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(RESEARCH ARTICLE)

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Organoleptic acceptance and characteristics of meatballs of jackfruit (artocarpus heterophyllus) mixed with tempeh

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Abstract

This study aims to determine the acceptance of panelists organoleptically including (color, aroma, taste, and texture) and the characteristics of meatballs of jackfruit mixed with tempeh. This study used a completely randomized design (CRD) with 5 treatments mixing jackfruit and tempeh with a ratio of 100:0, 90:10, 80:20, 70:30, and 60:40. The research data were analyzed using ANOVA and if it had a significant effect it was continued with the DNMRT test at the 5% level. The results showed a significant effect on moisture content, ash content, protein content, fat content, carbohydrate content, and organoleptic tests (taste and texture). However, it did not significantly affect the texture and organoleptic tests (color and aroma). The best treatment was in treatment B with a ratio of young jackfruit and tempeh of 225:25 with a product hardness of 3.70 N/cm2, moisture content of 65.81%, protein content of 2.38%, ash content of 1.64%, fat content of 2.26%, carbohydrate content 27.91%, and organoleptic color 3.8 (rather like), aroma 4 (like), taste 4 (like), texture 3.6 (kinda like).

Keywords: Acceptance; Characteristics; Meatballs; Jackfruit; Tempeh

1. Introduction

Bakso is a popular food in Indonesia which can be found in various regions. The main ingredient for meatballs is usually crushed meat, mixed with other ingredients such as flour and then rounded and then boiled. The most commonly used meat is beef, but over time, chicken and fish have been used as the main ingredients in making meatballs [1]. Meatball product is one of the processed foods that can be used with young jackfruit as a substitute for animal meat. The high-fat content in animal meat has caused some people to avoid consuming processed food products made from animal meat. Beef contains 14 g of total fat and 70 mg of cholesterol in 100 g of material, chicken meat contains 25 g of total fat and 60 mg of cholesterol in 100 g of material, and mutton contains 9.2 g of total fat and 70 mg cholesterol in 100 g of material [15].

Jackfruit is a plant that is widely grown in Indonesia because jackfruit has several advantages, namely this plant is widely known by the public. People are used to processing and consuming it. However, until now jackfruit has not been utilized optimally. The community only uses young jackfruit to be processed into vegetable side dishes. Even though young jackfruit has a lot of potentials to be processed into various processed foods. Jackfruit is still considered a low-value fruit due to the ignorance of the community in processing jackfruit young people into various processed foods [2]. Jackfruit is rich in vitamins A, B, and C, calcium, potassium, magnesium, and iron. Compounds contained in jackfruit include thiamine, riboflavin, and niacin. Jackfruit has a high vitamin C content and can be used as a good antioxidant. Antioxidants are known to neutralize free radicals in the body and improve white blood cell function.

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Vegetable products contain low protein so they need fortification. Fortification is an effort to enrich certain nutritional elements in a food ingredient. Fortification must be managed properly so that organoleptic values or sensory values related to consumer appetite are not neglected [3]. Some ways can be done to increase the protein value in jackfruit meatballs, one of which is protein fortification by adding protein sources from other ingredients. Tempeh can be used as a protein fortification for jackfruit meatball products because the protein content in tempeh is high and low in fat, so it is safe to use protein fortification for jackfruit meatballs.

Tempeh is a traditional food from Indonesia that is produced by fermenting soybean seeds processed by Rhizopus sp. Tempeh is a local food source of protein. 100 g of tempeh contains 20.8 g of protein which is rich in the amino acid lysine (43.1 mg/g), which can be complementary when combined with cereals. Tempeh also has protein with a higher digestibility value, which is 83% when compared to soybeans which are only 75% [4]. Nutrition in tempeh includes protein, fat, carbohydrates, vitamins, and minerals. The active compounds contained in tempeh include isoflavones which can reduce cholesterol levels. The mechanism for reducing cholesterol is through increasing the catabolism of fat cells as an energy source, thereby reducing plasma cholesterol levels. During the tempeh fermentation process, the degree of saturation of fat increases, which increases the amount (of polyunsaturated fatty acids, PUFAs). Unsaturated fatty acids have the effect of lowering serum cholesterol, so they can neutralize the effects of negative sterols in the body [5].

2. Methodology

2.1. Materials and Tools

The main ingredients used in the study were young jackfruit, a type of jackfruit pulp, with the characteristics of the fruit skin being still green, not yet emitting a distinctive aroma, the flesh was pale in color, and still contained a lot of latex [6] and tempeh, which was obtained from one of the markets in the city of Padang. The ingredients used for making meatballs include tapioca flour, ice water, salt, eggs, garlic, shallots, and pepper obtained from a market in the city of Padang.

2.2. Instrumentation

The tool used in this study were digital scales, a blender, a steamer, an oven, a measuring cup, a desiccator, Erlemeyer, a porcelain cup, rheotex, kjehdal flask, soxhlet, a beaker, and an aluminum cup.

2.3. Research Design

This research used in this study was a Completely Randomized Design (CRD) with 5 treatments and 3 replications. The data obtained were analyzed statistically using the F test, if significantly different it was continued with Duncan's Multiple Range Test (DNMRT) at a 5% significance level.

The treatments is:

- A = Young Jackfruit 250 g : Tempeh 0 g
- B = Young Jackfruit 225 g : Tempeh 25 g
- C = Young Jackfruit 200 g : Tempeh 50 g
- D = Young Jackfruit 175 g : Tempeh 75 g
- E = Young Jackfruit 150 g : Tempeh 100 gr

2.4. Implementation of Research

2.4.1. Determination of Formulation

The formulation in research this is the manufacture of meatballs from a mixture of young jackfruit, based on the formula made by Lamadjido et.,al [7] with modifications. The formula for the manufacture of jackfruit meatballs is shown in table 1.

Table 1 Formulation of Material in Making Jackfruit Mixed Meatballs Young With Tempeh

Material Component	Treatments				
	A	B	C	D	E
Tempeh (g).	0	25	50	75	100
Young Jackfruit (g).	250	225	200	175	150
Tapioca (g).	95	95	95	95	95
Wheat Flour (g).	18	18	18	18	18
Egg.	1	1	1	1	1
Shallot (g).	4	4	4	4	4
Garlic (g).	5	6	5	5	5
Pepper Powder (g).	1	1	1	1	1
Salt (g).	7	7	7	7	7
Flavoring (g).	1	1	1	1	1

Source: Lamadjido [7] modified.

2.4.2. Procedure

Making Jackfruit Meatballs by Lamadjido [7] with modification

- The young jackfruit is cut into small pieces and then steamed for about 45 minutes until the young jackfruit is soft.
- Then enter the young jackfruit which has been steamed in a food chopper until smooth.
- Additional ingredients in making meatballs are then added and stirred again with a food processor.
- After it is thoroughly mixed, then form a round dough and boil it in boiling water until the meatballs appear on the surface which indicates the meatballs are cooked.

2.4.3. Jackfruit Meatballs Product Analysis

Observations were made on texture tests [8], sliced appearance, moisture content [9], ash content [9], protein content [10], fat content [11], carbohydrate content, and organoleptic [12].

2.4.4. Data Analysis

The research data were analysed by analysis of variance (ANOVA), for the treatment that had an effect, continued with the MVL test at the 5% level. The data is displayed in tabular form in the form of mean ± standard deviation.

3. Results and discussion

Physical Properties Analysis of Jackfruit Mixed Meatballs Young with Tempeh

3.1. Texture/Hardness

The results on Texture/Hardness can be seen in table 2.

Based on the results of the data analysis, the results showed that the more tempeh mixed with the young jackfruit meatball product, the more the texture hardness of the meatballs increased. In this study, tests were also carried out on the control, namely meat-based commercial meatballs beef and chicken obtained an average texture of 3.74 N/cm^2.

The texture of the resulting meatballs is determined by the water content, fat content, and the type of carbohydrates mixed in it. The large amount of mixing of jackfruit and tempeh causes the absorption of water to increase which affects the resulting texture of the meatball product. In addition, according to research by Manurung [13] jackfruit contains starch which consists of amylose which gives it a springy nature and amylopectin which causes meatball products to

become sticky to one another which plays a role in gel formation. In this study, it was shown that treatment E had the highest value because treatment E had the most mixed tempeh.

Table 2 Texture/Hardness of Jackfruit Meatballs

Treatments	Texture (N/cm^2) ± SD
A (N 250 g : T 0 g).	3.68 ± 0.09
B (N 225 g : T 25 g).	3.70 ± 0.07
C (N 200 g : T 50 g).	3.77 ± 0.30
D (N 175 g : T 75 g).	4.02 ± 0.09
E (N 150 g : T 100 g).	4.14 ± 0.37
CV = 5.82%	

Note: Notes : N = Young Jackfruit, T = Tempeh. Numbers in the same column followed by unequal lowercase letters are significantly different according to DNMRT at the 5% level.

3.2. Sliced Appearance

Based on the results of the visual analysis, the meatballs that had mixed levels of tempeh and jackfruit did not differ significantly from the commercial meatballs traded in the market in terms of product smoothness and texture. However, when viewed from the shape of the product pores, the meatballs with treatment A (0%) had a smoother product result and were not porous compared to commercially traded meatballs.

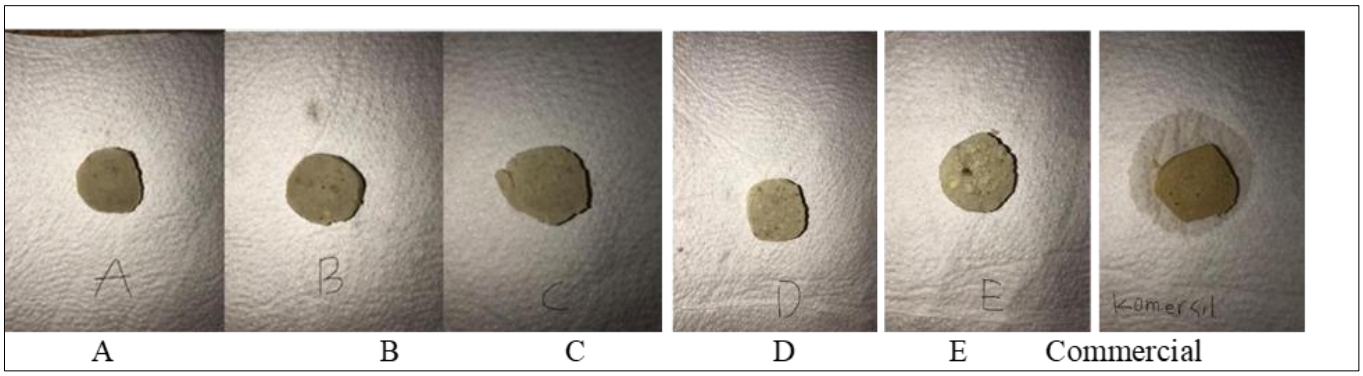

Figure 1 Product Jackfruit Meatballs

Table 3 Water content of Jackfruit Meatballs

Treatments	Water Content (%) ± SD	
A (N 250 g : T 0 g).	66.89 ± 0.55	d
B (N 225 g : T 25 g).	65.81 ± 0.55	c
C (N 200 g : T 50 g).	64.92 ± 0.32	b
D (N 175 g : T 75 g).	63.55 ± 0.46	a
E (N 150 g : T 100 g).	62.90 ± 0.20	a
CV = 0.68%		

The results of the visual analysis illustrate that the less tempeh mixture is added to the meatballs, the coarser the slices will be with a non-porous composition of the layer structure. This is because the meatballs made from jackfruit produce a stronger stickiness to bind the ingredients to the meatballs so that the meatballs look denser and less porous. This is to the results of a study by Sardiman et.,al [14] which found that jackfruit contains amylopectin which affects the swelling power of mixing substances in food. According to [15] increased swelling power affects maximizing the water

absorption of food products which is influenced by the weight of amylopectin and amylose molecules in the product. This is in line with the results of a visual observation study which resulted in the finding that the more jackfruit content is added to the product, the product looks denser and the more it binds the fibers to one another so that pores do not form in the meatballs when sliced crosswise. The most are treatment E (40%).

Chemical Properties Analysis of Jackfruit Mixed Meatballs Young with Tempeh

The resulted analysis of chemical properties analysis can be seen in table 3, table 4, table 5, table 6, table 7.

Table 4 Ash content of Jackfruit Meatballs

Treatments	**Ash Content (%) ± SD**	
C (N 200 g : T 50 g).	1.08 ± 0.20	a
E (N 150 g : T 100 g).	1.31 ± 0.29	a b
B (N 225 g : T 25 g)	1.64 ± 0.2	a b c
D (N 175 g : T 75 g).	1.72 ± 0.46	b c
A (N 250 g : T 0 g).	1.95 ± 0.49	c
CV = 20.53%		

Table 5 Protein Content of Jackfruit Meatballs

Treatments	**Average Protein Content (%) ± SD**	
B (N 225 g : T 25 g)	2.38 ± 0.08	a
A (N 250 g : T 0 g).	2.61 ± 1.10	a
C (N 200 g : T 50 g).	3.13 ± 0.39	a
D (N 175 g : T 75 g).	4.26 ± 0.03	b
E (N 150 g : T 100 g).	6.52 ± 0.31	c
CV = 14.33%		

Table 6 Fat Content Of Jackfruit Meatballs

Treatments	**Average Fat Content (%) ± SD**	
A (N 250 g : T 0 g).	2.06 ± 0.01	a
B (N 225 g : T 25 g).	2.26 ± 0.21	a b
C (N 200 g : T 50 g).	2.28 ± 0.52	a b
D (N 175 g : T 75 g).	2.98 ± 0.24	b c
E (N 150 g : T 100 g).	3.51 ± 0.28	c
CV = 16.11%		

Table 7 Carbohydrate Content Of Jackfruit Meatballs

Treatments	Average Carbohydrate Content (%) ± SD	
E (N 150 g : T 100 g).	25.76 ± 0.28	a
A (N 250 g : T 0 g).	26.49 ± 1.37	a
D (N 175 g : T 75 g).	27.49 ± 0.32	b c
B (N 225 g : T 25 g).	27.91 ± 0.63	c
C (N 200 g : T 50 g).	28.58 ± 0.05	c
CV = 2.57%		

Note: N = Young Jackfruit, T = Tempeh. Numbers in the same row followed by the letter small that doesn't same, different significant at 5% Duncan's New Multiple Range Test (DNMRT).

3.2.1. Water Content

Based on table 3, the results of the water content analysis test with a 95% confidence interval, it was stated that each test component had a significant difference relationship. The highest average water content test results were obtained by sample A (250 g young jackfruit: 0 g tempeh) while the lowest average water content was obtained by sample E (150 g young jackfruit: 100 g tempeh). The data stated that the higher the mixed concentration of tempeh in the meatballs.

This is because the difference in water content in the raw material for young jackfruit meatball products has a higher water content value than tempeh, which is 85%, while the moisture content of tempeh is 55.3%. The difference in water content in the raw material causes differences in water content in the resulting meatball products. Because the water content of Tempeh is lower than the water content of young jackfruit, which means that there is less young jackfruit in the product and more tempeh in the product, causing the water content to decrease as the mixing of tempeh increases [15].

3.2.2. Ash Content

Based on the table 4**,** the results of the analysis of ash content using a 95% confidence interval, it was found that the maximum ash content produced was in treatment A (250 g young jackfruit : tempeh 0 g), and the minimum ash content was found in treatment C (200 g young jackfruit: 50 g tempeh). The concentration the addition of tempeh in young jackfruit meatballs affects changes in the mineral content contained in young jackfruit meatballs.

This study shows that the less mixing of tempeh and the more mixing of young jackfruit in meatball products, the higher the value of ash content in the product. Young jackfruit raw materials contain several minerals including calcium, phosphorus, sodium, and iron which play an important role in the ash content of the product [15].

3.2.3. Protein Content

Based on the table 5, the average maximum protein content produced by meatballs was found in the E treatment, which was 6.52% and the minimum average protein content in the trial results was in treatment B, which was 2.38%. The highest protein content in this young jackfruit meatball product is almost the same as chicken meatballs in [16], which is 6.52%. Based on the observations, the higher the addition of tempeh in young jackfruit meatballs, the higher the yield of protein content contained in the meatball content. This indicates that tempeh has a considerable influence on the addition of protein levels in young jackfruit meatballs.

3.2.4. Fat Content

Based on the table 6, the greater the concentration of tempeh addition to young jackfruit meatballs results in a significant addition (95% confidence range) to the concentration of fat content produced by food products. This can be influenced by three things, including the main raw material for young jackfruit meatball products, namely young jackfruit, as well as the addition of tempeh concentration in the treatment. This is consistent with research by Astawan et.,al [17] which states that in tempeh various main ingredients shape the body's energy, especially fat.

3.2.5. Carbohydrate Content

Based on the table 7, carbohydrates were obtained in tempeh, which was 7.7% which caused the C treatment (Young jackfruit 200 g: Tempeh 50 g) to get the highest value because both raw material products both contain carbohydrates which are not small produced by young jackfruit meatballs with C treatment (Young jackfruit 200 g: Tempeh 50 g).

This happened because each sample contained erratic carbohydrates caused by the content of tempeh and young jackfruit in each treatment. Research by Handayani [18] explained that young jackfruit there is a fairly high carbohydrate content, which is around 36.7% so it has the potential to become an economical ingredient in making young jackfruit meatballs for the fulfillment of community nutrition. This is because the average carbohydrate consumed by Indonesians per day is as much as 300 grams out of 2100 calories needs every day.

3.3. Organoleptic analysis of Jackfruit Meatballs

The organoleptic test in this study were the hedonic test or the preference test. The hedonic test aims to determine the level of panelists' acceptance of the product jackfruit meatballs of color, aroma taste and texture carried out on 20 panelists.

3.3.1. Hedonic color

The Based on the research, there was no noticeable difference resulting from the assessment of the respondents on young jackfruit meatballs with a concentration of tempeh mixing. This is because the results of meatball products are boiled before serving, resulting in a relatively similar brownish ash color. The average study stated that the entire sample produced a value that was attracted by the color of the young jackfruit meatball product. This means that, in terms of color, young jackfruit meatballs with processed tempeh blending produce an attractive color for consumers. The results on hedonic color of jackfruit meatballs can be seen in table 8.

Table 8 Hedonic Color of Jackfruit Meatballs

Treatments	Hedonic Color ± SD
B (N 225 g : T 25 g)	3.8 ± 0.6
A (N 250 g : T 0 g).	3.9 ± 0.6
C (N 200 g : T 50 g).	4.0 ± 0
D (N 175 g : T 75 g).	4.0 ± 1
E (N 150 g : T 100 g).	4.0 ± 0
CV = 13.91%	

3.3.2. Hedonic aroma

Table 9 Hedonic aroma of Jackfruit Meatballs

Treatments	Hedonic color ± SD
A (N 250 g : T 0 g).	4.0 ± 1
B (N 225 g : T 25 g).	4.0 ± 1
C (N 200 g : T 50 g).	4.0 ± 0
D (N 175 g : T 75 g).	4.0 ± 1
E (N 150 g : T 100 g).	4.0 ± 1
CV = 18.56%	

The Based on the research, there was no noticeable difference resulting from the respondents' assessment of young jackfruit meatballs with the concentration of mixing tempeh against the aroma perspective. This is because of the same mixture of ingredients, namely young jackfruit and tempeh which produces a less pungent and not too characteristic odor when the concentration is changed. In addition, the results of meatball products are boiled before serving, resulting

in a relatively similar aroma The average study stated that the entire sample produced a value that was categorized as liking the aroma of young jackfruit meatball products. In other words, young jackfruit meatballs with processed tempeh mixed produce an attractive aroma for consumers. The results on hedonic aroma of jackfruit meatballs can be seen in table 9.

3.3.3. Hedonic taste

The Based on the research, it can be seen that the concentration of adding tempeh gives a different and quite noticeable taste between each sample. Taste is influenced by several factors, namely chemical compounds, temperature, concentration, and interaction of other flavor components. This is in line with the opinion [19] which states that the taste produced by food products is related to the concentration of ingredients and the combination of ingredient components in processed food. The results on hedonic taste of jackfruit meatballs can be seen in table 10.

Table 10 Hedonic taste of Jackfruit Meatballs

Treatments	Hedonic Taste ± SD
E (N 150 g : T 100 g).	3.2 ± 0.7
C (N 200 g : T 50 g).	3.0 ± 1
D (N 175 g : T 75 g).	3.0 ± 1
A (N 250 g : T 0 g).	3.2 ± 1
B (N 225 g : T 25 g).	4.0 ± 1
CV = 22.56%	

3.3.4. Hedonic Texture

The results of the study revealed that consumers prefer the texture produced from processed jackfruit meatballs with a concentration of tempeh mixed in the D treatment (30%). This is because the mixture results are smoother and more textured compared to other treatment mixtures. Factors that influence the suitability of this consumer assessment are the form of the ingredients mixed and the process of refining the materials. The results of a study by Pramuditya and Yuwono [20] produced similar findings where respondents did not like the texture of meatballs that are tender and soft or have a lot of pores. Respondents tended to be interested in the tougher or coarser texture of the meatballs. However, the results of this study found that the texture of meatballs that are too rough is also not liked by consumers. The results on hedonic texture of jackfruit meatballs can be seen in table 11.

Table 11 Hedonic texture of Jackfruit Meatballs

Treatments	Hedonic Color ± SD
E (N 150 g : T 100 g).	3.0 ± 1
C (N 200 g : T 50 g).	3.0 ± 1
A (N 250 g : T 0 g).	3.4 ± 0,8
B (N 225 g : T 25 g).	3.6 ± 0.8
D (N 175 g : T 75 g).	4.0 ± 1
CV = 21.78%	

4. Conclusion

The mixing of tempeh and young jackfruit in young jackfruit meatballs results in differences in physical, chemical, and organoleptic valuations in young jackfruit products. The results of the hardness texture test analysis ranged between the index of 36.82-41.27 N/cm2, the young jackfruit meatballs and tempe with the highest concentrations had a rougher structure than other meatballs according to the test results of the visual appearance of slices. The results of the chemical analysis include water content with an average of 62.90-66.89% which decreases as the concentration of young jackfruit and tempeh increases, protein content with an average range of 2.38-6.52%, ash content with a yield range of 1.08-

1.95%, fat content with a range of 2.06-3.51% which increases with the increase in the concentration of young jackfruit and tempeh, and carbohydrate content which has a range between 25.76-28.58%. Organoleptic analysis on the color and aroma sub-tests did not make a noticeable difference in consumers' perception of the product, the most preferred taste of consumers was a mixture of treatment B (10%), and the texture that consumers liked was D (30%) followed by treatment B (10%).

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest.

Significance Statements

Based on the research that has been carried out, the author suggested to the researchers analyze differences in physical, chemical, microbial, and organoleptic structures in variations of tempeh processed packages for young jackfruit meatballs.

Author Contributions

Rina Yenrina conducted the experiment, the data analysis and revise the manuscript, Kesuma Sayuti conducted the data analysis and revise the manuscript and Widya Fitri conducted the data analysis, writes the manuscript.

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