

The Utilization of Blue Swimming Crab (*Portunus pelagicus*) Waste Product, Lemi, as a Food Flavor

¹A Y Sasongko, E N Dewi and U Amalia

¹Department of Fish Products Technology, Faculty of Fisheries and Marine Sciences,
Diponegoro University
Jl. Prof. Soedarto, SH, Tembalang, Semarang, Central Java – 50275

Email: ulfahamalia0@gmail.com

Abstract. *Lemi* is a wasted product that resulted from the meating process of blue swim crab. One of the utilization of blue swim crab *lemi* is processed it into a food flavor. The aim of this research was to know the value of glutamic acid in blue swim crab *lemi* flavor with the addition of dextrin using different concentration and know the level of consumer preference of *lemi* flavor by using hedonic test. The research was using a Completely Randomized research Design (CRD) with a factor of 0%, 1%, 2%, and 3% dextrin concentration. The treatment that was tested was the additions of 0%, 1%, 2%, and 3% dextrin. The nonparametric data (panelist hedonic level) was analyzed by Kruskal-Wallis and further analysis using Mann-Whitney. The parametric data (glutamic acid content, protein content, moisture content, and solubility level) were analyzed by analysis of varians and further analysis using Honestly Significant Difference. The results showed that flavor with 1% dextrin addition has the highest hedonic score ($7,07 < \mu < 7,38$) than the others, and its chemical characteristics were as follows; protein content (d/b) was $(42,74\% \pm 0,60)$, glutamic acid content was $(66,12\% \pm 0,52)$, moisture content was $(11,78\% \pm 0,24)$ and dissolve level was $(80,86\% \pm 0,11)$. The addition of dextrin with different concentration gave effect to the blue swim crab *lemi* flavor. The flavor resulted from this experiment can be used as an alternative of blue swim crab *lemi* as processing waste so that it can optimized any further.

Keyword : Blue Swim Crab *Lemi*, Dextrin Concentration, Flavor, Glutamic Acid

1. Introduction

The by product of the processing of blue swim crab consists of solid and liquid waste. The solid waste of the processing of blue swim crab is blue swim crab carapace 55% body reject 5%, while the liquid waste is as much as 25%. Blue swim crab *lemi* is included in the body reject solid waste group. *Lemi* has a high amount of protein which is as many as 15.65% that is composed of amino acids. One amino acid that contained in its protein is glutamic amino acid. Glutamic amino acid has a very important role in giving an umami taste in food. Tastes that is formed by food are sweet, sour, salty, bitter, and umami taste [1].

Lemi is an unutilized product in the meating process of blue swim crab, because it could change the color of blue swim crab meat that could lead to the quality and price worsening. *Lemi* (mustard) is a yellowish product that usually found under the surface of the cooked blue swim crab carapace. This product has a delicious taste like the blue swim crab meat [2]. .



In the production of a powder from a liquid form, filler products that functioned as binding agent (binder) is needed. Dextrin can be used as a volatile compound and oil encapsulation products so that it can protect any compounds that is sensitive to high temperature and oxidation process. It is because dextrin has molecules that stable against high temperature and oxidation process. The use of dextrin is expected to be a good protein binding agent and protect it against high temperature during drying or any further processes [3].

2. Methods

2.1. Materials

The main material that used in this reserach was blue swim crab (*Portunus pelagicus*) lemi. Meanwhile, materials that is used in the making of blue swim crab flavor powder were dextrin, water, and blue swim crab lemi. The instruments used in the making of the product were analytical scales and spray dryer.

2.2. Research Design

This research was done by making flavor using blue swim crab lemi as main product that added with 3 different dextrin concentrations, with 0% dextrin addition as control. Each concentration of dextrin added is 1%, 2%, and 3%. This research was using Completely Randomized research Design (CRD).

2.3. Research Procedure

Flavor from blue swim crab lemi was made by cooking it with 1:2 comparison of water. Then, the product that already cooked was filtered and then dextrin was added with 0%, 1%, 2%, and 3% concentrations. The homogen mixture then was put into the spray dryer instrument with inlet temperature of 130°C and outlet temperature of 70°C so that flavor powder was formed.

2.4. Testing Procedures

Testing that conducted in this research were hedonic test which refers to National Standardization Institution [4], Protein and moisture content [5], Glutamic acid [6] and Solubility level test [7].

2.5. Data Analysis

The analysis method that used in this research was analysis of variance (ANOVA) with honestly significant difference (HSD) further analysis to determine either the affecting or not affecting point. If the obtained data difference was significant then HSD further analysis should be done.

3. Results and Discussions

3.1. Panelists Hedonic Level of Blue Swim Crab Lemi Flavor

The results of blue swim crab lemi flavor hedonic test can be seen in Table 1. below.

Table 1. The Results of Blue Swim Crab Lemi Flavor Hedonic Test

Specification	Panelists Hedonic Level			
	0% dextrin	1% dextrin	2% dextrin	3% dextrin
Flavor	8.10	7.70	6.20	4.26
Taste	8.20	7.70	5.83	5.00
Color	5.50	6.50	7.20	8.00
Texture	5.30	6.70	7.70	8.20
Averages	6.72±0.36	7.2±0.55	6.73±0.47	6.36±1.33

The results were average point ± standard deviation of 30 panelists

The results of hedonic test above showed that the best concentration of blue swim crab lemi flavor is in the range of 1% and 2% dextrin concentration. The concentration of dextrin that less than 1% will resulted in the flavor and taste of lemi that is too stingy so that it will be less preferred by panelists and the hedonic point results will be less than 7, so that the flavor will be less preferred and less acceptable by panelists. Meanwhile, in the concentration of dextrin that more than 2% will resulted in the less noticeable flavor and taste so it is also less preferred by panelists. The more the concentration of dextrin that being added, the better the color and texture of the product. The addition of dextrin causes the color of the resulting flavor product turn to yellowish white, where that color is more preferable than those flavor product that was made without using dextrin which has a brownish yellow color. The texture of the resulted flavor product also smoother and not clot when it is added with dextrin as the binder.

3.2. Protein Content

The results of blue swim crab lemi flavor protein content with addition of varies dextrin concentrations can be seen in Table 2.

Table 2. The Average Protein Content of Lemi Flavor with the Addition of Dextrin

Dextrin Concentration (%)	Average(s) WW \pm SD(%)	Average(s) DW \pm SD(%)
0	31.09 \pm 0.61 ^a	35.79 \pm 0.61 ^a
1	43.07 \pm 0.54 ^d	48.83 \pm 0.54 ^d
2	38.27 \pm 0.29 ^c	42.49 \pm 0.29 ^c
3	34.12 \pm 0.52 ^b	37.74 \pm 0.52 ^b

- The data was the average result \pm standard deviation with three replication
- Different superscript letters shown a significant difference among treatments ($p < 0,05$)
- WW: Wet Weight, DW: Dry Weight

The lowest protein content of lemi's flavor was controls; without dextrin addition, thus protein would be denature easily during the heating process. While in the 1% addition of dextrin treatment, protein that contained in the flavor will be protected because dextrin has a more stable characteristic against high temperature so that it can protect any volatile compounds and any compounds which are sensitive to high temperature in the drying process using spray dryer so that the protein content will be increased. On the other hand, the other treatments were 2% and 3% dextrin addition causing lower of lemi's flavor moisture content. This was because the amount of solid products that contained in it was increased, while the source of protein was derived from the moisture content of blue swim crab lemi itself. The more the binding agent used the less the protein content because the carbohydrate content of binding agent was acid characterized so that protein will be hydrolized by acid that contains in the dextrin and lead to protein denaturation. This present study in line with previous studies done by Jinap *et al.* [8] stated that the above condiments are added to foods during food preparation in a relatively small amount and they interact with the original food matrix, including the present glutamate and other free amino acids.

The protein denaturation process was occur in the secondary and tertiary protein structure but it does not change the primary structure of protein. The mechanism of protein denaturation caused by acid was; the protein will experience the biggest turbidity upon reaching the isoelectric pH, which is the pH that the protein has the same positive and negative charge, at which time the protein undergoes denaturation that is marked by the increasing turbidity. Acid can also disrupt salt bridges in the presence of ionic charges. A type of double-replacement reaction occurs when positive and negative ions in the salt alternate with positive and negative ions derived from the acid present in dextrin. According to Meiyni *et al.*, [9] the acid characteristic of dextrin will cause starch to undergo chain breaking process by enzyme or acid during heating process to a smaller molecules.

As a comparison, Sutardi research [10] shown that protein content was decreasing as the increasing number of added binder. The higher the binder that added will lead the protein content of

sweet corn syrup to decreases, Considering that the binder in the form of dextrin is a carbohydrate group and has no free protein component at all. Thus precisely the addition of dextrin physically lowers the resulting protein powder levels. The highest protein content was found in the addition of 0% dextrin which was 9.20% and the lowest protein content was found in the addition of 7.5% dextrin concentration which was 3.25%.

3.3. Glutamic Acid

The results of blue swim crab lemi flavor glutamic acid value with addition of varies dextrin concentrations can be seen in Table 3.

Table 3. The Average Glutamic Acid Value of Lemi Flavor with the Addition of Dextrin

Dextrin Concentration (%)	Average(s) WW \pm SD(%)	Average(s) DW \pm SD(%)
0	48.65 \pm 0.27 ^a	52.38 \pm 0.27 ^a
1	66.12 \pm 0.63 ^d	74.94 \pm 0.63 ^d
2	60.32 \pm 0.49 ^c	66.95 \pm 0.49 ^c
3	54.19 \pm 0.19 ^b	59.95 \pm 0.19 ^b

- The data was the average result \pm standard deviation with three repeatences
- Different superscript letters shown a significant difference among treatments ($p < 0,05$)
- WW: Wet Weight, DW: Dry Weight

The increased glutamic acid value from 31.09% to 43.07% at 0% and 1% treatment was caused by the characteristics of dextrin as binding agent. Dextrin as binding agent of blue swim crab lemi flavor was functioned to protect the nutrients contained in the blue swim crab lemi flavor along the drying proces period. The increased glutamic acid also affected by the occurence of hydrolysis processes between proteins with acid that contained in dextrin. According to Meiyani *et al.* [9], one of the properties of protein is it can be hydrolyzed, so that the protein in the shrimp head was hydrolyzed with acid that contained in the dextrin and deamination will occur and form glutamic, those was the process which results in increased glutamic acid. Where glutamic acid consists of 2 carboxyl groups, 1 amino group, hydroxy group and branch chain. The formation of carboxyl groups in glutamic acid was occur from the hydrolysis process between protein and acid. The C = O compound in the protein bids to OH in dextrin of which both are present in dextrin.

The glutamic acid value decreased at 2% and 3% treatments because the higher the concentration of dextrin added the higher the amount of solids it contained. More dextrin added into lemi's flavor formulation causing the content of glutamic acid lower. While the source of glutamic acid comes from the boiling water of blue swim crab lemi itself. Glutamic acid is a part of the main structure of various types of protein molecules that contained naturally in food and low protein content causes the least protein that can decompose into amino acids so that the resulting glutamic acid value was also lower. The resulting glutamic acid value is directly proportional to the protein content. This is because gluamate acid is a forming compound of proteins, so that if the protein content decreases then the glutamic acid value will also decrease. The previous studies Kim *et al.* [11] noted that the most abundant amino acid was glutamic acid in all the pastes, followed by aspartic acid and leucine.

Zuhra and Herlina [12] stated that glutamic acid is one type of amino acid, it is bonded with other amino acids to form a protein structure. Hydrolised protein during the cooking process with high temperature will release free glutamic. This free glutamic is a key component to get the umami food. Glutamic and leucine acids are the largest dominant amino acids with a proportion of 19.90% and 13.01% of all amino acids in the raw product. Glutamic acid is the most important component in the forming of taste and flavor in seafood product.

The average value of glutamic acid in this research's blue swim crab lemi flavor was between 48.65% - 66.12%. The results of glutamic acid in this reearch were higher than the value of glutamic acid flavor of boiled shrimp head in Meiyani *et al.*, [9] research, which was the best glutamic acid value wa found in 2,5% concentration which was 36.85% and the lowest was found in 7.5% concentration which was 31.5%. As regarded to Meiyani *et al.* [9] that he properties of protein is

denaturation which is breaking the active structure of proteins and in high temperature conditions or and in a strong and numerous acidic chemicals. So that at 7.5% concentration the glutamic acid value decreases.

3.4. Moisture Content

The results of blue swim crab lemi flavor moisture content with addition of varies dextrin concentrations can be seen in Table 4.

Table 4. The Average Moisture Content of Lemi Flavor with the Addition of Dextrin

Dextrin Concentration (%)	Average(s) \pm SD(%)
0	13.14 \pm 0.18 ^c
1	11.78 \pm 0.24 ^b
2	9.94 \pm 0.38 ^a
3	9.61 \pm 0.30 ^a

- The data was the average result \pm standard deviation with three replication
- Different superscript letters shown a significant difference among treatments ($p < 0,05$)

The moisture content of the sample flavor without binding agent (dextrin) quantitatively shows the highest value (13.14%) than the sample flavor with 3% binding agent (9.61%). The addition of dextrin can increase the product total solids. The higher the total solids that drained, the higher the speed of evaporation, so that the moisture content become lower. Dextrin can reduce the value of moisture content, because dextrin is one of product that has ability to bind other product. According to Meiyani *et al.*, (2014), the addition of dextrin with varies concentrations and the drying process could obtain significant results in lowering the moisture content of the flavor. Purnomo *et al.*, (2014), stated that filler product may increase the total solids of the product and the higher the total solids that dried to a certain extent, the higher the evaporation rate so that the moisture content of the products decrease. Sutardi *et al.*, (2010) also stated that, the effect of giving dextrin with varies concentrations was able to reduce moisture content, because the dextrin content has a low molecular weight and simple molecular structure, so that water can easily be evaporated during the drying process either in the form of free water, physically or chemically bound.

The heating process that was done in the production of flavor is by using spray dryer because it was greatly affect the moisture content in the product. Where the higher the heating temperature, the lower the ability of a food product to absorb water from the air, so that the moisture content that contained in the product was decreases. Moisture content is closely related to solubility, this thing is influenced by several factors and one of them is the used binding agent such as dextrin which is hydrophilic. As a comparison, Hastuti and Hidayati [13] research showed that based on the analysis of moisture content in each treatment the highest average value was obtained from the treatment of 0% dextrin concentration which was 4.05%, while the lowest was obtained from the treatment of 2% dextrin concentration which was 3.48%. the high amount of moisture content in the treatment without dextrin was because it does not use any binding agent, while the more the decreasing moisture content of 1% and 2% treatments were because dextrin was able to bind moisture content that contained in the food product.

3.5. Solubility of Blue Swim Crab Lemi Flavor Solids

The results of the solubility blue swim crab lemi flavor solids with addition of varies dextrin concentrations can be seen in Table 5.

Table 5. The Average Solubility Solids of Lemi Flavor with the Addition of Dextrin

Dextrin Concentration (%)	Average(s) WW \pm SD(%)	Average(s) DW \pm SD(%)
0	80.00 \pm 0.40 ^a	80.30 \pm 0.40 ^a
1	80.86 \pm 0.11 ^b	81.24 \pm 0.11 ^b
2	80.93 \pm 0.11 ^b	81.25 \pm 0.11 ^b
3	81.26 \pm 0.23 ^b	81.60 \pm 0.23 ^b

- The data was the average result \pm standard deviation with three replication
- Different superscript letters shown a significant difference among treatments (p < 0,05)
- WW: Wet Weight, DW: Dry Weight

The solids solubility value of blue swim crab lemi flavor was increased, this relates to the characteristic of dextrin which is a filler that able to bind flavor component in water. These properties cause the moisture content in the flavor product to be lower. The lower content of moisture content will result in the forming of more hygroscopic powder and it will be easily to absorb water so that the solubility of flavor in water is also getting bigger. Those results was similar with Hardjanti [14] opinion which state that low moisture content will cause the powder to become more hygroscopic so that there is a significant difference in water vapor pressure between solid and liquid. Beside that, the blue swim crab lemi flavor microencapsulation powder with low moisture content are more porous than those with higher water content. As a result the ability to absorb water is greater and the solubility will become larger.

Sutardi and Constantia [10] stated that, the granules structure in dextrin also affecting the solubility. The process of starch repolymerization with acidic help at the time of dextrinization makes the dextrin molecule split in smaller sizes with a more hygroscopic component, so that when it encounter heating process with low pressure, the starch particles will be damaged. As a result the water will easily moves into it while releasing water-soluble component, so that the solubility is high.

As a comparison Mulyadi *et al.* [15] research showed that on the comparison of physical quality for solubility parameters, the average value of solubility test obtained is almost the same, where the best treatment has 75.67% solubility level, while the solubility level of control treatment is 74.67%, this is because for powder product, the higher the solubility the better the product because it is able to dissolve faster when mixed with water. The addition of dextrin causes an increase in solubility.

4. Conclusions

Based on the obtained research results and discussions about the utilization of blue swim crab (*Portunus pelagicus*) waste product, lemi, as a food flavor, we can conclude that:

1. Flavor that made from blue swim crab lemi with addition of 1% dextrin concentration has the best averages in glutamic acid value (main parameter) which was 66.12%, with 43.07% protein content, 11.78% moisture content, and 80.86% solids solubility as supporting parameters.
2. The panelists hedonic level of blue swim crab lemi flavor with addition of 1% dextrin concentration has the highest averages point which was 7,2 \pm 0,55, which showed that this blue swim crab lemi flavor was more preferable by the panelists.

5. References

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