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Utilization of Milkfish (*Chanos chanos*) Bone Powder in Making of Rengginang, Local Food of Baduy Tribe

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ABSTRACT

Fishbone have a proportion of 10% of the total weight of fish and usually become fish processing waste that contains nutrients. One fish that has high nutritional value is milkfish. The utilization of milkfish bones can be an alternative way to provide a nutrient-rich food source because it contains a high number of mineral especially Ca and P. In Banten Province, milkfish bone is mainly waste from local food processing of Sate Bandeng (milkfish satay). This paper will discuss the results of research on the utilization of milkfish bone powder in making Rengginang, the local food of Baduy tribe. Baduy rengginang products are added milkfish bone powder with a concentration of 0%, 1%, 2%, and 3%. The products produced were characterized by parameters of linier expansion, crispness, hardness, organoleptic test, Total Plate Count (TPC), and proximate analysis. Rengginang product chosen was the treatment of adding 1% fish bone powder. Rengginang produced has the characteristics of volume expansion, crispness, and hardness in the range of 33.08-47.69%, 104.62-164.67 mm, and 958.20-2600.62 g. Water content, ash content, protein content and the amount of fat in the rengginang produced were 87%, 1.10-3.10%; 8.73-11.20%; and 0.48%. The water and protein content is very important because it is closely related to the physical characteristics of the rengginang produced.

Keywords: Rengginang, Milkfish Bone, Baduy tribe

INTRODUCTION

Baduy tribe is one of the dominant local ethnicity in Banten Province, Indonesia. This tribe has diverse food choice in terms of food stuff or food crops to provide food security in their areas. Baduy tribe acquired food produces its own food in agricultural land or buy in market or at a stall in their neighborhood (Khomsan 1993).

The Baduy main commodities are rice, fish and vegetables that are found in their surroundings. These commodities are processed to be a food named wajik, uli, rengginang, tapai ketan, gipang, getuk dangdeur, getuk cau panggalek, wedang jahe, sayur hiris, and dodol (Eris *et al.* 2017). The exploration of Baduy local food is important as its cultural heritage for the ethnicity. This exploration also includes the nutritional value of the local processed food. Less nutrition value in food may posses negative impact to human, hence adding food additives is needed to enhance the nutrition value of Baduy local food.

Milkfish is one of the alternative comodity that can be utilized as food additives. Milkfish is a typical fish in Banten Province which is rich in nutritional value and beneficial for human health,

especially as a source of protein. Research related to diversification and processing of milkfish are: marks from milkfish (Candra et al. 2007), milkfish without thorns (Nusantari et al. 2016), making chips milkfish skin and floss by UKM (Sugito et al. 2019) This study aims to carry out fortification of the local food of Baduy, Rengginang, to increase nutritional value by adding milkfish as an effort of fishery products diversification.

MATERIAL AND METHODS

Materials and tools

The materials used in this study were the basic ingredients of Rengginang. Rengginang is a processed food of Baduy that are made by glutinous rice, garlic and salt. Other materials needed for proximate, microbiological, physical and sensory analysis were distilled water, 96% alcohol, sterile 0.85% NaCl solution, Plate Count Agar (PCA) media, Acidified Potato Dextrose Agar (APDA), Brilliant media. Green Lactose Bile Broth (BGLBB), Eosin Methylene Blue Agar (EMBA), pH 7 buffer, saturated NaCl, H_2SO_4, NaOH, Boric acid, indicator phenolphtalein.

Tools used in the production of rengginang were scales, basins, glassware, stoves and knives. The tools for analysis are glassware, aluminum cup, desiccator, oven, furnace, stomacher, closed test tube, Durham tube, micropipette, incubator, bunsen, autoclave, hot plate, refrigerator, sealer, aluminum foil, spatula, pH meter, texture analyzer, chromameter, and reflux.

Stage of research

The experiment was conducted by direct field observation of the rengginang processing and by laboratory analysis. Sample of rengginang (control and fortified rengginang) were taken duplicates. The research began with conducting samples of rengginang. Milkfish bone was mixed with all ingredients of rengginang. The procedure for making rengginang is presented in Figure 1

The characterization of the rengginang product was carried out with experimental methods design with using a completely randomized design. The treatment given is concentration milkfish bone meal with four levels, namely 0%, 1%, 2%, and 3%. The treatment is carried out with three repetitions. Obtained data processed and tested ANOVA to see differences between treatments. If there was a significantly difference among treatments at $\alpha \leq 5\%$ then a further test was carried out using the real difference test smallest (LSD).

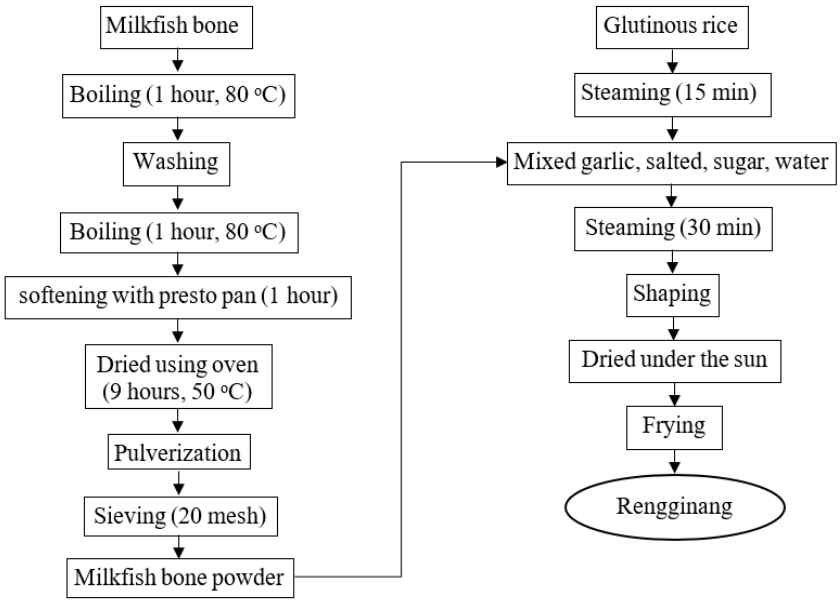

Figure 1. The procedure for making rengginang

The products were characterized by parameters of linear expansion, crispness, hardness, organoleptic test, Total Plate Count (TPC), proximate analysis, calcium and phosphorus content. Proximate analysis was then carried out to determine the content of protein, fat, ash, water, and carbohydrates. Protein analysis was done by using Kjedahl semi micro method, fat analysis by using Soxhlet method (SII 2453-90), carbohydrate by using total carbohydrate by difference method and TPC (AOAC, 2005; Faridah *et al*., 2008).

RESULTS AND DISCUSSION

Rengginang is one of the Baduy local foods. The results of proximate analysis of rengginang showed that rengginang had a water content of 0.47%, ash content of 1.33%, fat content of 31.10%, protein content of 7.19% and crude fiber of 2.49%. To complement the nutritional needs of rengginang, milkfish bone fortification was carried out to add calcium and increase protein. Salitus *et al*. (2017) described milkfish bone meal contains 35.22% protein; 9.68% calcium, 30.47% ash, and 23.06% fat and Bakhtiar *et al*. (2019) added that at 2.9 grams of milkfish bone meal containing 5.24% calcium and 2.36% phosphorus.

a. Linear expansion

The linear expansion is an important physical characteristic of the development of cracker products, including rengginang with the addition of milkfish bone. Linear expansion is a percentage of the difference between the diameter of the cooked and raw rengginang with the volume of the raw rengginang. Linear expansion volume ranged from 33.08% to 47.69%. Based on the analysis of variance, the treatment of milkfish bone concentration and storage duration significantly ($P < 0.05$) affect on the linear expansion of rengginang, but there was no interaction between the two treatments. Rengginang with 0% concentration was significantly different from 2% and 3% concentration, but not significantly different from 1% concentration. In the storage time, the storage capacity stored for 0 weeks was significantly different from storage for 3 and 4 weeks, but not significantly different for 1 and 2 weeks. Rengginang linear expansion with variations in milkfish bone concentration is presented in the Figure 2.

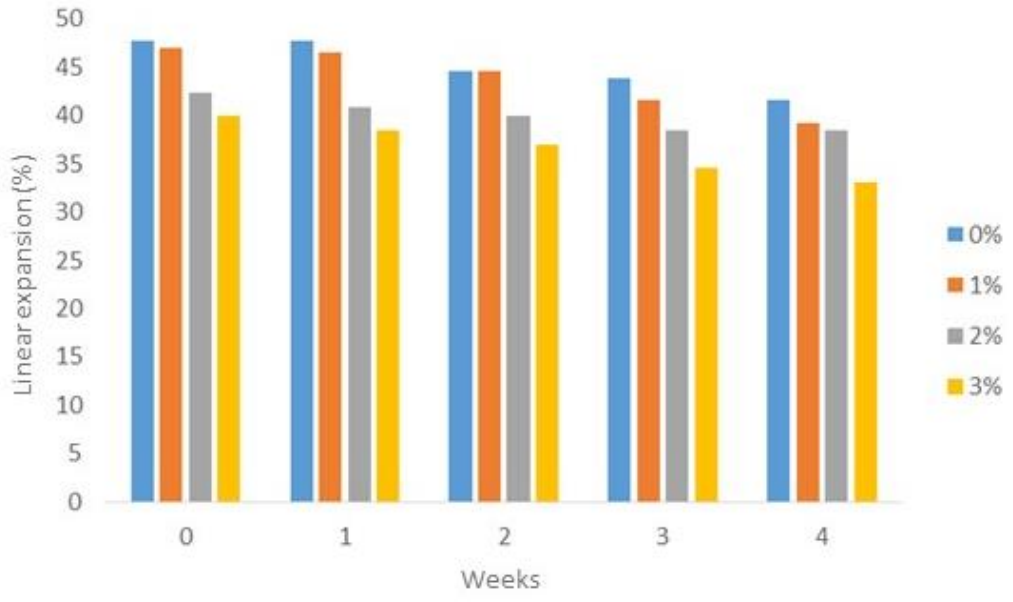

Figure 2. Linear expansion of rengginang with various concentration of milkfish bone

The results showed that the linear expansion decreased with increasing concentration of milkfish bone. According to Imaningsih (2012), when the mixture containing protein and tapioca is heated, the water will be used first to denaturate the protein before the gelatinization temperature is reached (75-76ºC) with the result that the water is not enough to make the tapioca completely gelatinized. Increased concentration of milkfish bone caused the ability of starch granules to bind water decreases. When rengginang was fried, the air cavity decreases because it was filled with other materials and the linear expansion decreases. The best linear expansion was in the treatment with a concentration of 1% because it could expand better than other treatments.

The results also showed that the linear expansion of rengginang with the addition of milkfish bone decreased during storage for 4 weeks. This happened because of the high water content in rengginang with the addition of milkfish bone. This process rendered it to expand when it was fried during the frying process. At a concentration of 3%, the resulting rengginang did not swell well but was more easily destroyed in texture.

The expansion mechanism of rengginang is the result of a number sparks of water that evaporate rapidly during the frying process so that air cavities are formed in the product. According to Fajriah (2014), the expansion of cassava rengginang is also influenced by the amylopectin content. Food with higher amylopectin content will have a tendency to expand more when it was fried. A good linear expansion is produced from the gelatinized starch so that the pores and surface area of the crackers become larger. Pores play an important role in the crispness and texture of the product. Crispy food will be difficult to chew if it does not have pores (Tsukakoshi *et al.*, 2008).

b. Crispness

Cripsness is one of the important quality parameters in rengginang. Product crispness, also known as brittleness, describes how strong a material is in resisting the compressive force that causes it to break (Faridah *et al.* 2014). Rengginang crispness value with the addition of milkfish bone can be seen in Figure 3.

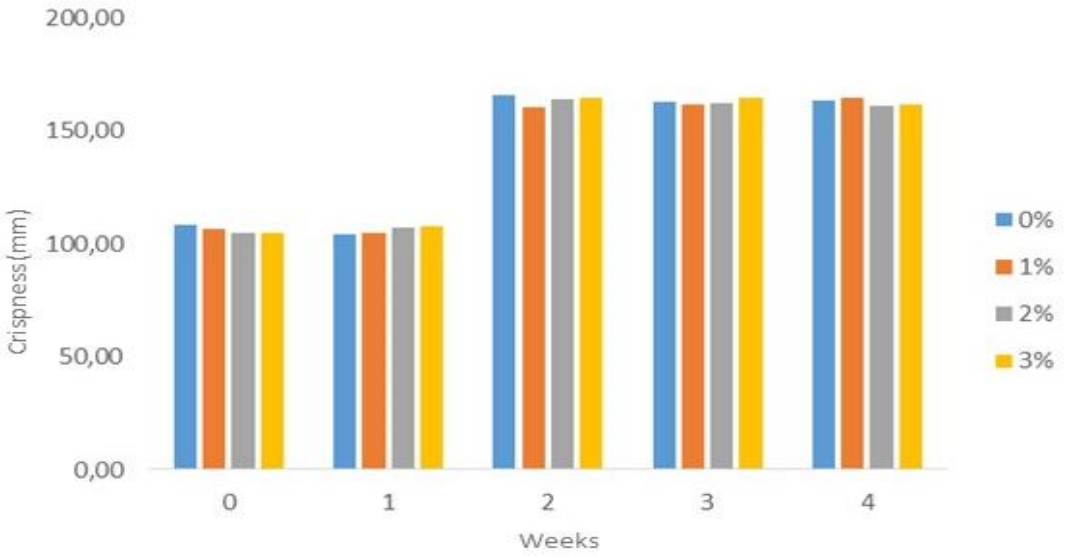

Figure 3. Crispness of rengginang with various concentration of milkfish bone

Based on the analysis of variance, treatment of fish bone and storage duration significantly (P <0.05) affection crispness of product, but there was no interaction between treatments. Rengginang crispness in each treatment was not significantly different. Rengginang with 0week storage was not significantly different from 1 week, but significantly different from 2, 3, and, 4 weeks storage.

Rengginang crispness increased with the increasing of storage time. Significant improvement occurred from week 1 with a range of 104.50-108 mm to 164.06-165.81 mm in week 2. The duration of storage affected the water content in rengginang which was related to the level of crispness (Wijaya and Nocianitri 2008). The water content during storage is relatively stable, but water evaporation occurs during drying before frying. The diminished water content causes increased product pores to increase its crispness (Rosiani *et al*., 2015).

Increasing the concentration of milkfish bone powder produced the same level of crispness of rengginang. The reason was the protein content that was relatively the same so it did not thicken the amylopectin granules (Zulfahmi *et al*., 2015). The process of heating the product before frying played a role in easing the tissue through the mechanism of starch gelatinization, decreasing cell adhesiveness, as well as the release of tissue-forming substances to the medium (Andersson *et al*., 1994; Grizotto and Menezes 2002). In this study, the rengginang product was preheated in the sun for ± 3 hours so that it could increase crispness even though it had been stored for 4 weeks.

c. Hardness

Hardness is the durability of the material to break due to the compressive force applied. The value of hardness is shown by the deformation force, the force needed to break down food products. This measurement is intended to look objectively at the value of hardness in rengginang with the addition of milkfish bone. Hardness is closely related to crispness, the lower the hardness, the higher the crispness, because the force needed to crack the product is smaller. Rengginang hardness value with the addition of milkfish bone can be seen in the Figure 4.

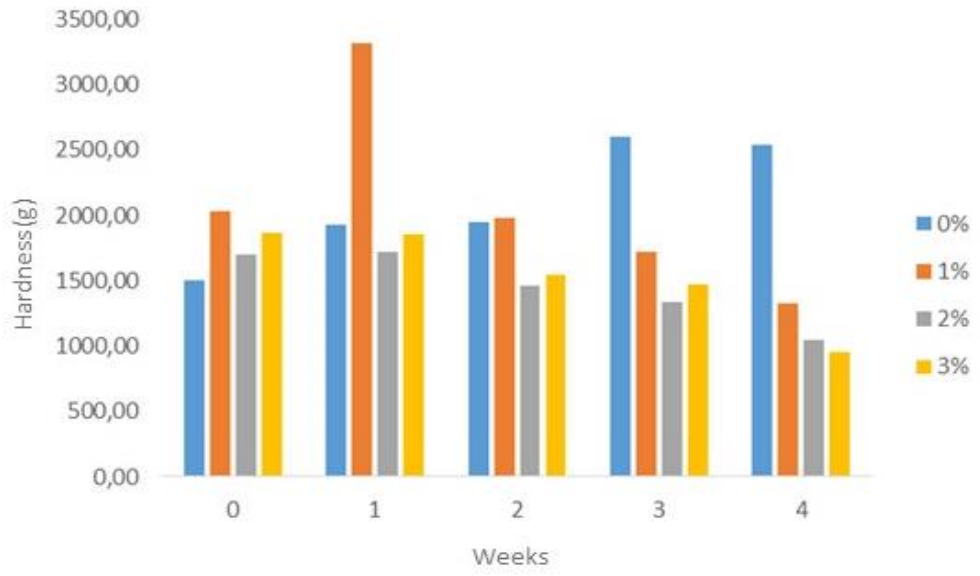

Figure 4. Hardness of rengginang with various concentration of milkfish bone

Based on the analysis of variance, the addition of milkfish bone had no significant effect (P> 0.05) on the hardness of rengginang. However, storage time had a significant effect (P <0.05) on the hardness of the product. Rengginang at 0-4 weeks storage had a hardness that was not significantly different. At chilling temperature storage (0-5^{o}C), hardness of rengginang was influenced by the binding capacity of water and protein. The binding power of water was due to the protein repelling each other, as a result, the space between myofilaments becomes larger and water enters to the meat which causes the hardness to be smaller (Laiya *et al*., 2014).

Rengginang produced in week 0 have a hardness with values in the range 1499.38 - 2034.91 gf. The product had a decreased hardness value along with the increase in the concentration of milkfish bone. This was due the amylose content was lower by increasing milkfish bone. Therefore, the product texture was not hard and tend to be crispy. Glutinous rice doesn't has amylose content (0-2%) so the texture was crispy and not hard. However, if the water content in rengginang increases, it could cause the product to have poor quality with low crispness and hard texture and cause the growth of microorganisms (Lertworasirikul and Tipsuwan 2008). Therefore, it is recommended that rengginang must have good and proper packaging so that the water content is maintained.

Figure 4 shows that the hardness value of rengginang tended to decrease with the increasing storage time. This happened because the water content of the product was maintained during storage so that physical and microbiological damage occurred slowly. According to Wijaya and Nocianitri (2008), rengginang has A_w of 0.4-0.6 so that bacterial growth is inhibited because it requires environmental conditions with a higher water activity. This was supported by the statement of the lower the amount of free water in food, the lower the level of hardness and the higher crispness.

The hardness value of rengginang was inversely proportional to the value of crispness. This could be seen in the value of hardness that decreased every week, but the value of crispness was increasing. In week 2, the crispness value of rengginang increased by about 50% from the previous week with an average value of 106.09 mm. These results were in line with the decrease of hardness value of rengginang products from an average value of 2372.75 gf in week 1 to 1727, 92 gf in the following week.

d. Total Plate Count (TPC)

The result of analysis of variance showed that milkfish bone powder and duration of storage were not significantly effect (P> 0.05) to the total microbial number in rengginang. Total microbes in rengginang products ranged at $7.0x10^2$ - $5.3x10^2$cfu / g for 4 weeks storage at chilling temperature (0-5^{o}C). Based on SNI 7388: 2009, the number of microbes for all calculations in rengginang is lower than the maximum limit of $1x10^5$cfu / g so that the resulting product still met the requirements. The total microbial count in rengginang with milkfish bone are presented in Figure 5.

The total microbial count of rengginang with a concentration of 3% increased until week 2, whereas at a concentration of 2% the increase of the total microbial occurred until the third week. Moreover, in the control, the total microbial count decreased until week 2, and increased until the end of storage. Microbial growth and activities are regulated by water content, protein, and temperature storage. Rengginang is a dry product that has slight water The water content in all rengginang produced was relatively the same so the effect of microbe was relatively small

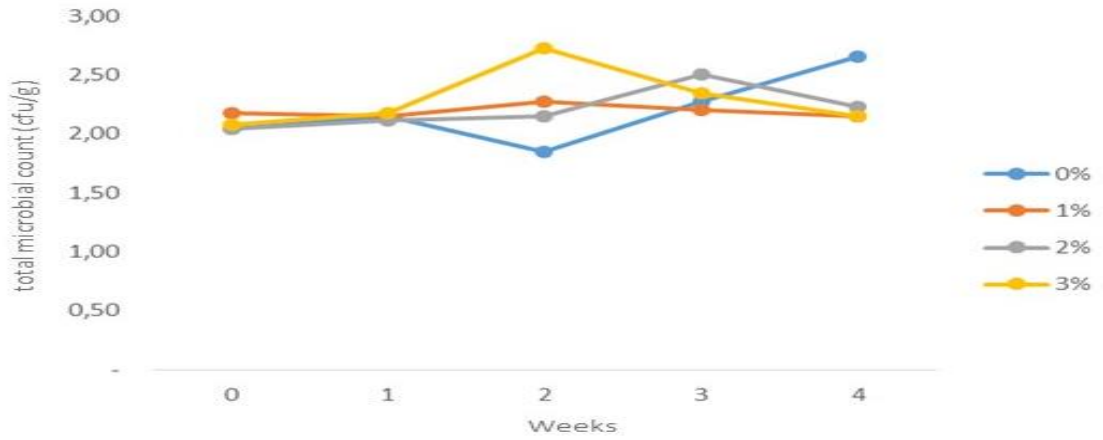

Figure 5. Total count of microbes in rengginang with various concentration of milkfish bone

Increased addition of milkfish bone causes the number of microbes in the rengginang to increase until week 2. This is because the nitrogen compounds in proteins can be used as microbial growth media. The presence of microorganisms in food degrades macromolecules (carbohydrates, proteins and lipids) into organic compounds. However, microbial growth also becomes stagnated due to storage at 0-5^{o}C. Therefore, the number of microbes in the entire range was relatively small and in accordance with the standards.

e. Proximate Analysis

Moisture content

The result of analysis of variance showed that the addition of milkfish bone had no significant effect (P> 0.05) on the moisture content of the rengginang. However, the duration of storage had a significant effect (P <0.05) on the moisture content of rengginang. Storage for 0 week was not significantly different from storage for 1, 2, 3, 4 weeks. Rengginang moisture content with the addition of milkfish is presented in Table 1. Rengginang moisture content with the addition of milkfish bone tended to decrease during storage. This was due to the heating process for ± 3 hours before frying. The process caused the water contained in rengginang to evaporate so that the water content decreases during storage for 4 weeks.

According to Salamah *et al*. (2008), the moisture content of Opak crackers is influenced by humidity, thickness level and texture of the material. Water will easily evaporate on thin products so that the moisture content gets smaller and vice versa. Rengginang moisture content in this study was influenced by the drying factor. Rengginang drying process was done by using solar heat which was strongly influenced by weather conditions.

Table1. Moisture content of rengginang with various milkfish bone concentration

Parameter	Week				
	0	1	2	3	4
0%	87.74	87.72	88.00	87.88	87.52
1%	87.02	87.19	87.01	87.06	87.00
2%	87.50	87.17	87.33	87.09	86.93
3%	87.17	87.41	87.16	87.25	87.21

Table 2. Ash content of rengginang with various milkfish bone concentration

Parameter	Week				
	0	1	2	3	4
0%	1.45	1.26	1.10	1.36	1.50
1%	1.75	1.81	1.89	1.33	1.91
2%	2.27	1.96	2.70	2.07	2.73
3%	3.02	2.69	3.30	2.06	3.10

Ash Content

The result of analysis of variance showed that the addition of milkfish bone and storage duration did not significantly effect (P> 0.05) on the ash content of Rengginang. Rengginang ash levels with the addition of milkfish are presented in Table 2. The results of the study showed that the ash content increased with increasing milkfish bone concentration, although it was not statistically significant. This value indicates the high levels of minerals that are important in terms of nutrition.

Ash content in rengginang products was relatively the same during 4 weeks storage. Minerals were stable to the high temperatures processing so that the ash content of rengginang did not changes significantly. Based on SNI 01-4307-1996, the content of rengginang ash with the addition of milkfish bone was still above the maximum limit of 1%. Rengginang ash content produced ranged from 1.10 to 3.10%.

Protein content

The result of analysis of variance showed that the addition of milkfish bone powder had no significant effect (P> 0.05) on the protein content of Rengginang. However, the duration of storage had a significant effect (P <0.05) on rengginang protein levels. Rengginang protein levels with the addition of milkfish bone can be seen in Figure 4. In t milkfish bone powder processing, protein content was eliminated as maximum as possible by protein hydrolysis. Protein removal aims to increase the mineral content in powder (Putranto *et al.*, 2015). Therefore, protein content in rengginang with the addition of milkfish bone powder was relatively the same.

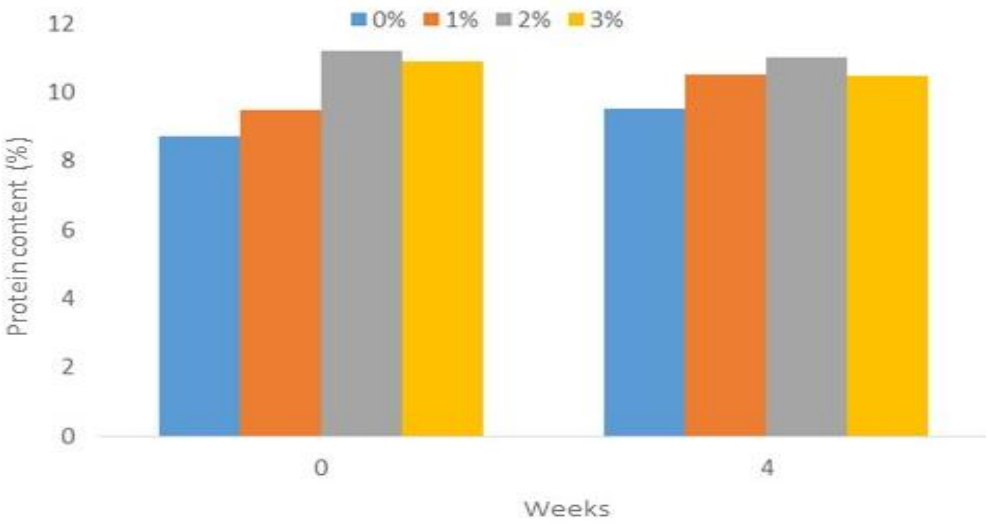

Figure 6. Protein content of rengginang with various milkfish bone concentration

Protein content in rengginang with the addition of milkfish bone powder tended to decrease with increasing of storage time. This could be caused by the process of protein denaturation in rengginang. Protein denaturation can occur due to heat, pH, chemicals, mechanics, and so on. Each of these methods has different effects on protein denaturation. Based on SNI 01-2713-1999, the protein content of rengginang met the standard of a minimum of 6%, the protein content of rengginang was in the range of 8.73% - 11.20%.

Fat content

The analysis of variance result showed that the addition of milkfish bone and storage time did not significantly affect (P> 0.05) on the fat content of rengginang. Rengginang fat levels with the addition of milkfish bone can be seen in Figure 6. According to Putranto *et al*. (2015), in milkfish bone powder, lower fat content is expected. Low fat content makes quality of rengginang more stable quality and uneasily to damage. High fat content causes powder to have fish taste and causes oxydative rancidity due to fat oxidation. Rengginang fat content with a concentration of 1% and 2% met the maximum fat content requirements in the SNI 01-2713 (1999), 0.8%. Rengginang fat content with a concentration of 1% and 2% were 0.48% and 0.36%.

f. Selection of Best Product

Bayes Method is one of the techniques that can be used to conduct analysis in decision making of a number of alternatives with the aim of producing optimal results. Optimal decision making will be achieved when considering various criteria. The treatment is a criterion that needs to be considered in selecting the best rengginang. The selection of the best rengginang with the performance index analysis is based on the highest total value of each treatment.

The parameters assessed of rengginang were objective parameters (linear expansion, crispness, nutrient content, total plate count, and hardness) and subjective (taste, texture, color, and aroma). The results of the Bayes method calculation on rengginang products are presented in the Table 3. The results of subjective assessment, taste and aroma of rengginang were relatively the same so that it had a lower importance than the other parameters.

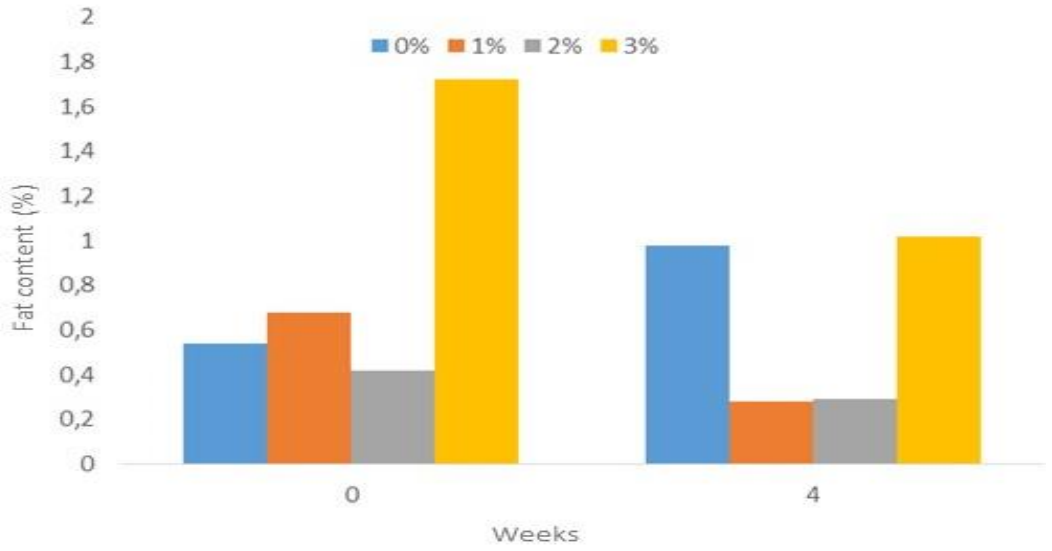

Figure 7. Fat content of rengginang in various milkfish bone concentration

Tabel 3. Bayes method result of rengginang

Parameter	Milkfish Bone Concentration			
	0%	1%	2%	3%
Linear expansion	4	3	2	1
Crispness	3	4	2	1
Protein content	1	2	3	4
Moisture content	1	4	3	2
Fat content	2	4	3	1
Ash content	4	3	2	1
Hardness	1	2	3	4
TPC	2	4	1	3
Texture	4	3	2	1
Aroma	4	3	2	1
Taste	4	3	2	1
Color	4	3	2	1
	2.83	3.17	2.25	1.75
Rank	2	1	3	4

Rengginang texture was different because the increasing milkfish bone content causing reduced crispness. Rengginang texture also decreased with increasing storage time. In addition, the aroma of rengginang produced was fishier with increasing fish bone concentration. The importance value of each parameter was based on a scale of 1 to 3, which is 1 representing ordinary, 2 representing important and 3 representing very important. The objective parameters that have the highest importance were linear expansion and crispness, followed by nutritional content were given a value of 2. Subjective parameters were given an assessment based on panelist acceptance. Based on the results of calculations with Bayes method, rengginang products with the addition of 1% milkfish bone powder was the best product. This was indicated by the highest average value compared to other concentrations.

CONCLUSION

The selected rengginang product was the treatment of adding 1% milkfish bone powder. Rengginang had characteristics of linear expansion, crispness, and hardness with a range of 33.08-47.69%, 104.62-164.67 mm, and 958.20-2600.62 g. The moisture and protein content are very importan because it is closely related to the physical characteristics of the rengginang.

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