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THE USE OF ARECA NUT EXTRACT ON THE ORGANOLEPTIC AND PHYSICAL CHARACTERISTICS OF TANNED TILAPIA SKIN

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KeyWords
Areca nut extract, tilapia skin, tanning, tannin.

ABSTRACT

Tanning is a process of turning raw skin into leather and aims to stop the rate of skin decay so as to make the skin resistant to physical, chemical and biological disorders. One of materials that can be used as a vegetable tanning is areca nut. The purpose of this research was to determine the concentration of areca nut extract that has the best physical characteristics and appearance of tilapia skin tanning. The parameter tests are physical tests (tensile strength, tear strength, elongation and shrinkage temperature) and organoleptic tests (texture, appearance and aroma). The method used in this research is a complete randomized design method, which consists of one factor and five levels with three repetitions (triplo). The treatment of this research is addition areca nut extract for 60 minutes with the following concentrations, 0% (control); 5%; 7.5%; 10%, and 12.5%. The results of the research showed that areca nut extract with a concentration of 7.5% was the best treatment with tensile strength of 224,72 ± 6,57 kg/cm^2, elongation of 68.12 ± 3.68%, tear strength of 36.88 ± 16,68 kg/cm, and the shrinkage temperature of 91.67 ± 0.577^{o}C, for organoleptic assessment has an average score of 9 for appearance, 8.2 for odor/smell, and 9 for texture.

INTRODUCTION

Tilapia is freshwater fish that is widely cultivated because it is easy to maintain, accelerate breeding and growth fast, resistant to pests and diseases (Prayitno et al 2012). Tilapia production in the last 5 years based on the 2017 Ministry of Maritime and Fisheries Report, the volume of production in 2013 – 2017 reach : 914,778 tons; 999,695 tons; 1,084,281 tons; 1,114,156 tons and 1,265,201 tons and tilapia fillets which can reach 80-100 tons per year (KKP 2018). From this production, the yield of tilapia skin reaches 3.2-4 tons / year. Based on the amount of waste from fish skins mentioned this will be a source of contamination.

Skin waste from the fish filet industry is generally used for processing skin crackers which have low economic value, whereas fish skin can be processed as raw material (tanned leather) and leather products that have high economic value (Hak et al. 2000; Sahubawa & Ambar 2016).

Tanning is the process of converting raw skin into leather that is more stable, not easily decomposed, and suitable for a variety of uses (Roigl *et al.* 2012). Leather tanning can be done using vegetable tanners, mineral tanners, and synthetic tanners. Most of leather tanning process used chrome tanning which is classified as mineral tanner. Chrome tanners has several advantages which is, more flexible, resistant to high heat and has a higher tensile strenght (Yazicioglu and Boler 1983).

The tanning material commonly used in the tanning industry is chrome because it produces high-quality tanned leather. however, chromium is very dangerous to human health and the environment, so we need an alternative tanning material that can produce tanned leather with high quality. One of alternative replacement for chrome is combination tanning (Pratama 2016).

Combination tanning is the use of two or more tanning materials in the tanning process (Widari et al. 2013). Sahubawa et al. (2011) added that the use of a mixture of tanning materials can improve the quality of tanned skin because each tanning materials can cover each other's deficiencies through its advantages, for example the tannin content in areca nuts that can protect the skin from microbial activity and give color to the tanned skin.

Areca nut has tannin which can be used as a tanning agent because it has amorphous, tightening and preserving skin properties and gives a natural color (Dur 2013). Areca nut extract can improve the properties of the skin for the better, which is denser, fuller, and smoother (Purnomo 1992).

MATERIAL AND METHODS

The research is divided into two stages, The first stage is the process of areca nut extract, and the second stage is process of tilapia skin tanning and the chracteristic test which included organoleptic and physical character tested in the laboratory of Balai Kulit Karet dan Plastik Yogyakarta. The tools used in this research are plastic buckets, knives, brushes, weighing instrument, funnels, plywood boards, rulers, rotating drums, cutters, thicness gauges, and tensile testing machine (Zwick and Roell brand). The material used in this research includes the main ingredients is, 2,5 kg of tilapia fish skin, Na_2S (sodium sulfide), Ca $(OH)_2$ (calcium hydroxide), (NH_4) SO_4 (ammonium sulfate), Pancerol (oropon), NaCl (kitchen salt), HCOOH (formic acid), H_2SO_4 (sulfuric acid), Cr_2O_3 (chrome tanner), Na_2CO_3 (Sodium carbonate), H_2O (water), and synthetic tanning agent (soft syntan).

The method that used in this research is complete randomized design consisting of one factor and five levels with three repetitions (triplo), the treatment is given is the difference in the concentration of areca nut extract as follows, 0% (control); 5%, 7,5%; 10%; and 12,5%. Then an analysis of the physical quality test of the tilapia skin tanned in accordance with the testing procedures listed on the National Standards Agency (BSN) which includes, tensile strength analysis (BSN 1990a), elongation (BSN 1990b), tear strength (BSN 1990), shrinkage temperatue (BSN 2005). The test results were then analyzed by comparing with SNI 06-6121-1999 (Stingray Skin for finished goods) data for tensile strength and tear strength. Whereas for stretching or elongation was analyzed by comparing SNI 06-4263-1996 data (finished leather from neat's leather). An analysis of the organoleptic of pangasius skin was also conducted by comparing with SNI 06-4586-1998 data.

Data Analysis

The obtained data during the research are presented in form of graphs, drawings, and tables. Data were analyzed using qualitative methods (Effendi 1979). Parametric analysis conducted for organoleptic testing using friedman two-way analysis of variance (Sudrajat 1999).

RESULTS AND DISCUSSION

Organoleptic Test (Appearance, Aroma, and Texture)

Organoleptic is one of the most important parameters used to determine the quality of leather, these are related to the appearance of the skin that can be seen and felt directly by consumers or prospective users. The most important organoleptic properties are smoothness, color, and aroma (Hak 2013). In this test the panelists used were trained panelists. Based on the results of the organoleptic test, the results of the test are as follows (figure 1):

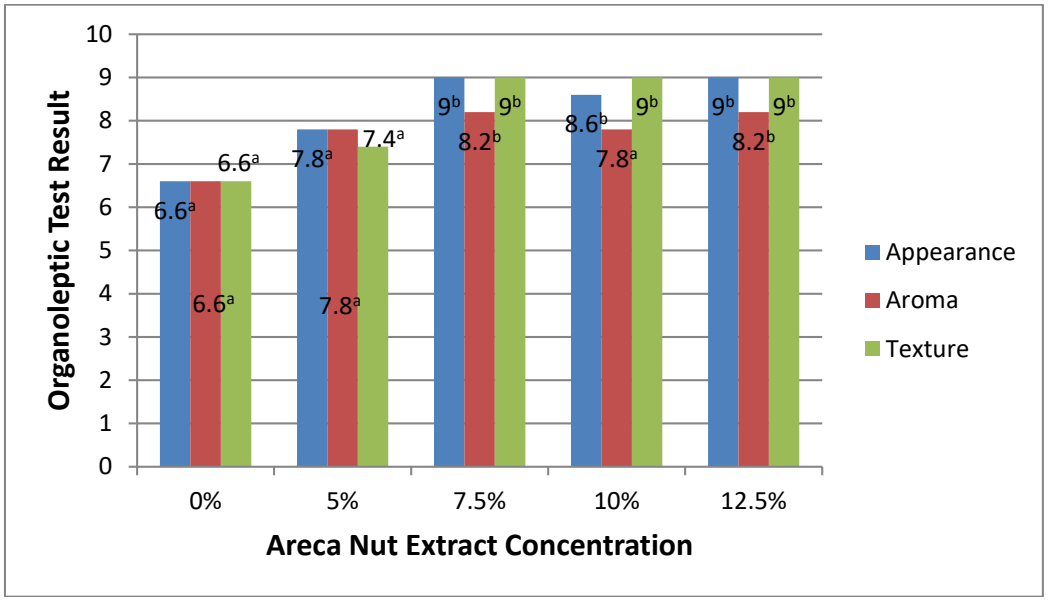

Figure 1. Graph of Organoleptic Test Result

Based on these graphs it can be concluded that as the concentration of areca nut extract increases, the value given by the panelists tends to increase both in terms of texture, appearance, and aroma. The control treatment (0% areca nut extract) had the smallest average value of each treatment while the 7.5% and 12.5% areca nut extract treatments had the highest average value. According to Bachtiar (1991), tannins can function to prevent skin rot and turn the skin to clay because it precipitates protein and protects protein from microbial enzyme degradation. In addition, the more concentration of areca nut extract added to the skin of tilapia will produce a more uniform and homogeneous color. Based on the friedman test results. the best treatment was the addition of areca nut extract with 7.5% and 12.5% treatments. Based on the assessment given by the panelists, the median values listed in Table 1 are as follows:

Table 1. Median Value of Organoleptic Test Result

No.	Areca Nut Extract Concentration (%)	Organoleptic Characteristics		
		Appearance	Aroma	Texture
1	0	7	7	7
2	5	7	7	7
3	7,5	9	9	9
4	10	9	9	7
5	12,5	9	9	9

Based on Table 1 in terms of appearance, the control treatment and 5% extract of areca nut get a median value of 7 which means that the appearance is intact, bright, less clean, thickness is less evenly distributed, the color is less homogeneous. Whereas in the treatment of 7.5%; 10% and 12.5% of betel nut extract have a median value of 9 which means that the appearance is intact, bright, clean, uniform thickness, and homogeneous color.

In terms of aroma, the treatment of 0% (control) and 5% extract of areca nut get a median value of 7 which means that the aroma smells a little. Whereas in the treatment of 7.5%; 10% and 12.5% betel nut extract is neutral, odorless.

In the assessment in terms of texture, the control treatments (0%), 5%, and 10% have a median value of 7 which indicates that the texture is pliable, and slightly wrinkled. Whereas in the treatment of 7.5%, and 12.5% had a median value of 9, which means that the texture is pliable, and not wrinkled.

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Tensile Strength

Tensile strength is the maximum force needed to pull the sample skin to break, expressed in kg/cm^2. Tensile strength is one of the factors that are dominant in determining the quality of tanned skin, this is because tensile strength can illustrate the strength of the bond between tanners and collagen fibers that make up the skin. Tanned skin with a good process will produce leather with high tensile strength. Results Tensile strength testing of five different treatments on the skin of tilapia using a areca nut extract re-tanning agent can be seen in Figure 2.

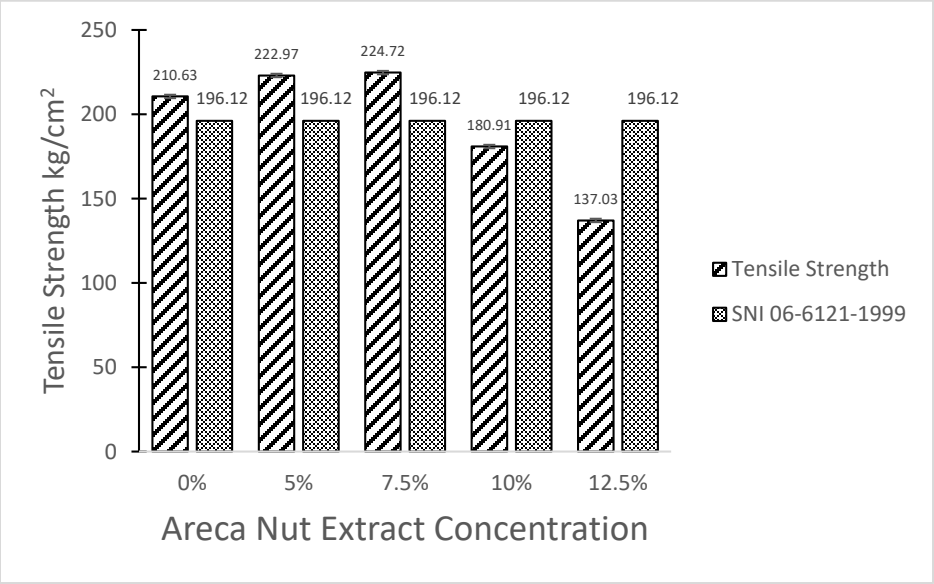

Figure 2. Graph of Average Value of Tensile Strength (kg/cm^2) Tilapia Tanned Skin and SNI Standard

Based on the results of the measurement of tensile strength of tanned tilapia skin (Figure 9), it can be seen that the highest average tensile strength is in the treatment of 7.5% areca nut extract of 224.72 kg/cm^2 followed by treatment of 5% of areca nut extract of 222, 97 kg/cm^2. The lowest average is in the treatment of 12.5% betel nut extract which is 137.03 kg/cm^2.

Areca nut extract added to retanning treatment affected the tensile strength of tanned tilapia 5% and 7.5% areca nut extract had higher tensile strength compared to other treatments. According to Mustakim et al. (2010), the addition of tannin (areca nut extract) to the chrome tanning can provide better tensile strength compared to using only a chrome tanning agent. Tensile strength decreased after treatment of 10% and 12.5% of areca nut extract, this was due to the relationship between tannin tanning agent from areca nut extract and less stable tilapia skin fibers meaning the skin was not perfectly resistant to the effects of acidic or basic conditions. Acidic conditions are able to convert triple helix collagen fibers into single chains, whereas base solutions can only produce double chains. This causes more collagen hydrolyzed by acidic solution than base solution (Haris 2008). Therefore, when tanning or tanning with areca nut extract tanner, the pH is set to be around 4-5 so that tannin is able to hydrolyze more amino acids in the tilapia skin collagen fibers (BBKKP 2014).

High collagen fiber composition in the skin will affect the high physical strength of the skin. High or low tensile strength of the skin is influenced by the thickness of the skin and skin protein density (Prayitno et al 2005). According to Purnomo (1992), the thicker the skin, the stronger the tensile strength. The thickness of the skin will affect the stability of the tanned skin, where the stability of the tanned skin is influenced by the cross-linking formed between the tanning material and skin protein. Mature skin will have a large number of cross-ties when compared to immature (raw) skin, so it is resistant to the physical forces that attack it.

Tensile strength of tilapia tanned with areca nut extract still meets SNI 06-6121-1999 standards, namely minimum tensile strength of 196.12 kg/cm^2, only 10% and 12.5% treatment of areca nut extract under SNI (Figure 2). Based on these data it can be said that tanned tilapia has a good tensile strength quality because it has a value above the SNI standard.

Elongation

Skin elongation is a skin length increase that is produced when the skin is pulled up to break divided by the original skin length and expressed in units of percent. The longer the size of the skin when pulled to break, the greater the elongation produced and this indicates that the skin has good stretchy quality. However, the skin that has an elongation value above the SNI value is a skin that has low quality because in its application if the skin is too stretchy, the resulting leather product tends to be too elastic so that the skin is difficult to maintain its original shape when given force/pressure. Results of elongation of tanned tilapia with tanning extract of areca nut can be seen in Figure 3.

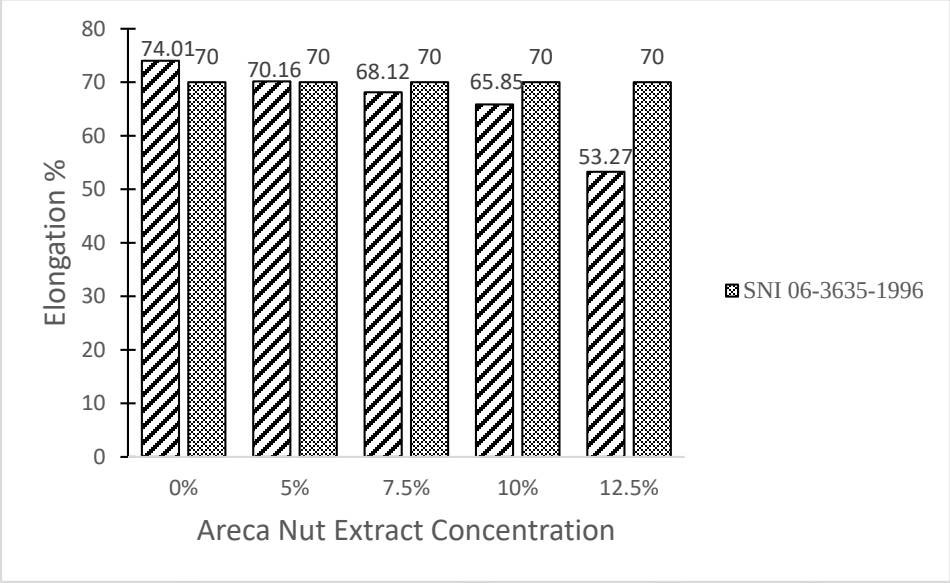

Figure 3. Graph of Average Elongation Tilapia Tanned Skin and SNI Standard

Based on the measurement of tanned tilapia skin (Figure 3), it can be seen that the highest elongation is in the treatment of 5% concentration of areca nut extract that is equal to 85.49% and the lowest in the treatment of areca nut extract concentration is 12.5% which is 53.27%.

Areca nut extract in the tanning process affects the elongation of the tilapia skin, the greater the concentration of the areca nut extract added will decrease the percentage of elongation of the tanned tilapia skin. According to Mustakim (2010), the addition of tannins in areca nut extract can reduce the stretching of the skin of chrome tanned.

Factors that cause high skin elongation due to high levels of fat in the skin (Untari et al 2004). According to Alfindo (2009), the low elongation obtained in tanned skin is caused by increasing bonding of skin fibers by tanning material or changing fibers into compact skin structures. Compact skin structure can inhibit the entry of oil as a relaxing agent, causing the skin to become stiff. In addition, stretching of the skin is also greatly influenced by the quality of the skin, the thickness of the skin and the composition of collagen fibers.

The results of tilapia skin elongation with areca nut extract ranged from 74.01% - 53.27%, the concentration of areca nut extract 7.5%; 10%; 12.5% had fulfilled the SNI 06-4263-1996 standard (Fancy leather from neat's leather), with elongation below 70%. Tilapia skin which is given the treatment of areca nut extract can reduce elongation because tannin in areca nut extract causes the skin to become stiff.

Tear Strength

The strength of the skin tear is the amount of force needed to tear the skin per unit thickness of the skin. The value of a large tear strength indicates that the skin's resistance to tearing is also large. In other words, the tear strength indicates the maximum limit of the tanned skin to tear. Tear strength test results of tilapia in this research are presented in Figure 4.

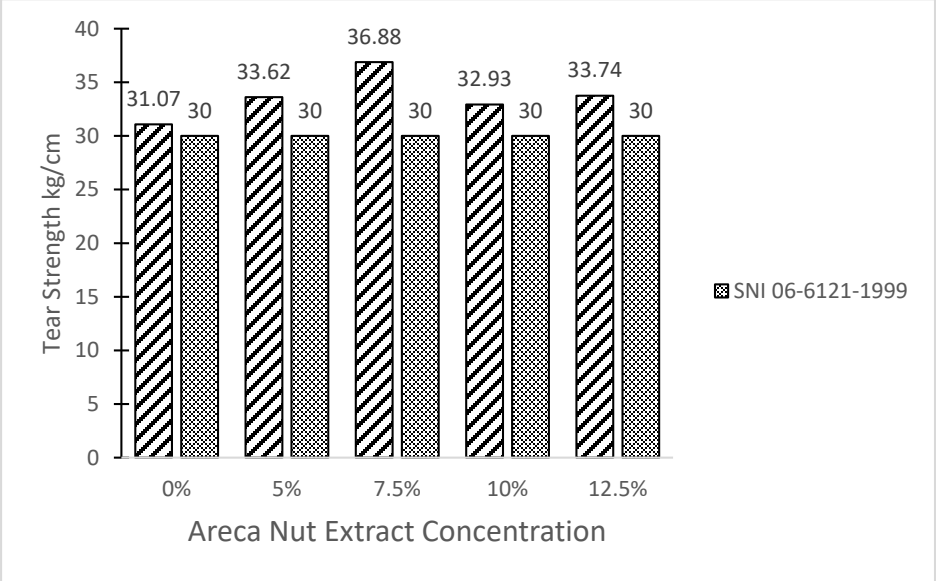

Figure 4. Graph of Average Tear Strength Tilapia Tanned Skin and SNI Standard

Based on the results of the tear strength measurement of tanned tilapia skin (Figure 4), it was found that tanned tilapia skin with 7.5% treatment of areca nut extract had the highest tear strength of 36.88 kg/cm, while the lowest average was in the control treatment with a tear strength of 31.07 kg/cm.

Tear strength of tilapia skin given by areca nut extract treatment increased compared to control treatment, this was due to the tannin content that entered the skin fibers so that the structure of tanned tilapia skin became more compact. In accordance with the statement of Mustakim (2007) the addition of tannins to the chrome tanning will increase the tear strength of the leather. This can occur because the binding of tannins by the treatment of the addition of areca nut extract into the protein molecules making up the tilapia skin collagen which results in the formation of cross bonds with the polypeptide chain in the tilapia skin collagen fibers determines the level of physical strength of the tilapia skin itself.

Treatment of 10% of areca nut extract has decreased the value of tear strength due to reduced tannin levels that enter the skin. Thick thickness of the leather affects the strength of the tear because thin skin collagen fibers tend to be loose so they are easily torn. According to Purnomo (1991), what affects the strength of a tear is the thickness of the skin. Didiek and Sukarsono (2006) added, that the strength of tearing as elongation is greatly influenced by oil absorbed by the skin and also at least chrome bound by the skin. The more oil that is bound, the skin becomes elastic so the tear strength becomes greater. Conversely the more chrome and tannin that is bound by the skin, the skin structure becomes stronger and stiffer so that elasticity becomes smaller which results in decreased tear strength.

Tear strength value of tanned tilapia skins ranging from 31.07 to 36.88 kg/cm (figure 4) still meets SNI 06-6121-1999 standards (stingray skin for finished goods) that is 30 kg/cm. Based on the graph (figure 4) it can be concluded that the tilapia skin in each treatment has fulfilled the SNI 06-6121-1999 standard (stingray skin for finished goods) so that it can be said to be suitable for use as a raw material in making leather products.

Shrinkage Temperature

Shrinkage temperature is the highest temperature that can be reached by a skin sample to shrinkage (Yahua et al. 2011). These are graph of the results of the test of shrinkage temperature of tanned tilapia with the addition of areca nut extract (Figure 5).

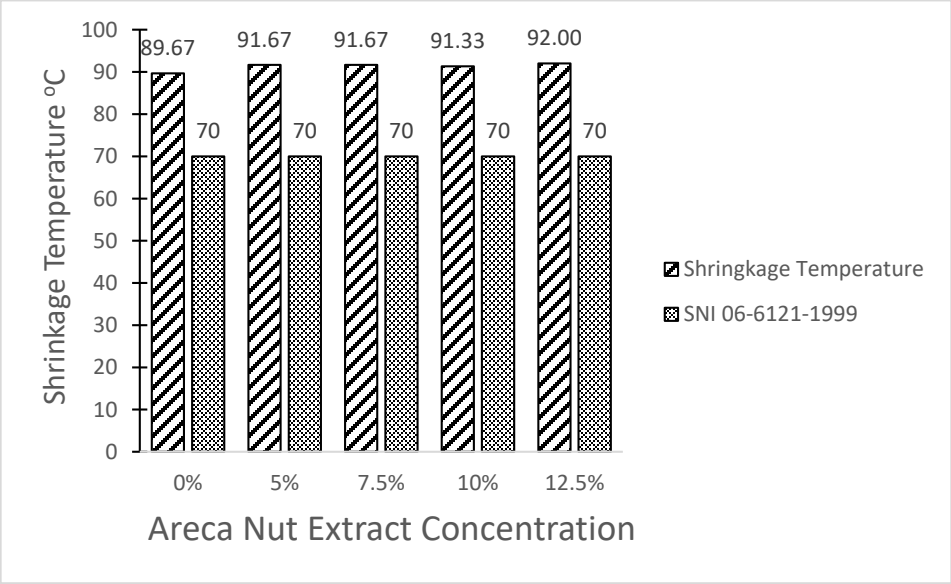

Figure 5. Graph of Average Shrinkage Temperature Tilapia Tanned Skin and SNI Standard

Based on the graph, the highest average shrinkage temperature was found in the addition of areca nut extract treatment by 12.5%, with a shrinkage temperature of 92°C, while the lowest average was in the control treatment (0% of areca nut extract) with a shrinkage temperature of 89.67°C. Areca nut extract affects the shrikage temperature of tanned tilapia skin. shown in Figure 5, the temperature of the shrikage skin of tilapia after adding areca nut extract tends to increase with increasing concentration. In accordance with the statement of Covington (2009), the plant tanning material used can increase the temperature of tanned skin wrinkles. At the time of the tanning process using tannins tanning agent, will form hydrogen bonds and covalent bonds between tannin acids from areca nut extract with amino acids that are extracted by tilapia skin collagen. The tannins will cross-link with collagen by hydrogen and covalent bonds which will produce leather with high shrinkage temperatures. Evans et al. (2012) added that the covalent bond between collagen and tannin was most responsible for increasing the temperature of skin wrinkles.

According to Sahubawa et al. (2010), skin products that have shrinkage temperatures more than 70°C will be more durable because they have higher heat (hydrothermal) resistance. This means that the skin of tilapia with the addition of areca nut extract including leather skin that is resistant to higher heat. Based on the graph (Figure 5), the shrinkage temperature of the tilapia skin is still above the SNI standard, where in the SNI 06-6121-1999 standard the specified wrinkle temperature value is at least 70°C. All treatments including controls have shrinkage temperatures above 70°C so it can be concluded that the skin of tilapia with the addition of areca nut extract has good quality based on the results of the shrinkage temperature test. Tilapia leather that meets SNI shrinkage temperature standards can be applied into the leather industry as a raw material

Conclusion

Based on research that has been done, the addition of areca nut extract to the retanning process affects the organoleptic and physical characteristics of tanned tilapia skin. The best tanned tilapia skin that meets SNI standards is found in tilapia skin which is added with a concentration of 7.5% of betel nut extract, with organoleptic characteristics with an average value of 9 in texture, 9 for

appearance, 8.2 for aroma and physical characteristics tensile strength of 224.72 ± 6.57 kg / cm^2, elongation of 68.12 ± 3.68%, tear strength of 46.24 ± 5.41 kg/cm, shrinkage temperature of 91.67 ± 0.577 ^oC.

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