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The Acceptance, Chemical and Physical Characteristics of Kolang-kaling Jam Sheet (Arenga pinata Merr.) and Mulberry Fruit (Morus nigra L.)

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ABSTRACT: *This study aims to determine the effect of the comparison of "kolang-kaling" and mulberry fruit on the characteristics of the slice jam. Mulberry fruit was rich in anthocyanin, so the use of this fruit was expected to produce anthocyanin-rich in the slice jam and attractive color apprearance. The study used a Completely Randomized Design (CRD) with 5 treatments, that was the level of comparison of "kolang-kaling" and Mulberry fruit; (A. 85:15; B. 80:20; C. 75:25; D. 70:30; E. 65:35) with 3 replications. Data were analysed statistically using ANOVA and continued with Duncan New Multiple Range Test (DMNRT) at a significance level of 5%. The results showed that treatment C was chosen as the best product by using sensory analysis, that value for color of 4.24 (likes), aroma of 3.64 (likes), taste of 4.08 (likes), and texture of 4.08 (likes). The physical and chemical test results of the best products are values of folding test of 5. water content of 23.17%, ash content of 0.38%, pH of 3.51, food fiber content of 7.31%, sugar content of 41.75%, total dissolved solids of 46.69°Brix, anthocyanin of 60.62 mg/L, antioxidant activity IC_{50} of 10.74 ppm, and energy content of 3114.61 Cal/gram.*

KEYWORD: *Anthocyanin, folding test, kolang-kaling, mulberry fruit.*

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I. INTRODUCTION

Jam is a semi-wet food product made from processing fruit pulp, sugar, with or without the addition of water. Jam sheet is a modification of a semi-solid spread of jam into compact, plastic and non-sticky sheets (Yenrina, et al, 2009).

Kolang-kaling (Arenga pinnata Merr.) Contains Galactomannan which functions as a thickener. According to Tarigan (2012), galactomannan is a polysaccharide which has a sugar group namely galactose and mannose, so that the kolang-kaling can potentially be the basic ingredients of jam sheet. To give flavor, color, and aroma and then addict mulberry fruit.

Mulberry (Morus nigra L.) is a fruit that has anthocyanin active substance that functions as an antioxidant (Utomo, 2013). With the addition of mulberry fruit is expected to provide flavor, color and aroma and improve appearance on the jam sheet. Mulberry fruit has active ingredients anthocyanin as an antioxidant and cianidin content which acts as anthocyanin, saccharides, linoleic acid, stearic acid, oleic acid and vitamins A, B_1, B_2 and C.

Based on the description above, the authors would like to research the "Acceptance, Chemical and Physical Characteristics of Kolang-kaling Jam Sheet (Arenga pinata Merr.) and Mulberry Fruit (Morus nigra L.)".

II. MATERIALS AND METHODS

Place: The research has been carried out in the Laboratory of Agricultural Product Technology and Process Engineering, Chemical Laboratory, Biochemistry of Agricultural Products and Food Nutrition, Central

Instrumentation Laboratory, Department of Agricultural Product Technology, Faculty of Agricultural Technology, Non-ruminant Laboratory of Animal Husbandry, Andalas University, Padang and PT. Saraswanti Indo Genetech Bogor.

Materials: The main in this study were fries obtained from Bandar Buat Padang Market, and mulberry fruit with various colors, namely red and blackish purple obtained from Alahan Panjang, sugar (sucrose), citric acid, agar powder, carrageenan and margarine.

Chemicals used for analysis include distilled water, distillate water, buffer pH 1 and pH 4, saturated ammonium oxalate solution, methyl red indicator, acetic acid, H_2SO_4, NaOH, HCl, CaCl, AgClO, $AgNO_3$, methanol, ethanol, 95% alcohol, DPPH, sucrose, phenol solutions, and other analyzers. The tools used are analytical scales, aluminum plates, desiccators, furnaces, porcelain cups, water baths, pH meters, 250 ml cup glasses, 100 ml cup glasses, erlenmeyer, litmus paper, measuring flask, refractometer, spectrophotometer, therrmometer, 100 ml flask ml and other glassware.

Research Design

The design used was a completely randomized design with 5 treatments and 3 replications. Data were analyzed statistically by the F test and if significantly different, continued with the Duncan's New Multiple Range Test (DNMRT) at 5% significance level. The treatment in this research was mixing the slurry pulp with mulberry pulp with each comparison as follows:

A = 85 g: mulberry 15 g
B = 80 g of foliage: 20 g of mulberry fruit
C = 75 g patch: 25 g mulberry fruit
D = 70 g of foliage: 30 g of mulberry fruit
E = 65 g: mulberry fruit 35 g

Research Implementation

Making Kolang-kaling Porridge

The kolang-kaling are washed to remove the mucus, then drained, then blended with a ratio of water: kolang-kaling (1: 3).

Making Mulberry Fruit Porridge

Red and purple black mulberry fruit washed with clean water. Each of the red mulberry berries and black-purple mulberry blended each. Porridge weighed, red mulberry: blackish purple mulberry (1: 1).

Jam Making Sheet

Red mulberry porridge: black-purple mulberry (1: 1) weighed with treatments A, B, C, D, E, 60 g of sugar, put into a frying pan, heated while stirring, 0.4 g of citric acid added, agar powder 1 g and 1 g of keragenan, 6 g of margarine and mulberry. All ingredients that have been mixed are stirred slowly.

Observations

Observations on the raw material of jam sheets include: water content, ash content, pH and anthocyanin. Observation of sheet jams includes physical, chemical and organoleptic tests such as crease, water content, ash content, pH, total sugar content, food fiber content, total dissolved solid test, energy value, anthocyanin and antioxidant activity.

III. RESULT AND DISCUSSION

Raw materials: The analysis of raw materials can be seen in Table 1.

Table 1: Analysis of Raw Materials for Jam Sheets

Analysis	Kolang-kaling ± SD	Murbei Fruits ± SD
Moisture content (%)	95.42 ± 3.53	91.83 ± 1.02
Ash content (%)	0.24 ± 0.01	0.35 ± 0.01
pH	4.63 ± 0.01	3.99 ± 0.00
Antosianin (mg/L)	-	253.15 ± 0.19

Information: (-) no test was performed

Based on Table 1. the water content of mulberry is 91.83%. According to Syafutri (2008), the water content of mulberry is 86.71%. Whereas the water level was obtained at 95.42%, the results of this analysis did not differ greatly from the results of research conducted by Torio, et al (2006) which amounted to 92.09%.

The ash content obtained in the analysis of the raw material is 0.24% and mulberry fruit is 0.35%. These results are consistent with the statement of Sudarmadji, Haryono and Suhardi (1997) that the ash content of fresh fruits ranged from 0.2 to 0.8%.

The pH value obtained in the analysis of the raw material of mulberry fruit is 3.99 while the pH value of the frosts is 4.63 so in the process of making jam sheets with the mulberry fruit it is necessary to add citric acid to reach the specified pH which is between 3.2 -3.4.

Anthocyanin concentration of mulberry fruit is 253.15 mg/L. According to Syafutri (2008), the anthocyanin concentration of mulberry fruit is 348.98 mg /L. Winarno (2002) states that if the concentration of anthocyanin is high, the color will turn purple.

Organoleptic test: Organoleptic tests were carried out on 25 panelists with numerical scale levels as follows: (1) very dislike, (2) dislike, (3) ordinary, (4) like, (5) like very much.

Color:. Organoleptic analysis of color can be seen in Table 2

Table 2. Organoleptic Values of Jam Colors in Fruit and Mulberry Fruit

Treatment	Color ± SD
E (KK 65 g : MF 35 g)	3.48 ± 0.71 a
D (KK 70 g : MF 30 g)	3.68 ± 0.85 a b
A (KK 85 g : MF 15 g)	3.92 ± 0.49 b c
B (KK 80 g : MF 20 g)	4.08 ± 0.70 b c
C (KK 75 g : MF 25 g)	4.24 ± 0.78 c
CV = 18.51%	

Information: KK= Kolang-kaling, MF= Murberry Fruits. The numbers in the same column by lowercase letters are not the same significantly different at the 5% level according to DNMRT.

Based on Table 2. The results of color analysis of jam sheets and mulberry fruit ranged from 3.48 to 4.24. The average value of panelists preference for the highest color of jam sheets and mulberry leaves was obtained in treatment C of 4.24 (likes) and the lowest in treatment E of 3.48 (ordinary). The results of variance showed differences in the addition of mulberry fruit in the making of jam sheets and mulberry fruit were significantly different at α level of 5% to the color of the resulting jam sheet.

The following data shows that the jam sheet and the resulting mulberry fruit are received by the panelists in the level of liking (3.68-4.24) found in treatments A, B, C, and D. The color on the jam sheet is caused by mulberry which is a anthocyanin-rich fruit which is an isomeric pigment that has a violet-red color (Vargaz and Lopez, 2003).

Aroma: Analysis on sheet jam products can be seen in Table 3.

Table 3. Organoleptic Scents of Jam Butter and Mulberry Fruit Kolang-kaling and Mulberry Fruit

Treatment	Aroma ± SD
A (KK 85 g : MF 15 g)	3.44 ± 0.77
B (KK 80 g : MF 20 g)	3.52 ± 0.71
C (KK 75 g : MF 25 g)	3.64 ± 0.76
D (KK 70 g : MF 20 g)	3.68 ± 0.85
E (KK 65 g : MF 35 g)	3.72 ± 0.84
CV = 21.55%	

Information: KK= Kolang-kaling, MF= Mulberry Fruits

Based on Table 3. The results of the scent of jam sheets and mulberry fruit between 3.44 to 3.72. The highest average value of the panelists preference for the aroma of sheets of jam and mulberry fruit was found in treatment E of 3.72 (likes) and the lowest in treatment A was 3.44 (ordinary). The analysis of variance showed that the difference in the ratio of the fruit and the mulberry fruit in the making of the jam sheet and the mulberry fruit was not significantly different at the α level of 5% on the aroma of the resulting jam.

The aroma of jam produced is typical of mulberry fruit. The unique aroma specific compound in mulberry is ethyl linoleate which produces fresh aroma characteristic (Elmaci and Tomris, 2002).

Taste: The analysis of the jam sheet products can be seen in Table 4.

Table 4. Average value of organoleptic flavors of jams in foliage and mulberry fruit

Treatment	Taste ± SD
A (KK 85 g : MF 15 g)	3.68 ± 0.63
E (KK 65 g : MF 35 g)	3.76 ± 0.93
B (KK 80 g : MF 20 g)	3.80 ± 0.65
D (KK 70 g : MF 30g)	4.04 ± 0.73
C (KK 75 g : MF 25 g)	4.08 ± 0.64
CV = 18.68%	

Information: KK= Kolang-kaling, MF= Mulberry Fruits.

Based on Table 4. it can be seen that the taste of jam mulberry fruit can be accepted by the panelists in the level of likes ranging from 3.68-4.08. The highest average value of panelists preference on the taste of jam and fries and mulberry fruit was highest in treatment C of 4.08 (likes) and the lowest in treatment A was 3.68 (likes). The variance analysis showed that the differences in the ratio of the fruit and the mulberry fruit were not significantly different at the 5% level on the taste of the resulting jam. The most effective compound for a unique taste in mulberry is ethyl linolenic which will produce a fruit, sweet, sour, musky taste that is like a rose (Elmaci and Tomris, 2002).

Texture: The results of the organoleptic analysis of the texture jam sheet products can be seen in Table 5.

Table 5. Average Value of Organoleptic Texture of kolang-kaling Jam Sheet and Mulberry Fruit.

Treatment	Texture ± SD
A (KK 85 g : MF 15 g)	3.56 ± 0.77
B (KK 80 g : MF 20 g)	3.68 ± 0.80
E (KK 65 g : MF 35 g)	3.84 ± 1.18
D (KK 70 g : MF 30 g)	3.92 ± 0.57
C (KK 75 g : MF 25 g)	4.08 ± 0.95
CV = 23.03%	

Information : KK= Kolang-kaling, MF= Murbei Fruit

Based on Table 5. it is known that the results of the texture analysis of jam sheets and mulberry fruit between 3.56-4.08. The average value of the panelists preference level for the texture of the highest jam sheets was in treatment C which was 4.08 (likes) and the lowest in treatment A was 3.56 (likes). The variance analysis showed that the comparison of the Kolang-kaling and mulberry fruit were not significantly different at α level of 5% on the texture of the resulting jam sheet.

The following data show that the jam sheet and the resulting mulberry fruit were received by the panelists at the preferred level (3.56-4.08) found in all treatments. The average value of the organoleptic test can be seen in Figure 1.

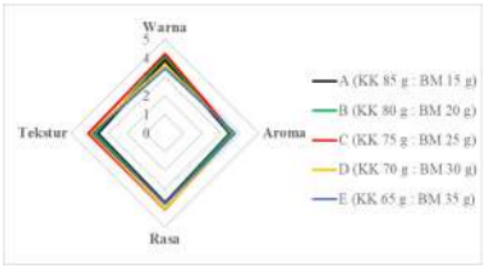

Figure 1. Organoleptic Radar Sheet Sheets. (KK = Kolang-kaling, MB = Mulberry Fruit)

Based on the above radar, it can be seen that the best treatment favored by panelists is treatment C with a ratio of fro and mulberry 75 : 25 with a score for color 4.24 (likes), aroma 3.64 (likes), taste 4.08 (likes), and texture 4.08 (likes).

Analysis of physical properties

Folding Test: The results of observations of folding tests on sheet jam products can be seen in Table 6.

Table 6. Average Values of the Jam Blades and Mulberry Sheet Folders

Treatment	Crease Value
A (KK 85 g : MF 15 g)	4.00 ± 0.00
B (KK 80 g : MF 20 g)	4.00 ± 0.00
C (KK 75 g : MF 25 g)	5.00 ± 0.00
D (KK 70 g : MF 30 g)	5.00 ± 0.00
E (KK 65 g : MF 35 g)	5.00 ± 0.00
CV = 0	

Information: KK = kolang-kaling, MF = Mulberry fruit, 1 = material that breaks when pressed with a finger without being folded, 2 = material that is directly cracked but still fused, 3 = material that is cracked after one fold, 4 = material that is cracked after two folds but not cracked for one fold, 5 = material that does not crack for two folds.

Based on Table 6. it was found that the results of the folded sheet and mulberry jam folds ranged from 4.00-5.00. The highest crease test was found in the treatments C, D, and E with an average value of 5.00. The lowest crease test was found in treatments A and B with an average value of 4.00. The variance analysis showed that the difference in the ratio of the fruit and the mulberry fruit on the making of the jam sheet and the mulberry fruit was not significantly different at the α level of 5% to the resulting folds of jam.

The following data shows that the jam sheet produces good folds. The effect of agar and keragenan on the jam sheet is also important because the agar and keragenan molecules when cooled begin to close and solidify (Puncomulyo, 2006).

Chemical Analysis

Water content

Water content in the jam sheet products can be seen in Table 7.

Table 7. Average of water Content of jam sheet from kolang-kaling and Mulberry Fruit

Treatment	Water content (%) ± SD
A (KK 85 g : MF 15 g)	15.98 ± 0.59 a
B (KK 80 g : MF 20 g)	19.51 ± 0.47 b
C (KK 75 g : MF 25 g)	23.17 ± 2.45 c
D (KK 70 g : MF 30 g)	25.44 ± 0.77 d
E (KK 65 g : MF 35 g)	26.97 ± 0.38 d
CV = 5.45%	

Information: KK= Kolang-kaling, BM=Buah murbeiThe numbers in the same row are followed by significantly lowercase letters at the 5% level of Duncan's New Multiple Range Test (DNMRT).

Based on Table 7. shows the moisture content of the jam sheet and mulberry fruit produced ranged between 15.98-26.97%. In the test results of the water content of raw materials, the fro has a water content of 95.42% and mulberry fruit is 91.83%. The lowest water content is in treatment A of 15.98% and the highest water content is in treatment E of 26.97%. The analysis of variance showed that the difference in the ratio of the fruit and the mulberry fruit on the making of the jam sheet and the mulberry fruit was significantly different at the α level of 5% on the moisture content of the resulting jam sheet. The more addition of mulberry fruit, the moisture content of the jam sheet will increase. Fachruddin (2008) states that the maximum moisture content of fruit jam is 35%.

Increased jam water content is related to crude fiber content. According to Tario, Joydee and Florinia (2006), crude fiber obtained in the fissures is 1.59%, while according to Syafutri (2008), crude fiber found in mulberry is 2.28%. So that the water content in the product is more influenced by the number of mulberry fruit comparisons.

Ash content

The results of the analysis of ash content in the jam sheet products can be seen in Table 8.

Table 8. Average of water Content of jam sheet from kolang-kaling and Mulberry Fruits

Treatment	Ash content (%) ± SD
E (KK 65 g : MF 35 g)	0.24 ± 0.13
D (KK 70 g : MF 30 g)	0.28 ± 0.13
C (KK 75 g : MF 25 g)	0.38 ± 0.01
B (KK 80 g : MF 20 g)	0.39 ± 0.01
A (KK 85 g : MF 15 g)	0.41 ± 0.03
CV = 24.61%	

Information: KK= Kolang-kaling, MF= Murbei Fruits

Based on Table 8. shows that the ash content of jam sheets and mulberry fruit produced ranged from 0.24 to 0.41%. The highest ash content was in treatment A that was 0.41% and the lowest ash content was in treatment E that was 0.24%. The variance analysis showed that the difference in the ratio of the fruit and the mulberry fruit in the making of the jam sheet and the mulberry fruit was not significantly different at the α level of 5% to the ash content of the resulting jam. In the analysis of raw materials, the level of gray ash obtained by 0.24%, while the ash content of mulberry fruit obtained by 0.35%. So the more the comparison of the fissures, the ash content obtained increases. In the analysis of raw materials, the level of gray ash obtained by 0.24%, while the ash content of mulberry fruit obtained by 0.35%. So the more the comparison of the fissures, the ash content obtained increases.

pH value: The results of the pH analysis of the jam sheet products can be seen in Table 9.

Table 9. Average values of pH values for jams in foliage and mulberry fruits.

Treatment	pH value ± SD	
A (KK 85 g : BM 15 g)	3.77 ± 0.02	a
B (KK 80 g : BM 20 g)	3.64 ± 0.05	a
C (KK 75 g : BM 25 g)	3.51 ± 0.03	b
D (KK 70 g : BM 30 g)	3.30 ± 0.02	c
E (KK 65 g : BM 35 g)	3.26 ± 0.01	c
CV = 0.90%		

Information: KK= Kolang-kaling, BM= Murbei Fruit. The numbers in the same row are followed by significantly lowercase letters at the 5% level of Duncan's New Multiple Range Test (DNMRT).

Based on Table 9. shows the pH value of the jam sheet and mulberry fruit ranged from 3.26 to 3.77. The highest acidity level was in treatment E of 3.26 while the lowest acidity level was in treatment A of 3.77. The pH or acidity of the fuselage is 4.63, while the pH of the mulberry fruit is 3.99. The analysis of variance showed that the difference in the ratio of the fruit and the mulberry fruit on the making of the jam sheet and the mulberry fruit was significantly different at the α level of 5% against the pH value of the resulting jam sheet. This also relates to the pH of the resulting jam sheet. According to Dalimartha (2000), mulberry has several components such as linoleic acid, stearic acid, oleic acid, vitamins B1, B2, and C. The added citric acid also affects the pH of the jam sheet.

Food fiber: food fiber content are based on the results of the best organoleptic testing. The best results obtained from the organoleptic test were treatment C (75 g of porridge slurry: 25 g of mulberry pulp). So the results obtained from the test of food fiber jam and mulberry fruit in treatment C that is equal to 7.31%. According to Muchtadi (2000) an increase in agar and keragenan concentrations causes an increase in food fiber.

Total sugar: The results of the analysis of total sugar levels are based on the results of the best organoleptic testing. The best results obtained from the organoleptic test were treatment C (75 g of porridge slurry: 25 g of mulberry pulp). So that the results obtained from the test of total sugar content of the frosted jam sheet and mulberry fruit in C treatment amounted to 41.75%.

The sugar content in the jam sheet comes from sugar or sucrose which is added to the jam sheet making. Besides being added sugar, the total sugar content obtained is also influenced by the water content of the jam sheet. The higher the water content obtained, the components contained in food will decrease, including the value of sugar obtained. This is because the water contained in food acts as a solvent of several components in addition to being a reagent (Purnomo, 1995).

Total Dissolved Solids: The results of the analysis of the total dissolved solids in the jam sheet product can be seen in Table 10.

Table 10. Average Value of Total Test of Dissolved Solids in the Framing Sheets and Mulberry Fruit

Treatment	Total Dissolved Solids ^{0}Brix ± SD
E (KK 65 g : BM 35 g)	40.85 ± 0.02 a
D (KK 70 g : BM 30 g)	45.64 ± 0.01 b
C (KK 75 g : BM 25 g)	46.69 ± 0.02 c
B (KK 80 g : BM 20 g)	47.64 ± 0.04 d
A (KK 85 g : BM 15 g)	50.34 ± 0.57 e
CV = 0.57%	

Information: KK= Kolang-kaling, BM= Murbei Fruits.The numbers in the same row are followed by significantly lowercase letters at the 5% level of Duncan's New Multiple Range Test (DNMRT).

Based on Table 10. shows the total dissolved solids of jam sheet and mulberry fruit produced ranged between 40.85-50.34 ^{0}Brix. The highest total dissolved solids were in treatment A of 50.34 ^{0}brix and the lowest total dissolved solids were in treatment E of 40.85 ^{0}brix. The analysis of variance showed that the difference in the ratio of the fruit and the mulberry fruit in the making of the jam sheet and the mulberry fruit was significantly different at the α level of 5% of the total dissolved solids of the resulting jam sheet. According to Putri, I.R, Basito, and E. Widowati (2013), the total dissolved solids in Raja Bulu banana jam was 20 ^{0}brix.

Antocyanin: The results of anthocyanin analysis on sheet jam products can be seen in Table 11.

Table 11. Average value of anthocyanin jam in the faded sheet and mulberry fruits

Treatment	Antocyanin (mg/L) ± SD
A (KK 85 g : MF 15 g)	45.05 ± 1.64 a
B (KK 80 g : MF 20 g)	51.66 ± 2.75 b
C (KK 75 g : MF 25 g)	60.62 ± 5.09 c
D (KK 70 g : MF 30 g)	66.96 ± 1.02 d
E (KK 65 g : MF 35 g)	71.52 ± 3.19 d
CV = 5.21%	

Information: KK= Kolang-kaling, MF= Murbei Fruits. The numbers in the same row are followed by significantly lowercase letters at the 5% level of Duncan's New Multiple Range Test (DNMRT).

Based on Table 11. shows anthocyanin jams fro and mulberry fruit ranged from 45.05 to 71.52 mg / L. The highest anthocyanin levels were in treatment E at 71.52 mg / L, while the lowest anthocyanin levels were in treatment A at 45.05 mg / L. According to Hermawan and Pertiwi (2010), anthocyanin is one of the antioxidant components that can be decreased due to the light and the effect of the heating process during processing but does not disappear entirely because its solubility to water also affects the stability of the heating temperature. The variance analysis showed that the differences in the ratio of the fruit and the mulberry fruit on the making of the jam sheet and the mulberry fruit were significantly different at α level of 5% on the anthocyanin level of the resulting jam sheet.

IC50 antioxidant activity: The results of the analysis of antioxidant activity were carried out based on the results of the best organoleptic testing. The best results obtained from the organoleptic test were treatment C (75 g of porridge slurry: 25 g of mulberry pulp). So the results obtained from the analysis of the antioxidant activity of IC50 amounted to 10.74 ppm. Tests carried out using the IC50 method. IC50 value obtained on the jam sheet is classified as very strong. Many factors can reduce antioxidant activity in the resulting jam sheets, one of which is the process of heating and processing (Desroiser, 1988).

Energy value: The results of the analysis of energy values are based on the best organoleptic test results. The best results obtained from the organoleptic test were treatment C (75 g of porridge slurry: 25 g of mulberry pulp). So the results obtained from the analysis of the energy value of 3114.61 Cal / gram. The high water content in mulberry makes it a low-calorie fruit (Utomo, 2013).

IV. CONCLUSION

Based on research that has been carried out on jams kolang-kaling and mulberry fruit, the following conclusions are obtained.

1. The results of the analysis of the jam sheet and mulberry fruit have a significant effect on the level (α = 5%) of the organoleptic test (color) and chemical tests (water content, pH, anthocyanin and total dissolved solids).

2. The results of the study obtained the best treatment in the comparison between the fro and the mulberry fruit (75 g: 25 g). This was obtained based on organoleptic tests received by panelists with a score of color values of 4.24 (likes), aroma 3.64 (likes), flavors 4.08 (likes) and textures 4.08 (likes).

Significance Statements

Based on research that has been carried out, the authors advise researchers to determine the type of packaging, namely primary packaging (edible film) and secondary packaging (PE plastic) used to package jam sheets.

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