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The Effects of Concentration from Mimosa and Formalin Tanner Materials Mixture on the Tanned Black Tilapia Leather Quality

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Abstract
This research aims to determine the quality of tilapia leather tanned using tanning material mixture that is mimosa-formalin and determine the best concentration that can be applied in the fish leather tanning industry. Research using a Completely Randomized Design (CRD) 1 (one) factor (the mixture of mimosa and formalin) with 4 treatments and 3 replications treatment are a1 (mixture of 5% mimosa and 4% formaline), a2 (mixture of 5% mimosa and 6% formaline), a3 (mixture 7.5% mimosa and 4% formaline) and a4 (mixture of 7.5% mimosa and 6% formaline). The data obtained were tested using multiple comparison (Least Significant Different, LSD). The parameters were Tensile strength (N/cm^2), Elongation (%), Tear strength (N/cm), Softness (mm), Wrinkle temperature (°C), Water content (%) and Oil/fat content (%). The results showed that the mixture of mimosa and formalin hasn't significant effect on Tensile strength, Elongation, Tear strength, Softness and Wrinkle temperature but differs with the parameters of Water content and oil/fat content. The average value of the parameters meet the quality requirement of SNI 06-4586-1998 about freshwater snake leather that chrome tanning, while the parameters of softness, water content and elongation didn't met standards. Treatment 4^{th} (a4) is the best treatment because it produced the most excellent quality on every parameter that the tensile strength of 1,537.14 N/cm^2, elongation of 69.68 %, tear strength of 301.50 N/cm, softness of 2.15%, wrinkle temperature of 79.06 ^{0}C, water content of 18 %, and fat/oil content of 2.69 %.
Keywords: formalin, mimosa, black tilapia, leather, quality, tanning

1. Introduction

Indonesia has a wide range of potential fisheries. One of the fishery commodities that have economic value is black tilapia fish. Statistical Data from the Ministry of Marine Affairs and Fisheries, showed that the 2010-2014 tilapia production increased by 464,191 tons in 2010 to 999,695 tons in 2014 (KKP, 2015). Tilapia is widely cultivated in several regions in Indonesia and the results are utilized in the fish processing industry. Fish fillet industry will produce waste in the form of fish head, bone, edible offal and leather that has not been utilized optimally as derived material that has high economic value. According Riyanto et al (2012), tilapia waste of 12.75%, when viewed from the production of tilapia cultivated in 2010 will generate waste of 127,461.11 tons. Skin waste is only a small part of which is utilized by the community as raw materials for animal feed and crackers. One alternative to the utilization of other skin waste is to process the skin into tanned skin through the process of tanning. Selection of tilapia skin as a tannery material because it has a large size, and has a beautiful pattern of rajah because of the former scales owned and the fish is not dependent on the catch because cultivated.

The tannery is a process of converting the decaying fresh skin into a stable skin. The tannery aims to convert raw skin which is easily damaged by microorganism, chemical or physical activity into a more stable tanned skin (Vishnu, 1994). Tanning is the most important stage in the production of leather because during tanning, collagen will fix tanners on its reactive sites (Suparno et al., 2008).

2. Materials and Methods

2.1. Equipment and materials

The equipment used for this research is divided into two types, namely for tanning process and tanned skin analysis. Tanning process equipment include: storage box, slant blade, plastic tub, pH paper, embossing machine, glazing machine, thermometer, measuring cup, nail and hammer, stretch board, analytical scales, plastic cups, stirrer, gloves, mask, and Stacking tool. Equipment for analysis include: tensile strength machine test, sliding term, soxhlet, softness tester, eksikator, term, thickness gauge, and shrinkage temperature tester.

The material used is divided into main material and supporting materials. The main material used are black tilapia skin and tanning materials namely mimosa and formalin. The supporting materials in this research are: sodium sulfide (Na_2S), water, lime ($CaOH_2$), ammonium sulphate (ZA), PB-1, Dephan-B, salt (NaCl), HCOOH, baking soda ($NaHCO_3$), Tanicor PWB, MS sincal, base paint, sulfonation oil.

2.2. Research Methods

The method of processing fish skin as finished leather (raw material) products and leather goods are "tanning method", which consists of three (3) stages: stage pre-tanning, tanning and finishing. The method used in the

study is a completely randomized design (CRD) single factor, using single factor as the source of the treatment with 4 levels that consist of: **a1** (mixture of 5.0 % mimosa and 4.0 % formaline), **a2** (mixture of 5.0 % mimosa and 6.0 % formaline), **a3** (mixture of 7.5% mimosa and 4.0 % formaline) and **a4** (mixture of 7.5% mimosa and 6.0 % formaline). Statistical analysis of the data processed by SPSS devices. If the results of the analysis show a real effect, then continued with the least significant difference test (BNT) at a significant level of 95% to determine the differences between treatments. Quality parameters of tanned tilapia leather that analyzed are (1) physical quality (tensile strength, elongation, tear strength, enervation and wrinkle temperature) and (2) chemical quality (moisture and content oil/fat). The tilapia tannery process using natural tannery materials (mixture of mimosa and formalin) as shown in Figure 1.

3. Results and Discussion

The results of the analysis of the quality parameters of tilapia leather tanned mixture of mimosa and formalin are as follows.

3.1. Tensile strength (N/cm^2)

The result of the variance analysis showed that the experimental treatments (mixture of formaline and mimosa) had no significant effect on the tensile strength of the tanned black tilapia skin sample at a significant level of 95%. The mean value of tensile strength of tanned black tilapia skin sample from treatment of a1, a2, a3 and a4 are respectively: 1,537.14 ; 1,266.46 ; 953.62 and 1,142.98 N/cm^2 (see Table 1). The mean value of tensile strength of skin samples from each treatment tended to decrease with increasing concentration of tanners. According to Robert and Etherington (1982), the high or low tensile strength is influenced by several factors including the type of tanner, the tanning process, the tanning time, the species and the age of the animal. The vegetable tanner contains tanin, this tannin will be associated with skin proteins, then bind and form a dense tanned skin. This skin density causes the skin to become plastic so that the strength of the skin to be produced using the vegetable tanners is lower than the synthetic tanners material (Farid, 2013).

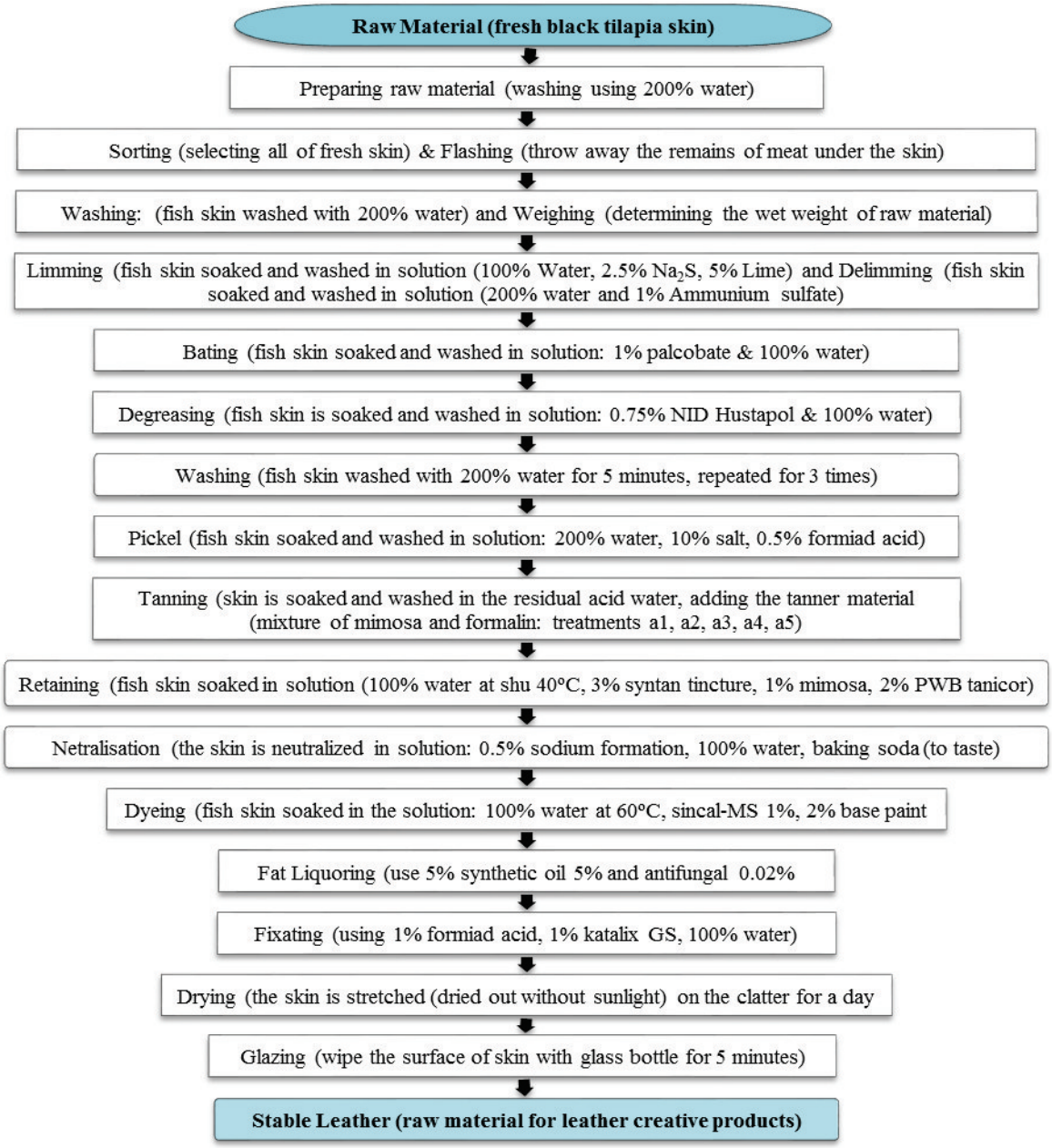
3.2. Elongation (%)

The results of variance analysis showed that the experiment did not significantly affect the elongation of tanned black tilapia skin sample at a significant level of 95% ($p>0.05$). The average value of skin elongation of each treatment (a1, a2, a3, a4) are 69.68%, 64.01%, 56.14% and 59.53% (see Table 1). Skin elongation is influenced by differences in raw materials, tanners, physical processes on tanning, water content and the large number of interlaced corners of collagen fibers (Prastiyanto, 2011). The average value of water content produced by this research is quite high, that is 18.00% to 19.99%, it can cause high yielded elasticity. Tannin material also affects the resulting elongation. According to Purnomo (1991), formaldehyde tanners material has the advantage of producing tanned skin with the characteristics of tensile strength, enervation, tear strength and high elongation. Setiawan et al. (2015) adds high skin elasticity values can also be caused by loss of elastin from preservation to tanning.

The average value of elongation that yielded is lower than Prastiyanto (2011) that using 10% mimosa (837.33%) on tanners black tilapia skin, also lower than Kuswanto (2009) that using chromium reuses and fresh chromium on tanners red tilapia skin of 79.33%, and also lower when compared research of Setiawan et al. (2015) using 12.5% of gambier extract (75.06%). The mean value of elongation of all treatments does not fulfill SNI 06-4586-1998 (BSN, 1998) about on freshwater snake skin tanned chrome with the requirement of 30% maximum elongation quality. According to Untari et al. (2004), high skin elongation values were attributed to the leather sample which contain high oil/fat.

3.3. Tear strength (N/cm)

The results of the variance analysis showed that the experiment did not significantly affect the tear strength of the skin sample at a significant level of 95%. Average value of tear strength of skin sample from treatment a1, a2, a3, a4 is respectively 301.50, 332.95, 299.13 and 277.40 N/cm (see Table 1). The resulted quality score has fulfilled the requirements of SNI 06-4586-1998 (BSN, 1998) on the chrome-tanned freshwater snake skin with a minimum tear strength standard of 150.0 N/cm. Tear strength is also affected by the structure of skin tissue, the greater the value of tear strength, the better quality of the skin (Prastiyanto, 2011). According to Astrida (2008), formalin tanners have a large (easy to seep) tanning that is easy to bind to skin collagen which ultimately forms a strong complex. As a result, the empty cavities in the skin structure will be filled by formalin tanners then the skin becomes solid (Astrida, 2008). Purnomo (1991), added that leather tanned formaldehyde will produce tanned skin with high tear strength. Therefore, the mixture of mimosa and formalin provides a high mean value of tear strength. The average value of tear strength produced was higher than that of Astrida (2008) using 10% formalin on tilapia resulting in a tear strength value of 309.20 N/cm, and also higher than Farid (2013) using gambir extract on red tilapia skin that resulting high tear strength value of 252.88 N/cm.



Pigure 1. Tanning processing of black tilapia leather

Table 1. The results of the analysis of the quality parameters of tilapia leather tanned mixture of mimosa and formalin

Parameters	Treatments				Standard Quality
	a1	a2	a3	a4	
Tensile strength (N/cm^2)	1,537.14	1,266.46	953.62	1,142.98	Min. 1.000 (N/cm^2)*
Elongation (%)	69.68	64.01	56.14	59.52	Max. 30 %*
Tear strength (N/cm)	301.50	332.95	299.13	277.40	Min. 150 N/cm*
Enervation (mm)	1.78	1.75	1,.98	2.15	Min. 2 mm***
Wrinkle temperature (°C)	79.06	83.83	82.33	84.89	Min. 70 °C**
Water content (%)	18.00	18.41	19.99	18.99	Max. 18 %*
Oil content (%)	2.69	2.20	2.53	3.19	Around 2-6%*

Note * : Terms of quality of chrome-tanned freshwater snake skin (SNI 06-4586-1998)
** : Quality terms of stingray skin for finished goods (SNI 06-6121-1999)
*** : Quality terms of enervation value for shoe tops and Suede Leather Burk's Bay ™

3.4. Enervation (%)

The result of variance analysis showed that the experiment did not give any significant effect to evervation parameter of the tanned skin sample at a significant level of 95% (p> 0.05). The enervation average value of black tilapia skin from treatment of a1, a2, a3, a4 is respectively: 1.78 mm, 1.75 mm, 1.98 mm and 2.15 mm. The average value of the overall produced enervation has not met the quality requirements for shoe tops and Suede Leather Burk's Bay ™ with a minimum quality standard of at least 2 mm except a4 treatment (mixture of 7.5% mimosa and 6% formalin). Overall, the higher the concentration of mimosa and formalin tannery mixtures the higher the value of the resulting enervation. According to Mustakim et al. (2007), high enervation value is caused by active substances of tanners entering into skin fibers (collagen) leavingf room in the skin to be filled by oil during the process of giving oil resulting in a flexible skin sample. The value of the study results was lower than the study results of the Astrida (2008) using 10% mimosa (2.15 mm) and 10% chrome (2.37 mm) on red tilapia skin and study results of the Hayati (2009) that using syntan 10 % on red tilapia skin (3.76 mm).

3.5. Wrinkle temperature (^{o}C)

The results of variance analysis showed that the experiment did not significantly affect to the wrinkle temperature of the tanned skin sample at a significant level of 95%. Average of skin wrinkle values of tanned skin samples from treatment a1, a2, a3 and a4 was respectively: 79.06, 83.83, 82.33 and 84.89 ºC. Quality requirement based on SNI 06-6121-1999 (BSN, 1999) about stingray leather for finished goods with minimum standard of 70ºC, the mean value of wrinkle temperature has fulfilled the quality requirement of tanned skin. This means that the samples of tanned skin with formaline and mimosa are very resistant to changes in ambient temperature.

3.6. Water content (%)

The result of variance analysis showed that the treatments significantly affect the water content of black tilapia samples at a significant level of 95%. Average value of water content of black tilapia samples from treatment a1, a2, a3 and a4 isrespectively 18.00%, 18.41%, 19.91% and 18.99. The higher the concentration of tanning materials used, the more water tied up by the tanner so that the water content of the skin sample tends to decrease (Asgha, 2010). The mean value of water content of all treatments has fulfilled the requirements of SNI 06-6121-1999 (BSN, 1999) on stingray skin for finished goods requiring maximum water content of 18% except a1 (5% mimosa + 4% formaline). The result of BNT analysis showed that the treatments a1 and a2 were significantly different from the a3 and a4 treatments, the a3 treatment was significantly different from the treatments a1, a2 and a4, the a4 treatment was significantly different from the treatments a1, a2 and a3. Water content of skin samples significantly influence the quality of stored leather products. Tanned fish skins with low water content (according to ISO standard) are more resistant to microbial activity and changes in ambient temperature.

3.7. Oil/fat content (%)

The tried treatments significantly affect the fat content of black tilapia samples at a significant level of 95% (p> 0.05). The mean value of the fat content of tanned skin samples from the treatment of a1, a2, a3 and a4 was respectively 2.69%, 2.20%, 2.53% dan 3.19%, tending to decrease along with the increase of tanner concentration. The result of the BNT analysis showed that the treatment a1 was significantly different from the a2 and a4 treatments, the a2 treatment was significantly different from the a1 and a4 treatments, the a3 treatment was only significantly different from the a4 treatment, the a4 treatment was significantly different from the treatments a1, a2 and a3. Mean of fat content value of all treatments have fulfilled SNI 06-4586-1998 (BSN, 1998) about chrome-tanned freshwater snake skin which requires 2.0 to 6.0 %. Oil process occurs oil penetration efforts into the webbing of skin that uses to improve the skin enervation. Excessive concentration of oil given will result in high oil levels of tanned tilapia skin. The oil/fat content will affect the preservation and consumers' convenience. Fat content will affect the product to be made, because if the fat/oil content exceeds the recommended limit it will cause the skin physical damage. This is in accordance with the statement of Sahubawa et al (2010) where the skin that exceeds the maximum limit will cause physical damage such as the growth of fungi, rancid odor, discoloration and skin swelling.

4. Conclusion

Treatment of the tanning mixture did not have a significant effect on the 95% significance level on the physical but it has a significant effect on chemical quality of the black tilapia samples. The parameters of tensile strength, tear strength, wrinkle temperature and moisture and oil content have fulfilled the quality standard (SNI 06-4586-1998) about chrome-tanned freshwater snake skin and SNI 06-6121-1999 on stingray skin for finished goods respectively, whereas elongation parameters and evervation have not met the SNI standard and Suede Leather Burk's Bay™. The skin sample obtained by treatment with **a1** (mixture of 5.0% mimosa and 4.0 % formaline)

was the best treatment (efficient).

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