

# The evaluation on the quality of lambskin leather originated from lambs fed by different feedstuffs

*by Sri Mulyani*

---

**Submission date:** 21-May-2023 06:46PM (UTC+0700)

**Submission ID:** 2098260900

**File name:** iwan\_Fajar\_P\_et\_al\_2023.pdf (505.88K)

**Word count:** 3860

**Character count:** 20535

# The evaluation on the quality of lambskin leather originated from lambs fed by different feedstuffs

Cite as: AIP Conference Proceedings **2586**, 040008 (2023); <https://doi.org/10.1063/5.0106682>  
Published Online: 24 January 2023

Iwan Fajar Pahlawan, Endang Purbowati, Sri Mulyani, et al.



View Online



Export Citation

## ARTICLES YOU MAY BE INTERESTED IN

[Growth rate and body composition of lambs receiving agricultural wastes as grass substitutes](#)

AIP Conference Proceedings **2586**, 040007 (2023); <https://doi.org/10.1063/5.0112541>

[Agricultural byproducts in lamb's diet can substitute Napier grass without decreasing lambs products](#)

AIP Conference Proceedings **2586**, 040001 (2023); <https://doi.org/10.1063/5.0107786>

[Dissimilarity analysis of wheat dough of different final thermal processing techniques based on the chemical composition and starch hydrolysis](#)

AIP Conference Proceedings **2586**, 060001 (2023); <https://doi.org/10.1063/5.0107951>



## APL Machine Learning

Machine Learning for Applied Physics  
Applied Physics for Machine Learning

Now Open for Submissions

# The Evaluation on the Quality of Lambskin Leather Originated from Lambs Fed by Different Feedstuffs

Iwan Fajar Pahlawan<sup>1, a)</sup>, Endang Purbowati<sup>2, b)</sup>, Sri Mulyani<sup>3, c)</sup>, Retno Adiwini<sup>2</sup>, Agung Purnomoadi<sup>2</sup>, Edy Rianto<sup>2</sup> and Vita Restitrisnani<sup>2</sup>

<sup>1</sup>Center for Leather, Rubber and Plastics, Ministry of Industry, Yogyakarta 55166, Indonesia.

<sup>2</sup>Department of Animal Sciences, Faculty of Animal and Agricultural Sciences, Diponegoro University, Semarang 50275, Indonesia.

<sup>3</sup>Department of Food Technology, Faculty of Animal and Agricultural Sciences, Diponegoro University, Semarang 50275, Indonesia.

<sup>a)</sup> iwan.fp@kemenperin.go.id

<sup>b)</sup> Corresponding author: purbowati@hotmail.com

<sup>c)</sup> srimulyani@lecturer.undip.ac.id

**Abstract.** An evaluation has been done on the properties of lambskin leather. The lambskin leather was originated from lambs fed with feedstuff contained a combination of Napier grass (*Pennisetum purpureum*) and agricultural wastes, as the main ingredient. The study evaluated 24 wet-salted lamb skins derived from lambs which fed by a combination of feedstuffs as the treatment. Experimental design was applied in this research with a completely randomized design. Treatments in the study involved the feeding of lambs with Napier grass (P0), Napier grass and corn cobs (P1), Napier grass and bagasse (P2), and Napier grass and peanut shells (P3), while the replication for each treatment were six. The raw lamb skins, flayed from the carcass and salt-preserved, were processed into crust leather with chrome tanning method. The evaluation of lambskin leather emphasized on the softness, tensile strength, elongation at break, tear strength, shrinkage percentage, and water vapor permeability. The result showed that the resulted leather had softness value in the range of 5.79±0.47 mm to 5.96±0.31 mm. All treatments resulted the leather in a good thermal stability with shrinkage percentage 16.44±1.32%, at maximum. Further, water vapor permeability of the lambskin leather was 14.21±0.85 – 17.29±1.47 mg/cm<sup>2</sup>.jam. In term of mechanical properties, the leather with treatment P2 promoted higher tensile strength (1661.19±116.34 N/cm<sup>2</sup>) than other treatments. Meanwhile, treatment P3 resulted leather with the highest value of elongation at break (104.42±6.69%) and tear strength (189.87±4.98 N/cm). Overall evaluation proposes a conclusion that most of treatments support the resulted lambskin leather to meet the requirement of leather for jacket in SNI 4593:2011.

## INTRODUCTION

Livestock management involves many activities, from breeding to harvesting. From industry's point of view, livestock production covers all activities from upstream to downstream. Upstream activity consists of all activities related to raise animal until they are ready to be harvested, for their milk, egg, carcass, and non-carcass. Meanwhile, downstream activity relates to all activities in processing animal products, including animal by-products. The influence of upstream activities on the quality of downstream product has been drawn researchers' attention for years. Previous study has covered the investigation on how feeding, as one of upstream activities, affects the quality of animal products [1] [2] [3]. Hide or skin, which is converted into leather, is also an animal product that could have different characteristics depend on the upstream activity. Leather could be manufactured from big ruminant animal's hides or small, ruminant and non-ruminant, animal's skins.

Indonesia has wide biodiversity, including livestock animal. That advantage supports the development of leather tannery industry in Indonesia. Leather tanneries utilize hides and skins which are categorized as waste for meat industry. Commonly, tanneries in Indonesia use hides of big ruminant animals, such as cattle and buffalo, and skins

of small ruminant animals, such as goat, sheep, and lamb. The use of those raw materials depends on the desired leather article which will be manufactured. Each article has its own specification, where one of the considerations is hides/skins characteristics. Bovine hides are mainly used for producing heavy leather, such as shoe upper, working glove, and upholstery. Meanwhile, ovine skins are mainly used for producing light leather, such as golf gloves, purse, accessories, and jacket. In order to obtain good quality leather, leather tanning industry pay attention to the quality of hides/skins, which could determine the quality of the resulted leather at the end of tanning process.

In a decade, studies that discussed the factors which influence the quality of skins/hides or leather has encompassed several aspects, such as genotype [4], sex, age [5], breed [6], seasonal change [7], production system [8], and feeding system [9] [10] [11] [12]. Among all studies regarding the influence of feeding systems on the quality of leather, none of them used lamb as the object of investigation, as well as the utilization agricultural waste as feedstuff to combine with Napier grass. Hence, the study aimed to evaluate the properties of lambskin leather taken from lambs fed by a combination of Napier grass and agricultural wastes, as the main ingredient, in feedstuff.

## MATERIALS AND METHOD

### Materials

Wet-salted lambskins were collected from the experiment conducted by Purbowati *et al.* [13]. Chemicals for beam house operation were supplied by UD. Karyanti, included Teepol, Na<sub>2</sub>S, CaOH, ammonium chloride, ammonium sulfate, Feliderm bate PB-1 (Stahl), Dephan B, NaCl, formic acid, sulfuric acid, Chromosal B (Stahl), Novaltan PF (Zschimmer & Schwarz), sodium formate, sodium bicarbonate, Tanit LSW (Dr. Bohme), PSE, R40, dyestuff, Garboil SBH (Galic Bina Mada), Pellan 802 (Pulcra Chemicals), and Busan (Buckman Lab.). The study was equipped with stainless-steel rotating drum, digital scale, mechanical scale, 2 L measuring cup, wooden stirrer, fleshing machine, shaving machine, toggle drying unit, and stacking vibration machine.

### Experimental Design

The study involved different treatment which proposed a combination of Napier grass with agricultural wastes (corn cobs, bagasse, and peanut shells), as main ingredient, in feed formulation. The main ingredients were mixed with rice bran (34.05%), soybean meal (12.95%), molasses (6%), cassava waste product (5%), and mineral mix (2%). Meanwhile, the proportion of the main ingredient, in whole feedstuff composition (100% basis), were 20% Napier grass and 20% corn cobs (P1), 20% Napier grass and 20% bagasse (P2), 20% Napier grass and 20% peanut shells (P3), while 40% Napier grass (P0), without agricultural waste substitution, were used as the control. Prior to feeding treatment, the feedstuffs were determined for its nutritional composition (Table 1). The experiment was performed in a completely randomized design.

**TABLE 1.** Nutrition content of feedstuff ingredients.

Substance	P0	P1	P2	P3
	----- % -----			
Dry matter	76.23	85.52	82.35	81.99
Crude protein	15.00	12.32	12.08	12.93
Crude fat	5.64	5.96	6.06	5.77
Crude fiber	22.69	28.00	27.36	30.04
Total digestible nutrients	66.55	66.62	65.82	67.36

### Lamb Skins Tanning

Wet-salted lamb skins were processed into crust leather through beam house operation with chrome tanning method. The operation consisted of soaking, unhairing, liming, fleshing, deliming, bating, degreasing, pickling, tanning, shaving, neutralization, retanning, dyeing, fatliquoring, toggling, and staking. Table 2 provides the formula for the beam house operation.

**TABLE 2.** Formula of beam house operation.

Process	Chemical	Amount (%)	Run (min.)	Remarks
Soaking	Water	100		
	Teepol	0.5	30	
Unhairing	Water	100		
	Na <sub>2</sub> S	1.5	20	
Liming	CaOH	2	20	
	Na <sub>2</sub> S	1		
	CaOH	3	20	Hair-loss checking
			60	Intermittent, run 20' and stop 30'
Deliming	Water	100	20	Left O/N
			30	Drain, wash, drain and fleshing
	Water	100		
	NH <sub>4</sub> Cl	0.5		
Bating	Ammonium sulfate	1	45	Cross-section checking w/ PP indicator, drain, wash, drain
	Water	100		
Degreasing	Feliderm bate PB-1	2	60	Thumb-test checking
	Dephan B	0.5	30	Drain, wash, drain
Pickling	Water	100		
	NaCl	10	10	7 °Be
	Formic acid (diluted 1:10)	2	40	2× insertion
	Sulfuric acid (diluted 1:20)	1.5	90	3× insertion
			60	pH 2.5 – 2.8, Left O/N
			30	
Tanning	Novaltan PF	2	30	
	Chromosal B	8	180	Cross-section checking (even blue)
	Sodium formate	1	30	
	Sodium bicarbonate	2	40	2× insertion, pH 3.8 – 4.0
Aging			180	Shrinkage temperature checking, drain
Shaving				Left O/N
Neutralization	Water	150		Thickness 0.75 mm
Retanning	Sodium format	2	30	
	Sodium bicarbonate	2	60	3× insertion, pH 5.8
	Water 40°C	100		
	Tanit LSW	1		
Dyeing	PSE	3		
	R40	3	45	Drain
	Water 50°C	50		
	Sincal MS	1	10	
Fatliquoring	Dyestuff	2	60	Cross-section checking (even color)
	Water 60°C	50		
	Garbiol SBH	4		
	Pellan 802	6		
	Formic acid	1.5	40	2× insertion, float color checking
Toggling, staking	Busan	0.02	15	Drain

## Evaluation Parameter

Lambskin leathers were evaluated for its quality, emphasizing on physical properties, i.e., softness, tensile strength, elongation at break, tear strength, water vapor permeability, and shrinkage percentage. Leather softness evaluation were conducted referring to the method of leather softness determination in ISO 17235:2015 [14]. Indonesian national standard SNI 06-1795-1990 [15] was used to test the tensile strength and elongation testing of the sample. For tear strength parameter, the method released by the Indonesian standard [16] was followed in the study. Meanwhile, the evaluation on water vapor permeability and shrinkage temperature followed the Indonesian standards [17] and [18], respectively.

## RESULTS AND DISCUSSION

### The Shrinkage and Softness of Lambskin Leather

Shrinkage percentage indicates the stability of leather against deformation as well as the degree of tannage. This parameter is an initial evaluation that determines the success of leather tanning process. Morera *et al.* [19] explained that the deformation of leather caused by the break of collagen bonds which resulted up to 35% of shrinkage. Figure 1 shows that the treatments resulted lambskin leather which shrank  $12.59 \pm 1.01$  –  $16.44 \pm 1.32\%$ . In addition, the fed with Napier grass and corn cobs resulted the highest shrinkage of lambskin leather ( $16.44 \pm 1.32\%$ ), while the lowest shrinkage of lambskin leather was obtained from sample code P2 ( $12.59 \pm 1.01\%$ ). From Fig. 1, it can be denoted that the use of bagasse combined with Napier grass, in feedstuff, improved the stability of the resulted lambskin leather. This result conforms with the finding of Ariram and Madhan [20] that bagasse has a tanning effect and, further, improves the collagen fiber stability as well as avoids the shrinkage.

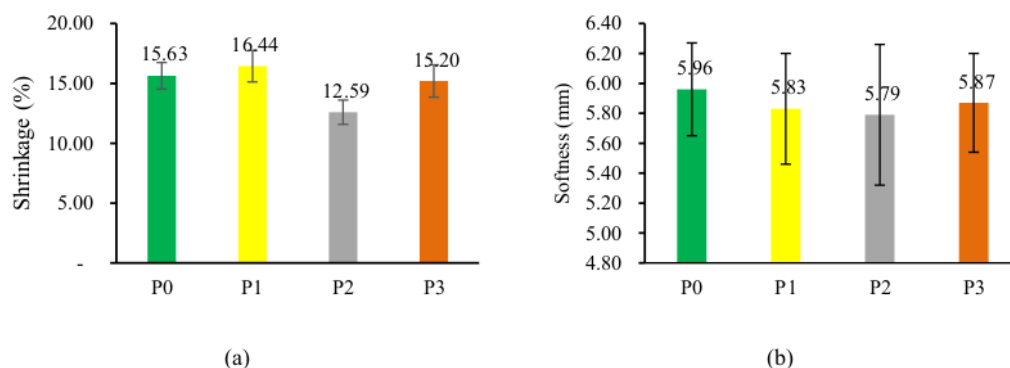


FIGURE 1. Shrinkage percentage (a) and softness (b) of lambskin leather.

Softness is one of important properties for evaluation purpose of leather and leather products [21]. The evaluation result (Fig. 1) revealed that the lambskin leather derived from lambs fed by the diet with Napier grass, without addition of agricultural waste, was the softest leather ( $5.96 \pm 0.31$  mm). It was also shown that the feeding of lambs with the diet, composed by Napier grass and bagasse, resulted the lowest softness value ( $5.79 \pm 0.47$  mm). The study found that different feedstuff composition proposed different softness condition of lambskin leather. The difference could be caused by nutritional content of feedstuff. A determination on nutritional content prior to feeding experiment provided information that the feedstuff contained 12.08% to 15.00% of crude protein. It can be indicated that the level of protein in lamb feedstuffs has influence on the softness of lambskin leather. The protein content of feedstuffs had similar trend with softness value of lambskin leather. Even though, Merkel *et al.* [10] found that feedstuff composition did not have much impact on the softness property of ovine leather. In general, the lambskin leather fulfilled the requirement of SNI 4593 [22] for softness parameter, except for the percentage of shrinkage.



## Mechanical Properties

Mechanical property of leather associates with tensile strength, elongation at break, and tear strength [23] [24] [25]. The evaluation on this property is essential in leather manufacturing and trading. Most of parameters in leather article consider this property as a must-have requirement to assess the fulfillment of leather quality standard. Table 3 exhibits the mechanical properties of lambskin leather derived from lambs fed by Napier grass, with and without agricultural wastes as the substitution, in feedstuff formulation. The highest value of for each mechanical properties were resulted from the use of Napier grass and bagasse (tensile strength), as well as Napier grass and peanut shells (elongation at break and tear strength), with the value of  $1,661.19 \pm 116.34$  N/cm<sup>2</sup>,  $104.42 \pm 6.69\%$ , and  $189.87 \pm 4.98$  N/cm, respectively. On the contrary, feedstuffs with Napier grass, as single main ingredient, gave the lowest mechanical properties of the resulted lambskin leather ( $1,311.31 \pm 82.58$  N/cm<sup>2</sup>,  $96.59 \pm 0.34\%$ ,  $179.27 \pm 10.80$  N/cm).

TABLE 3. Mechanical properties of lambskin leather

Sample Code	Tensile Strength (N/cm <sup>2</sup> )	Elongation at Break (%)	Tear Strength (N/cm)
P0 (Napier grass)	$1,311.31 \pm 82.58^a$	$96.59 \pm 0.34^a$	$179.27 \pm 10.80^a$
P1 (Napier grass + corn cobs)	$1,515.68 \pm 68.44^b$	$98.57 \pm 0.37^a$	$189.39 \pm 12.00^b$
P2 (Napier grass + bagasse)	$1,661.19 \pm 116.34^b$	$99.05 \pm 0.42^a$	$187.14 \pm 15.86^b$
P3 (Napier grass + peanut shells)	$1,357.22 \pm 67.45^a$	$104.42 \pm 6.69^b$	$189.87 \pm 4.98^b$

Note: Means with different superscripts differ ( $P < 0.05$ )

Previous research have been done to evaluate the correlation between feed consumption and leather quality, especially for small animal. Most of studies were focused on mechanical properties, such as tensile strength, elongation, and tear strength. According to Dahlman *et al.* [26], low level of protein content in feedstuff could attenuate the mechanical properties of blue fox leather. Meanwhile, the study exhibited that the increase of protein content could decrease the tensile strength. Thus, this provides new insight on how the level protein in feedstuff could improve the tensile strength of lambskin leather. In the meantime, the trend of lambskin leather elongation was linear with the sample coding, where the control sample (P0) had the lowest elongation and the trend of elongation value rose up for sample P1, P2, and P3, respectively. Compared to tensile strength and elongation at break, tear strength of lambskin leather displayed a dynamic condition, where the situation was similar with the situation found by Cloete *et al.* [27]. This situation might be caused by the effect of crude fibre content in the feedstuff, although there are limited references in support the argument. Overall, the quality of lambskin leather has met the requirement of the Indonesian standard SNI 4593 [22].

## Water Vapor Permeability

The permeability of leather against water vapor were evaluated based on the requirement of Indonesian standard for sheep/goat jacket leather [22]. Pozza [28] described the water vapor permeability as an evaluation on transpiration capacity, quantitatively. Laboratory results of water vapor permeability testing indicated the water vapour permeability value of lambskin leather varied from  $14.21 \pm 0.85$  mg/cm<sup>2</sup>.h (sample P3) to  $17.29 \pm 1.47$  mg/cm<sup>2</sup>.h (sample P2). It can be seen in Fig. 2 that water vapor permeability was inverse with softness value. Figure 2 expresses a disagreement with the finding of Smiechowski *et al.* [29], where the water vapor permeability increased as softness improvement. It can be indicated that leather article affects the water vapor permeability value, between garment leather and upper leather. The values of water vapor permeability were more than  $14.21 \pm 0.85$  mg/cm<sup>2</sup>.h. Therefore, it can be set that the treatment could provide lambskin leather which fulfilled the requirement for sheep/goat jacket leather [22].

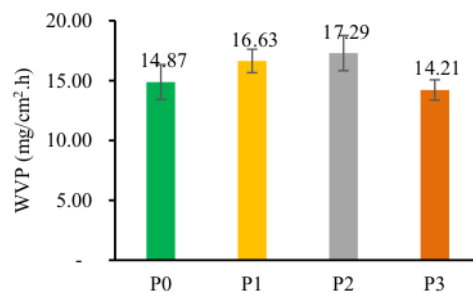


FIGURE 2. Water vapor permeability of lambskin leather

## CONCLUSION

As indicated by all graphs and tables, the treatment of feeding with Napier grass and agricultural wastes (corn cobs, bagasse, and peanut shells), as main ingredients, promoted new insight on the quality evaluation of lambskin leather. Lambskin leather derived from lambs fed by feed combination, between Napier grass and agricultural wastes, met the requirement of Indonesian standard for sheep/goat jacket leather (SNI 4593:2011). Further investigation should be conducted in order to support the implementation of an integrated livestock farming, from upstream to downstream. Thus, the sustainability of livestock industry could be achieved.

## ACKNOWLEDGMENTS

This study was funded by the Faculty of Animal and Agricultural Sciences, Diponegoro University through “Non-APBN” grant scheme. Authors would like to acknowledge the Center for Leather, Rubber and Plastics for facilitating the research. We also thank to all research technicians for their support.

## REFERENCES

1. A. Campione, A. Natalello, B. Valenti, G. Luciano, P. J. Rufino-Moya, M. Avondo, L. Morbidini, C. Pomente, B. Krol, M. Wilk, P. Migdal, and M. Pauselli, *Effect of Feeding Hazelnut Skin on Animal Performance, Milk Quality, and Rumen Fatty Acids in Lactating Ewes*, *Animals* **10**, 588–603 (2020).
2. M. H. A. Alasadi, K. C. K. Al-Salhie, and S. K. M. Al-Hummod, *The Effect of Adding Different Levels of Cumin Oil (Cuminum Cyminum) to Feed on Productive and Physiological Performance of Local Duck (Anas platyrhynchos)*, in *International Conference on Emerging Applications in Material Science and Technology: ICEAMST 2020*, edited by G. Ranganathan (American Institute of Physics, Melville, NY, 2020), p. 020030.
3. Y.-H. Hwang, A. Bakhsh, I. Ismail, J.-G. Lee, and S.-T. Joo, *Effects of Intensive Alfalfa Feeding on Meat Quality and Fatty Acid Profile of Korean Native Black Goats*, *Korean J. Food Sci. Anim. Resour.* **38**, 1092–1100 (2018).
4. M. A. C. Jacinto, F. M. de Vargas Junior, C. F. Martins, G. dos Santos Pinto, F. A. Reis, and A. R. de Oliveira, *Influence of Genotype on the Quality of Sheep Leather*, *Rev. Bras. Zootec.* **40**, 1830–1836 (2011).
5. M. Salehi, I. Kadim, O. Mahgoub, S. Negahdari, and R. S. E. Naeeni, *Effects of Type, Sex and Age on Goat Skin and Leather Characteristics*, *Anim. Prod. Sci.* **54**, 638–644 (2014).
6. M. A. Ebrahiem, I. Y. Turki, and H. E. Haroun, *The Effect of Breed on Skin/Leather Quality of Sudan Desert Sheep*, *J. Africa Leather Leather Prod. Adv.* **1**, 45–53 (2014).
7. M. A. Ebrahiem, I. Y. Turki, and H. E. Haroun, *Effect of Seasonal Changes on Skin/Leather Quality of Sudan Desert Sheep*, *Glob. J. Anim. Sci. Res.* **3**, 104–108 (2015).
8. L. C. V. Ítavo, R. G. Mateus, C. C. B. F. Ítavo, A. M. Dias, F. C. Gomes, F. F. da Silva, A. R. Schio, E. Nogueira, and H. V. Petit, *Leather Quality of Beefalo-Nellore Cattle in Different Production Systems*, *Anim. Sci. J.* **88**, 807–816 (2017).



9. K. C. Das, G. Mukherjee, K. K. Baruah, K. Khate, and C. Rajkhowa, *Study of Growth Performance and Leather Quality in Mithun (Bos Frontalis) and Its Comparison with Local Cattle (Bos Indicus) Fed on Tree Leaves Based Ration*, *Livest. Res. Rural Dev.* **23**, 1–7 (2011).
10. R. C. Merkel, C. K. Liu, N. P. Latona, A. El Amma, and A. L. Goetsch, *Effect of Level and Length of Supplementation on Leather Characteristics of Yearling Boer and Spanish Wethers*, *J. Am. Leather Chem. Assoc.* **108**, 139–145 (2013).
11. F. Negussie, M. Urge, Y. Mekasha, and G. Animut, *Effects of Different Feeding Regimes on Leather Quality of Finished Blackhead Ogaden Sheep*, *Sci. Technol. Arts Res. J.* **4**, 222–227 (2016).
12. A. Abebe, *Effect of Feeding Regime on Skin/Leather Characteristics of FI Crossbreed Sheep in the Highlands of Ethiopia*, *Int. J. Agric. Ext.* **8**, 17–25 (2020).
13. E. Purbowati, C. M. S. Lestari, R. Adiwiniarti, V. Restitrisnani, S. Mawati, A. Purnomoadi, and E. Rianto, *Productivity and Carcass Characteristics of Lambs Fed Fibrous Agricultural Wastes to Substitute Grass*, *Vet. World* **14**, 1559–1563 (2021).
14. ISO, *ISO 17235:2015 Leather — Physical and Mechanical Tests — Determination of Softness* (International Organization for Standardization, Geneva, 2015).
15. BSN, *SNI 06-1795-1990 Test Method for Tensile Strength and Elongation of Leather* (Badan Standardisasi Nasional, Jakarta, 1990).
16. BSN, *SNI 06-1794-1990 Test Method for Tearing Strength and Tearing Strength of Upper Leather* (Badan Standardisasi Nasional, Jakarta, 1990).
17. BSN, *SNI 06-4587-1998 Test Method for Water Vapour Penetration on Finished Leather* (Badan Standardisasi Nasional, Jakarta, 1998).
18. BSN, *Standar Nasional Indonesia SNI 0253:2009 - Kulit Bagian Atas Alas Kaki - Kulit Kambing* (Badan Standardisasi Nasional, Jakarta, 2009).
19. J. M. Morera, B. Esteban, G. Baquero, and R. Cuadros, *A New System to Measure Leather Shrinkage Temperature*, in *IULTCS Congress 2019*, edited by D. Tegtmeier and M. Meyer, Vol. 1 (Verein für Gerberei-Chemie und -Technik e. V., Freiberg, 2019), pp. 89–93.
20. N. Ariram and B. Madhan, *Development of Bio-Acceptable Leather Using Bagasse*, *J. Clean. Prod.* **250**, 119441 (2020).
21. K. Kazanavičius and V. Tričys, *Evaluation of Leather Softness*, *Mater. Sci.* **14**, 179–182 (2008).
22. BSN, *SNI 4593:2011 - Sheep/Goat Jacket Leather* (Badan Standardisasi Nasional, Jakarta, 2011).
23. G. Sanchez-Olivares, A. Sanchez-Solis, F. Calderas, L. Medina-Torres, O. Manero, A. Di Blasio, and J. Alongi, *Sodium Montmorillonite Effect on the Morphology, Thermal, Flame Retardant and Mechanical Properties of Semi-Finished Leather*, *Appl. Clay Sci.* **102**, 254–260 (2014).
24. M. Sathish, T. S. Bhuvanewari, J. R. Rao, and N. N. Fathima, *Effect of Syntan to Fatliquor Ratio on Porosity and Mechanical Properties of Wet-Blue Leather*, *J. Am. Leather Chem. Assoc.* **112**, 121–127 (2017).
25. I. F. Pahlawan and G. Griyanitasari, *Physico-Mechanical Properties of Cattle Hide Leather for Working Gloves with Flame Retardant Addition*, *Livest. Anim. Res.* **18**, 151–159 (2020).
26. T. Dahlman, M. Mäntysalo, P. V. Rasmussen, and L. L. Skovlørkke, *Influence of Dietary Protein Level and the Amino Acids Methionine and Lysine on Leather Properties of Blue Fox (Alopex Lagopus) Pelts*, *Arch. Anim. Nutr.* **56**, 443–454 (2002).
27. S. W. P. Cloete, S. J. van Schalkwyk, T. S. Brand, L. C. Hoffman, and C. J. Nel, *The Effects of Dietary Energy and Protein Concentrations on Ostrich Skin Quality*, *S. Afr. J. Anim. Sci.* **36**, 40–44 (2006).
28. G. Pozza, *The Measurement of Water Vapour Permeability of Leather with ISO 14268 and Related Methods*, *J. Soc. Leather Technol. Chem.* **99**, 157–162 (2015).
29. K. Smiechowski, J. Żarłok, and M. Kowalska, *The Relation Between Water Vapour Permeability and Softness for Leather Produced in Poland*, *J. Soc. Leather Technol. Chem.* **98**, 259–263 (2014).

# The evaluation on the quality of lambskin leather originated from lambs fed by different feedstuffs

## ORIGINALITY REPORT

24%

SIMILARITY INDEX

17%

INTERNET SOURCES

18%

PUBLICATIONS

7%

STUDENT PAPERS

## MATCH ALL SOURCES (ONLY SELECTED SOURCE PRINTED)

1%

★ Abdalla, E. B, Khalil, F.A, Azzam, A. H, Swelim, H. H, Hekal, Samia, A, Kassem, S. T. "SOME PHYSIOLOGICAL RESPONSES AND SKIN PROPERTIES OF SHAMI GOATS AS AFFECTED BY SALINITY UNDER DESERT CONDITIONS", Journal of Environmental Science, 2018

Publication

Exclude quotes Off

Exclude bibliography Off

Exclude matches Off