

Skin Quality and Physical Properties of Leather Based on Sex, Age and Body Parts of Goats Reared on Sub-Humid Hill Country

Research Article
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ABSTRACT

To investigate the characteristics of skin and leather of hairy goats according to their sex and age, 120 goat skins were selected from the western part of Iran. Results indicated that sex and age had significant effects on weight and area of skin and leather. Moreover, sex and age had significant effects on thickness in different parts of skin except the belly. In this regard, the overall mean weight of skin and leather were 1074.8 ± 27.9 g and 427.2 ± 25.9 g, respectively. High coefficients of variation (28.3 and 66.3 percent, respectively) were found in these traits. The ranges of skin and leather area were from 30 to 80 dm² and 38 to 115 dm², respectively. Parts of the body (shoulder, hip and ribs) and sample position (parallel and perpendicular) significantly affected the mean of breakage force, tensile strength and elongation of tested pieces. A wide range of breakage force, tensile strength and elongation 4.5-66.0 kgf, 63.4-558.3 kgf cm⁻² and 22.0-141.3% were found in the goat leathers, respectively. The results of this study indicated that there are differences between quantitative and qualitative traits of skin and leather of different goats. To achieve better quality goat products, attention should be paid to differences in skin quality of different sexes and ages of goats.

KEY WORDS age, leather, physical characteristics, sex, skin.

INTRODUCTION

Trade in hides, skins, leather and leather manufactures have been in a great growth at an average of about 12% over the last 30 years, reaching to around US\$ 53.8 billion in early 2000. According to [FAO \(2010\)](#), commodity trade patterns have changed during a period between 1999 and 2008 and practical methods for evaluation and classification of skin are necessary. Furthermore, goat population has been increased worldwide from 587.6 to 861.9 million heads. This suggests that many new challenges will be introduced into the future of goat production in semiarid zones ([Orskov, 2011](#)). Leather of goat has received increasing attention and has become a demanding trend, especially in making upper

leather. Looking to these trends, those working with leather would appreciate that the raw material such as the goat skin and the leather technology should receive special attention.

Spread out to various climates of different parts of Iran, goat, as an adaptable animal, plays a major role in the economy with about 26 million heads. However, the main products of goats in Iran are milk and meat. The fiber and the skin are the third important products of goat. Annual crust export from Iran exceeds to 5 to 6 thousand tons which is a major part of yearly income.

It is obvious that determining the characteristics of fiber and skin produced by native goats would help to organize the grading and sorting of these products. Some studies were done in the past to improve goat production but more

trials are needed to contribute their full potential in national and household economies. Few recent papers deal with such important subject in tropical countries.

The aim of the present study was to evaluate the effect of the age and sex on the quality and quantity of skin and leather of hair goats. Therefore, a typical hair goat that is adapted and reared in the harsh climate of the Lorestan province, with about 1.6 million heads, called Lori goats were selected.

MATERIALS AND METHODS

Selection of animals

In order to carry out this study, 120 Lori male and female, young and adult goats, were selected and purchased from commercial flocks in the Lorestan province. Lorestan province is located in the west of Iran (33° 29' N, 48° 21' E) on Zagros Mountains. The local climate is generally sub-humid continental with winter precipitation. Animals were usually the goats in this region are bred in an intensive system, grazing on different pastures during spring, summer and autumn, during winter they are fed limited amounts of forage and grain. Before slaughter, the average weights of the adult animals were 46.0 kg (males) and 32.0 kg (females) and of the young goats were 33.5 kg (males) and 23.5 kg (females). The goats were slaughtered and their skins were cured by salting method. The salted skins were placed in the shade (15 °C and 50% RH) for drying (IOS, 2002a).

Sample collection and measurements

The extra salt was removed through shaking and the dry salted skins were weighed. The leather traits were measured using methods presented by the International Organization for Standardization. The thickness was measured at top of shoulder, back, hip, rip and belly using a manual thickness gauge.

A chrome-tanning without fleshing was conducted to skins to make crust leather (IOS, 2002a). The size and weight of the crusts were measured. In order to measure tensile strength, the leather samples were cut into two pieces by applying a press knife capable of cutting a test piece with standard dimension of 110 mm to the grain surface (IOS, 2002b).

Two test samples were taken from the long side in parallel to the backbone and from long side perpendicular to the backbone (IOS, 2006). Vernier caliper was used to measure the width and thickness of each test sample to the nearest 0.1 mm at areas between the grain side and the flesh side (IOS, 2002c). The arithmetic mean of the three measurements was obtained.

The tensile strength (T_n) was measured (kg force/mm²) using tensile testing machine (model 4001 Intron) with cell force of 100 kg (IOS, 2002b). The greatest force recorded as the breaking force and the tensile strength (T_n) in kg.f/mm² which was then converted to kgf cm⁻².

Statistical analysis

Data were analyzed by ANOVA through SAS software (SAS Institute, 2002). Statistical model was as follows:

$$Y_{ijk} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \varepsilon_{ijk}$$

Where:

Y_{ijk} : observations.

α_i : effect of age of animal.

β_j : effect of sex of animal.

$(\alpha\beta)_{ij}$: interaction between age and sex.

ε_{ijk} : residuals.

The thickness of different regions skin and leather was compared using the t-test analyses using SAS (2002). A Pearson correlation test was used to assess the significance of correlation of skin and leather traits.

RESULTS AND DISCUSSION

Weight and area

Least square means and standard errors of the skin and leather traits are summarized in Tables 1 and 2, respectively. According to the standard measures of Iranian goat, weight and area of the skin of Lori adult goats (1270 g and 57 dm², respectively) are similar to the standard indexes and they are ranked in medium to large skins. According to the weight and area of skin of young goats (924 g and 43 dm², respectively), they get a very big score of the standard degree.

Thickness

Males had more thickness of skin and leather in different parts of the body than female, but the only difference in thickness of the skin in various parts of the body that was attributable to age was in the back and hip area. Adult goats produced thicker skins than young ones. In contrast, the differences in thickness due to age were noticeable for all body parts, except in the belly region.

Physical traits

The physical test results for leather of Lori goats are summarized in Table 3. It is evident that there is a large variation in the tensile strength (63.4-558.3 kgf cm⁻²) of the samples.

Table 1 Least square means and standard errors of skin characteristic of Lori goat by sex and age

Effects and traits	No	Weight (g)	Area (dm ²)	Thickness (mm)				
				Top Shoulder	Back	Hip	Ribs	Belly
Sex		****	****	**	****	****	**	*
Male	50	1227.5±33.7	53.1±0.1	1.5±0.03	1.5±0.02	1.6±0.03	1.3±0.02	1.2±0.02
Female	70	966.7±28.5	46.8±0.1	1.4±0.03	1.4±0.02	1.5±0.02	1.2±0.02	1.1±0.02
Age		****	****	NS	*	**	NS	NS
Young	60	924.1±30.4	42.9±0.1	1.5±0.03	1.4±0.02	1.5±0.03	1.2±0.02	1.1±0.03
Adult	60	1270.1±31.7	57.0±0.1	1.5±0.03	1.5±0.02	1.6±0.02	1.3±0.02	1.2±0.02
Overall	120	1074.8±27.9	54.5±1.1	1.45±0.01	1.48±0.01	1.54±0.1	1.30±0.01	1.15±0.02
CV		28.3	20.2	15	11.6	11.7	13	15.7
Range		555-2220	30-80	1-2	1-1.9	1-2.1	0.8-1.8	0.8-1.7

NS: non significant.

CV: coefficient of variation.

* P<0.05; ** P<0.01; *** P<0.001 and **** P<0.0001.

Table 2 Least square means and standard errors of the leather characteristics of Lori goat leather by sex and age

Effects and traits	No	Weight (g)	Area (dm ²)	Thickness (mm)				
				Top Shoulder	Back	Hip	Ribs	Belly
Sex		**	***	***	****	***	****	****
Male	50	519.7±38.7	72.0±2.0	1.1±0.02	1.1±0.03	1.3±0.03	1.0±0.02	0.9±0.02
Female	70	361.2±32.7	63.7±1.6	0.9±0.02	0.9±0.02	1.1±0.03	0.9±0.02	0.8±0.02
Age		**	****	*	*	****	**	NS
Young	60	373.8±38.9	52.1±2.2	0.97±0.02	0.9±0.03	1.1±0.03	0.9±0.02	0.8±0.03
Adult	60	507.0±36.3	74.1±2.2	1.05±0.02	1.0±0.02	1.3±0.03	1.0±0.02	0.8±0.02
Overall	120	427.2±25.9	70.0±2.2	0.99±0.01	0.99±0.02	1.2±0.02	0.94±0.02	0.85±0.01
CV		66.3	22.2	16.7	18.2	19.3	19.3	19.6
Range		125-3000	38-115	0.7-1.4	0.6-1.7	0.7-1.8	0.5-1.6	0.5-1.6

NS: non significant.

CV: coefficient of variation.

* P<0.05; ** P<0.01; *** P<0.001 and **** P<0.0001.

Table 3 Physical properties of leather base on sex, age, body parts, and sample position

Effects and traits	Thickness (mm)	Breaking load (kg)	Tensile strength (kgf cm ⁻²)	Elongation (%)
Sex	****	****	***	*
Male	0.98±0.02	27.2±1.07	275.2±6.8	65.1±1.3
Female	0.87±0.02	21.5±0.9	248.5±5.9	60.8±1.1
Age	*	NS	NS	*
Young	0.90±0.02	23.5±1.0	260.9±6.2	64.9±1.2
Adult	0.95±0.2	25.1±1.0	262.8±6.5	61.1±1.3
Part of body	****	****	****	****
Shoulder	0.90±0.01	27.8±0.8	304.0±5.4	56.5±1.1
Hip	0.82±0.01	22.5±0.8	270.0±5.4	66.8±1.1
Ribs	1.02±0.01	21.4±0.8	205.7±5.4	64.7±1.1
Sample position	NS	****	****	***
Parallel	0.93±0.01	26.8±0.8	287.6±4.9	60.0±1.1
Perpendicular	0.89±0.01	21.0±0.8	232.2±4.9	65.3±1.1
Total mean	0.9±0.0	23.9±0.4	259.9±3.3	62.7±0.7
CV	20.0	40.4	31.8	26.6
Range	0.5-1.8	4.5-66.0	63.4-558.3	22.0-141.3

NS: non significant.

CV: coefficient of variation.

* P<0.05; ** P<0.01; *** P<0.001 and **** P<0.0001.

However, the average result is in accordance to BASF standards of leather quality, in which tensile strength should be about 200 kgf cm⁻² and the acceptable range for elongation is 40-80% (BASF, 2010).

There were differences between all traits of skin and leather according to sex.

Male goats produced heavier skin and leather than females (1227.5±33.7 g and 519.7±38.7 g versus 966.7±28.5 g and 361.2±32.7 g, respectively). Furthermore, the area of the skin and leather of male goats was larger than female (53.1±0.1 dm² and 72.0±2.0 dm² versus 46.8±0.1 dm² and 63.7±1.6 dm², respectively).

In addition, the age had the same effect. Similarly, [Mrai and Khalil \(2000\)](#) reported that skin weight of males was significantly heavier than the skin of females due to various growth rates in both sexes.

The results of the present study showed that there was a significant difference in the thickness of various parts of the body (shoulder, hip and ribs) of the Lori goat skin and leather, but there was no significant difference between the top shoulder and back regions. However, the smallest and largest thickness was found in the belt and hip of skin and leather of goats, respectively (Table 3). [Adel and Elboushi \(1994\)](#) reported that the thickness of the skin differed and was dependent on the breed, varieties, age, sex and different parts of the body.

According to the standards for the leather cloth, the value of tensile strength must be about 150 kgf cm⁻² ([British Standards, 1984](#)). Therefore, the tensile strength of the leather of Lori goat in this study was generally higher than those reported for leather cloth. Compared to the leather of wool sheep breeds as well as hair sheep breeds ([Snyman and JacksonMoss, 2000](#)), the leather of Lori goats had higher breaking force, more tensile strength, but lower extension at break. [Oliveira et al. \(2007\)](#) reported lower thickness for sheep leather than the goat leather in the present study.

[Stosic \(1994\)](#) suggested that leather of goat had more tenacity and strength in comparison to the leather of sheep, which is likely due to the grain and protein fibers, so it makes them a very good stuff for making boots and garments.

A significant difference was observed between sexes for tensile strength and elongation (Table. 3). The males have stronger leather (275.2±6.8 kgf cm⁻²) than females (248.5±5.9 kgf cm⁻²). It is in agreement with some other studies ([Bal, 1978](#)).

Although, there was no significant difference in breaking load and tensile strength between two age groups, the leather of youngs performed poorer than adult goats, while adult goats have produced significantly thicker and more elongated than the youngs. Higher values in physical performance related to thickness were observed with gradual increases of ages in sheep and ostrich by [Passman and Sumner \(1987\)](#) and [Cloete et al. \(2004\)](#).

The physical traits were different between parts of the body. The leather in shoulder has the higher breaking force and tensile strength and considerably was stronger than leather of hip and ribs, samples.

The elongation of the leather at the hip and rib were higher than the samples of leather from the shoulder region (Table 3). This aspect was similar to others reported in some other native goats.

For Balady goats, the elongation at break and strength of flank and rump regions were significantly different ([Abdelsalam and Haider, 1993](#)).

The results indicated that the breaking force and the tensile strength of parallel leather samples were higher and the percentage of elongation was lower than those in the perpendicular samples.

For the tensile strength of goat skin, [Sivasubramaniana et al. \(2008\)](#) reported the ranges from 203 to 255 kgfcm⁻² and 153 to 204 kgfcm⁻² for the parallel and perpendicular samples, respectively. For cattle skins these amounts were 255 to 306 kgfcm⁻² and 204 to 255 kgf cm⁻², respectively ([Sivasubramaniana et al. 2008](#)). They also reported that the elongation at break of parallel and perpendicular samples were 40-80% and 60-80% for goatskin and cattle skin, respectively.

Moreover, a study on the tensile strength of the skin and leather of Merino sheep showed that the tensile strength was highly dependent on the sample position and its orientation to the backbone.

According to [Gordon \(1995\)](#), the strength of samples taken in parallel to the backbone decreased as the distance from the backbone increased.

The weight and area of goat leather were increased as the skin weight and area increased. The correlation of skin thickness with skin and leather weight was 0.6 and 0.5, respectively.

The breaking force was generally increased as the leather thickness rose ($r=0.6$) but tensile strength decreased as leather thickness increased. Although, [Passman and Sumner \(1987\)](#) reported tensile strength of lambskin increased as its thickness increased.

CONCLUSION

Lori goats produce leather with the acceptable variable tensile strength and elongation range of 63.4-558.3 kgf cm⁻² and 22.0-141.3%, respectively which will result in the good aspects of the commodity production. Also it was found a variation in quantitative and qualitative traits of skin and leather of different goats in western Iran according to sex and age. It is recommended to achieve a better quality of goat products, attention should be paid to the factors affecting skin quality such as sex and age of goats and to the use of advanced techniques for leather processing.

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