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RESEARCH ARTICLE

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Effects of turmeric extracts (*Curcuma domestica*) on the quality of octopus (*Octopus* sp.) crackers

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Abstract
Although octopus is an economically valuable fishery commodity, it is underutilized with some popular processes such as boiling, frying and salting. The octopus-based product development of octopus can be extended through preservation using natural preservatives including turmeric extract. The use of turmeric water extract is expected to be an alternative preservative as well as a seasoning in the production of octopus crackers. The purpose of this study was to determine the best formulation of turmeric extracts (Curcuma sp.) on the quality of octopus crackers (Octopus sp.). The cracker's formula was added with different levels of turmeric extracts as follows: K.0 (no turmeric extract), K.1 (3%), K.2 (6%), K.3 (9%). The parameters studied were organoleptic quality (appearance, odor, taste and texture) and TPC (Total Plate Count). The results showed that the best quality of octopus crackers on organoleptic parameters was at a concentration of 3%, resulting in appearance (7.2703), odor (7.316), taste (8.03), and texture (8.2802), while the score for the shape reached 9. TPC test at sample with turmeric extract of 9% was 2.7 x 10^2.

KEYWORDS
Octopus, turmeric extract, crackers, fisheries

1. INTRODUCTION

Processing and preserving fishery products are important to maintain the quality and freshness of fishery products. The processes aim to extend the shelf life of fishery products and maintain their nutritional value. The following are several techniques commonly used in preserving and preserving fishery products: washing, cooling, freezing (Ninan, 2003), canning (Lahamy and Mohammed, 2020), smoking (Ohoiwutun et al. 2020), salt preservation (Assadad & Utomo, 2011), and preservation with chemicals. The use of appropriate processing and preservation techniques really depends on the type of fishery product, the purpose of preservation, and the environmental conditions where the product will be stored or sold (Tuarita et al., 2023). Octopus is a fishery product that is easily spoiled because it contains high levels of water and protein; thus, its quality rapidly deteriorates. Octopus meat (O. cyanea) contains chemicals, i.e., water 70.79-74.36%, protein 13.55-18.41%, carbohydrates 5.44-6.37%, ash 2.23-3.43%, fat 2.20-2.22%, and crude fiber 1.51-2.54% (Soewarlan et al. 2023). The octopus can be developed into crackers.

Crackers are a type of snack that is usually consumed as a snack or as a variation in side dishes.

It is made from a mixture of octopus meat mixed with tapioca flour and spices and then fried until dry. The function of ingredients containing protein is as an adhesive; the dough can be formed into the desired shape (Sari et al. 2019). The fish crackers are widely available on the market, but crackers made from octopus are rarely found. For example, fish crackers made from a mixture of snakehead fish and mackerel (Fauzi et al., 2022), skipjack fish crackers (Mawaddah et al. 2021), and tilapia fish crackers (Rahmawati et al. 2023). Octopus crackers contain simple ingredients such as octopus' meat, tapioca flour, water, vegetable oil, salt, and spices such as garlic or pepper which are used to provide additional flavor and aroma. In the cracker's making process, additional ingredients are needed that can support the quality of the crackers, such as garlic, turmeric, coriander, and bay leaves. The use of spices can play double roles: improving the taste and providing preservative effects.

Turmeric has antimicrobial and antioxidant properties which make it effective as a natural preservative. Some of the active compounds in turmeric, especially curcumin, have antimicrobial properties that can inhibit the growth of bacteria, fungi and other microorganisms that can cause food to rot. In addition, curcumin also has antioxidant properties that help protect food from damage caused by oxidation, which is one of the main factors in food spoilage (Adamczak et al. 2020). However, it is important to remember that turmeric may not be effective as a preservative in all situations or for all types of food. The use of turmeric as a preservative must be done wisely, and other factors such as the pH of the food, the concentration of turmeric used, and the food processing method also need to be considered. In addition, in the context of the food industry, there are food safety standards and regulations that must be adhered to when using preservatives, including turmeric. Curcumin, showing antibacterial properties, comes from one of the curcuminoid fractions (Jyotirmayee & Mahalik, 2022). An appropriate concentration of turmeric is highly recommended in using turmeric as a natural food preservative so that it can extend the shelf life and quality of octopus crackers.

A research by Amalia (2019) studied the concentration of turmeric extracts (0; 30; 45 and 60%) and soaking time (60; 90 and 120 minutes) in making the wet crackers. The works explained that the treatment of turmeric extract concentration and soaking time had a real influence on pH and TPC on wet crackers. The best treatment was obtained on wet crackers with a combination of turmeric extract concentration of 45% and soaking time of 60 minutes, with a water content of 62.93%, protein 4.36%, pH 6.90, fat 7.14% and TPC 3.94 × 106. The aim of this research is to determine the best formulation for using turmeric water (Curcurma domestic) on the quality of octopus crackers (Octopus sp.) which includes organoleptic parameters (hedonic test) and microbiological parameters (TPC test).

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2. MATERIALS AND METHODS

2.1 Materials

The ingredients used in this research included the main ingredients of octopus meat, tapioca flour, wheat flour, sugar, salt, baking soda, garlic, turmeric, ice water, lime, fresh water, and cooking oil. Analysis materials include nutrient agar (NA) media and distilled water, 70% alcohol, tissue and aluminum foil.

2.2 Data collection procedures

The processing of octopus (Octopus sp.) cracker products consisted of two (2) stages, namely stage 1: making turmeric extract; and stage 2:

making octopus cracker products. The octopus was obtained from catches using homemade weapons made from wood taken from Sorbat waters, North Dullah District, Tual City.

2.3 Turmeric extraction procedures

Fresh turmeric was peeled, washed, weighed 18 g, then thinly sliced. The slices were, blended with 99 mL of water and filtered. The extract was then diluted into various concentrations (0%, 3%, 6% and 9%).

2.4 Cracker Making

The octopus raw material was cleaned from the skin, washed with fresh water, then weighed 300 g, cut into small pieces to make it easier when blending. Next, the octopus was marinated with lime and garlic. The purpose of soaking was to remove the fishy smell of the octopus. They were then soaked for 30 min and washed using ice water. The next stage, the octopus was blended and mixed with additional ingredients (wheat flour, tapioca flour, sugar, salt, baking soda); the mixture was stirred until homogeneous. Then the mixture was divided into 4 parts and turmeric extract was added according to the concentration (0%, 3%, 6% and 9%). The next stage was formed to obtain a uniform shape and size. The cracker dough was shaped into a cylinder by hand, with the dough length of 25-30 cm and the diameter 4-5 cm. Next, the dough was steamed for 45 min to get a chewy texture, and once completed, it was removed and cooled for 30 min, then sliced with a knife to obtain cracker sheets with a uniform thickness of around 1-2 mm. The octopus crackers were then dried for 2-3 days. The purpose of drying was to adjust moisture content, because it affects the quality and capacity of the crackers during the frying process. After that, the octopus crackers were tested for microbiology (TPC). The organoleptic test was carried out after the crackers are fried, the test parameters include appearance, smell, taste, texture and shape.

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2.5 Data analysis

The experimental design used in this research was a completely randomized design (CRD) with one factor, Sensory data analysis used SPSS version 17 software. Data obtained from sensory data was analyzed using One Way ANOVA at a 95% confidence level or the effect or difference in each formula. If there is a real difference, then proceed with the Duncan Multiple Range Test (DMRT) at the $\alpha = 0.05$ level. The best formula assessment is based on an assessment of each sensory aspect and the best overall assessment.

3. RESULTS AND DISCUSSION

3.1 Organoleptic Test of Octopus Crackers

Organoleptic or sensory testing is used to assess the level of acceptance or liking of a person (panelist) towards the product studied. The organoleptic assessment in this study was to see the panelists' level of acceptance of octopus crackers. The sensory test used in this research was a scoring test with 30 panelists. The organoleptic parameters tested include appearance, odor, taste, texture and shape. Octopus cracker products are depicted in Fig. 1, while the organoleptic test results are seen in Table 1.

Figure 1. Octopus crackers added with turmeric extracts

Table 1. Organoleptic test results of octopus crackers with the addition of turmeric extracts

Concentration of Turmeric Extracts	Appearance	Odor	Taste	Texture
0	7.10^{ab}	6.80^{a}	6.43^{a}	7.67^{c}
3	7.10^{b}	7.10^{a}	7.07^{b}	7.63^{c}
6	7.80^{c}	8.13^{b}	8.13^{c}	6.77^{b}
9	6.77^{a}	6.93^{a}	6.63^{ab}	6.23^{a}

Note: Numbers followed by different superscript letters in each column indicate a significant difference at p = 0.05. The rating scale is (1) dislike extremely, (2) dislike very much, (3) dislike moderately, (4) dislike slightly, (5) neither like nor dislike, (6) like slightly, (7) like moderately, (8) like very much, (9) like extremely.

The organoleptic test results in Table 1 show that there are different numbers, followed by additional letters for each value. This shows that the higher the organoleptic value, the higher the level of panelist acceptance of cracker products. The parameters seen in Table 1 can determine whether there is an effect of adding turmeric water on octopus crackers or not.

3.1.1. Appearance

Appearance or color is the main visual factor in a person's assessment of a food. The results of the organoleptic appearance test show that there is a real difference in octopus crackers with the addition of 6% turmeric extract, but there is no real effect on the 3% and 9% extract addition compared with control regarding the level of panelist acceptance. This is because the more turmeric water added, the less the panelists' preference for the color of the crackers. Apart from that, it is also influenced by the octopus meat used; thus, the color brightness of the crackers decreases after steaming. According to Koswara (2009), the steaming process results in a color change in the crackers. The browning process of proteins and carbohydrates, which is a non-enzymatic browning reaction, causes color changes in the product during the cooking process. On the market, the quality of crackers varies greatly, this is due to the type, composition of raw materials and additional materials used, as well as the different shapes and sizes of crackers.

Furthermore, the cracker color is influenced by the raw materials. According to Winarno (1997), natural pigments in food ingredients, caramelization reactions, Maillard reactions, reactions of organic compounds with air, and the addition of dyes, both natural and synthetic, are the sources of color for foods. The browner color of the crackers results from the rise of turmeric extract and octopus meat proportion, which is influenced by the Maillard reaction. Changes in aroma, taste and color, especially in foods such as the process of roasting coffee beans, bread, cereals and cooking meat, are caused by the Maillard reaction (Lund & Ray, 2017). The Maillard reaction occurred in this research when the crackers underwent a steaming and roasting process.

3.1.2. Odor

The aroma or odor organoleptic test was carried out to determine the level of panelists' preference for the aroma of crackers with the addition of turmeric extracts. Table 1 shows that the organoleptic test for the smell of crackers experienced a significant difference when adding turmeric water with a concentration of 6%, but there was no significant difference when adding turmeric water with a concentration of 2% and 9% compared to the control.

The overuse of turmeric extracts resulted in a reduction in the level of panelists' acceptance for aroma. This is because turmeric contains volatile oils which give the crackers a pleasant smell. According to Anwar (2012), the aroma of fried food can be produced from the food itself or from the aroma of oil if decomposition has occurred during the frying process. The higher the frying time, the greater the aroma produced, but the increase in aroma is not significant, causing the frying time to not meet the aroma quality characteristics of octopus crackers.

3.1.3 Taste

According to Bachmanov & Beauchamp (2007), most investigators agree that the sense of taste is composed of a small number of primary or basic taste qualities, usually consisting of sweet, sour, salty, bitter, and savory or umami. The tongue is sensitive to taste. Based on the organoleptic test results for the taste of crackers in Table 1, it is known that the addition of turmeric water with a concentration of 6% had significantly different results from the control, but the addition of turmeric water with a concentration of 3% and 9% was not significantly different from the control.

The greater the concentration of turmeric water, the lower the panelist acceptance due to the possibility of a strong bitter taste. The bitter taste of crackers comes from the Maillard reaction. Changes in brown color due to non-enzymatic reactions of ingredients undergoing the steaming and frying process on flavor, color and taste indicate a decrease in the quality of the product (Perez-Locas & Yaylayan, 2010).

The taste of the crackers is influenced by the main ingredient of the crackers, namely octopus meat, as well as the added turmeric extracts and also the spices. The taste of crackers with the addition of turmeric extracts is slightly salty. Nurmillah et al. (2022) showed that salt functions as a salty taste, enhances taste, and acts as a preservative in food. Salt contains 40% sodium and 60% chloride and furthermore it inhibits certain enzymatic reactions in foods, which contributes to activating reactions that facilitate the characterization of color, texture and taste properties.

The savory taste of crackers comes from protein in these crackers. During steaming, the protein hydrolyzes into amino acids such as glutamic acid which contribute to a delicious taste (Yamaguchi & Takahashi, 1984). The spices used in making crackers function to improve and add to the taste of the crackers (Mustofa & Suyanto, 2011).

3.1.4. Texture

The crunchiness of a food is largely determined by its cracker-like texture. Panelists had varying degrees of preference for food textures. To determine the panelists' acceptance of the texture, an organoleptic test was carried out. As a result, Table 1 shows that the more turmeric extract leads to the lower level of panelist acceptance. c. Panelists tended to prefer the control crackers and those with the addition of 3% extract, since they had a crunchy texture compared to samples with higher level of turmeric extracts. The samples with higher addition of the extracts were less dry and slightly brittle. Such condition is caused by the inadequacy of wheat flour and tapioca flour in the formulation.

Starch is the main component in making crackers. Amylose (soluble fraction) and amylopectin (insoluble fraction) are the two main components of starch. The swellability of crackers is influenced by amylopectin, where the function of amylopectin is to provide crunch to crackers (Rosiana, 2015). The high crunchiness

of crackers depends on the amylopectin content. This situation is caused by the starch gelatinization process and the formation of an elastic structure which allows the crackers to expand in volume during the cooking process. The amount of water that evaporates during the heating process also affects the texture of octopus crackers. The more water content does not evaporate, the level of porousness decreases, leading to the drop of product crispness.

3.2 Total Plate Count Analysis (TPC)

The Total Plate Count (TPC) aims to estimate all the microbes that grow on the product as well as some indications of whether the food is suitable for consumption or not. The presence of bacteria in food causes spoilage, causes food-borne diseases and fermentation occurs (Buckle et al. 1985). Microbial growth and activity is one of the factors that can cause food spoilage. The Total Plate Count test results can be seen in Table 2.

Table 2. Bacterial Test Results (TPC) for Octopus Crackers

	Total plate count (colony/g)			
	K0	**K1**	**K2**	**K3**
Mean	5.5×10^{-2}	4.21×10^{-2}	3.3×10^{-2}	2.75×10^{-2}

Determination of TPC levels is to assess the number of microbes that form colonies in the samples. Table 2 shows that the TPC value of each treatment decreased very significantly. This shows that the higher the dose of turmeric water given, the more microbial growth can be inhibited. The test results showed that the lowest bacterial content was found in the K3 treatment with a turmeric water concentration of 9%, namely $2{,}75x10^{-2}$

According to SNI 01-2713-1992, the maximum number of bacteria in crackers / TPC per gram is 5×10^4, which means that the crackers are still suitable for consumption, including K3, K0, and K2. According to Shan and Iskandar (2018), the best treatment is giving turmeric with the highest concentration to kill bacteria or function as an antibacterial.

4. CONCLUSION

This research concluded that the best quality of octopus crackers in terms of organoleptic parameters was achieved in K1 treatment containing 3% turmeric extract. The sample had appearance score of 7.2703, smell 7.316, taste 8.03, texture 8.2802 and shape 9. In terms of microbiological quality expressed as TPC, the sample with 9% turmeric extract showed the best. Based on the results of the research that has been carried out, it is necessary to carry out further research regarding the proximate content (protein, ash, fat content) of squid crackers using turmeric extracts according to the National of Indonesian Standards (SNI).

This research concluded that the best quality of octopus crackers in terms of organoleptic parameters was achieved in K1 treatment containing 3% turmeric extract

CREDIT AUTHORSHIP CONTRIBUTION STATEMENT

Mirna Zena Tuarita: Writing – original draft, Conceptualization, Writing – review & editing, Supervision. Stenly Gawi Mambo Renjaan: Writing – original draft, data curation, Methodology. Maria Kristina Ohoiwutun: Writing – review & editing, Conceptualization, Methodology, Supervision.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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