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Growth Performance of Barbados Blackbelly, Katahdin and St. Croix Hair Sheep Lambs Fed Pasture- or Hay-based Diets[1]

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Summary

Two experiments evaluated growth of mixed-sex Barbados Blackbelly, Katahdin, and St. Croix hair sheep lambs raised on pasture or hay-based diets with moderate levels of energy supplementation. In Experiment 1, 36 ewe and wether lambs were allocated to a pasture or pen feeding group in May. Pasture animals rotationally grazed tall fescue pasture, while pen animals were offered chopped alfalfa hay, and both groups were supplemented with corn/soybean meal at 0.75% of body weight. In Experiment 2, 72 lambs were allocated to pen and pasture in April, and provided either a low or high crude protein concentration corn/soybean meal supplement at 1.5% of body weight. Pasture animals were continuously grazed, while pen animals were offered chopped mixed grass hay. In both experiments, starting and final body weights were higher ($P < 0.05$) in Katahdin than St. Croix and Barbados Blackbelly. In Experiment 1, daily gain was similar between Katahdin (84 g/d) and St. Croix (75 g/d), and higher ($P < 0.01$) than in Barbados Blackbelly (56 g/d). Daily gain was higher ($P < 0.05$) for lambs in pens (77 g/d) than for lambs on pasture (67 g/d). In Experiment 2, growth rates were higher than in Experiment 1, and Katahdin (109 g/d) grew faster ($P < 0.05$) than St. Croix (86 g/d) and Barbados Blackbelly (73 g/d). Growth was not affected ($P > 0.10$) by forage or supplement type, but wether lambs grew faster ($P < 0.05$) than ewe lambs. The growth rates in both trials were moderate and produced lambs of medium size, suitable primarily for the Muslim and Hispanic ethnic markets.

Key words: Hair Sheep, Growth, Forage, Supplementation.

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Introduction

Hair sheep are smaller in size and have slower growth rates than most wool breeds in the United State. However, they perform well under low-input, sustainable production systems, and are able to utilize low- to moderate-quality forages. Hair sheep resources in the United States and their performance have been reviewed by Wildeus (1997). Under feedlot conditions using high-concentrate finishing diets, hair sheep had 35 percent to 40 percent slower growth rates than wool breeds in Ohio (Ockerman et al., 1982; McClure et al., 1991), 27 percent to 42 percent slower growth rates in Utah (Foote, 1983; Bunch et al., 2004), and 20 percent slower growth rates in Oklahoma (Philips et al., 1995). In contrast, Mann et al. (1987) reported that growth rates of hair sheep lambs (Barbados Blackbelly) exceeded those of wool lambs (Dorset) fed moderate-quality forage diets (Coastal bermudagrass pellets) in North Carolina.

With an expansion of ethnic lamb markets that accept smaller and leaner carcasses, there is a need to evaluate the ability of hair sheep to produce lamb for these niche and specialty markets on forage-based rations with limited grain supplementation. The experiments described here were designed to evaluate the growth performance of Barbados Blackbelly, Katahdin, and St. Croix hair sheep lambs fed forage-based rations of either pasture or hay with limited supplementation and management input.

Materials and Methods

The experiments were conducted at the Small Ruminant Program Facilities of Virginia State University, followed accepted guidelines for the care and use of animals in agricultural research and teaching (FASS, 1999), and were approved by the Institutional Animal Care and Use Committee. Katahdin and St. Croix flocks at this facility were established in 1997 and 1999, respectively, from a diverse, genetic cross-section of each breed representing a minimum of five breeders and are maintained as purebred populations with several sire lines. Polled Barbados Blackbelly sheep have a very narrow genetic base in the United States. Animals in our facility were received in 1998 from a single source and were crossed with polled rams from another unrelated flock to increase genetic diversity. All three flocks are considered representative of these breeds in the eastern United States.

Both experiments used December-born Barbados Blackbelly, Katahdin, and St. Croix lambs, produced in separate years in an 8-month, accelerated-mating system, using two single-sire mating groups per breed in each year. Different sires were used in the two years. Lambs were weaned at 63±3 days of age, maintained as one group, and ram lambs were castrated prior to use in the experiments. In Experiment 1, ewe and wether lambs (n=36) were allocated to a pasture or pen feeding group in May, stratified by breed and sex. Pasture animals were maintained on native, predominantly tall fescue (*Festuca arundinacea* Schreb.) pasture (1.5 ha; see Table 1 for nutritional quality), subdivided into three units for rotational stocking. Forage biomass availability exceeded consumption by lambs throughout the grazing season. Pen animals were allocated to six partially covered pens (26 m^2 floor space) stratified by breed and separated by sex, and offered *ad libitum* chopped alfalfa (*Medicago sativa* L.) hay (Table 1). Both groups were supplemented with a corn/soybean meal mixture (calculated composition: 15.7 percent CP and 74.7 percent TDN) at 0.75 percent of body weight. Supplement also contained 2 percent limestone and 1 percent ammonium chloride. Supplementation level was selected to improve growth rate, with forage remaining the major component of the diet.

In the second year (Experiment 2), 72 mixed-sex lambs of the same three breeds were allocated to pen and pasture groups in April, stratified by breed and sex. In Experiment 2 animals were supplemented at a higher level (1.5 percent BW) to allow breeds to more readily express their growth potential. Isocaloric supplements with either a low protein (16.8 percent CP) or high protein content (24.3 percent CP) were fed to determine the effect protein intake on parasite resilience and forage utilization. Supplement feeds were prepared from an appropriate corn/soybean meal mixture, and contained 2 percent limestone and 1 percent ammonium chloride. Pasture animals were allocated to the same pasture area as in Experiment 1, divided into two 0.8 ha units to facilitate feeding of the two supplements. Despite higher stocking rates than Experiment 1, forage biomass availability exceeded consumption by lambs throughout the grazing season. Pen animals were allocated to six partially covered pens (44 m^2 floor space), balanced by breed and sex (3 pens per supplement type), and were offered *ad libitum* chopped mixed grass hay (Table 1).

Animals remained on trial for 168 days in Experiment 1 and 180 days in Experiment 2. In both experiments body weights were recorded at 14-day intervals and supplement levels adjusted at this time. In both experiments lambs had access to trace mineralized salt blocks. Lambs were dewormed (moxidectin, oral, 0.5 mg/kg BW) once at the beginning of each experiment with no further dewormings. Packed blood cell volume (PCV) was determined in all lambs at 14-day intervals to monitor for clinical signs of gastrointestinal parasitism, but PCV never decreased below a pre-determined threshold (17 percent) to be used for strategic deworming of individual animals.

Pasture samples were collected (4 sites) at 28-day intervals throughout the grazing season, and hay samples were collected at the beginning, middle and end of the experiment to determine forage quality. Samples were dried at 60°C

Table 1. Nutritional quality of pasture and hay fed in Experiments 1 and 2

% (DM basis)	Pasture[1]	Alfalfa hay (Exp. 1)	Grass hay (Exp. 2)
CP	12-17	16.6	15.1
NDF	66-69	60.3	67.6
ADF	36-38	45.2	36.7
IVOMD	34-60	57.6	54.2

[1] range throughout the grazing season

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in a forced-air oven for 48 h, and ground to pass a 1-mm screen in a Wiley mill. Ground samples were analyzed for DM and ash (AOAC, 1990); total N (Carlo-Erba Ea 1108 CHNS elemental analyzer, Fisons Instruments, Beverly, MA); neutral detergent fiber (NDF) and acid detergent fiber (ADF) (Goering and Van Soest, 1970; Van Soest et al., 1991) using ANKOM (Ankom Technology Corp., Fairport, NY) procedures, and *in vitro* organic matter disappearance (IVOMD) (Tilley and Terry, 1963; Moore, 1970).

Initial and final body weight and daily gain were analyzed with a statistical model that included breed, forage base, sex and their interactions as main effects in Experiment 1; and breed, forage base, supplement type, sex and their interaction as main effects in Experiment 2 using the GLM procedure of SAS (1996). Pen was excluded from the final model as a non-significant effect after preliminary analysis. Contrasts between breeds were evaluated using the PDIFF option in the presence of a significant F value.

Results and Discussion

Starting body weight of lambs in both experiments were higher ($P < 0.01$) in Katahdin than Barbados Blackbelly and St. Croix, and reflected the difference in mature body weight of these breeds. At our location body weight of Barbados Blackbelly, Katahdin and St. Croix ewes range from 38 kg to 40 kg, 58 kg to 60 kg and 45kg to 50 kg, respectively. In Experiment 1, there was no difference ($P < 0.1$) in starting body weight between St. Croix and Barbados Blackbelly, but daily gain was higher ($P < 0.05$) in St. Croix than Barbados Blackbelly and actually similar to Katahdin. As a result, final body weight was different ($P < 0.05$) for all three breeds. Pen-fed lambs receiving alfalfa hay grew faster ($P < 0.05$) than lambs grazing pasture (Figure 1). There was no effect of sex of lamb on daily gain (Table 2), nor were there significant interactions between breed and forage base.

In Experiment 2, lambs were one month younger at the beginning of the experiment and had lower starting weights than in Experiment 1, but starting weights differed ($P < 0.05$) among all three breeds (Table 3). Daily gain was higher in Experiment 2 than Experiment 1, and higher ($P < 0.001$) in Katahdin than in St. Croix, which were higher ($P < 0.05$) than Barbados Blackbelly (Figure 2). No difference was observed in daily gain between pen and pasture-raised lambs, or between lambs receiving the high or low protein supplement (Table 3), but wether lambs grew faster ($P < 0.01$) than ewe lambs. Again, no significant interactions between breed, forage base, supplement type and sex were observed in Experiment 2.

Differences in growth rates between the two experiments were likely the result of the increased level of supplement feeding in Experiment 2, and possibly some faster growth in the younger, lighter animals. The higher level of supplement feeding also allowed Katahdin

Figure 1. Body weight change (LSM) in Barbados Blackbelly (BB), Katahdin (KA), and St. Croix (STX) lambs fed alfalfa hay (pen) or pasture (past) with corn/soybean meal supplement at 0.75% BW

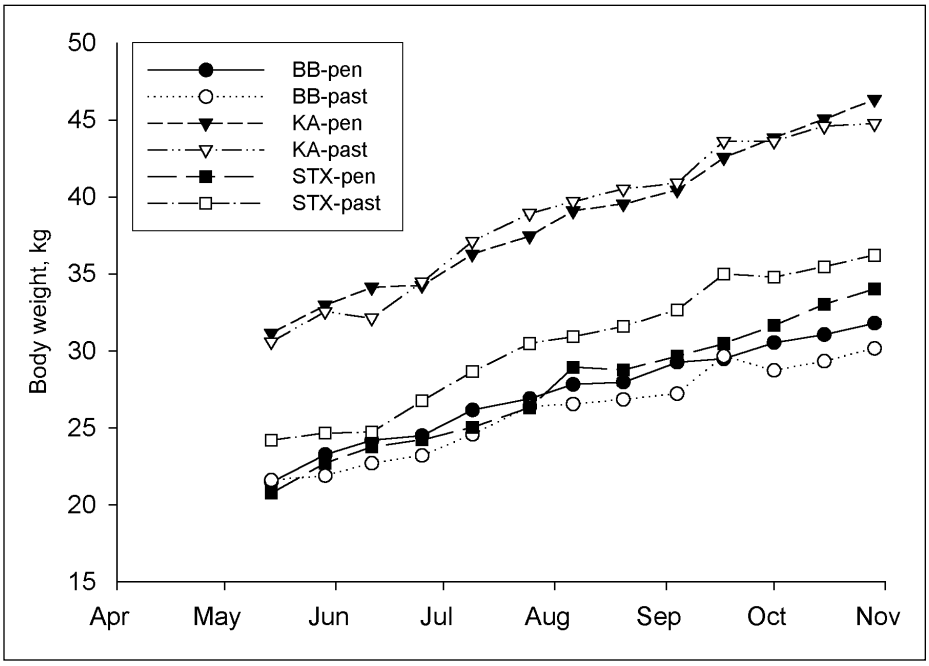
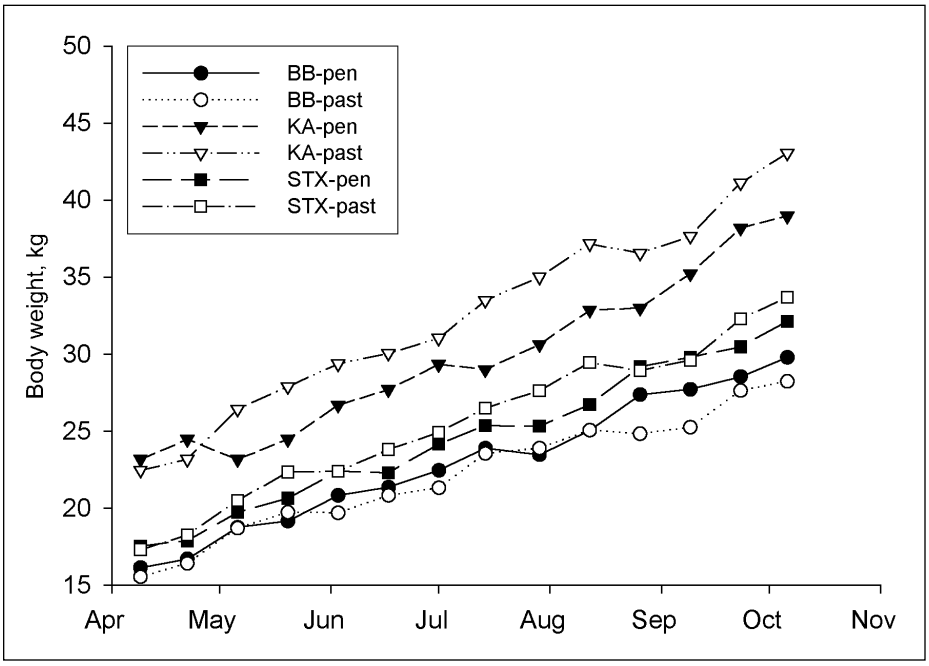


Table 2. Effect of breed, forage base and sex on body weight and daily gain (LSM) in hair sheep lambs fed pasture and hay-based diets, supplemented with corn/soybean meal at 0.75% BW (Experiment 1)

	Starting weight, kg	Final weight, kg	Daily gain, g/d
Breed			
Blackbelly	21.5[a]	31.0[a]	56[a]
Katahdin	31.4[b]	45.5[c]	84[b]
St. Croix	22.5[a]	35.1[b]	75[b]
SE	1.10	1.43	4.0
Forage base			
Pasture	25.8	37.0	67[a]
Alfalfa hay	24.4	37.4	77[b]
SE	0.89	1.17	3.3
Sex			
Ewe	24.7	36.9	72
Wether	25.5	37.5	71
SE	0.90	1.17	3.3

[a,b,c] values in same column with unlike superscripts within same category differ ($P<0.05$)

Figure 2. Body weight change (LSM) in Barbados Blackbelly (BB), Katahdin (KA), and St. Croix (STX) lambs fed grass hay (pen) or pasture (past) with corn/soybean meal supplement at 1.5% BW



lambs to express their increased growth potential compared to St. Croix and Barbados Blackbelly. The same reasoning may account for the higher daily gain of wether compared to ewe lambs in Experiment 1 compared to Experiment 2. In Experiment 2 the higher level of supplement feeding may have masked differences in daily gain in lambs on pasture and hay-based diets.

Lambs in both experiments had lower growth rates than hair sheep lambs fed finishing diets in several other studies. St. Croix lambs fed concentrate diets achieved growth rates of 259 g/d (Foote, 1983), 210 g/d (Bunch et al., 2004), 200 g/d (McClure et al., 1991), and 187 g/d (Philips et al., 1995). Under more stressful, tropical production conditions in the Caribbean, St. Croix lambs fed a complete pelleted ration of 19 percent crude protein at 4 percent of body weight and *ad libitum* coastal bermuda grass hay had an average daily gain 144 g/d (Godfrey and Collins, 1999). These studies suggest that the hair sheep lambs in the present experiment fed a forage-based diet grew below their production potential.

Few studies have directly compared the growth performance of the breed types evaluated here. Horton and Burgher (1992) fed small groups of Barbados Blackbelly, Katahdin and St. Croix lambs (3 to 4 lambs/breed) a commercial pelleted growing ration (16 percent crude protein) and achieved average daily gains of 138, 267 and 203 g/d, respectively. Although the actual growth rates were higher in their study, the relative growth performance of the three was similar to that observed here. In a study using Katahdin and St. Croix among other breeds, Burke et al. (2003) reported an average post weaning daily gain of 181 and 205 g/d in Katahdin and St. Croix lambs, respectively, fed a finishing diet formulated for moderate growth in Arkansas. This ranking in growth performance of the two breeds is in contrast to the results here, and may have been caused by the stress in the Katahdin lambs in Arkansas due to relocation just prior to the experiment. Ockerman et al. (1982) observed a faster daily gain in St. Croix (222 g/d) than Barbados Blackbelly lambs (172 g/d) when fed a high concentrate diet, in agreement with breed differences observed here.

The growth rates of the lambs in both experiments were higher than those reported in Barbados Blackbelly and Barbados Blackbelly x Dorset lambs fed Coastal bermudagrass pellets (50 g/d; Mann et al. 1987), likely as a result of the higher quality forage (both pasture and alfalfa and grass hay) and moderate levels of supplementation employed in the present experiments. Hair sheep lambs fed tropical forages had growth rates that ranged from 34 g/d in St.

Table 3. Effect of breed, forage base, supplement type, and sex on body weight and daily gain in hair sheep lambs fed pasture and hay-based diets, supplemented at 1.5% BW (Experiment 2)

	Starting weight, kg	Final weight, kg	Daily gain, g/d
Breed			
Blackbelly	15.8[a]	29.0[a]	73[a]
Katahdin	22.8[c]	42.5[c]	109[c]
St. Croix	17.4[b]	32.9[b]	86[b]
SE[1]	0.54	0.79	3.7
Forage base			
Pasture	18.4	34.9	92
Grass hay	18.9	34.6	87
SE	0.44	0.64	3.0
Supplement			
Low protein	18.6	34.0	86
High protein	18.8	35.5	93
SE	0.44	0.64	3.0
Sex			
Ewe	18.2	33.2[a]	83[a]
Wether	19.2	36.4[b]	95[b]
SE	0.44	0.64	3.0

[a,b,c] values in same column with unlike superscripts within same category differ ($P<0.05$)
[1] pooled standard error of means

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Croix lambs fed guineagrass (Hammond and Wildeus, 1993) and Blackhead Persian lambs fed rhodesgrass (Sarwatt, 1990) to 44 g/d in Somali lambs fed napiergrass (Barros et al. 1990). Performance of lambs in these trials generally improved with protein, but not energy supplementation. In contrast, no difference in growth rate was observed in lambs fed either the high or low protein supplement in Experiment 2, which could be attributed to the higher crude protein concentration in both pasture and grass hay in the present experiments, compared to those of tropical grasses. Experiment results further suggest that protein was not a limiting factor, either as a component of forage utilization or the ability of lambs to cope with gastrointestinal parasitism.

Conclusion

Growth rates generally reflected the mature size of the three breeds, however, there was no difference in growth between Katahdin and St. Croix lambs when a lower level of concentrate supplement was supplied. This suggests that Katahdin were not able to express their improved growth potential on a high-forage diet. Overall, growth rates in both experiments were moderate and considerably lower than has been achieved for these breeds when fed high concentrate diets. The final weight of lambs at the end of the grazing season made them suitable primarily for the Muslim and Hispanic ethnic market, rather than the traditional lamb market.

Literature Cited

AAOC, 1990. Official methods of analysis. 15th ed. Association of Official Analytical Chemists, Arlington, VA.

Barros, N. N., J. Kawas, W. L. Johnson and J. M. Shelton. 1990. Energy utilization by Somali lambs fed napier grass 'ad libitum' and energy supplement in incremental levels. Pesq. Agropec. Bras. 25: 1283-1291.

Bunch, T. D., R. C. Evans, S. Wang, C. P. Brennand, D. R. Whittier and B.J. Taylor. 2004. Feed efficiency, growth rates, carcass evaluation, cholesterol level and sensory evaluation of lambs of various hair and wool sheep and their crosses. Small Rumin. Res. 52: 239-245.

Burke, J. M., J. K Apple, W. J. Roberts, C. B. Boger and E.B. Kegley. 2003. Effect of breed-type on performance and carcass traits of intensively managed hair sheep. Meat Sci. 63: 309-315.

FASS. 1999. Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching. 1st rev. ed. Fed. Anim. Sci. Soc., Savoy, IL.

Foote, W. C. 1983. The St. Croix sheep in the United States. In: Fitzhugh, H. A. and G. E. Bradford (Eds), Hair Sheep of Western Africa and the Americas: A Genetic Resource for the Tropics. Westview Press, Boulder, Colorado. pp. 275-287.

Goering, J. K., and P. J. Van Soest. 1970. Forage fiber analysis (apparatus, reagents, procedures, and some applications). Agriculture Handbook 370, USDA-ARS, Washington, DC, 20 pp.

Godfrey, R. W. and J. R. Collins. 1999. Post-weaning growth and carcass traits of hair and wool x hair lambs in the U.S. Virgin Islands. Sheep & Goat Res. J. 15: 100-105.

Hammond, A. C. and S. Wildeus. 1993. Effect of coconut meal or fish meal supplementation on performance, carcass characteristics and diet digestibility in growing St. Croix lambs fed a tropical grass-based diet. Small Rumin. Res. 12: 13-25.

Horton, G. M. J. and C. C. Burgher. 1992. Physiological and carcass characteristics of hair sheep and wool breeds of sheep. Small Rumin. Res. 7: 51-60.

Mann, D. L., L. Goode and K. R. Pond. 1987. Voluntary intake, gain, digestibility, rate of passage, and gastrointestinal tract fill in tropical and temperate breeds of sheep. J. Anim. Sci. 64: 880-886.

McClure, K. E., C. F. Parker and N. A. Parrett. 1991. Feedlot performance and carcass characteristics of hair, wool and hair crossbred lambs fed high energy diets. In: Wildeus S. (Ed.), Proc. Hair Sheep Research. Symposium., University Virgin Islands, St. Croix. pp. 252-256

Moore, J. E. 1970. Procedure for the two-stage in vitro digestion of forages. In: Harris, L. E. (Ed.), Nutrition Research Techniques for Domestic and Wild Animals, vol. I. Utah State University, Logan, pp. 5001.1-5001.3.

Ockerman, H. W., H. Emsen, C. F. Parker and C. J. Pierson. 1982. Influence of type (wooled or hair) and breed on growth and carcass characteristics and sensory properties of lambs. J. Food Sci. 47: 1365-1371.

Phillips, W.A., D. L. Von Tungeln and M. A. Brown. 1995. Feedlot performance of spring born Polypay, Romanov, St. Croix, and Texel crossed lambs finished during the summer. J. Anim. Sci. 73) (Suppl. 1) 252 (Abstr.).

Sarwatt, S. V. 1990. Feed intake, growth rate and digestibility coefficients of growing sheep fed hay supplemented with *Crotalaira ochroleuca*. Anim. Feed Sci. Technol. 28: 51-59.

SAS Institute Inc., 1996. SAS User's Guide: Statistics, 6th ed. SAS, Cary, NC, p. 956.

Tilley, J. M. A. and R. A. Terry. 1963. A two-stage technique for the in vitro digestion of forage crops. J. Br. Grassl. Soc. 18: 34-43.

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

Wildeus, S., 1997. Hair sheep genetic resources and their contribution to diversified small ruminant production in the United States. J. Anim. Sci. 75: 630-640.