niloticus) (Riyadi et al., 2015), tuna fish (Nur et al., 2017), stingrays (Nur et al., 2017), catfish, sharks, snapper.
The process of tanning fish skins goes through the following stages (Hak, 2013) : t

a. Liming

Fresh fish skins are soaked for two nights (48 hours) in a solution consisting of 500% water, 3% Na2S and 3% Ca(OH)2. Every hour should be stirred around for 5 minutes. The percentage of ingredients is calculated based on the weight of the skin of fresh fish.

b. Lime removal (deliming) and enzyme administration (bating).

The skin of the fish was washed in a rotating drum using water (500%) plus (NH4)2SO4 as much as 0.5% and HCOOH as much as 0.5%. The drum is rotated continuously for 30 minutes. Add to the rotating drum the 1.5% oropon (enzyme) which is dissolved first with water and the drum is rotated continuously for about 90 minutes and the skin is rinsed with clean water. All percentages of ingredients are calculated based on the weight of fresh fish skin.

c. Bleaching

Cleansing is carried out by soaking the skin of the fish that has been *deified* and *grounded* in a 3% peroxide solution

d. Pickling

The skin of the fish is rotated in a drum for 20 minutes with a solution consisting of 500% water and 50-75% table salt, then add 1% HCOOH to the drum and the fish skin is rotated again for 90 minutes. Next add 2% H2SO4 to the drum and the fish skin is turned again for 90 minutes. The skin of the fish is left submerged in the drum with the acid solution for one night. The percentage of ingredients is calculated based on the weight of the skin of fresh fish.

e. Chrome tanning

The drum containing the fish skin and acid solution is added with a chrome tanning agent (chromosal B) which is a 10% multiplier. Then the playback of fish skins in drums is continued for 2 hours. Add it into the drum that rotates 2% Na2CO3 and the drum continues to play for 6 hours. After that the kulilt is removed from the drum and stretched over the frame of the easel for one night.

f. Neutralizing

The skin of the fish is rotated in a drum for 90 minutes with a solution consisting of 500% warm water and 2% Na2CO3. After which the skin is rinsed with clean water.

g. Retanning

The skin of the fish is rotated in a drum for 2 hours with a solution consisting of 500% warm water and 10% synthetic tanning (Lowatan).

h. Dyeing and fat liquoring

The skin of the fish is rotated in a drum for 1 hour with a solution consisting of: 500% warm water and 2% dye. After that it is added to the drum 8% sulfonated oil and the skin is rotated again for 1-2 hours. Add it again to the 1% HCOOH drum and the skin is rotated again for 30 minutes. The skin is stretched over the frame of the easel for the night.

i. Finishing

The skin of the fish is stretched on the pentangan board by nailing it to the edges. After that, the dried skin is taken from the staging board, tidied up by cutting on the edges. After that it is sanded on its bottom. Tanned fish skins ready for downstream/handicraft products

One of the handicraft industries with a fairly potential contribution in Indonesia is the leather handicraft industry. Raw materials that are often used by the leather handicraft industry come from farm animals and reptiles. As the market demand for leather handicraft products increases and the development of science and technology, fish skins can become an alternative and meet the needs of the industry.

The results of fish skin tanning are usually used for the manufacture of accessories such as bags, clothes, shoes, wallets, flower vases (Nur et al., 2017). Salamah et al. (2018), make *fashion* accessories such as Women's shoes, clothes of various shapes and models.

Figure 1. Processed tilapia skin waste after going through several processing

Source : Salamah et al., 2018

Figure 2. Women's shoe products from processed tilapia skin waste
Source : Salamah et al., 2018

In his research (Salamah et al., 2018) approved the results of a previous study conducted by Prayitno, Emiliana K, Wachid N, which discussed tilapia skin that can be used for raw materials for making garments. The physical and mechanical properties of the tanned tilapia skin resemble conventional tanned skin and are in accordance with the requirements of SNI.06-4593-1998.

Extraction of Gelatin from Fish Skin for Photosresist and Capsule Shells

The extraction of gelatin from fish skin generally uses the acidic method, which is to use acidic compounds such as acetic acid to mellow gelatin from fish skin. According to Samosir et al (2018), acids are able to convert helical triple collagen fibers into a single chain so that the amount of collagen hydrolyzed by acid solutions is more than alkaline solutions. Various studies have reported on the quality and quantity of gelatin obtained from making up fish species as found in Table 1.

Table 1. Quantity and Quality of Gelatin Extracted from Various Types of Fish through the Acid Method

Parameter	Gelatin kulit ikan Kakap merah (Trilaksani dkk, 2012)	Gelatin kulit Ikan Tuna (Pelu dkk, 1998)	Gelatin Kulit Ikan Patin (Peranginan-gin dkk (2004)	Gelatin kulit ikan Balide (Fe-bryana dkk 2018)
Rendemen (%)	16,8	10,48	9,36	3,30
Kekuatan Gel (bloom)	312,5	536 g/cm^3	263m3	50,25
Viskositas (cp)	17,4	22,8	10	2,50
pH	5,45	5,06	6,7	5,60
Titik gel (^{0}C)	10,5	12	-	5,5
Titik leleh (^{0}C)	27,26	-	-	24,5

Based on Table 1, the physico-chemical properties of gelatin from fish skin are suitable for use as a pharmaceutical and photographic ingredient. Therefore gelatin from the skin of fish can be used for photoresist and capsule shells.

In the field of photography, gelatin produced from fish skin can be used to extend shelf life in storing photos, namely as a photoresist who can avoid (coating) from the presence of sensitive light (Agustin, 2013). The use of fish gelatin in the photographic process is quite good, because it has high gel strength and is sensitive to light in actively *coated* photo applications. Therefore, the use of gelatin from fish skin has a direct advantage, which can be used without complicated treatment in its application, and can be used in the same container for several days of use (Agustin, 2013).

In the pharmaceutical industry, gelatin is used as an ingredient in making hard and soft capsules, tablet coating agents, stabilizers, binders, and emulsifiers (Schreiber & Gareis, 2007). One of its uses is that red snapper skin fish waste can be used as raw material for making gelatin. This gelatin is a raw material for the manufacture of capsules. In pharmacy, the term capsule is used to describe *edible packages* made of gelatin or other suitable material that is then filled with drugs to produce a specific unit of dose, usually to be eaten.

The manufacture of hard capsules is carried out through several stages, namely melting, staining (dying), and capsule formation, then an examination of the quality of the capsules produced is carried out. The melting process is the process of dissolving gelatin with demineral water in a melter at a temperature of 80-90°C. During the melting process, the regulation of important parameters such as temperature, pressure, and stirring speed is carried out. After a homogeneous solution, cold demineral water

(40-50°C), Sodium Lauryl Sulfate (SLS), 50% Acetic Acid (AA) were added and stirred at low speed for ± 90 minutes to obtain a homogeneous mixture between gelatin with SLS and AA. The gelatin solution from the melting process is introduced into the GFT which has been filled with demineral water and then added dyes to give it the color as desired. The process of making hard capsules occurs in HCM (Hard Capsule Mechine). In this process, the appropriate GFT solution is put into a dish in the HCM which is continuously controlled for viscosity and temperature automatically by the computer. The temperature of the solution is between 45-55°C while the viscosity ranges from 400-500 cps.

Fish Skin as an ingredient in Healing Burns

Scientists at the Federal University of Ceara, Brazil have found that tilapia skin has moisture, collagen, and disease resistance comparable to human skin, and can help the healing process. On the skin of tilapia are found non-insectivus microbiota, a large amount of type I collagen, and a morphological structure similar to human skin, so it can be suggested as a potential xenograft to deal with burns. Collagen plays an important role in the healing process of wounds in connective tissue. Macrophages in wounds release FGF and TGF-β thereby stimulating fibroblast proliferation and producing collagen (Gaspar, et al., 2012). Some research on processed fish collagen has been pretty much done. One of them is the one done by Nagai & Suzuki (2000) which reports that fish skin contains collagen with a yield value that varies between 11-63% depending on the type of fish, extraction material, and collagen extraction technique.

The application of tilapia skin as a healer for burns can be done as follows: Fish skin that has been cleaned and strerilkan is given directly to the burned area, then covered with a bandage, after 10 days the bandage can be removed and the dried tilapia skin can be removed by hand.

Figure 3. Implementation of tilapia skin on burns
Source: Lordello *et al.* (2019)

Collagen Extraction from Fish Skin for Lotions (Cosmetics)

Collagen obtained from fish skin extraction results can be used as a formulation ingredient in the manufacture of lotions as reported by Dewangga et al (2001). Collagen acts as an active substance in lotions that can provide many benefits for the skin, such as preventing wrinkles, increasing skin moisture, protecting the skin from free radicals, and maintaining skin elasticity. Lotions are preparations in the form of suspensions, solutions, or emulsions for use on the skin, lotions can also be defined as liquid creams (Zulkarnain AK, 2017).

The procedures for making fish skin collagen lotion are as follows (Dewangga et al, 2001):

1. The material is separated into two parts, namely the manufacture of the oil phase (stearic acid, cetyl alcohol, liquid paraffin) and the water phase(glycerin, triethanolamine, aquades).
2. The oil phase material is put into a 250 ml beaker glass heated using a hot plate stirrer for 10 minutes to a temperature of 70-75 ^{0}C then stirred until homogeneous.
3. The water phase material is mixed into a 250 ml beaker heated using a hot plate stirrer for 25 minutes until a temperature of 70-75 ^{0}C then stirred until homogeneous.
4. The oil and water phase ingredients are mixed at a temperature of ± 70 ^{0}C and then stirred. Then added a deodorizer at a temperature of 35 ^{0}C then stirred to a homogeneous length of 1 minute.
5. Collagen is added slowly then homogenized.
6. Then the lotion is allowed to stand for 30 minutes then put in a container.

Conclusion

Based on the results of literature studies, information was obtained that fish skin, fish processing industry waste can be used as non-food products. Some non-food products that can be made from fish skin 1) Processing fish skin into the same skin as Downstream Product Raw Materials. 2) Extraction of Gelatin from Fish Skin for Photoresist and Capsule Shell. 3) Fish Skin as an ingredient in Healing Burns. 4) Extraction of Collagen from Fish Skin for Lotions (Cosmetics).

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