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PHYSICAL CHARACTERISTICS OF RAW LEATHERS IN TEXEL AND CHAROLLAIS RAM LAMBS

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Abstract

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The objective of work was to evaluate effect of breed on basic physical characteristics of sheep leather. A total of 12 leathers of purebred Texel (n = 6) and Charollais (n = 6) lambs were included in the trial. The basic indicators of the physical analysis of leather quality: leather thickness (LT, mm), tensile strength endwise (TSE, N/mm^2) and across (TSA; N/mm^2) as well as maximal elongation endwise (MEE; %) and across (MEA; %) were assessed. The statistical analysis was performed by SAS 9.3 (SAS/STAT® 9.3., 2011) with the used MIXED procedure. All the physical parameters were higher in Charollais breed compared to Texel, except of MEA. More specifically LT and TSE were non-significatnly higher +0.03 mm and +3.03 N/mm^2 in Charollais breed. Statistically significantly higher difference TSA and MEE (+3.31 N/mm^2; $P < 0.01$ and +7.22%; $P < 0.01$) were also observed in Charollais breed compared to Texel. On the other hand there was also noticed a lower MEA (–7.17%; $P > 0.05$) in Charollais breed.

Keywords: leather thickness, tensile strength, maximal elongation

INTRODUCTION

High quality leather of small ruminants is a valuable raw material for various industrial sectors. The farming of meat sheep breeds has become much more widespread in the Czech Republic recently, mainly due to high quality meat production. The characteristics of these breeds also include a good fleece that has to be sheared to ensure the welfare of the animal. Moreover the sheep leather should provide to sheep farmers an alternative product to compensate lack of demand for wool.

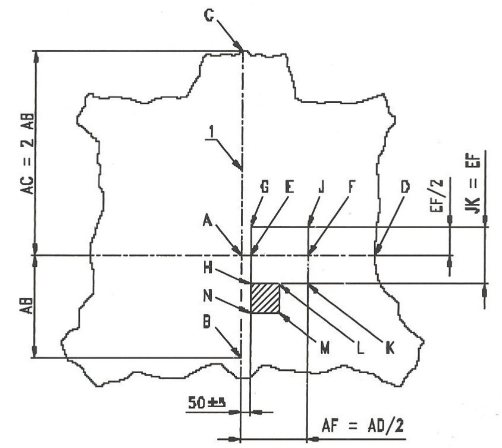
Lamb's leather quality is influenced by many factors. Oliveira *et al.* (2007) studied the influence of genotype on the physic-mechanical traits of lamb's skins. This involved local breeds in Brazil, where – as they state – the skin is an important financial component in the slaughter of lambs. Effects of genotype ($P < 0.01$) and age ($P < 0.05$ to 0.01) on physical parameters of leather thickness, tensile load and tensile strength in Morada Nova, Polwarth and Ideal sheep were confirmed by Jacinto *et al.* (2004). Rehbein *et al.* (2000) evaluated physical traits in leather depending on Ivermectin CRC treating of the lambs after *Psoroptes ovis* infection in Merino landrace. According to their results lambs treated by Ivermetcin had higher qualitative traits of leather thickness, elongation break and tear resistance ($P < 0.01$). Leather quality is influenced by subsequent processing as confirmed by De Brito *et al.* (2002). They studied the process of leather tanning with using different percentage of chromium, i.e. 1.5%, 3% and 4.5%. All mentioned authors confirmed influence of internal factors, especially breed or genotype differences, on physical characteristics of raw leather as well as external factors as herd management, animal health or processing the leather.

Based on the introduction there is poor information in this area of global point of view as well as in the Czech Republic. However, based on published studies it is possible to hypothesize, that lamb's breed affects the quality traits of sheep leather as a raw material for manufacturing industry. Therefore, the objective of work was to evaluate effect of breed on basic physical characteristics of sheep leather.

MATERIAL AND METHODS

The study was carried out at an organic sheep farm located in Central Bohemia region 40 km southern from Prague, Czech Republic. The selected flock was located at the altitude 480 m above sea level. The feeding ration of the ewes was consisted of grassland pasture and meadow hay *(ad libitum)*. The feeding ration of lambs was consisted of mothers milk (*ad libitum*), the grassland pasture and meadow hay (*ad libitum*). At the age of 100 day the ram lambs were weaned. Ewe lambs were kept naturally together with their mothers. All the lambs were sheared at this age.

A total of 12 leathers of purebred Texel (n = 6) and Charollais (n = 6) lambs from the basic flock were included in the trial. The selected lambs – all males born in 2nd half of April 2013 (from 15th to 30th) – were kept in the same climatic condition and the same flock and grazing management. All the selected lambs came from ewes in the same age of 3 years. Lambs were slaughtered according to EU laws in 2nd half of October (all at the same age of 180 days). The leathers were clipped after the slaughter and the skin was subsequently treated with salt. The skins were tanned using chromium in a standard manner (Jůva, 1983). After tanning the leathers were sent to the Testing Laboratory of leather and textile materials and products (AZL Otrokovice s. r. o., Zkušebna kožedělných a textilních materiálů a výrobků, Otrokovice, Czech Republic) to be further processed. The leathers were conditioned 48 hrs. before processing, 23 °C/50% relative humidity (ÚNMZ, 2012a). The basic indicators of the physical analysis of leather quality: leather thickness (LT, mm), tensile strength endwise (TSE, N/mm^2) and across (TSA; N/mm^2) as well as maximal elongation endwise (MEE; %) and across (MEA; %) were assessed (ČNI, 2003b; ÚNMZ, 2012b). LT was determined by thickness gauge PL 60b (Q. Meissner, Freiberg, Germany) and parameters of strength characteristics (TSE, TSA, MEE and MEA) were determined by TIRAtest 2200 dynamometr (VEB TIR, Rauenstein, Germany). The measurement of official sampling square area of leather (MSA; dm^2) was given by the square G, H, J, K on the Fig. 1 (ČNI, 2003a). The MSA reflects in itself the proportions of the total size of the skin and thus the lamb's body frame. The particular values of MSA ranged from 42 to 63 dm^2 in Texel and Charollais breeds. The measurement in MSA was repeated 6 times in LT parameter and 3 times in TSE, TSA, MEE or MEA parameters respectively.



Key
1 Backbone
B is the root of the tail
AD is a line perpendicular to BC
The lines GH and JK are parallel to BC
AC = 2AB
AF = FD
JK = EF
GE = EH
HL = LK = HN
AE = 50 mm ± 5 mm

1: *Official sampling area for physical characteristics of raw leathers analysis*
ČNI (2003a)

The statistical analysis was performed by SAS 9.3 (SAS/STAT® 9.3., 2011) with the used CORR and MIXED procedures. MSA parameter as the total size of the lambs' skin was taken account in the form of linear regression. The parameters of LT, TSE, TSA, MEE and MEA were measured repeatedly (6 or 3 times) according to the official norm (ČNI, 2003a) in defined area of official sampling square area. Therefore the fixed effect of repeating the measurement was taken account of the model equation.

$$Y_{ijk} = \mu + BREED_i + REP_j + b(MSA) + e_{ijk},$$

Y_{ijk}............ value of the dependent variable (leather thickness; tensile strength endwise; tensile strength across; maximal elongation endwise; maximal elongation across),

$BREED_i$ ... fixed effect of i^{th} breed (i = Texel, n = 6; i = Charollais, n = 6),

REP_j.......... fixed effect of repeating the measurement (6 times in LT parameter; 3 times in TSE, TSA, MEE and MEA parameters),

b(MSA).... linear regression to the measurement of official sampling square area,

e_{ijk}............. residual error.

The statistical significant differences were observed on the levels P < 0.05; P < 0.01or P < 0.001.

RESULTS AND DISCUSSION

Basic Statistics

The means, standard deviations, extreme values and variation coefficient are presented in Tab. I. The average value of leather thickness (LT) was 1.10 mm. The average values of tensile strength endwise (TSE) and across (TSA) achieved 11.62 mm and 8.64 mm, respectively. Finally the average values of maximal elongation endwise (MEE) and across (MEA) achieved 52.23 mm and 77.53 mm, respectively. Based on the standard deviation and variation coefficient the data set can be considered as homogenous with the values being spread in a normal pattern.

Correlation Analysis

The correlation coefficients of physical characteristics of raw leathers are presented in Tab. II. MSA was significantly (P < 0.05 to 0.01) correlated to LT, TSE, TSA (r = 0.381 to 0.493) and non-significantly to MEE and MEA. Similarly non-significant correlation coefficients were observed among LT and all the others parameters. Significantly positive correlations among TSE and TSA or MEE and MEA (r = 0.616 to 0.884; P < 0.001) were found. High or middle-high correlation was detected between TSA and MEE (r = 0.709; P < 0.001) or TSA and MEA (r = 0.465; P < 0.01), respectively.

I: *Means, standard deviations, extreme values and variation coefficients of physical characteristics of Texel and Charollais raw leathers*

Variable value	$\bar{x}$	s_d	min.	max.	VC
MSA (dm^2); n = 12	53.55	6.10	42.00	63.00	11.39
LT (mm); n = 72	1.10	0.08	0.92	1.24	7.27
TSE (N/mm^2); n = 36	11.62	5.20	2.00	23.00	44.75
TSA (N/mm^2); n = 36	8.64	3.74	1.80	15.60	43.29
MEE (%); n = 36	52.23	8.16	32.40	63.10	15.62
MEA (%); n = 36	77.53	13.80	45.90	106.70	17.80

MCA = measurement of official sampling square area; LT = leather thickness; TSE = tensile strength endwise; TSA = tensile strength across; MEE = maximal elongation endwise; MEA = maximal elongation across; VC = variation coefficient (%)

II: *Correlation coefficients among of physical characteristics Texel and Charollais raw leathers*

		LT	TSE	TSA	MEE	MEA
MSA	r	0.398	0.493	0.381	0.285	0.208
	P	0.001	0.004	0.029	0.108	0.245
LT	r		0.213	0.261	0.270	–0.040
	P		0.234	0.143	0.129	0.826
TSE	r			0.884	0.821	0.616
	P			< 0.001	< 0.001	< 0.001
TSA	r				0.709	0.465
	P				< 0.001	0.006
MEE	r					0.601
	P					< 0.001

MCA = measurement of official sampling square area (dm^2); LT = leather thickness (mm); TSE = tensile strength endwise (N/mm^2); TSA = tensile strength across (N/mm^2); MEE = maximal elongation endwise (%); MEA = maximal elongation across (%)

Finally high correlation (r = 0.601; P < 0.001) was observed between MEE and MEA parameters. The results corresponded to general biological and physical principles.

Description of the Statistical Model

The model equation for evaluation of LT, TSE, TSA, MEE parameters was significant (P < 0.05 to 0.01) and it explained 22% to 34% of their variability. The MEA was explained of 11% by model, however non-significantly. Factor of breed was statistically significant in the model equation (P < 0.01) for TSA and MEE parameters. Only slightly non-significant was this factor for parameters of LT (P = 0.054) and TSE (P = 0.065). Non-significant value of breed was found for MEA as well. The factor of MSA was significant for LT and TSE parameters (P < 0.01). On the other hand MSA was non-significant in model for TSA, MEE and MEA.

Effect of Breed on Physic-mechanical Characteristics of Raw Leathers

The results of physical characteristics of raw leathers in Texel and Charollais ram lambs are presented in Tab. III. Generally all the physical parameters were higher in Charollais breed compared to Texel, except of MEA. More specifically LT and TSE were non-significatnly higher +0.03 mm and +3.03 N/mm^2 in Charollais breed. Significantly higher TSA and MEE parameters (+3.31 N/mm^2; P < 0.01 and +7.22%; P < 0.01) were also observed in Charollais breed compared to Texel. On the other hand there was also noticed a lower MEA (–7.17%; P > 0.05) in Charollais breed.

DISCUSSION

Only several previous studies evaluated leather quality on local sheep breeds in Brazil or in Merino landrace. The reference quality range of physic-mechanical values of leather is presented in BASF standards (BASF, 1984). All the studies are discussed due to absence of other appropriate current sources. Oliviera *et al.* (2007) observed LT in multiple-purpose Brazilian sheep breeds Santa Inês, Morada Nova and their crossbreds respectively. Their results confirmed no significant differences in LT in relation to observed breed. The values of LT according to their study were in range from 0.73 mm to 0.90 mm. All these values were lower than LT in Texel and Charollais meat breeds achieved in our study. Jacinto *et al.* (2004) oppositely to our results found statistical significant differences in LT between Morada Nova and Ideal sheep (P < 0.05). The BASF standards of leather quality suggested 0.70 mm of LT as the reference value. According to this norm both the Texel and Charollais leather corresponded to this criterion. The Texel resp. Charollais leather were +0.38 mm resp. +0.41 mm higher to BASF standards.

Oliviera *et al.* (2007) and Rehbein *et al.* (2000) similarly to our research evaluated tensile strength and maximal elongation in lambs, although they did not differ measurement of endwise and across in both these parameters. The tensile strength was in range of 20.00 N/mm^2 to 29.42 N/mm^2 and no significant differences were observed. In opposite both parameters of tensile strength (TSE and TSA) presented in our study were lower compared to their results. According to BASF the minimal tensile strength slould be 19.6 N/mm^2 (BSAF, 1984). Similarly to previous both the parameters observed in our study were deeply (–12.77 to –6.6 N/mm^2) under minimal values of tensile strength published in BASF. Rehbein *et al.* (2000) found tensile strength in Merino landrace 14.0 N/mm^2 in Ivermectin CRC treated lambs after *Psoroptes ovis* infection. This result was higher than both tensile strength traits (TSE and TSA) in our study obtained in Texel and Charollais lambs.

Values of elongation ranged according to Oliviera *et al.* (2007) from 67.8% to 78.4% in Santa Inês, Morada Nova and their crossbreds lambs. Similarly to previous there were found no statistical significant differences among breeds. Compared to our results the values of meat sheep breeds were –24.31% resp. –17.09% lower in MEE in Texel resp. Charollais breeds. On the other hand +8.84% resp. +1.67% higher values MEA were found in Texel resp. Charollais breeds compared to results of Oleveira *et al.* (2007). The acceptable range for percentage elongation is 40–80% (BSAF, 1984). Leathers of Texel and Charollais ram lambs met these requirements in both MEE and MEA parameters.

Generally leather quality is primary determined by tanner processing. There are also no specified official norms to leather physical parameters. In practice sheep leathers are used in clothes, gloves and upholstery industry as additional material. Anyway based on ČSN EN ISO 14906, ČSN EN ISO 14931, ČSN EN ISO 13336 and practical experiences of specified Laboratory of leather and textile materials and products the Charollais and Texel lamb's leather can be considered as appropriate from the viewpoint of leather manufacturing. Oppositely

III: *Effect of breed on physical characteristics of raw leathers*

Breed	LT (mm)	TSE (N/mm^2)	TSA (N/mm^2)	MEE (%)	MEA (%)
	LSM ± SE	LSM ± SE	LSM ± SE	LSM ± SE	LSM ± SE
CH (n = 6)	1.11 ± 0.012	13.00 ± 1.061	10.14 ± 0.764^B	55.51 ± 1.745^B	74.27 ± 3.274
T (n = 6)	1.08 ± 0.013	9.97 ± 1.162	6.83 ± 0.837^A	48.29 ± 1.912^A	81.44 ± 3.588

CH = Charollais; T = Texel; LT = leather thickness; TSE = tensile strength endwise; TSA = tensile strength across; MEE = maximal elongation endwise; MEA = maximal elongation across; A,B – different letters mean significant difference within column at the level P < 0.01

leathers of Texel and Charollais ram lambs did not comply fully the BASF criteria for further leather processing in TSA and TSE parameters.

The presented study was a testing project with the aim of evaluating of leather quality in two meat breeds in commonly breeding flock management in the Czech Republic. Based on obtained results and together with previous studies it seems that sheep leathers are quite dissimilar products from the viewpoint of their quality. These conclusions clearly demonstrate the necessity of updating current official norms or establishing new official norms respectively. These official norms should include complete physic-mechanical characteristics of leathers for different sheep breeds from the viewpoint of further processing including minimal and optimal leather characteristics. There are studied new alternative opportunities of sheep products realization to improve the total flock economy. The leather of meat type sheep as a byproduct could be potentially getting current nowadays especially in connection with low prices on wool markets. However specified requirements for leather quality in meat breeds have not been observed yet.

CONCLUSION

Generally all the physical parameters were higher in Charollais breed compared to Texel, except of MEA. Statistical significant differences between both meat sheep breeds were found in TSA and MEE ($P < 0.01$). According to our result and together with previous studies, it can be summarized that Charollais and Texel lamb's leathers represent appropriate material for the garment industry. However, further investigation on continuing and more detailed mapping of qualitative indicators of leathers from the individual meat sheep breeds in the Czech Republic would be usable, especially from the perspectives of the leather processing industry requirements.

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