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Production Fruitghurt from Watermelon Skin with The Addition of Dragon Fruit Extract as A Natural Colorant

Hamsina[1,✉], Sonia[1], Fitri Ariani[1], Andi Zulfikar Syaiful[1], M. Tang[1], Ridwan[1], Hermawati[1], Al Gazali[1], Andi Abriana[2], Nani Anggraini[3], Ruslan Hasani[4]

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[1] Chemical Engineering Study Program, Faculty of Engineering, University of Bosowa Jalan Urip Sumoharjo Km.04 Makassar, Indonesia
[2] Food Technology Study Program, Faculty of Agriculture, University of Bosowa Jalan Urip Sumoharjo Km.04 Makassar, Indonesia
[3] Environmental Engineering Study Program Faculty of Engineering, University of Bosowa Jalan Urip Sumoharjo Km.04 Makassar, Indonesia
[4] Department of Nursing, Health Polytechnic, Ministry of Health Makassar Jl. Monumen Emmy Saelan III No. 1 Makassar , Indonesia

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Abstract

This study aimed to determine the optimum formulation of fruitghurt from the white layer of watermelon skin with the addition of dragon fruit extract and to analyze the effect of adding dragon fruit extract to pH, lactic acid levels, vitamin C and fruitghurt acceptability from the white layer of watermelon skin. This research method consisted of 5 stages, namely making watermelon skin filtrate, making watermelon extract, making dragon fruit extract, making fruitghurt and incubation (fermentation). In this study, 4 formulations were carried out with different proportions of adding dragon fruit extract. Formula A (100 ml of watermelon skin filtrate, 15 ml of watermelon extract, 0 ml of dragon fruit extract, 11.5 grams of skim milk, 11.5 grams of sugar, 23 grams of plain yogurt), formula B (100 ml of skin filtrate, 15 ml of watermelon extract, 3.5 ml dragon fruit extract, 11.5 grams skim milk, 11.5 grams sugar, 23 grams plain yogurt), formula C (100 ml watermelon peel filtrate, 15 ml watermelon extract, 6.5 ml extract dragon fruit, 11.5 grams of skim milk, 11.5 grams of sugar, 23 grams of plain yogurt), formula D (100 ml of watermelon skin filtrate, 15 ml of watermelon extract, 9.5 ml of dragon fruit extract, 11.5 grams of milk skim, 11.5 grams of sugar, 23 grams of plain yogurt). The sample tests that have been made include the pH test, lactic acid level test, vitamin C level test, and organoleptic test. The test data were analyzed statistically by using Analysis of Variance (ANOVA) and Ducans multiple Range Test (DMRT). The results obtained were the addition of dragon fruit extract had a significantly different effect on pH, lactic acid levels, vitamin C levels, taste, aroma, color, but had no significant effect on the texture of the fruitghurt produced. The optimum formulation obtained was in treatment D with a pH value (4.57), lactic acid content (2.04%), vitamin C content (0.031%), taste test 2.72 (somewhat like), color test 4.88 (like very much), texture test 4.08 (like), and aroma test 3.48 (like).

INTRODUCTION

Watermelon skin consists of a white layer which contains many substances that are useful for health (Khotimah, 2019) .Watermelon skin or watermelon albedo is the thickest and whitest part of the watermelon skin. Albedo contains nutrients such as vitamins, citrulline, minerals and enzymes, as well as pectin which is quite high at 21.03% so it is very good to be utilized and developed in

✉ Corresponding author:
E-mail: hamsinah@universitasbosowa.ac.id

Indonesia as a new food source (Rahmawati et al., 2019) . The sugar content in the white layer (mesocarp) of watermelon is one of the main components in lactic acid fermentation.

Fruitghurt is a fermented product of fruit juice or a mixture of various fruit juices. Even now fruitghurt has been developed with raw materials from fruit waste, namely fruit skin. (Arisanti & Islamiyah, 2020). Fruitghurt uses additional fruit juice in the fermentation process or a mixture of various types of fruit juice by utilizing the ability of lactic acid bacteria (LAB). According to (Mawarni & Fithriyah, 2015) Watermelon skin waste can be used as raw material for making fruitghurt, the results of the analysis of lactic acid levels show that watermelon skin fruitghurt meets national quality standards for probiotic drinks .

The producing of watermelon skin white layer filtrate in the use of watermelon skin as a raw material for producing yogurt shows the best combination of watermelon skin white layer and water based on organoleptic results is 1:2 (Prasetyo et al., 2017) .Producing fruitghurt from the white layer of watermelon skin needs innovation. The addition of this dye is intended to increase the attractiveness of the fruitghurt produced.

The fruits that can be used as a source of natural dyes is red dragon fruit (*Hylocereus polyrhizus).* Dragon fruit (H*ylocereus polyrhizus*) has red skin and purple flesh. Dragon fruit contains antioxidants and also prebiotic characteristics that can help the growth of lactic acid bacteria. According to (Cantika et al., 2019) red dragon fruit (*Hylocereus polyrhizus*) contains higher levels of vitamin C, vitamin B3 (niacin), fiber and betacyanin than white dragon fruit (*Hylocereus undatus*). The addition of yogurt with red dragon fruit besides being able to produce yogurt which is rich in antioxidants, red dragon fruit can also improve the appearance in terms of color because of the red or purple violet color which is sourced from the content of anthocyanin and betacyanin pigments.(Pratiwi et al., 2018)

The addition of red dragon fruit juice has an effect on chemical, microbiological characteristics and improves sensory properties (color, aroma and taste) produced from cow's milk yogurt and red beans dragon fruit contains 8-9 mg of vitamin C In per 100 g, red dragon fruit is expected to be able to produce the resulting fruitghurt product a good source of antioxidants for the body (Putri et al., 2019). Therefore, it is necessary to investigate the number of formulas using the optimum red dragon fruit extract in the process of producing watermelon rind fruitghurt so as to produce the best chemical and microbiological characteristics and improve sensory properties that can improve the quality of the resulting product. The purpose of the study was to determine the effect of adding dragon fruit extract to pH, lactic acid levels, vitamin C levels, and organoleptic properties of watermelon peel fruitghurt and to determine the optimum formulation of watermelon peel fruitghurt with the addition of dragon fruit extract.

MATERIALS AND METHOD

Materials

Materials used in this study were watermelon, dragon fruit, skim milk powder, aquadest, sugar, plain yogurt, phenolphthalein indicator, 0.1 N NaOH, $C_6H_8O_6$, $C_2H_2O_4$

The method used in this study was a completely randomized design (CRD) with 4 treatments of dragon fruit extract variations (0%,2%,4%,6%), with 3 repetitions each.The fixed variables in this study were watermelon skin filtrate, watermelon juice, 10% sugar, 10% skim milk, 20% plain yogurt, temperature 37 ^oC, and 8 days of fermentation.The independent variable in this study was dragon fruit extract (3%, 6%, 9%). The dependent variables in this study were pH, lactic acid levels, vitamin C content and organoleptic properties

Methods

Raw Materials Preparation

The white part of the watermelon rind was washed and cut into small pieces, it was then put in a blender and added to aquadest with a ratio of 100 gr: 200 ml, then mashed and filtered to obtain a clear filtrate.

Production of Watermelon Fruit Extract

The red watermelon was cut into small pieces and then mashed without using water in a blender. Watermelon juice was then filtered using a filter cloth to obtain watermelon juice.

Production of Dragon Fruit Extract

Red dragon fruit was peeled using a knife, and then it was cut into pieces to reduce the size to make it easier to destroy the dragon fruit. Peeled dragon fruit was crushed using a juicer. The red

dragon fruit pulp obtained was then filtered to separate the juice from the pulp using a filter cloth. After that, pasteurization was carried out at a temperature of 60-65°C for 15 minutes.

Production of Fruitghurt

Watermelon skin filtrate was added to watermelon juice in a ratio of 100 ml: 15 ml, added 10% sugar, 10% skim milk, it was then pasteurized at 75-80°C while stirring for 15 minutes. After pasteurization, it was cooled to a temperature of 40-43°C. Then, dragon fruit was added according to the treatment and inoculates the starter (*Lactobacillus bulgarius* and *Streptococus thermophillus* cultures), namely plain yogurt at a temperature of 43-45°C as much as 20% of the raw material volume and then it was stirred until evenly distributed so that a homogeneous texture is obtained. After that, it was put in glass bottles that have been previously sterilized. The glass jar was then covered with a bottle cap and covered with aluminum foil. Samples were fermented for 8 days at 37°C.

pH Test

Fruitghurt samples were tested using a pH meter. The pH meter was previously calibratied with a buffer solution. Measurements were made by immersing the pH meter electrode into 10 ml of sample.

Lactic Acid Content (AOAC et al., 1980)

10 ml of sample was poured into Erlenmeyer A then added distilled water until the volume became 100 ml and homogenized. Then, 10 ml of Erlenmeyer A solution was poured into Erlenmeyer B and 3 drops of Phenolphtalein indicator were added. Next, the solution in Erlenmeyer B was titrated with 0.1 N NaOH until the solution was pink and stable. Lactic acid levels are calculated by the following formula;

$$Lactic\ Acid\ Levels\ (\%) = \frac{V_{NaOH} \times N_{NaOH} \times 0.09 \times fpc \times 100}{W_{sample}} \quad (1)$$

Where, V_{NaOH} is the voluem of NaOH (ml), N_{NaOH} is the normality of NaOH, fpc is dillution factor and W_{sample} is the sample weight.

Content of Vitamin C (Sudarmadji, 1989)

The content of vitamin C was tested using the spectrophotometric method. The fruitghurt sample was weighed in the amount of 0.4 gram and then put into a 10 ml volumetric flask then added distilled water until the boundary mark was then homogenized. Furthermore, the absorbance was measured at the maximum wavelength obtained, namely 265.8 nm.

Organoleptic Test

The organoleptic test was carried out by testing by 25 people using a hedonic scale with a value between 1-5 descriptively, namely 5 (very like), 4 (like), 3 (rather like), 2 (dislike), 1 (dislike very much), for assess color, texture, aroma, taste and acceptability

RESULTS AND DISCUSSION

Determination of Watermelon Fruitghurt pH with the addition of dragon fruit extract

The results of the analysis of the pH value of the watermelon Fruitghurt with the addition of dragon fruit extract (*Trigona* sp) can be seen in Figure 1.

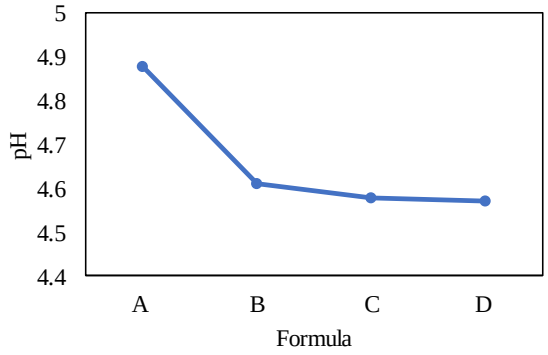

Figure 1. pH of the fruitghurt.

The results of the analysis of variance showed that the concentration of dragon fruit extract had a significant effect (P<0.05) on the pH of watermelon skin fruitghurt. The value of p = 0.00 which means that there is a significant difference in the pH level of watermelon skin yogurt with the addition of dragon fruit extract. Then proceed with the Duncan test to find out which formulas have differences and the results obtained are that formula A (0% dragon fruit extract) is significantly different from formula B (3% dragon fruit extract), C (6% dragon fruit extract), and D (9% dragon fruit extract). (Asikin et al., 2017). However, formulas B (3% dragon fruit extract), C (6% dragon fruit extract) and D (9% dragon fruit extract) had no significant difference Figure 1.

Based on the results of analysis of variance, the addition of red dragon fruit extract concentration had a significant effect on the pH value of watermelon rind yogurt. The average pH of the resulting fruitghurt indicated that the higher the concentration of dragon fruit extract, the more acidic the fruitghurt was. The average pH value of the resulting fruitghurt is around 4.88-4.57, the pH is in accordance with the quality requirements of SNI yogurt with number 2981:2009 is 4.5-5.

Based on Duncan's test, the addition of dragon fruit extract had a significant effect on the pH of fruitghurt and the results of the pH meter measurement showed that giving dragon fruit extract to fruitghurt watermelon rind formula A (control) was 4.88 without adding dragon fruit, which was higher than fruitghurt which was given dragon fruit extract. This is because dragon fruit contains simple sugars such as glucose, fructose and oligosaccharides which can be a food source for lactic acid bacteria so that the lactic acid bacteria produced also make the atmosphere more acidic and lower the pH. This is also in accordance with research (Rasbawati et al., 2019) the addition of red dragon fruit pulp to this yoghurt set is able to create more acidic conditions compared to no treatment.

Determination of Fruitghurt Lactic Acid Levels With the Addition of Dragon Fruit Extract

The results of the analysis of lactic acid levels in watermelon fruitghurt with the addition of dragon fruit extract can be seen in Figure 2.

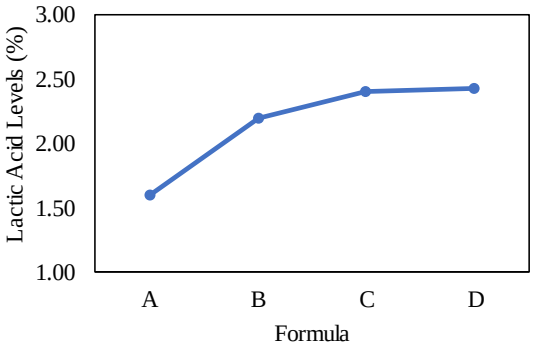

Figure 2. Lactic acid levels.

The results of the analysis of variance showed that the concentration of dragon fruit extract had a significant effect (P<0.05) on the lactic acid content of fruitghurt watermelon rind. The value of p = 0.000 which means that there is a significant difference in lactic acid levels of watermelon skin fruitghurt with the addition of dragon fruit extract. Then proceed with Duncan's test to find out which formula has a significant difference. The results of formula A (0% dragon fruit extract), formula B (3% dragon fruit extract), C (6% dragon fruit extract) and D (9% dragon fruit extract) had no significant difference. Based on the results of the analysis of variance, the addition of the concentration of red dragon fruit extract had a significant effect on the lactic acid content of watermelon rind fruitghurt. Then proceed with Duncan's test (appendix B) to find out formulas that have significant differences. Based on the results of Duncan's test, formula A (0% dragon fruit extract) was significantly different from formula B (3% dragon fruit extract), C (6% dragon fruit extract) and D (9% dragon fruit extract). This is because fruitghurt with the addition of dragon fruit extract contains simple sugars such as glucose, fructose and oligosaccharides which can be a food source for lactic acid bacteria (Maisaro & Utomo 2022).

Determination of Vitamin C content of Watermelon Peel Fruitghurt With the Addition of Dragon Fruit Extract

Table 1 shows the results of the analysis of vitamin C content of watermelon skin fruitghurt with the addition of dragon fruit extract, which ranges from 0.018 to 0.037%. The results of the analysis of variance showed that the concentration of dragon fruit extract had a significant effect (P<0.05) on the lactic acid content of fruitghurt watermelon rind. The value of p = 0.000 which means that there is a significant difference in the levels of vitamin C fruitghurt watermelon rind with the addition of dragon fruit extract. Then proceed with Duncan's test to find out which formula has a significant difference and the results obtained for each formulation have a significant difference. so that it can accelerate the growth rate of bacteria and the resulting lactic acid bacteria also make the atmosphere more acidic and lower the pH.(Xie et al., 2021).

Vitamin C is also called ascorbic acid, is the simplest vitamin, easily changed due to oxidation, but very useful for the human body. Its chemical structure consists of a chain of 6 C atoms and its position is unstable ($C_6H_8O_6$), because it easily reacts with O_2 in air to become dehydroascorbic acid. Vitamin C acts as an antioxidant which is one of the body's most important defense mechanisms against free radicals (Hasanah, 2018). In formula A (0% addition

Table 1. Watermelon skin fruitghurt vitamin c levels with dragon fruit extract addition.

Vitamin C Levels	Average Value (%)
A (addition of dragon fruit extract 0%)	0.018[a]
B (addition of dragon fruit extract 3%)	0.037[b]
C (addition of dragon fruit extract 6%)	0.027[c]
D (addition of dragon fruit extract 9%)	0.031[s]

Note: a,b "Different superscript notations show significantly different effects at the p<0.05 level.

of red dragon fruit juice) the total acid produced was the lowest. This is because the energy source for LAB only comes from watermelon carbohydrates and skim milk, while formulas B (3% dragon fruit extract), C (6% dragon fruit extract) and D (9% dragon fruit extract) produce higher levels of lactic acid. high, because the addition of red dragon fruit juice is another source of energy used by LAB in the fermentation process, stated that the sugar contained in the fermentation media would be utilized by LAB during the fermentation process for its growth.

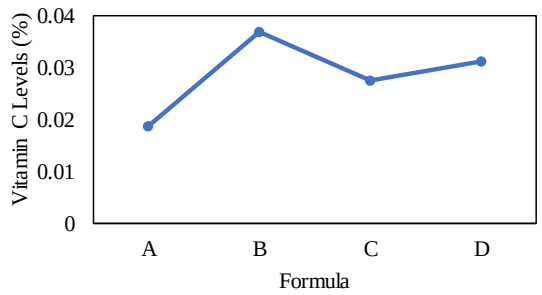

Figure 3. Vitamin C levels

Vitamin C levels in watermelon skin fruitghurt with the addition of dragon fruit extract ranged from 0.018-0.037%. This is because the materials used are watermelon and dragon fruit. Based on the results of analysis of variance, the addition of dragon fruit extract had a significant effect on watermelon rind fruitghurt (P<0.05). Then Duncan's further test was carried out with the result that formulas A (0% dragon fruit extract), B (3% dragon fruit extract), C (6% dragon fruit extract) and D (9% dragon fruit extract), there were significant differences. A (0% dragon fruit extract) contains lower levels of vitamin C than formula B (3% dragon fruit extract), C (6% dragon fruit extract) and D (9% dragon fruit extract). This is due to the addition of dragon fruit extract can increase the levels of vitamin C in the resulting fruitguhrt. The vitamin C level of red dragon fruit was 14.92 mg/100 grams (Yulianto, 2022).

The cause of increased and decreased levels of vitamin C in fruitghurt with the addition of dragon fruit extract is because vitamin C has properties that dissolve easily in water, is easily oxidized by outside air and other factors that can reduce vitamin C levels, namely also due to the heating process during processing. materials used. Storage factors can affect the vitamin C content of an ingredient. There is a reduction rate because based on research, dragon fruit is stored in the refrigerator at 6 °C, the longer the vitamin C will decrease.

Organoleptic Test

Taste

The results of the fruitghurt acceptability assessment based on taste can be seen in Table 2.

Table 2. Fruitghurt taste acceptability.

Formula	Average value
A	3.48[a]
B	2.16[b]
C	2.43[b]
D	2.72[a]

Notes: a,b "Different letters in the notation column show a markedly different influence on the level of p<0.05.

In Table 2 Acceptability of fruitghurt based on taste, the average value obtained ranges from 2.16 to 3.48. the value of p <0.05, which means the addition of dragon fruit extract has a significant effect on the taste of the resulting watermelon skin fruitghurt. Followed by the Ducan test and the results obtained for each formula had a significant difference, and it can be concluded that the treatment with the best value based on taste was Formula A (0% Dragon fruit extract) and the treatment with the lowest score was Formula B (3% dragon fruit extract).

Based on the results of the organoleptic test, the panelists preferred formula A (0% dragon fruit extract) because the resulting taste was not too sour. while formulas B (3% dragon fruit extract), C (6% dragon fruit extract) and D (9% dragon fruit extract) were not liked by the panelists because they had a very sour taste.

According to Kumalaningsih et al (2016) in the process of making yogurt, lactic acid bacteria

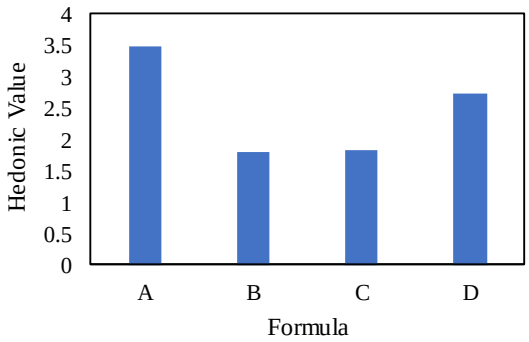

Figure 4. Fruitghurt taste acceptability.

have a very important relationship, where these bacteria will mutually utilize the results of metabolism to produce acid. At the beginning of growth, S. thermophilus and L. bulgaricus need free amino acids found in milk, then the proteolytic activity of *Lactobacillus Bulgaricus* will produce the amino acids histidine and lysine and peptides needed by S. thermophilus. Meanwhile *Stearothermophilus* produces carbon dioxide and formate which will stimulate the growth of *Lactobacillus Bulgaricus* to produce lactic acid which can lower the pH so that the yogurt will taste sour.

At a concentration of 3%, 6%, 9% dragon fruit extract, the fruitghurt produces a very sour taste. This is because the addition of dragon fruit extract increases lactic acid levels and decreases the pH value of the resulting fruitghurt. So the panelists tend to prefer formula A (0% dragon fruit extract) because the taste is not too sour.

Color

The results of the fruitghurt acceptance assessment based on color can be seen in Table 3.

Table 3. Fruitghurt color acceptability.

Formula	Average value
A	3.32[a]
B	4.28[b]
C	4.28[b]
D	4.88[c]

Note: a,b "Different letters in the notation column showed a significantly different effect at the level of $p < 0.05$.

In Table 3 the acceptability of fruitghurt based on color, the average value obtained ranges from 3.32 to 4.88. Based on the test results of the analysis of variance it was found that $p < 0.05$, which means that the treatment given had a significant effect on the color of the resulting watermelon skin fruitghurt. Followed by the Ducan test with the results of each treatment having a significant difference, and it can be concluded that the treatment with the best value based on color is formula D (9% dragon fruit extract) and the treatment with the lowest score is formula A (0% dragon fruit extract).

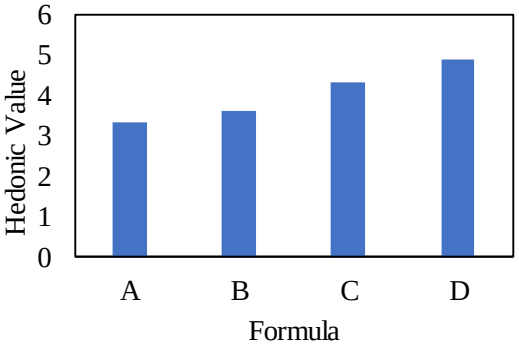

Figure 5 .Acceptability of fruitghurt colors

Based on the results of the organoleptic test, the panelists really liked formula D (9% dragon fruit extract) which had a pink color compared to formula A (0% dragon fruit extract) which had a yellowish white color derived from watermelon skin filtrate and skim milk. formula B (3% dragon fruit extract) is slightly pink in color, and formula C (6% dragon fruit extract) is pale pink in color. The change in the color of the fruitghurt to pink is due to the red dragon fruit containing the betacyanin pigment contained in the dragon fruit. The addition of higher red dragon fruit juice will increase the concentration of betacyanin in Caspian Sea yogurt, so that the color of the resulting yogurt will be even redder, and panelists prefer yogurt that has a striking color compared to the control. have white color (Maleta & Kusnadi 2018).

Texture

The results of the fruitghurt acceptability assessment based on texture can be seen in Table 4.

Table 4. Acceptability of fruitghurt textures.

Formula	Average value
A	4.04[a]
B	4.08[a]
C	4.08[a]
D	4.08[a]

Notes: a,b "Similar letters in the notation column show no noticeable difference in effect at the level of $p > 0.05$.

In Table 4 of the acceptability of fruitghurt texture, it is known that the results of the assessment

of the acceptability of watermelon peel fruithhurt with the addition of dragon fruit extract, with 5 assessments, namely very dislike, dislike, neutral, like and very like, obtained an average value of 4.04-4.08. Based on the results of the variety analysis (P<0.05) which means that the addition of dragon fruit extract has no real impact on watermelon rind fruitghurt. The textures of all four formulas get the same value from the panelists, as the textures of all four fruitghurts have a semi-solid viscous texture.

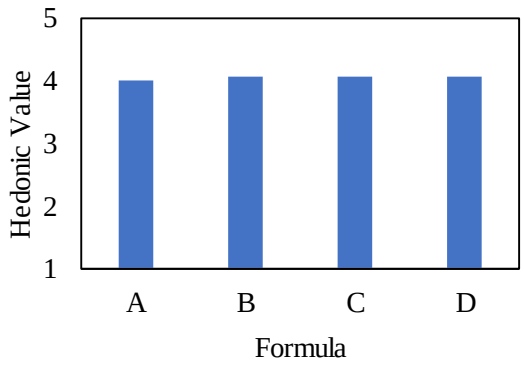

Figure 6. Acceptability of fruitghurt textures.

Based on organoleptic tests, the panelists' liking for the resulting fruitghurt was the average like to very like. The texture of the resulting fruitghurt is thick and semi-dense so the panelists like the texture of the resulting fruitghurt. The results of the non-significant variety analysis are thought to be because the coagulated milk proteins are relatively the same so as to produce a texture that is not different (Pamela, 2022).

The texture in yogurt is influenced by the use of ingredients and fermentation time. The texture of yogurt using skim milk will have a thick texture, this is because skim milk can increase the amount of protein coagulated in the fermentation process. In addition, the formation of a viscous texture is caused by a decrease in the pH value. This explaining that the viscosity of yogurt can be influenced by the pH value contained in yogurt products, this pH value can affect the protein denaturation process which can result in viscosity in yogurt, the lower the pH value will create an acidic atmosphere that will cause the clumping of milk protein so that the texture becomes viscous. In addition, the thick texture is also caused by the ingredients used, (namely watermelon peel filtrate which contains pectin which is useful in the formation of gels and stabilizers. Watermelon albedo has high pectin levels so that pectin can form a gel and the water content of albedo can be absorbed.

Aroma

The results of the fruitghurt acceptability assessment based on aroma can be seen in Table 5.

Tabel 5. Fruitghurt Aroma Acceptability.

Formula	Average value
A	3.48^{b}
B	3.0^{a}
C	3.19^{ab}
D	3.48^{b}

Notes: a,b "Similar letters in the notation column show no noticeable difference in effect at the level of p>0.05.

In Table 5 of acceptability based on aroma, it is known that the assessment of the acceptability of watermelon peel fruitghurt with the addition of dragon fruit extract with 5 assessments, namely very dislike, dislike, somewhat like, like and very like, obtained an average value for the favorability level of 3.0-3.48. Based on the results of the variety analysis test in obtained a value (p<0.05) which means that the addition of dragon fruit extract has a significant effect on the aroma of the watermelon peel fruitghurt produced. Followed by the Ducan test with the best formulation results, namely formula A (0% dragon fruit extract) and D (9% dragon fruit extract), and the formulation with the lowest value is formula B (3% dragon fruit extract).

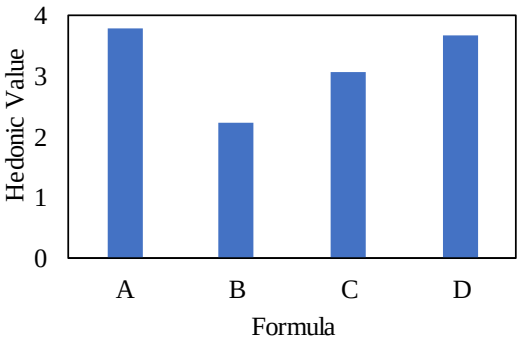

Figure 7. Fruitghurt aroma acceptability.

Aroma is one of the important factors in determining the favorability of the panelists influenced by fermented compounds. Based on the results of organoleptic tests, the level of liking of the panelists for the fruitghurt aroma produced was that the panelists preferred formula A (0% dragon fruit extract) and D (9% dragon fruit extract) to formula B (3% dragon fruit extract) and formula C (6%

dragon fruit extract). This is because the aromas in formulas A and D are not too sour compared to the aromas of B and C, because they have a slightly more sour aroma. The aroma produced on the fruitghurt is influenced by the addition of the concentration of dragon fruit extract, the higher the concentration of dragon fruit extract will dominate the aroma and make the resulting fruitghurt aroma also sour. The addition of red dragon fruit with a higher concentration can reduce the langu aroma in kefir, but the aroma produced is more pungent due to the fermentation of red dragon fruit by BAL which produces its own distinctive aroma.

The resulting fruitghurt aroma is a characteristic watermelon rind and sour-scented. According to (Krisnaningsih et al., 2020) the acidic aroma in yogurt is caused by a decrease in pH due to the work of lactic acid bacteria, which break down starch and lactose into lactic acid and other acids such as acetaldehyde and diacetyl. Both acids play a role in forming a distinctive aroma in yogurt. Acetaldehyde begins to form, when fermentation reaches pH 5. So that the sharp sour aroma is not liked by the panelists, where the sour aroma comes from lactic acid as a result of fermentation the addition of lactic acid bacteria that produce volatile acid during the fermentation process.

CONCLUSION

The addition of dragon fruit extract at concentrations of 3%, 6%, 9% had an effect on pH, lactic acid levels, vitamin C, taste, color, and aroma, but had no effect on the texture of the resulting watermelon rind fruitghut. In this study, the best treatment was obtained, namely treatment D (9% dragon fruit extract) with a pH value (4.58), lactic acid content (2.04%), vitamin C content (0.031%), taste preference level (2.72), color (4.88), texture (4.43), and aroma (3.48).

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