The Effect of Storage Time on Physical Quality of Vegetable Tanned Goat Leather

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Abstract. The study aimed to investigate the effect of storage time on the physical properties of vegetable-tanned goat leather. We divided the storage time into three treatments, namely P0 (0 months), P1 (3 months), and P3 (12 months). The observation parameters for investigation included tensile strength, elongation, and shrinkage temperature, while the statistical analysis was done using the analysis of variance, completely random design, and the orthogonal contrast test α to get optimum value. The results showed that there were significant differences ($P < 0.05$) in all treatments. The values of tensile strength, elongation, and shrinkage temperature of vegetable tanned-goat leather were evaluated in comparison with Indonesian National Standard (SNI) Number 06-0237-1989. From the current study, it is concluded that the storage time of 0 months produced the best physical quality of vegetable-tanned goat leather.

Keywords: Goat leather · physical quality · vegetable tanned · time storage

1 Introduction

Indonesia is a tropical country with a climate that is suitable for goat farming, supported with large areas of land that are widely used for agriculture and animal husbandry. The meat goat industry is one of the potential commodities to be developed in Indonesia. This can be seen from the data of the Central Statistics Agency 2020 stating that the goat population in Indonesia reached 19.096.381 heads.

Goat skin is widely processed as a raw material in the leather industry. It has been a major material for making wallets, jackets, shoes, bags and other products. To maintain the good quality of the leather, it is necessary to carry out a tanning process to bind the chemicals so that the leather can be more stable. However, the current problem is that the chemicals used can have an impact on the environment.

With the increasing public awareness about the environment, many consumers ask for products that are made from eco-friendly materials. In the leather industry, a greener method of the tanning process is by using vegetable tanner. This can be considered as an alternative to non-chrome tanning technology, but innovations need to be made so as not to produce dense, stiff and hard leather with relatively long tanning [3].

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Vegetable tanners are tanning materials derived from plants such as acacia, gambir (*Ucaria gambir*), mahogany, and others. Mimosa is a tanning agent that contains tannin and is obtained from the extraction of the bark of acacia (*Acacia mearnsii*) [2]. The important properties of mimosa tanners are that it is easily soluble in water and environmentally friendly, and it produces leather products that are fuller, brown in colour, and have a more attractive look [6].

Leather tanning is the process to make the skin durable and resistant to damage or decay with the help of chemicals, both organic and non-organic. The leather tanning process can be broadly divided into three stages. The first stage is the soaking process or known as pre-tanning, the second stage is the tanning process, and the third stage is the final or post-tanning process [8].

The leather tanning process results in various physical properties depending on the factors that influence it. The physical properties of leather are the skin's resistance to environmental influences such as storage. Skin storage aims to prevent skin damage that can be caused by microorganisms in a certain period of time. Storage time can have a direct effect on the chemical properties of the skin, and an indirect effect on the physical properties of the skin. This is because, during skin storage, a hydrolysis process can occur [7]. This study aimed to determine the effect of storage time on the physical quality of goat skin including tensile strength (N/cm^2), elongation (%) and shrinkage temperature (^oC).

2 Materials and Methods

2.1 Tensile Strength and Elongation Test

This study used one pieces of vegetable-tanned goat skin which were stored at room temperature (±28 °C) for different periods of 6 and 12 months. Each sample was then tested for physical qualities including tensile strength test, elongation test and shrinkage temperature test. The tensile strength and elongation test began with the skin being cut into a pattern. The skin thickness was then measured using a deal thickness gauge while the skin width was also measured using a digital calliper. The sample that had been measured for thickness and width was then clamped on a tensile strength meter with a distance of 5 cm. The scales indicating the maximum load and the increase in length were set to zero. The tool was then run by increasing the load little by little until the leather broke off. The length increment was then recorded.

2.2 Shrinkage Temperature

The shrinkage temperature test began by cutting the leather according to the pattern, then the preparation process was carried out by mixing a solution of water and glycerin in a 50:50 ratio of 300 ml and storing it in a measuring cup. The skin that has been cut according to the pattern was then attached to the shrinkage meter by clamping the two ends of the sample. The prepared solution was heated to a temperature of 50 °C, then poured into the skin sample that had been installed on the shrinkage meter. The temperature was increased by 3 °C every minute until the skin shrank, and the temperature at which the skin shriveled was then recorded.

Data analysis. All data obtained were statistically analyzed using ANOVA which was arranged based on the Completely Randomized Design with a unidirectional pattern. The data with significant differences were further tested using orthogonal contrast with the help of Microsoft Excel personal computer software. To get the optimum results, regression analysis was performed.

3 Results and Discussion

3.1 Tensile Strength

Tensile strength is the amount of force required to pull the skin until it breaks and is expressed in units of N/m^2. The data on the tensile strength value of the three types of storage treatment was higher than the minimum value of the Indonesian National Standard (SNI), namely 1600 N/cm^2 (Table 1).

The results of orthogonal contrast analysis showed that there was a significant difference ($P < 0.05$) between each storage treatment in terms of tensile strength of vegetable-tanned goat skin. The P0 treatment gave a higher tensile strength than P1 and P2 treatments. From the results of the regression analysis that had been conducted, it can be seen that there was a significant difference ($P < 0.05$) in each storage treatment in terms of tensile strength of vegetable-tanned goat skin. The optimum storage for the tensile strength occurred in the 16th month with a tensile strength value of 1.887,2 N/cm^2 (Fig. 1).

Judging from the graphs and data, it can be seen that the longer the storage time, the lower the tensile strength. Over time, the skin will be damaged. One of the causes of damage due to storage treatment is the environment around the skin. The skin environment that is not in accordance with the standards will accelerate the lysis occurrence, while the tanning process tries to prevent this process by reducing the microbes in the skin. The strength and hardness of the skin are influenced by several factors, including the thickness of the skin, the density of collagen protein, the carcass braiding angle of collagen fibres, the thickness of the corium, and the fat level.

3.2 Elongation

The elongation of the skin is the percentage obtained from the result of the division of the length increment of the skin that is pulled until it breaks by the initial length of

Table 1. Results of tensile strength test (N/cm^2) of vegetable tanned goat leather.

	P0	P1	P2
Replication 1	3.045,07	2.462,1	2100
Replication 2	3.126,14	2.050,38	1686
Replication 3	3.459,91	2.668,54	2115
Average	$3.210^{b} \pm 219.87$	$2.400,37^{a} \pm 323,54$	$1.967^{a} \pm 243.46$

^{ab} uncommon superscripts indicated significant different ($P < 0.05$)

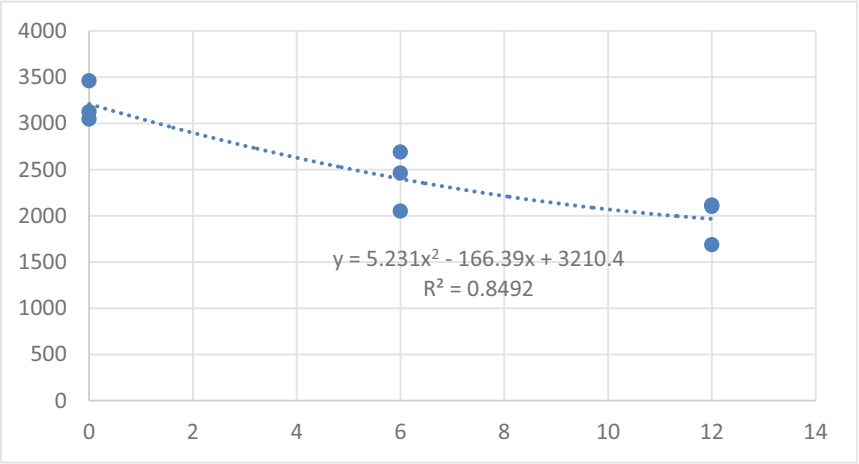

Fig. 1. Graph of the relationship between storage level and storage time in terms of tensile strength of vegetable tanned goat skin

Table 2. Results of elongation test (%) of vegetable tanned leather.

	P0	P1	P2
Replication 1	30,44	38,24	37,26
Replication 2	35,05	40,78	43,02
Replication 3	33,36	35,78	39,12
Average	$32,95^{b} \pm 2,33$	$38,25^{b} \pm 2,52$	$39,8^{a} \pm 2,93$

^{ab} uncommon superscripts indicated significant different ($P < 0.05$)

the skin before being pulled. Skin elongation is usually associated with slackness or elasticity. The data of skin elongation value in Table 2 shows that the three types of storage treatments were higher than the SNI, which was 30% at maximum.

The results of orthogonal contrast analysis showed that there was a significant difference ($P < 0.05$) in each storage treatment in terms of the elongation of vegetable-tanned goat skin. The P2 treatment gave higher elongation when compared to P0 and P1 treatments. In addition, the results of the regression analysis also showed the significant difference ($P < 0.05$) in each storage treatment in terms of the elongation of vegetable-tanned goat skin. The optimum storage for elongation occurred in the 11th month with an elongation value of 39.81% (Fig. 2).

Judging from the graph, it can be concluded that the longer the storage time, the elongation will increase. The elongation of the skin is influenced by the composition level of fiber protein present in the skin [4]. The longer the storage time, the tannery material that binds to the collagen fibre protein will decrease, causing the skin to be damaged quickly.

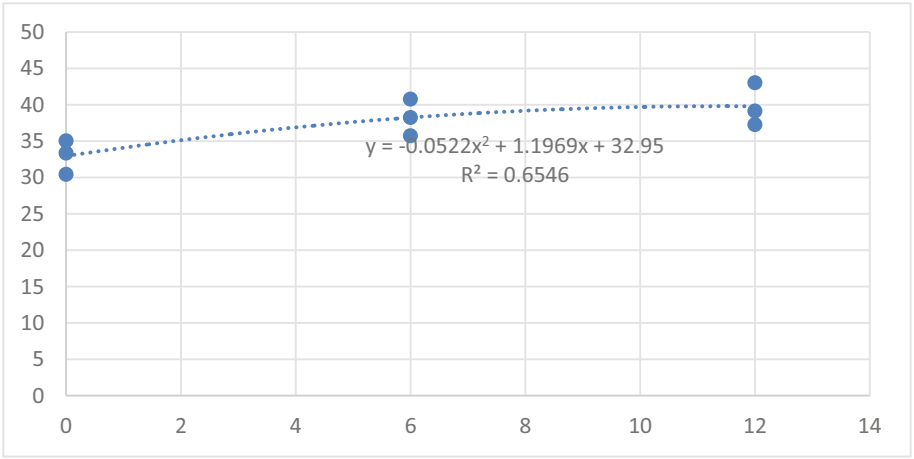

Fig. 2. Graph of the relationship between storage level and storage time in terms of elongation of vegetable tanned goat skin.

Table 3. Results of shrinkage temperature test (°C) of vegetable tanned goat leather.

	P0	P1	P2
Replication 1	86	76	73
Replication 2	87	69	67
Replication 3	89	65	66
Average	$87{,}33^{b} \pm 1{,}52$	$70^{a} \pm 5{,}56$	$68{,}67^{a} \pm 3{,}78$

^{ab} uncommon superscripts indicated significant different ($P < 0.05$)

3.3 Shrinkage Temperature

Shrinkage temperature is the temperature at which the skin shrinkage when heated in a medium containing water [1]. Shrinkage temperature data in Table 3 shows that the values in three types of storage treatments were higher than the SNI, which was 70 °C at minimum.

The results of orthogonal contrast analysis showed that there was a significant difference ($P < 0.05$) in each storage treatment in terms of shrinkage temperature of vegetable-tanned goat skin. The P0 treatment gave a higher shrinkage temperature compared to P1 and P2 treatments. The results of the regression analysis also gave us the information that there was a significant difference ($P < 0.05$) in each storage treatment in terms of shrinkage temperature of vegetable-tanned goat skin. The optimum storage for shrinkage temperature occured in the 9th month with a shrinkage temperature value of 67.27 °C (Fig. 3 and Table 3).

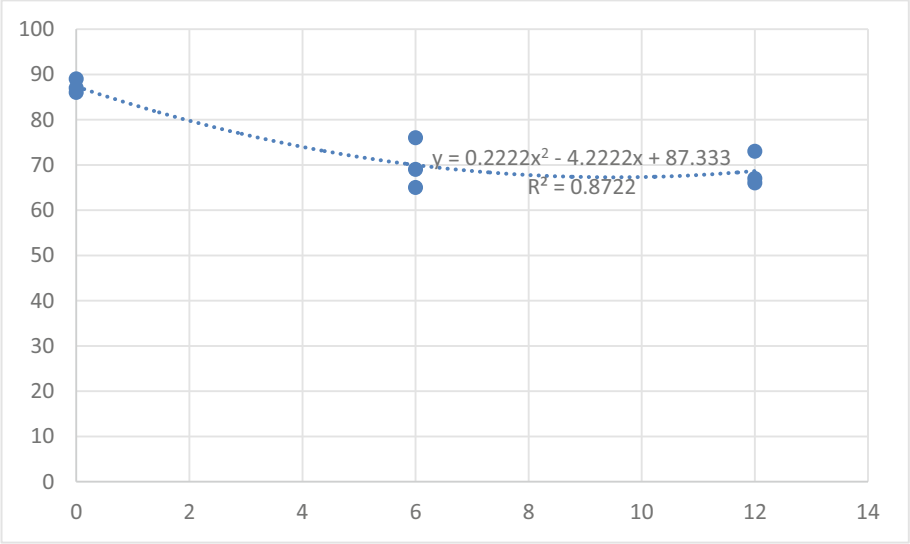

Fig. 3. Graph of the relationship between storage levels and storage time in terms of shrinkage temperature of vegetable tanned goat leather.

Judging from the graph, we can observe that the longer the storage time, the lower the shrinkage temperature. The decrease in shrinkage temperature was due to the differences of protein content and water content in the skin. The level of shrinkage temperature of the skin is associated with the level of hydroxyproline and water content bound to collagen [5]. Longer storage treatment will give more time for the bacteria which produce the collagenase enzyme to lyse the collagen protein. In addition, the longer storage time causes evaporation of water in the skin, hence affecting the water content bound to collagen and reducing the quality of the skin.

4 Conclusions

This based on the research, it can be concluded that the long storage time can have an impact on the physical qualities of vegetable-tanned goat skin. The optimum storage for tensile strength occurred in the 16th month with a tensile strength of 1887,2 N/cm^2. The optimum storage for skin elongation occurred in the 11th month with an elongation rate of 39.81%. And the optimum storage for shrinkage temperature occurred in the 9th month with a shrinkage temperature of 62.27 °C.

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