

# Consumer Acceptance Level of Crispy Shrimp with the Margarine, Corn, Cheese, and Chili Flavour

Muflikhah Noor Asmiarsari Ustadi Siti Ari Budhiyanti Latif Sahubawa\*  
Fisheries Sciences Departement, Agriculture Faculty, Gadjah Mada University, PO box 55281, Kampus GMU  
Bulaksumur, Yogyakarta, Indonesia

*The research is financed by Asian Development Bank. No. 2006-A171(Sponsoring information)*

## Abstract

This research aimed to determine the effect of addition flavouring to the nutritional value and consumer acceptance of crispy shrimp. The research used completely randomized design (CRD) experimental methods with five treatments, consist of : p1 (without flavour), p2 (margarine 3%), p3 (corn flavour 1,5%), p4 (cheese flavour 5%), and p5 (chili powder 0,5%), each treatment repeated three times. The results showed that addition flavour agent of crispy shrimp that give effect to the yield, hardness, water content, ash content, protein content and fat content, but does not affect on the carbohydrate content. Crispy shrimp without flavour agent produces good nutritional value with a water content (5.52%), ash content (4.68%), protein content (22.17%), fat content (26.64%), and carbohydrate content (46.67%). A consumer test results indicate that there are significant influence to the appearance, crispness and taste, but does not affect on the odour of crispy shrimp. A value of consumers is influenced by age groups. Consumers of children, adults and parents are preferred crispy shrimp with chili powder, while the teen consumers prefer crispy shrimp with cheese flavour.

**Keywords:** crispy shrimp, flavour, nutritional value, consumer acceptance, consumer age

## 1. Introduction

Shrimp is the one commodity of fisheries that high economic value. The development of shrimp production from year to year has increased. Shrimp production in 2010 to 2014 increased by 14.03%. Soebjacto (2015) states that shrimp production in Indonesia on 2015 is predicted to rise by 32% over the previous year. Indonesia put shrimp aquaculture competitive commodities because demand for shrimp exports high enough to make it as an important commodity (Anonym, 2010). Vaname shrimp exported must reach quality standards and size standards. Trisik Beach, Kulon Progo not produce raw materials vaname shrimp uniformly, so that not all can reach export standards. The shrimp is exported have large size at less than 100 individuals per kg, while the small size shrimp (undersize) does not reach export standards. Vaname shrimp undersize contain approximately 150 individuals per kg. The size is a standard for the price of shrimp itself, where the larger size is the higher price (Fitriyana, 2007).

Shrimp are easily damaged, therefore, required rapid handling and processing, and meticulously. Commodities shrimp in Indonesia are usually marketed in the form of fresh or frozen (Wahyudi, 2003). To increase the value added vaname shrimp undersize, can the processing of crispy shrimp. Crispy products closely related to dry and crunchy texture. Along with the times, consumers are increasingly demanding food products that reach the needs and satisfaction for themselves. Currently, crispy shrimp products in Depok Beach Yogyakarta contained in one type (crispy shrimp without flavour). Research on the addition of flavour to the crispy shrimp has not been done in the area of Yogyakarta, so in this study conducted with the addition of crispy shrimp processing with margarine, corn, cheese, and chili flavour. The addition of these flavours impact a varian so that the consumers choice of these products is more. Based on the raw material, crispy shrimp has the advantage that high protein content. In addition crispy shrimp is a product without preservatives MSG, so it is safe for consumption. Crispy shrimp processing is one way of diversification the products that can be done easily in the scale of industrial and household scale. Results are expected to provide nutritious food product, durable, and can be produced with the appropriate technology to support self sufficiency and food security.

## 2. Materials and Methods

### 2.1. Equipment and materials

Equipment used for the processing of crispy shrimp, among others : analytical scales, digital scales, frying pan, gas stoves, knives, basins, spoons, stirrers, drainer, strainer, sealer, and spinner. Equipment for the examination of crispy shrimp, among other things : analytical scales (Denver Instrument Company AA-200), pumpkin kjeldahl (Buchi), electric stove, muffle furnaces, desiccator, exchange porcelain, oven, destillation unit (Buchi K-314), erlenmeyer, Universal Testing Machine (Zwick/ Z 0,5), ashing furnace, pan, glass slide, soxhlet extractor (Buchi Extraction System B-811), and the scoresheet.

The main materials used in the processing of crispy shrimp, among others : shrimp vaname undersize  $\pm$  150 individuals per kg, garlic, garlic powder (Koepoe-Koepoe), salt (Revina), pepper (Koepoe-Koepoe), baking soda (Sari Tanny), rice flour (Rose Brand), baking powder (Sari Tanny), corn flavour (Point), the cheese flavour (Point), margarine (Blue Band), chili powder (Koepoe-Koepoe), water, and cooking oil (Tropical). The main

materials used in the examination of crispy shrimp, among other things : solution HNO<sub>3</sub>, NaOH, distilled water, H<sub>2</sub>SO<sub>4</sub>, HCl, 4% boric acid, BCG indicator MR, and N-Hexane.

## 2.2. Research Methods

### 2.2.1. Processing methods and analysis of crispy shrimp

The method of processing crispy shrimp as finished leather (raw material) products which consists of two (2) stages : determine the concentration and processing of crispy shrimp various flavours. To determine the concentration of flavor and preferred consumers is used method of organoleptic for analysis of acceptance consumer, physical methods for the analysis of texture test (hardness) and yield, and chemical methods for the analysis of water content, ash content, protein content, fat content, and carbohydrate content.

### 2.2.2. Methods of data analysis

The method used in the data analysis observations and measurement are statistical methods used in the study is the Analysis of Variance and Duncan Multiple Ranges Teste with a completely randomized design (CRD) single factor (Gaspersz, 1991), using factors as the source of the treatment is "addition flavour in crispy shrimp" with 5 (five) treatments and each treatment repeated three (3) times. Statistical analysis of the data processed by SPSS version 16.

- (1). Without the addition of flavour..... (a1)
- (2). Addition margarine 3.0%..... (a2)
- (3). Addition corn flavour 1.5% ..... (a3)
- (4). Addition cheese flavour 5.0% ..... (a4)
- (5). Addition chili powder 0.5%..... (a5)

## 2.3. Quality Parameters of Crispy Shrimp

Quality parameters of crispy shrimp analyzed are (1) physical quality (texture/hardness and yield), (2) the chemical quality (water content, ash content, protein content, fat content, carbohydrate content), and (3) organoleptic quality or acceptance consumer (appearance, odour, crispness, and taste).

## 2.4. Procedure for Implementation

### 2.4.1. Preliminary research (determine the concentration)

Treatment concentration in this research use by approach other product. Concentration in product crispy shrimp can be seen in table 1.

Table 1. Treatment concentration in product

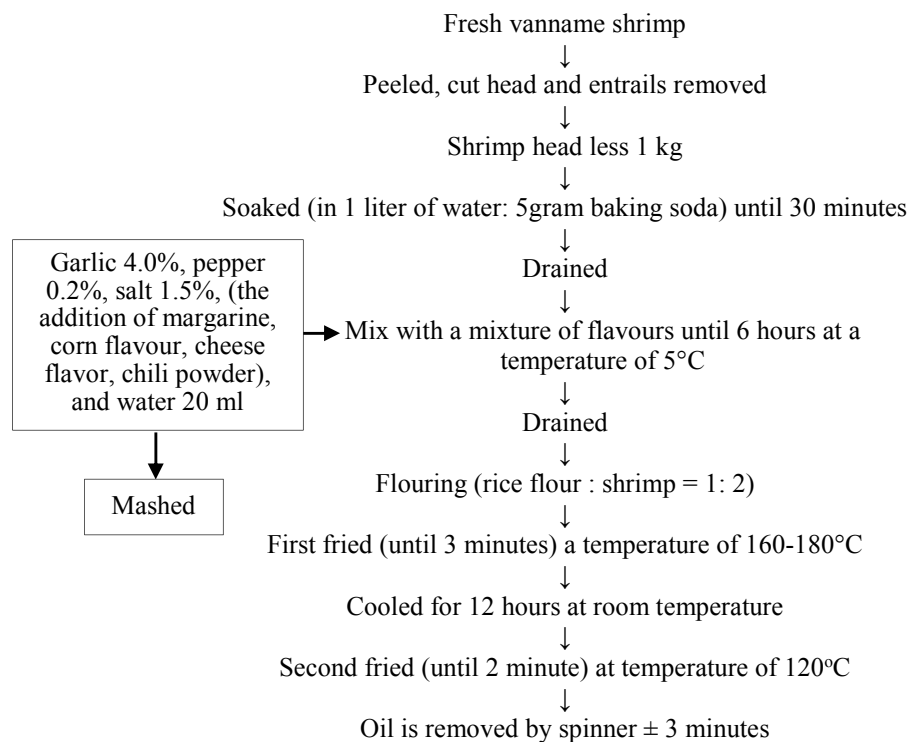
| Treatment       | Concentration                    | Source                         |
|-----------------|----------------------------------|--------------------------------|
| Margarine**     | 2% ; 3% ; 4% ; 5% ; 6%           | Mursalina (2012)               |
| Corn flavour*   | 0,5% ; 1% ;1,5% ; 2% ; 2,5%      | Zulpikar <i>et al.</i> (2012)  |
| Cheese flavour* | 5% ; 6% ; 7% ; 8% ; 9%           | Kalsum <i>et al.</i> (2012)    |
| Chili flavour*  | 0,1% ; 0,3% ; 0,5% ; 0,7% ; 0,9% | Murniyati <i>et al.</i> (2010) |

Note : \*\* percentage based on shrimp mass

\* percentage based on flour mass

### 2.4.2. Preparation raw material& processing of shrimp crispy

Vaname shrimp raw materials ordered from Trisik Beach, Kulonprogo, Yogyakarta in the form of fresh shrimp preserved with ice in a styrofoam, where 1 kg of vaname shrimp consist of 150 individuals. Handling vaname shrimp in this research are head less and peeled to the last tail segment. Then take digestive tract of shrimp and cleaved to form butterfly and make it thin so that product can dry when fried. Process of crispy shrimp can be see in the Figure. 1.



Parameters of Analyzed  
 (yield, texture, water, ash, protein, fat, carbohydrates, consumer acceptance/hedonic test)  
 Figure 1. The processing of crispy shrimp

### 3. Results and Discussion

The main research is processing crispy shrimp from the determination of the concentration flavour in the preliminary research. The treatments in the main study is the crispy shrimp without flavour as a control, crispy shrimp with margarine 3%, crispy shrimp with corn flavour 1.5%, crispy shrimp with cheese flavour 5%, and crispy shrimp with chili powder 0.5%. Furthermore, crispy shrimp testing the parameters of physical, chemical and consumer acceptance can be see in the Table 2.

#### 3.1. Physical Characteristic

##### 3.1.1. Yield (%)

Yield of food processing is an important parameter known as the basis for the calculation of financial analysis, estimating the amount of raw materials to manufacture products in a certain volume, and determine the level of efficiency of a treatment process. The higher yield, shows good efficiency due to the amount of wasted material is getting a little (Junianto et al., 2006). The yield of the resulting crispy shrimp ranged from  $73.84 \pm 1.74$  to  $89.57 \pm 3.70$ .

Results analysis of variance showed that the addition of flavour agent impact on the yield of crispy shrimp ( $P < 0.05$ ). Crispy shrimp without flavour agent and with margarine have a low yield and the both are not significantly different, while the yield crispy shrimp with corn flavour, cheese and chili has a high value, which amounted to 82.46%, 89.57%, and 85, 70%. This shows that the addition of flavour agent can be produces a higher yield than without flavour and the addition of pasta margarine. This is because flavour powder can be evenly mixed with seasoning and raw materials so that not a lot of wasted material. The high value of the yield on crispy shrimp with flavour due process of attachment of flour on the shrimp body becomes more easily and evenly. Crispy shrimp with margarine produces a low yield due to the form of pasta, resulting in a lot of material attached to the appliance.

Table 2. The testing result physical and chemical parameters of crispy shrimp

| No | Parameters               | Treatments (Flavouring Agent, %) |                     |                     |                     |                     |
|----|--------------------------|----------------------------------|---------------------|---------------------|---------------------|---------------------|
|    |                          | Without flavor                   | Margarine 3.0%      | Corn flavour 1.5%   | Cheese flavour 5.0% | Chili powder 0.5%   |
| 1  | Yield (%)                | 73.84 <sup>a</sup>               | 77.87 <sup>ab</sup> | 82.46 <sup>bc</sup> | 89.57 <sup>d</sup>  | 85.70 <sup>cd</sup> |
| 2  | Texture/Hardness         | 11.84 <sup>a</sup>               | 47.47 <sup>b</sup>  | 48.24 <sup>b</sup>  | 12.26 <sup>a</sup>  | 13.12 <sup>a</sup>  |
| 3  | Water content (%)        | 5.52 <sup>ab</sup>               | 7.59 <sup>bc</sup>  | 9.51 <sup>c</sup>   | 3.40 <sup>a</sup>   | 4.89 <sup>ab</sup>  |
| 4  | Ash content (%)          | 4.68 <sup>a</sup>                | 4.53 <sup>a</sup>   | 4.89 <sup>a</sup>   | 4.98 <sup>a</sup>   | 3.84 <sup>b</sup>   |
| 5  | Protein content (%)      | 22.17 <sup>a</sup>               | 20.57 <sup>ab</sup> | 21.29 <sup>ab</sup> | 17.53 <sup>b</sup>  | 17.71 <sup>b</sup>  |
| 6  | Fat content (%)          | 26.64 <sup>a</sup>               | 28.01 <sup>c</sup>  | 25.84 <sup>ab</sup> | 25.95 <sup>ab</sup> | 24.99 <sup>b</sup>  |
| 7  | Carbohydrate content (%) | 46.67 <sup>a</sup>               | 49.15 <sup>a</sup>  | 47.98 <sup>a</sup>  | 51.54 <sup>a</sup>  | 51.25 <sup>a</sup>  |

Note \* : value followed by a different letter on each treatment that indicate a real difference

Weight decrease products is thought to occur when frying resulted in a process of evaporation water in the material. Winarno (2004) states, the yield is the percentage by weight of the resulting product to the weight of the materials used. Research Peranginangin (2010) about an increase in the value added of pelagic fish stated that fresh trevally fish processed into crispy trevally fish has about 75% yield. Crispy shrimp are added various flavours provide a greater yield than trevally fish crispy. This shows that the addition of flavours is able to increase the yield of a food product.

Texture/hardness (Lloyd Test)

Texture is a role in the overall acceptance of a food product and is an important criteria for consumers to certify the quality of food products. Consumer are preferred snacks crunchy texture, crisp not loud, and sluggish (Thomas, 2007). Texture is influenced by the material used in making these products (Fellows, 2000). Compressive force being required to show the degree of hardness of such foodstuffs. Broken power is closely linked with the crispness. The lower value, can increases the value crispiness (Ernawati, 2011). Values texture (hardness) crispy shrimp ranged from 11.84 ± 0.59 to 48.24 ± 6.82.

Result analysis of variance showed that the addition of flavour have a significant influence on the texture of crispy shrimp (P<0.05). Crispy shrimp with corn flavour and margarine have a high hardness value. High hardness indicates that the crispy shrimp is loud. This is because the force used to suppress the crispy shrimp surface to break or rupture is very large, so the texture becomes a great value. The value of texture is low, indicates that the crispy shrimp is crispy. Crispy shrimp without flavour, with cheese flavour, and chili flavour has a low value of texture (hardness) and the three were not significantly different, so that the three products classified as crispy. The high value of the texture crispy shrimp with margarine and corn flavour caused both of these products have a high water content so that the texture of the product is not dry. In addition to the fat crispy shrimp with margarine resulting product becomes mushy.

According to Putri (2012), the water content is closely related to the texture of product. Low water levels resulted in the value of the texture (hardness) is also low, so that the product becomes dry. Dry texture caused by water trapped in the gelatinization will evaporate and cause the starch granules swell to form air cavities are easily broken when pressed. Crispy shrimp without flavour and crispy shrimp with chili and cheese flavour has a low water content, so that the texture of the product is hollow so that it has a value of texture (hardness) is low.

### 3.2. Chemical Characteristic

#### 3.2.1. Water content (%)

Water content in food ingredients also determine the freshness and lasting power of these foods. Water content can affect the appearance, texture, and flavour of the food (Murdinah & Maharani, 2009). Water content of the resulting crispy shrimp ranged from 3.4 ± 0.27 to 9.51 ± 3.3. Result analysis of variance showed that the water content of crispy shrimp significantly different between treatments (P <0.05). This means that adding flavour give effect to the water content of crispy shrimp.

Sipahuntar (2008), states that the chemical composition of the product, especially the water content determines the nature of crispness, the lower water content of a product is more crunchy. Rachmawati (2008) states that the high water content causes the texture less dry or not crisp. The water content crispy shrimp with corn flavour and margarine has a high value, whereas low water levels in crispy shrimp obtained without flavour, corn and chili flavour. Low levels of water prawn crispy with cheese flavour due to the heating process resulting in denatured protein that decreases the water binding capability. According to Ahmad et al. (2008), cheese flavour is complex amino acids, fatty acids, esters, volatile compounds, and others. Apriantono (2002), states that the meat processing using high temperature cause denaturation of protein, causing coagulation and decrease the solubility or ability. Low water content of crispy shrimp with chili powder cause chilli powder is a product that powdery and has a long shelf life. The nature of the product powder having a particle size is very small and has a low water content (Sudaryati, 2011).

High water content of crispy shrimp with corn flavour and margarine increasing the water content of the product, because shape flavour is solid flavouring material and hygroscopic (Heath, 1978). Frying process resulted in decreased water content in product. Research Widati et al. (2012) on the chips meatballs explained that at the time of frying, the water content will evaporate, cause the product to be low water content or decreased due to evaporation of water. According to Sahin et al. (1999), the frying process a transfer phenomena occurring simultaneously, the heat is transferred from the oil to the material causes the mass of water evaporated from the material and oil is absorbed by the material. Research conducted Peranginangin (2010) concerning anchovy crispy states that the water content crispy whitebait much lower than the raw anchovy. This is due to the frying process, the water out of the material so that the water content is reduced. The water content of crispy whitebait whole generated amounted to 9.81%. When compared with this research, the water content of crispy shrimp is lower than the water content of crispy whitebait.

### 3.2.2. Ash content (%)

Ash is an inorganic substance waste products of combustion of an organic material. The ash content is closely related to the mineral content of a food (Sudarmadji et al., 1997). Crispy shrimp ash content produced ranged from  $3.84 \pm 0.07$  to  $4.98 \pm 0.54$  (% db). Result of analysis of variance showed that crispy shrimp ash content significantly different between treatments ( $P < 0.05$ ). This means that the addition of a varian flavour give effect to the ash content crispy shrimp. The ash content crispy shrimp with chili powder is the lowest compared to other treatments, which amounted to 3.84%, while crispy shrimp with cheese flavour has a high value 4.98%. This is because the amount of additional flavour concentrations is varian, so ash content value is different. Extra cheese flavour concentration is 5% (higher than most other treatments), so that the resulting high ash content, while the addition of chili powder is 0.5% (the lowest compared to other treatments) so that the resulting ash content is low. According Novalinda & Asni (2010), low levels of water can increase the ash content of the product. This is because the inorganic material in the form of minerals will accumulate with reduced water content.

The ash content in crispy shrimp with margarine is 4.53%. The ash content probably derived from margarine because there are trace minerals, including iron and phosphorus. Corn contain minerals including calcium, iron, and phosphorus in large enough quantities, so that the high ash content (Ketaren, 2012). Research Peranginangin (2010) concerning the processing of crispy anchovy stated that the ash content of anchovy raw ash content lower than crispy whitebait. This is because the additional material in the form of flour and spices are thought to increase the ash content. Crispy anchovy produce ash content of 8.58% are derived from herbs and head and tail anchovies. While the ash content is obtained from the crispy shrimp prawns.

### 3.2.3. Protein content (%)

Protein is one of the ingredients macronutrient group was instrumental in the formation of biomolecules rather than as a source of energy (Sudarmadji et al., 1989). The protein content is one of the most important parameters to indicate the quality of a foodstuff for the protein to function as an essential building block and it takes the body, the quality is considered to be the better (Nurhidajah et al., 2009). Crispy shrimp protein content produced ranged from  $17.53 \pm 0.5$  to  $22.17 \pm 3.96$  (% db).

Result of analysis of variance showed that crispy shrimp protein content significantly different between treatments ( $P < 0.05$ ). This means that the addition of various flavour on crispy shrimp influence on protein content. Crispy shrimp without flavour, with corn flavour and margarine have a high protein content, whereas low levels of protein produced in crispy shrimp with cheese flavour and chili powder. Crispy shrimp without flavour have higher protein levels because the product is not hygroscopic, so that water can be evaporated resulting proteins are not soluble in water. Crispy shrimp with cheese flavour has a low protein content, which amounted to 17.53%. Cheese flavour is added to the protein content in crispy shrimp.

Cheese flavour is a complex of amino acids, fatty acids, esters, volatile compounds, and others (Ahmad et al. 2008). Low levels of protein in crispy shrimp with cheese flavour due to the frying process will cause the protein content in food to decreasing (Dalilah, 2006). Denaturated protein causes the heating of product. Denaturation of protein is a change in the protein structure resulting in loss of protein secondary structure, tertiary, quarterner without termination of the peptide bond. Denaturation caused the loss of solubility, changes in texture, and solubility (Buckle et al., 1987). At the time of heating, the heat will penetrate the meat and lower the functional properties of proteins. Heating can destroy the amino acid wherein the protein by heat resistance is strongly associated with the amino acids making up the protein, so it is that causes the protein content decreased (Yuniarti, 2013).

According Jacoeb et al. (2008), a reaction that occurs when heating proteins can damage the protein so that the protein content can be decreased. Frying method commonly used for frying chips are deep frying method, but if the temperature used is too high can cause damage to nutrition (Lawson, 1995). Research Peranginangin (2010) concerning anchovy crispy stated that crispy anchovy protein levels higher than raw anchovies. This is because one of the supplementary material manufacture crispy whitebait are rice flour and other flour also protein. Crispy anchovy produce the protein content of 23.07%. This shows that with the addition of crispy shrimp flavour produce a lower protein content.

#### 3.2.4. Fat content (%)

Fat is an energy source that is more effective than carbohydrates and protein. Fat can add calories and improve the texture and flavour of the product (Winarno, 1997). Crispy shrimp fat content produced ranged from  $24.99 \pm 0.09$  to  $28.01 \pm 0.93$  (% db). Results of analysis of variance showed crispy shrimp fat content significantly different between treatments ( $P < 0.05$ ). This means that the addition of a various flavours give effect to the fat content crispy shrimp. The highest content contained on crispy shrimp with the addition of margarine that is equal to 28.01%. High levels of fat in crispy shrimp with the addition of margarine because besides coming from fat contained in shrimp itself, there are also extra fats from margarine. In addition, the process of frying oil resulted caught in shrimp so that the fat content is higher. Fat levels in the crispy shrimp with cheese flavour also has a high value, because cheese also contains fat (Kalsum et al., 2012).

Crispy shrimp with chili powder and corn flavour has a low fat content, which amounted to 24.99% and 25.84%. Maize has a high fiber content and a role in the prevention of gastrointestinal diseases (Harmain, 2012). Crispy shrimp with corn flavour has a fat content low enough, this is because the fiber has a function to lower the fat content (Winarno, 1997). Research conducted Peranginangin (2010) of trevally fish processing crispy showed that soaking spices have the highest fat content. This is because the spices also contain fat that will increase the levels of fat in the fish crispy trevally.

Lawrie (1995) states that the fat content is also influenced by the cooking process, cooking temperature, and long cooking meat. High temperature will melt fat and tends to damage the texture in it. According Widati et al. (2012), the low water content in the chips causes fat chicken meatballs chips increased. This is because in the frying process, the water evaporates and meatballs cavity tissue dries and has been replaced by oil. Elinda (2007) states that the factors that affect the extent of the oil is absorbed chips are the ingredients, cooking oil temperature, the thickness of the material, as well as the physical surface of the wedge. Research Peranginangin (2010) concerning the processing of crispy anchovy stated that the fat content of anchovy increased sharply due crispy frying process used oil so that the oil is absorbed on the product. Crispy anchovy has a fat content of 24.9%, so it can be seen that the crispy shrimp has a fat content higher than crispy whitebait resulting from the addition of flavour.

#### 3.2.5. Carbohydrates content (%)

Carbohydrates are the main source of calories for humans. Carbohydrates also have an important role in determining the characteristics of foodstuffs, such as flavour, color, and texture. Carbohydrates in the body serves to prevent the onset of ketosis, excessive body protein breakdown, mineral loss, and helps metabolize fats and proteins (Winarno, 2002). Crispy shrimp carbohydrate content produced ranged from  $46.67 \pm 0.48$  to  $51.54 \pm 4.51$  (% db).

Results of analysis of variance carbohydrate crispy shrimp showed that among the treatments were not significantly different ( $P > 0.05$ ). This means that the addition of various flavours on crispy shrimp does not affect the carbohydrate levels in this study. Contributed carbohydrates from rice flour that has a carbohydrate content of 80%. Carbohydrate content of food is the influence of the large proportion of the content of water, ash, protein content and fat content (Riansyah et al., 2013). Crispy shrimp with a sense of higher carbohydrate content than the crispy shrimp without flavour, but not significantly different. This shows that the addition of flavour can increase levels of carbohydrates crispy shrimp.

Crispy shrimp with cheese flavour has a high carbohydrate content, in addition to the water content of the resulting product is low, so this product has a crispness that is preferred by consumers. Crispy anchovy has a carbohydrate content of 33.64%, while the crispy shrimp carbohydrate levels have higher values. This is due to the use of different flour, using the crispy anchovies seasoned flour, while the crispy shrimp using rice flour. Moreover, the share of chemical composition such as moisture, ash, protein, and fat products also affects the carbohydrate content of each product.

### 3.3. Consumer Acceptance (Hedonic Test)

A hedonic test aimed to assess the state of sensory crispy shrimp products using a scale of values based on certain parameters. A test result may determine acceptance or consumer preferences towards product sensory characteristics such as colour, aroma, texture, flavour, etc. (Setyaningsih et al., 2010). This test aims to determine the level of consumer acceptance of crispy shrimp with a various of additional flavours. Result of consumer acceptance of crispy shrimp can be see in Table 3.

#### 3.3.1. Appearance

The appearance of a product is first observed by consumers, especially when the product is a new product. Appearance (colour) plays an important role in food products for consideration in the consumer receives the product. Before other factors are considered, visually factor colour will appear first and be the first consideration when foods were selected (Soekarto, 1985).

Statistical analysis showed that the addition of flavour variations influence consumer ratings of the appearance of crispy shrimp ( $P < 0.05$ ). Appearance of crispy shrimp without flavour is golden brown. According

Estiasih & Ahmadi (2009), the frying process produces a golden brown colour desired. A test results indicate that there are differences in the scores given consumers against the appearance of crispy shrimp. It means that differences in the scores given consumers are affected by age. Crispy shrimp with corn flavour gives brownish orange colour with fondness values ranged from 3.53 to 4.53. This shows that consumers are children liked the appearance of the product, while consumers adolescents, adults, and the elderly tend to be somewhat like the appearance of the product. Research Zulpikar et al. (2012) on the effect of corn flavour to the consumer acceptance of macaroni catfish stated that produces bright yellow colour. The colour caused by carotenoids in the corn with the amount of 6.4 to 11.3 mg/g, 22% of which are beta carotene and 51% are xantofil. Xantofil is the main pigment lutein and zeaxanthin (Koswara, 2000). Crispy shrimp with corn flavour is brownish orange colour for raw materials when fried shrimp will be reddish, while an increase in corn flavour resulting orange crispy shrimp. This is because the shrimp contains astaxanthin which is a carotenoid pigment derived from red carrier. Red to orange colour is formed due to the release of astaxanthin from the bonds of protein in shrimp caused by protease enzyme (Rahmayati et al., 2014). According to Aryanto (2006), chips mushrooms with corn flavour has the appearance and colour are the most interesting of the three products mushroom chips added flavour cheese, spicy sweet, and barbeque.

Crispy shrimp with cheese flavour gives a brown colour with values ranging from 1.66 to 3.1 (very not like to rather like). The appearance of this product provides a low yield than other treatments. This is because the product is brown so it looks like a little burnt. Crispy shrimp with margarine gives a golden yellow colour with fondness values ranged from 3.67 to 4.23. This shows that children consumer and parents tend to like the appearance of this product, while consumers teen and adults somewhat like the appearance of this product. Crispy shrimp with chili powder gives the appearance of slightly reddish yellow. This product resulted in the creation of a spicy flavour to the food product, and can be used as natural dyes (Koswara, 2009). A value of products ranging from 3.2 to 3.9 which means that all consumer groups tend to be somewhat like the appearance of the product. Consumer preference towards a product there is an interaction between each age. Based on all the products tested, consumer teen, adults, and parents tend to like the appearance of crispy shrimp with margarine, while the consumer preferences of children tend to like crispy shrimp with corn flavour.

Table 3. The testing result of consumer acceptance of shirmp crispy

| No | Parameter of consumer acceptance | Segment of Consumer | Treatment (Flavour Agent, %)* |                    |                    |                    |                   |
|----|----------------------------------|---------------------|-------------------------------|--------------------|--------------------|--------------------|-------------------|
|    |                                  |                     | Without Flavour               | Margarine 3.0%     | Corn 1.5%          | Cheese 5.0%        | Chili 0.5%        |
| 1  | Appearance                       | Children            | 3.73 <sup>a</sup>             | 4.23 <sup>ac</sup> | 4.53 <sup>c</sup>  | 3.00 <sup>b</sup>  | 3.90 <sup>a</sup> |
|    |                                  | Teen                | 3.37 <sup>a</sup>             | 3.67 <sup>a</sup>  | 3.53 <sup>a</sup>  | 3.10 <sup>b</sup>  | 3.60 <sup>a</sup> |
|    |                                  | Adults              | 3.37 <sup>bc</sup>            | 3.77 <sup>c</sup>  | 3.74 <sup>c</sup>  | 1.66 <sup>a</sup>  | 3.20 <sup>b</sup> |
|    |                                  | Parent              | 3.97 <sup>b</sup>             | 4.20 <sup>b</sup>  | 3.73 <sup>b</sup>  | 2.47 <sup>a</sup>  | 3.80 <sup>b</sup> |
| 2  | Odour                            | Children            | 3.97 <sup>a</sup>             | 3.80 <sup>ac</sup> | 3.77 <sup>c</sup>  | 3.67 <sup>b</sup>  | 4.10 <sup>a</sup> |
|    |                                  | Teen                | 2.97 <sup>a</sup>             | 3.27 <sup>a</sup>  | 3.23 <sup>a</sup>  | 3.53 <sup>a</sup>  | 3.37 <sup>a</sup> |
|    |                                  | Adults              | 3.41 <sup>ab</sup>            | 3.50 <sup>ab</sup> | 2.91 <sup>a</sup>  | 2.92 <sup>a</sup>  | 3.55 <sup>b</sup> |
|    |                                  | Parent              | 3.67 <sup>a</sup>             | 3.50 <sup>a</sup>  | 3.47 <sup>a</sup>  | 3.80 <sup>b</sup>  | 3.83 <sup>b</sup> |
| 3  | Crispiness                       | Children            | 4.33 <sup>a</sup>             | 3.43 <sup>b</sup>  | 2.50 <sup>c</sup>  | 4.57 <sup>c</sup>  | 4.23 <sup>c</sup> |
|    |                                  | Teen                | 3.67 <sup>b</sup>             | 2.67 <sup>a</sup>  | 2.63 <sup>a</sup>  | 4.27 <sup>c</sup>  | 3.90 <sup>c</sup> |
|    |                                  | Adults              | 3.17 <sup>b</sup>             | 2.30 <sup>a</sup>  | 2.09 <sup>a</sup>  | 3.87 <sup>c</sup>  | 3.94 <sup>c</sup> |
|    |                                  | Parent              | 3.90 <sup>b</sup>             | 3.13 <sup>c</sup>  | 2.53 <sup>a</sup>  | 4.40 <sup>d</sup>  | 3.70 <sup>b</sup> |
| 4  | Taste                            | Children            | 3.73 <sup>b</sup>             | 3.73 <sup>b</sup>  | 3.07 <sup>a</sup>  | 3.57 <sup>ab</sup> | 4.37 <sup>c</sup> |
|    |                                  | Teen                | 3.20 <sup>a</sup>             | 3.00 <sup>a</sup>  | 3.27 <sup>a</sup>  | 4.03 <sup>b</sup>  | 3.40 <sup>a</sup> |
|    |                                  | Adults              | 3.10 <sup>ab</sup>            | 3.03 <sup>a</sup>  | 2.91 <sup>a</sup>  | 3.37 <sup>ab</sup> | 3.71 <sup>b</sup> |
|    |                                  | Parent              | 3.70 <sup>ab</sup>            | 3.50 <sup>a</sup>  | 3.60 <sup>ab</sup> | 4.07 <sup>b</sup>  | 4.13 <sup>b</sup> |

Note \* : value followed by a different letter on each treatment that indicate a real difference

### 3.3.2. Odour

Odour or smell is defined as something that can be judged by the sense of smell. Testing the odour in the food industry is particularly important as quickly produce an assessment of acceptance or rejection of a product. Moreover before eating, some consumers tend to smell the food product to assess whether or not edible (Kartika et al., 1988). Crispy shrimp without flavour is savory flavour, while adding various flavours resulting odour of crispy shrimp be varied. The addition of corn flavour and crispy shrimp with cheese flavour resulted in savory and sweet. Odour crispy shrimp with margarine resulted into a savory and salty than crispy shrimp without flavour, while crispy shrimp with chili powder resulted into a flavourful crispy shrimp savory and spicy.

The addition of flavours affect consumer satisfaction with the odour of crispy shrimp ( $P < 0.05$ ). Crispy shrimp had a savory odour. Odour of crispy shrimp without flavour of fondness value of 2.97 to 3.97 indicating

that all consumer groups tend to be somewhat like the product. Values consumer preferences crispy shrimp with corn flavour ranges from 2.91 to 3.77, indicating that all consumer groups tend to be rather like the odour of crispy shrimp. Crispy shrimp with cheese flavour gives odour of savory and sweet with fondness values ranging from 2.92 to 3.8, which means consumers tend to not like to kind a liked the crispy shrimp odour. Odour of crispy shrimp with margarine resulted into a savory and salty with fondness values ranging from 3.27 to 3.28, which means that all consumer groups rather liked the smell of this product. Crispy shrimp with chili powder resulted in slightly spicy flavourful crispy shrimp with fondness ranged from 3.37 to 4.1, which means consumers tend to love the smell somewhat like this crispy shrimp.

Assessment of consumer preferences on flavour crispy shrimp there was an interaction on each consumer. That is favorite odour influenced by the age of the consumer. Consumer preferences of children and parents on the odour of crispy shrimp given on crispy shrimp with chilli powder that is equal to 4.1 and 3.83, while the teen and adult consumer preferences given to the crispy shrimp with margarine, which amounted to 3.27 and 3.5. Addition flavour in crispy shrimp can improve and give rise to a distinctive odour to the crispy shrimp products.

### 3.3.3. Crispness

Crispness of a food product can be assessed based on the sound produced when the product is broken. Crispness on products such as chips can also be felt when the product is bitten (Ernawati, 2011). Crispness associated with the water content contained in the material. The result of consumer preference towards parameter crispness crispy shrimp with different treatments showed that there is interaction between treatment addition of flavour given by ratings all age groups of consumers. It means that differences in the scores given to crispness crispy shrimp are affected by age consumers (each age group has different tastes).

The use of starch as a coating material serves to maintain the texture and crispness of the product. This is because the starch content in rice flour composed of amylose and amylopectin are arranged in the form of semicrystalline lead does not dissolve in water. With the heat treatment, the crystal structure is damaged and polysaccharide chain will cause gelatinization is perfect (Febrianto, 2014). According to Martz (1992), when the starch is perfect gelatinization the amount of water coming out is big enough so that it will form large cavities and produce products that are crunchy texture. According to Yusuf et al. (2012), the crispness of products affected by the starch content in the starch consisting of amylose and amylopectin. Phase shrimp with flour coating causes water in the shrimp body been absorbed. Later in the frying process for their water evaporation and heat transfer simultaneously occur gelatinization process and development. Flour coating expands upon heating, so that the grains of starch will swell and hollow. The process is closely related to the composition of starch which is owned by the flour. Starch with a high content of amylopectin which tend to have a more crunchy texture.

Statistical analysis showed that the addition of various flavours affect consumer preference towards crispness of crispy shrimp ( $P < 0.05$ ). Consumer preferences towards value crispness crispy shrimp ranged from 2.09 (dislike) to 4.57 (love). Crispy shrimp with cheese flavour on consumer children's favorite high value than other treatments. Crispy shrimp with cheese flavour has a low water content, so this product has a good crispness. As with children, teenagers and parents consumer preference is also given to the crispy shrimp with cheese flavour, with a mean are respectively 4.27 and 4.44. Meaning that consumers teens and parents like the crispness of the crispy shrimp. Adult consumer preferences are crispy shrimp with chili powder in the amount of 3.94 which means that consumers tend to be somewhat like the crispness crispy shrimp. Crispy shrimp with corn flavour have a lower value in all age groups, ranging from 2.09 to 2.63 which means that all consumer groups do not like the crispness of the product. This is because the addition of corn flavour crispy shrimp resulting in high water levels in foods to be tough or crisp.

Vaname shrimp used in this study split butterfly shrimp which aims to become thin and crispy after being fried. According Pakpahan (2014), crispy chips affected by the thickness of the slice. When sliced chips are too thick then the resulting chips after frying will be hard, otherwise when sliced thin chips, the chips produced will be crisp. Ediaty et al. (2006), states that through the heating during frying, the water evaporates and leaves empty pores that some of them will be filled by oil. The empty pores make the material become porous and if eaten crunchy.

### 3.3.4. Taste

Taste is the most decisive factor of a product is accepted or not by consumers. Statistical analysis showed that the addition of flavour variations affect customer satisfaction with crispy shrimp ( $P < 0.05$ ). This shows that the addition of various flavours give different taste to the shrimp crispy. A test result of the taste of crispy shrimp with a various of additional flavours show that there is interaction between the treatment given to the addition of flavour assessment of all age groups of consumers. It means that differences in the scores given consumers are affected by age.

Consumer preferences towards value crispy shrimp flavour ranges from 2.91 (dislike) to 4.37 (like). Crispy shrimp without flavour provide a savory taste, while adding flavour provides taste varies with the product. Crispy shrimp with chilli powder has a high value for the consumer preferences of children and parents with joy sequentially mean is 4.37 (like) and 4.13 (like). Spicy flavours preferred by consumers because there are a mix of



savory taste and a little spicy so it becomes crispy shrimp tasted delicious. A high while the value of the sense of crispy shrimp for consumers teen and adults given to the addition of cheese flavour, which amounted to 4.03 and 3.37. This is because the addition of cheese flavour resulting taste crispy shrimp into savory and sweet. Crispy shrimp with corn flavour provides taste savory and sweet corn with fondness values ranging from 2.91 to 3.6. While the addition of margarine provide a more savory flavour with fondness values ranging between 3 to 3.73, which means consumers tend to be somewhat like the product.

The taste were formed on crispy shrimp caused by the effect of adding seasonings such as garlic, salt, pepper, and spices during processing. In addition, the taste is also caused by the influence of fat in cooking oils used when frying. According Gaman & Sherrington (1994), fried foods have the colour, odour, and taste is accepted by almost everyone. Addition of fat in margarine to improve appearance and physical structure of foods, adding nutritional value as well as provide a savory taste in food (Ketaren, 2012).

#### 4. Conclusions and Recommendation

##### 4.1. Conclusions

- a. The concentration of flavour is added to the shrimp is margarine 3 %, corn flavour 1.5%, cheese flavour 5 % , and chili powder 0.5 % .
- b. The addition of flavours affect the chemical composition of the product. The results of chemical analysis of crispy shrimp knows that product without adding flavour aggent have a low water content (5.52%), high protein content (22.17%), ash content (4.68%),fat content (26.64%) and carbohydrate content (46,67%).
- c. The level of consumer acceptance of crispy shirmp from the children, adults and parents like product with chili flavour, while teenage liket product crispy shrimp with cheese flavour.

##### 4.2. Recommendation

- a. Need for continued research to improve crispness parameters to produce crispy shrimp with a crunchy texture and accepted by consumers.
- b. Need further research to determine the shelf life and durability of the product crispy shrimp.

#### Acknowledgements

This work was financially supported by the Competitive Grant of Agricultura Faculty (CGAF) of Gadjah Mada University (No. 50/PN/KSP/2015). Thank you presented to the Honorable Mr. Latif Sahubawa (head of research project) which gives us the opportunity to help carry out research in the completion of my studies, and technician of FishTechnology Laboratory, Animal Feed and Nutrition Laboratory, Department of Fisheries Science, Faculty of Agriculture, Gadjah Mada University who has helped smooth the study.

#### References

- Ahmad, N., L. Li., X. Yang., Z. Ning, dan M.A. Randhawa. 2008. Improvements in the Flavour of Soy Cheese. *Food Technology. Biotechnol.* 46(3) 252–261.
- Anonim. 2010. Udang Komoditas Unggulan. <http://www.kkp.go.id/index.php/arsip/c/2026/udang-komoditas-unggulan>. Accessed 5 Januari 2015.
- Apriantono, A. 2002. Pengaruh Pengolahan Terhadap Nilai Gizi Dan Keamanan Pangan. Seminar Online Kharisma ke-2. <[www.kharisma.com](http://www.kharisma.com)>. Accessed Sudaryati., Latifah., dan D.E. Hermawan. 2011. Pembuatan Bubuk Cabe Merah Menggunakan Variasi Jenis Cabe dan Metode Pengeringan. *Teknologi Pangan. FTI Jawa Timur.* 20 November 2015.
- Buckle, K. A., R.A. Edwards., G.H. Fleet., dan M. Wootton. 1987. *Ilmu Pangan, alih bahasa : Hari Purnomo dan Adiono*. UI Press, Jakarta.
- Dalilah, E. 2006. Evaluasi Nilai Gizi dan Karakteristik Protein Daging Sapi dan Olahannya. Skripsi. Program Studi Teknologi Hasil Ternak. Fakultas Peternakan. Institut Pertanian Bogor.
- Ediati, R., B. Rahardjo., dan P. Hastuti. 2006. Pengaruh Kadar Amilosa Terhadap Pengembangan dan Kerenyahan Tepung Pelapis Selama Penggorengan. *Jurnal Agrosains* 19(4).
- Elinda, Y. 2007. Produksi Keripik Daging dengan Perlakuan Jenis Tepung yang Digoreng Vakum. Sekolah Pasca Sarjana. Institut Pertanian Bogor.
- Ernawati. 2011. Product Development Know Being Tofu Chips (Study Type of Raw Materials, Temperature Frying and Production Costs). *Bulletin of Food Technology*.
- Estiasih, T. dan K. Ahmadi. 2009. *Teknologi Pengolahan Pangan*. Bumi Aksara, Jakarta.
- Febrianto, A., Basito., dan C. Anam. 2014. Kajian Karakteristik Fisikokimia dan Sensoris *Tortilla Corn Chips* dengan Variasi Larutan Alkali pada Proses Niksmatalisasi Jagung. *Jurnal Technosains Pangan* Vol 3 No. 3.
- Fellows, P.J. 2000. *Food Processing Technology, Principle and Practice*. Second edition. CRC Press, England.

- Fitriyana. 2007. Pengaruh Harga Terhadap Volume Ekspor Udang Beku. Fakultas Perikanan dan Ilmu Kelautan Universitas Mulawarman. Laporan Penelitian.
- Gaman, P.M dan K.B. Sherrington. 1994. Pengantar Ilmu Pangan Nutrisi dan Mikrobiologi. Edisi kedua. Gadjah Mada University Press, Yogyakarta.
- Harmain, R.M. dan N. Yusuf. 2012. Formulasi Produk Ilabulo Ikan Patin (*Pangasius* sp.). Fakultas Ilmu-ilmu Pertanian Universitas Negeri Gorontalo.
- Heath, B. 1978. Flavor Chemistry and Technology. Van Nostrand Company, New York.
- Jacob, A.M., M. Hamdani, Nurjanah. 2008. Perubahan Komposisi Kimia dan Vitamin Daging Udang Ronggeng (*Harpiosquilla raphidea*) Akibat Perebusan. Departemen Teknologi Hasil Perairan Fakultas Perikanan dan Ilmu Kelautan Institut Pertanian Bogor. Buletin Teknologi Hasil Perikanan 11(2).
- Junianto. 2006. Produksi Gelatin dari Tulang Ikan dan Pemanfaatannya Sebagai Bahan Dasar Pembuatan Cangkang Kapsul (Laporan Penelitian Hibah Bersaing). Fakultas Perikanan dan Ilmu Kelautan. Universitas Padjadjaran.
- Kalsum, U., Suparmi, dan Sumarto. 2012. The Effect of Cheese Flavor on Consumer Acceptance Of Catfish Macaroni (*Pangasius hypophthalmus*). Faculty of Fisheries and Marine Science University of Riau.
- Kartika, B., B. Hastuti., dan W. Supartono. 1988. Pedoman Uji Inderawi Bahan Pangan. PAU Pangan dan Gizi. UGM, Yogyakarta.
- Ketaren, S. 2012. Pengantar Teknologi Minyak dan Lemak Pangan. UI Press, Jakarta.
- Koswara, S. 2009. Teknologi Pengolahan Sayuran dan Buah-buahan (Teori dan Praktek). eBookPangan.com. Diakses 21 Desember 2015.
- Lawrie, R.A. 1995. Ilmu Daging (Alih Bahasa : Aminuddin Parakasi). UI Press, Jakarta.
- Lawson, H. 1995. Food Oils and Fats : Technology, Utilization, and Nutrition. Chapman and Hall, New York.
- Matz, S.A. 1992. Teknologi Bakery dan Rekayasa. The AVI Publishing Co. Inc., Westport, Connecticut.
- Murdinah dan S. Maharani. 2009. Pengaruh Konsentrasi Kappa-karaginan Terhadap Karakteristik Mutu Nugget Ikan Cunang. Seminar Nasional Perikanan. 6 : 1-10.
- Murniyati., F.R. Dewi., dan I. Hermana. 2010. Riset Peningkatan Nilai Tambah Udang Ukuran Kecil Menjadi Produk Spicy Shrimp Snack. Seminar Nasional Tahunan VII Hasil Penelitian Perikanan dan Kelautan.
- Mursalina., S.M. Sinaga., dan J. Silalahi. 2012. Penetapan Kadar Serat Tak Larut pada Keripik Simulasi. Journal of Natural Product and Pharmaceutical Chemistry. 1(1) : 1-7
- Novalinda, D., dan N. Asni. 2010. Citarasa Keripik Pisang pada Beberapa Perlakuan Antioksidan. Balai Pengkajian Teknologi Pertanian (BPTP). Jambi.
- Nurhidajah., S. Anwar., dan Nurrahman. 2009. Daya Terima dan Kualitas Protein in Vitro Tempe Kedelai Hitam (*Glycine soja*) yang Diolah pada Suhu Tinggi. Program Magister Gizi Masyarakat Universitas Diponegoro Semarang.
- Pakpahan, Y.E., Z. Lubis., Setyohadi. 2014. Pengaruh Lama Perebusan dan Lama Penyangaian dengan Kualiti Tanah Liat Terhadap Mutu Keripik Biji Durian (*Durio zibethinus murr*). Fakultas Pertanian USU Medan. Jurnal Rekayasa Pangan dan Pertanian. (2):3.
- Peranginangin, R. 2010. Peningkatan Nilai Tambah Ikan Pelagis Gelondongan Menjadi Produk Siap Saji Kualitas Ekspor Untuk Mendukung Kemandirian Dan Ketahanan Pangan. Balai Besar Riset Pengolahan Produk dan Bioteknologi Kelautan dan Perikanan Jakarta Pusat. Laporan Akhir Riset.
- Putri, A.R. 2012. Pengaruh Kadar Air Terhadap Tekstur dan Warna Keripik Pisang Kepok (*Musa parasidiaca formatypica*). Universitas Hassanudin. Skripsi.
- Rachmawati, R. 2008. Pengaruh Komposisi Tepung Tapioka dan Suhu Penggorengan Terhadap Mutu Sensoris Keripik Bakso Ayam dan Efisiensi Energy Mesin Penggoreng Vakum. Teknologi Hasil Pertanian. Fakultas Teknologi Pertanian. Universitas Brawijaya Malang. Skripsi.
- Rahmayati, R., P.H. Riyadi., dan L. Rianingsih. 2014. Perbedaan Konsentrasi Garam terhadap Pembentukan Warna Terasi Udang Rebon (*Acetes* sp.) Basah. Jurnal Pengolahan dan Bioteknologi Hasil Perikanan. (3) : 1 108-117.
- Riansyah, A., A. Supriadi., dan R. Nopianti. 2013. Pengaruh Perbedaan Suhu dan Waktu Pengeringan terhadap Karakteristik Ikan Asin Sepat Siam (*Trichogaster pectoralis*) dengan Menggunakan Oven. (2) : 1.
- Setyaningsih, D., A. Apriyanto, dan M.P. Sari. 2010. Analisis Sensori Untuk Industri Pangandan Agro. Institut Pertanian Bogor Press, Bogor.
- Sipahuntar, S.R. 2008. Pengaruh Konsentrasi Humektan dan Lama Penyimpanan Terhadap Mutu Keripik Biji Durian (*Durio zibethinus Murr*). Departemen Teknologi Pertanian. Fakultas Pertanian. Universitas Sumatera Utara.
- Soebjakto, S. 2015. Produksi Udang Bakal Naik 32%. <<http://www.beritasatu.com/ekonomi/278856-kkp-produksi-udang-bakal-naik32.html>>. Accessed 5 August 2015.
- Soekarto, T.S. 1985. Penilaian Organoleptik untuk Industri Pangan dan Hasil Pertanian. Bhatara Karya Aksara, Jakarta.

- Sudarmadji, S., B. Haryono dan Suhardi. 1997. *Prosedur Analisa untuk Bahan Pangan dan Pertanian*. Liberty. Yogyakarta.
- Sudarmadji, S., Haryono, B., dan Suhardi. 1989. *Analisa Bahan Makanan dan Pertanian*. Liberty. Yogyakarta.
- Thomas, P.R. 2007. *Pengembangan Produk Makanan Ringan dengan Proses Ekstruksi dan Penggorengan*. Institut Pertanian Bogor. Tesis.
- Wahyudi. 2003. *Penerimaan dan Persiapan Bahan Baku Udang*. Departemen Pendidikan Nasional. Jakarta.
- Widati, A.S., E.S. Widyastuti., Rulita., M.S. Zenny. 2012. The Effect of Addition Tapioca Starch on Quality of Chicken Meatball Chips with Vacuum Frying Method. *Fakultas Peternakan Universitas Brawijaya. Jurnal Ilmu-ilmu Peternakan* 21 (2): 11 – 27.
- Widati, A.S., E.S. Widyastuti., Rulita., M.S. Zenny. 2012. The Effect of Addition Tapioca Starch on Quality of Chicken Meatball Chips with Vacuum Frying Method. *Fakultas Peternakan Universitas Brawijaya. Jurnal Ilmu-ilmu Peternakan* 21 (2): 11 – 27.
- Winarno, F.G. 1997. *Kimia Pangan dan Gizi*. Gramedia Pustaka Utama, Jakarta.
- Winarno, F.G. 2002. *Kimia Pangan dan Gizi*. Gramedia Pustaka Utama, Jakarta.
- Winarno, F.G. 2004. *Kimia Pangan dan Gizi*. Gramedia Pustaka Utama, Jakarta.
- Yuniarti, D.W., T.D. Sulistiyawati., dan E. Suprayitno. 2013. Pengaruh Suhu Pengeringan Vakum Terhadap Kualitas Serbuk Albumin Ikan Gabus (*Ophiocephalus striatus*). *Fakultas Perikanan dan Ilmu Kelautan. Universitas Brawijaya*.
- Yusuf, N., S.Purwaningsih., dan W.Trilaksani. 2012. Formulasi Tepung Pelapis *Savory Chips* Ikan Nike (*Awaous melanocephalus*). *JPHPI* vol 15 No.1.
- Zulpikar., Suparmi., dan Sumarto. 2012. The Effect of Corn Flavor on Consumer Acceptance of Catfish Macaroni (*Pangasius hyphopthalmus*). *Faculty of Fisheries and Marine Science University of Riau*.