Market Lamb 38-10 Supplement, CHS Nutrition, Sioux Falls, S.D.; DM basis; Table 1); the NAT commercial pellet contained decoquinate (0.1432 g decoquinate/kg NAT pellet, 90 percent DM basis). Naturally raised lambs did not receive antibiotics in any form (feed, water, injectable, etc). If treatment with antibiotic administration was necessary, the treated lamb was removed from the pen as well as the data set. Lambs were offered feed ad libitum via bulk feeders as mixed diets for both treatments. Lambs had continuous access to fresh water and shade. Water tanks were cleaned weekly, or more often as needed. Lamb health was monitored daily, with morbid lambs monitored two to three times daily.

Experimental Periods and Sampling Procedures

The study was initiated in May and concluded in August of 2009. Lambs were weighed two consecutive days at initiation (d -1 and d 0) and termination (d 111 and d 112) of the trial to determine initial and final BW. Additionally, lambs were weighed once every 28 d throughout the study. Feed refusals were collected every 28 d to determine period DMI and G:F. Feed-ingredient-grab samples (approximately 0.2 kg) were collected once every 28 d, dried at 55°C for 48 h to determine DM, and analyzed by a commercial laboratory (Midwest Laboratories, Omaha, Neb.) for CP, calculated energy, crude fat, ADF, and mineral concentrations. Two-hundred forty-five lambs (126 CONV and 119 NAT), weighing a minimum of 61 kg were transported (768 km) to Iowa Lamb Corp. (Hawarden, Iowa) and harvested on d 116. Data from lambs too light for shipment to commercial abattoir (15 CONV, 24 NAT) were included in growth analyses, but not carcass analyses. One lamb was treated and removed from the study due to complications not related to treatment. Four mortalities occurred over the course of the study. Dry matter intake for pens in which lambs died or were removed from the study was accounted for using a weighted average of lambs per pen for that period. Lambs were removed from the data set for periods in which they were not present when calculating ADG, DMI, and G:F.

Carcass data were collected 24 h post chill by trained university personnel. Data collected included HCW, leg score, conformation score, fat depth (over the 12th rib), body wall thickness (at the 12th rib), ribeye area, flank streaking, quality grade, and yield grade. Leg score, conformation score, and quality grade were scored on a scale of 1 to 15 (1 = cull; 15 = high prime). Flank streaking was assigned, with scores of 100 to 199 = Practically Devoid, 200 to 299 = Traces, 300 to 399 = slight, 400 to 499 = Small, and 500 to 599 = Modest. Percentage of boneless, closely trimmed retail cuts (%BCTRC) was calculated using the equation from Savell and Smith (2000).

Statistical Analysis

Lamb performance data were analyzed as a completely randomized design using the MIXED procedure of SAS (SAS Inst. Inc., Cary, N.C.) with pen serving as experimental unit. Carcass data were analyzed similarly, with missing data points from underweight lambs not included in the data set. Repeated measures was used to analyze period effects for body weight, ADG, DMI, and G:F. The model specifications included treatment, period, and treatment x period interaction. The covariance structure used was 1st Order Ante-dependence for body weight, DMI, and G:F. Simple covariance structure was used for ADG. Other structures were tested; however, 1st Order Ante-dependence and Simple were the best fit, respectively. Results are presented as least squares means with differences considered significant at $P \leq 0.10$.

Results and Discussion

Growth

Results for lamb growth are reported in Table 2. Overall, CONV lambs had increased ADG (0.35 kg vs 0.33 kg ± 0.006 kg; $P = 0.03$) and d 112 BW (73.3 kg vs 71.3 kg ± 0.71 kg; $P = 0.07$) compared to NAT lambs, but DMI (1.64 kg/d vs 1.58 kg/d ± 0.04 kg/d; $P = 0.55$) and G:F (0.22 kg gain/kg feed vs 0.21 kg gain/kg feed ± 0.004 kg gain/kg feed DMI; $P = 0.32$) were not different between treatments (d 0 to d 112; $P \geq 0.32$). Treatment x period effects were observed ($P \leq 0.003$) for ADG, BW, DMI, and G:F. Body weight was greater in CONV lambs on d 56 (57.0 kg vs 54.7 kg ± 0.53 kg; $P = 0.02$) d 84 (66.0 kg vs 62.9 kg ± 0.56 kg; $P = 0.005$), and d 112 (73.3 kg vs 71.3 kg ± 0.71 kg; $P = 0.07$). Conventional lambs gained faster (0.47 kg vs 0.39 kg ± 0.01 kg; $P < 0.001$), consumed more daily DM (1.68 kg vs 1.57 kg ± 0.02 kg; $P = 0.001$), and gained more efficiently (0.28 kg gain/kg feed vs 0.24 kg gain/kg feed ± 0.007 kg gain/kg feed DMI; $P = 0.005$) than NAT lambs from d 29 to d 56. However, NAT lambs gained more (0.30 kg vs. 0.26 kg ± 0.01 kg; $P = 0.09$) and were more efficient from d 85 to d 112 (0.18 kg gain/kg feed vs 0.15 kg gain/kg feed ± 0.008 kg gain/kg feed DMI; $P = 0.02$) than CONV lambs, respectively.

In other reports in the literature, lasalocid increased ADG and G:F for lambs (Funk et al., 1986; Schwulst et al. 1991). Fluharty et al. (1999) reported increased DMI and decreased days on feed for lambs fed concentrate diets and supplemented with lasalocid, but reported no differences in G:F, ADG, or final weight. The Fluharty data is in contrast to research that found decreased DMI for cattle fed lasalocid in high-concentrate diets (Berger et al., 1981), or low-concentrate diets (Bartley et al., 1979), and no difference in DMI for lambs supplemented with lasalocid in high-concentrate diets (Paterson et al., 1983). Research by Paterson et al. (1983) is in agreement with the results of the present study. Moreover, research in cattle has indicated the addition of lasalocid to high-concentrate rations increased ADG and G:F (Berger et al., 1981; Thonney et al., 1981). These results agree with the present study findings of increased overall ADG and increased G:f for d 29 to d 56, but not with the decreased G:F from d 85 to d 112.

The effects of CTC on feedlot lambs have been inconsistent, but research has indicated that CTC can improve ADG (Hatfield et al., 1954; Johnson et al., 1956) and feed efficiency (Hatfield et al, 1954; Kunkel et al., 1956). This agrees

Table 2. Comparison of conventional and natural management practices on feedlot lamb performance, incidence of prolapse, and mortality

Item	Treatment[1] CONV	NAT	SEM[2]	*P*-value[3]
Wt[4], kg				
d 0	34.1	34.1	0.13	0.97
d 28	43.9	43.6	0.42	0.96
d 56	57.0	54.7	0.53	0.02
d 84	66.0	62.9	0.56	0.005
d 112	73.3	71.3	0.71	0.07
ADG[5], kg				
d 0-28	0.35	0.36	0.01	0.95
d 29-56	0.47	0.39	0.01	<0.001
d 57-84	0.32	0.30	0.01	0.13
d 85-112	0.26	0.30	0.01	0.09
d 0-112	0.35	0.33	0.006	0.03
Intake[6], kg DM · hd^{-1} · d^{-1}				
d 0-28	1.39	1.47	0.05	0.26
d 29-56	1.68	1.57	0.02	0.001
d 57-84	1.75	1.67	0.03	0.87
d 85-112	1.77	1.64	0.04	0.33
d 0-112	1.64	1.58	0.04	0.55
G:F[7]				
d 0-28	0.26	0.25	0.01	0.45
d 29-56	0.28	0.24	0.007	0.005
d 57-84	0.18	0.18	0.004	0.24
d 85-112	0.15	0.18	0.008	0.02
d 0-112	0.22	0.21	0.004	0.32
Prolapse, %	8.3	0	1.0	0.001
Mortality, %	2.8	0	0.6	0.01

[1] Treatments: CONV (conventionally raised) and NAT (naturally raised).
[2] Standard Error of Mean; n = 6.
[3] P-value for F-tests of mean.
[4] P-values for period body weight treatment ($P = 0.04$), period ($P < 0.001$), treatment x period ($P = 0.003$).
[5] P-values for ADG treatment ($P = 0.03$), period ($P < 0.001$), treatment x period ($P < 0.001$).
[6] P-values for Intake treatment ($P = 0.55$), period ($P < 0.001$), treatment x period ($P = 0.003$).
[7] P-values for G:F treatment ($P = 0.32$), period ($P < 0.001$), treatment x period ($P < 0.001$).

with the present study, which found increased ADG and period G:F for CONV lambs compared with NAT lambs, and no difference for DMI between treatments.

The implanting strategy in the present study is divergent from that traditionally utilized in feedlot lambs. Historically, the lamb-feeding industry used 12 mg zeranol implants. However, there is not a 12 mg zeranol implant currently available; therefore, lambs in the present study were implanted with a commercially available 36 mg zeranol implant (three, 12 mg zeranol pellets). The majority of previous research in lambs utilized single or multiple implants containing a total of 12 mg of zeranol. Results from d 29 to d 56 in the present study agree with previous research that indicates lambs implanted with 12 mg zeranol have increased ADG and G:F when implanted with 12 mg zeranol one, two, three, or five times (Hutcheson et al., 1992; Hufstedler et al., 1996; Salisbury et al., 2007) compared with non-implanted lambs. However, zeranol can also decrease DMI in lambs implanted with 12 mg zeranol twice (Hutcheson et al., 1992), in contrast with the results of the present study. The increased overall ADG of the present study (d 0 to d 112) also agrees with the aforementioned research. The combination of decreased ADG and non-significant increase in DMI from d 85 to d 112 in CONV lambs resulted in CONV lambs having decreased G:F from d 85 to d 112 compared to NAT lambs. The increased G:F from d 29 to d 56 combined with the decreased G:F from d 85 to d 112 resulted in no differences between treatments for G:F from d 0 to d 112. Similar to Salisbury et al. (2007), the present study found no differences between conventional and natural treatments for DMI from d 0 to d 112.

A limited amount of research is present in the literature comparing growth of livestock in natural- and conventional-management systems. Current research indicates conventionally raised livestock have a distinct advantage compared to naturally raised livestock. Faulkner et al. (2010) compared steers managed in conventional- and natural-management systems. Steers under conventional management were fed monensin and tylosin, and were implanted with growth promotants. Naturally raised steers received no antibiotics or implants. Conventional steers had increased final body weight, ADG, and G:F, as well as decreased days on feed and DMI. Thompson et al. (2010) also observed increased BW, ADG, and G:F in cattle fed monensin and implanted with a zeranol implant and a progesterone and estradiol benzoate implant compared to cattle raised without growth promotants. Research analyzing the effects of implants and antibiotic-feed additives found implants improved growth, but feed additives had no effect on growth (Sawyer et al., 2003). The improved performance of implanted steers agrees with other research (Guiroy et al., 2002; Johnson et al., 1996; Pampusch et al., 2003).

On d 84, CONV and NAT body weights were 66.0 kg and 62.9 kg, respectively; heavy enough for harvest (average U.S. lamb harvest weight is 61.2 kg; Viator et al., 2007); however, ending the trial on d 84 was not feasible due to the logistics of transporting animals to the harvest facility. Naturally

Table 3. Comparison of conventional and natural management practices on feedlot lamb carcass characteristics

	Treatment[1]			
Item	CONV	NAT	SEM[2]	*P*-value[3]
HCW, kg	37.0	36.5	0.36	0.35
Leg Score[4]	11.5	11.5	0.07	0.95
Conformation Score[4]	11.5	11.6	0.06	0.50
Fat Depth, cm[5]	0.84	0.79	0.03	0.25
Body Wall Thick, cm	2.82	2.69	0.03	0.05
Ribeye Area, cm^2	16.58	17.16	0.13	0.03
Flank Streaking[6]	351.03	356.89	5.85	0.50
Quality Grade[4]	11.4	11.4	0.06	0.85
Yield Grade[7]	3.72	3.55	0.1	0.25
BCTRC, %[8]	43.57	43.92	0.11	0.05
Lean, kg	16.1	16.0	0.13	0.69
Dressing, %	49.26	49.26	0.15	0.99

[1] Treatments: CONV (conventionally raised) and NAT (naturally raised).
[2] Standard Error of Mean; n = 6.
[3] *P*-value for F-tests of mean.
[4] Leg score, conformation score, and quality grade: 1 = cull to 15 = high prime.
[5] Adjusted fat depth and yield grades.
[6] Flank streaking: 100-199 = practically devoid; 200-299 = traces; 300-399 = slight; 400-499 = small; 500-599 = modest.
[7] Yield Grade = 0.4 + (10 x adjusted fat depth, in).
[8] Boneless closely trimmed retail cuts, % = (49.936 – (0.0848 x 2.205 x HCW, kg) - (4.376 x 0.3937 x fat depth, cm) – (3.53 x 0.3937 x body wall thickness, cm) + (2.456 x 0.155 x ribeye area, cm^2)).

raised lambs had improved G:F and ADG from d 85 to d 112 compared to CONV lambs. Had the trial ended on d 84, CONV lambs may have had increased overall G:F in addition to increases in weight gain.

Prolapse and Mortality

The increased incidence of vaginal and rectal prolapses ($P = 0.001$) in the CONV treatment raises concerns about animal health (Table 2). The increased incidences of prolapses subsequently led to increased percent mortality ($P = 0.01$) in CONV lambs. Incidence of prolapse has been cited as a reason for decreased use of zeranol by lamb feeders (Lupton, 2008). Treatment for prolapse included antibiotics and purse-string sutures to keep expelled tissue in place. In this study, 12 CONV lambs prolapsed, 5 CONV lambs prolapsed repeatedly (4, 2, 2, 2, and 3 times, respectively), and 4 CONV lambs died as a result of complications from prolapses. Salisbury et al. (2007) reported a numerical increase in percent prolapse in feeder lambs implanted once or twice with 12 mg zeranol, but did not report increased mortality associated with the increased prolapse. Arnsperger et al. (1976) also found increased prolapses in lambs implanted with zeranol and raised in the feedlot, but could not find any differences between implanted and non-implanted lambs raised on pasture. Anecdotal evidence also indicates as many as 50 percent of feedlot lambs in Mexico are implanted with zeranol, yet these lambs do not experience an increased incidence of prolapse. The absence of prolapse in Mexican lambs implanted with zeranol could be associated with the use of higher-forage diets in Mexican feedlot rations compared to counterparts in the United States (Amaya, 2010). No other factors associated with the present study have been implicated in increased percent prolapse in lambs.

Carcass Characteristics

The effects of lamb management (CONV vs NAT), as described in this paper, on subsequent carcass characteristics are given in Table 3. Naturally raised lambs had decreased body wall thickness, increased ribeye area (REA), and increased percent boneless, closely trimmed, retail cuts (%BCTRC; $P \leq 0.05$) compared to CONV lambs (Table 3). Other carcass measurements were similar between treatments ($P \geq 0.25$). The decreased %BCTRC in CONV is a result of the decreased REA and increased body wall thickness. The results of the present study disagree with previous research comparing the effects of natural and conventional management on carcass characteristics of steers. Conventionally managed steers have been reported to have increased HCW and REA and decreased marbling score when compared to naturally managed steers (Faulkner et al., 2010; Thompson et al., 2010). Additionally, conventionally managed steers had increased dressing percent and decreased KPH and yield grade compared to naturally managed steers (Faulkner et al., 2010). The effects of zeranol on carcass characteristics are inconsistent. Zeranol has been reported to increase fat depth (Field et al., 1993), increase leg score (Hutcheson et al., 1992; Nold et al., 1992), decrease kidney and pelvic fat (Hufstedler et al., 1996), and increase carcass weight (Hutcheson et al., 1992; Wilson et al., 1972). Lasalocid has not been reported to influence carcass characteristics in sheep (Fluharty et al., 1999) or cattle (Berger et al., 1981). Chlortetracycline does not alter carcass quality, but may improve quality grade of carcasses (Hatfield et al., 1954; Jordan et al., 1956). Differences in quality grade were not observed in the present study ($P = 0.85$).

Economics

A simple, enterprise budget is presented in Table 4 to compare the costs and profits associated with raising ten lambs according to the respective treatments. The revenue from lambs sold was calculated according to final BW for each treatment, with corrections made for percent mortality. Factors included in costs for lamb production were: lamb-purchase price, feed cost, additional labor cost from prolapse, implant cost, and yardage. Total costs were increased for CONV lambs due to increased costs

Table 4. Cost of raising a pen of ten lambs using conventional or natural management systems

Item	Unit	CONV[1] Price ($)	CONV Quantity	CONV Amount ($)	NAT Price ($)	NAT Quantity	NAT Amount ($)
Revenue							
Lamb Harvested[2]	Kg	2.03	712	1445.36	2.03	713	1447.39
Total Revenue				**1445.36**			**1447.39**
Costs							
Lamb[3]	Kg	2.76	341	941.16	2.76	341	941.16
Feed[4]	Kg	0.218	2060	449.86	0.217	1980	430.29
Labor (Prolapse)[5]	Prolapse	7.2	0.83	5.98	7.2	0	0
Implant	Dosage	1.25	10	12.50	1.25	0	0
Yardage[6]	Head/Day	0.04	1120	44.80	0.04	1120	44.80
Total Costs				**1454.30**			**1416.25**
Profit				**(8.94)**			**31.14**

[1] Treatments: CONV (conventionally raised) and NAT (naturally raised).
[2] Market price determined by sale prices at Hawarden Lamb Corporation, Hawarden, IA at time of sale. Conventional lamb harvested accounts for 2.8% mortality.
[3] Purchase price estimated based on USDA National Weekly Market Summary at time of purchase.
[4] Rations calculated using feed costs of $0.15/kg corn, $0.45/kg CONV pellet, $0.48/kg NAT pellet, $0.73/kg Deccox, and $0.73/kg CTC. DMI is 1.64 and 1.58 kg/hd/d for CONV and NAT lambs respectively, fed for 112 d.
[5] Labor cost for prolapse calculated based on 0.5 hr of work at $12/hr, plus 12 mL oxytetracycline ($0.10/mL).
[6] Yardage rate was based on commercial rates and accounted for fixed costs of infrastructure, mixer wagon and tractor, and labor for feeding and daily health checks.

for labor to treat prolapses, implants, and feed. Additionally, CONV lambs had decreased revenue resulting from increased mortality. Therefore, NAT lambs were more economically viable despite having decreased growth compared to CONV lambs.

Conclusions

Lambs raised using conventional-management system had increased ADG and final BW compared with naturally raised lambs, but there were no differences in DMI or G:F. Additionally, conventionally raised lambs had an increased incidence of prolapse and mortality. Although the majority of carcass characteristics were not different between treatments, lambs from naturally raised management did have increased ribeye area and decreased body wall thickness, subsequently increasing % BCTRC. Future research should evaluate if improved carcass characteristics can again be attained from naturally raised management. Research should also examine whether these conventional-management practices can be used to increased growth without increasing incidence of prolapse and mortality.

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