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BRIEF CONTENTS

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A. MATHEMATICS EDUCATION

B. CHEMISTRY

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LEVELS OF LEAD AND MERCURY IN CRACKER SUPPLEMENTED BY GORONTALO BLOOD COCKLE (*Anadara granosa)* POWDER

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Abstract
Blood cockle has been recognized as an alternative protein and mineral source which is potential to be diversified as a new food product. *Kerupuk kerang darah* (traditional Blood cockle cracker) is one of food products made from blood cockle. Nevertheless, blood cockle is known for its capability of accumulating heavy metal such as lead (Pb) and mercury (Hg) and other heavy metals, depends on its habitat. The purpose of research was to investigate levels of the heavy metal lead and mercury content in *Kerupuk kerang darah* (traditional blood cockle cracker). This study used a completely randomized design with 5 different blood cockle powder supplemented crackers (K = 0%, P1 = 5%, P2 = 10%,P3= 15%, P4 = 20%). Onion Cracker was used as control (K). Measurement of lead and mercury level was done with AAS method. Data analysis was performed with one-way ANOVA and LSD. Result showed that the average lead level on control group (K) and blood cockle supplemented groups (P1-P4) were 0.1593 ppm; 0.1581 ppm; 0.1672 ppm; 0.1693 ppm; and 0.1740 ppm respectively. The average mercury level on control group (K) and blood cockle supplemented groups (P1-P4) were 0.0037 ppm; 0.0033 ppm; 0.0040 ppm; 0.0057 ppm; and 0.0067 ppm respectively. It was concluded that blood cockle powder supplementation increased the lead level in cracker (p=0.003) but did not increase the mercury level (p=0.091). Both levels of lead and mercury in Gorontalo blood cockle cracker were below the National Standard for heavy metals in food (SNI 2009), made it safe for consumption.

Keyword: *Anadara granosa*, cracker, lead, mercury

1. Introduction

Blood cockle (*Anadara granos*a) is an invertebrate, member of the bivalves class. It is included in Arcidae family and genus Anadara (Broom, 1985). Blood cockle is a marine product with economic value. The shells of blood cockle contain red blood pigment (haemoglobin), hence the name, helping it to live in low oxygen level area (Broom, 1985), even in the condition without water, after being harvest (PKSPL, 2004).

The amount of protein and zinc in blood cockle are higher than egg white 0.02 mg / 100 g or chicken 1 mg / 100 g (Widowati, 2008). Fresh blood cockle from Bualemo Regency, Gorontalo Province contains 19.48% protein, and the mineral content of Cu, Fe, and Zn (Nurjanah, et al., 2005). Gorontalo blood cockle powder contains 27.26% total protein, total fat 2.54%, water 9.74% and 10.62% ash, with mineral content of zinc 81.16 ppm, Fe 1720.46 ppm, Cu 4.26 ppm, and Ca 318.67 ppm (Solang, 2014).

Zinc from animal source foods is easier to be absorbed than those from plant source food (Almatsier, 2004). Zinc plays a role in the synthesis, secretion and action of growth hormone (GH) on the production of IGF-1. Gluckman et al. (1987) stated that the target of GH either directly or through the IGF-I is to stimulate anabolic processes, such as cell division, bone growth and protein synthesis. The presence of protein in blood cockle will also help the

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absorption of zinc and increase body protein intake. High protein and zinc content makes blood cockle suitable as a nutrition source. Using blood cockle as a supplement significantly increases blood levels of albumin, zinc, and the IGF-I hormone of malnutritioned male common rat (*Rattus norvegicus*) (Solang, 2014).

In Gorontalo Province, blood cockle is usually sold raw and only available on demand. It is still not a popular food as it is eaten as an alternative when it is not possible to catch fish because of bad weather, suggesting the blood cockle is still not optimally used despite of its high nutrient content. Food diversification may be used as a way to introduce blood cockle as a food source, by making it as a snack product in the form of crackers. Blood cockle cracker is an alternative food that contains protein and zinc needed especially for children growth. On the other hand, blood cockle is known for its capability of accumulating heavy metal such as lead (Pb) and mercury (Hg). Thus, in order to ensure food safety and to prevent any side effects, analysis of lead and mercury level in snacks was carried out.

2. Materials and Methods

Blood cockles were obtained from Pohuwato Regency, Gorontalo Province. Blood cockle processing was done in phases: boiling, cutting, drying, and grinding into powder form. Blood cockle crackers were made in the laboratory of Biology Department UNG. Analysis of lead and mercury level in crackers was performed in Center of Health Laboratory (BBLK), Surabaya.

This study is an experimental research using completely randomized design (CRD) with 5 treatments and 3 replications. Supplementation of blood cockle powder in crackers was done in concentration level of K:0% ,P1: 5%, P2:10%, P3:15% and P4: 20%, based on the acceptable sensory quality and nutritional value of the food. Onion Crackers without supplementation of power blood cockle, were used as control.

Levels of lead and mercury in crackers were measured using Atomic Absorbant Spectrophotometer (AAS) (Zeenit 700). Lead and mercury level were stated in mg/L (ppm). Data was analyzed with parametric statistical tests one-way ANOVA and Least Significance Difference (LSD) (Steel and Torrie, 1980).

3. Result and Discussion

3.1. Result

Levels of lead and mercury in blood cockle supplemented crackers see Table 1

Table 1. Levels of lead and mercury in blood cockle powder and blood cockle supplemented cracker

No.	Sample	Lead (ppm)	Mercury (ppm)
1	Blood cockle powder	0.1731	0.0040
2	K	0.1581	0.0037
3	P1	0.1593	0.0033
4	P2	0.1627	0.0040
5	P3	0,1693	0,0057
6	P4	0,1740	0,0067

Note: K: control group(0%), P1= 5% blood cockle powder as supplementated, P2 = 10% blood cockle powder as supplementated , P3 = 15% blood cockle powder as supplementated, and P4 = 5% blood cockle powder as supplementated.

Blood cockle powder contains lead 0.1731 ppm and mercury 0.0040 ppm. Levels of lead and mercury in control crackers were 0.1581 ppm and 0.0037 ppm. Lead levels in blood cockle supplemented crackers in concentration level of 5%, 10%, 15%, and 20% were 0.1593 ppm; 0.1627 ppm; 0.1693 ppm; and 0.1740 ppm, respectively, while mercury levels were 0.0033 ppm; 0.0040 ppm; 0.0057 ppm; and 0.0067 ppm, respectively (see **Table 1**). Blood cockle powder supplementation significantly increased the lead level in crackers (p= 0.003) but insignificantly increased the mercury level (p= 0.091).

3.2. Discussion

3.2.1. Level of Lead (Pb) in Supplemented Crackers

Crackers are snack food with a dry, light, and porous character, made of high starch ingredients (Koswara, 2009). Crackers can be divided into two kinds, crackers as protein source and crackers as a non-protein source. The first kind usually contains animal source or plant source protein, such as fish, shrimp, or soy. The latest kind is the opposite with no protein sources added in food processing, for example jengkol crackers, rice crackers, etc. (National Standardization Agency of Indonesia (BSN), 2009). By using high protein content blood cockle powder (46.60%) (Solang, *et al*, 2015) in crackers supplementation, it is expected that it may add the nutritional value of the crackers.

While blood cockles are known to have high protein content, they also have the ability to accumulate heavy metals such as lead (Pb) and mercury (Hg). Lead with odorless and tasteless characteristics can be found naturally in soil. It may react with other compounds to form a variety of lead compounds, such as organic compounds likeplumbum oxide (PbO), plumbum chloride ($PbCl_2$) and others. Sources of lead include old painting, dust, air, water, food, soil contaminated with fuel containing Pb (BSN, 2009).

Results showed that control crackers (with 0% of supplementation of blood cockle) had higher lead level (0.1581 ppm). This high level of lead was assumed to originate from the basic ingredient of the crackers, tapioca starch which contained lead 0.169 ppm (Labkesda, 2015). The results also showed the lead level in blood cockle powder supplemented cracker increased along with the increased concentration of blood cockle powder supplementation. Differences in lead levels in crackers were probably due to the variation of blood cockle powder concentration. Blood cockle powder it self contained lead 0.1731 ppm (Table 1).

Lead in blood cockle flour was assumed to be caused by the ability of blood cockle to accumulate heavy metals such as lead (Umbara, *et al*, 2006, DGHCP, 2004). Blood cockle may accumulate heavy metals because it is fixed in a particular area, has a slow movement that makes it difficult to avoid pollution and its effects, and has a high tolerance to the concentration of a particular metal. Lead in blood cockle powder supplemented crackers might also derive from tapioca starch used as basic ingredient in making crackers. Lead could also derive from the tools used inmaking crackers (Saksono, 1986; Deman, 1997; DGHCP, 2004).

BSN (2009) sets a limit on lead contamination in blood cockle at 1.5 mg/kg while lead contamination limit in processed foods is at 0.25 mg/kg. Based on these limits specified by BSN (2009), the levels of lead in blood cockle powder supplemented crackers were still below the limit. Lead tolerance limit per week, is 1.75 mg or 1750 µg/70 kg body weight/week (DGHCP, 2004) while the consumption of supplemented crackers at the highest concentration was 10057g/70 kg body weight/week or 1436.5 g/70 kg body weight/day.

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3.2.2. Level of Mercury (Hg) in Supplemented Crackers

Mercury (Hg) is a toxic metal found in many fishery products. Mercury contained in seafood is in the form of methyl mercury. The content of methyl mercury in fish and clams varies ((DGHCP, 2004). Mercury also can be found in the air, soil, and at the contaminated and high risk place (BSN, 2009). Lu (1995), states mercury levels in the air are generally very low, while unpolluted water contains about 0.1 mg/L. Foods also may have a very low level of mercury, typically in the range of 5-20 μg/kg.

Results showed that there was an insignificant increase in average mercury level of blood cockle powder supplemented crackers. Mercury found in the blood cockle cracker was assumed to come from the blood cockle since blood cockle are known as sessile filter feeders, thus able to accumulate heavy metals, including mercury.

The presence of mercury might also derive from tapioca starch. The highest level of lead was found in supplemented crackers at the concentration level of 20%, i.e.0.0067 ppm while the lowest concentration level of 5% also showed a lower mercury level at 0.0037 ppm. The mercury level in control crackers was at 0.0040 ppm. Mercury levels in blood clam cracker were in the range of 5-20 mg/kg (Lu, 1995).

Mercury contamination limit in processed foods is 0.03 mg/kg (BSN, 2009). Thus, mercury levels in blood cockle powder supplemented crackers were under the standard limit, suggesting that the crackers made of Gorontalo blood cockle were safe for consumption. However, this crackers consumption should be done with attention to the consumption tolerance limit of mercury per week, i.e. 0.35 mg/70 kg body weight/week or 350 mg/70 kg body weight/week (DGHCP, 2004). Based on this, the maximum consumption of blood cockle powder supplemented crackers was 10 057 g/70 kg body weight/week or 1436.5 g/70 kg body weight/day.

4. Conclusion

Supplementation of blood cockle powder in crackers increased the lead levels significantly, but the mercury levels did not increase significantly. Levels of lead and mercury in supplemented crackers were still below the maximum limit of the National Standard for heavy metals in food, suggesting the crackers were safe for consumption. Maximum consumption blood cockle powder supplemented crackers was 10 057 g/70 kg body weight/week or 1436.5 g/70 kg body weight/day.

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CERTIFICATE

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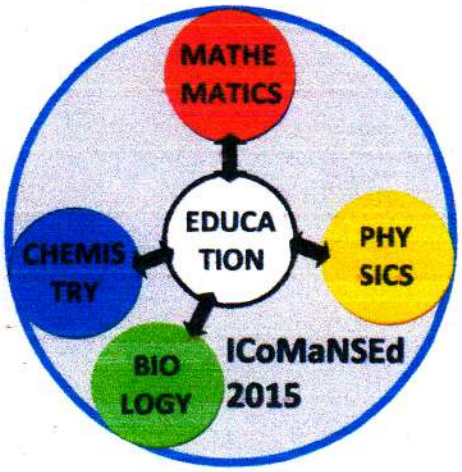

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