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THE EFFECT OF THE AMOUNT OF PEROXIDE CONCENTRATION ON TANNING PROCESS TOWARDS PHYSICAL AND ORGANOLEPTIC CHARACTERISTICS OF PANGASIUS SKIN

Mohammad Rizki Akbar[1], Evi Liviawaty[2], Iis Rostini[2] and Emma Rochima[2]

[1]Student at Faculty of Fisheries and Marine Science, Padjadjaran University, Bandung – Sumedang KM. 21 Jatinangor 45363, Indonesia E- mail address: akbarstam7@gmail.com
[2]Lecturer at Faculty of Fisheries and Marine Science, Padjadjaran University, Bandung – Sumedang KM. 21 Jatinangor 45363, Indonesia

KeyWords
bleaching agent, physical quality, skin, bleaching, tanning.

ABSTRACT

The purpose of this research was to determine the concentration of hydrogen peroxide that has the best physical characteristics and effective as a bleaching agent in the proses of pangasius skin tanning. The research was held during April-May 2019. The research divided into two stages, namely the production process of pangasius tanned skin and characterization consisting of physical character (tensile strength, elongation, and tear strength), chemical character (water content), and organoleptic (appearance, aroma and texture). Tanning process and quality testing are carried out in the laboratory of the Center for Leather Rubber and Plastic Yogyakarta. The method that used in this research is complete randomized design consisting of one factor and five levels with three repetitions (triplo). The treatment of the research is the soaking of pangasius skin in following concentrations, 0% (control), 2%, 4%, 6% and 8%. The result showed that hydrogen peroxide with 6% concentration has the best result, with a tensile strength of 322,08±50,13 kg/cm^2, elongation or stretch strength of 43,76±4,61 %, tear strrength of 59,20±6,78 kg/cm, and water content of 16,84±0,071%, while the organoleptic test has an average score of 8,6 for appearance, 8,2 for odor/smell, and 8,4 for texture.

INTRODUCTION

Indonesian goverment is currently increasing industrial develompment in the fisheries sector. One of them is pangasius fish due to high demand from both domestic and international markets. The production of pangasius fish in 2006 reached 31.490 tons and continued to increased until in 2012 it reached 651.000 tons (Kemendag RI 2013).

Pangasius meat is usually processed into various kinds of food such as pempek, tekwan, and fish crackers. In general, the part of the fish that can be consumed is about 35%, while the inedible part is bone (11,2%), part of the head (10%), skin (4%), tail fin (3,4%), and stomach contents (4,4%) (Irawan 1995). The parts of the fish that cannot be eaten, one of them is skin. Fish skin can still be utilized by being processed into tanned leather through tanning process which can increased the economic value of fish skin.

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 body color of the pangasius fish on the back near the dorsal fin is grayish or bluish, while has a white or silvery color on the stomach part (Susanto and Khairul 2007). To get tanned skin with a bright and homogeneous surface color, bleaching process can be added before the pickling process. Bleaching process can eliminate all pigments in fish skin (Hak 2013).

Hydrogen peroxide has the advantage of not leaving a harmful residues and enviromentally friendly compared to other oxidizing agent or other bleaching agents. Beside that, the oxidation strength of hydrogen peroxide can be adjusted according to the strength requirements or oxidation rate (Skuler 2007).

MATERIAL AND METHODS

The research is divided into two stages, The first stage is the process of pangasius skin tanning, and the second stage is the chracteristic test which included physical, and chemical character and 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, 5 kg of pangasius fish skin obtained from PT. Hayati Seafood, H2O2 (hydrogen peroxide), Na2S (sodium sulfide), Ca (OH) 2 (calcium hydroxide), (NH4) SO4 (ammonium sulfate), Pancerol (oropon), NaCl (kitchen salt), HCOOH (formic acid), H2SO4 (sulfuric acid), Cr2O3 (chrome tanner), Na2CO3 (Sodium carbonate), H2O (water), and synthetic tanning agent (soft syntan).

The method that usesd 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 hydrogen peroxide as follows, 0% (control), 2%, 4%, 6%, and 8%. Then an analysis of the physical quality test of the pangasius 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), water (BSN 1989). 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 06-4586-1998 data (finished leather from freshwater snakeskin), and SNI 06-3635-1994 (goat/sheep skin). 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

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. According to test result, the highest tensile average was in the control treatment of 0% hydrogen peroxide at 347.55 kg / cm^2 followed by 6% hydrogen peroxide treatment of 322.08 kg / cm^2. Whereas the lowest average is in the treatment of 8% hydrogen peroxide which is equal to 270.86 kg / cm^2 which can be seen on following graph (figure 1) :

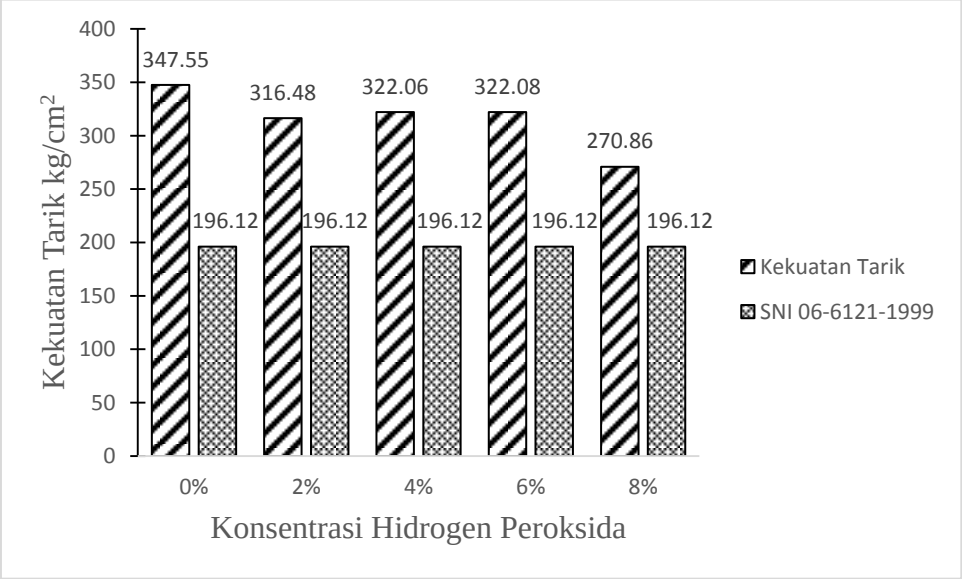

Figure 1. Graph of Average Value of Tensile Strength (kg/cm^2) Pangasius Tanned Skin and SNI Standard

Based on the graph shows that hydrogen peroxide affects the tensile strength of tanned skin, the control treatment has a higher tensile strength when compared to tanned skin that treated. according to the opinion of Hak (2013) that the skin given hydrogen peroxide treatment has a lower tensile strength than the control (0% hydrogen peroxide). Tensile strength tends to decrease with the increasing concentration of hydrogen peroxide, especially at a concentration of 8% hydrogen peroxide. This is caused by the characteristic of hydrogen peroxide which can break down natural fat that contains in the skin (Herawati 1996), so it can reduce the tensile strength of tanned skin.

The fat that is lost during the tanning process is replaced when entering the fatliquoring process where at this stage the skin is given natural oils such as fish oil or synthetic oil which determine based on the product needs to be produced, in this research the oil used in the fatliquoring process is synthetic oil. However, at a certain concentration of 8% hydrogen peroxide, it certainly causes a greater amount of natural fat decomposition compared to other treatments so that when the process of fatliquoring the skin with hydrogen treatment 8% absorbs more synthetic oil which gives a smaller tensile strength compared to with control and other treatment. Besides that, it can also be proved by the high tensile strength in the control treatment (0% hydrogen peroxide immersion), were in the control treatment there was no breakdown of the skin's natural fat which in the end results in greater tensile strength.

The oiling process affects the tensile strength of the tanned skin because of oil functions as a lubricant that will make the skin fibers soft and flexible. Oil also influences the physical properties of the skin such as tear resistance, tensile strength, water resistance, and moisture and water and air absorption (Herawati 1996).

The tensile strength of tanned pangasius skin still meets the SNI 06-6121-1999 standard, the minimum tensile strength of 196.12 kg / cm2 both given treatment and control (figure 1). Based on these data, it can be said that pangasius skin has a good quality of tensile strength because it has a value above the SNI standard.

Based on the graph (figure 1), it can be concluded that the pangasius tanned skin is meet the standards of SNI 06-6121-1999 (stingray for finished goods) in each treatment including controls. Another factor that affects the tensile strength of the skin is thickness. If the skin is thicker it has stronger 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 bond formed between tanning material and skin protein. Tanned skin will have a large number of crosslinks when compared to unripe (raw) skin, so it is resistant to the physical force that attacks it (Purnomo 1992).

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.

Based on the results of measurements of tanned skin elongation (Figure 2) it can be seen that the highest elongation was found on the control treatment (0% concentration of hydrogen peroxide) that is equal to 57.35% and the lowest in the treatment of 4% hydrogen peroxide, which was 36.74%.

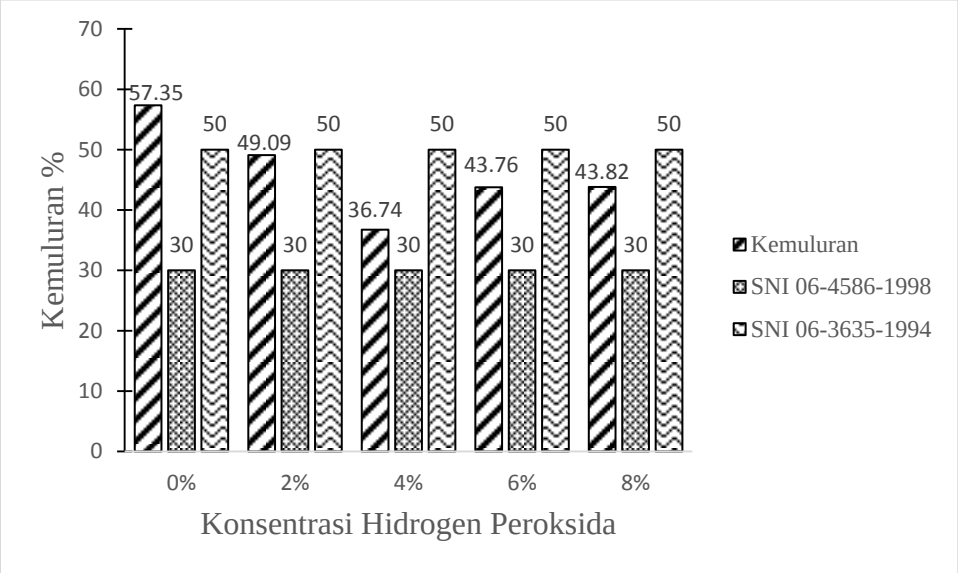

Figure 2. Graph of Average Elongation Pangasius Tanned Skin and SNI Standard

Based on the graph it can be said that the addition of hydrogen peroxide in the tanning process affects the elongation of tanned leather. The pangasius skin that undergoes a bleaching process has a lower value in each treatment when compared to the control. This is caused by the reaction given by hydrogen peroxide to the skin. According to Herawati (1996), bleaching using hydrogen peroxide can remove pigments from tanned skin. Whereas according to Nurbalia (2015), the bleaching process can eliminate spots from fish skin. The loss of pigments and spots on the skin of fish can cause a tanner compound to more easily enter and fill the skin so that the cross-link between tanner compound and skin proteins is more formed. According to Alfindo (2010), the low elongation obtained in tanned leather is caused by the increasing bond of skin fibers by tanning materials or the change of fiber into a compact skin structure. The compact structure of the skin can inhibit the entry of oil as an ingredient that causes the skin to become stiff. In addition, skin elongation is also strongly influenced by skin quality, skin thickness and the composition of collagen fibers.

The elongation results ranged from 57.35% to 36.74% (figure 2) which didn't meet the standards of SNI 06-4586-1998 (finished skin from freshwater snakeskin), which is a maximum of 30%, but tanned leather can still meet the quality requirements of tanned leather. Goat/sheep which is a maximum of 50% (SNI 06-3635-1994).

Based on the graph (figure 2), it can be seen that the control treatment (0% concentration of hydrogen peroxide) does not meet the two specified standards, namely SNI 06-4586-1998 (finished skin from freshwater snakeskin) and SNI 06-3635-1994 (goatskin tanned / goat sheep), while for tanned skin which is given treatment still meets one SNI standard, namely SNI 06-3635-1994 (tanned leather of goat / sheep). In other words, treatment of 2%, 4%, 6%, and 8% is a good treatment. The control treatment (0% concentration of hydrogen peroxide) did not meet the two SNI standards because the skin with the control treatment still contained natural pigments and spots on the skin which resulted in tanneries being slightly hampered to enter and fill the skin so that fewer cross-formed bonds were treated. Broken tanned skin given hydrogen peroxide immersion treatment can still be suitable for use as raw material for leather products in industrial activities because it can still fulfill one of the SNI criteria.

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.

Based on the measurement of the tear strength of the pangasius skin, the graph is obtained as follows (Figure 3):

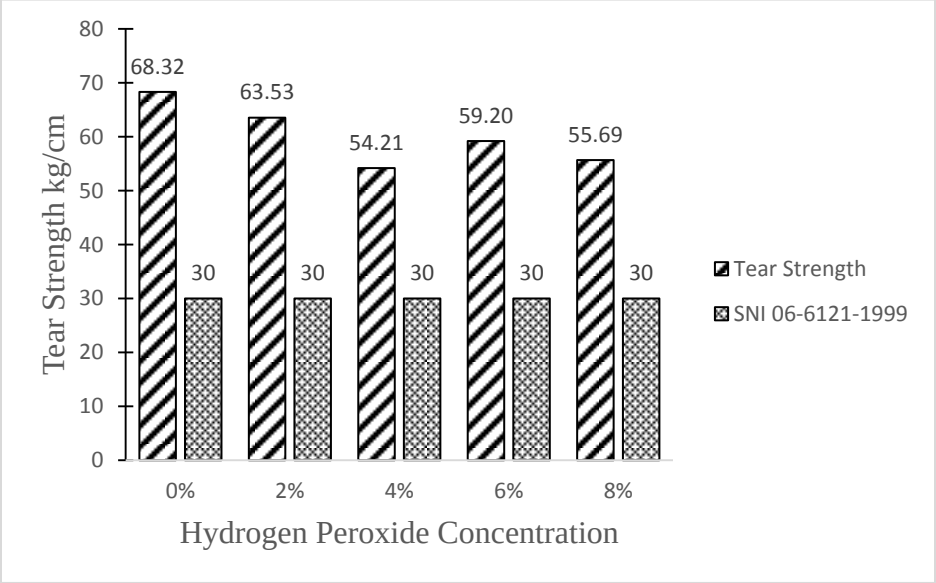

Figure 3. Graph of Average Tear Strength Pangasius Tanned Skin and SNI Standard

Based on the graph it can be seen that pangasius tanned leather with a control treatment (0% concentration of hydrogen peroxide) has a tear strength with the highest average of 68.32 kg/cm, while the lowest average is found in the treatment of hydrogen peroxide with concentration 4 % that is with tear strength of 54.21 kg/cm. The strength of tanned pangasius skin tends to decrease with increasing concentration of hydrogen peroxide given. This is caused by the breakdown of natural skin fat on fish skin (Herawati 1996). The missing natural fats will be replaced by synthetic oil at the fatliquoring process but the quality is lower when compared to natural fish skin oil. This is proven by the control treatment that the skin of pangasius which is not soaked with hydrogen peroxide has a higher tear strength value than each treatment given.

The composition of collagen fibers is strongly influenced by the thickness of the skin and the location of the skin. The thinner skin has loose collagen fibers that have lower tear strength or melting compared to thicker skin (Haines and Barlow 1975).

The tear strength of tanned pangasius skin which ranges from 54.21 to 68.32 kg/cm (figure 3) still meets the standards of SNI 06-6121-1999 (stingray skin for finished goods), which is equal to 30 kg/cm.

Based on the graph, it can be concluded that the pangasius skin tanned at each treatment has met 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 the manufacture of leather products. Collagen is a fiber protein that is a major component in leather. The protein has a role as mechanical support that can provide strength to the bones and the resistance to tearing on the skin (Winarno 1989).

The size of the tear strength is according to the high and low levels of tanner substances contained in tanned leather and the appearance of the skin will reflect the tanneries contained in the skin (Untari 1995). In other words, the amount of tear strength shows the degree of stability between tanners and the skin layer. According to Purnomo (1985), the strength of the skin tear is affected by the high composition of fiber proteins in the skin and structural changes that occur in the skin. Skin fibers will contract when the calcification and erosion of proteins occur so that the tear strength will decrease or below. Tearing strength will increase again when in the tanning process, collagen fibers in the skin bind to chromium in the chromium complex. In other words, mature skin will have a good tear strength value, but otherwise, the tear strength will be low if tanned skin is not ripe or undercooked when the tanning process occurs.

Chemical Characteristic (Water Content)

Water content is a percentage of the water content of a material expressed in wet weight (wet base) or based on dry weight (dry base). Water content in dry weight can be more than 100%, while wet weight water content has a maximum limit of 100%. (Sharif and Halid 1993).

Based on the results of measurements obtained data on tanned leather water content contained in the graph as follows (figure 4):

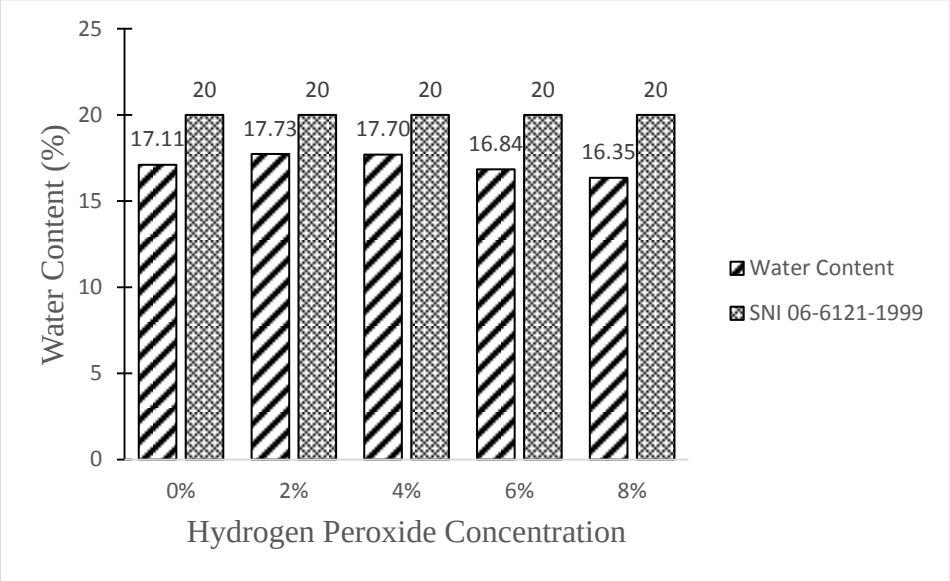

Figure 4. Graph of Average Water Content Pangasius Tanned Skin and SNI Standard

Based on the graph, the highest average water content was found in the treatment of hydrogen peroxide immersion as much as 2%, namely with a moisture content of 17.73%, while the lowest average was found in the treatment of hydrogen peroxide immersion as much as 8% with a water content of 16.35 %. Water content tends to decrease with increasing concentration of hydrogen peroxide given. Bleaching or bleaching can remove spots from fish skin (Nurbalia 2015). The loss of spots on fish skin causes an increased chance of tanning material to penetrate and bind to skin collagen fibers and minimize the chance for water to bind to pangasius skin. Novia (2009), states that the moisture content of the skin is influenced by the penetration (penetrating) properties of tanning material into the skin, where the tanning agent diffuses into the skin and attaches itself to the skin fibers and at the same time releases an amount of water.

Water content and fat or oil content found on tanned leather are very closely related, the higher the fat/oil content, the lower the water content found in tanned leather. This is because the acid compounds contained in fats/oils have the ability to release hydrogen shells to reduce water content in the skin (Juliyarsi 2013). The higher the concentration of hydrogen peroxide, the higher the natural fat that decomposes and increases synthetic fat to better fill the skin during the fatliquoring process. This increase in levels of synthetic fats/oils has resulted in a decrease in water content as the concentration of hydrogen peroxide is increased during the immersion process. Nurwanto and Djariah (1997), argued that the water content of a material is inversely proportional to fat or oil where the lower the fat/oil content of a material, the lower the water content, this is because the acid compound will release the hydrogen bonds of water contained in the skin.

Based on the graph (figure 4), the pangasius skin tanning water is still above the SNI standard, wherein the SNI 06-6121-1999 standard the value of the water content determined is a maximum of 20%. In each treatment including the control has a water content that is below 20% so it can be concluded that tanned leather has good quality based on the results of the water content test. With moisture content that meets SNI standards, the catfish tanned leather can be applied to the leather industry as raw material. Water content that exceeds the SNI standard is possible to be easier to mold when compared to skin that meets SNI standards.

Organoleptic Test (Appearancem 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 5):

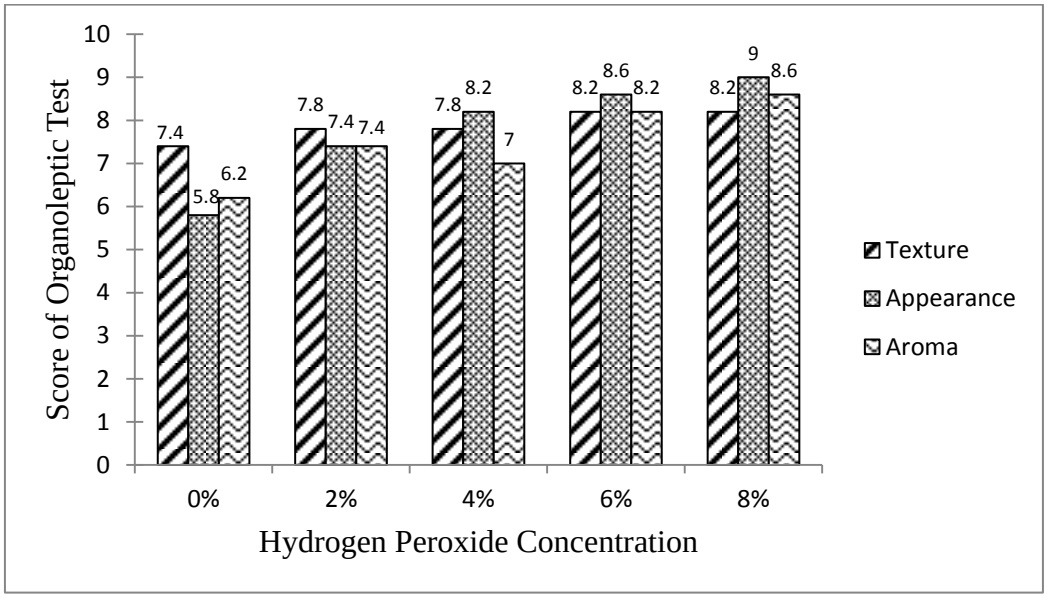

Figure 5. Graph of Organoleptic Test Result

Based on the graph it can be concluded that as hydrogen peroxide immersion concentration increases, the value given by panelists tends to increase in terms of texture, appearance, and aroma. The control treatment (0% hydrogen peroxide) has the lowest average value of each treatment while the 8% hydrogen peroxide treatment has the highest average value. This is due to reactions that occur between the skin and hydrogen peroxide, which according to Herawati (1996), the process of bleaching using peroxide can remove pigments on the skin that cause the skin to be better in terms of texture, appearance, and aroma. Based on the results of the Friedman test the best treatment is at the immersion of hydrogen peroxide with a treatment of 6% and 8%.

The values given by panelists are described in accordance with the SNI 8268: 2016 standards as follows (Table 1):

Table 1. Median Value of Organoleptic Test Result

No	Orgnoleptic Characteristic	Hydrogen Peroxide Concentration				
		0%	2%	4%	6%	8%
1	Appearance	5	7	9	9	9
2	Aroma	7	7	7	9	9
3	Texture	7	7	7	9	9

Based on the table in terms of appearance, the median value of 5 is in the control treatment (0% hydrogen peroxide) which means that the skin in the control treatment is not intact, less bright, less clean, uneven thickness and the color is less homogeneous. In the treatment of 2% hydrogen peroxide get a median value of 7 which means that the appearance is intact, bright, less clean, less evenly distributed, the color is less homogeneous. While the treatment of 4%, 6%, and 8% hydrogen peroxide has a median value of 9 which means that the appearance is intact, bright, clean, evenly distributed, and homogeneous.

In terms of aroma, 0% (control), 2%, and 4% hydrogen peroxide treatment get a media value of 7, which means that the aroma smells a little. While the treatment is 6%, and 8% of hydrogen peroxide is neutral and does not smell.

In terms of texture, control treatment (0%), 2%, and 4% have a median value of 7 which indicates that the texture is flexible and slightly wrinkled. Whereas the treatment is 6%, and 8% has a median value of 9 which means that the texture is flexible, and not wrinkled. Description of assessment of each organoleptic characteristic in accordance with SNI 8268: 2016.

Conclusion

The bleaching process affects the physical quality (tensile strength, tear strength, and elongation), chemical (moisture content) and organoleptic tanned leather. In terms of physical quality, the bleaching process tends to have lower physical quality values when compared to controls (without hydrogen peroxide immersion) whether it is tensile strength, tear strength, and elongation. However, the value of physical quality that threated by bleaching still meets SNI requirements whether it is tensile strength, strong tear, and elongation. In terms of chemical quality by checking water content, tanned leather which is treated with bleaching or control meets SNI requirements. In the organoleptic assessment, the best average value was in the treatment with a concentration of 6% with an

average value of 8.2 in texture, 8.6 in appearance, and 8.2 in odor.

Bleaching using hydrogen peroxide has good results in 6% treatment with physical and chemical qualities as follows, the tensile strength of 322.08 ± 50.13 kg / cm2, elongation 43.76 ± 4.61%, tear strength at 59.20 ± 6.78 kg/cm, and water content of 16.84 ± 0.071%. Whereas the organoleptic test has an average value of 8.2 textures, 8.6 for appearance, and 8.2 for odor/smell.

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