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The Effects of Tanning with Kepok Banana (Musa Paradisiaca L) Bunch on the Physical Quality of Rabbit Skin

Tutik Maryati, Ambar Pertiwiningrum, Zaenal Bachruddin

Abstract*: *Vegetable tanning is leather tanning using tanning agents derived from plants. Utilization of mimosa (as a source of tannins from Acacia wood) for tanning materials has various weaknesses in terms of influence on the environment. Kepok banana (Musa paradisiaca L.) bunch is one of the abundant banana waste and not yet utilized. Banana bunches contain 2-5% tannins so they have the potential to be used as tanning agent. Although the tannin content is not high, it is still possible to be used as tanning agent for small-sized skin, such as rabbit skin. This study aimed to determine the physical quality of rabbit skin that wastanned with banana bunches. The results showed that Kepok banana bunches can be used as a good tanning material that is environmentally friendly. The use of Kepok banana (Musa paradisiaca L.) bunch as tanning material had a significant effect (P <0.05) on physical quality of rabbit skin. With 25% Kepok banana (Musa pardisiaca L.) bunch as tanning agent, the tanning process could produce leather sheets that met Indonesian National Standard (SNI) no 06-0237-1989 with 1.17 mm of thickness, 4.7 mm of softness, 12.02 kg/cm of tear strength, 239.55 kg/cm2 of tensile strength, and 174.12% of elongation.

Index Terms*: *vegetable tanning, banana bunch, Musa paradisiacal L., physical quality, rabbit skin.

I. INTRODUCTION

Rabbit skin is a high quality skin that is rarely utilized. Fresh rabbit skin is a good medium for the growth and reproduction of microorganisms. Therefore, after the removal of skin from rabbit's body, it must be immediately preserved and tanned [1]. The utilization of rabbit skin is started with the tanning process that will convert raw skin into leather that is stable and does not rot easily. The principle of tanning is to insert the tanning material into the skin tissue (in the form of collagen tissue), so the bonds are formed between the two and create a leather that is more resistant in damaging factors such as microorganisms, chemicals, and physical factors, and can be processed into a product [2]. According to Brown and Shelly [3], vegetable tanning is a tanning process using tannins derived from plants, either from the leaves, wood, bark, twigs, roots or fruits. Vegetable tanning is preferred because tannin has several abilities such as filling, tightening, preserving the skin from microbial attacks, and gives color to tanned skin [4].

The waste generated in vegetable tanningprocess is more environmentally friendly compared to tanning using chrome materialproceses. The amount of 25% of the chromium used in chrome tanning will be wasted [5-6] thus it will be contributing to the problem of environmental pollution [7]. The most widely used material for vegetable tanning in the industry is mimosa, which is derived from Acacia wood. However, mimosa is still an expensive imported material, which is a major disadvantage. Acacia and mangrove wood are also sources of mimosa which are considered protected plants [8]. Other ingredients that are easily and quickly obtained need to be found as an alternative tanning materials to replace mimosa.

Banana plant (*Musa paradisiacal L.*) is widely cultivated in Indonesia and produces various types of waste. Banana peel waste reaches 40% of the total fresh fruit, as well as a lot of banana bunch waste. Banana peel waste is only used as animal feed, while banana bunches only become organic waste which can pollute the environment [9]. Banana bunches are wastes that have the potential to contain tannins. The tannin content in banana leaves, trunk, and banana peels varies between 3.7% to 5.5% so they can be used as vegetable tanning agents [10]. The use of banana bunches can reduce the use of chemicals in the process of tanning and making leather products [11]. This study aimed to determine the physical quality of the rabbit skin which was tanned with the bunches of Kepok banana (*Musa paradisiaca L.*).

II. METHODS

The process of tanning rabbit skin began with wetting (soaking). The raw rabbit skin was put in a bucket containing the following solution: 300% water, 2% wetting agent (Peramit ML), 1% NaOH, 0.01% biocide. The percentage of the materials was calculated based on the salted skin's weight. To help the soaking process well, the skin was kneaded for 120 minutes or until the solution looked turbid and reached the pH of 12. The skin was then soaked overnight. The next day, the soaking solution was drained. The second process was liming and unhairing (removing the hair). The skin was put in a bucket of 150% water, 0.3% Na_2S, and 1% lime. The skin was kneaded for 90 minutes. The process was considered sufficient when the hair was completely removed from the skin, the condition of the skin was swollen and slippery, and the solution reached the pH of 12-13. The third process was cleaning the remaining meat (fleshing) and removing the hair (scudding). The skin was stretched over the floor with the meat above, then scraped clean with a sharp knife. The same method was applied to the other side with the furs above, only it was scraped with the upper part of the knife (blunt) until it was clean. The processed skin was then weighed. The fourth process was the removal of lime

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TutikMaryati, Faculty of Animal Science, UniversitasGadjahMada, Yogyakarta, Indonesia.

Ambar Pertiwiningrum, Faculty of Animal Science, UniversitasGadjahMada, Yogyakarta, Indonesia.

ZaenalBachruddin, Faculty of Animal Science, UniversitasGadjahMada, Yogyakarta, Indonesia.

(deliming). The skin was put in a bucket of 150% water and 1% ammonium sulfate (Za), then kneaded for 60 minutes. The deliming process was monitored by cutting the skin cross-section and checking the pH value by means of PP indicator. If the color does not change and the pH of the solution is 8, the deliming process is considered complete. The fifth process was the removal of fat (degreasing) and protein (bating). The skin was put in a bucket containing 100% water and 1% degreasing agent (HustapolNd), then the skin was kneaded for 30 minutes before 0.3% bating agent (bate pb) was added. The kneading process continued for another 30 minutes. The process was verified by pressing on the skin with one thumb. If a prolonged indent is noticeable on the skin and the skin feels smooth, the process is considered complete. Another way to check was by applying the air permeability test. If air bubbles are formed, they indicate that the globular protein that fills the spaces between the fibers has gone and let the air enters. The sixth process was washing. The skin was washed under running water for 10 minutes until it was clean. The seventh process was pickling. The skin was put in a bucket containing 100% water and 10% salt, then kneaded for 10 minutes until the density reached 8º Be. The 1.5% diluted formic acid (1:10) was then added. The skin kneading was done for 120 minutes and the process was checked. The pickling process is considered sufficient if the solution shows a pH of 3.0 to 3.2; the skin was white, clean, and not slippery; and the skin becomes yellow when BCG indicator was applied. The skin was then weighed to be the guideline in the tanning process. The eighth process was tanning. In this process, the skin was separated into 3 drums containing 30% pickle water and 2% gluteraldehyde (Reltant Gt 50), then the drums were rotated for 30 minutes. 2% penetration material (Coralon OT) was added and the drums were rotated again for 30 minute. The treatments were applied to each drum: the first drum had no addition of tanning agent, the second drum with the addition of 25% mimosa, and the third drum with the addition of the solution made of 25% Kepok banana (Musa paradisiaca L.) bunch and 100% water that are boiled together. The drums were rotated for 120 minutes and 100% water was added to each treatment-drum. The drums were rotated again for 3 hours. The control of this tanning process was the brownish color when the skin was cut cross-section. The skins were soaked overnight in 3 different buckets afterwards. The percentage of tanning agent and chemical adjuvants was calculated based on the weight of the pickled skin. The next day, the skins were checked for wrinkle temperature by taking a small cut of skin and boiling it at a temperature of 60-70ºC, and see if the skin does not shrink. The skins were then stacked overnight on wood (ageing) and the waste of tanning solution from each treatment was collected for analysis. The ninth process was neutralization. The skin was put into a drum containing 300% water, 1% wetting agent, and 0.3% baking soda. The drum was then rotated for 30 minutes. The solution was checked for pH, which was 5.6. Then the solution was drained and the skins were rinsed under running water for 5 minutes. The percentage of the materials was based on skin weight after ageing. The tenth process was retanning. The skin was put in a drum containing 50% water at 50ºC and 4% chemical adjuvant (tanicorPwb). The drum was rotated for 60 minutes and we continued with the next process, which was oiling (fatliquoring) and fixation by putting 100% water at 50ºC and 10% oil (Lipoderm Liq. SAF) into the drum. The drum was rotated for 90 minutes, then added with 1% oxalic acid before rotated again for 30 minutes. It was finally added with 0.03% antiseptic and rotated for another 15 minutes. The solution was checked for pH which was 4-5. Then the solution was drained and the skin was rinsed with water. The next processes were drying (hangdry), moisturizing (conditioning), stacking, and toggling.

III. RESULTS AND DISCUSSION

The physical quality of rabbit skin with the addition of Kepokbanana (Musa paradisisca L.) bunch, mimosa tanning agent, and without tanning material shown in Table 1.

A. Thickness

Because the thickness test results in the above table meet the standards of finished vegetable tanned leather SNI 06-0237-1989 with an average of 0.7 mm-1.2 mm. The best thickness test results were found in the treatment with Kepokbunches and treatment without tanning agent which was 1.17 mm each. The results of the analysis of variance showed that the treatment with different tanning agents had a significant effect ($P <0.05$) on the thickness value of rabbit skin. The treatment with Kepok banana bunches and the treatment without tanning agent gave the same thickness value of 1.17 mm; they have the same ability to influence the entry of tanning agent/tannin into the skin, causing the same thickness of the skin. The test results of skin thickness in this study were similar to those reported by Fantova et al. (2015), that the thickness of tanned leather with chocolate (vegetable) was around 1.2 – 1.5 mm with the basic indicator of skin thickness (mm) around 0, 7–1.46 mm. This was confirmed by Yusuff et al. [12], that the thickness of West African goat skin (mm) tanned using Acacia nilotica was 1.04 ± 0.03 mm.

B. Softness

Based on the table 1, different tanning agents in this study could significantly affect the softness ($P <0.05$) of tanned rabbit skins. The highest average of softness of tanned rabbit skin was 5.5 mm in the treatment with mimosa and the lowest average of softness was 2.76 mm in the treatment without tanning material, while the treatment with bunches had softness value of 4.70 mm. It was possible that the bunch entering the spaces and collagen of rabbit skin was less than mimosa material, so the skin was soft and not stiff, whereas in mimosa treatment, the tannin that entered and filled the spaces between collagen fibers was more so the structure of the tanned rabbit skin became solid and the skin became stiff. According to Sahubawa et al. [13], the tanning process can result in open skin tissue, making it easier to absorb the substances or tanning agent into the skin.

Table 1. Physical quality of rabbit skin with the addition of Kepok Banana (*Musa paradisiacal L.*) bunch, mimosa tanning agent, and without tanning material

Parameters	Without tanning material	Mimosa tanning agent	Kepok banana bunch tanning	P value	Indonesian National Standart (SNI)
Thickness (mm)	1.17[b]	1.03[a]	1.17[b]	<0.05	0.7 – 1.2
Softness (mm)	2.76[a]	5.50[c]	4.70[b]	<0.01	-(soft)
Tear strength (kg/cm)	18.83[c]	4.91[a]	12.02[b]	<0.01	-(not strength)
Elongation (%)	203.03[b]	173.68[a]	174.12[a]	<0.01	Maximum 25%

[a,b, and c] different superscript on the same column show real differences.

C. Tear Strength

The test results of tear strength above show that different tanning material had a significant effect (P <0.05) on the tear strength of tanned skins. The average tear strength value in the treatment withKepokbunches(12.02 kg/cm) was higher than that of mimosa. This was possible because the bunch tannin was strongly bound to the carboxyl group of the skin so it had high tear strength, whereas in the treatment with mimosa, the tear strength value was low because the bond between tannin and collagen was weak. According to O 'Flaherty et al. [14], the physical properties of the tanned skin are affected by the skin tissue, the tanning process, and tanning material that enters the skin.

D. Tensile Strength

The results of tensile strength testing in this study have fulfilled Indonesian National Standard (SNI) 06-0237-1989 about leather sheets which is at least 75 kg/cm2. The value of tensile strength of tanned rabbit skin with Kepok bunches and without tanning materials had the highest values of 302 kg/cm2 and 294.73 kg/cm2, while the lowest tensile strength value was in mimosa treatment (239.55 kg/cm2). The results of the analysis of variance showed that the use of different tanning had a significant effect (P <0.05) on the tensile strength of tanned rabbit skin. In two treatments for this study: using Kepok bunches and without tanning agent, the materials used easily bind to skin collagen. The penetrating material (Relugan GT50), which is a glutaraldehyde material, has the ability to easily bind to skin collagen and eventually forms strong complex bonds so the skin becomes stronger and denser. This is in accordance with the opinion of Raharjo et al. [15] that the nature of formaldehyde and its derivatives (glutaraldehyde) has great activity power (easily binds to skin collagen) and can increase the tensile strength of the tanned skin. In the treatment with mimosa, the tensile strength of tanned rabbit skin had the lowest value. This was due to the high absorption ability of mimosa which resulted in faster reactions. According to Untari et al. [16], the sheep scrotal skin which is tanned with mimosa has low tensile strength because vegetable tanning material has a buffing effect, an ability that allows the skin surface to be hard and not slippery. Skin properties are affected by the amount of water content that is bound to collagen fibers. The tensile strength will decrease if collagen fibers are swollen due to the binding of water molecules [17]. According to Pahlwan and Kasmudjiastuti [18], tensile strength can be influenced by several factors including the quality of raw skin, skin preservation, liming, protein removal, tanning, fatliquoring, and finishing process such as toggling.

E. Elongation

Number The table 1 shows that the highest elongation value was obtained with the treatment without tanning agent (203.03%). The lowest elongation value belonged to the treatment with Kepokbunches (174.12%). The average elongation value in the treatment with mimosa materials was 173.68%. The treatment without tanning agent had the highest value compared to the treatments with bunches and mimosa. The results of the analysis of variance showed that the treatment with different tanning materials significantly affected (P <0.05) on the elongation of the tanned skin. This was due to the ability of tanning material to reduce the composition of collagen fibers contained in the skin and also the relaxation process when finishing. According to Judoamidjojo [19], the high value of skin elongation can be caused by the loss of elastin from the process of preserving to tanning. Untari et al. [20]

added that the elasticity or elongation of the skin are due to the finishing process such as toggling and stacking.

IV. CONCLUSION

The physical quality of rabbit skin tanned with 25% Kepokbanana (Musa pardisiaca L.) bunch meets Indonesian National Standard (SNI) no. 06-0237-1989 about leather sheets with 1.17 mm of thickness, 4.7 mm of softness, 12.02 kg/cm of tear strength, 239.55 kg/cm2 of tensile strength, and 174.12% of elongation.

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AUTHORS PROFILE

Tutik Maryati was born in Bantul**,** April 21,1980 andhas a focus on research and work in the field of leather tanning. Her educational background is in vocational schools in the field of leather technology and magister program in Universitas Gadjah Mada, Faculty of Animal Science, especially in tanning of leather research.

Ambar Pertiwiningrum was born in Ambarawa, September 2, 1966. Her educational background is doctoral program in Gifu University, Japan, especially in microbiological science.

In renewable energy, she was/is involved in community empowerment programs. She was/is also involved in training or workshop were: Technical Guidance Biogas in KulonProgo Yogyakarta Special Region (2014), Technical Guidance Biogas in Palu (2014) and Utilization of Livestock Waste to Biogas and organic fertilizer delivered on Livestock Waste Management Technical Assistance Training (2014). Today, she is a senior lecturer in Faculty of Animal Science, Universitas Gadjah Mada, Yogyakarta, Indonesia. She concerned in livestock waste management. She has published publication are: Isolation, Identification and Dehairing Activity of Indonesian Native Keratinolytic Bacteria Exiguobacterium (2015), A commentary on occupational infectious diseases due to agricultural practices in Sub-Saharan Africa (Science Direct, 2014) and so on.

Zaenal Bachruddin was born in Majenang, April 28,1952. His background of education doctoral in University of Swansea Germany especially in Agriculture Science. Heis also a Senior Lecturerin Faculty of Animal Science, Universitas Gadjah Mada, Yogyakarta, Indonesia. He has published publications are : Feed Additive For Ruminant Production Animal Products Quality And Green Environment (2017), The Sodium Nitrate Addition In Total Mixture Fermentation Of Tofu Waste As Ration On Methane Production Of The Rumen Fluid (2017, Japan)The Effect Of Temperature Treatment To Milk Replacer Quality And Its Application On Kid Growth (2016,Turkey),Total Silage Fermentation Of Tofu Industry By-Product And Its Application For Local Sheep Production Of Farmer Group(2015).