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# CHEMICAL CHARACTERISTICS OF KECIMPRING CHIPS WITH ADDITION OF FISH MEAT FROM CIRATA RESERVOIR

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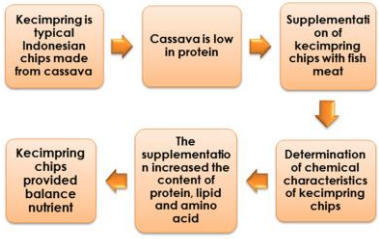
## Graphical abstract




## Abstract

Kecimpring is a typical Indonesian chip made from cassava. This study aimed to determine the chemical characteristics of kecimpring chips with the addition of fish meat. There were three species of fish used in this study, tilapia (*Oreochromis niloticus)*, pomfret (*Colossoma macropomum)* and catfish (*Pangasius hypopthalmus)*, collected from Cirata Reservoir. The chemical characteristics of kecimpring chips were measured from the content of water, protein, lipid, ash, and fiber. The result showed that the highest yield of minced fish was obtained from *Colossoma macropomum* (32.87 %). Kecimpring chips with the addition of *Oreochromis niloticus* meat contained the highest water (12.98 %), protein (11.54 %) and lipid (1.55 %). In addition, the highest ash content (4.67 %) was provided from kecimpring chips with the addition of *Pangasius hypopthalmus* meat while the highest fiber content (2.28 %) was obtained from kecimpring chips with the addition of *Colossoma macropomum* meat. The value of the highest total amino acid was provided from kecimpring chips with the addition of 30 % *Oreochromis niloticus* (8.57 % w/w), with the domination of glutamic acid (1.57 % w/w).

*Keywords*: Chips, Cirata Reservoir, *Colossoma macropomum*, fish meat, kecimpring, *Oreochromis niloticus*, *Pangasius Hypopthalmus*



## 1.0 INTRODUCTION

Kecimpring is a typical cassava chip in West Java, Indonesia. It has been produced by rural communities and subsequently traded in traditional markets. Cassava (*Manihot esculenta* Crantz), raw material used for kecimpring, was simply obtained so that the production of kecimpring can be continuously maintained. It is a major source of food for approximately 600 x $10^6$ populations worldwide [1], enriched with carbohydrates but low in protein and calcium [2]. Therefore, according to nutritional requirement, it is not sufficient to fulfil the dietary needs. Consequently, predominant consumption of cassava could trigger protein-deficiency symptoms [1]. The main nutritional problem in Indonesia is still dominated by malnutrition or Protein Energy Malnutrition [3], caused by unbalanced nutritional intake. With regard to the limited amount of protein in cassava, the addition of fish meat can be considered as a diversification process to improve the nutritional quality of kecimpring chips.

Cirata is a reservoir located in West Java. Fish which are commonly cultivated in Cirata are tilapia [*Oreochromis niloticus* (Linnaeus 1758)], pomfret [(*Colossoma macropomum* (Cuvier, 1818)] and catfish [*Pangasius hypopthalmus* Sauvage, 1878)], containing high amount of protein, 12.52 % [4], 12.86 % [5] and 13.60 % [6], respectively. Therefore, these three species of fish can be used to increase the protein content of kecimpring chips. Protein contained in the fish meat is enriched with essential amino acids [7] which in turn could increase the intake of essential amino acids required by body [1]. In addition, it can be added into

processed products as the meat is quite thick with white color and neutral flavor. This research aimed to determine the fish meat which provided the best chemical characteristics of kecimpring chips including the content of water, protein, ash, lipid, fiber and amino acid.

## 2.0 EXPERIMENT

The research was carried out at the Laboratory of Technology of Fish Processing, Faculty of Fisheries and Marine Science, Padjadjaran University from May to July 2015. The research was using experimental method with three factors (fish species), three treatments (10 %, 20 %, and 30 % of meat addition) and three replications. The chemical analysis conducted in this research was analysis of water, protein, lipid, ash, fiber, and amino acid of kecimpring chips.

### 2.1 Materials

The materials used in this research were tilapia (*O. niloticus*), pomfret (*C. macropomum*) and catfish (*P. hypopthalmus*) from Cirata Reservoir, with weight about 300 g to 500 g per fish. The cassava was obtained from Sumedang West Java. In addition, the seasoning was also prepared including garlic, onion and salt, added by 2 % (w/w) each.

### 2.2 Minced Fish Production

Tilapia, pomfret and catfish were freshly obtained from Cirata Reservoir. The fish were acclimatized and aerated for 1 d in the laboratory, followed by keeping the fish in a cool box containing ice for 30 min. Afterwards filleting and removing the fish skin were conducted in order to obtain the fish meat. It was then washed, drained and milled using a meat grinder. The minced fish was packaged and stored in the refrigerator for later added to kecimpring chips. The addition of fish meat of each species, 10 %, 20 %, and 30 %, were calculated based on the weight of cassava

### 2.3 Kecimpring Chips Production

Cassava was peeled and washed. It was then grated and mixed with the seasoning, followed by the addition of fish meat. The dough was put on the leaves and was then steamed for 5 min, then dried under the sun. Afterwards the dried kecimpring chips were packaged and analyzed.

### 2.4 Yield of Minced Fish

Yield of minced fish was obtained from the weight ratio of minced fish with fresh fish. The yield was determined according reference (8) through the formula (1),

$$\text{Yield} = \frac{\text{Weight of minced fish}}{\text{Weight of fresh fish}} \times 100\ \% \quad (1)$$

### 2.5 Proximate Analysis

Proximate analysis was conducted to determine the chemical characteristics of kecimpring chips. Analysis of the moisture content was conducted as follows: 5.0 g of sample were put on an aluminum dish and kept in an oven at 105 °C for about 24 h until a constant weight was achieved. The results were expressed in g of water per 100 g of sample. Assay was made in duplicate for each sample. Meanwhile, protein, lipid, ash and fiber were determined following the method of AOAC [8].

### 2.6 Amino Acid Analysis

Amino acid was determined and analyzed using liquid chromatography in cationic exchange resin columns and post column derivation with ninhydrin and autoanalyzer. For the calculation, the sample was hydrolyzed with HCl 6 N for 22 h at 110 °C according to method described by Moore and Stein [9].

### 2.7 Statistical Analysis

Data were subjected to analysis of variance (ANOVA). Comparison of means was carried out by Duncan's multiple-range test [10]. Analysis was performed using a SPSS package (SPSS 16 for windows, SPSS Inc., Chicago, IL).

## 3.0 RESULT AND DISCUSSION

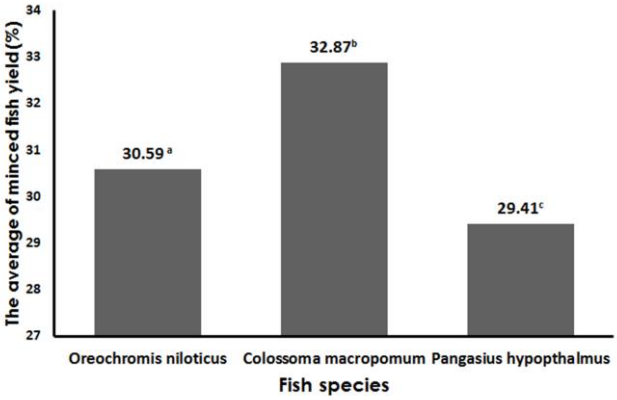
### 3.1 Yield

#### *3.1.1 Yield of Minced Fish*

Yield is percentage of material that can be utilized. It is the most important parameter to determine the economic value and effectiveness of a product or material. In this study, the yield indicates the efficiency and effectiveness of the process of minced fish production. The yield value was obtained by comparing the weight of meat produced with the weight of fresh fish. The average of minced fish yield is shown in Figure 1.

Figure 1 shows that the highest yield was provided by pomfret (*C. macropomum*), which was 32.87 %. There were some factors influencing the yield, such as the method of removing the meat and the weight of the fish. In addition, the content of the muscle fibers in the fish meat also affected the value of the yield. Catfish (*P. hypopthalmus*) has the highest amount of muscle fibers and lipid content compared to the other fish, resulting in the lowest amount of the yield. The weight of the fish used in this study was between 300 g and 500 g which impacted on the minimum yield obtained. The yield of catfish meat which was

measured between 500 g and 1000 g ranged from 30 % to 42.5 % which showed that the larger the size of the fish, the higher the yield obtained [11].

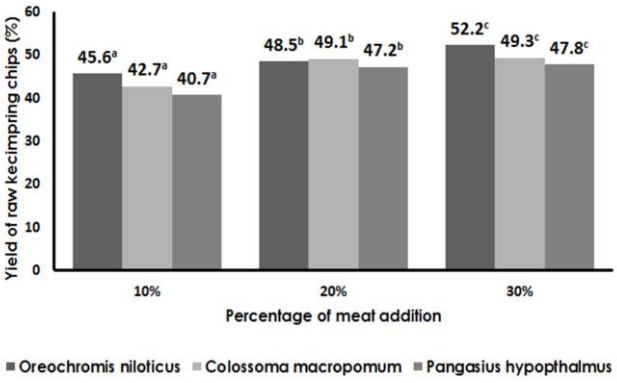



Means followed by different superscripts were significant (P>0.05).

**Figure 1** The average of minced fish yield

### 3.1.2 Yield of Dried Raw Kecimpring Chips

The yield of dried raw kecimpring chips was determined and its average was shown in Figure 2. The average yield of raw kecimpring chips ranged between 41 % and 52 %. The highest yield was obtained by which added with 30 % tilapia fish meat while the lowest yield was provided by kecimpring which was added with 10 % catfish meat. This showed that the higher the amount of fish meat added, the higher the yield produced.




Means followed by different superscripts were significant (P>0.05).

**Figure 2** The average of dry raw kecimpring chips yield

The yield of dried raw kecimpring chips is presented in Figure 3. Compared with the other products, the yield of raw cassava opak crackers supplemented with layur or sword fish meat was 20 % [12]. Kecimpring chips in this study provided the higher yield. This might be caused by the use of different fish which provided different meat characteristics.

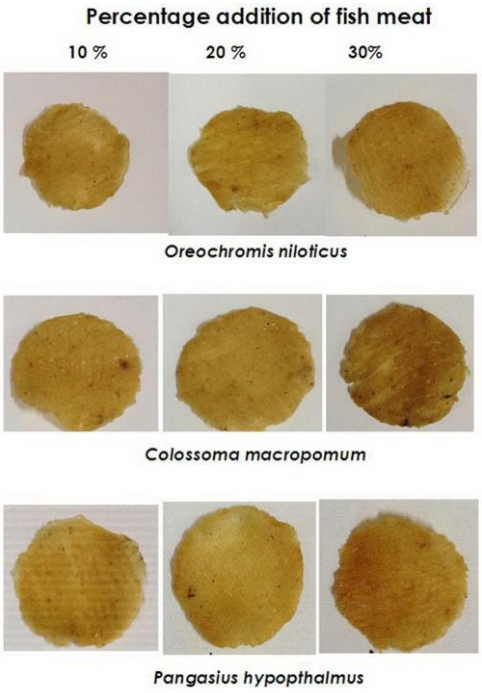
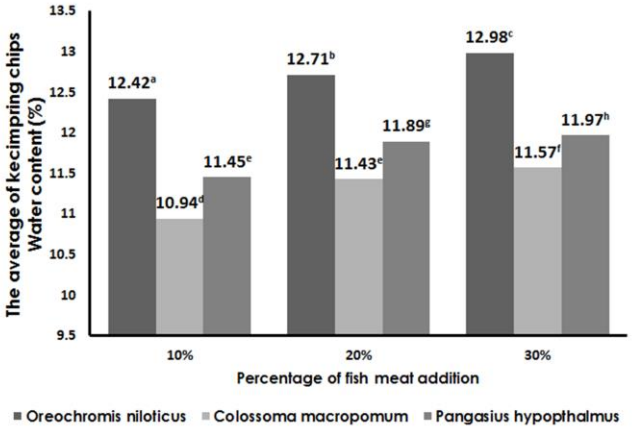



**Figure 3** Dried raw kecimpring chips

## 3.2 Water Content

Water is an important component in food products as it influences the appearance, texture, and taste. Fishery products have a very high water content of about 80 %. In addition, water content determines acceptability, freshness and shelf life of food products [13]. Water content of kecimpring chips is shown in Figure 4.




Means followed by different superscripts were significant (P>0.05).

**Figure 4** The average of kecimpring chips water content

Water content of kecimpring chips without meat addition was 11.30 %. According to Figure 4, the highest water content (12.98 %) was shown by kecimpring chips which was added with 30 % tilapia

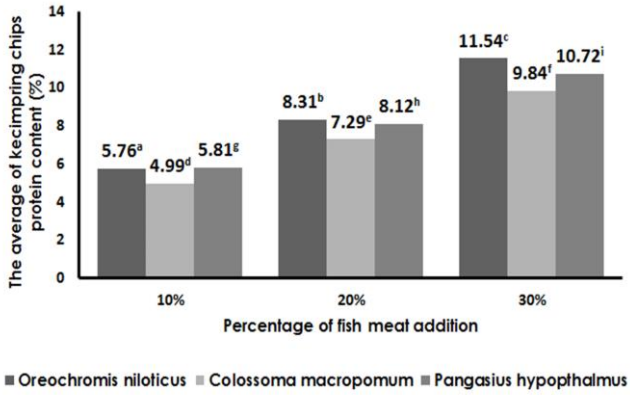
(*O. niloticus*) while the lowest water content (10.94 %) was provided in the addition of 10 % pomfret (*C. macropomum*). This showed that water content in kecimpring chips increased with the percentage of the addition of fish meat.

The difference of water content in kecimpring chips might be caused by the different species of fish and the percentage of fish meat added. Water content of tilapia (*O. niloticus*) was 79.44 % [4], followed by catfish (*Pangasius* sp) 78.29 % [14] and pomfret (*C. macropomum*) 68.92 % [5]. The increase of water content was influenced by the addition of cork fish meat residue into the dough of crackers [16]. In addition, it was also influenced by raw material, cassava. Starch of cassava contains hydrophilic side, causing the easiness to bind with the water contained in the fish.

According to statistical test analysis of variance (ANOVA), the different addition of percentage of fish meat was a significant effect on the difference of water content of kecimpring. In addition, regarding to the Indonesian National Standard (SNI 01-2713-1999), maximum water content allowed in raw crackers is 12 %. Water content of raw kecimpring chips with the addition of pomfret and catfish already met the standard of SNI 01-2713-1999. However, those added with tilapia fish meat did not meet the standard as it was higher than 12 %. This might be caused by the water content of tilapia meat which is higher than the others, concerning on the same treatment parameters including the drying process.

### 3.3 Protein Content

Protein is an essential nutrient that plays an important role in carrying out most of functions in the body. It also contributes on providing nitrogen based energy which is not available in fat and carbohydrate [13].




Means followed by different superscripts were significant (P>0.05).

**Figure 5** The average of kecimpring chips protein content

Figure 5 shows the average protein content of kecimpring chips. Without the addition of fish meat, kecimpring chips contained 2.53 % protein. The highest percentage of protein content (11.54 %) was provided by kecimpring chips with the addition of 30 % tilapia (*O. niloticus*) while the lowest protein content (4.99 %) was shown by kecimpring chips with the addition of 10 % pomfret (*C. macropomum*).

This shows that the protein content increased with the percentage of fish meat added. According to a study about crackers [16], the higher the fish meat added, the higher the protein of crackers obtained.

It has been known that protein content of tilapia (*O. niloticus*), pomfret (*C. macropomum*), catfish (*P. hypopthalmus*) is 12.52 % [4], 12.86 % [5] and 13.60 % [6], respectively. The variation of chemical composition can occur between species and individuals within a species [17]. In addition, meat protein is unstable and has the properties that may change with the environmental conditions [18].

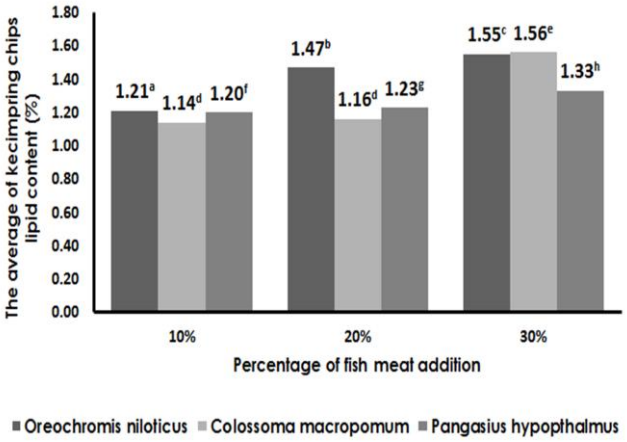
The result of statistical test analysis of variance (ANOVA) showed that the addition of different percentage of fish meat was a significant effect on the difference of protein content of kecimpring chips. According to (SNI 2713.1-2009), the minimum protein content in raw crackers is around 5 %. This means that the protein content of kecimpring chips obtained in this research already met SNI 2713.1-2009. Therefore, kecimpring chips with the addition of tilapia, pomfret, and catfish can be considered as a source of protein in crackers.

### 3.4 Lipid Content

Lipid is a nutrient that supplies the highest energy to the body and is able to dissolve vitamin A, D, E, and K. Animal lipid contains many sterols called cholesterol. Lipid can be stored in the body when excessive carbohydrate is converted into lipid, then stored in adipose tissue [13].

The average fat content of kecimpring chips is presented in Figure 6. Lipid content of kecimpring chips without meat addition is 1.05 %. However, the increase in lipid content was occurred when the fish meat was added into kecimpring chips. It can be seen that the highest percentage of lipid content was provided by kecimpring chips with the addition of 30 % tilapia (*O. niloticus*), which was 1.54 %, while the lowest lipid content was 1.14 %, presented by kecimpring chips with the addition of 10 % pomfret (*C. macropomum*). This might occur due to the difference in the lipid content of each species of fish used in the study.

The lipid content in cassava ranges from 0.1 % to 0.3 % [19]. Thus, the addition of fish meat can increase the value of lipid content in processed cassava–based products. Comparing with another product, lipid content of cassava opak crackers added with 6 % layur fish (*Trichiurus* sp.) meat was 1.22 % [12] which was close to the result obtained in this research, showing that fish meat is able to increase the lipid content.



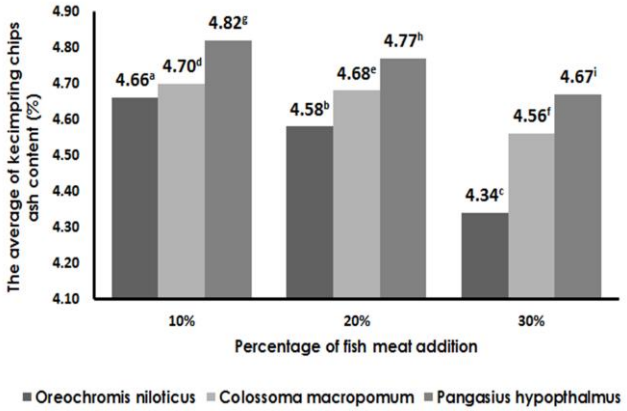

Means followed by different superscripts were significant (P>0.05).

**Figure 6** The average of kecimpring chips lipid content

According to SNI 01-2713-1999, the maximum content of lipid allowed in fish crackers is 0.8 %. This shows that kecimpring chip is not in the range mentioned as it contained higher lipid content. The difference of lipid content in human being is caused by the difference of eating habits, digested food and availability of food in the habitat [20]. The presence of elevated content of lipid in crackers might be caused by the change of water content [16]. The result of statistical test analysis of variance (ANOVA) showed that the addition of different percentage of fish meat was a significant effect on the difference of lipid content of kecimpring chips.

## 3.5 Ash Content

Ash is inorganic substance which is residue of combusted organic material [21]. Ash content and its composition are dependent on the kinds of materials and the process. The average of ash content of kecimpring chips is shown in Figure 7.




Means followed by different superscripts were significant (P>0.05).

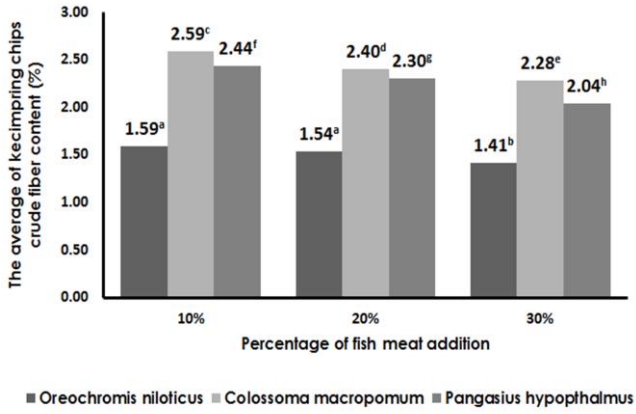
**Figure 7** The average of kecimpring chips ash content

Ash content of kecimpring chips without meat addition was 4.75 %. Based on Figure 7, the range of ash content is between 4.34 % and 4.82 %. Ash content values were highest for kecimpring chips with the addition of 10 % catfish meat while the lowest value was in kecimpring chips with the addition of 30 % tilapia meat. The additional seasoning can cause an increase in the value of ash content. The seasoning amount added, including garlic, onion and salt, was 2 % each treatment.

Comparing with another product, the average ash content of cassava opak crakers supplemented with layur fish meat is 4.38 % [12]. This shows that the average range of ash content in kecimpring chips added with tilapia, pomfret, and catfish meat was close to the product mentioned. According to statistical test analysis of variance (ANOVA), the different percentage of fish meat addition was a significant effect on the difference of ash content of kecimpring chips.

## 3.6 Crude Fiber Content

Crude fiber is the result of hydrolysis of the remaining components of a food with a strong acid, then hydrolyzed with a strong base, causing loss of about 50 % cellulose and 85 % hemicellulose [22]. The average of crude fiber content of kecimpring chips is presented in Figure 8.




Means followed by different superscripts were significant (P>0.05).

**Figure 8** The average of kecimpring chips crude fiber content

The highest fiber content was provided by kecimpring chips with the addition of 10 % pomfret meat (*C. macropomum*), which was 2.59 %, whereas the lowest fiber content was1.41 %, provided by kecimpring chips with 30 % tilapia meat (*O. niloticus*). Without the addition of fish meat, crude fiber content of kecimpring chips was 1.61 %, while another product, sundried cassava chip, contained 1.78 % crude fiber.

Dietary fiber should not be consumed in excessive amount as the recommended reference needs of fiber is 30 g per d [23]. In addition, the recommended dietary fiber intakes for children and adults are 14 g

per 1 000 kcal [24]. The fibers contained in the kecimpring chips are expected to contribute to the human needs of food fibers.

The main source of fiber contained in kecimpring chips is derived from cassava. With the addition of fish meat, fiber content kecimpring chips tends to decrease. It is associated with an increase in the amount of water and protein in kecimpring chips. This is supported by Sugito *et al.* [22] who stated that the higher the concentrations of fish added in the cassava crackers, the less the fiber contained. The result of statistical test analysis of variance (ANOVA) showed that the addition of different percentage of fish meat was a significant effect on the difference of fiber content of kecimpring chips.

### 3.7 Amino Acids Content

The difference of functional protein is primarily formed from its chemical composition. Amino acids are the building blocks of protein that form a complex polymer which is linked through a substituted amide bond. Several different strategies have been investigated to improve the protein content and amino acid compositions of cassava ready–to–eat products [7].

Protein is composed of 20 different amino acids, however, some proteins probably contain one or several of the 20 amino acids [25]. Amino acids content in kecimpring chips is shown in Table 1.

**Table 1** The amino acids content in kecimpring chips

| Amino acids | The addition of *O. niloticus (%)* | | | The addition of *C. macropomum (%)* | | | The addition of *P. hypopthalmus* (%) | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 | 20 | 30 | 10 | 20 | 30 | 10 | 20 | 30 | |
| **Aspartic acid** | 0,54 | 0,87 | 1,04 | 0,45 | 0,71 | 0,72 | 0,51 | 0,70 | 0,95 | % w/w |
| **Glutamic acid** | 0,82 | 1,30 | 1,57 | 0,71 | 1,09 | 1,11 | 0,78 | 1,11 | 1,50 | % w/w |
| **Serine** | 0,18 | 0,34 | 0,34 | 0,15 | 0,25 | 0,26 | 0,18 | 0,26 | 0,34 | % w/w |
| **Histidine** | 0,11 | 0,19 | 0,24 | 0,08 | 0,14 | 0,14 | 0,09 | 0,14 | 0,18 | % w/w |
| **Glycine** | 0,21 | 0,38 | 0,46 | 0,21 | 0,31 | 0,32 | 0,20 | 0,25 | 0,34 | % w/w |
| **Threonine** | 0,18 | 0,32 | 0,42 | 0,16 | 0,27 | 0,27 | 0,19 | 0,28 | 0,38 | % w/w |
| **Arginine** | 0,35 | 0,51 | 0,60 | 0,31 | 0,44 | 0,44 | 0,32 | 0,44 | 0,55 | % w/w |
| **Alanine** | 0,28 | 0,48 | 0,57 | 0,23 | 0,38 | 0,39 | 0,25 | 0,35 | 0,49 | % w/w |
| **Tyrosine** | 0,12 | 0,17 | 0,15 | 0,06 | 0,09 | 0,10 | 0,06 | 0,10 | 0,14 | % w/w |
| **Methionine** | 0,08 | 0,16 | 0,20 | 0,06 | 0,12 | 0,12 | 0,07 | 0,11 | 0,19 | % w/w |
| **Valine** | 0,25 | 0,42 | 0,52 | 0,20 | 0,34 | 0,35 | 0,23 | 0,34 | 0,47 | % w/w |
| **Phenylalanine** | 0,20 | 0,34 | 0,43 | 0,17 | 0,28 | 0,29 | 0,18 | 0,27 | 0,37 | % w/w |
| **I-leucine** | 0,29 | 0,39 | 0,49 | 0,20 | 0,32 | 0,33 | 0,23 | 0,34 | 0,46 | % w/w |
| **Leucine** | 0,36 | 0,61 | 0,75 | 0,29 | 0,51 | 0,52 | 0,34 | 0,51 | 0,72 | % w/w |
| **Lysine** | 0,34 | 0,64 | 0,79 | 0,30 | 0,57 | 0,58 | 0,33 | 0,48 | 0,73 | % w/w |
| **Total amino acids** | **4,33** | **7,12** | **8,57** | **3,59** | **5,82** | **5,93** | **3,95** | **5,67** | **7,81** | % w/w |

The total content of amino acid in kecimpring chips for the whole treatments ranged from 1.66 % w/w to 7.81 % w/w. Based on the study conducted, it is revealed that the glutamic acid in kecimpring contributed in the highest value, ranging from 0.33 % w/w to 1.50 % w/w. Protein of pomfret has a well-

balanced amino acid composition, with a high amount of glutamic acid (114 mg · $g^{-1}$) [26]. The amino acid composition of the dried non-expanded fish crackers is dominated by glutamine acid, aspartic acid, lysine, and leucine [27]. This is consistent with the findings in kecimpring chips revealing that the amino acid content is dominated by glutamic acid, aspartic acid, lysine, and leucine in each treatment of fish meat addition.

Amino acid in food technology has several beneficial properties. Winarno [13] stated that the glutamic acid played an important role in food processing as it could improve the palatability. The increase of fish meat addition caused the increase of amino acids in kecimpring chips. In addition, according to Sautter *et al.* [1], it has been found that the additional protein also increases the amount of essential amino acids. Cassava with crude protein content of about 1.5 % provides minimum level of protein and some essential amino acids.

## 4.0 CONCLUSION

Kecimpring chips with the highest value of water, protein, lipid and total amino acid was provided by kecimpring chips with the addition of 30 % tilapia (*Oreochromis niloticus*) meat, with predomination of glutamic acid (1.57 % w/w). The other two species of fish, *Pangasius hypopthalmus* and *Colossoma macropomum*, were contributed in providing the highest ash and fiber content, respectively, by the addition of 10 % each.

## Acknowledgement

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