The effect of mimosa and syntan mixture on the quality of tanned red snapper leather

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Abstract. This study aimed to determine the effect of syntan and mimosa combination on the quality of tanned red snapper leather. The study was designed using complete randomized design (CRD) and the advanced test of Least Significant Difference (LSD) with three replications and three treatments of combined syntan and mimosa, namely: p1 (4 % syntan, 5 % mimosa), p2 (8 % syntan, 5 % mimosa), p3 (12 % syntan, 5 % mimosa). Data were analyzed using SPSS 18. The measured parameters were tensile strength (N cm²), elongation (%), tear strength (N cm⁻¹), enervation (mm), wrinkle temperature (°C), fat/oil content (%) and water content (%). The results indicate that the combined syntan and mimosa tanners gave no significant effect on the physical parameters (tensile strength, elongation, tear strength, enervation and wrinkle temperature) and chemical parameters (moisture and fat/oil). All treatments (p1, p2 and p3) met the Indonesian National Standard (SNI) 06-4586-1998 for chrome tanned freshwater snake leather for the parameters of tensile strength, tear strength, enervation, wrinkle temperature and moisture. The parameter of elongation and fat/oil content did not meet with the SNI 06-4586-1998. Among the three combinations of a tanner, syntan 4 % and mimosa 5 % treatment gave the best leather quality.

1. Introduction

Red snapper fish is one of the marine fishery commodities with high economic value with increased production volume from year to year in the last five years. Based on the Ministry of Marine, total volume of national capture fishery production in 2012 amounted to 5,435,632 tons, while the volume of red snapper production in 2008 to 2012 respectively: 109,299; 115,523; 123,794; 118,608 and 119,008 ton [1]. Along with the increase of the catch, it will certainly have an impact on the development of fishery processing industry in general, and especially the industry of fish snapper.

Snapper fillet industry in the production process produces a large amount of waste that has the potential to be used as raw material for food or feed products and other derivative products. Snapper fillet processing industry produces about 40% of raw material waste per ton consisting of leather (35 %), head (25 %), offal (25 %) and bone (15 %) [2].

Leather waste from the fish filet industry is generally used for the processing of leather cracker which has low economic value, whereas fish leather can be processed as raw material (leather tanned) and leather products that have high economic value [2, 3]. Along with advances in science and technology in the field of leather processing, the red snapper leather waste in particular and the leather of fish, in general, can be utilized into a variety of commercial leather products that have high economic value because it has a scarred scar on the leather surface that is very interesting and unique.
The tanning process produces tanned leather (finished leather) as raw material for commercial leather products (bags, wallets, shoes, jackets, HP covers, key chains, belts, backpacks, laptop bags and other accessories) [2]. The attractiveness of the leather products is strongly influenced by the quality of the tanned leather, where the quality of the tanned leather is favorably affected by the tanning and tanning process used [3]. The tanner commonly used in the leather tanning industry is chrome because it produces high-quality tanned leather, but chromium is very harmful to human health and the environment so that alternate tanner alternatives are needed that can produce high quality tanned leather. One alternative replacement is the use of vegetable tannin or a combination of vegetable tannin with chemicals (mimosa and syntan or formaldehyde) and or with minerals.

The combination tanning is the use of two or more tanning materials in the tannery process [4]. The use of tanner mixtures can improve the quality of tanned leather as each tanner can cover each other's deficiencies through its own advantages [5]. Each tanner (syntan, formaldehyde, mimosa and chrome) has its own characteristics and advantages. Syntan has characters that do not give the effect of color on tanned leather, resulting in tanned leather that is solid, soft, and resistant to acid and base influences and can increase water resistance of tanned leather [4]. Mimosa has the ability to produce tanned leathers that contain, tighten and protect the leather from microbial activity and provide color to tanned leather, as a secondary effect of tan nin compounds [6]. Research on the combination of tanners has been done by previous researchers [7], which used a mixture of 6 % mimosa and syntan 4 % for stingray leather tanning resulted in high tensile strength, tear strength, enervation and wrinkle temperature but low in water and fat content. The use of a mixture tanner is recommended in the process of leather tanning with the aim of improving and enhancing the quality of the raw material of leather [8]. Furthermore, loyal tanners (natural, mineral and chemical) have their respective advantages so that mixtures of two or more tanners will improve the quality of tanned skin [8].

2. Materials and Methods

2.1. Equipment and materials
Equipment used in processing tanning is knife, scales, measuring cup, plastic bucket, small bowl, paper pH, thermometer, boards, gloves, stacking boards, softness tester, tensile strength tester and wrinkle temperature tester. Materials used in the tanning process are red snapper leather, salt, water, sodium sulfide (Na₂S), lime (Ca(OH)₂), ammonium sulphate (ZA), palcobate, hustapol NID, formicacid, syntan, mimosa, chrome, sodium bicarbonate (NaHCO₃), sincl-MS, paint base, sulfonation oil, antifungus and katalix GS.

2.2. Methods
The method of processing fish leather as finished leather (raw material) products and leather goods are "tanning method", which consists of three stages: stage pre-tanning, tanning and finishing (figure 1) [9, 10]. The method used in the study is a completely randomized design (CRD) single factor, using single factor as the source of the treatment with three levels: p1 (mixture of 4 % syntan and mimosa 5 %), p2 (mixture of 8 % syntan and mimosa 5 %) and p3 (mixture of 12 % syntan and mimosa 5 %). Statistical analysis of the data processed by SPSS version 18, 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 fish leather analyzed are, (1) physical (tensile strength, elongation, tear strength, enervation and wrinkle temperature) and (2) chemical (moisture and content oil/fat) [9, 10].
3. Results and Discussion
The study used mixed treatment of syntan and mimosa tanner as a single factor, consisting of three treatments that were p1 (a mixture of 4% syntan and 5% mimosa), p2 (a mixture of 8% syntan and 5% mimosa), p3 (a mixture of 12% syntan and 5% mimosa). Leather quality parameters that analyzed consisted of physical quality (tensile strength, elongation, tear strength, enervation and wrinkle temperature) and chemical quality (moisture and fat/oil content). The result of the physical and chemical quality of tanned red snapper leather was shown in Table 1.
3.1. Tensile strength

The result of the variance analysis shows that the experimental treatments (a mixture of Syntan and mimosa) had no significant effect on the tensile strength of the tanned red snapper leather sample at a significant level of 95%. The mean value of tensile strength of tanned red snapper leather sample from the treatment of p1, p2 and p3 were 1,339.19 N·cm⁻²; 1,129.76 N·cm⁻² and 1,075.78 N·cm⁻², respectively. The mean value of tensile strength of leather samples from each treatment tended to decrease with increasing concentration of tanners.

**Table 1.** The result of physical and chemical testing of tanned red snapper leather.

| Kind of Test | Test Parameters      | Treatment (Tanning Materials) | Standard                                      |
|--------------|----------------------|-------------------------------|-----------------------------------------------|
|              |                      | p1       | p2       | p3       |                                |                                |
| Physical     | Tensile strength (N·cm⁻²) | 1,339.19 | 1,129.76 | 1,075.78 | > 1000 (SNI of freshwater snake leather) |
| Quality      | Elongation (%)       | 57.72    | 45.99    | 55.86    | < 30 (SNI of snake leather)     |
|              | Tear strength (N·cm⁻¹) | 266.93   | 203.89   | 266.84   | > 150 (SNI of freshwater snake leather) |
|              | Enervation (mm)      | 4.03     | 3.29     | 4.05     | > 2 Burks’s Bay TM (Nukom manufacturing) |
|              | Wrinkle temperature (°C) | 93.97    | 85.53    | 84.92    | > 70 (SNI of stringray leather) |
| Chemical     | Moisture (%)         | 8.95     | 9.02     | 8.93     | < 18 (SNI of freshwater snake leather) |
| Quality      | Oil content (%)      | 15.16    | 14.24    | 13.93    | 2 to 6 (SNI of freshwater snake leather) |

Based on the analysis result, tensile strength value of sample tended to decrease but still higher than the resulting reported by previous researchers [11], using mimosa 20 % in red snapper leather with the value of 1,115 N·cm⁻²; also higher than the result reported by previous researchers [12], using 3 % of chrome on red snapper with value of 1,150.314 N·cm⁻². This condition indicates that the use of mixed tanner concentration tends to be better compared with the use of single tanning material (without combination).

All the treatments in this study fulfill the requirements of BSN [9] concerning freshwater snake leather tanned by chrome, with the recommended minimum standard for tensile strength of 1,000 N·cm⁻². The resulting tensile strength was quite high because the syntan has a great ionization capacity in the tanning process so that the penetration process of the tanner material goes well and binds perfectly to the collagen protein [13]. Syntans have a complex active substance in the form of polyhydroxy benzoles that have large (positive and negative) hydroxyl groups in order to react perfectly with leather collagen forming a hydrogen bond to produce high-quality tanned leather [14].

3.2. Elongation

The results of variance analysis showed that the experiment did not significantly affect the elongation of tanned red snapper leather sample at a significant level of 95 % (p > 0.05). The average value of leather elongation of each treatment (p1, p2 and p3) was 57.72 %; 45.99 % and 55.86 %, respectively. The addition of syntan concentration has no significant effect on the change of sample elongation characteristic. The results of this study show the same characteristics with the result reported by previous researchers on red tilapia with a value of 56 % elongation at 10 % of syntan treatment [15]. In contrast, higher than the result reported by previous researchers who using 5 % chrome on red snapper with a value of 38.3 % elongation [12]. Based on these comparative results, the use of mixed syntan and mimosa on tanning process and the use of chrome on the re-tanning process obtained a better elongation value compared with the use of syntan alone as a single tanner. The mean value of elongation of all treatments did not fulfill BSN [9], on chrome-tanned freshwater snake leather with
the requirement of 30% maximum elongation quality. High leather elongation values were attributed to the sample containing a large amount of oil/fat [16].

3.3. Tear strength
The results of the variance analysis show that the experiment did not significantly affect the tear strength of the leather sample at a significant level of 95%. Average value of tear strength of snapper leather sample from treatment p1, p2 and p3 was 266.93 N·cm⁻¹, 203.89 N·cm⁻¹ and 266.84 N·cm⁻¹, respectively. The resulted quality score has fulfilled the requirements of BSN [9], on the chrome-tanned freshwater snake leather with a minimum tear strength standard of 150 N·cm⁻¹. The characteristic of the tear strength was almost the same as the tensile strength that was strongly influenced by the quality of the tanner. Syntan has a polyhydroxy benzoles having a large amount of positive and negative charged hydroxyl groups that can react with collagen perfectly to form a hydrogen bond to produce a better quality of tanned leather [14].

The tear strength is affected by the histology of the leather of the fish (the extent/width of the leather and the constituent cells) affecting the leather-forming collagen fibers, where the more dense collagen fibers, the stronger the formed-leather collagen fibers the leather forms, the stronger the strength tensile and tear strength of leather sample [17]. The tear strength of this study was higher than results reported by previous researchers [18], using 10% of mimosa on tilapia leather with a value of 137.40 N·cm⁻¹, but lower than results reported by previous researchers that using 5% of chrome on the snapper leather with the same tear strength value of 289.29 N·cm⁻¹ [12].

3.4. Enervation
The result of variance analysis showed that the experiment did not give any significant effect to enervation parameter of the tanned red snapper leather sample at a significant level of 95% (p > 0.05). The enervation average value of red snapper leather from the treatments of p1, p2 and p3 were 4.03 mm, 3.29 mm and 4.05 mm, respectively. The standard parameters for the elongation were not mentioned in the BSN [9], on chrome-tanned freshwater snake leather, but they are usually compared to the Burks's Bay TM requirements by the Nukom industry on leather quality for superior leather and suede leather with a minimum quality standard of 2 mm. Thus, the enervation average value of leather sample produced had met the quality requirements. High enervation value is caused by active substances of tanners entering into leather fibers (collagen) leaving room in the leather to be filled by oil during the process of oil addition resulting in a flexible leather sample [19]. The value of the study results was higher than the results reported by previous researchers [18], using 10% of mimosa (2.15 mm) and 10% of chrome (2.37 mm) on the tilapia leather and that using 10% of syntan on the tilapia leather with the value of 3.76 mm [15].

3.5. Wrinkle temperature
The results of variance analysis showed that the experiment did not significantly affect the wrinkle temperature of the snapper leather sample at a significant level of 95%. Average of leather wrinkle values of snapper fish samples from treatment p1, p2 and p3 were 93.97 °C, 85.53 °C and 84.92 °C, respectively. The minimum quality requirement for wrinkle temperature based on BSN [10] about stingray leather for finished goods is 70 °C, hence, the mean value of wrinkle temperature in this experiment had fulfilled the quality requirement of tanned leather. This means that the samples of tanned leather with syntan and mimosa are very resistant to changes in ambient temperature.

3.6. Water content
The result of variance analysis showed that the treatments did not significantly affect the water content of red snapper samples at a significant level of 95%. Average value of water content of snapper leather samples from treatment p1, p2 and p3 was 8.95 %, 9.02 % and 8.93 %, respectively. The higher the concentration of tanning materials, the more water tied up by the tanner so that the water content of the leather sample tends to decrease [7]. The mean value of water content of all treatments
has fulfilled the requirements of BSN [10] on stingray leather for finished goods requiring maximum water content of 18 %. The water content of leather samples significantly influences the quality of stored leather products. Tanned fish leathers with low water content (according to ISO standard) are more resistant to microbial activity and changes in ambient temperature.

3.7. Oil content
All treatments did not significantly affect the fat content of red snapper samples at a significant level of 95 % (p > 0.05). The mean value of the fat content of the snapper leather samples from the treatment of p1, p2 and p3 was 15.16 %, 14.24 % and 13.93 %, respectively, tend to decrease along with the increase of tanner concentration. Mean of the fat content value of all treatments did not fulfill with BSN [9] about chrome-tanned freshwater snake leather which requires 2 to 6 %. Oil process occurs oil penetration efforts into the webbing of leather that uses to improve the leather enervation. Excessive concentration of oil given will result in high oil levels of red snapper leather. The oil/fat content will affect the preservation and consumers' convenience.

4. Conclusion
Treatment of the tanning mixture did not have a significant effect on the 95 % significance level on the physical and chemical quality of the red snapper samples. The parameters of tensile strength, tear strength, elongation, wrinkle temperature and moisture content had fulfilled the quality standard of BSN [9] about chrome-tanned freshwater snake leather respectively, whereas elongation parameters and oil content had not met the SNI standard. The leather sample obtained by treatment with p1 (mixture 4 % of syntan and mimosa 5 %) was the best (efficient) treatment.

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