The technology of fish processing to improve nutritional status children under five years old

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Abstract. The general objective of the study is to develop a fish processing of technology to improve total nutritional consumption for children under five years old in the area around the Campus of Semarang University (UNNES). Specific objectives are included: 1) Making prototypes of technology processing freshwater fish based (FWF). 2) To analyse protein and calcium levels, 3) Identifying the level of fish consumption of the children under five years old, 4) To analyse the total nutritional consumption of children under five years old. The study used a randomized controlled trial design (RCT) of children under five years old in the area around the Campus of UNNES. Retrieval of consumption data was done using the Food Consumption Recall (FCR) method and nutritional status with anthropometry. The result of the study is to prototype FWF nuggets and sausage given to the children under five years old in the feeding group model. The protein content of FWF nuggets and sausage are 14.91% and 13.81% as well as calcium are 1.95% and 1.88%. The children under five years old 100% like FWF nuggets and sausage. Consumption of fish and total nutrition consumption in children under five years old is improved (p <0.05). The results of the research can be used to develop FWF-based of nutrition improvement program to support the GEMARIKAN programme.

1. Introduction
The basis of the study was due to the surge in meat prices in early 2013 which influenced the adequacy of level protein needs for children under five. One alternative to meat replacement is freshwater fish (FWF). The nutritional composition of FWF is not inferior to meat. FWF is safer for consumption, because the level of contamination is relatively low, and the fat content in FWF is very good for growing children. Fish is the first choice besides chicken meat which is heavily polluted with chemicals, also the presence of the H5N1 virus that can attack humans at any time. Fond of eating fish need to be pursued, there is no day without eating fish. Fish is very abundant and relatively inexpensive but is not liked by children because processing is only fried and boring [1][10].

To improve fish preferences in children under five, fish processing technology is developed to improve their nutritional status. Lack of consumption of animal protein will adversely affect the nutritional status of children five years old, so have an impact on intelligence and future survival [2][4][5][6]. Based on the results of the Basic Health [7], it showed that 17.7% of children under five years old were still experiencing severe malnutrition, 3.9% and 13.8% under nourished. Malnutrition, a gateway for all infectious diseases results in children being exposed. Good nutrition consumption will easily increase the immune response of children under five with an increase in Ig G [9]. The high rate of infectious diseases is expected to decrease to 9.5% in Healthy Indonesia 2025.
Various studies have shown that nutritional deficiencies in children can cause illness (44.8%), diarrhoea (60.7%), pneumonia (52.3%), and malaria (7.3%). In addition, children with mild nutritional status, moderate, and severe; each have a risk of death of 2.5; 4.6 and 8.4 times higher than normal nutritional status children. Can we imagine how many generations are lost? If nutritional problems are not handled seriously, the heavier level of malnutrition and OR occurs.

Fish consumption is important to form smart, healthy and excellent stamina generation. Giving fatty acids contained in fish affect cognitive development, school attendance, and school time [1], and giving during pregnancy will improve cognition and visual development of children born [2][4]. Fish is a perfect source of protein containing complete types and amounts of amino acids. The current condition of meat is an expensive item that may not be bought by certain groups of people especially in the pandemic era Covid-19. The most appropriate alternative to meet the adequacy of animal protein from fish food sources. Fish is a source of protein and minerals that are needed by children under five, because it is a good source of animal protein that has high digestibility and utilisable [8].

Fish are able to contribute proteins and minerals that are very necessary for the growth and development of children under five years old, especially brain development. The level of fish consumption in the Semarang city is still low at 11.3 kg/y/capita and 16 kg/year/capita in Central Java. This figure is still far lower than the national target of 31.4 kg/year/capita. The low level of fish consumption of the community must be overcome immediately by the like fish movement is GEMARIKAN, which is the right solution to stimulate people to want and love to consume fish.

The results revealed that there were several factors causing children under five to dislike fish, including: (1) fish processing is less variable, monotonous processing, only frying and still smell of HANYIR, (2) lack of fish habituation of fish consumption, (3) limited knowledge of mother's nutritional knowledge, (4) perception is not good and does not like fish [10]. The more fish consumed as a predictor the better the contribution of peptide and minerals for the growth and development of children under five years old, especially for the continued growth of brain cells.

Various studies have inspired researchers to provide fish processing technology that is quite popular and can improve the nutritional consumption of children under five years old. In the line of thought presented in Figure Therefore there needs to be appropriate and quick action to overcome the nutritional problems of the community and prevent lost generation. Tackling the nutritional problem must get top priority according to the vision and mission of the development of the Semarang "realizing an independent family aware of nutrition to achieve optimal nutritional status of the community" and improve quality human resources and make the central embryo FWF-based food processing sustainable.

To answer the research problem, several objectives were formulated, among others: 1) making prototype of WFW fish processing technology, 2) to analysis protein and calcium levels, 3) Identifying the level of consumption of fish, and 4) Analysis the nutritional status of children under five years old. The results of the study can make a meaningful contribution to the relevant departments or stakeholders as a program for eradicating micronutrient deficiencies based on local food based approach. Fish processing technology is expected to be an alternative to solving the problem of low daily fish consumption in children under five years old.

2. Research Methods

The results of the study are useful for: (1) Mothers of children so that they are good at varying fish processing to avoid boredom; (2) popularizing nuggets and increasing fish consumption; Contribute to strengthening the economic sector of the community around the campus to open embryos of FWF-based food processing businesses; (3) Make a meaningful contribution to relevant ministries or stakeholders as a program to eradicate local food-based micro nutrition deficiency.

Urgency in this research is able to provide alternative solutions to the problem of low daily fish consumption in children under five because they are bored and not varied. The child's favourite nugget, so as to increase fish consumption, automatically increases the nutritional consumption status of the community, making it easier for community empowerment. Fish processing technology is
based on several study studies and the facts that exist in the field and the results of previous studies. This linkage appears in Figure 1.

![Figure 1. Literature Review and Preliminary Studies base on Fish Processing Technology](image1.jpg)

### 2.1 Research Methods and Prototype

The design used is the Experiment design in the form of a randomized controlled trial (RCT), which is a study that involves the process of intervention to subjects randomly. Subjects were grouped into 2 study samples, namely the control group and the treatment group. Making prototype of FWF-based processed food in TJP GD E7 Lt 3 laboratory, in the form of Nugget and FWF sausage. The results are chemically tested in the Chemical Laboratory MIPA Faculty of UNNES to know the nutritional content. That is protein and calcium. FWF Nuggets and sausage were intended for 4 weeks to a group of children under five years old were able to increase nutritional consumption and subsequently improve nutritional status.

Prototype models made are FWF Nugget and Sausage. The prototype was made with a laboratory scale in the Food Technology Laboratory E7 Floor 3. The future, FWF nugget and sausage expectation can be a snack that is loved by children under five years old, to increase fish consumption and increase the nutritional consumption of children under five years old. An overview of FWF nugget and sausage is presented in Figure 2.

![Figure 2. FWF Nugget and Sausage](image2.jpg)

The protein and calcium content of FWF nugget and sausage did not differ much, respectively 14.91% and 1.88%; 13.81% and 1.95%. Making nuggets and sausages uses crushing or refining technology, and mixing or blend FWF to get a smooth and good texture, and the fish spines are not included. FWF nugget and sausage are produced in sufficient quantities on a laboratory scale to be tested on children under five years old in the campus area.

### 3. Result and Discussion

The most preferred food for children is instant noodles. In the control group 100.0% of children under five years old like food from noodles, including pop noodles, glass noodles, crispy noodles,
INDOMIE, and others. Other foods favoured by children under five years old are: meatballs (91.42%), Kentucky (88.57%), nuggets (80.00%), and sausages by 71.43%. Not much different from the condition of children under five years old in the treatment group. The types of foods that are liked the same can even be considered homogeneous types of foods that are loved by children under five years old. Most children under five years old in the treatment group liked meatballs 91.42%, then nugget and fried chicken each by 85.71%, sausages 80.00% and instant noodles by 77.14%.

3.1 Fish Consumption

Based on the results of interviews and questionnaires there were 57.14% of children under five years old who did not like fish as much as in the control and treatment groups, however, most children liked nuggets. In other word, only 42.86% of children like fish. The results of interviews with children under five years old often buy fish dishes. This means that the opportunity to eat fish has a great opportunity for children under five years old. The average frequency of fish purchases 3-4 times a week is around 48.57% in the control group and 45.72%. There are only a few that purchase fish more than 5 times a week. This means that almost every day buying fish. Only a small proportion of the frequency of purchasing fish for infants who rarely buy fish is 8.57% in both the control and treatment groups. Many factors affect decisions on fish consumption including awareness of the health benefits and risks, access to guides, availability of fish and cost. Consumer guidance should therefore be coordinated combining benefit and risk information and be easier to access and easier to understand [11].

3.2 Level of Energy and Nutrition Consumption

Consumption of children under five is explored using the food recall consumption (FRC) method for 24 hours 4 times with non-consecutive days. The average consumption of children under five years old in the control and treatment groups illustrates homogeneous food consumption. This means that the food consumed by the two groups does not show any difference. The consumption variants of the two groups are the same which do not affect the results of the study. The average daily food consumption of children under five is presented in Table 1 below.

Table 1. Total of Energy and Nutrition Consumption

| Energy and Nutrition Consumption | C Group (n=35) | T Group (n=35) |
|---------------------------------|---------------|---------------|
| **Before the intervention**     |               |               |
| 1. Energy (Cal)                | 1130.43 ± 182.73 | 1135.83 ± 212.73 |
| 2. Protein (g)                 | 27.01 ± 6.67   | 26.98 ± 6.35  |
| 3. Fat (g)                     | 49.33 ± 12.56  | 48.20 ± 13.23 |
| 4. Vitamin C(mg)               | 36.90 ± 5.74   | 36.70 ± 6.56  |
| 5. Calcium (mg)                | 804.11 ± 165.22 | 809.84 ± 133.59 |
| 6. Fe (mg)                     | 7.58 ± 5.23    | 7.12 ± 6.74   |
| **After the intervention**     |               |               |
| 1. Energy (Cal)                | 1150.48 ± 167.31 | 1180.83 ± 112.73 |
| 2. Protein (g)                 | 28.15 ± 4.61   | 29.97 ± 4.35  |
| 3. Fat (g)                     | 49.98 ± 12.02  | 49.20 ± 11.23 |
| 4. Vitamin C(mg)               | 37.40 ± 4.84   | 38.87 ± 4.15  |
| 5. Calcium (mg)                | 806.21 ± 151.22 | 816.21 ± 101.21 |
| 6. Fe (mg)                     | 8.18 ± 4.98    | 8.41 ± 4.87   |

Consumption between the control and treatment groups is balanced and homogeneous because they come from the same type of food and the food variants aren’t different. The level of nutrient
consumption is obtained by comparing real consumption data with nutrient adequacy figures [5]. The average level of daily consumption of children under five is presented in Table 2.

| Table 2. Average of Level Energy and Nutrition Consumption |
|----------------------------------------------------------|
| **Energy Consumption and Nutrition** | **C Group (n=35)** | **T Group (n=35)** |
|-------------------------------------|--------------------|--------------------|
| Before the intervention             |                    |                    |
| 1. Energy (Cal)                     | 25.71              | 74.29              |
| 2. Protein (g)                      | 8.57               | 91.43              |
| 3. Fat (g)                          | 28.57              | 71.43              |
| 4. Vit C (mg)                       | 34.28              | 65.72              |
| 5. Calcium (mg)                     | 22.86              | 77.14              |
| 6. Fe (mg)                          | 17.14              | 82.86              |
| After the intervention              |                    |                    |
| 1. Energy (Cal)                     | 25.71              | 74.29              |
| 2. Protein (g)                      | 5.71               | 94.29              |
| 3. Fat (g)                          | 28.57              | 77.14              |
| 4. Vit C (mg)                       | 28.57              | 71.43              |
| 5. Calcium (mg)                     | 17.14              | 82.86              |
| 6. Fe (mg)                          | 17.14              | 82.86              |

Based on Table 2, the average level of energy and nutrient consumption of children under five years old is good and only a small proportion of them are consuming less. Feeding children under five years old in the form of FWF nuggets and sausages, was able to increase the liking to like fish in children under five years old. It can be seen in the distribution of energy and nutrient consumption data that there is an increase in consumption towards children liking the nuggets and sausages served.

3.3 Impact of Consumption of FWF Nuggets and Sausages

Most children who are fed nuggets and sausages eat immediately and some children whimper to ask for more nuggets and sausages served. This means that children really like fish nuggets and sausages. Thus there is an increase in the level of consumption of energy and nutrients. The level of energy and nutrient consumption after the intervention is not much different from the condition before the intervention. In the treatment group the level of nutrient consumption was better than the control group. According to the statistical test results there was a significant difference (p<0.05) of the level of energy and nutrient consumption before and after the intervention in the treatment group. The increase in nutrients and energy in the treatment group was much higher than the control group. Lack of consumption of children under five, especially fish, can cause imbalance in the input of nutrients from the food consumed, resulting in delayed growth and development of body tissue organs. Besides toddlers easily exposed to diseases such as flu, it is proven that the condition of children under five is often exposed to diseases.

Fish is a source of animal protein that is very necessary in its infancy. Good protein consumption is one that can meet the needs of essential amino acids which can only be obtained from foods such as fish. The explanation is in line with the exposure of the Ministry of Health [5] that animal protein has better quality compared to vegetable protein because the amino acid composition is more complete and numerous (complete and perfect amino acids). Quality food will improve health and not be easily exposed to diseases. One food that contains high nutritional value is fish. Fish is a food ingredient that contains complete nutrients with Omega-3 content which is very good for improving nutritional status, maintaining health and increasing stamina. In infancy, protein is needed for body growth and brain.
development. The protein content of fish is higher with protein derived from meat, milk or eggs. Besides fish is one source of animal protein which is cheaper than other animal protein sources such as beef and chicken meat. Culture of consuming fish should be instilled from an early age, bearing in mind that eating habits from childhood will carry over into a child's life. If the toddler is accustomed to eating enough fish, it will get used to consuming these types of food as an adult. Children under five are a period of brain development and growth that needs special attention. According to Atiqah [3] that the low level of fish consumption per capita/year shows that the culture of fish consumption is still low compared to other developed countries. Gibson et al. [12] found that over 50% of mother-child pairs failed to meet the minimum recommended dietary diversity, and, while fish was the main animal-source food in diets, the introduction of fish to infant and young child diets was delayed due to fears of allergies and illnesses. Moreover, access to nutrient-dense foods was affected by variable and insufficient income from fisheries-based livelihoods, isolation from markets, and the broader food environment.

The more fish consumed as an estimator the better the contribution of nutrients from fish for the growth and development of children under five, especially for continued peak brain growth at the golden age. Fish is a source of protein and minerals that are needed by children under five, because it is a good source of animal protein that has high quality digestibility and utilizable. Fish protein is a source of high phosphorus, iron and calcium minerals as well as high concentrations of iodine and omega-3 fatty acids.

4. Conclusions
Fish processing technology has an impact on the consumption of children under five years old for fish to be improved. Children under five years old prefer to like fish. The FWF nugget and sausage can be utilized for the preparation of a FWF based nutrition improvement program to support the program so that it can improve the community will be aware of nutrition. The FWF nugget and sausage had a high protein content of 14.91% and 13.81%, as well as calcium were 1.95% and 1.88%. Fish consumption in children under five years old becomes better and increases (p<0.05) after FWF nuggets and sausages consumed.

Suggestions for the need for further research to produce FWF nuggets and sausages into food that is ready for sale so that it can improve the welfare of the local community. The need for industrial production of FWF nuggets and sausages as a nutritious snack that is able to daily protein adequacy.

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