Effect of using fresh palm oil and used palm oil as a fat liquoring agent to the chemical quality of leather from tilapia fish skin

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Abstract. Tilapia skin has a high value in the form of tanned tilapia skin. One of the factors that play an important role in the tanning process is the using of tanning agents. This research was carried out by vegetable tanning to the tilapia fish skin using selected concentration of fresh palm oil and used palm oil. The study aims to find out the chemical quality of leather through the using of fresh and used palm oil as fat liquoring agent in the vegetable tannery process. The same concentration of fresh palm oil (10%), and used palm oil (10%) were used in this study. The parameter of fat content, and water content as chemical quality was observed in triplicates. Based on the results, the fat content of the leather using fresh palm oil (19.265%) was significantly increased (p<0.05) compared to used palm oil (15.825%), while the water content was also significantly different (p<0.05). In conclusion, the addition of palm oil improved the moisture of tilapia fish skin and become softer that can be used for commercial products, and it became the alternative material that could be use in vegetable tannery processing.

1. Introduction
Tilapia is a type of freshwater fish consumption and is sold as a fresh fish. There are several companies that process tilapia into fillets, and by-product of processing tilapia into fillets is skin. Tilapia skin can have high economic value in the form of tanned tilapia skin [1]. One of the factors that play an important role in the tanning process is the using of tanning agents. The tanning material has advantages and disadvantages, and the properties of tanning agent affect the chemical quality. The quality of skin to be a leather depends on the character of the fresh skin itself, especially for fish skin, tilapia fish skin has a good and unique character (Table 1) to be processed in vegetable tannery.

Fat liquoring process is part of the tannery which aims to put the oil molecules in space that exists between the fibers of the skin and can serve as a lubricant. Oil is an important component in the skin that functions as a lubricant for skin tissue in the tanning process to make the skin soft [2]. Oils or fats can change the important properties of the skin, including the skin becomes softer, more supple, stretchy, soft, and has a smoother tattoo surface. Plant oils are widely used as ingredients for skin oiling because they are affordable and easy to obtain. Some examples of vegetable oils are rubber seed oil, soybean oil, sunflower seed oil and palm oil. Vegetable oils, animal oils and fish oils contain triglycerides. Palm oil consists of triglycerides which are esters of glycerol with three fatty acid molecules. The use of palm oil

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in the tanning process can function as an emulsion stabilizer and a good lubricant to produce a limp leather [3], [4], [5].

Table 1. Simply character of skin as a tannery object.

|                | Fresh Skin | Tilapia Fish Skin | Leather       |
|----------------|------------|-------------------|---------------|
| Form           | Cleavage   | Fish scales       | Sheet         |
| Colour         | As a common animal skin | Various colour | Various depend on tanning material |
| Appearance     | Fresh      | Fresh             | Soft and elastic |
| Character      | Easily rotten | Easily rotten | resistant to rot |
| Section arrangement | Epidermic, hypodermic, cutis | Epidermic, hypodermic, cutis | Cutis |

In this study, we investigated the using of fresh palm oil and used palm oil as a fat liquoring agent in the tannery of tilapia skin. The study aims to find out the chemical quality of leather through the using of fresh and used palm oil as fat liquoring agent in the vegetable tannery process. The chemical quality of tilapia leather was observed and evaluated by examining parameters of fat content and water content.

2. Materials and methods

2.1. Tannery process of tilapia fish skin

The study was used 100 pieces of tilapia fish skin in tannery process that was conducted in two treatments of fat liquoring process. The process of tannery was used the same concentration of fresh palm oil (10%) and used palm oil (10%) as fat liquoring agent. The tanning process was carried out in three stages consisting of pre-tanning, tanning, and finishing. The tanned tilapia leather as a finished leather is show in figure 1.

![Figure 1](a)![Figure 1](b)

**Figure 1.** The tilapia fish skin that has finished in the vegetable tannery process. The above figure was using 10% fatliquoring agent: (a) fresh palm oil; (b) 10% used palm oil.

2.2. Chemical quality

The chemical quality parameters of tanned tilapia leather are fat content and water content. The measurement of fat content and water content was carried out at the Yogyakarta Central Rubber, Leather and Plastic Laboratory (BBKKP). The tilapia tannery process using vegetable tannery materials, as shown in figure 2.

2.3. Data analysis

Data on the results of tilapia fish skin tannery using same concentrations of fresh palm oil and used palm oil were analyzed using a T-Test.
3. Results and discussion

3.1. Fat content
The standard fat content of tilapia leather based on the Indonesian National Standard (SNI) 06-6121-1999 for finished goods product is maximum of 12%. The oil or fat content is a chemical quality examination to determine the percentage level of fat contained in the leather. Low oil or fat content in leather which is in accordance to the maximum standard of SNI indicates a better quality [8]. Moreover, the results of the fat content (Figure 3) with the using of fresh palm oil and used palm oil at a concentration of 10% were exceeded to SNI, but still in a good range. The using of used palm oil was significantly different (p<0.05) compared to fresh palm oil. This indicated that the used palm oil is better to produce the tilapia leather with lower fat content.

The high levels of fat are affected by differences in the concentration of oil used in the fat liquoring process. The higher the concentration of using the oil, the higher the fat content. The increase in the value of fat content in fish skin is in line to the high concentration of the using oil, so that it increases the leather elasticity and is easy to mold [9]. The value of fat content with the use of oil on the Stingray skin in the tannery process also had high results compared to the control treatment [10]. The high value of fat content is caused by the amount of oil that lubricates the skin's collagen fibers more. The value of fat content is in line to the amount of oil used during the fat liquoring process. The high and low levels

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**Figure 2.** Vegetable tannery process of tilapia fish skin using palm oil as fat liquoring agent.
of oil or fat are due to the low of water temperature used in the fat liquoring process, then the oil is not well dispersed into the skin [7]. The temperature for fat liquoring process in the tannery ranges from 50ºC to 60ºC.

![Figure 3](image1.png)

**Figure 3.** Fat content of tilapia leather using 10% of fresh and used palm oil as fat liquoring agent (Error bars represent standard deviation of mean). *p < 0.05.

![Figure 4](image2.png)

**Figure 4.** Water content of tilapia leather using 10% of fresh and used palm oil as fat liquoring agent (Error bars represent standard deviation of mean). *p < 0.05.

### 3.2. Water content
The water content of tilapia leather in vegetable tannery process with the addition of 10 % used palm oil showed the higher concentration compared to the addition of 10% fresh palm oil (Figure 4). The results of the water content with the addition of used palm oil were significantly different (p<0.05). The standard of water content of stingray’s leather based on the Indonesian National Standard (SNI) 06-6121-1999 stingray leather for finished goods is 20% in maximum. This indicated that the using of either
used palm oil or fresh palm oil was in accordance with the water content of SNI for tilapia fish leather. Furthermore, the appearance of tilapia leather that has been finished in the vegetable tannery process using the fresh palm oil or used palm oil as fat liquoring agent was not different (Figure 1).

The high-water content value is caused by imperfect interaction between synthetic oil and skin collagen which causes free water in skin collagen not to be fully emulsified, so that there is still free water in the skin collagen cavities. The low water content value is caused by a fairly perfect interaction between synthetic oil and skin collagen which causes free water in skin collagen to be well emulsified, and free water in the skin collagen cavities is reduced [10]. The tanning process there is a binding process between two similar molecules into a larger molecule by removing water [11]. The release of free water and bound water in the tanning process can cause the water content that is still in the skin to decrease, so the amount becomes relatively the same. Another factor that causes the water content to be significantly different is the finishing process, which the stretching and drying process were conducted until the skin is deemed dry enough. The drying process aims to remove the moisture content. The water content of leather products that exceeds the maximum limit has an impact on the growth of microbes (bacteria and fungi) on leather, as well as the opportunity for physical damage to occur (such as products being peeled off, cracked, and causing unpleasant odors) [12]. The pickling process removes a certain amount of water present on fresh skin, especially free water present on the skin. In addition to free water, bound water also comes out as a result of protein denaturation in the skin due to the influence of acids. The process of protein denaturation is a change in the polypeptide bond of the protein, which in the end the water bound in the protein is released. The release of water from the skin also occurs in the tanning process, when the binding between complex chromium molecules in the skin occurs [13]. The tanning process an olation process occurs, which is a binding between two similar molecules (complex molecules) into larger molecules by removing water. The release of free water and bound water in the pickle process and the tanning process, can cause the water content that is still in the skin of the tilapia to decrease, so that the amount of water content is relatively the same for each treatment [14], [15].

4. Conclusions
It concluded that the tilapia leather due to the addition of palm oil improved the moisture of the leather and become softer that can be used for commercial products, and it became the alternative material that could be use in vegetable tannery processing.

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