Available online at www.sciencedirect.com

ScienceDirect

Small Ruminant Research 74 (2008) 64–71

Small Ruminant Research

www.elsevier.com/locate/smallrumres

Comparison of three systems for concurrent production of high quality mohair and meat from Angora male kids

C.J. Lupton [a,*], J.E. Huston [a], J.W. Hruska [b], B.F. Craddock [c], F.A. Pfeiffer [a], W.L. Polk [c]

[a] *Texas Agricultural Experiment Station, 7887 U.S. Highway 87 North, San Angelo, TX 76901, USA*
[b] *Department of Agriculture, Angelo State University, San Angelo, TX 76901, USA*
[c] *Texas Cooperative Extension, 7887 U.S. Highway 87 North, San Angelo, TX 76901, USA*

Received 2 February 2006; received in revised form 14 March 2007; accepted 14 March 2007
Available online 26 April 2007

Abstract

Castrated Angora kids ($n = 210$, initial BW = 25.4 ± 4.0 kg) approximately 7 months of age were used in two consecutive years (2002 and 2003) to evaluate three production systems and coats in terms of animal performance, carcass traits, mohair production and quality, and production costs. In both years, half the animals were assigned to an innovative feeding system (RF) that consisted of an open-sided barn having a raised, slatted floor, and the remaining goats were assigned in equal numbers to traditional feedlot (FL) and pasture (P) systems. Half the goats in each system were fitted with coats. Treatments and coat groups were blocked by body weight. The FL and RF goats had *ad libitum* access to rations formulated to produce high and moderate growth rates, respectively. Goats in the P treatment were supplemented three times a week to produce moderate growth. After shearing, fleeces were weighed and fully characterized using objective measurements. In 2002 (only), the goats were slaughtered and carcass traits were measured. The rations and supplements were formulated to produce weight gains and fleece weights that should have ranked FL > RF ≥ P. In fact, the FL and RF goats gained faster and grew more than the P goats. Overall gain rates were 124, 61, and 135 g/day for FL, P, and RF, respectively, while corresponding shorn body weights were 37, 30, and 38 kg. The larger animals in the FL and RF systems produced more mohair than goats in the P system (3.3 kg versus 2.8 kg, greasy). Mohair from RF goats was coarser than that from P goats (31.5 μm versus 29.6 μm) and contained lower curvature (18.8°/mm versus 20.6°/mm). System did not affect any of the other measured traits including scoured yield, mohair production efficiency (mohair production/kg BW), medullation, staple length, or any of the measures of trait variability (CV). System had no effect on dressing percentage but the consistent trend for carcass weight, back fat thickness, and body wall thickness, was consistent with live weights, FL = RF > P. As planned, coated produced higher yielding (74% versus 71%) fleeces compared to those from uncoated animals. Coats did not affect any other measured trait. Fiber and meat production were most expensive in the RF system and least expensive in the P system. Even with coats, mohair produced in the FL and P systems was not clean enough to qualify for the hand spinner niche market. The RF coated fleeces exhibited exceptional visual cleanliness that permitted them to be sold for several multiples of the prevailing mohair commodity price.
Published by Elsevier B.V.

Keywords: Angora goat; Goat meat; Mohair; Niche market; Production system

1. Introduction

The declining profitability of traditional production systems is a problem facing United States agriculture today. This is especially true in the ranching areas

* Corresponding author. Tel.: +1 325 653 4576; fax: +1 325 658 4364.
E-mail address: c-lupton@tamu.edu (C.J. Lupton).

0921-4488/$ – see front matter. Published by Elsevier B.V.
doi:10.1016/j.smallrumres.2007.03.008

of western Texas. In 2004, Texas Cooperative Extension economists projected net returns of US$ −23.15, −20.44, and +46.59 per animal unit for sheep, meat goat, and Angora goat operations, respectively, in West Central Texas (Texas Cooperative and Extension, 2004). The positive projected returns for Angora goats were encouraging but actual returns have been very erratic over time from this livestock enterprise. Following the phase-out of the U.S. Wool Act and loss of wool and mohair incentive programs beginning in 1994, Angora goat numbers have decreased steadily. From 1992 to 2006, the number of Angora goats in the U.S. declined from 2,254,000 to 285,000.

With traditional demands for mohair being so volatile and unpredictable, the time appeared to be ripe to investigate new markets that might require implementation of a new production system. A proposed system for producing higher quality fibers involves the use of housing equipped with raised, slatted floors. Wool quality, production, and value of castrated male lambs was increased using such techniques (Scarlett, 1993; Lupton et al., 2001, 2007). The wool produced was finer, more uniform in fiber diameter, and contained almost no dirt and vegetable matter. In addition, coats were used to further increase cleanliness of the fleece. Wool prices received were greatly increased when this exceptionally clean, high quality wool was sold into niche markets, e.g., handspinning. We hypothesized that the same result might be accomplished with mohair. After studying the economics of this type of production system adapted to a U.S. environment, we concluded that fiber income alone would not produce a profitable system. Therefore we investigated a system that produced fiber, meat, and hides. To pursue this concept, a 168 m^2 facility was designed and constructed that consisted of an open-sided, covered shed with a raised, wooden, slatted floor built 1.2 m above a concrete slab. This provided adequate space to feed 200 kids. The slatted floor was designed to release fecal material and urine and was constructed above ground to facilitate removal of manure and provide adequate ventilation. Feeding and watering systems were designed to provide adequate access to the goats while preventing contamination from feces and urine. An automated feed system was designed to deliver a pelleted ration by auger into a centered feed bunk from an adjacent bulk feed tank. The facility was designed for low labor requirement—one man can operate the system for 10 min delivering enough feed for 2 days.

This project was designed to compare live animal performance, mohair quality and production, carcass characteristics, and net income from castrated Angora kids fed to slaughter on an indoor, raised floor system with contemporary goats fed in traditional feedlot and supplemented pasture production systems. Coats were tested in each system for their effectiveness at producing cleaner, higher yielding fleeces. Each of the three systems compared in this study include the facilities in which the kids were fed (3), the diets (3), the methods used to sell mohair (2), and the methods used to sell hides (1) and meat (1).

2. Materials and methods

2.1. Experimental design

In October, 2002, 112 castrated Angora kids averaging 7 months of age and weighing 27.2 ± 8.9 kg were used to compare the effects of three production systems and coats on performance, carcass traits and mohair production and quality. The experiment was repeated in 2003 with 98 castrates of similar age but lighter and more uniform in weight (23.3 ± 2.8 kg) at the start of the experiment. In both years, the incoming kids were vaccinated for enterotoxemia (Clostridium perfringens type C and D toxoid, a product of Boehringer, Ingelheim Vetmedica, Inc., St. Joseph, MO, USA; dosage rate: 2 ml/head). An anthelmintic was also administered (Ivermectin–Ivomec, a product of Merck and Co., Rahway, NJ, USA; dosage rate: 4.5 ml/11.8 kg). The goats were then fed a uniformity diet for 3 weeks (2 weeks in 2003) after which they were weighed and assigned to system (blocked by weight). Coats were assigned to half of the goats in each system in such a way that average BW of goats in the coated and uncoated groups was not different. The three systems were the feed lot (FL), supplementation on pasture (P), and the raised floor barn (RF). Goats in the FL system were fed a typical goat feed lot ration (Table 1) that was made available on an *ad libitum* basis. The kids also had *ad libitum* access to clean water and salt blocks. Goats in the P system were supplemented with 1.6 kg per head of a salt-limiting ration (Table 2) three times a week (Monday, Wednesday, and Friday at 13.45). After 6 December 2001 (31 January 2003) the P goats were supplemented with a different ration (Table 3) at a rate of 2.3 kg/head three times per week (1.6 kg/head in 2003). Goats in the RF system were provided with *ad libitum* access to a pelleted ration (Table 4). Goats in the P and RF systems also had *ad libitum* access to clean water and salt blocks. After 98 days on feed (127 days in 2003), the goats were shorn and the fleeces were packaged individually for weighing and testing. In 2002, the goats were slaughtered a week later. Goats were not slaughtered in the 2003 evaluation.

2.2. Fleece and fiber measurements

Fleece and fiber measurements were made at the Texas Agricultural Experiment Stations' Wool and Mohair Research Lab in San Angelo. After a grease weight had been obtained, staples (10) were removed from random positions in the fleece for length measurement (ASTM, 2004b). The remainder of the fleece was pressure cored (32 mm × 13 mm cores, Johnson and

Table 1
Dietary composition and nutrient summary of feedlot ration*

	DM	As fed
Ingredient composition		
Cottonseed hulls	15.1	15.0
Alfalfa meal	5.1	5.0
Milo	68.9	68.5
Cottonseed meal	2.6	2.5
Soybean meal	2.5	2.5
Molasses	3.0	4.0
Ammonium chloride	0.9	0.7
Salt	1.1	1.0
Calcium carbonate	0.8	0.8
*Rumensin added at 20 g active/tonnes	100.0	100.0
Chemical composition and nutritive value[a]		
Crude protein (%)	13.5	
Digestible intake protein (% of DM)	7.9	
NE_m (Mcal/kg)	1.6	
NE_g (Mcal/kg)	1.0	
eNDF (% of DM)	16.7	
Ca (%)	0.5	
P (%)	0.3	

[a] Calculated using the Texas Tech University Beef Cattle Diet Formulation Program using dietary ingredient composition values from NRC (1996).

Table 2
Dietary composition and nutrient summary of first supplement ration for goats on pasture*

	DM	As fed
Ingredient composition		
Alfalfa meal	4.6	4.6
Milo	67.0	67.5
Cottonseed meal	9.2	9.0
Soybean meal	4.6	4.6
Molasses	2.7	3.6
Ammonium chloride	0.8	0.7
Urea	0.2	0.2
Calcium carbonate	0.6	0.5
Vitamin/mineral/antibiotic premix	0.2	0.2
Salt	10.1	9.1
*Rumensin added at 20 g active/tonnes	100.0	100.0
Chemical composition and nutritive value[a]		
Crude protein (%)	17.0	
Digestible intake protein (% of DM)	10.2	
NE_m (Mcal/kg)	1.6	
NE_g (Mcal/kg)	1.0	
eNDF (% of DM)	4.3	
Ca (%)	0.4	
P (%)	0.4	

[a] Calculated using the Texas Tech University Beef Cattle Diet Formulation Program using dietary ingredient composition values from NRC (1996).

Table 3
Dietary composition and nutrient summary of second supplement ration for goats on pasture*

	DM	As fed
Ingredient composition		
Alfalfa meal	4.6	4.6
Milo	73.9	74.3
Cottonseed meal	4.7	4.6
Soybean meal	2.2	2.2
Molasses	2.7	3.6
Ammonium chloride	0.8	0.7
Urea	0.2	0.2
Calcium carbonate	0.6	0.5
Vitamin/mineral/antibiotic premix	0.2	0.2
Salt	10.1	9.1
*Rumensin added at 20 g active/tonnes	100.0	100.0
Chemical composition and nutritive value[a]		
Crude protein (%)	14.6	
Digestible intake protein (% of DM)	8.8	
NE_m (Mcal/kg)	1.6	
NE_g (Mcal/kg)	1.0	
eNDF (% of DM)	4.0	
Ca (%)	0.4	
P (%)	0.3	

[a] Calculated using the Texas Tech University Beef Cattle Diet Formulation Program using dietary ingredient composition values from NRC (1996).

Table 4
Dietary composition and nutrient summary of raised floor pelleted ration*

	DM	As fed
Ingredient composition		
Cottonseed hulls	20.3	20.0
Alfalfa hay	55.6	55.0
Barley grain	20.0	20.0
Molasses, cane	3.0	4.0
Ammonium chloride	0.6	0.5
Salt	0.5	0.5
*Rumensin added at 20 g active/tonnes	100.0	100.0
Chemical composition and nutritive value[a]		
Crude protein (%)	14.1	
Digestible intake protein (% of DM)	11.1	
NE_m (Mcal/kg)	1.3	
NE_g (Mcal/kg)	0.8	
eNDF (% of DM)	43.8	
Ca (%)	0.8	
P (%)	0.2	

[a] Calculated using the Texas Tech University Beef Cattle Diet Formulation Program using dietary ingredient composition values from NRC (1996).

Larsen, 1978) to obtain a random sample (>50 g) of the fleece. Two 25 g sub-samples were used to determine lab scoured yield (ASTM, 2004a). One of the washed and dried duplicates was mini-cored (ASTM, 2001) to obtain a few milligrams of 2 mm snippets that represented the whole fleece. These snippets were washed in a Buchner funnel with 1,1,1-trichloroethane (10 ml) and acetone (10 ml), dried at 105 °C for one hour and cooled and conditioned for 12 h in a standard atmosphere of 21 ± 1 °C and 65 ± 2% rh (ASTM, 2004c). The conditioned snippets were then spread onto microscope slides (7 cm × 7 cm) and measured for fiber diameter distribution (mean, S.D., and CV), comfort factor (% fibers ≤ 30 μm), along-fiber average fiber diameter, S.D. and CV and average fiber curvature, S.D. and CV, using an OFDA 100 (BSC Electronics, Ardross, Western Australia; Baxter et al., 1992; ASTM, 2001). This instrument was also used to measure medullation (total, flat fibers, and objectionable fibers) in the samples (IWTO, 1998).

2.3. Carcass measurements

The 2002 kids were slaughtered and carcasses were evaluated at the Ranchers' Lamb of Texas, Inc. facility in San Angelo. Carcass measurements (except hot carcass weight) were made after the carcasses had been in the cooler for 24 h. These included back fat thickness (measured between the 12th and 13th ribs) at the midpoint of the ribeye and body wall thickness measured from the inside of the rib to the outside fat about 10 cm below the ribeye. In addition, hind leg circumferences (thickest point) were measured. Dressing percentage was calculated by dividing the hot carcass weight by shorn final live weight and multiplying by 100.

2.4. Statistical analysis

Due to resource limitations, individual animals were used as experimental units in this case study. Because independent replicates were not available, effects of system were determined on the basis of non-overlapping confidence limits. Ninety-five percent confidence intervals (alpha = 0.05) were calculated for each characteristic measured in each system and for the coated and uncoated groups separately.

3. Results

3.1. Effect of system

The effects of system on performance and fleece characteristics are summarized in Table 5. The rations and supplements were formulated in such a way that weight gains and fleece weights were expected to rank FL > RF ≥ P. However, in actuality the FL and RF goats gained faster and grew more than the P goats. Lack of exercise and apparent contentment in the RF system resulted in higher gains than expected and severe drought conditions in the pasture (both years) resulted in lower gains than expected. This resulted in slightly higher fleece weights (greasy and clean) for the larger animals with no difference in lab scoured yield. The RF fleeces were coarser than the P fleeces (∼2 μm) this being consistent with the respective sizes and fleece weights of the animals. Interestingly, efficiency of mohair production (∼65 g/kg body weight) did not differ among systems. Considering the dietary differences among treatments, this was unexpected. The amount of fiber produced in this experiment is higher than that reported for mature does on rangeland (54.2 g/kg, Lupton et al., 2000), but very similar to that produced by intact male yearlings during a performance test (67.5 g/kg, Waldron and Lupton, 2005).

The effect of system on medullated fiber (total, flat, and objectionable) was not significant in this study. The effects of nutrition on medullated fiber production in Angora goats remain somewhat unclear (Lupton et al., 1991). One aspect of medullation in mohair that has not received much attention to date is the average fiber diameter and distribution of the medullated fibers. On average, the medullated fiber population was ∼18 μm coarser than the fiber population as a whole but the former appeared to be unaffected by system.

Average fiber curvature is a measure of crimp or waviness in a fiber and is being used in wool assessments (e.g., Lupton et al., 2003) because it is known to affect processing efficiency. Since mohair has relatively low levels of crimp (compared to wool of similar dimensions), this characteristic is not often reported in mohair studies. A small difference was present in this study between the P and RF goats. As expected, the coarser RF goats produced mohair having lower curvature than the P goats.

Finally, system did not produce differences in average staple length or variation of staple length. In fact, all CV measurements were comparable within trait (5) across systems indicating that no system was producing more uniform fibers than any other system. So, in the second year (only) of the study, we also measured variability in fiber diameter along the length of the 2 mm snippets prepared for the OFDA measurements. This was done primarily in an attempt to identify differences in diameter uniformity along the fiber that could be attributable to system. No such differences were detected (CV of along-fiber diameter was constant among treatments = 2.3%).

3.2. Effects of coats on performance and fleece traits

The effects of protective coats on performance and fleece traits are summarized in Table 6. The most

Table 5
Effects of system on performance and fleece traits (means ± 95% confidence limits)

Item	System		
	Feedlot	Pasture	Raised floor
n	53	51	106
Initial weight (kg)	25.5 ± 1.1	25.3 ± 1.1	25.3 ± 0.8
Shorn final weight (kg)	36.6 ± 1.6	29.8 ± 2.3	37.8 ± 1.1
Body average daily gain (g/day)	95.6 ± 10.7	37.0 ± 7.7	105.9 ± 8.5
Unshorn final weight (kg)	39.9 ± 1.7	32.5 ± 1.2	41.1 ± 1.2
Total average daily gain (g/day)	124.4 ± 10.3	61.2 ± 7.1	134.8 ± 8.4
Grease fleece weight (kg)	3.3 ± 0.2	2.8 ± 0.2	3.3 ± 0.1
Lab scoured yield (%)	71.8 ± 1.7	72.6 ± 1.8	72.9 ± 1.0
Clean fleece weight (kg)	2.3 ± 0.1	2.0 ± 0.1	2.4 ± 0.1
Clean fleece weight/unit body weight (g/kg)	64.0 ± 3.8	66.7 ± 3.5	64.1 ± 2.3
Average fiber diameter (μm)	31.2 ± 1.0	29.6 ± 0.9	31.5 ± 0.6
Coefficient of variation of fiber diameter (%)	27.7 ± 0.8	27.2 ± 0.7	27.8 ± 0.6
Total medullation (per 10,000 fibers)	130.7 ± 14.1	122.5 ± 12.8	121.1 ± 9.8
Flat fibers (per 10,000 fibers)	63.4 ± 15.0	62.8 ± 9.2	60.5 ± 4.5
Objectionable fibers (per 10,000 fibers)	19.8 ± 4.9	15.8 ± 4.4	16.6 ± 2.9
Average fiber diameter of medullated fibers (μm)	47.9 ± 3.0	46.9 ± 3.0	49.7 ± 1.5
Coefficient of variation of fiber diameter of medullated fibers (%)	38.6 ± 2.1	36.9 ± 2.2	39.7 ± 1.4
Average fiber curvature (°/mm)	18.8 ± 0.9	20.6 ± 1.0	18.8 ± 0.6
Coefficient of variation of fiber curvature (%)	124.7 ± 3.5	119.0 ± 2.6	122.3 ± 2.2
Along-fiber average fiber diameter (μm)	29.2 ± 1.2	27.5 ± 1.0	29.9 ± 0.6
Coefficient of variation of along-fiber diameter (%)	2.3 ± 0.1	2.3 ± 0.1	2.3 ± 0.1
Average staple length (cm)	14.6 ± 0.7	14.1 ± 0.8	14.9 ± 0.5
Coefficient of variation of staple length (%)	6.6 ± 0.6	6.1 ± 0.6	6.6 ± 0.4

Table 6
Effects of coats on performance and fleece traits (means ± 95% confidence limits)

Item	Coated	Not coated
n	106	105
Initial weight (kg)	25.3 ± 0.8	25.4 ± 0.8
Shorn final weight (kg)	35.1 ± 1.1	36.1 ± 1.3
Body average daily gain (g/day)	82.7 ± 8.6	90.6 ± 10.0
Unshorn final weight (kg)	38.2 ± 1.2	39.3 ± 1.4
Total average daily gain (g/day)	110.1 ± 8.8	118.6 ± 10.0
Grease fleece weight (kg)	3.1 ± 0.1	3.2 ± 0.2
Lab scoured yield (%)	74.1 ± 1.0	70.9 ± 1.1
Clean fleece weight (kg)	2.3 ± 0.1	2.2 ± 0.1
Clean fleece weight/unit body weight (g/kg)	66.1 ± 2.2	63.3 ± 2.6
Average fiber diameter (μm)	31.0 ± 0.6	30.9 ± 0.6
Coefficient of variation of fiber diameter (%)	27.4 ± 0.6	27.8 ± 0.6
Total medullation (per 10,000 fibers)	122.6 ± 9.0	125.2 ± 10.2
Flat fibers (per 10,000 fibers)	59.6 ± 4.9	63.9 ± 5.4
Objectionable fibers (per 10,000 fibers)	18.2 ± 3.0	16.3 ± 3.1
Average fiber diameter of medullated fibers (μm)	47.9 ± 1.8	49.3 ± 1.9
Coefficient of variation of fiber diameter of medullated fibers (%)	38.0 ± 1.4	39.5 ± 1.5
Average fiber curvature (deg/mm)	19.1 ± 0.6	19.4 ± 0.6
Coefficient of variation of fiber curvature (%)	120.7 ± 2.0	123.6 ± 2.3
Along-fiber average fiber diameter (μm)	29.5 ± 0.7	8.8 ± 0.8
Coefficient of variation of along-fiber diameter (%)	2.3 ± 0.1	2.4 ± 0.1
Average staple length (cm)	14.6 ± 0.5	14.7 ± 0.5
Coefficient of variation of staple length (%)	6.5 ± 0.7	6.4 ± 0.4

Table 7
Effects of system and coats on carcass traits (2002 data only, means ± 95% confidence limits)

Item	System			Coats	
	Feedlot	Pasture	Raised floor	Coated	Uncoated
n	29	27	56	56	56
Warm carcass weight (kg)	15.9 ± 1.2	13.1 ± 0.9	15.5 ± 0.7	15.1 ± 0.7	14.9 ± 0.8
Dressing percentage (%)	44.8 ± 1.5	44.3 ± 1.3	43.9 ± 0.8	44.5 ± 0.7	44.0 ± 1.0
Back fat thickness (mm)	1.9 ± 0.3	1.2 ± 0.3	1.8 ± 0.2	1.7 ± 0.2	1.7 ± 0.2
Body wall thickness (mm)	21.9 ± 1.9	15.3 ± 1.4	20.2 ± 0.9	19.5 ± 1.2	19.4 ± 1.3
Hind leg circumference (cm)	51.8 ± 1.0	50.1 ± 1.1	51.8 ± 0.6	51.6 ± 0.6	51.3 ± 0.8

important and only significant effect of coats (from a fleece quality viewpoint) was the higher clean yield of coated fleeces. Further, the coated fleeces appeared much cleaner and whiter, this being very important from the point of view of potential customers, i.e., hand spinners. It was interesting to note that coats did not significantly affect rates of gain, the amount of waviness (fiber curvature) in individual fibers or any other measured property. It was an important observation that cleaner fleeces can be produced with coats without undermining any other production or fiber quality traits.

3.3. Effects of system and coats on carcass traits

Dressing percentages were not different among systems. This was a different result than reported previously for similar lamb feeding systems (Lupton et al., 2007). The lamb RF group consistently had lower dressing percentages presumably due to greater gut fill from less activity and the high roughage diet. Except for hind leg circumference, the other three carcass traits (warm carcass weight, back fat thickness, body wall thickness) followed the same trend, i.e. FL = RF > P (Table 7). None of the carcasses were excessively fat (or lean) and all were acceptable to the trade. Coats had no effect on carcass traits (Table 7).

3.4. Financial considerations

A budget scenario, Table 8, was used to compare the net income per head of the three production systems. Two distinct scenarios were considered for the RF system. In the first (or commercial) situation, the mohair was sold at prevailing commercial prices. In the second situation (niche), mohair from coated animals was sold to hand spinners for US$ 22.05/kg. The values in Table 8 include the actual costs of feed, labor, and the amortized cost of building feedlot pens and a raised-floor facility along with the cost of a grass lease on pasture. In the 2003 experiment, Angora goats were not slaughtered. Consequently carcass prices were estimated for the time period when animals were shorn (Livestock Weekly, 27 March 2003). The feed cost for the RF group was greater than for the other two treatments because it was a custom, pelleted ration that had to be transported 332 km to the research location in San Angelo. Pellets are considered to be essential in the RF system to minimize fleece contamination by feed dust. In this scenario, net income per head for FL, P, and RF (commercial) goats was US$ 21.03, 18.15, and −2.47, respectively. The loss in the RF (commercial) system was attributed mainly to the extra cost of feed and the relatively high annual payment for the raised-floor facility. Thus, when the mohair from the RF goats was sold in a traditional manner (as a commodity), it was not possible to show a profit.

In the RF (niche) system when mohair was sold into a niche market (i.e., to hand spinners) for US$ 22.05/kg (this price was actually achieved with most of the 2002 and 2003 RF coated mohair), a substantial net income was the result.

Prices paid for goat offal and pelts in our area in 2002 and 2003 were non-existent at that time, but since these products both have potential to generate income in the future, we included them in the table. The fleece testing would only be required for the RF group because hand spinners would be targeted to purchase this hair and this is the cost to measure AFD, which is of some interest to these buyers. The cost of mohair packaging for the RF (niche) system is also higher since these fleeces were offered in 1 kg individually packaged lots. Mohair marketing commission is a percentage that goes to the warehouse once the mohair is sold. In this scenario it was not applied to the RF (niche) mohair because the producer is expected to personally sell this mohair to the hand spinners. Coats would be worn by all the RF (niche) goats to ensure production of cleaner mohair. Medication cost takes into account deworming and overeating for the goats upon arrival and tetanus shots after castration. Cost of slaughter was the normal, local price in

Table 8
Budget scenario for feedlot, pasture, and raised-floor systems—actual and estimated values, 200 kids/system

	Feedlot	Pasture	Raised floor (commercial)	Raised floor (niche)
Assumptions				
Death loss (%)	3.0	3.0	3.0	1.0
Labor (h/day)	0.25	1	0.25	0.25
Mileage (km/day)	0.8	14.5	0.8	0.8
Lease property (US$/year)	0.00	2000.00	0.00	0.00
Carcass prices received (US$/kg)	4.14	5.20	4.21	4.21
Kid prices paid (US$/kg)	1.92	1.92	1.92	1.92
Income (US$/head)				
Meat[a]	70.69	69.38	75.45	75.45
Mohair[b]	25.13	21.54	22.18	77.00
Mohair LDP payment[c]	13.86	11.88	15.25	15.25
Offal[d]	0.00	0.00	0.00	0.00
Pelt[d]	0.00	0.00	0.00	0.00
Total income per head	109.68	102.80	112.88	167.70
Expenses (US$/head)				
Purchase cost[e]	45.00	45.00	45.00	45.00
Death loss[f]	1.35	1.35	1.35	1.35
Feed cost[g]	23.00	9.26	34.18	34.18
Lease property (annual)	0.00	10.00[h]	0.00	0.00
Shearing cost	1.85	1.85	1.85	1.85
Fleece testing	0.00	0.00	0.00	7.50[i]
Cost of packaging mohair	0.30	0.30	0.30	1.90[j]
Mohair marketing commission[k]	1.76	1.51	1.55	0.00
Coat cost[l]	1.00	1.00	1.00	2.00
Vet/medication costs	1.00	1.00	0.50	0.50
Slaughter cost	9.00	9.00	9.00	9.00
Labor[m]	0.95	3.81	0.95	0.95
Fuel cost[n]	0.03	0.57	0.03	0.03
Structure cost[o]	3.41	0.00	19.64	19.64
Total expenses per head	88.65	84.65	115.35	123.90
Net income per head[p]	21.03	18.15	(2.47)	43.80

[a] Actual carcass weight × average carcass price per kg.
[b] Actual fleece weight × actual price paid per kg.
[c] Actual federal loan deficiency payment received.
[d] Actual price received.
[e] Actual price paid.
[f] Purchase cost × % death loss.
[g] Actual total kg fed × actual cost of feed per kg/200.
[h] 162 ha × US$ 12.35 per ha/200.
[i] US$7.50 if fiber diameter measured in USA.
[j] 15 min labor × US$ 6.00 per h + US$ 0.10 per bag × 4 bags.
[k] 7% of mohair value when sold through commercial channels.
[l] US$ 6.00 per coat with a 3 years expected coat life.
[m] Labor h/day × days to slaughter × US$ 6.00/200.
[n] km traveled × days to slaughter × 6.3 km per l × US$ 0.40 per l/200.
[o] Annual payment/200. Initial cost of US$ 4479.80 for feedlot and US$ 28,539.94 for raised floor facility amortized over 10 years at 9% interest.
[p] Total income per head − total expenses per head.

2003. To avoid this cost in the commercial scenario, one could take a chance at the auction. Labor and fuel costs were calculated according to the length of time the goats were on feed (127 days).

The data in Table 8 illustrate the potential to produce significantly higher net income when the producer has the right product and is able and willing to market it himself.

4. Conclusions

The effects of three different production systems (feedlot, pasture, raised floor) and coats were determined for growth, mohair production and quality, and carcass traits of castrated Angora kids. Goats in the RF and FL systems gained faster than those in the P system. Grease and clean fleece weights, fiber diameter and curvature exhibited comparable trends. Importantly, from the perspective of successfully accessing niche markets, the coats produced cleaner, more attractive fleeces. When mohair from the RF system was sold in the traditional manner through the warehouse, net income was negative. In contrast, both the FL and P systems produced significant net income (US$ 21.03 and 18.15/head). When mohair from RF coated goats was sold into niche markets, net income from this innovative production system rose to US$ 43.80/head.

Most of the anticipated advantages of the RF system were realized, i.e. low labor requirements, clean healthy environment, no predation, no internal parasites, cleaner fleeces, more consistent products, including seed-free manure, and applicability to most U.S. environments. However, our manipulation of diet in the RF system did not result in the anticipated, leaner carcasses of comparable weight to those of the FL system. Conditions for profitably and concurrently producing high-value mohair and goat meat were identified.

Acknowledgements

Support for this research provided by the Texas Food and Fibers Commission and the USDA, CSREES (Agreement No. 00-34148-9006) is gratefully acknowledged.

References

ASTM, 2001. Designation: D6500. Standard test method for diameter of wool and other animal fibers using an optical fiber diameter analyzer. Annual Book of American Society for Testing and Materials Standards, sec. 7, vol. 07.02. ASTM, West Conshohocken, PA, pp. 1129–1140.

ASTM, 2004a. Designation: D584. Standard test method for wool content of raw wool—laboratory scale. Annual Book of American Society for Testing and Materials Standards, sec. 7, vol. 07.01. ASTM, West Conshohocken, PA, pp. 174–179.

ASTM, 2004b. Designation: D1234. Standard test method of sampling and testing staple length of grease wool. Annual Book of American Society for Testing and Materials Standards, sec. 7, vol. 07.01. ASTM, West Conshohocken, PA, pp. 269–272.

ASTM, 2004c. Designation: D1776. Standard practice for conditioning and testing textiles. Annual Book of American Society for Testing and Materials Standards, sec. 7, vol. 07.01. ASTM, West Conshohocken, PA, pp. 419–422.

Baxter, B.P., Brims, M.A., Taylor, T.B., 1992. Description and performance of the optical fibre diameter analyser (OFDA). J. Text. Inst. 83, 507–526.

IWTO, 1998. International Wool Textile Organisation Specification IWTO-57-98. Determination of Medullated Fiber Content of Wool and Mohair Samples by Opacity Measurements Using an OFDA. The Woolmark Company, Ilkley, United Kingdom, 15 pp.

Johnson, C.L., Larsen, S.A., 1978. Clean wool determination of individual fleeces. J. Anim. Sci. 47 (1), 41–45.

Lupton, C.J., Pfeiffer, F.A., Blakeman, N.E., 1991. Medullation in mohair. Small Rumin. Res. 5, 357–365.

Lupton, C.J., Huston, J.E., Rhee, K.S., Craddock, B.F., Polk, W.K., Pfeiffer, F.A., 2001. New technology for producing, evaluating, and marketing exceptionally high quality wool, mohair, and cashmere. Texas Agric. Exp. Stat. Ann. Prog. Rep. Texas Food Fibers Commun., 33–52.

Lupton, C.J., Thompson, P.V., Pfeiffer, F.A., 2000. Relationship of face cover with productivity of Angora does on rangeland. Sheep Goat Res. J. 16 (3), 136–139.

Lupton, C.J., Waldron, D.F., Pfeiffer, F.A., 2003. Interrelationships of traits measured on fine-wool rams during a central performance test. Sheep Goat Res. J. 18, 1–7.

Lupton, C.J., Huston, J.E., Craddock, B.F., Pfeiffer, F.A., Polk, W.L., 2007. Comparison of three systems for concurrent production of lamb meat and wool. Small Rumin. Res. 72, 133–140.

National Research Council, 1996. Nutrient Requirements of Beef Cattle, 7th ed. NRC Press, Washington, DC, USA.

Scarlett, E.C., 1993. Production of Sharlea Wool. Agfact A3.2.7. New South Wales Agriculture, Wagga Wagga, 4 pp.

Texas Cooperative Extension, 2004. Texas Livestock Enterprise Budgets. B-1241 (L7).

Waldron, D.F., Lupton, C.J., 2005. Angora goat performance test report. Texas Agric. Exp. Sta. Res. Cen. Tech. Rep. 2005-3.