Stannum : Jurnal Sains dan Terapan Kimia, 5 (1) (2023) 38-42

Stannum : Jurnal Sains dan Terapan Kimia

Website: https://journal.ubb.ac.id/index.php/stannum
doi: doi: 10.33019/jstk.v5i1.4047
Research paper

Utilization of Fish Bone (*Rastrelliger kanagurta)* Waste as High Calcium Flour

Pemanfaatan Limbah Tulang Ikan (*Rastrelliger kanagurta*) sebagai Tepung Kalsium Tinggi

Nila Tanyela Berghuis*, Ida Fitri Maharani, Cantika Samsrestu R, Rahmad Gunawan, Sri Wahyuni Siregar, Sherina Saskia, and Alfiyah Qaulan

Department of Chemistry, Universitas Pertamina
Jl. Teuku Nyak Arief-Simprug, Kebayoran Lama, Jakarta Selatan, 12220

*Corresponding author, email: nila.tanyela@universitaspertamina.ac.id

Received: April 11, 2023 Accepted: May 8, 2023 Published: May 30, 2023

ABSTRACT

Fish bones are one of the by-products of processing fish fillets. The yield produced from the process of making fish fillets produced is only about 36% and the remaining 64% is waste that is lost in each processing process. Fish bones consist of organic compounds and inorganic compounds (minerals). The waste generated from the fish processing industry has the highest calcium content in the fish body. From the point of view of food and nutrition, fish bones are very rich in calcium that humans need, because the main elements of fish bones are calcium, phosphorus, and carbonate. Thus, fish bone waste has great potential to be used as raw material for calcium-rich fish bone meals. In this study, the utilization of mackerel bones will be studied, so it is very important to know the formula for the best concentration of mackerel bone meal, to know the potential calcium content in mackerel bones. The characterization in this project is intended to determine and determine the experimental results quantitatively. The characterizations carried out in this study were atomic absorption spectrophotometer (AAS) to determine the levels of Ca, Fe, and Zn and UV-Vis spectrophotometer to determine phosphate levels in mackerel bones. The results of the average mineral levels of Zinc, Iron, and Calcium respectively were 32.425 mg/100 gr, 4.3 mg/100 gr, and 213.825 mg/100 gr. While the value of phosphate concentration in mackerel bone meal was 2784.116 ppm. This is following the standards of BPOM.

***Keywords*: :** *AAS analysis; Fishbone waste; UV-Vis analysis*

INTRODUCTION

Milk is the main source of calcium for people in western countries in Indonesia, milk is still considered an expensive food ingredient, so it can only be reached by the middle and upper economic class people. One of the consequences of this condition, people are more likely to choose other types that are easier and cheaper to obtain when compared to milk. Especially for teenagers who are allergic to milk, must require high nutritional intake and quality. Due to adolescence, is the last period of nutritional improvement, so with alternatives, we examined

fishery preparations, especially mackerel bones (Maspaitella, M.L., and Dieny, F.F., 2012)

Processed fishery products produce unwanted material, namely waste. Waste is generated in the form of head, tail, fins, bones, and offal by 35%. Fish bones are one of the by-products of processing fish fillets. The yield produced from the process of making fish fillets produced is only about 36% and the remaining 64% is waste that is lost in each processing process, including fish bones (Kusumaningrum, I., Sutono, D. and Pamungkas, B.F., 2016). Fish bones are waste from the fishing industry that has not been used properly. Fish bones consist of organic compounds and inorganic compounds (minerals). The waste generated from the fish processing industry has the highest calcium content in the fish body. From the point of view of food and nutrition, fish bones are very rich in calcium that humans need, because the main elements of fish bones are calcium, phosphorus, and carbonate. Thus, fish bone waste has great potential to be used as raw material for calcium-rich fish bone meals. Fish bones contain a lot of mineral salts such as calcium phosphate and creatine phosphate which have the potential to increase the nutrition of food products (Putra, M.R.A., Nopianti, R. and Herpandi, H., 2015). The handling of fishery industry waste so far is generally only buried and processed into animal feed. One of the water products rich in calcium is fish, especially the bones. Calcium from fish bones has quite good quality and is easy to obtain. Utilization of bone meal can be used as a supplement and drug to prevent osteoporosis. (Meiyasa, F. and Tarigan, N., 2020).

Processing of fish bone meal goes through several stages so that fish bone meal has a long shelf life. Based on information from Santosh P. Lall and Sadasivam J, 2021. review on nutrition and metabolism of minerals in fish is Fe requirements ranging from 60 to 166 mg/kg; Zn requirements ranging from 80 to 130 mg Zn/kg. The way to extend the shelf life of fish bone meal is by drying using heating temperatures (blanching, pasteurization, and heating with tools). Drying aims to reduce the amount of water content in the material so that it can inhibit the activity of microorganisms in product fishery processing. Drying is often done by utilizing sunlight, so it is less effective in drying. Sun drying is considered not very effective because it is very dependent on weather conditions and the resulting product is less hygienic because it is contaminated with dust or other materials in the air. Good drying and free from contamination can be done using an oven so that the resulting product is more hygienic (Putranto, H.F., Asikin, A.N. and Kusumaningrum, I., 2016); (Rozi, A. and Ukhty, N., 2021).

Mackerel is usually consumed as a side dish that is cooked as a whole, such as peda, fried, grilled, pindang sauce, and so on. Research that has been carried out on processed mackerel products includes salted fish, mackerel peda, surimi, mackerel flour, cookies with mackerel fish meal substitution, and made as a side dish for children with autism (Siswanti, S. and Agnesia, P.Y., 2017). In this study, the utilization of mackerel bones will be studied, so it is very important to know the formula for the best concentration of mackerel bone meal, to know the potential calcium content in mackerel bones. The chemicals used are used main objectives of the research on the use of puffer fish (*Rastrelliger kanagurta*) bones as raw materials for high-calcium flour are to determine the levels of calcium (Ca), iron (Fe), zinc (Zn) in mackerel bone meal using AAS instrumentation, determination of phosphorus content in mackerel bone meal using UV-VIS instrumentation.

METHODS

Chemical and Reagents

Mackerel bone, NaOH technical, Hexane technical, Sodium Hypochlorite p.a (Merck), Hydrogen Peroxide 30% p.a (Merck), Aquades, Ammonium Molybdate p.a (Aldrich), Ammonium Vanadate p.a (Aldrich), H_2SO_4 5 M, HNO_3 65% (v/v), and monopotassium phosphate p.a (Merck).

Making Mackerel Bone Meal

Prepared mackerel (*Rastrelliger kanagurta*) fish bone waste, Fish bones were cut and cleaned, Bone samples were crushed using a mortar, Fish bones were dried in an oven for 2 hours at 50 °C, Fish bones were soaked in NaOH, bone/solution ratio 1:10 (w/v) at 50 °C; 30 minutes, the sample is put into a hexane solution (1:10), the sample solution is stirred for 60 minutes while stirring, the sample is dried and allowed to stand at room temperature, the

sample is washed with running water for 5 minutes, the sample is immersed in hydrogen peroxide for 60 minutes, the sample is inserted and immersed in sodium hypochlorite for 30 minutes, Samples were dried in an oven at 50°C for 5 hours, Samples were ground/pulverized with a Ball Mill, Samples were inserted to vials.

Determination of phosphorus content using a UV-Vis Spectrophotometer

Then determine the phosphorus content using a UV-Vis Spectrophotometer (Merk: Thermo Fisher Scintific), first carried out several stages, namely Preparation of mother liquor, Preparation of 100 mg/L phosphate standard solution, Preparation of 10 mg/L phosphate standard solution, Determination of Maximum Wavelength, Preparation of standard series curves, Analysis of phosphorus mineral content in mackerel bone meal, and characterization of iron, zinc, and calcium levels using the AAS instrument

RESULT AND DISCUSSION

Characterization Results Using AAS

Determination of levels of calcium (Ca), Iron (Fe), and Zinc (Zn) in this study using the AAS (Atomic Absorption Spectrophotometer) instrument. The fish meal sample that has been obtained will be dissolved first using an mL of HCl solvent. The use of HCl as a solvent because concentrated HCl can stabilize the metals Ca, Fe, and Zn to be analyzed. In addition, concentrated HCl solvent is also the most widely used material as a solvent for AAS. The results of the analysis of the concentration and metal content of the puffed fish bone meal (*Rastrelliger kanagurta*) can be seen in **table 1**.

Table 1. Analysis of concentration and metal content of the puffed fish bone meal

Sample	Mineral	Concentrate (µg/L)	Content (mg/ 100 gr)
I	Seng (Zn)	0,650	**32,5**
II	Seng (Zn)	0,647	**32,35**
Average		0,6485	**32,42**
I	Fe (Besi)	0,087	**4,35**
II	Fe (Besi)	0,085	**4,25**
Average		0,086	**4,3**
I	Kalsium (Ca)	4,269	**213,45**
II	Kalsium (Ca)	4,284	**214,2**
Average		**4,2765**	**213,825**

Based on the above results, the average mineral levels of Zinc, Iron, and Calcium respectively were 32.425 mg/100 gr, 4.3 mg/100 gr, and 213.825 mg/100 gr. It can be seen that the data among the three minerals, Calcium has the highestgrade value. If these results are compared with the average mineral content that is usually used by almost all dairy product companies, these include: Calcium (Ca), 106 mg/100 gram; Phosphorus (P), 83 mg/100 grams; Iron (Fe), 0.07 mg/100 grams; and Zinc (Zn), 0.37 mg/100 grams (Rachmaningrum, C.A., and Kusumastuti, A.C., 2016), concluded that the levels of all contained in the fish bone meal were greater than the levels of minerals found in milk.

Zinc (Zn) is an important mineral that plays a role in the work of more than 10 types of enzymes. If the Zn intake is not met, a deficiency will occur. Zinc deficiency is associated with decreased appetite, reduced food intake and activity and can lead to slow growth. Albumin is the main means of transport for Zn. Zn absorption is reduced when there is a decrease in the value of albumin in the blood, such as in people who are malnourished. Some Zn uses transferrin as transport, which is also a transport

for iron. If the ratio between iron and zinc is more than 2:1, transferrin is available to reduce Zn intensity, thereby inhibiting Zn. On the other hand, too high a Zn dose will inhibit iron absorption (Prahadina, V.D., Boer, M. and Fahrudin, A., 2015).

Iron (Fe) is a micronutrient that plays an important role in the production of hemoglobin in which hemoglobin functions to transport oxygen from the lungs to body tissues, transports electrons in cells, and is used in the process of synthesizing iron-containing enzymes needed to use oxygen safely to produce cellular energy. Iron deficiency is feared to cause anemia. Anemia of iron deficiency disease needs to be given special attention because it not only has a direct impact but also has an impact on the future. Iron deficiency during childhood especially in the first 5 years of life can hurt children's quality of life. In addition, children who occupy 30% of the population will certainly determine 100% of the nation's future. Iron deficiency is the most abundant micronutrient deficiency in the world and can cause slow growth and development and decreased cognitive development in humans (Musbir, M., 2007), (Aminah, S., 2011).

From the mineral content data obtained above, it can be concluded that the puffer fish bone meal (*Rastrelliger kanagurta*) meets and even exceeds the mineral content standard commonly applied by dairy product companies. However, for direct consumption, it is necessary to carry out several further tests, including involving the Food and Drug Supervisory Agency (BPOM) so that the safety of product consumption is guaranteed and does not cause side effects to consumers.

The data obtained from the UV-vis spectrophotometer is attached in the table 1. The maximum and minimum wavelengths used in this experiment were 530 nm and 390 nm, respectively, which were previously obtained from readings of the phosphate standard series. Previously, in sample preparation, the sample had to be destroyed with ammonium molybdate so that the sample was transparent and could be read with a UV-Vis spectrophotometer. Then from the standard curve and calculations, the phosphate concentration in mackerel bone meal was 2784.116 ppm.

CONCLUSION

The average mineral levels of Zinc, Iron, and Calcium respectively were 32.425 mg/100 gr, 4.3 mg/100 gr, and 213.825 mg/100 gr, and the results obtained from the phosphate content of 2784.116 ppm. Mackerel bones can be used as a substitute for milk as a source of calcium and other minerals.

ACKNOWLEDGMENTS

We would like to thank Pertamina University for financing multidisciplinary project activities.

REFERENCES

Aminah, S., (2011). Analisis Pemanfaatan Sumberdaya Ikan Kembung (Rastrelliger spp) di Perairan Kabupaten Tanah Laut Provinsi Kalimantan Selatan. *Fish Scientiae*, *1*(2), pp.179-189.

Kusumaningrum, I., Sutono, D. and Pamungkas, B.F., (2016). Pemanfaatan tulang ikan belida sebagai tepung sumber kalsium dengan metode alkali. *Jurnal Pengolahan Hasil Perikanan Indonesia*, *19*(2), pp.148-155.

Lall, S.P.; Kaushik, S.J. Nutrition and Metabolism of Minerals in Fish. Animals (2021), 11, 2711. https://doi.org/10.3390/ani1109271

Maspaitella, M.L. and Dieny, F.F., (2012). *Hubungan asupan kalsium dan fosfor, indeks massa tubuh, persen lemak tubuh, kebiasaan olahraga, usia awal menstruasi dengan kepadatan tulang pada remaja putri* (Doctoral dissertation, Diponegoro University).

Meiyasa, F. and Tarigan, N., (2020). Pemanfaatan limbah tulang ikan tuna (Thunnus sp.) sebagai sumber kalsium dalam pembuatan stik rumput laut. *Jurnal Teknologi Pertanian Andalas*, *24*(1), pp.66-75.

Musbir, M., (2007). *Analisis populasi dan pemanfaatan ikan kembung lelaki (rastrelliger kanagurta) di perairan laut flores sulawesi selatan* (Doctoral dissertation, Universitas Hasanuddin).

Prahadina, V.D., Boer, M. and Fahrudin, A., (2015). Sumberdaya kan kembung (Rastrelliger kanagurta Cuvier 1817) di perairan selat sunda yang didaratkan di PPP Labuan, Banten. *Marine Fisheries: Journal of Marine Fisheries Technology and Management*, *6*(2), pp.169-175.

Putra, M.R.A., Nopianti, R. and Herpandi, H., (2015). Fortifikasi tepung tulang ikan gabus (channa striata) pada kerupuk sebagai sumber kalsium. *Jurnal Fishtech*, *4*(2), pp.128-139.

Putranto, H.F., Asikin, A.N. and Kusumaningrum, I., (2016). Karakterisasi tepung tulang ikan belida (Chitala sp.) sebagai sumber kalsium dengan metode hidrolisis protein. *Ziraa'ah Majalah Ilmiah Pertanian*, *41*(1), pp.11-20.

Rachmaningrum, C.A. and Kusumastuti, A.C., (2016). Pengaruh Suplementasi Seng (Zn) Dan Zat Besi (Fe) Terhadap Kadar Hemoglobin Balita Usia 3-5 Tahun. *Journal of Nutrition College*, *5*(4), pp.328-333.

Rozi, A. and Ukhty, N., (2021). Karakteristik tepung tulang ikan tuna sirip kuning (Thunnus albacares) sebagai sumber kalsium dengan perlakuan suhu pengeringan yang berbeda. *Jurnal FishtecH*, *10*(1), pp.25-34.

Siswanti, S. and Agnesia, P.Y., (2017). Pemanfaatan daging dan tulang ikan kembung (Rastrelliger kanagurta) dalam pembuatan camilan stik. *Jurnal Teknologi Hasil Pertanian*, *10*(1), pp.41-49.

Suryono, S., Setiawan, B., Martianto, D. and Sukandar, D., (2007). Pengaruh pemberian susu terhadap kadar kalsium darah dan kepadatan tulang remaja pria. *Media Gizi dan Keluarga*, *31*(1).