Quality parameters of skin from Menz, Awassi X Menz and Washera sheep breeds for leather production

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Abstract

This study aimed at assessing the influence of crossbreeding on physical characteristics of leather considering that important leather characteristics can be affected when exotic breeds are introduced to improve meat production in native breeds. Sheep skin (n = 72) from three different genotype and three feeding levels were evaluated for their grade at pickling stage and physical characteristics of crust leather. Sheep genotypes were Menz and Washera, and half-bred Awassi x Menz sheep. The feed levels were grazing; grazing + 400 g day^{-1} concentrate feed supplement and grazing + 600 g day^{-1} concentrate supplement. At raw stage all skin was graded between 1 and 3 (best to medium) however at pickling stage no skin was graded between 1 and 3 rather graded as poor quality (5A and above). Tensile strength and single edge tear force was affected by sheep genotype. Awassi x Menz crossbred sheep had similar ($p>0.05$) tensile strength with the indigenous Menz sheep, whereas lower ($p<0.05$) than Washera sheep breed. Menz sheep had similar ($p>0.05$) tensile strength with Washera sheep. Both sheep genotype and feeding level had no effect ($p>0.05$) on elongation at break. Menz sheep had similar ($p>0.05$) single edge tear force with its Awassi crosses and other indigenous Washera sheep. In contrary to the tensile strength, Awassi x Menz crossbred sheep had higher ($p<0.05$) single edge tear force than Washera sheep breed. Single edge tear force and skin thickness were increased as feed level increased. Tear resistance was not affected ($p<0.05$) by genotype and feeding. This study confirmed that there is no evidence of supporting the suspected inferiority of skins from crossbred sheep. All the three sheep breeds studied produced leathers with physical characteristics compatible with the quality standards required by the leather industry. Thus, introduction of Awassi sheep and its inheritance to 50% could not result in a significant decrease in leather quality. Further investigation should be done for the exotic inheritance of above 50% in order to quantify if there is a loss of quality at that higher Awassi blood levels.

Key words: Genotype, feeding, leather, skin.

Introduction

Because of abundant and renewable resource base in Ethiopia due to large livestock population, the leather industry is an important strategic sector for the economic and industrial development. Abundant livestock resource, less production cost and increasing demand for leather and leather goods show that the leather processing will continue to be a major industry for Ethiopia (Mahmud, 2000; Mammo, 2000). Small ruminant improvement program in Ethiopia has primarily based on meat production. However, semi-processed skins and hides in the form of pickled, wet-blue and finished leather and leather products constitute the most important export products of the livestock sub-sector. Indigenous sheep breeds particularly those from the Ethiopian highlands are reputed to have one of the best quality skins for leather products having fine natural qualities of clarity, thickness, flexibility, strength, and compact texture (Mahmud, 2000). Skins of tropical sheep are generally thicker than those obtained from the layered structure of skins of finer-wool breeds like Merino which gives them a poor reputation. It is hypothesized that importing exotic genotype for meat and milk production in native breeds might also negatively affect important leather characteristics. Skins from Awassi x Menz crossbred sheep are either sold at lower prices or are rejected completely. There is, however, no scientific proof for or against the alleged inferiority of skins from Awassi x Menz crossbred sheep. Thus, it is indispensable to investigate the quality of the skins of indigenous and crossbred sheep breeds to ensure their true value and incorporate in evaluating and designing crossbreeding programs.

Materials and methods

Animal management

Sheep skin (n = 72) from three different genotype and three feeding levels were evaluated. Sheep breeds were indigenous Menz and Washera, and half-bred Awassi x Menz sheep. The feed levels were grazing; grazing +400g day^{-1} concentrate feed supplement and grazing +600 g day^{-1} concentrate supplement. Indigenous Menz and Washera sheep breed were purchased from local markets in Menz and Gojjam areas, respectively.

Awassi X Menz crossbred sheep were purchased from Amed Guya Sheep Breeding and Multiplication Center. Feeding was started in July 2009 and was conducted for 90 days. At the beginning of feeding, Menz and Awassix Menz crossbred sheep were at about 15 months old while Washera sheep was at about 9 months old. Before the beginning of the feeding, all sheep were treated against internal and external parasites. Then from each breed, sheep were allocated randomly into three feeding levels after stratifying by their live weight. All animals were managed similarly during the day and sheep in supplemented group received their corresponding amount of supplement feed after grazing. Supplement feed was provided for each animal individually using individual feeding trough for 90 days. Initial weight, slaughter weight and average daily gain of sheep are presented in Table 1.

After the 90 days feeding trial, all sheep were slaughtered at Debre Berhan Agricultural Research Center and the skins were flayed by local slaughter men. All skins were washed with cold water and salted on the flesh side of a skin. On the next day, part of the skin (n = 25) 3 skins from each treatment were selected randomly and submitted to Mojo tannery and the remaining skins (n = 45) 5 skins from each treatment were submitted to Ethiopian Leather and Leather Products Technology Institute (ELPTI) for skin grading and physical characteristics test, respectively.

Table 1. Initial, slaughter weight and average daily gain of sheep by genotype and feed level.

Genotype/feed level	N	Initial weight (kg)	Slaughter weight (kg)	Average daily gain (g)
Awassi X Menz				
Low	8	26.84	32.91	76.74
Medium	8	27.13	39.63	130.21
High	8	27.19	41.69	144.10
Menz				
Low	8	19.71	22.84	41.67
Medium	8	20.19	28.0	67.59
High	8	21.25	28.53	75.00
Washera				
Low	8	19.63	23.50	56.25
Medium	7	20.75	29.75	87.04
High	7	20.83	31.33	90.74

N = number of animals.

Skin grading and physical test

Skin size, presence of defects on skins and quality grading were done at Mojo tannery. Size of the skin classified as medium, large and extra large based on subjective assessment. Skin quality was graded in 1 to 5 scales where 1 is the best and 5 are the poorest considering sheep ked infestation and size. At ELPTI skin processing was performed according to the following main steps: soaking, liming, washing, fleshing, trimming, deliming, pickling, tanning, blastification, sammying, neutralization, re-tanning, drying and smoothing. After tanning the leather were conditioned based on ISO 2419:2005 and sampling for test was done based on the procedure of ISO 2418:2005. Environmental test condition was at temperature of 20$\pm$2 ^{0}C and relative humidity of 65$\pm$5%. Samples were taken parallel to the back bone and perpendicular to the back bone.

Physical test gives an indication of the strength as well as the amount of the leather could be stretched before the upper grain layers crack, which will cause damage to the surface of leather. The following physical tests were implemented ELPTI.

Tensile strength: Tensile strength is defined as the force required for the breaking of a dumbbell-shaped leather sample on the Instron machine. The sample is held firmly in two clamps. These two clamps move apart at a steady speed of ± 100 mm min^{-1}. As they move apart, the force required to stretch the leather is measured automatically. At some point, the leather sample breaks. The force required to break the sample is called the tensile strength of the leather and is measured in Newtons. For each test, samples cut along as well as across the length of the skin were used. Tensile strength was measured based on ISO 3376:2000 procedure.

$$Tensile\ strength\ (N/mm^2) = \frac{Measured\ breaking\ load\ (N)}{(Thickness\ (mm) X\ Width\ (mm))}$$

Elongation at break: This is measured during the tensile strength test described above. At the point of breaking, the leather has also been stretched. The percentage stretch is called the elongation at break. It is defined as the percentage stretch of the dumbbell shaped leather sample before it broke.

$$Elongation\ at\ break\ (\%) = \left(\frac{Length\ at\ break\ (mm) - \ Initial\ length\ (mm)}{Initial\ length\ (mm))}\right) X\ 100$$

Tear resistance: The test for slit tear strength involved a rectangular leather sample with a small slit cut in it. The sample was then pulled apart by a clamp attached to its base and another clamp inserted through the slit. The point at which the slit starts to tear was defined as the slit tear strength. The slit tear strength was expressed in relation to average leather thickness.

$$Tear\ resistance\ (N/mm) = \left(\frac{Force\ at\ tear\ (N)}{Skin\ thickness\ (mm)}\right)$$

Single edge tear force (N): This is the highest load reached at tear. Measured using ISO 3377-2:2002 procedure.

Data analysis

Descriptive statistics were implemented using SPSS to summarize the proportion of skin defect, size and grade by genotype. Fisher's exact test was used to test the association of skin defect, size and grade with genotype. Data on tensile strength, percent elongation, single edge tear, skin thickness and tear resistance was analyzed using GLM procedure in SAS by fitting breed and feeding level as class variable. The interaction of the two was not significant so that excluded from the model. When significant, means were separated using Tukey Kramer test.

Results and discussion

Sheep skin defect due to sheep ked by genotype before and after pickling are presented in Table 2. There was significant (P<0.05) association between sheep ked infestation and genotype before pickling. Less proportion of sheep ked infestation was observed for Awasi X Menz crossbred sheep. p. H b after pickling. This is due to the fact that ked infestation becomes more evident at pickling stage.

Table 2. Number of skin and percentage in bracket for sheep ked infestation before and after pickling by genotype.

	Before pickling		Fisher's exact test	After pickling		Fisher's exact test
Genotype	Sheep ked	No ked	p value	Sheep ked	No ked	p value
Awassi x Menz	2(22.2)	7(27.8)	0.013	8(88.9)	1(11.1)	1.00
Menz	8(88.9)	1(11.1)		8(88.9)	1(11.1)	
Washera	6(75.0)	28(25.0)		8(100)	0(0.00)	
Overall	16(61.5)	10(38.5)		24(92.31)	2(7.69)	

Sheep skin size of Awassi xMenz crossbred and Menz sheep are presented in Table 3. There was association ($p<0.05$) between size and genotype. Large size skin was obtained from crossbred sheep. Washera sheep skin was not considered in this analysis as the age of Washera sheep at slaughter was 6 months less than the other two breeds.

Table 3. Number of skin and percentage in bracket for skin size by genotype.

	Size		Fisher's exact test
Genotype	Large	Extra large	p value
Awassi x Menz	0(0.00)	9 (100)	0.02
Menz	5(55.6)	4(44.4)	
Overall	5(27.8)	13(77.2)	

The results of skin grade at pickled stage are presented in Table 4. Out of the total (n = 25) skins most of the skins (87.5%) were graded as poor quality (5A and above), and 37.5% were rejected due to poor quality. There was no association between genotype and grade ($p>0.05$). At raw stage all skin was graded between 1 and 3 (best to medium) however at pickling stage no skin was graded between 1 and 3. Sheep ked was noted as the major reason for the downgrading of the skin. This was also reported by Tefere and Abebe (2007) that they found hides and skin problems caused by lice, keds, ticks and mange mites are among the major pre-slaughter defects that cause downgrading and rejection. The price of skin in international market is highly influenced by size and grading quality of semi-processed skin (Tefera and Abebe, 2007). As the proportion of ked increased the grade of sheep and goat skin decreased (Tefera and Abebe, 2007). Thus, controlling or treating external parasite in farmers' sheep flock should be given highest attention.

Table 4. Number of skin and percentage in bracket for skin grade by genotype.

Genotype	Grade				Fisher's exact test p value
	4	5A	5B	R	
Awassi x Menz	1(11.1)	6(66.7)	0(0.00)	2(22.2)	0.287
Menz	1(11.1)	4(44.4)	0(0.00)	4(44.4)	
Washera	2(28.57)	4(57.14)	1(14.29)	0(0.00)	
Overall	4(25.0)	14(87.5)	1(6.25)	6(37.5)	

Tensile strength, percent elongation, single edge tear and tear resistance by genotype and feed level are presented in Table 5. Tensile strength was affected by sampling direction. Better result was obtained for parallel direction. This is in agreement with (Snyman and Jackson-Moss, 2000; Oliveira *et al.,* 2007). Tensile strength obtained in this study ranged from 16.11 to 18.84 N/mm^2 was in agreement with 10 South African sheep breeds ranged from 11.86 to 22.56 N/mm^2 (Snyman and Jackson-Moss, 2000), higher than 12.8 N/mm^2 reported for sheep breed in Germany (Rehbein *et al.,* 2000) and lower than 20 to 29.42 N/mm^2 reported for the Brazilian sheep breeds (Oliveira *et al.,* 2007). Tensile strength was influenced ($p<0.05$) by genotype of the sheep. Awassi X Menz crossbred sheep had similar ($p>0.05$) tensile strength with the indigenous Menz sheep where as lower ($p<0.05$) than Washera sheep breed. Menz sheep had similar ($p>0.05$) tensile strength with Washera sheep. Tensile strength was not affected ($p>0.05$) by feeding.

Elongation at break was also affected by sampling direction. The vertical direction gave the best result and this was also in agreement with (Oliveira *et al.,* 2007; Snyman and Jackson-Moss, 2000). Both sheep genotype and feeding level had no effect ($p>0.05$) on elongation at break. The value of elongation at break 65.88 % obtained in this study was found to be in the acceptable range of 40 to 80 % by the standard of the Brazil leather industry (Oliveira *et al.,* 2007).

Single edge tear force was affected ($p<0.05$) by genotype and feeding level. Menz sheep had similar ($p>0.05$) single edge tear force with its Awassi crosses and other indigenous Washera sheep. In contrary to tensile strength, Awassi X Menz crossbred sheep breed had higher ($p<0.05$) single edge tear force than Washera sheep breed. Single edge tear force was increased as feed level increased. Sheep in high feeding level had higher single edge tear force than sheep in low feeding level (grazing only). Sheep in medium feeding level had similar single edge tear force with sheep in low and high feeding level. Skin thickness was increased as feed level increased. Tear resistance was not affected ($p<0.05$) by genotype and feeding.

Tear resistance of 15.01 to 15.99 N/mm obtained in this study was lower than Brazilian and South African sheep breeds (Snyman and Jackson-Moss, 2000; Oliveira *et al.,* 2007) however, it was in agreement with the result from sheep breed in Germany (Rehbein *et al.,* 2000).

In this study, Washera sheep breed was evaluated in average of 6 months less than Menz and Awassi_Menz crossbred sheep. Tensile strength of ostritches skin was increased at rate of 0.43 N/mm^2 per month up to the age of 14 months (Cloete *et al.,* 2004) and it was also observed that there is a trend of increases in skin physical characteristics of goat skins up to 24 months age (Wang and Attenburrow, 1993). With this fact the superiority of Washera sheep skin in tensile strength even at lower age indicated that the breeds ability of providing skin with highest value of tensile strength. Our result on physical test parameters was comparable with hair Dorper sheep breeds of South Africa which is known as the most popular and required in leather industry.

Table 5. Physical characteristics of leather produced from different genotype and feeding level.

Genotype/feed level	Thickness (mm)	Tensile strength (N/mm^2)			Elongation at break (%)			Single edge tear force (N)			Tear resistance
		parallel	vertical	average	parallel	vertical	average	parallel	vertical	average	
Genotype		*	*	*	NS	NS	NS	*	*	*	NS
A x M	1.23^{a}	18.15^{a}	13.99^{a}	16.11^{a}	51.49	81.17	66.34	23.92^{a}	15.61^{a}	19.79^{a}	15.99
Menz	1.18^{a}	20.15^{ab}	15.69^{ab}	17.92^{ab}	51.40	80.73	66.00	22.22^{a}	13.10^{b}	17.66^{ab}	15.02
Washera	0.99^{b}	21.97^{b}	15.93^{b}	18.94^{b}	49.77	80.82	65.29	17.34^{b}	13.07^{b}	15.21^{b}	15.53
Feed level		NS	NS	NS	NS	NS	NS	*	*	*	NS
Low	1.02a	20.60	15.55	18.07	49.12	80.71	64.85	18.52^{a}	12.41^{a}	15.47^{a}	15.01
Medium	1.17b	20.24	14.81	17.53	49.60	84.38	67.00	21.79^{ab}	14.34^{ab}	18.06^{ab}	15.69
High	1.21c	19.42	15.25	17.38	53.95	77.64	65.78	23.22^{b}	15.04^{b}	19.13^{b}	15.85
R2 (%)	41.64	26.10	19.64	27.93	14.24	5.55	3.40	35.17	30.13	39.21	6.75
CV (%)	14.48	14.54	12.92	11.69	11.82	14.94	8.42	23.27	18.87	18.22	13.64
SE	0.04	0.75	0.51	0.58	1.55	3.12	1.43	1.27	0.68	0.83	0.55

* = significant at p = 0.05, NS = not significant at p = 0.05 and means with different subscript within a column are statistically different (p<0.05).

Conclusion and recommendation

This study confirmed that there is no evidence of supporting the suspected inferiority of skins from crossbred sheep. All the three sheep breeds studied produced leathers with physical characteristics compatible with the quality standards required by the leather industry. Thus, introduction of Awassi sheep and its inheritance to 50% could not result in a significant decrease in leather quality. Further investigation should be done for the exotic inheritance of above 50% in order to quantify if there is a loss of skin quality at that higher Awassi blood levels.

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