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Manufacture of Exotic Leather and Small Leather Goods from Ovine Stomach

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Abstract

Leathers made from exotic skins or rare parts of animals have very good market value. The exotic leathers are usually preferred because of their patterns, naturally occurring marks and their unique structures. The objective of this study was to investigate the feasibility of tanning the ovine stomach into novelty leather and leather products. The ovine stomach was converted into an exotic leather using oil tanning methodology, with goat oil as a tanning agent. The rumen and reticulum parts of the stomach were taken through pre-tanning, tanning and post-tanning operation. The resultant leather had a different grain from the ordinary leather. Then mechanical operations like drying, toggling and staking were done. Physical properties of the leathers were analyzed by determining their thickness, tensile strength, elongation at break, tear strength, flex endurance and ball burst extension test. The grain structure of the leathers was analyzed using a light microscope. The results of physical tests were poor compared to the grains of conventional leathers since the composition of raw outer coverings of animals and those of the stomach are different. The leather processed from this non-conventional source has been found suitable for manufacturing fancy small leather goods like coin purse, key holders, purses and wallets.

Introduction

Exotic leather production refers to the tanning of the outer covering of rare species of animals and other parts of animals that are not used for making leather.[1] The beauty, durability, texture, and extraordinary properties of these leathers have fascinated many people. Several types of skins such as crocodile, ostrich, emu, alligator,[2] stingray, eel, snake, shark,[3] pythons, frogs,[4] lizards and stingray fish[5] have become popular as materials for making leather for fashion apparel, footwear, accessories, and interior products.[6] The use of exotic skins dates back to the early man. The hunting and the gathering communities used skins from reptiles, birds, fish and amphibians for adornment to their clothing or for their head-dresses as well as for covering articles such as drums.[7] The skins were made less resistant to putrefaction by drying, they were made supple by fleshing and applying animal oils.[7] Different animals have different features that provide leather with varying properties and these have resulted in increased demand for various leather products in the market.[6]

There are four compartments of the stomach of a ruminant animal. These are the abomasum, omasum, rumen and reticulum. The abomasum is the main diction and absorption compartment of the stomach. Rumen, the bulk of the stomach, constantly mixes, turns and digests the food.[8] The inside of the rumen is lined with finger like structures called papillae.[1] The papillae help to increase digestion by moving the food around inside the rumen. The omasum is made up of many folds. The reticulum looks like a honeycomb.[8] The reticulum differs from the rumen regarding to the texture of its lining. The reticulum is lined with ridges that form a hexagonal honeycomb pattern. Despite the differences in the texture of the lining of the two parts of the reticulorumen, it represents one functional space.[9]

The process of converting raw material into exotic leather generally involves three steps, with the first step being pre-tanning. Pre-tanning involves soaking, liming and unhairing, deliming, bating, pickling and degreasing to remove unwanted components, hair, adipose tissue, fats, etc., leaving a network of fiber proteins.[10] The next step, tanning, involves reacting the pre-tanned material with suitable tanning agents such as chrome, vegetable, combined tanning or oil to produce a stabilized fiber structure.[11] Finally, post-tanning which involves neutralization, retanning, dyeing, fatliquoring and finishing in order to improve fiber characteristics and to produce a useful product.[12] In the present study the rumen and the reticulum parts of the stomach were processed into exotic leather with a grain, which has a different variety from the ordinary leather.

Experimental procedures

Sample collection and preparation

The ovine stomachs were collected from a slaughter house in Nyeri town, Kenya. The stomachs were cleaned by washing dirt with clean water and cutting off the unwanted parts on the stomach. Goat oil was obtained using the procedure described in literature.[13]

Pre-tanning

The ovine stomachs were washed using 400% water and 0.5% wetting agent. The stomachs were washed thoroughly and drained until

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they were clean. Liming was done with 200% water and 8% lime (in two portions) for 24 hours, with the drum left to stand for every 15 minutes for every two hours. The tanning drum was drained and the limed pelts were washed with clean water. During deliming process, 150% water at normal temperature, 2% ammonium sulphate and 1% sodium metabisulfate were added and the drum left to run for one hour. The cross-section was checked by phenolphthalein (colorless). The delimed stomachs were then bated with 1% enzymatic bate for one hour.

Tanning

Tanning of the ovine stomach was carried out according to the recipe provided in Table I.[13] Goat oil tannage was conducted since we had reported in our previous work that cod oil had poor rating in terms of odor compared to goat oil. The resultant leather was then dyed, horsed up, dried and staked.

Leather analysis

The leather was conditioned using ISO 2419 test method. Physical and organoleptic properties of leather were tested.[14] Physical properties, which included thickness, tensile strength, elongation at break, tear strength, flex endurance and ball burst extension test were measured using IUP methods. Organoleptic properties, i.e., softness, color and grain pattern, and general appearance were tested by leather experts. Sink test and Eward effect were also conducted.

Structural analysis

The grain patterns of the exotic chamois leather from the reticulum and rumen stomach were analyzed using a Light Microscope, Zeiss Axio Zoom.V16. The samples were analyzed by cutting pieces measuring10 mm by 10 mm, clamping them on the stage and the micrographs for the grain pattern was obtained by operating the microscope at (16×) magnification.

Results and Discussion

Sink test

When the stomach chamois leather was immersed in cold water, it absorbed little amount of water. This could be because the amount of water absorbed depend greatly on the porosity of the hide or skin, thus indicating that oil tanned stomach is not very porous.[15] The leathers were buffed on flesh side with the aim of improving water absorption capacity of the leather but no appreciable increase in the amount of water absorption was noted. It was also observed that buffing and snuffing on either side of the stomach leather was not effective.

Eward effect

Ovine stomach chamois leather showed unique Eward effect, whereby when immersed in hot water at about 70°C, they shrunk immediately and the area became thick and when the shrunken leathers were immersed in cold water, they relaxed immediately and regained 90% of its original area implying that the leathers passed the Eward effect test. Oil-tanned leather is one of a few cases where the leather exhibits reversibility effect following hydrothermal shrinking.[16]

Table I

Recipe for oil tanning of the ovine stomach

Process	Chemicals	Amount (%)	Time (h)	Remarks
Pickling	Water	150	2	The pH was adjusted to 3.2
	Salt	10		
	Formic acid	0.8		
	Sulfuric acid	1		
Pre-tanning	Glutaraldehyde	0.5	2	The pH was adjusted to 8.5 and the skins were piled for 12 hours
Oil tanning	Oil (Goat oil)	30	6	The skin was uniformly drummed along with oil for 6 hours
Oxidation (inside the drum)	Hydrogen peroxide	6	4	The skin was drummed for 4 hours
Oxidation (outside the drum)			12	The materials were hung on the toggle drier at room temperature
Alkali wash	Water	400	1	The leather was washed three times and drained.
	Soda ash	0.25		
	Wetting agent	0.5		

Table II

Physical properties of ovine stomach leather

Physical properties		Exotic chamois leather		
		Reticulum stomach leather	Rumen stomach leather	Standard value SNI06-1752-1990 (minimum)
Thickness (mm)		1.22 ± 0.19	0.65 ± 0.12	0.3 - 1.5
Tensile strength (N/mm^2)		15.64 ± 0.86	11.51 ± 0.61	>7.5
Elongation at break (%)		58.63 ± 1.24	45.01 ± 1.22	>50
Tearing strength (N/mm)		33.01 ± 0.51	28.90 ± 0.61	>15
Flex endurance at 100,000 flexes		No damage	No damage	No damage
Ball burst extension (mm)	Grain crack	7.79 ± 0.21	5.88 ± 0.22	6.5
	Grain burst	8.45 ± 0.22	6.93 ± 0.06	7

Physical tests

The physical properties of the chamois leathers obtained thus are summarized in Table II below.

Thickness

The oil tannage, which is actually a "shrinkage" tannage, raised the thickness of ovine stomach. From the results recorded in Table II, it could be observed that the thickness of reticulum and rumen part of the stomach leather was 1.22 ± 0.19 mm and 0.65 ± 0.12 mm respectively. These thicknesses achieved by the exotic chamois leather were within the minimum recommended values.[17]

Tensile strength

Tensile strength of leather is the greatest longitudinal stress leather can bear without tearing apart. The tensile strength of leather is determined by the fibrous structures that constitute the collagen network structure and the modification of this structure by the tanning agents.[16] The minimum tensile strength for chamois leather should be at least 7.5 N/mm^2.[17] This study found the tensile strength of the exotic chamois leather was higher than 7.5 N/mm^2. The reticulum part of the exotic leather had a tensile strength of 15.64 ± 0.86 N/mm^2 while the rumen part had a tensile strength of 11.51 ± 0.61 N/mm^2. Leather obtained from the rumen recorded lower tensile strength as compared to the tensile strength of the reticulum part and this could be attributed to the fact that leather is anisotropic in nature.[18] The hexagonal honeycomb-like structures on the reticulum may also be playing a role as a reinforcement of the belt, thus making it less susceptible break compared to the rumen.

Elongation at break

Elongation refers to the ability of a leather product to lengthen/stretch when stress is applied to it and represents the maximum extent leather can stretch without breaking. Elongation is an important property to be considered when choosing leathers because a low elongation value results in easy tear while a high elongation value causes leather goods to be deformed very quickly or even lose usability.[19] Leathers that have a lower tensile strength have a lower percentage elongation and vice versa. From Table II, it could be observed that the percentage elongation of reticulum and rumen part of the stomach leather was 58.63 ± 1.24 and 45.01 ± 1.22 respectively. The elongation at break of the rumen was poor since it was below the minimum recommended value while the elongation at break of the reticulum part of exotic chamois leather met the standard of 50% minimum.[17] The observed trend could as well be attributed to the honeycomb-like features on the surface of the reticulum.

Tearing strength

The strength of the leather products in use is indicated by the quality standard relating to tearing load. Table II shows that all the leathers tested had more than 15 N/mm which is the minimum recommended value of tear strength of chamois leather and it was concluded that the leather fulfilled the SNI-06-1752-1990 standard.[17] The tearing strength of the rumen part of the leather recorded lower tearing strength as compared to the reticulum and this could be attributed to different parts of the stomach serving different purposes and therefore having different properties.[18] Similarly, the characteristic patterns on the surfaces of the different parts of the stomach could be at play as pointed out earlier.

Flexing endurance

Flexing test was applied to the respective leathers and there was no damage at 100,000 flexes to any of the leathers. All the studied leather samples passed the flexing test hence, it could be inferred that the method of tanning did not affect the flexing endurance of the leathers. Therefore, the obtained exotic leathers could be used to make small leather product that flex.

Ball burst test

The ball burst test is another physical property for testing quality of leathers. It is intended to indicate the grain resistance to cracking.

Figure 1. Photographic plate of finished ovine stomach chamois leather

From Table II, it could be observed that the reticulum part of chamois leather samples tested had values 7.79 ± 0.21 mm, 8.45 ± 0.22 mm for grain burst and grain crack respectively, which are higher than the minimum recommended values of 6.5 mm and 7.0 mm. The rumen part failed the test since it recorded lower values of 5.88 ± 0.22 mm and 6.93 ± 0.06 mm respectively for grain crack and gain burst against the above minimum recommended values.[17] Pre-tanning, tanning and post tanning processes and also the type of raw material are known to affect the grain crack and grain burst test.[20] Howbeit, in this case, it is evident from Table II that the thickness also affected all the analyzed physical properties. The rumen that recorded lower thickness value consistently displayed lower values in all the conducted tests.

Color and dyeing

The stomach leathers were yellow except for papillae which were light brown. According to the SNI 06-1752-1990, preferred color of chamois leather is yellow to nearly white.[17] The color possibly indicates that oxidation on the papillae was faster and more severe than on the stomach, and a brown color in oil tanning always point to a fast rate of auto oxidation.[15] Due to poor color uniformity of the exotic chamois leather, the leathers were dyed and this gave uniform color to the leathers as shown in Figure 1 below. The color intensity of the applied dye ranged between 6-7 as shown in Table III.

Organoleptic properties

The table below shows the organoleptic properties of the exotic leathers from ovine stomach.

The evaluated organoleptic properties of the chamois leather included softness, color intensity, general appearance and grain pattern. Soft leather tends to increase its water absorption and flexibility, so it will provide comfort during use[15]. From Table III, it can be seen that organoleptic properties of the leathers obtained from this study were above average on a scale of 10. Color intensity of the stomach leathers ranged between 6-7. This shows that the dye had penetrated. The obtained leather had unique appearance which was different from the ordinary leather. Reticulum leather was lined with ridges that form hexagonal honeycomb-like patterns while rumen leather was covered in small finger-like projections called papillae, which are flattened. These features gave the leathers an appealing look (given the general appearance rating of 8) as shown in Table III.

Table III

Organoleptic properties of stomach leather

Organoleptic properties	Reticulum leather	Rumen Leather
Softness	6	7
Color intensity	7	6
General appearance	8	8
Grain pattern	9	8

Grain structure

The grain structures of the leathers obtained from reticulum and rumen parts of the stomach are shown in Figure 2. The reticulum leather is lined with ridges that form hexagonal honeycomb-like patterns while rumen chamois leather is covered in small finger like projection which are flattened. The retention of the primary features of the raw materials is what gives chamois leathers their aesthetic look,[3] hence their high pricing due to high demand. Most customers are willing to pay more just to access chamois-based products since the uniqueness in the products gives them the inherent social status and ornamental value. Therefore, products manufactured from ovine stomach chamois will find a market share due to this factor.

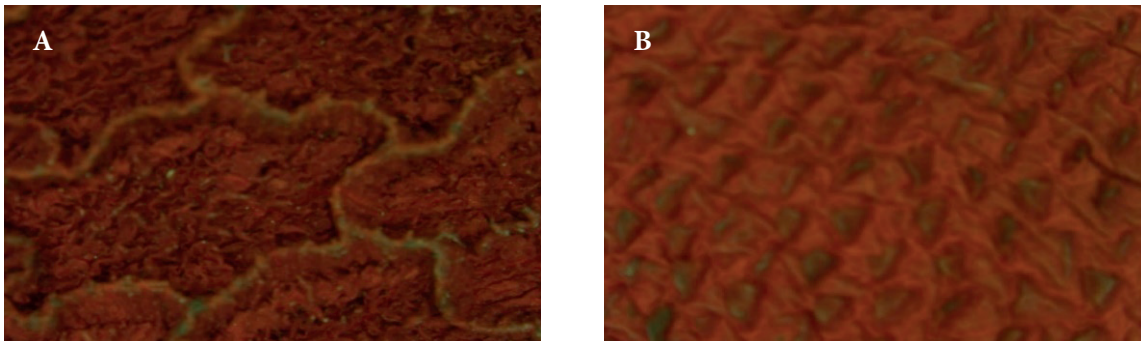

Figure 2. Optical microphotographs (16X) of stomach leather: Reticulum **(A)**, Rumen **(B)**

Figure 3. Products made from exotic ovine stomach leather: wallets and key holders

Products

The leather obtained from the ovine stomach was used for making novelty products as shown in Figure 3 below. Here, wallets and key holders were made. The results indicate that ovine stomach can be used as a source of raw material for exotic chamois leather production and subsequently for manufacturing small goods and products. In so doing, value addition to animal parts that are otherwise discarded during slaughtering[21] process will be achieved.

Conclusion

The ovine stomach, a non-conventional source of leather, was used to produce a new variety of exotic chamois grain leather. The oil tannage impacted on the softness and stretch of the obtained leathers. The thickness of the stomach increased to a reasonable degree due to shrinkage effect of the tannage. The organoleptic properties of the leathers were above average. Small products such as purses and key holders were made out of the exotic leathers. Therefore, ovine stomach can be a source of raw materials for exotic leather production.

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