UTILIZATION OF LIQUID WASTE FROM FISH PROCESSING

Iis Rostini[1], Heti Herawati[1]

[1] Department of Fisheries Processing Product, Faculty of Fisheries and Marine Sciences, Universitas Padjadjaran, Indonesia

ABSTRACT

Liquid waste is ejected liquid from a community and industrial environment where the main component is water and contains solid matter consisting of organic and inorganic substances. The purpose of this study was to analyze the sources of fish processing wastewater and provide alternative utilization of fish processing wastewater. Liquid waste from the fish processing industry can come from various stages from handling fish to processing. The fish handling stage will produce liquid from the process of washing fresh fish, cutting and washing before processing. The product processing process can produce liquid waste from the boiling and steaming process. Liquid waste contains blood, fat, liquid from the stomach contents and water from the rest of the processing process. Fishery industry liquid waste contains high organic matter. Wastewater treatment techniques that have been developed are generally divided into 3 treatment methods namely physical, chemical and biological treatment. Products that can be produced from fish processing wastewater include materials for making fish crackers, "petis" paste, a source of flavor in powder and liquid form, as a source of omega 3 lipids, and organic liquid fertilizer. The resulting product can add economic value and minimize the impact of the liquid waste on the environment.

Keyword: - *Liquid waste, Fish processing, Waste sources, Fishery product*

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1. INTRODUCTION

Fisheries industry waste can be defined as anything that remains and is wasted from an activity of catching, handling and processing fishery products. Waste from fisheries processing is known to reach 75% of the total weight of fish [1]. The processing of fishery waste is expected to be able to reduce the volume of waste while at the same time providing added value to the products produced. Industrial waste can produce toxic materials to the environment that can have a negative impact on humans and other environments. Industrial wastewater most often causes environmental problems such as fish mortality, poisoning in humans and livestock, plankton death, accumulation in fish and mollusk meat [2].

Liquid waste is ejected liquid from a community and industrial environment where the main component is water and contains solid matter consisting of organic and inorganic substances. Fishery industry liquid waste contains high organic matter. The level of contamination of the fishery processing industrial wastewater is highly dependent on the type of processing and the species of fish being processed [3]. The fish processing industrial wastewater has the characteristics of a high amount of dissolved and suspended organic matter when viewed from the values of BOD and COD. Fats and Oils are also found in high quantities. Sometimes suspended solids and nutrients such as nitrogen and phosphorus are also found in high amounts [4]. The main objective of wastewater treatment is to reduce BOD, particulate matter and kill pathogenic organisms. Sometimes it is necessary to remove nutrients, toxic components and non-degradable materials so that the concentrations are low and harmless [5].

The fish processing process will produce by-products in the form of waste, especially liquid waste resulting from the process of washing and boiling fish in large quantities. The remaining liquid waste from processing fish still contains a number of nutrients and flavor components that were dissolved during boiling the fish, such as protein and amino acids and minerals. When the cooling process is complete, there will be a lot of liquid left in the container used and known as boiled water [6].

Fishery industry wastewater contains a lot of protein and fat, resulting in high nitrate and ammonia values [7]. In general, pindang fish entrepreneurs do not handle waste before disposing of waste water into receiving water bodies (rivers), which in turn results in water pollution and bad smell [8]. Liquid waste from the fish processing industry has the potential to pollute the environment because it contains a lot of organic matter. The waste from the heat treatment has not been utilized at all so that it can cause pollution and cause an unpleasant odor [6].

The impact of fish processing liquid waste is so great if it is discharged directly into water bodies, it doesn't even have economic value. The impact of water pollution causes water to no longer be used for household needs, industrial needs, agricultural needs and fishing ponds [9]. In fact, if utilized, fish liquid waste, whether produced from the process of boiling or boiling, can produce new products that have economic value. According to [8], the content of the ingredients contained in fish waste liquid waste are useful, namely protein, fat, salt and others. Therefore, there needs to be an effort that is able to utilize fish liquid waste as well as create new products resulting from the use of fish liquid waste. This research discusses what products are and how to process them so that the liquid waste can have economic value. The purpose of this research is to analyze the sources of fish processing liquid waste and provide alternative utilization of fish processing liquid waste so that the handling can minimize the impact of the liquid waste on the environment and can add economic value.

2. SOURCE OF WASTE

Liquid waste from the fish processing industry can come from various stages from handling fish to processing. The fish handling stage will produce liquid from the process of washing fresh fish, cutting and washing before processing. The product processing process can produce liquid waste from the boiling and steaming processes. Liquid waste contains blood, fat, liquid from the stomach contents and water from the rest of the processing process.

Fishery industry wastewater contains high organic matter and varies greatly from one industry to another depending on the technology used, the type of fish processed and the type of product produced. The largest contribution to the waste load content comes from the canning and fish meal processing industries [10]. The largest share of the organic load contribution to fisheries waste comes from the canning industry with a COD load of 37.56 kg/m3, followed by the salmon fillet processing industry which produces a waste load of 1.46 kg COD/m3. Then the crustacean industry with a small COD load [11].

The fish processing industry is very diverse. Most of the liquid waste from the fish processing industry is produced from the fish fillet industry, fish pindang processing, shrimp processing, and canning. Furthermore, Fish processing basically varies according to raw materials, water utility sources, and available processing units. The characteristics of the wastewater produced also vary depending on the process used. The degree of wastewater contamination can be low (eg in fish washing), medium (eg in filleting), or high (eg fish blood from fish storage tanks) [12]. The process of the fishery industry can be divided into the process of preserving, salting and processing, the canning industry, freezing, smoking, flouring and making fish oil.

3. LIQUID WASTE TREATMENT

Liquid waste is all liquid waste generated from various activities. The nature of liquid waste is very specific, depending on the type of activity. Characteristics of liquid waste include:

1. Quality
   a. Varies, depending on the type of industry and the process
   b. Has various chemical parameters
2. Quantity
   a. The amount of liquid waste production varies and is difficult to predict, depending on the pattern and amount of usage

b. If an industry or activity does not have a wet process, the liquid waste will only come from domestic waste.

Wastewater treatment technology is the key in maintaining environmental sustainability. Whatever type of wastewater treatment technology is built, it must be able to be operated and maintained by local companies/institutions. The wastewater treatment techniques that have been developed are generally divided into the following 3 treatment methods.

3.1 Physical processing

In general, before further treatment of wastewater, it is desirable that large suspended and easily settled or floating materials are removed first. Screening is an efficient and inexpensive way to remove large suspended matter. Suspended materials that settle easily can be removed easily by the settling process. The main design parameters for this settling process are the settling rate of the particles and the hydraulic detention time in the settling bath. Some examples of liquid-solid separation include:

- Filtration
- Membrane filters
- Gravity type
- Micro filters
- Ultra filter
- Reverse osmosis
- Clarifiers

3.2 Chemical Processing

Chemical wastewater treatment is usually carried out to remove particles that do not settle easily (colloids, heavy metals, phosphorus compounds, and toxic organic substances, by adding certain necessary chemicals. Some examples of Chemical-Physical treatment include:

- Neutralization
- Ion exchange
- Coagulation and Flofucation
- Activated lumine
- Activated carbon
- Adsorption
- Oxidation and/or reduction
- Aeration
- Ozonization
- Electrolysis
- Chemical oxidation/reduction

3.3 Biological Processing

Biological treatment aims to remove the dissolved content in the waste that cannot be separated by physical treatment. The process uses organic matter or microorganisms which are put into the waste, for example activated sludge.

Liquid Waste Treatment System The main purpose of liquid waste treatment is to break down the content of contaminants in water, such as organic compounds, suspended solids, pathogenic microbes, and other organic compounds that cannot be broken down by natural microorganisms. When viewed from the treatment of waste handling, the stages can be classified into several stages, namely pre-treatment, primary treatment, secondary treatment, tertiary treatment and sludge treatment.

a. Initial Processing (Pretreatment)

This treatment stage involves a physical process that aims to remove suspended solids and oil in the wastewater stream. Several processing processes that take place at this stage are screen and grit removal, equalization and storage, and oil separation (if there is oil content in it).

b. First Stage Processing (Primary Treatment)

Basically, this first stage of processing still has the same goal as the initial processing. The difference lies in the process that takes place. The process that occurs in the first stage of processing is to remove organic and inorganic solid particles through physical processes, namely neutralization, chemical addition and coagulation, flotation, sedimentation, and filtration. After going through this process, the solid particles will settle (called sludge) while the fat and oil particles will be on the surface (called grease). With this deposition, it will reduce the need for oxygen in the next biological treatment process and the precipitation that occurs is gravity deposition.

c. Second Stage Processing (Secondary Treatment)
The second stage of treatment aims to remove or reduce the content of dissolved organic or inorganic compounds in the waste which cannot be removed by ordinary physical processes. The second stage of processing can be a chemical process or a biological process. To remove these dissolved compounds, additional chemicals and biological microorganisms are needed in it according to the process. The chemical process at this stage is the addition of chemicals (eg alum) for the coagulation-flocculation process. While the biological process aims to remove organic compounds, especially those dissolved in the waste. The principle is to use microorganisms (biocatalysts) in the reaction of decomposing (degrading) organic matter into minerals CO_2 and H_2O (aerobic) or CH_4 (anaerobic). These microorganisms consume organic materials to form new cell biomass as well as organic substances and utilize the energy generated from oxidation reactions for metabolism.

d. Advanced Stage Processing (Tertiary Treatment)
This processing is a continuation of secondary processing (secondary treatment). This system treats waste with high concentrations of contaminants or waste with varying parameters with relatively large volumes. Examples are Reverse Osmosis and Adsorption.

e. Sludge Treatment
The sludge formed as a result of the four previous processing stages is then reprocessed through the process of digestion or wet combustion, pressure 7 filtration, centrifugation, drying bed, incineration, or landfill.

4. ALTERNATIVE UTILIZATION OF LIQUID WASTE FROM FISH PROCESSING

4.1. Crackers Production

Crackers are a dry food product, which is made from flour and fish meat with the addition of other ingredients such as spices commonly used in making crackers [13]. In the manufacture of crackers are generally added additional ingredients. Additives are materials added for a specific purpose. The use of additional ingredients aims to add flavor, add nutritional value, and improve appearance [14].

Liquid waste from fish processing can be used to make crackers. Crackers are one of the snacks that are very popular with the community, both consumed as a side dish or as a snack. The liquid waste used in the manufacture of crackers comes from the remaining cooking water for tuna. Making crackers using boiled tuna water as a source of flavor and additional ingredients. Additional ingredients used in making coriander crackers include garlic, sugar, coriander and baking soda [6].

Crackers are snacks that expand when dipped in hot oil [15]. Many crackers are made from ingredients such as rice flour, wheat flour, or tapioca flour. These ingredients can be mixed with additional ingredients so that they become shrimp crackers, fish crackers, or crackers with other flavors [16].

The tuna cooking water used has physical characteristics in liquid form, light brown color, distinctive tuna aroma, and salty taste, while the chemical characteristics obtained are: water content 66.41%, ash content 8.29%, fat content 0 .21%, protein content 24.58%, carbohydrate content 0.52%. Crackers with the addition of tuna cooking water have a water content of 10.07%, ash content of 3.57%, protein content of 10.4%, fat content of 0.09%, carbohydrate content of 75.88%, histamine content of 3.99 mg/100g , and hardness 256.65 gf [6].

4.2 Processing into "Petis" Paste

Liquid waste left over from cooking fish still contains a number of nutrients and other components that are dissolved during boiling of fish. Therefore, this waste can be reused to be used as raw material for making fish paste. “Petis” paste is a by-product of boiling (fish, shellfish and shrimp) which thickens like sauce but is denser. In further processing, the “petis” paste is given additional ingredients such as brown sugar which causes the color to become dark brown and tastes sweet. “Petis” is in the form of a paste, which is processed from fish or shrimp added with spices, rice flour or starch. Fish paste collected from the resulting liquid is further evaporated by further boiling, while sugar is added as a preservative.”Petis” is usually used as a flavoring (seasoning) in some foods [17].

Petis paste is categorized as a semi-moist food which has a moisture content of around 10-40%, an water activity value of 0.65-0.9 and has a plastic texture. The nutritional elements in shrimp paste and fish paste are energy 151.0 kcal, water 56.0%, protein 20%, fat 0.2%, carbohydrates 24%, calcium 37 mg, phosphorus 36 mg, iron 2.8 mg [17]. Semi-wet processed food, also known as intermediate moisture food (IMF), has a moisture content of 20-35% with a protein content of 15-35% and an aw value of 0.6-0.85. Products that are included in the semi-moist food category have resistance to decay and have high shelf life during room temperature storage [18].

Boiled fish “pindang” cob liquid waste is waste obtained from cob boiled fish processing in the form of a brownish liquid containing cloudy precipitate, has a distinctive aroma of pindang cob, with a very strong salty taste. The liquid waste resulting from the milling process can be used to make paste or flour. If not, the liquid waste needs to be collected first before being disposed of. Waste is precipitated and needs to be given some special treatment, for example to get rid of the stench of the waste. Pindang processors collect the remaining water from cooking fish to be resold to be processed into fish paste or fish crackers. According to [17] The results of the physical-chemical test of tuna boiled water had a water content of 64.96%, ash content of 17.40%, protein content of 14.30%, fat content of 0.95%, carbohydrate content of 2.19%, degree of acidity (pH) 5.25, microbiology $1.3x10^2$ CFU/ml, heavy metals Hg and Pb were not detected while Fe was 24.62 ppm, salt content was 19.37%, and histamine level was 43.91 ppm.

Fish boiled water from the cob fish industry can be used as raw material for fish paste and has a characteristic salty taste and fishy smell but still has a high nutritional value of protein. The best tuna paste has a moisture content of 12.5%, ash content of 7.69%, protein content of 6.70%, fat content of 0.2%, carbohydrate content of 72.9%, degree of acidity (pH) 5.32, activity water (aw) 0.62 , viscosity 150,000 cp, microbiology $1.2x10^1$ CFU/ml, heavy metals Hg and Pb were not detected while Fe was 39.52 ppm, salt content was 9.44%, and histamine level was 11.88 ppm [17].

4.3 Processing into Flavor

Flavor is a food additive that can provide and enhance the taste of a food. Utilization of processing wastewater can be used as a flavor obtained from boiling water of white shrimp heads (*Panaeus merguiensis*) [19]. Production of natural flavors using shrimp heads, complementary seasonings and fillers such as dextrin. Dextrin has a function in food processing, including as a water binder. It is acidic, hydrolyzes starch, is in the form of a powder, dissolves in water and has a low viscosity, so it can increase the solids contained therein (carbohydrates, proteins and minerals) by adding dextrin to flavors to improve the glutamate acid value that produced [19].

According to [19], the content of the flavor powder produced by boiling shrimp heads and adding dextrin is a glutamic acid value of around 36.85%, a protein content value range of 48.95%. Value of water content of all samples with the addition of 9.39% -5.91% dextrin. The range of values for fat content increased by 0.2% -0.33%. The value of carbohydrates experienced an increase in all samples, namely 3.44% -23.7%. The solubility value increased after adding dextrin to all samples, namely 77.02% -98.78%. The pH value of all samples has an average of 6% -6.9%.

4.4. Processing into a Source of Omega 3 Lipids

Fish canning is an important economic sector, fish that are commonly processed by canning are fish such as tuna, sardines and other species of sardines and mackerel [20]. One of the main concerns of the fish canning industry is related to the liquid waste it produces. The fish canning industry generates large amounts of liquid waste which is disposed of, after proper treatment to remove organic matter. However, alternative treatment processes can also be designed to target the recovery of valuable compounds by special procedures, this wastewater is converted to liquid by-products [21].

An evaluation study regarding green and economically sustainable methodologies for the extraction of omega 3 lipids from fish canning liquid by-products was conducted by [21]. Lipids are extracted by combining physical and chemical parameters (conventional and pressurized extraction processes), as well as chemical and biological parameters. Furthermore, LCA is applied to evaluate environmental performance and cost indicators for processes. The results showed that high hydrostatic pressure extraction provided the highest amount of omega 3 polyunsaturated fatty acids (3331.5 mg L-1 effluent), apart from presenting the lowest environmental impact and cost. The procedures studied made it possible to obtain alternative, sustainable and traceable sources of omega 3 lipids for further applications in the food, pharmaceutical and cosmetic industries.

4.5 Organic Liquid Fertilizer

Based on the results of research by [7], industrial wastewater contains a lot of protein and fat, resulting in high levels of nitrate and ammonia. Fish liquid waste can be used as raw material for organic liquid fertilizer. Fish liquid waste with the addition of coconut water can increase the element of Potassium by 0.36% and if it is added by banana weevil, it can increase phosphorus by 0.008%.

5. CONCLUSION

The characteristics of liquid waste resulting from fish processing vary depending on the processing process used. Liquid waste from the fish processing industry contains nutrients such as protein, amino acids, fat, salt, and others. Based on the liquid waste content, it is necessary to utilize the liquid waste so that it has added value. Products that can be produced from fish processing wastewater include materials for making fish crackers, “petis” paste, a source of flavor in powder and liquid form, as a source of omega 3 lipids, and organic liquid fertilizer. The resulting product can add economic value and minimize the impact of the liquid waste on the environment.

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