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Effect of Salak Seed Flour *(Salacca edulis)* and Tapioca Flour Addition on the Quality of Chicken Meatballs

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A B S T R A C T

The meatballs are a food that all people of various ages favor because they taste good and are nutritious. In this study, chicken meatballs will be made with salak seed flour and tapioca flour. The purpose of this study was to determine the effect of the addition of salak seed flour (Salacca edulis) and tapioca flour on the quality of chicken meatballs and to determine the best treatment for the addition of salak seed flour (Salacca edulis) and tapioca flour on the quality of chicken meatballs that consumers like. This study uses the method of Completely Randomized Design (CRD) factorial pattern consisting of 2 factors, where Factor l is the concentration of salak seed flour consisting of three levels (5%, 10%, and 15%) and Factor ll is the concentration of tapioca flour consisting of three levels (25%, 30%, and 35%). The data from the analysis were processed using Analysis of Variance (ANOVA) to determine the presence of significant differences in each treatment. If there is a significant difference, further tests are carried out with the DMRT (Duncan Multiple Range Test) method at 5%. Chicken meatballs obtained the best treatment results with the treatment of adding the concentration of salak seed flour and tapioca flour (10%: 35%) which produced a yield value of 107.75%, moisture content of 69.56%, fat content of 5.48%, protein content of 15.50%, WHC 18.68%, chewiness (hardness 234.93 N and cohesiveness 0.50 mJ), as well as color (4.20), aroma (4.17), taste (4.03) and texture (3.37).

Contribution to Sustainable Development Goals (SDGs):
SDG 2: Zero Hunger
SDG 3: Good Health and Well-being
SDG 9: Industry, Innovation, and Infrastructure

1. INTRODUCTION

1.1. Research Background

The meatballs is a food that is favored by all circles of society because of their delicious and nutritious taste. The basic ingredients usually used to make meatballs are beef, chicken or fish. However, some make meatballs using chicken meat because the price is relatively cheap, the texture is softer and smoother [1].

To produce good meatball characteristics is the use of binders. The binder commonly used in making meatballs is *sodium tripolyphosphate* (STPP), but the use of chemicals like this has been limited in its use in food mixtures. The material used as a substitute for *sodium tripolyphosphate* (STPP) is hydrocolloid. Hydrocolloids are gelling agents that can function as binders. One hydrocolloid that has the potential to replace STPP in meatballs is salak seed flour. Salak seed flour contains glucomannan, where glucomannan is included in water-soluble polysaccharides (PLA), which are commonly referred to as hydrocolloids [2].

Glucomannan has the ability as a gelling agent, these properties can be used as a binder in food products. Glucomannan is a hydrocolloid polysaccharide composed of D-mannose and D-glucose monomers with β-1.4 bonds that

have very high elasticity so that they can be used as chewers to improve texture in food, for example in the manufacture of noodles, meatballs, jellies, bread, ice cream, and jam.

The addition of salak seed flour to meatball products is expected to improve the physicochemical properties of the meatballs produced, especially the texture of the meatballs will provide different properties from salak seed flour. Research on the addition of salak seed flour to food products has not been widely conducted. Research on meatball products has been conducted on the addition of porang flour [3], namely, the use of porang flour in beef meatballs affects the concentration of water content, protein content and fat content.

In addition to the addition of salak seeds, in making meatballs, fillers are also needed which function to improve emulsion, increase water binding capacity, minimize shrinkage, and increase product weight. The most commonly used filler in making meatballs is tapioca flour. In previous studies, the best filler used in making meatballs was tapioca flour. The results of research [4] the proportion of 50% tapioca flour: 50% porang flour gives a very significant difference to the value of water holding capacity (WHC), the yield value of chicken meatballs, and produces good physical and hedonic characteristics of chicken meatballs.

1.2. Literature Review

Meatballs are made using a mixture of ingredients and seasonings, such as tapioca flour, shallots, garlic, pepper, ice cubes, and salt, with the main ingredient being meat [5]. The way to process chicken meatballs is that the chicken meat is mashed and then mixed with flour and spices, then formed into balls and boiled until cooked in hot water. In general, meatballs are characterized by a compact and chewy texture. Therefore, chewers are needed to get meatballs that have compact and chewy texture characteristics [6].

Glucomannan is a polysaccharide that is hydrocolloidal in nature, where the compound is a combination of glucose and mannose with β-1.4 glycoside bonds. Glucomannan contains high crude fiber and can form a gel structure in food ingredients, so that it can be used as a gelling agent. Furthermore, the mesh captures the water inside and forms a strong structure. The formation of gels occurs due to the phenomenon of combining or crosslinking polymer chains so that a three-dimensional mesh is formed. Furthermore, the mesh captures water in it and forms a strong structure. Analysis of glucomannan content using a reflux condenser is more effective than using other methods because the glucomannan content produced is higher.

The use of tapioca flour is as a filler because of its starch content. Starch will increase the water-binding capacity of the meatballs so that it will produce meatballs with a chewier texture. The ability of starch to absorb water is determined by its amylose and amylopectin content. High amylose content will make the food product absorb more water, while amylopectin content will make the product more chewy. The addition of tapioca aims to increase the chewiness of processed meat products. As a binder, starch can absorb or bind excess water. With the binding of water molecules by starch, when the starch-water suspension is heated, gelatinization occurs. The gelatinization process occurs because water that was previously outside the starch granules and free to move before the suspension is heated. after heating, some of the water is in the starch grains and cannot move freely because it is bound by hydroxyl groups in starch molecules, causing the starch cavities to close. Furthermore, the starch granules can swell excessively and irreversibly. This gelatinization process causes the texture of the meatballs to become chewy [2].

1.3. Research Objective

The purpose of this study was to determine the effect of the addition of salak seed flour *(Salacca edulis)* and tapioca flour on the quality of chicken meatballs and to get the best treatment for the addition of salak seed flour *(Salacca edulis)* and tapioca flour on the quality of chicken meatballs that consumers like.

2. MATERIALS AND METHODS

2.1 Materials and Tools

The raw materials used in the manufacture of salak seed flour are salak seeds obtained from the Salak Processing UMKM Market “Saloka” in Bekasi, West Java. The chemicals used for the analysis of salak seed flour are aquadest, 95% isopropyl alcohol, 95% ethanol, 2% HCl, 10% NaOH, phenylhydrazine hydrochloride, and Na-acetate. The ingredients used for making meatballs are commercial tapioca flour brand “Rose Band”, salak seed flour, chicken meat, garlic, egg white, salt, ice cubes, and pepper. Materials used for proximate analysis of chicken meatball quality are concentrated sulfuric acid (H2SO4), sodium hydroxide (NaOH), boric acid (H3BO3) 1%, standard solution of hydrochloric acid (HCL) 0.1 N, N-Hexan, Selen Reagent Mixture, phenolphthalin indicator (PP), Bromocresol green indicator (BCG), distilled water, and filter paper.

The tools used for making salak seed flour are milling machine, oven, heat-resistant tray, 80 mesh sieve, basin, and pan.The tools used for making meatballs are plastic gloves, knives, digital scales, pans, basins, stoves, and spoons. The tools used to analyze the quality of meatballs are stirring rods, spatulas, scales, ovens, sieving, furnaces, gegep, exicators, erlenmeyers, volumetric flasks, volume pipettes, burettes, dropper pipettes, Soxhlet devices, measuring cups, and round-bottom flasks.

Table 1. Treatment Combinations of Meatballs

Concentration Of Salak Seed Flour	Tapioca Flour		
	T_1	T_2	T_3
S_1	S_1T_1	S_1T_2	S_1T_3
S_2	S_2T_1	S_2T_2	S_2T_3
S_3	S_3T_1	S_3T_2	S_3T_3

Description:
S1T1 = Salak seed flour concentration 5% : tapioca flour concentration 25%
S1T2 = Salak seed flour concentration 5% : tapioca starch concentration 30%
S1T3 = Salak seed flour concentration 5% : tapioca starch concentration 35%
S2T1 = Salak seed flour concentration 10% : tapioca flour concentration 25%

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S2T2 = Salak seed flour concentration 10% : tapioca flour concentration 30%
S2T3 = Salak seed flour concentration 10% : tapioca flour concentration 35%
S3T1 = Salak seed flour concentration 15% : tapioca flour concentration 25%
S3T2 = Salak seed flour concentration 15% : tapioca flour concentration 30%
S3T3 = Salak seed flour concentration 15% : tapioca flour concentration 35%

The data obtained were processed using Analysis of Variance (ANOVA) and continued with Duncan's Multiple Range Test (DMRT) to determine the differences between treatments. The results of all tests were analyzed using the De Garmo method to determine the product with the best treatment results.

2.1.1 Making of Salak Seed Flour

In the first stage, salak seeds were washed thoroughly and then dried under the sun. The next process was soaked with water in a ratio of 1:2 (b/v) for 8 hours. Then the salak seeds were oven dried at 65˚C for 48 hours. After drying, salak seeds were pulverized with a grinder and then filtered with an 80-mesh sieve.

2.1.2 Making of Meatballs

Prepare 100 grams of chicken meat that has been weighed. Grinding chicken meat with a meat chopper until evenly smooth, mixing (add tapioca flour, salak seed flour, garlic, egg, cooking oil, salt, pepper, and ice cubes). Then mashed again until evenly distributed with a meat chopper. Printing the meatball dough to form a round shape. Then the finished meatball dough is boiled in water at 60 - 80˚C for 8 minutes until the meatballs float, then boiled again with boiling water for 30 minutes. Meatballs that have been boiled are cooked, drained to cool.

2.2 Research Analysis

2.2.1. Raw Material Evaluation

The raw material analyzed was snake fruit seed flour. The analysis included moisture content, ash content, and glucomannan content.

2.2.2. Physicochemical Evaluation of Meatballs

Parameters analyzed include moisture content, protein content, WHC *(Water Holding Capacity)*, and chewiness test, including *hardness* and *cohesiveness*.

2.2.3 Evaluation of Sensory of Meatballs

The sensory characteristics selected to evaluate the quality of chicken meatballs include aroma, taste, color, and texture. A total of 30 panelists were assigned to rate the acceptability of the product using a 5-point scale ranging from “strongly like” to “strongly dislike.” Data analysis included the use of the Friedman test.

3. RESULT AND DISCUSSION

3.1 *Raw Material Analysis*

Analysis of raw materials in this study was carried out on salak seed flour. The results of raw material analysis can be seen in **Table 2.**

Table 2. Chemical Composition of Salak Seed Flour

Analysis	Salak Seed Flour (%)	Literature (%)	Tapioca Flour (%) “Rose Brand”
Moisture Content	12.64	11.18	11.1
Ash Content	2.9	1.2	3.73
Glucomannan Content	40.29	30.56	-

Based on **Table 2.** it is known that salak seed flour has a moisture content of 12.64%, ash content of 2.9%, and glucomannan content of 40.29%. Based on the results of research with the three literatures, most of the differences in results are not too significant. Then in tapioca flour in this study used tapioca flour brand “Rose Band” as listed above.

The shelf life of food can be extended by removing the water content to a certain level to avoid microbial growth. Too high water content can cause a decrease in the quality of the resulting product [7]. The results of the moisture content analysis showed that moisture content of salak seed flour amounted to 12.64%. The moisture content of the flour analysis results above is quite good because it has reached the range of safe flour moisture content of less than 14%. When compared with the water content in previous studies, the water content obtained in this study is not much different from the results [8], which is 11.18%.

The main benefit of determining the ash content of a food ingredient is to determine the amount of mineral content contained in the material [9]. The results of the ash content analysis showed that the ash content of salak seed flour was 2.9%. When compared with the results of previous studies, the ash content obtained in this study is also not much different from the results of [8], which is 1.2%. Then in the results of glucomannan content research, obtained glucomannan content of salak seed flour as large as 40.29%. The results of the research on glucomannan levels are not much different from the research of [10], who measured glucomannan levels in konjac flour from iles-iles plants with the phenylhydrazine method, which amounted to 30.56%. This means that glucomannan in salak seeds is much higher when compared to konjac tubers, which have been the source of glucomannan.

3.1 Physicochemical Analysis of Meatballs

3.1.1. Moisture Content

Based on the analysis of variance, it can be seen that there is a significant interaction ($p \leq 0.05$) between the treatment of the addition of salak seed flour concentration and tapioca flour in chicken meatballs and each treatment gives a significant effect on the water content of meatballs. The highest water content of meatballs was 69.71% in the treatment of 15%

salak seed flour addition and 35% tapioca flour treatment, while the lowest water content obtained was 68.42% in the treatment of 5% salak seed flour addition and 25% tapioca flour. The higher the addition of salak seed flour and the higher the addition of tapioca flour, the higher the water content of the meatballs produced. This is due to the high starch content in salak seed flour and tapioca flour. The starch content in salak seed flour is 85% and the starch in tapioca flour is 90%, so it has properties that can absorb water.

Table 3. Physicochemical Characteristics of Meatballs

Samples	Cohesiveness (mJ)	Hardness (N)	WHC (%)	Moisture (%)	Ash (%)	Lipid (%)	Protein (%)
S1T1	0.40±0.010	216.64±0.618	18.58±0.016	68.42±0.096	1.36±0.099	5.54±0.127	15.48±0.186
S1T2	0.42±0.000	219.40±0.572	18.59±0.003	68.51±0.097	1.40±0.015	5.55±0.045	15.47±0.044
S1T3	0.43±0.006	220.66±0.570	18.63±0.009	68.57±0.072	1.59±0.138	5.55±0.062	15.39±0.136
S2T1	0.44±0.006	223.97±0.538	18.61±0.007	68.48±0.127	1.49±0.091	5.41±0.015	15.41±0.082
S2T2	0.46±0.006	230.79±0.535	18.66±0.058	68.93±0.026	1.81±0.151	5.44±0.025	15.45±0.015
S2T3	0.50±0.006	234.93±0.565	18.68±0.006	69.56±0.031	1.81±0.056	5.48±0.026	15.50±0.021
S3T1	0.50±0.006	230.15±0.050	18.62±0.004	69.45±0.056	1.87±0.023	5.38±0.021	15.53±0.040
S3T2	0.51±0.010	242.09±0.035	18.75±0.003	69.53±0.035	1.84±0.061	5.41±0.025	15.54±0.082
S3T3	0.54±0.010	247.13±0.046	18.79±0.005	69.71±0.036	1.93±0.010	5.49±0.067	15.62±0.068

This is reinforced [11], which states that at the end of the amylose and amylopectin molecular chains, there are hydroxyl groups that are in the water and starch dispersion system, so the hydroxyl groups can interact with hydrogen groups from water, thus causing flour with high starch content to have a large absorption capacity. [12] The maximum moisture content of meatballs is 70%. In this study, it has met the Indonesian National Standard, namely the moisture content of chicken meatballs, ranging from 68.42-69.71%

3.1.2. Ash Content

Based on the results of the analysis of variance, it can be seen that there is no significant interaction ($p \geq 0.05$) between the treatment of salak seed flour concentration and tapioca flour on the ash content of meatballs. The highest average ash content of meatballs was found in the 15% salak seed flour addition treatment at 1.88%, while the lowest ash content of meatballs was found in the 5% salak seed flour addition treatment at 1.45%. The higher the concentration of salak seed flour added, the higher the ash content. It is suspected that the addition of salak seed flour to chicken meat dough can increase the ash content so that the ash content in salak seed flour increases. This is following the research of [9] which stated that there was a significant increase in ash content along with the increase in the addition of purple sweet potato added in meatball processing. According to [12] the ash content in processed meatballs is a maximum of 3%. In this study, it has met the Indonesian National Standard, namely ash content ranging from 1.66-1.88%.

The highest average ash content of meatballs was found in the 35% tapioca flour addition treatment at 1.77%, while the lowest ash content of meatballs was found in the 5% tapioca flour addition treatment at 1.57%.

Based on the results of the analysis of the ash content of meatballs, tapioca flour contributes to the ash content of meatballs, the higher the concentration of tapioca flour added, the ash content will increase. It is suspected that there are many minerals present in tapioca flour, these minerals are considered as impurities that enter the glycerin during processing or are already present in the ingredients for making glycerin. This is following the research of [13] which states that emulsion products such as sausages with the addition of porang flour can change the concentration of some minerals which increases.

3.1.3. Fat Content

Based on the results of the analysis of meatball fat content in salak seed flour, it can be seen that the higher the concentration of salak seed flour added, the fat content of meatballs increases so that it is significantly different. This is because the largest content in salak seed flour is glucomannan at 40.29%, while the fat content in low salak seed flour is only around 3.07%, so salak seed flour does not contribute to the fat content of the meatballs produced. [12], the fat content in processed meatballs is a maximum of 10%. In this study, it has met the Indonesian National Standard, namely the fat content of chicken meatballs ranging from 5.43%-5.55%.

Based on the results of the analysis of meatball fat content in tapioca flour, it can be seen that the higher the concentration of tapioca flour added, the fat content of meatballs increases but is not significantly different. This is due to the low fat content in tapioca flour, which is only around 3.39%, so it does not significantly affect the fat content of the meatballs produced.

3.1.4. Protein Content

Based on the analysis of variance, it can be seen that there is no significant interaction ($p \geq 0.05$) between the treatment of salak seed flour concentration and tapioca flour. The treatment of salak seed flour concentration has a significant effect on the protein content of the meatballs produced, but the treatment of tapioca flour concentration has no significant effect on the protein content of the meatballs.

The highest meatball protein content in the treatment of the addition of salak seed flour was found in the treatment of

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15% salak seed flour addition at 15.57%, while the lowest meatball protein content value was found in the treatment of 5% salak seed flour addition at 15.45%. The higher the concentration of salak seed flour added, the higher the protein content of the meatballs. This is due to the protein content in salak seed flour of 4.30%, so the higher the addition of salak seed flour added can contribute to the protein content of the meatballs produced. [12] the minimum protein content in meatballs is 11%. In this study, it has met the Indonesian National Standard, namely the fat content of chicken meatballs ranging from 15.45%-15.57%.

The highest protein content of meatballs in the treatment of adding tapioca flour was in the treatment of adding 35% tapioca flour at 15.50%, while the lowest value of meatball protein content was in the treatment of adding 25% tapioca flour at 15.47%. The higher the concentration of tapioca flour added, the higher the protein content of the meatballs, but not significantly different. This is because the protein content in tapioca flour is only 0.59%, so the more tapioca flour added does not significantly affect the protein content of the meatballs produced.

3.1.5. WHC (Water Holding Capacity)

Based on Figure 9, it can be seen that the higher the addition of salak seed flour and the higher the addition of tapioca flour, the higher the WHC of the meatballs produced. This is because the higher the salak seed flour added, the glucomannan content in the meatballs will increase because it can form more hydrocolloid gel. Then the higher the tapioca flour added in the meatball dough, the starch content in the meatballs will also increase, so that the salak seed flour and tapioca flour have a real effect and can contribute to the WHC of the meatballs produced, both of which have strong water binding power. This is following the research [14] which states that increasing the concentration of glucomannan can increase water binding power because in the process of forming a water gel that can be bound by hydrocolloids more and more.

The starch contained in tapioca flour in this study amounted to 98%. This is supported by the statement [15] which states WHC is important for the quality of meat and meat products including meatballs. The greater the water binding power, the higher the percentage of water bound in the product. Compounds that can bind water in meatballs are protein and starch/tapioca. Tapioca functions as a filler in making meatballs that can form a gel when heated. Gelatinization of starch results in considerable water binding and trapping.

3.1.6. Hardness Value

Hardness is one of the important parameters in food texture. Hardness in principle uses the amount of power (N) used to break the meatball product sample. The highest hardness of meatballs was 247.13 N in the treatment of 15% salak seed flour addition and 35% tapioca flour treatment, while the lowest hardness obtained was 216.64 N in the treatment of 5% salak seed flour addition and 25% tapioca flour.

Based on Figure 10, it can be seen that the higher the addition of snake fruit seed flour and the higher the addition of tapioca flour used, the higher the hardness value of the meatballs produced. This is because the use of more salak seed flour and tapioca flour will give the meatballs a harder texture, due to the high glucomannan content in salak seed flour, which is 40.29% and the starch content of tapioca flour is 98% which plays a role in the hydrocolloid gel. So that the high content of glucomannan in salak seed flour and starch in tapioca flour in this meatball dough contributes and increases the hardness value of the meatballs produced. This is following the research of [16] which states that the hardness of meatballs is influenced by the amount of flour added, the more the amount of flour used, the harder the meatballs produced.

3.1.7. Cohesiveness Value

Cohesiveness is done by looking at how far a material can deform before breaking or how much a material is pressed between teeth [17]. The highest cohesiveness of meatballs was 0.54% in the treatment of 15% salak seed flour addition and 35% tapioca flour treatment, while the lowest cohesiveness obtained was 0.40% in the treatment of 5% salak seed flour addition and 25% tapioca flour.

It can be seen that the higher the addition of salak seed flour and the higher the addition of tapioca flour used, the higher the cohesiveness value of the meatballs produced. This is influenced because high salak seed flour and tapioca flour will increase the cohesiveness of the meatballs. This is due to the high glucomannan content in salak seed flour and starch content in tapioca flour which plays a role in hydrocolloid gels that can contribute and increase the cohesiveness value of the meatballs produced. This is following the research [14] which states that cohesiveness is a sign of the strength of internal bonds that can form food, so the higher the cohesiveness value, the denser and more compact the texture of the resulting food product. Glucomannan is soluble and expands in water so that the molecules contained in salak seed flour will interact with water, then expand into a harder gel. Therefore, the higher the concentration of glucomannan used, the higher the cohesiveness value.

3.2. Sensory Analysis

Table 4. Sensory test result of Meatballs

Samples	Colour	Aroma	Taste	Texture
S1T1	4.00±0.95	3.90±1.18	3.17±0.91	3.57±0.90
S1T2	3.90±0.76	3.70±0.79	3.73±1.11	3.27±1.14
S1T3	3.73±1.05	3.80±0.92	4.07±0.98	3.30±1.09
S2T1	3.80±1.03	3.77±0.82	3.87±1.14	3.47±0.82
S2T2	3.93±0.98	3.93±1.05	4.10±0.96	3.57±1.17
S2T3	4.20±4.20	4.17±0.87	4.03±0.93	3.37±1.00
S3T1	3.80±3.80	3.77±0.94	4.13±1.11	3.90±1.24
S3T2	3.90±3.90	3.97±0.72	3.90±0.99	3.87±1.20
S3T3	3.87±0.84	3.83±1.05	3.60±1.16	337±1.27

3.2.1. Color

The treatment of adding the concentration of salak seed flour and tapioca flour (10%:35%) produced the highest color level of 126 and the treatment of adding the concentration of salak seed flour and tapioca flour (5%:35%) produced the lowest color level of 112. The comparison of the concentration of salak seed flour and tapioca flour used in making meatballs

does not really affect the color of the meatballs. The meatballs exhibit a slightly brownish color, influenced by both the type of flour used and the cooking process. Increasing the amount of salak seed flour tends to reduce the brightness of the meatball's color. This is following the research [2] on making meatballs with the addition of porang flour stating that after the boiling process in meatballs, the resulting color has a decrease in brightness with the increase in porang flour added.

3.2.2. Aroma

The treatment of the addition of salak seed flour and tapioca flour (10%: 35%) produced the highest level of aroma liking of 125 and the treatment of the addition of the concentration of salak seed flour and tapioca flour (5%: 30%) produced the lowest color level of 111. The ratio of the concentration of salak seed flour and tapioca flour used in making meatballs does not affect the aroma of the meatballs. In this study, the aroma of meatballs that stands out is the aroma of meat and spices used to make meatballs. This is thought to be because the salak seed flour and tapioca flour added to the product do not change the aroma of the chicken meatballs. This is supported by research [18] which states that the aroma that exists and arises in meatballs is due to spices or additives mixed in the main ingredients of meatballs (meat and flour) including garlic, salt, pepper, etc.

3.2.3. Taste

Panelists liked the meatballs with a taste preference level value of 124 in the treatment of adding salak seed flour and tapioca flour (15%: 25%) and the treatment of adding the concentration of salak seed flour and tapioca flour (5%: 25%) produced the lowest taste preference level of 95. the ratio of the concentration of salak seed flour and tapioca flour used in making meatballs affects the taste of meatballs. The taste of the meatballs produced in this study is slightly savory. Apart from the addition of supporting ingredients such as (garlic, pepper, and salt), the taste of meatballs is also influenced by the addition of snake fruit seed flour. The higher the use of salak seed flour in chicken meatballs produces the low the savory taste. This is thought to be because the taste of snake fruit seed flour as a binder dominates other ingredients so that the savory taste of the meatballs produced will also decrease.

3.2.4. Texture

The treatment of adding the concentration of salak seed flour and tapioca flour (15%: 25%) produced the highest level of texture liking, namely 117 and the treatment of adding the concentration of salak seed flour and tapioca flour (5%: 30%) produced the lowest texture level, namely 98. The ratio of the concentration of salak seed flour and tapioca flour used in making meatballs affects the texture of the meatballs. From the results of this study, the meatballs produced had a chewy texture due to the addition of salak seed flour binder. Meatballs that are highly favored by the public are meatballs with a chewy texture. This is also supported by the research [16] which states that salak seed flour contains glucomannan which can trap water in the gel matrix so that the texture becomes more compact and hard. Panelists preferred the texture of chicken meatballs with a high chewiness value compared to chicken meatballs with low chewiness.

4. CONCLUSION

There was a significant interaction between moisture content, WHC, taste, and texture, but there was no interaction on protein content, and color and aroma preference scores of chicken meatballs. The best treatment is the proportion of salak seed flour: tapioca flour 10:35 with a moisture content of 69.56%, protein content 15.50%, WHC 18.68%, chewiness (hardness 234.93 N and cohesiveness 0.50 mJ), and color (4.20), aroma (4.17), taste (4.03), and texture (3.37).

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