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An Analysis of Biscuit Nutrition Substitution of Eel Flour, Given to Children in Elementary School

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Biscuits are a processed food products, made from flour. They have high carbohydrate and fat content, whereas protein content is relatively low. Eels are a fish with a very good protein content. In addition, their content of minerals such as calcium exceeds that of some other fish. This study aims to determine the nutritional content of biscuits to which eel flour (*Monoptherus albus zuieuw*) has been added. It is purely experimental research. The sample is a biscuit with eel flour which consists of three formulas, namely the addition of eel flour 10, 20 and 30 grams. The analysis was conducted by the Laboratory of Analysis and Measurement Unit of the Department of Chemistry, Faculty of Mathematics and Natural Sciences, Universitas Brawijaya Malang, Indonesia. The results of this research are the components in biscuits containing for eel flour ranged as follows: Carbohydrates, 29.71 - 39.16; protein, 18.99 - 24.88%; fat, 14.29 to 14.79; ash, from 1.14 to 1.79%; water, 6.44 to 8.41; iron, 1.06 - 1.65%; and calcium, 33.0 - 51.03%. Biscuit F3 has higher nutritional and mineral content, compared to F1 and F2 formulas. Eel flour has a high content of protein, Calcium (Ca), Iron (Fe) and Zinc (Zn).

Key words: *Eel, biscuits, nutritional value, protein*

Introduction

Eel (*Monoptherus albus zuieuw*) is a freshwater fish whose potential has not been fully realised. Eels are classified as a fish that has a very good protein content. In addition, the content of minerals such as calcium in eels is higher than in some other fish (PERSAGI, 2009).
Research by Suprayatmi et al. (2016) utilizes eels as crackers containing omega 3. The crackers with eel dough inserts, and 15% sugar concentration, are preferred. They have a water content

of 3.23%, protein 16.47%, fat 12.04%, omega-3 in the form of DHA (Docosahexanoic acid) and EPA (Eicosapentanoic acid) of 2,264 mg / 100gram and 0.675 mg / 100gram.

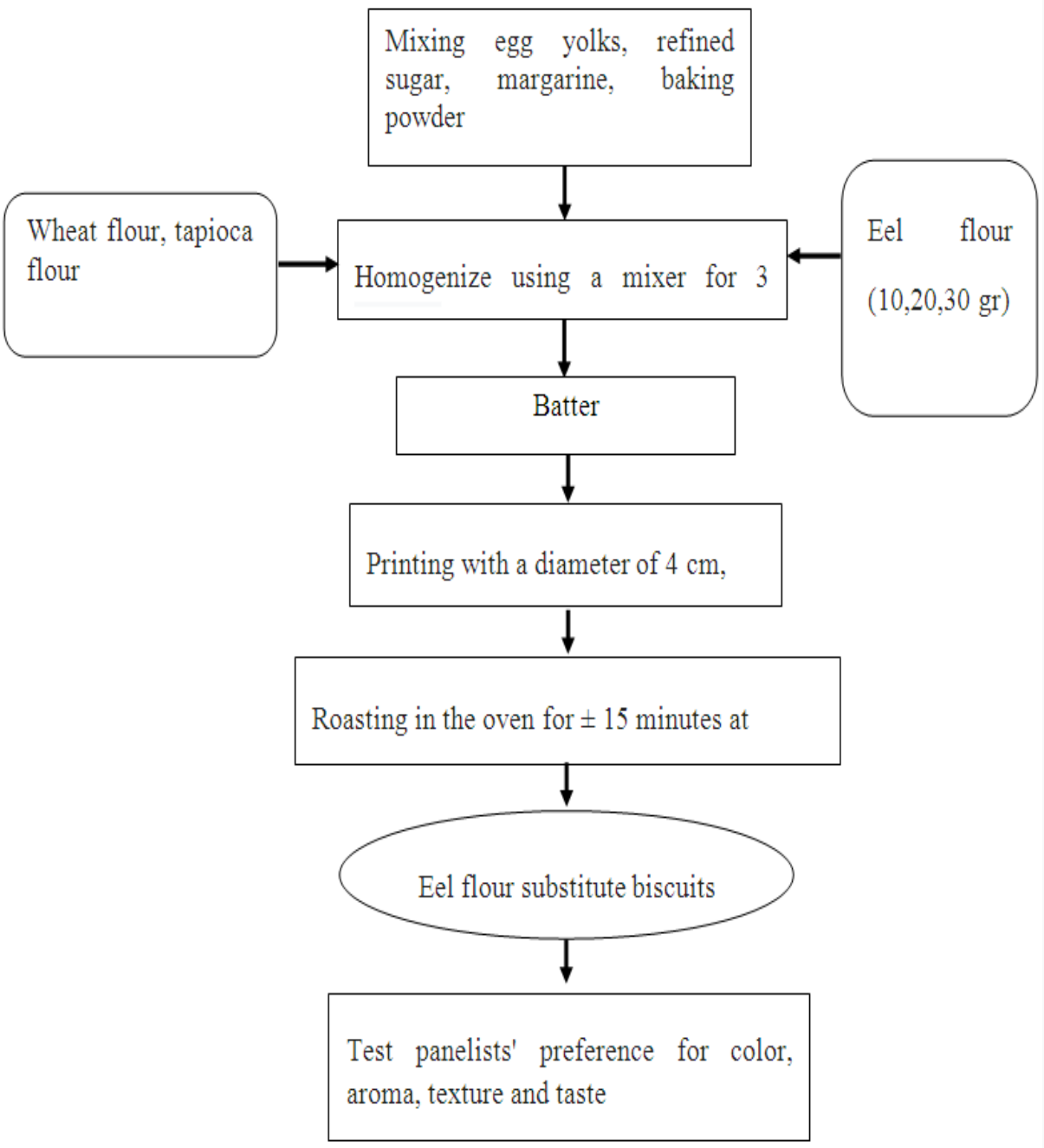
Another research utilises eels. Rahayu's research (2018) develops onion stick substitute eel flour (*monopterus albus zuieuw*) and sunflower seeds (*helianthus annuus*), as an alternative snack for pregnant women. The result is that one serving of onion sticks (75 g) fulfills the nutritional needs of pregnant women; specifically: energy (12%), protein (14.06%), fat (10.35%), carbohydrate (12.90%), calcium (18.15%), iron (25.35%), zinc (12.91%), and phosphorous (21.98%) of the RDA (Nutrition Adequacy Rate). Other research also uses eel flour in making meatballs and adding eel flour to soybean tempeh, although research on eel flour in biscuits for school children is still lacking (Patmavathy & Ilangkumaran, 2017).

Biscuits are one of the processed food products made from flour. According to Wijaya (2010) biscuits are obtained by baking dough from wheat flour, with the addition of other food ingredients, with or without food additives. Usually fat or oil are added fat or oil, to make the biscuits softer or crisper, and delicious. Protein content in biscuits is low. Protein builds and maintains cells and living tissue. In addition, proteins form essential body bonds, regulate water balance, and maintain body neutrality and antibody formation (Ang, 2018). To reiterate, eels are a food source of protein. Protein is unique. It cannot be replaced by other nutrients, in building and maintaining living cells and tissues (Ang, 2018).

Method

This research is a purely experimental study, by conducting laboratory analysis of nutrient content in biscuits with the addition of eel flour (*Monoptherus albus zuieuw*). This research was conducted in October 2019, at the Laboratory of Analysis and Measurement Unit of the Department of Chemistry, Faculty of Mathematics and Natural Sciences, Universitas Brawijaya Malang, Indonesia. The sample was biscuits with the addition of eel flour which consisted of three formulas; namely F1 (addition of 10g eel flour), F2 (addition of 20g eel flour) and F3 (addition of 30g eel flour). The recipe for biscuits with eel flour substitution is as follows:

Figure 1. Recipe for Making Eel Flour Addition Biscuits



Nutritional analysis includes carbohydrates, proteins, fats, iron and calcium. Analysis of Protein Content by Kjeldahl Method, Fat Analysis of Soxhlet Method, Analysis of carbohydrate levels using HCl reagents.

Results

Analysis of the nutrient content of biscuits with three biscuit sample ingredients, namely biscuits F1, F2 and F3, where the main ingredient is eel flour. The overall analysis appears in the following table.

Table 1: Results of Biscuit Nutrition Analysis

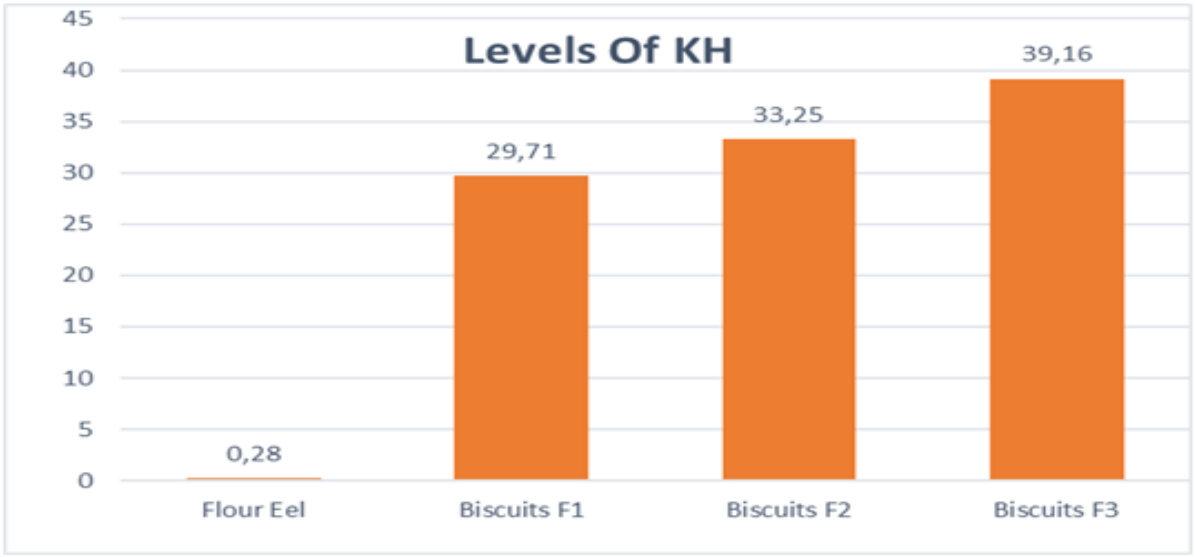
No	Nutritional Substances	Eel Flour	Biscuits		
			F1	F2	F3
1	KH (%)	0,28	29,71	33,25	39,16
2	Protein (%)	78,98	18,99	22,17	24,88
3	Fat (%)	2,99	14,29	14,55	14,79
4	Ash content (%)	3,22	1,14	1,53	1,79
5	Water content (%)	10,78	6,44	8,69	8,41
6	Iron content (mg/kg)	2,49	1,06	1,41	1,65
7	Calcium levels (mg/kg)	74,93	33,0	41,24	51,03
8	Zinc concentration (mg/kg)	11,18	3,08	3,73	4,16

Source: primary data

Carbohydrate Levels

Carbohydrate analysis is carried out by difference, which is the result of a reduction of 100% water content, ash content, protein content and fat content (Sudarmadji et al., 1989). Based on the analysis of eel flour and the three biscuit formulas, the highest carbohydrate content obtained was through the addition of 30 g (F3) eel flour biscuits; 39.16%.

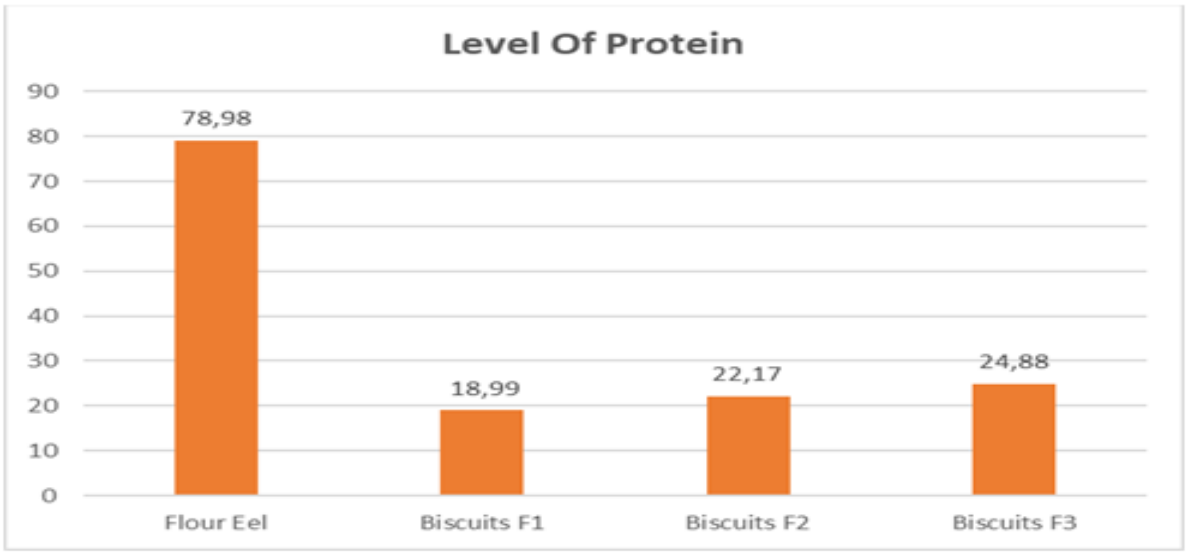
Figure 2. Carbohydrate content in biscuits



Protein Levels

Determination of crude protein content (crude protein) is done by the Kjedahl method. The aim is to calculate the protein content in food, and determine the protein quality in terms of nutrition (Apriyantono et al., 1989). In this study, crude protein analysis was carried out on eel flour as well as on three biscuit formulas.

Figure 3. Protein Content in Biscuits

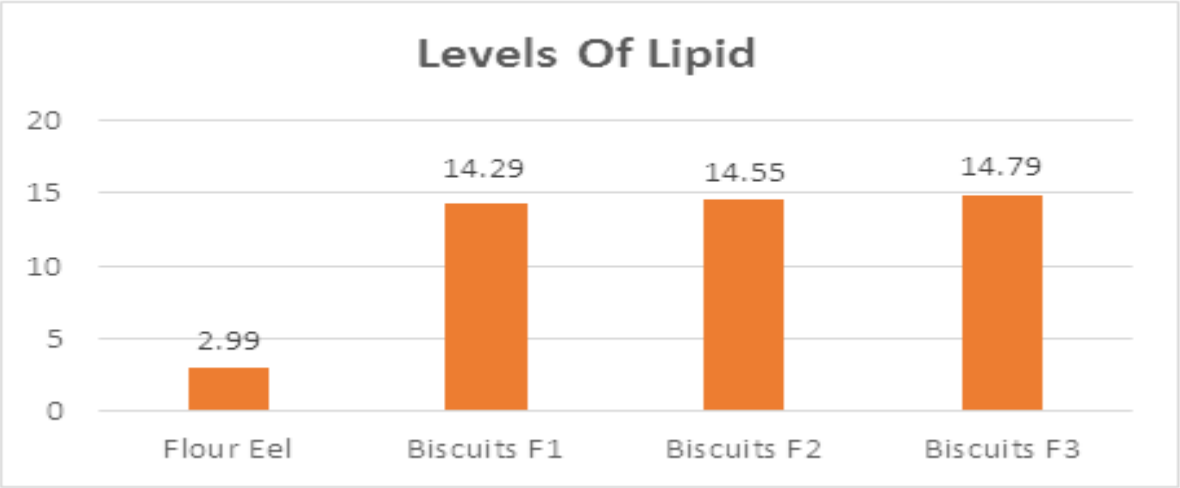


In Figure 3 it can be seen that the results of the analysis of protein content, in all three types of biscuits and in eel flour, obtained the highest protein content in biscuits with the addition of 30 g eel flour (F3) at 24.88%.

Fat Content

Determination of fat content is done by Soxhlet extraction method. Analysis of fat in biscuits is only crude fat content. Determination of fat content is calculated gravimetrically.

Figure 4. Fat Content in Biscuits

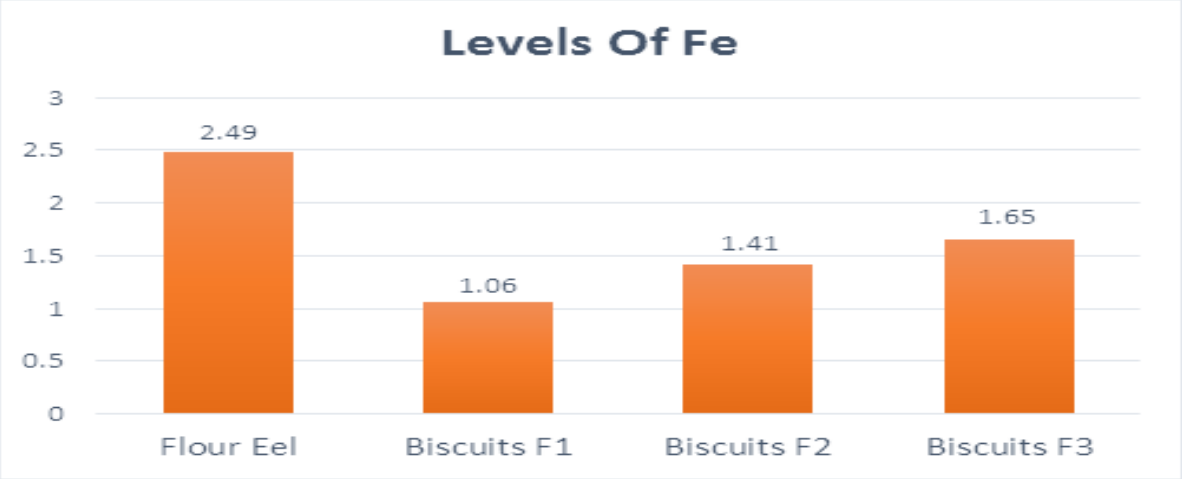


In Figure 4 it can be seen that the fat content in eel flour is 2.99%; F1 biscuits are 14.29%, F2 biscuits are 14.55% and F3 biscuits are 14.79%. From these results it can be said that eel flour biscuits have a higher value at F3.

Fe levels

Iron in food is analysed using the Atomic Absorption Spectrophotometer (AAS) method. The light absorbed by atoms from the elements is measured (Andarwulan et al., 2011). In Figure 5, it can be seen that the highest iron content is in biscuits with the addition of 30 g eel flour (F3), which is equal to 1.65mg / kg.

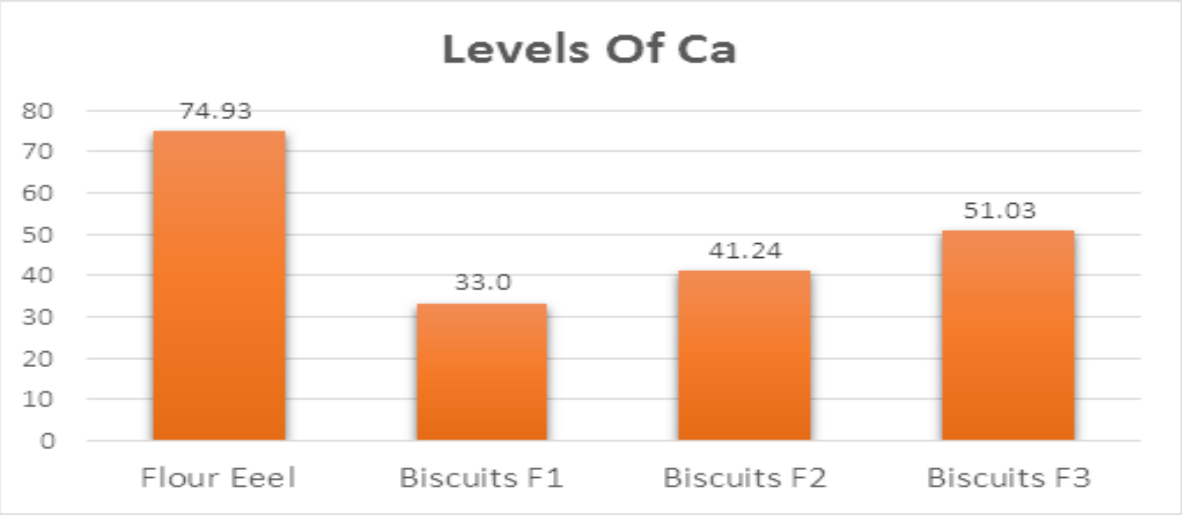
Figure 5. Iron Content in Biscuits



Calcium Levels

Calcium levels were analysed using the Atomic Absorption Spectrophotometer (AAS). The principle of determining calcium thus, is that the sample is dampened wet then measured at a wavelength of 420 nm. The dissolved sample is dissolved in hydrochloric acid. Atomised minerals absorb the energy emitted by the cathode lamp. The amount of energy absorbed is proportional to the amount of calcium in the sample. The sample solution and the blank are measured for emissions absorption with AAS wavelength 420 nm and compared with Ca standards whose concentrations are known.

Figure 6. Calcium Content in Biscuits



In Figure 6, calcium levels in biscuits range from 33.00 - 51.03 mg / kg, with the highest calcium levels occurring with the addition of 30 g eel flour (F3), which is 51.03 mg / kg.

Discussion

Carbohydrate Levels

The main source of carbohydrates in food comes from plants, the main energy sources which are found as starch (amylum) and sugars (mono and disaccharides). Carbohydrate content in biscuits is calculated by rough carbohydrate determination using the "by difference" method. Based on the results of carbohydrate analysis on biscuit samples with the addition of eel flour, the highest carbohydrate content is in biscuits with the formula F3 with 39.16% carbohydrate content. The lowest carbohydrate content occurs in F1 formula, namely with levels carbohydrates as much as 29.71%.

The high content of carbohydrates in the F3 formula is due to the composition of the eel flour which exceeds that of other formulas. Ingredients that are the source of carbohydrates in making biscuits include flour, tapioca flour and sugar.

Protein levels

Protein is a very important nutrient, because it is most closely related to life processes; the protein source is animal and vegetable. Body protein fuels, builds and regulates. Based on the analysis of protein with the addition of eel flour, the biscuit sample with the highest protein content is the formula F3, which is biscuits with the addition of eel flour; as much as 30 g.

The low protein content of biscuits when compared to eel flour in this study is due to protein hydrolysis, which repeats during biscuit manufacturing. It is protein hydrolysis at the boiling and oven stages. Nabil (2005) states that proteins are very sensitive to heat which will change their chemical structure (denaturation). The higher the hydrolysis temperature, the more protein molecules become unstable. High heating will affect the covalent bonds of proteins, degrading protein molecules. This degradation results in many derivatives of water-soluble proteins (Winarno, 1997).

Further, the higher the cooking temperature and pressure, the more that raw materials will be soft and destroyed. This is caused by the increasing hydrolysis of protein, so that the secondary bonds of protein are brittle. This condition makes it easy for the protein that remains, or has not dissolved in hydrolysis, to be removed during washing. Protein when heated will experience denaturation.

Protein in biscuits produced in this study ranged from 18.99 - 24.88%. This value meets the standards according to SNI No. 01-2973-1992, which require a minimum of 6.5%. This is caused by the portion of carbohydrates replaced by the supplemented material, eel flour. The more eel flour is supplemented or added to the biscuits, the higher the protein content.

Fat Content

Fat is formed from 95% fatty acids and glycerol. Fat is a source of energy, in addition to carbohydrates and protein. Excess fat that is consumed can be stored by the body as an energy reserve. Fat has several functions; producing energy, producing essential fatty acids, vitamin solvents, giving a feeling of fullness, and saving protein. Fatty sources of various foodstuffs such as meat, fish, eggs, milk, avocados, peanuts, and several types of vegetables contain fats and oils. Based on the analysis of fat from several biscuit samples, the highest fat content is in formula F3, with a total fat content of 14.79%. The increased fat content in these biscuits is influenced by the composition of other ingredients outside the raw material, namely margarine. In 100 grams of margarine there is as much as eight grams of fat.

Calcium Levels

Research shows that the human body contains about 22 grams of calcium per kilogram of body weight without fat. Of that calcium, about 99% is deposited in bones and teeth. Our body contains more calcium than other minerals. It is estimated, that 2% of adult body weight or about 1.2-1.4 kg consists of calcium. However, babies contain only a little calcium (25-30 grams). After the age of 20 years, about 1,200 grams of calcium will normally be added in the cartilage and teeth; the rest in body fluids and soft tissue. In this study Atomic Absorption Spectrophotometer (AAS) was used to determine calcium levels. It is known that the highest levels of calcium (Ca) are biscuits with the formula F3, as much as 51.03 mg / kg. The lowest calcium occurs in F1 formulas, as much as 33.0 mg / kg. The low calcium content in F1 formula is due to the composition of eel flour which is less compared to other biscuit formulas. The composition of formula F3 of eel flour contributes to the increase in calcium content in biscuits.

Iron Levels

Iron (Fe) is an essential microelement for the body. It is especially needed in hemopoiesis (blood forming), in the synthesis of haemoglobin (Hb). In addition, iron is an activating factor for various enzymes. Iron levels were determined in this study using AAS. Based on the analysis of the iron content of some biscuit samples with added eel flour, F3 has the highest iron content at 1.65 mg / kg. The lowest iron content occurred in F1 formula biscuits, at 1.06 mg / kg. The high iron content in formula F3 occurred with a composition of 30 grams of eel flour. Factors that cause low iron content in tuna bone flour due to the heating process can

degrade iron so that the bioavailability of iron will be low. The longer the heating process the lower the iron solubility.

Conclusion

Innovation making biscuits by adding the eel flour can be healthy food where the biscuits contain the protein, calcium, iron and zinc. Biscuit F3 (addition of 30g eel flour) has higher nutrient and mineral content, compared to F1 (addition of 10g eel flour) and F2 (addition of 20g eel flour) formulas. Therefore, the more adding the eel flour in biscuits will increase the nutrient of protein, calcium, iron and zinc.

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