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Evaluation of Chamois Leather Using Corn Oil (*Zea Mays*) as The Tanning Material

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ABSTRACT

One of the main characteristics of chamois leather is its high ability to absorb water; thus, chamois leather is generally used for cleaning and drying. The usual tanning material for chamois leather is fish oil. However, it makes the chamois leather product have a strong odor. This study aims to evaluate the quality of chamois leather from rabbit skin tanned with corn oil. The treatments included the addition of several corn oil concentrations consisting of P0 (30% fish oil), P1 (10% corn oil), P2 (20% corn oil), and P3 (30% corn oil). The results showed that corn oil as a tanning material was able to increase the ash content, elongation, tear strength, and water absorption of chamois skin and was able to reduce oil content, and did not change the tensile strength, color and odor of the chamois leather produced. The quality of chamois leather with 30% corn oil indicated the ash content as much as 3.19%, oil content as much as 7.87%, elongation as much as 94.51%, tear strength as much as 46.47 N/mm, water absorption (24 hours) as much as 279.03%; and tensile strength as much as 9.9 N/mm2. It also produced yellowish-white color with no odor. This quality has met the requirements of the Indonesian National Standard (SNI): 0617521990. The study concludes that 30% corn oil can substitute fish oil to produce chamois leather.

Keywords: Chamois leather, Corn oil, Evaluation, Rabbit skin, Quality

Introduction

Chamois leather has special properties, such as having low density, excellent softness, and high flexibility. Besides, it can absorb water at least twice as much as its weight. The water absorption property comes from the effect of the oil matrix that can hold the leather protein apart; thus, it becomes highly porous leather (Sandhya *et al*., 2015).

Chamois leather is widely used for filtering, cleaning, and drying. It is also for glove materials and orthopedic appliances (Suparno, 2010). Generally, the chamois tanning process applies fish oil, such as cod oil, shark oil, and menhaden oil, as it contains unsaturated triglycerides taking the ability to tan. However, the tanning process using fish oil has a significant drawback as it causes a sharp odor due to the remaining oxidized fish oil sticking on chamois leather products (Krishnan *et al*., 2005a).

Researchers have attempted to search alternatives to fish oil as a tanning material to reduce odor and increase the water absorption of chamois leather, including using fish oil esterified with Poly Ethylene Glycol (PEG) (Krishnan *et al*., 2005b), rubber seed oil (Suparno, 2010), flaxseed oil (Sandhya *et al*., 2015), oil from fleshing process waste in the leather industry (Peris *et al*., 2019), methyl esters of castor oil (Vedaraman *et al*., 2014), and methyl esters of fish oil (Vedaraman *et al*., 2012).

One of the efforts to find a substitute for fish oil is to use vegetable oils, such as corn oil. Utilization of corn as industrial raw material will provide value added for the farming of these commodities, one of which is used for chamois tanner. In addition, the development of corn production in Indonesia tends to increase by an average of around 5.26% per year in the last 10 years. This is directly proportional to the average productivity increase of about 4.30% per year. (Aldilah, 2017).

Corn oil contains a large amount of unsaturated fat. This fat is in the form of monounsaturated and polyunsaturated fat (O'kuru *et al*., 2011). In addition, corn oil has met the requirements as a tanning material because it contains Iodine Number 107-135 (Abdullah *et al*., 2018). Oil with a high Iodine value contains more unsaturated fatty acids, which have at least two double bonds; the double bond will take two groups of oxygen atoms leading to the peroxide process (-0-0-). Eventually, this peroxide will react with the amino groups of collagen.

The raw materials of chamois leather can be from goat, sheep or cow skin. Sheepskin produces softer chamois leather as compared to goatskin. Besides, the chamois leather from goat and sheepskin has way better quality than cowhide (Lawal and Odums, 2015). However, there is very little information about rabbit skin as the raw material for chamois leather. The use of rabbit skin that is smaller and thinner than goat and sheep skin has not been widely studied.

The current research uses rabbit skin as raw material for chamois skin and corn oil as the tanning material. This study aims to evaluate the quality of chamois leather made of rabbit skin using corn oil as the tanning ingredient.

Materials and Methods

The materials consisted of raw materials and auxiliary materials. The raw materials were fifteen sheets of male Rex rabbit skin obtained from a rabbit farm in Malang. The auxiliary materials in the chamois peeling process included sodium sulfate, lime, sulfuric acid, alum, oropon, sodium carbonate, formalin, cod liver oil (obtained at a supermarket in Malang), and detergents.

The instruments used in this study included tools for the chamois tanning process, namely tanning drum, thermometer, sawhorse, and skin stretcher. The tool to test the quality of chamois leather was the Atlas crock meter model M238AA; it was to measure the resistance of both wet rub fastness and dry rub fastness. Meanwhile, The tool used to test the tear strength was the universal testing machine; and, the tool to test the leather elongation was the strength tester.

The study was conducted experimentally, with a completely randomized design (CRD). This study used 4 treatments and 5 replications. The treatments given in this study were P0 = 30% fish oil, P1 = 10% corn oil, P2 = 20% corn oil and P3 = 30% corn oil. The variables measured include chemical factors, namely ash and oil content, physical factors include elongation test, tensile strength and tear strength, while organoleptic includes color and odor of chamois skin.

Corn oil extraction for tanning materials

150 g of mashed corn were extracted in 300 ml n-hexane at a temperature of 70-80°C using a soxhlet with the 12-hour extraction time. The extraction results were then concentrated with a rotary evaporator at 70°C. Next, the extracted oil was collected in a weighing bottle and stored at a temperature of 20°C. The process was repeated until the required amount of corn oil sufficed. The oil tanning process are shown in Table 1.

Chamois leather quality testing

The parameters tested in the study referred to the SNI requirements for tanned chamois leather. It included some chemical properties consisting of ash and oil content. Also physical properties consisting of elongation, tear strength, tensile strength, and 24-hour water absorption. An organoleptic test was conducted to measure the color and smell of chamois leather. The ash content test followed the Indonesian National Standard (SNI) number 06-0563-1989 (BSN, 1989a); the oil content test used the Indonesian National Standard (SNI) number 06-0564-1989 (BSN, 1989b). Meanwhile, the

Table 1. Oil tanning process

Process	Chemical Ingredient	Amount	Time	Aim
Washing	Water	200%	Wash and drain 60' minutes	To remove preservative salt
	Na_2S	5%	Rotated for 60 minutes, then	To remove hair and fat
Liming	Water	400%	soaked for 24 hours and drain	
	$Ca(OH)_2$	8%		
	Water	200%	Rotated for 60 minutes and drain	To remove lime
Deliming	H_2SO_4	1.0%		
	$(NH_4)_2SO_4$	0.5%		
Bating	Oropon	0.5%	Rotated for 60 minutes and drain	To scrape protein Check pH 8-9
	Water	100%	Rotated for 60 minutes and drain	For the initial tanning process
Pre-tanning	HCOH	5%		
	Na_2CO_3	3%		
Oil tanning	P0 (Corn oil)*	(0%)	Rotated for 24 hours and drain	For oil tanning
using corn oil	P1 (Corn oil)	(10%)		
	P2 (Corn oil)	(20%)		
	P3 (Corn oil)	(30%)		
Washing	Na_2CO_3	200 g		To remove excess oil from the leather
	Water	1 liter of water 50˚C		
Aeration			24 hours	To reduce the water content
Drying				
Buffing				To make the leather surface as smooth as velvet
Chamois leather testing				To determine the quality of chamois leather

* P0 = using 30% cod oil (without corn oil).
The percentage is based on % of leather weight.

elongation test, tensile strength, and tear strength referred to the Indonesian National Standard (SNI) number 06-1795-1990 (BSN, 1990a) ; and, the water absorption test used the Indonesian National Standard (SNI) number 06-1752-1990 (BSN, 1990b).

Data analysis

The data in the forms of ash content, oil content, skin elongation, tensile strength, tear strength, and water absorption were analyzed by analysis of variance (ANOVA). When an effect on the measured variables was found, the Duncan Multiple Range Test (DMRT) test was conducted. Meanwhile, the organoleptic data in the forms of color and odor were analyzed descriptively (Steel and Torrie, 1991).

Results and Discussion

Chemical quality of chamois leather tanned with corn oil

The results of the chemical quality are shown in Table 2. Table 2 shows that the use of corn oil has a significant effect (P<0.01) on the ash content and oil content of Chamois leather. The ash content ranges from 2.76 % to 3.19 %. Its value meets the Indonesian National Standard (SNI): 06-1752-1990 with a maximum value of 5% (BSN, 1990b). It is probably because corn oil can bind perfectly to skin collagen. The tanning process begins with the hydrolysis of fatty acid triglycerides. Then by the air into fatty acid oxidation – fatty acid oxidation that reacts with collagen. Therefore, the more oil enters the collagen matrix, the more non-collagenous materials trapped in the matrix will be released. It is evidenced by the low ash content in the produced Chamois leather.

According to Suparno (2010), the ash content in Chamois leather is influenced by the mineral content in the leather. Such as potassium, calcium, iron, phosphorus. These minerals are generally found in leather as chloride salts, sulfates, carbonates, or phosphate salts. The low ash content in chamois tanned leather is probably caused by the remaining part of the mineral material on the leather due to the processes before tanning, namely the washing, liming, deliming and pre-tanning processes.

Table 2 also shows that the oil content ranges from 7.87% - 10.73%. The value the oil content slightly increases with the use of corn oil at a level of 10 - 20%; however, it decreases on the use of 30% corn oil. Oil content that has a low value indicates better quality because it can reduce the effect of odor and oily effect on tanned skin and indicates that the tanning activity is taking place better or perfectly. According to Novia (2009), high oil content indicates that the tanning process is not perfect, this will inhibit the penetration of tanners into the skin so that the skin will look like blemishes. Further said (Suparno and Febianti, 2014), High oil levels on chamois skin can result in odor, stickiness and discomfort when used.

The oil content values of chamois leather tanned with COD fish 30% and corn oil 30% are aligned with the Indonesian National Standard (SNI): 06-1752-1990 with a maximum value of 8% (BSN, 1990b). Therefore, the value of oil content that meets the requirements of SNI indicates good quality.

The low value of the oil content is because with a 30% oil level, the chamois tanning process runs perfectly. It indicates that the oil is bound to the leather's collagen, so that it does not fill up the surface of the produced chamois leather. On the other hand, when using an oil level of 10 - 20%, the Chamois tanning process is less than perfect. In addition, the oil level in tanned leather is also influenced by the pre-tanning process, namely the calcification stage of the skin, the skin calcification process functions to dissolve the epidermis and hydrolyze fat and other substances, so that in the calcification process some of the fat on the skin will be wasted.

The low value of the oil content in the tanning products shows their good quality. The excessive use of oil in the tanning process can be removed during the washing process with warm alkaline water. Besides, the oil content in tanned leather depends on the washing and pre-tanning processes (Maharani *et al*., 2015).

Physical quality of chamois leather tanned with corn oil

The physical quality of the chamois leather tanned with corn oil are shown in Table 3. Table 3 shows that corn oil has a significant effect (P<0.01) on elongation, tear strength, and water absorption of Chamois skin; however, it does not affect the tensile strength. The elongation of the chamois leather is from 70.88% until 94.51%. The elongation value fits the quality requirement in SNI 06-1752-1990, in which it must be at least 50%. The elongation value that is too high is not recommended as the product may stretch quickly. According to Rahmat *et al*. (2008), leather products that have too high elongation value may experience an increase in length (loose and deformed). On the contrary, if the elongation value is much lower than the SNI value, the leather may easily get broken or cracked.

Table 2. Chemical qualities of chamois leather tanned with corn oil

Variable	Cod liver oil		Corn oil		
	(30%)	(10%)	(20%)	(30%)	Standard SNI 06 – 1752 – 1990
Ash content (%)	3.11[b]	2.76[a]	3.26[c]	3.19[bc]	Maximal 5%
Oil content (%)	7.97[a]	10.56[b]	10.73[b]	7.87[a]	Maximal 10%

[a,b,c] Different superscripts in the same column are significantly different (P<0.05).

Table 3. Physical qualities of chamois leather tanned with corn oil

Variable	Cod liver oil		Corn oil		
	(30%)	(10%)	(20%)	(30%)	Standard SNI 06 – 1752 – 1990
Elongation (%)	91.96[b]	70.88[a]	84.24[ab]	94.51[b]	Minimal 50
Tear Strength N/mm	40.57[b]	22.62[a]	35.76[b]	46.47[c]	Minimal 15
2-hour Absorption (%)	237.70[a]	233.44[a]	237.15[a]	268.57[b]	Minimal 100
24-hour Absorption (%)	238.65[a]	254.42[ab]	239.22[a]	279.03[b]	Minimal 200
Tensile Strength N/mm^2	9.5[a]	9.9[a]	9.4[a]	9.3[a]	Minimal 7.5

[a,b,c] Different superscripts in the same column are significantly different (P<0.05)

From the findings, the lowest elongation value is found in the treatment using 10% corn oil. Due to the oil tanning process, many non-collagenous substances are released, making the leather structure more open. Thus, the corn oil can seep into the leather's collagen. As a result, the leather becomes weaker. According to (Pahlawan and Kasmudjiastuti, 2012). explained that the more amount of oil added, the skin will become more stretchy. The leather elongation is mainly determined by the amount of oil absorbed by the leather during the tanning and oiling stage. It also depends on the amount of cross-linking formed between the tanning materials and collagen.

From Table 3, the tear strength value is from 22.62 N/mm to 46.47 N/mm. This value is in accordance with the quality requirements of Chamois leather set in SNI 06-1752-1990, in which the minimum tear strength value must be 15 N/mm. The highest tear strength value is found in 30% corn oil; this value is almost similar to that of 30% cod liver oil. It is because 30% corn oil is sufficiently penetrated into the leather and binds to skin collagen perfectly. Consequently, the tanned skin fibers become compact and robust. The result indicates that the right concentration can produce a high value of tear strength. Nonetheless, an inappropriate amount of oil concentration will make the leather's physical strength decrease.

According to Mustakim *et al*. (2006), if the oil concentration used in the oiling process is small, the oil particles cannot be dispersed evenly, and the oil penetration into the skin fibers is weakened. With such a condition, the leather may get easily torn when pulled.

Water absorption is a determining factor of chamois leather quality. This property determines the ability of chamois skin to absorb water. In table 3, both the absorption value (for 2 hours) and absorption value (24 hours) meet the SNI 06-1752-1990, in which the minimum absorption value must be 200%. The result of 2-hour absorption ranges from 233 (%) - 268 (%). Meanwhile, the result of 24-hour absorption ranges from 238.65 (%) to 279.03 (%). The result of the variance analysis shows that the corn oil concentration affects the water absorption at both 2-hour and 24-hour periods. The highest water absorption is found in the use of 30% corn oil. It is because in the application of 10-20% corn oil, the triple helix bond of the leather collagen is lower than that in the use of 30%. Therefore, the water absorption is not strong enough as compared to the use of 30% oil.

In general, the 24-hour water absorption capacity is higher than the 2-hour water absorption capacity. This is because the longer the absorption time is, the more water is absorbed by the leather. However, the water absorption will remain when the saturation point is achieved.

In Table 3, the tensile strength value of chamois leather ranges from 9.3 N/mm^2 to 9.9 N/mm^2. This value is in accordance with the quality requirement set in SNI 0617521990 with the minimum tensile strength value as many as 7,5 N/mm^2. The value of the tensile strength using 30% corn oil produces a low tensile strength value. The more corn oil is used in the oil tanning process, the more surface of the leather fiber is lubricated with oil. Consequently, the leather becomes weak and stretches easily. It causes the leather fiber bonds to loosen, causing the decrease of the leather's ability to withstand tensile loads.

The higher the tensile strength is, the lower the elongation will be and vice versa. It is also assumed that breaking collagen fibers will reduce the ability of the leather to withstand tensile loads; therefore, the tensile strength decreases, yet the elongation value increases.

Organoleptic quality of chamois leather tanned with corn oil

The organoleptic quality of the chamois leather tanned with corn oil are shown in Table 4. The color indicates the level of brightness and cleanliness of the leather. According to SNI 06-1752-1990, the preferred chamois color is yellow to almost white (BSN, 1990b). The result of the organoleptic test of chamois leather is yellowish-white. This color is influenced by the formation of linoleate glycerides of unsaturated ketone compounds during the soaking process with acid. It indicates that chamois leather color is not caused by the use of corn oil. On the other hand, the yellow color can be produced from the protein and nitrogen extraction process (Ketaren, 2008).

Meanwhile, the odor of chamois leather is generally caused by the residual oil on the leather due to an insufficient washing process. Unwanted odors will reduce the aesthetics of the product and consumers' appeal. From the result of the organoleptic test on the odor of the chamois leather, 30% corn oil gives the same odor value as that of 30% fish oil. It shows that corn oil in the chamois tanning leather does not make any

Table 4. Organoleptic qualities of chamois leather tanned with corn oil

Variable	Cod liver oil	Corn oil			
	(30%)	(10%)	(20%)	(30%)	Standard SNI 06 – 1752 – 1990
Color	Yellowish white	Yellowish white	Yellowish white	Yellowish white	Yellowish white
Odor	Odorless	Odorless	Odorless	Odorless	Odorless

difference to the odor of the leather. Generally, the smell of chamois leather depends on the washing process; if the washing process is not perfect, it will leave an unwanted odor as the odor is produced by oil residue adhering to the leather.

Conclusions

The quality of chamois leather from rabbit skin tanned with 30% corn oil generally meets the Indonesian National Standard. Thus, corn oil up to 30% can be used as a substitute for fish oil as a tanning ingredient to produce chamois leather.

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