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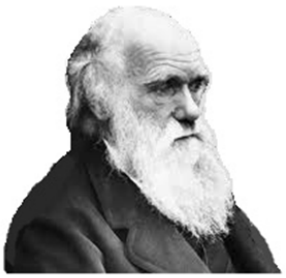

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Addition of squid ink (*Loligo vulgaris* Lamarck, 1798) on tortilla chips to favorite levels

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ABSTRACT

This research aims to determine the amount of squid ink that can be added into the make up of tortilla chips in order to obtain the most preferred product according to organoleptic panelist preference. This research was carried out at the Fisheries Product Processing Laboratory of the Faculty of Fisheries and Marine Sciences, Padjadjaran University, which began on May 6, 2019, until May 10, 2019. The research was carried out experimentally and consisted of 4 squid ink treatments, namely, control, 0.75%, 1%, and 1.25%. The parameters observed were the level of organoleptic preference (appearance, aroma, texture and taste) of tortilla chips and performed by 20 semi-trained panelists. The results of the study concluded that the addition of squid ink to the manufacture of Tortilla chips by 1% was the most preferred treatment, as based on organoleptic characteristics, with media values 7 and alternative values 7.62.

***Keywords*:** Tortilla chips, Squid Ink, Level of Favorite, *Loligo vulgaris*

1. INTRODUCTION

Squid is a group of cephalopod animals and is one of the invertebrate animals. Squid is a group of cephalopods or types of mollusks that live in the sea. The name cephalopoda in Greek means the head of the head, this is because its legs are separated into a number of hands that surround the head. For all cephalopods, squids are separated by having different heads.

The spread of squid in Indonesia is almost evenly distributed in all waters, namely from West Sumatra to the south of Irian Jaya, from the Malacca Strait to the east of the waters of

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East Sumatra, the Java Sea, the Banda Sea, and Maluku or Arafura waters. The spread of squid in almost all the seas in the world, from the coast to the high seas and begins to surface to a depth of several thousand meters.

Classification of squid namely:

Kingdom : Animalia
Phylum : Mollusk
Class : Cephalopods
Sub-class : Coleoidea
Order : Teuthoidea
Family : Loliginidae
Genus : Loligo
Species : *Loligo vulgaris* Lamarck, 1798.

Picture 1. Squid (*Loligo vulgaris* Lamarck, 1798)
Source: Personal documentation

Squid has a protein content of 17.9 gram / 100 gram fresh squid. The specific characteristics possessed by squid are the presence of a bag of ink rich in melanin. Dark colored liquid in squid ink contains melanin grains or black pigments. Melanin or black pigment is a melanoprotein containing 10-15% protein, which consists of essential and non-essential amino acids and polysaccharide sulfates, anticoagulants, antibacterial and anti-tumor. States that squid ink melanoproteins contain natural glutamic acid so that it tastes savory like cheese. A polysaccharide of ink squid has also studied or possessing superior antioxidant, tumors and anti chemotherapy. Squid ink is removed when squid processing becomes waste, the ink bag is removed because the resulting black color makes the product look unattractive and has a fishy taste, besides that squid ink also has the properties for health.

Melanin squid ink is melanin which is usually used as a standard for melanin with free radical protection activities. Squid ink melanoproteins have the dominant essential acid in the

form of lysine, leucine, arginine and phenylalanine, while the dominant non-essential amino acids are glutamic acid and aspartic acid. Squid ink is antiseptic in processed products of ika-shiokara squid meat. Squid ink is also known to be rich in taurine and hydroxyproline. Processed products that are added with squid ink have a longer shelf life.

Generally Tortilla chips are made from ingredients in the form of corn which are given additional ingredients such as salt, water, garlic powder and oil which is formed by thin sheets then baked and fried. Corn which can be used in making tortilla chips varies, there are yellow corn, white corn, blue corn and red corn. But what is commonly used is yellow corn.

Tortilla chips are one of the most popular processed corn products. Tortilla chips are in the form of chips or chips made from corn in the form of triangles and square with a size of a certain thickness. Tortilla chips are expected to increase the acceptance of food types in the community by modifying the addition of squid ink as a source of protein.

The carbohydrate content of theTortilla chips is 80% and the protein content is 11%. Adding squid ink to tortilla chips is expected to increase protein content and consumer acceptance. The consumer trend now a day is towards more healthy foods, creating the necessity of developing new products that offer variety, convenience, quality, cost-efficiency and are high on nutritive value.

Squid is one of the commodities of fishery products that have a higher economic value compared to other fishery commodities. The existence of squid ink fortification in making Tortilla chips can utilize waste that has black color and produce fishy taste that will affect the nutritional content and level of preference but in some countries squid ink has been used as food additives.

Squid ink has been used in some dishes and food namely rice black, in a sauce baby squid ink, ink soup with pork and squid in addition ink processed food as a dye. Adding squid ink to tortilla chips will make this snack also has a high protein content and has delicious, salty and savory flavors. This research aims to determine the level of addition of squid ink on Tortilla chips to obtain the most organoleptically educated products.

2. MATERIALS AND METHODS

2. 1. Materials and Tools

Tools used: digital scales, containers, knives, tortilla chips, spoons, spatulas, measuring teapots, rolling pins, baking pans, drying ovens, pressure cookers, steamed pan, stove deep frying, meat grinder and plastic. The ingredients of tortilla chips are used: pipil corn, squid ink, cornstarch, granulated sugar, water, salt and garlic.

2. 2. Research Methods

The method used in this research is the experimental method. The treatment used is by adding squid ink to tortilla chips based on the corn weights, are as follows:

1. Treatment A (control): without the addition of 0% squid ink.
2. Treatment B: add squid ink as much as 0.75%.
3. Treatment C: add squid ink as much as 1%.
4. Treatment D: add squid ink as much as 1.25%.

Table 1. Formulation of Making Tortilla chips

Material	Treatment (%)			
	A	**B**	**C**	**D**
Pipile Corn (g)	100	100	100	100
Squid ink (mL)	0	0.75	1	1.25
Water (mL)	5	5	5	5
Salt (%)	3.2	3.2	3.2	3.2
Sugar (%)	6	6	6	6
Garlic (%)	2	2	2	2
Cornstarch (%)	5	5	5	5

The formula used in this research is as follows:

The procedure for making tortilla chips refers to the research that has been done modified.

1. The stages of squid ink preparation are as follows:
   a. Prepare fresh, whole squid.
   b. Ink bags from the bottom of the whole body of the squid are taken, then separated in a clean container.
   c. The ink in the squid bag is taken by slowly applying pressure, then the ink coming out is accommodated in a clean container.
   d. The squid ink is stored in a separate container according to the treatment which will be added to the Tortilla chips mixture.

2. The stages of making tortilla chips *are* as follows:
   a. The treated squid ink (0%, 0.75%, 1%, 1.25%) is mixed with corn flour and additional herbs according to the treatment.
   b. Stir the mixture until smooth.
   c. Make thin sheets using a *rolling pin* with a thickness of ± 1-2 mm.
   d. Printed round and in a rectangular shape with a length of ± 35 mm and width ± 25 mm.
   e. Oven (45 ºC for 120 minutes).
   f. Fried (*deep frying* ± 5-10 seconds).

2. 3. Parameters Observed

The observed parameters are characteristics organoleptic tortilla chips product by using a hedonic test for appearance, aroma, texture, and taste. The test was carried out by 20 semi-trained panelists. Panelists are asked to fill the Favorite Level Test Questionnaire according to

personal opinion. The numerical scale consists of five types, namely: 1 (very dislike), 3 (dislike), 5 (neutral / normal), 7 (like), and 9 (really like).

2. 4. Data Analysis

Data obtained from hedonic tests (preferences) on appearance, aroma, texture and taste will be analyzed by Friedman test. Data will be analyzed statistically non parametric. Data obtained from the level of preference will be tested statistically non parametric, the test used is two-way analysis and Multiple Comparison. Friedman's two-way variance analysis to determine the effect of squid ink addition treatment depends on the level of aroma preference, appearance, texture and taste. Two-way analysis using Friedman is defined by the following formula:

$$X^2 = \frac{12}{bk(k+1)} \sum_{i=1}^{t} (Rj)^2 - 3b\ (k+1)$$

where:

X^2	= Friedman Test Statistics
B	= Repeat
K	= Treatment
Rj	= Total rank for each treatment.

Furthermore, to determine the best treatment, the Bayes method is used. Bayes method is one technique that can be used to perform analysis in n basis for taking the best decision from a number of alternatives with the aim of producing the acquisition, considering various criteria. The criteria in the question are parameters of color, aroma, texture and taste.

The Bayes equation is as follows:

$$X_G = \sqrt[n]{\sqcap, \mathrm{Xi}}$$

where:

X_G	= geometric average
⊓	= permutation
n	= number of panelists
Xi	= rating from the 1st panelist.

In the evaluation, the priority value of each criterion is obtained from the data from the geometry average of each criterion.

3. RESULTS

3. 1. Hedonic Test

3. 1. 1. Color

Color is the main factor that is seen by the consumer visually, before from the other two factors. A product that does not have attractive colors, people will hesitate to eat it [16].

The color observation result of Tortilla chips with the addition of squid ink are presented in **Table 2**.

Table 2. Color Favorite Level Test Results

Add Squid Ink (%)	Median	Average
0	9	7.7 a
0.75	7	7.3 a
1	7	7.1 a
1.25	7	6.7 a

Information: Values followed by the same letters vertically show no significant difference according to the Multiple Comparisson test level of 5%.

Based on the results of panelists' assessment of color Tortilla chips are known to have median values ranging from 7 and 9 and the average values range from 6.7 to 7.7, which means color Tortilla chips range in size or are still accepted until the pane is preferred. Average color value, the highest is found in the addition of squid ink treatment of 0%, 7.7. and the median value of 9 (very preferred) with a uniform, intact, and yellow color. The lowest average color value is found in the addition treatment of 1.25%, namely 6, 7, and the median value of 7 (preferred) with a uniform, intact, and black shape.

The black color of tortilla chips is not preferred by panelists because it does not resemble the color of tortilla chips in general. This is similar to research that the more addition of squid ink, the lower the level of preference of the panelists for the quality of the organoleptic squid ink in the cup cake. The brownish yellow produced on tortilla chips is influenced by the high carbohydrate content of corn. Browning is a browning reaction in food which is divided into two, namely enzymatic browning and non-enzymatic. Enzymatic browning reactions occur in fruits and vegetables, especially if there is dextrusion. Non-enzymatic reactions occur in the processing of food using heat and during food storage. Non-enzymatic browning consists of caramelization reaction and the reaction Maillard reaction browning due to the oxidation of vitamin C. The maillard reaction is a reaction between carbohydrates, especially sugar preduction with NH_2 from a protein which then continues to furfural and forms melanoidin compounds which give brown color.

Friedman's analysis results showed that all treatments were 0%, 0.75%, 1%, and 1.25% which were not significantly different (significant), which meant that the addition of squid ink had no effect on the appearance (color) of tortilla chips. This is indicated by the average value of each squid ink addition treatment which is still more than the panelist's rejection rating value.

The panelists' preference for color with 0% treatment is not in accordance with the hypothesis that is equal to 1% due to differences in the addition of squid ink. Therefore, the conditions with the control treatment did not have the addition of squid ink treatment so that

there was still the original color of the main ingredient, namely corn. The colors of tortilla chips can be seen in **Picture 2**.

Without additional squid ink Treatment control 0%

The addition of squid ink Treatment 0.75%

The addition of squid ink Treatment 1%

The addition of squid ink Treatment 1.25%

Picture 2. The Color of Tortilla chips Various Treatments for Adding Squid Ink
Source: Personal Documentation

3. 1. 2 Aroma

Aroma is one of the attractions in addition to color from food ingredients to be consumed; compounds that produce aroma must be able to evaporate and the molecules of these compounds make contact with the receiver (receptor) of the panelist. The yawning aroma is received by olfactory cells found in the nose which continues to the brain in the form of electrical impulses. Scent assessment aims to determine the delicacy of the product based on the sense of smell. Observation results in aroma Tortilla chips with the addition of squid ink are presented in **Table 3**. Based on the panelists' assessment of the aroma of tortilla chips, it is known that the median value ranges from 5-7 and the average value ranges from 6-7.3, which means that the aroma of tortilla chips ranges from normal or is still accepted by panelists.

The highest average value of scent is found in the addition of squid ink treatment by 1%, namely 7.3 and the median value of 7 (preferred) which produces a distinctive aroma of corn and smells of squid. The lowest average aroma value is found in the addition treatment of 1.25%, which is 6 and the median value is 6 (normal) which produces a distinctive aroma of corn and smells of the squid's aroma.

Table 3. Aroma Fragrance Level Test Results

Add Squid Ink (%)	Median	Average
0	9	7.7 a
0.75	7	7.3 a
1	7	7.1 a
1.25	7	6.7 a

Information: Values followed by the same letters vertically show no significant difference according to the *Multiple Comparisson* test level of 5%.

Squid ink itself does not have a fishy aroma like fish or other stinging aroma. This is thought to occur because in each treatment only different amounts of squid ink were added, besides all the ingredients added were the same.

Friedman's analysis showed that the treatment that did not differ significantly was the addition of ink treatment by 0% with 0.75%, 0% with 1%, 0% with 1.25%, 0.75% with 1%, and 0.75 % with 1.25%. Thus, significantly different is the treatment of adding 1% ink with 1.25%, which means that the addition of squid ink affects the aroma of tortilla chips. However, until the addition of 1% tortilla chips, the panelists still liked it. This is indicated by the average value is still greater than the limit value of the panelists' rejection.

3. 1. 3 Texture

Texture is a food quality factor to determine the level of crispness that can affect the reception of food products. Texture can affect the image of food and is important in soft and crunchy foods. Texture observation results of Tortilla chips with the addition of squid ink are presented in **Table 4**. The results of the statistical analysis show that the texture has an influence on the level of preference of the panelists. Based on the results of the panelists' assessment of the hedonic texture of tortilla chips, the median values ranged between 7 and 8 and the average values ranged from 7-7.9, which means that the texture of tortilla chips ranges from normal or is still accepted by panelists. The highest average value of the texture is found in the addition of squid ink treatment of 1% which is 7.9 and the median value of 8 (preferred) with a very crunchy texture. The lowest average value of the texture is in the addition treatment of 0%, namely 7 and the median value of 7 (normal) with a crisp texture.

The higher the concentration of lime used during immersion, the higher the crispness of the tortilla chips. This happens because the higher the concentration of alkali, the pericarp is

released optimally so as to facilitate the penetration of water and calcium into corn kernels which will produce a final product that is increasingly crispy.

Friedman's analysis showed that there were no significant differences in the treatment of 0%, 0.75%, 1%, and 1.25% of the texture of tortilla chips. The addition given is still preferred by panelists to the treatment of adding cumi-squid ink by 1.25%.

Table 4. Texture Favorite Level Test Results

Add Squid Ink (%)	Median	Average
0	7	7 a
0.75	7	7.5 a
1	8	7.9 a
1.25	7	7.7 a

Information: Values followed by the same letters vertically show no significant difference in the *Multiple Comparison* test at the level of 5% .

3. 1. 4. Taste

Taste is one of the important sensory properties in receiving a food product. Taste is valued by the sense of taste (tongue) which is the unity of interaction between the sensory nature of aroma, taste, and texture. Observation results taste of Tortilla chips with the addition of squid ink are presented in **Table 5**.

Table 5. Taste Levels Test Results

Add Squid Ink (%)	Median	Average
0	7	7.1 a
0.75	7	7.2 ab
1	7	7.8 b
1.25	7	7.1 ab

Information: Values followed by the same letters vertically show no significant difference in the *Multiple Comparison* test at the level of 5% .

Based on the panelists' assessment of the hedonic taste of tortilla chips, it is known that the median value of each treatment is 7 and the average value ranges from 7.1 to 7.8, which means the panelists feel the taste of tortilla chips. The highest average value of taste was found in the addition of squid ink treatment of 1%, namely 7.8 and median value 7 (preferred) with

corn, savory and salty flavor. The lowest average value is found in the addition treatment of 0% and 1.25%, namely 7.1 and the median value of 7 (preferred) with the taste of corn and squid which is somewhat felt at 0% addition and the corn and squid taste dominantly felt in 1.25% addition.

The addition of squid ink resulted in the product having a slightly savory tortilla chips flavor at 0.75% addition, savory tortilla chips at 1.25% addition. The squid's specific savory taste arises because of the different proportions of squid ink given, so the protein content in the final product is different.

The results of Friedman's analysis showed that treatments that were not significantly different were 0% with 0.75%, 0% with 1.25%, 0.75% with 1%, 0.75% with 1.25%, and 1% with 1.25%, while the treatment that is significantly different is 0% with 1%, which means the addition of squid ink affects the taste of tortilla chips. However, until the addition of 1% tortilla chips, the panelists still liked it. This is indicated by the average value which is still greater than the bat value of the panelists' rejection.

3. 1. 5 Bayes Method

Decision making on the value of weight and alternative values of the appearance criteria, aroma, texture, and taste of tortilla chips is done by pairwise comparisons (Pairwise Comparison), decision making using the Bayes method is a technique used to carry out analysis taking into account the weight of criteria. Completion of the results of pairwise comparisons is done by matrix manipulation to determine the weight of alternative criteria and values. The calculation results on the weight of the appearance criteria, aroma, texture and taste of tortilla chips and alternative values in determining the best treatment can be seen in **Table 6**.

Table 6. Bayes Method Assessment Decision Matrix

Treatment	Criteria				Alternative Value
	Color	Aroma	Texture	Taste	
0%	7.70	6.30	7.00	7.10	7.10
0.75%	7.30	6.80	7.50	7.20	7.28
1%	7.10	7.30	7.90	7.80	**7.62**
1.25%	6.70	6.00	7.70	7.10	7.10
Criteria Value	0.22	0.12	**0.37**	0.29	29.11

Based on calculations on the criteria for color, aroma, texture, and taste of tortilla chips, it was obtained 0.22, 0.12, 0.37 and 0.29, respectively. The value of the texture criteria has the greatest value, which is 0.37 compared to other criteria. This proves that texture is the most influential parameter for panelists to assess tortilla chips. Based on the calculation of alternative values, it was found that tortilla chips with the addition of squid ink as much as 1% was the

most preferred treatment for panelists with an alternative value of 7.62 compared to other treatments.

3. 2. Results of Overall Observations

The results of the overall observations from the research that has been conducted are hedonic tests with the addition of squid ink on tortilla chips can be seen in **Table 7**.

Table 7. Research Recapitulation Results

Observation	Average Treatment for Adding Squid Ink			
	0%	**0.75%**	**1%**	**1.25%**
Hedonic				
Appearance	**7.70**	7.30	7.10	6.70
Aroma	6.30	6.80	**7.30**	6.00
Texture	7.00	7.50	**7.90**	7.70
Taste	7.10	7.20	**7.80**	7.10
Bayes Method				
Alternative Value	7.10	7.28	**7.62**	7.10

Based on the results of the hedonic test, the addition of squid ink has a real influence on the characteristics of the aroma and taste. The characteristics of the aroma, taste, and texture of Tortilla chips at 1% treatment have the highest average value, but in the characteristics of the appearance of Tortilla chips the treatment to 0% addition of squid ink has the highest average value.

After the Bayes test, the highest alternative value was obtained at 1% treatment, namely 7.62, so it can be concluded that Tortilla chips with 1% addition are Tortilla chips which are preferred by panelists rather than other treatments. This shows that the addition of squid ink to as much as 1% of tortilla chips is the organoleptic characteristic most favored by pills with the highest value of aroma, texture and taste compared to other treatments. This result is in accordance with the hypothesis. Criteria for aroma, texture and taste play a role in determining the best treatment based on the Bayes method.

4. CONCLUSION

Based on the results of research that has been done that the addition of squid ink as much as 1% is the most preferred treatment based on organoleptic characteristics with a median of 7 and an alternative value of 7.62.

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