Processing Sky Rocket Melon into Jam with Various Acidifiers and Sugar Concentrations

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Abstract. The high production of melons in Indonesia is affected by non-optimal post-harvest handling and the accelerated loss of quality due to its abundant water content, which reduce its economic value. The Sky Rocket variety is Indonesia's most widely grown type of melon. The post-harvest handling of melon that has not been implemented is the production of jam. The correct recipe must be determined to produce melon spread, or jam, with good characteristics. This study aims to determine the effects of the sucrose and acidifier on the physicochemical and sensory characteristics of the melon spread and to find the combination of treatments that produce the melon spread with the best physicochemical and sensory characteristics. This study used experimental methods and factorial randomized block design. The observed factors were the concentration of sucrose, 40%, 50% and 60%, and the type of acidifier, citric acid, lime and pineapple. Experiments were performed three times; thus, there were 27 experimental units. The variables observed included water content, acidity (pH), total dissolved solids and vitamin C content, as well as sensory variables such as colour, spreadability, texture, melon aroma, sweet taste and preference. The use of different concentrations of sucrose affected the water content, total dissolved solids, and sensory variables of the melon spread. The type of acidifier affected the physicochemical and sensory variables of the melon spread, except for the total dissolved solids. The interaction between the sucrose and the acidifier only affected the sensory variables. The best treatment combinations were treatment with 50% sucrose and pineapple with a water content of 31.49%, pH 6.90, TPT 71.00°Bx, vitamin C of 114.40 mg/100 g, colour 3.55 (bright green), spreadability 4.05, texture 3.12, melon aroma 3.00, sweet taste 4.23 and preference 3.43.

Keywords: jam · melon · pineapple · Sky Rocket · sugar concentration

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1 Introduction

Melon, with its sweet taste and distinctive texture, has great potential for development in Indonesia. According to the Central Statistics Agency, melon production in Indonesia in 2018, 2019 and 2020 reached 118,708, 122,105 and 138,177 tonnes, respectively. The Sky Rocket melon variety is the most widely grown melon species in Indonesia [1]. Melon is a climacteric fruit with a high water content (93 ml/100 g), making it rot quickly [2]. Currently, melons are mostly consumed fresh, and post-harvest handling requires minimal processing [3]. Post-harvest handling of melons in Indonesia is non-optimal, and the high water content can accelerate the decline in quality, reducing its economic value. Therefore, it is necessary to process melons while increasing their economic value.

Research on melon processing that has been carried out includes jelly drinks [4], a substitute for soursop fruit leather, while [5] examined extracted sheet jams produced from raw watermelon albedo and red melon. Jam is a potential fruit preparation, but until now, the melon jam has not been studied, even though jam is one of the most widely used fruit preparations. The need for new jams is increasing because fruit jam is used in spreads and fillings for bread and toppings for various food products [6]. Melon can be used for making jam because it has a high methoxyl content with a concentration of 7.13%. The large amount of methoxyl pectin can form gels with the sugars and acids [7].

Jam is a semi-solid food with a characteristic taste and perfect gel texture [8]. Three factors influence gel formation in jam, namely the amounts of pectin, sugar and acid. The pectin content in melon is about 1.4% [9], which is sufficient or gelling in jam, which requires at least 0.75%–1% [10].

Using the right amounts of pectin and sugar in jam making will affect the pectin–water balance and reduce the pectin stability by forming fine fibres so that the gel formed is not too hard [11]. According to [12], to produce a gel with good hardness, the sugar content used should not be more than 65%. The addition of granulated sugar in *langsat* jam in [13] showed that the preferred jam colour was produced at a concentration of 65%. However, based on preliminary research, melon spread made with a sucrose concentration of 65% resulted in a crystallised texture. This could be due to the use of too much sucrose, crystallising the surface of the jam. However, if there is not enough sugar in the jam, it will produce a weaker gel at all acidity levels, so more acid must be added to strengthen the structure [14].

In making jam, acid is added to lower the pH of the fruit because the gel structure is only formed at low pH [15]. Citric acid is often used for this purpose. The amount of citric acid added to produce a good jam texture depends on the ingredients used and the concentration of sugar [16]. According [17], commercial citric acid has been widely used because citric acid is easy to obtain, abundant and relatively inexpensive. [8] stated that the treatment with 0.5% of added citric acid resulted in the best-quality melon jam with the organoleptic experience preferred by the panellists.

Acids for making jam can also be obtained from fruits. This study also uses natural acids derived from lime and pineapple because the two fruits are easy to find and widely consumed by the public. Lime and pineapple contain citric acid, which can be an acidity regulator in jams. According to [18], the content of citric acid in lime juice is 7%, which is ten times more than the citric acid content of tangerines and six times that of sweet oranges. In research on tomato jam by [19], lime juice has been shown to help hydrolyse sugar to produce invert sugar that does not crystallise, giving the jam a soft feeling in the mouth.

According to [20], the citric acid content in pineapple amounted to 87% of the total acid. However, pineapple fruit in the liquid form, pineapple juice, has never been applied to jam products as an acidifier.

In addition to the citric acid content, the reason for using lime and pineapple as a source of acidity in jam is because they have a fairly high vitamin C content of 27 mg [21] and 24 mg [20], respectively. Improper processing of melons will cause their natural vitamin C content to be damaged or reduced because of its unstable nature, which is easily soluble in water and easily undergoes oxidation processes during cooking and slicing, exposure to air and improper storage [3]. Therefore, natural acidifying sources with high enough vitamin C content are expected to maintain and even increase these nutrients in the resulting jam products.

The purposes of this study were to determine 1) the effects of different concentrations of sucrose on the physicochemical and sensory characteristics of melon jam, 2) the effects of different types of acidity on the physicochemical and sensory characteristics of melon jam, and 3) the combination of treatments that produced melon jam with the best physicochemical and sensory characteristics.

2 Materials and Methods

2.1 Materials

The main ingredients are Sky Rocket melons, Gulaku-brand sugar, citric acid stamped elephant, lime and Bogor pineapple.

2.2 Making Melon Jam

The manufacture of melon jam followed [8] with modifications in ingredients. Namely, 300 g of melon pulp was weighed, heated to 70 °C and cooked for 10 min. After that, sugar was added according to the recipe (40%, 50% or 60%) and stirred while cooking until it boiled. The acid (citric acid, lime, or pineapple juice) was added with a concentration of 0.5%. The jam was cooked until it thickened, which was tested with a spoon test. Overall, the cooking time for each formulation was 31 min. After that, the jam was removed, cooled, and placed in a previously sterilised jar. Jar sterilisation was carried out according to Handoyo & Suseno (2021) by dipping the jar into 100 °C water for 30 min.

2.3 Experimental Design

The study used a factorial randomised block design. The research factors observed were the concentration of sucrose (40%, 50% and 60%) and acidifier (citric acid, lime and pineapple juices). There were nine treatment combinations with three repetitions; 27 experimental units were obtained.

2.4 Variables

Physicochemical and sensory variables were observed. The physicochemical variables were moisture content [22], acidity using pH meter, dissolved solids using refractometer, and vitamin C content. Sensory analysis was performed by 60 semi-trained panellists. Sensory testing included hedonic quality tests (colour, evenness when smeared, texture, melon aroma, and sweetness), while hedonic test assessments were carried out on preference parameters using a numerical scale.

2.5 Determination of Best Product

The best combination was determined using the effectiveness index method [6], which produces the largest relationship between the weighting and the treatment. The calculation is made by assigning a weighting from 0 to 1 to each physicochemical attribute and sensory variable based on their level of importance. The higher the importance of the attribute, the higher the number or weighting value assigned. The best treatment combination is determined from the total value of the largest treatment, which is the result of the sum of the results of each attribute.

3 Results and Discussions

3.1 Physicochemical and Sensory Properties of Melon Jam

3.1.1 Moisture Content

The sucrose concentration and the type of acidifier had a significant effect on the water content of the melon spread, while the interaction between these two factors had no significant effect. In determining the water content, the amount of water analysed is the water contained in the foodstuffs, including the physically bound water.

The higher the sucrose concentration, the lower the water content of the jam (Fig. 1). These results agreed with research on *belimbing* fruit jam by [23], where adding 50 g of sucrose produced the highest water content of 28.12% and the lowest water content, 22.96%, was produced by the addition of 90 g of sucrose. This study also agreed with [16], where the highest water content of mango jam.

The decreased water content is due to the addition of sugar. According to [24], sugar in the form of sucrose is hygroscopic; that is, it can bind water, decreasing free water. According to [25], the water content of jam is also influenced by heating or cooking. Nisa [26] have shown that the ability of sucrose to bind water is stronger than other types of sugar. When the jam is made by heating in the presence of an acid, sucrose will be hydrolysed into invert sugar (fructose and sucrose) [6], decreasing the amount of bound water and making more free water available for evaporation during cooking. Therefore, the higher the concentration of sucrose used in making jam, the lower the final water content.

Different types of acidifiers produced melon jams with different moisture contents. The water content of melon jam using citric acid was higher than that made using lime and pineapple juices (Fig. 2). The lower the acidity level of the acidifier used, the lower

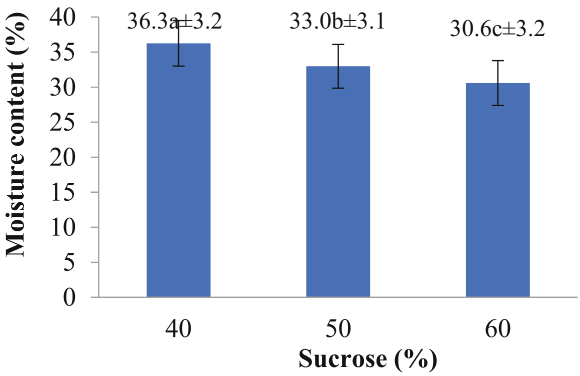

Fig. 1. Moisture content of melon jam affected by the sucrose concentration. Note: the numbers followed by different letters that show a significant difference at $p < 0.05$.

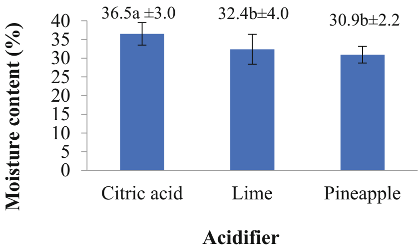

Fig. 2. Moisture content of melon jam affected by the acidifier. Note: the numbers followed by different letters that show a significant difference at $p < 0.05$.

the water content of the resulting jam. The citric acid solution used has a pH of 0.61, lime juice has a pH of 2.07, and pineapple juice has a pH of 3.15. These results are almost the same as HR research (2011) regarding young coconut shell jam, where the highest concentration of citric acid (1%) produced the highest water content, 19.1622%, and the lowest concentration of acid (0.5%) produced the lowest water content, 16.4223%.

According to [16], the water content of jam can increase due to the proportions of pectin, sugar and acid, which can trap water. Acidic conditions cause an imbalance of hydrogen ions (H^+) with free carboxyl groups, which can affect the stability of the pectin and water bonds. The higher the acidity, the more hydrogen ions are released that will reduce the negative charge of the pectin molecule. This frees more water to evaporate, and less water is trapped by the structure of the jam [27, 28]. However, pH that is too low or acidity that is too high can cause syneresis, which is the release of water from the gel of the jam. The syneresis process in jam is related to water content, where higher syneresis results in higher water content [29].

The water content of the melon jam in this study ranged from 28.48% to 39.66%. Most melon jams met the quality requirements for fruit jams set by the Indonesian Industrial Standard (1978), with a maximum water content of 35%. High water content can encourage bacteria, fungi and other microbes.

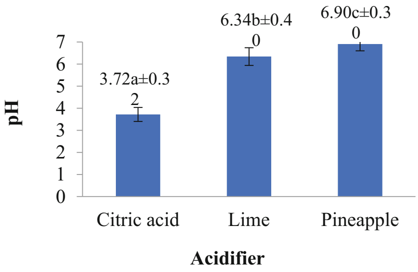

Fig. 3. pH of melon jam affected by the acidifier. Note: the numbers followed by different letters that show a significant difference at $p < 0.05$.

3.1.2 pH

Melon jam with added citric acid had a higher pH (3.72) than added lime (6.34) and pineapple (6.9) juices (Fig. 3). These results indicate that the lower the acidity of the acidifier, the higher the pH of the melon spread. As stated above, the citric acid solution has a pH of 0.61, lime juice has a pH of 2.07, and pineapple juice has a pH of 3.15. Therefore, the pH of the jam is proportional to the pH of the acidifier.

The acid content of the acidifier influenced the pH of the melon jam. According to [28], citric acid is an acidulant compound that can lower pH. Citric acid is a pure acid which is acidified during the extraction process. Lime juice is more acidic than pineapple juice because its citric acid content is 7% [30] while pineapple juice only contains 87% citric acid of the total 0.51% acid [31]. According to [16] on mango with the addition of 0.5%, 0.75% and 1% citric acid resulted in pH values of 3.153, 2.877, and 2.770, respectively.

The higher the sucrose concentration, the more the pH of melon jam increased, but it had no significant effect. The increase in pH is due to the increased sucrose, glucose and fructose formed during heating. This is called sucrose inversion and occurs in acidic environments, where the pH value of sucrose is 7 and glucose ranges from 4 to 6 [32]. This process is also related to gel formation, where the gel rigidity will increase as the pH decreases. However, a pH that is too high in jam cannot form a gel, and the gel that is formed hardens if the pH value is too low [28]. The research [23]) on *belimbing* jam has shown that the lowest amount of added sugar was 50 g and had a pH of 4.01. The jam with the highest added sugar, 90 g, had a pH of 4.93.

In this study, the pH of the melon jam ranged from 3.68 to 6.96. There was no significant interaction effect between the concentration of sucrose and the type of acidifier on the pH of the jam. The use of citric acid, lime juice and pineapple juice at 0.5% as a source of acidity in making jam did not reach the optimum pH of jam, which is 3.1–3.5 [33]. The optimum pH for jam products is not listed in the quality requirements for fruit jam (SNI-01-3746-2008).

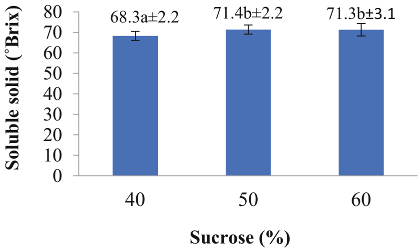

Fig. 4. Total soluble solids of melon jam affected by the sucrose concentration. Note: the numbers followed by different letters that show a significant difference at $p < 0.05$.

3.1.3 Total Soluble Solids

Melon jam with 40% added sucrose had total soluble solids of 68.33°Brix, lower than 50% added sucrose (71.39°Brix) and 60% added sucrose (71.33°Brix) (Fig. 4). Dissolved solids tended to increase with increasing sucrose concentration because sucrose decomposed into glucose and fructose during the cooking process in the presence of an acidifying agent. This study is in accordance with the work of [33] where dissolved solids increased when sucrose was dissolved in water and heated because some of the sucrose decomposed into glucose and fructose. The dissolved solids in a material consisting of reducing sugars (glucose and fructose), non-reducing sugars (sucrose), organic acids, pectin and protein. However, to increase the dissolved solids, the addition of sugar should not be too high because adding too much sucrose during the manufacture of jam can result in crystallization on the surface of the gel [27].

Bekele et al. [16] have shown that in the manufacture of mango jam, the higher the added sucrose, the greater the dissolved solids. The soluble solids of langsat jam with 60% sucrose concentration were 51.19°Brix, lower than that of the melon jam with the same sucrose concentration, 71.33°Brix. According to [23], the soluble solids contained in fruits were dominated by sugar, so the TPT represents the sweetness and fruit maturity levels. The results of this study are also comparable to Rani (2018), where the increase in dissolved solids was caused by adding other ingredients and making the jam. The addition of acid avoided crystallisation, but the higher the added acid concentration or the higher the acidity level used, the greater the dissolved solids content of the resulting jam.

Melon jam with the addition of citric acid, lime and pineapple had soluble solids of 71.33, 69.50 and 70.22°Brix, respectively. The difference is not large enough to significantly affect the dissolved solids content. The sucrose and acid contents can affect the dissolved solids in jam. Sucrose is non-reducing because it does not have a free reactive OH^- group. However, it can be hydrolysed into the inversion sugars, fructose and glucose, which are reducing sugars, during heating and in the presence of acid [8]. Therefore, the addition of citric acid, which has the highest acidity, was able to hydrolyse sucrose into more reducing sugars, thereby increasing the dissolved solids.

The melon jam in this study has 67.17–74.17°Brix dissolved solids. This melon jam has met the quality requirements for the total dissolved solids criterion of fruit jam according to SNI-01–3746-2008 of at least 65%.

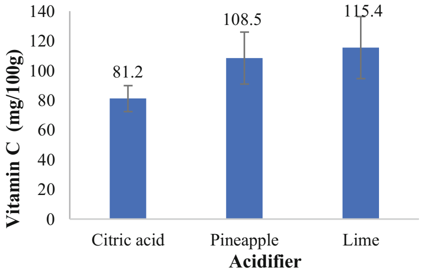

Fig. 5. Vitamin C of melon jam affected by the acidifier. Note: the numbers followed by different letters that show a significant difference at $p < 0.05$.

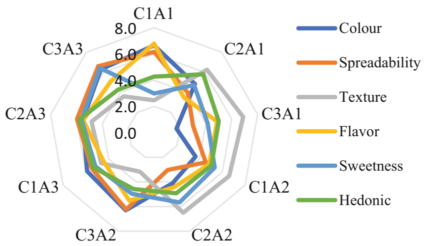

Fig. 6. Sensory properties of melon jam affected by the acidifier

3.1.4 Vitamin C

The use of citric acid produced melon jam with the lowest levels of vitamin C (81.2 mg/100 g) compared to those produced using lime (115.4 mg/100 g) and pineapple (108.5 mg/100 g) as acidifiers (Fig. 5). Lime and pineapple contain 27 mg/100 g and 24 mg/100 g of vitamin C, respectively, whereas citric acid does not. This result is in accordance with the work of [34], which has shown that using pineapple in jam making can increase the vitamin C content.

3.1.5 Sensory Properties

The combination of the concentration of sucrose and the type of acidifier significantly affected the colour of the melon spread. The panellists' assessments of the colour of the melon spread were between 2.13 and 4.03 (brown to bright green) (Fig. 6). The higher the sucrose concentration, the darker the colour of the melon jam. According to [27], the colour change in jam occurs due to the Maillard reaction (non-enzymatic browning), a reaction that occurs between amino acids and reducing sugars during the cooking process. In the process of cooking jam and the presence of an acid, sucrose, a non-reducing sugar, will be converted into glucose and fructose, which causes the Maillard reaction to occur rapidly. This observation is in accordance with [8] the colour of the melon jam comes from the combination of the melon colour and the cooking process using sugar. In addition, melons contain proteins and carbohydrates that contribute to the Maillard reaction, resulting in a brownish colour.

The lowest added sucrose and citric acid combination produced a bright green jam. The bright colour produced in the jam was influenced by the addition of citric acid because one of the functions of citric acid is to increase the colour and clarify the gel formed [27]. The combination of the highest added sucrose and the use of citric acid resulted in the darkest jam colour. The colour of the jam gets browner with an increased concentration of added sucrose because of the increase in the browning reaction [16]. The use of citric acid in the S3P1 treatment has not produced a brighter jam colour because although the acidity was higher, the amount of sucrose increased, which increased the amount of glucose and fructose that form the compound 5-hydroxymethyl 2-furfural (HMF), resulting in a brown colour. In addition, according to [35], citric acid can undergo oxidation at low pH, which also causes a browning reaction.

The results of this study are comparable to the melon jam research by [36], where an increase in the amount of sucrose caused the brightness of the jam to decrease due to the hydrolysis of sucrose into glucose and fructose during cooking, which led to a browning reaction. This is also similar to the study of purple eggplant jam by [37] (2021), which stated that the higher the concentration of citric acid used, the darker the colour of the resulting jam.

The use of pineapple juice produces the brownest jam. This is because, in addition to containing citric acid, pineapple also contains pigments that enhance the colour of the jam. According to [38], pineapple fruit contains the carotenoid pigments carotene and xanthophyll, which can cause a yellow colour. The carotene content in pineapples is greater than the xanthophyll content, which is as much as 25.20 g/100 g.

The spreadability of the melon jams was 3.05–4.33 (Fig. 6). The addition of 60% sucrose and pineapple juice had the highest average of 4.33, while 50% added sucrose and the use of lime had the lowest average of 3.05. The higher the sucrose concentration and the lower the acidity level used, the more evenly the jam could be spread on the bread. According to [6] high levels of sucrose produced easily spreadable jams because the sucrose helped to shape the texture of the jam and produced an ideal appearance. According to [23], the principle of jam formation is due to the nature of pectin, which can form a gel with acid and sugar so that the higher the acidity level, the stronger the gel formed, which makes the jam difficult to spread on the bread. Conversely, the lower the acidity level, the easier the jam will be to spread.

Using 60% added sucrose and pineapple juice produced a jam with a slightly thick and gritty texture that could be spread evenly on the bread. The use of 50% added sucrose and lime juice has the lowest evenness when smeared because it has a thick and smooth texture. According to [16], the higher the sugar concentration, the greater the spreadability of the resulting jam because sugar absorbs water. Jams with high viscosity tend to have poor greasing power or are difficult to spread. Along with the increasing acidity of the acidifier used, the evenness when smeared decreased. This was also found in melon jam with 60% added sucrose and citric acid with a score of 3.07 because it has a thick and smooth texture.

The raw materials and processing influenced the aroma of the jam. The aroma of melon in the resulting jam still dominated. This study is comparable to [16], which states that the aroma of mango was more pronounced in mango jams that use lower sugar concentrations than those with high sugar concentrations. This effect was because the aroma of sugar covered the distinctive aromas of the raw materials used to make the jam. In addition, according to [19], the distinctive aroma of melon in jam will be reduced because it evaporates during processing and cooking.

The distinctive aroma of melon in the jam with 40% added sucrose tended to decrease along with the acidity of the different acidifiers used, that is, 3.52 for citric acid (typical); 2.83 on lime (rather typical); and 2.65 in pineapple (rather typical). The content of citric acid and limonene essential oil in lime juice can create a fresh sour aroma that affects the aroma of the jam. Limonene is a pale liquid hydrocarbon compound containing a terpene group and has a very strong citrus aroma [30]. The distinctive aroma of pineapple juice comes from volatile components, specifically compounds with methyl ester and ethyl ester groups. Esters are volatile compounds that give aromas to most fruits [39].

The evenness of the jam when spread is also related to the water content of the jam. According to [40], the ability of the jam to be spread evenly on bread will increase as the water content decreases. Using 60% added sucrose and pineapple juice resulted in the lowest water content, and it could be spread evenly on the bread. The addition of sucrose to materials containing pectin will negate the stability of pectin by forming fine fibres so that the gel is not too hard and the resulting jam has a longer smear [23]. According to [6], the value of the spreadness decreased with increasing product viscosity and hardness.

The panellists' assessment of the aroma of melon jam is 2.33–3.52. The lowest aroma of melon jam had 50% added sugar and citric acid with a score of 2.33, while the highest aroma was with 40% added sugar and citric acid, with a score of 3.52. The melon aroma in the jam tended to decrease as the sucrose concentration increased.

The panellists' assessment of the sweetness of the jam was 3.10–4.43. The 60% added sucrose and pineapple juice had the sweetest score of 4.43, while the lowest was the jam with 40% added sucrose and citric acid with a score of 3.10. The higher the concentration of sucrose and the lower the acidity of the acidifier were, the sweeter the resulting jam tended to be, in accordance with [16], where the higher the amount of sucrose, the sweeter the jam produced tended to be. According to [32]the use of large amounts of sugar caused the resulting jam to be sweeter because more glucose and fructose are produced from the inversion of the sucrose.

Using citric acid resulted in the lowest sweetness values because citric acid is a pure acid and consequently has a sourer taste compared to the other acidifiers. Citric acid is often used as a sour taste enhancer in various food products [28]. According to [41], citric acid can act as a flavour enhancer and disguise less desirable aftertastes. Therefore, the higher the acidity level of the acidifier used, the sourer the jam will be.

The panellists' preference for the melon jam was 2.93 – 3.55. The panellists' preferred melon jam (3.55) had 50% added sucrose and citric acid, while the jam with 40% added sucrose and citric acid had the lowest preference, 2.93.

3.2 Best Product

The results of the effectiveness index show that the best product is made from 50% added sucrose and pineapple juice. The product has a water content of 31.49%, pH of 6.90; TPT of 71.00°Bx; and vitamin C of 114.40 mg/100 g, while the sensory properties were 3.55 (bright green); 4.05 flatness when smeared (average); 3.12 texture (a bit thick and a bit gritty); 3.00 melon aroma (rather typical); 4.23 sweet taste (sweet); and 3.43 appeal (somewhat like). The resulting melon jam has a lower water content than the melon jam measured by Zulfahfitriah (2009), which was 32.112%.

The water content and dissolved solids of the melon jam met the fruit jam standards: the water content was 31.49% (maximum 35% according to Indonesian Industrial Standards (1978)), and the TPT was 71.00°Bx (minimum 65% according to the National Standards Agency (2008)). Meanwhile, the pH of 6.90 did not reach the optimum pH for jam, which is between 3.1 and 3.5 (Rani, 2018). The use of 50% added sucrose gave the highest TPT and vitamin C values compared to the other amounts of added sucrose. The addition of pineapple juice produced the lowest water content and met the SNI standards compared to other acidifiers. The higher the acidity used, the higher the resulting water content.

4 Conclusion

Higher amounts of added sucrose increased the total dissolved solids, spreadability, texture, sweetness, and appeal and decreased the water content, colour, and melon aroma. Acidifiers with high acidity levels increased the water content, vitamin C, texture, melon aroma and appeal and reduced the pH, colour, spreadability, and sweet taste of melon jam. The melon jam made with 50% added sucrose and pineapple juice had the best physicochemical and sensory characteristics with 31.49% moisture content; pH 6.90; TPT 71.00°Bx; vitamin C of 114.40 mg/100 g; colour of 3.55 (bright green); flatness when smeared of 4.05 (average); texture of 3.12 (a bit thick and a bit gritty); melon aroma of 3.00 (rather typical); sweet taste of 4.23 (sweet) and appeal of 3.43 (somewhat like).

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References

1. R. P. Siwi, A. Anjarwani, and T. Tujiyanta, "Pengaruh waktu pemupukan Phonska dan jumlah buah pertanaman terhadap hasil tanaman melon (Cucumis melo L.) var. Glamour," *J. Trop. Subtrop. Agric. Sci.*, vol. 1, no. 1, pp. 31–37, 2016, doi: https://doi.org/10.31002/vigor.v1i1.314.g248.
2. Y. Wang *et al.*, "Effects of biodegradable films on melon quality and substrate environment in solar greenhouse," *Sci. Total Environ.*, vol. 829, pp. 1–11, 2022, doi: https://doi.org/10.1016/j.scitotenv.2022.154527.
3. M. Ning *et al.*, "Physiological and transcriptomic analysis of postharvest Jiashi melon at different storage temperatures," *Postharvest Biol. Technol.*, vol. 191, no. April, p. 111963, 2022, doi: https://doi.org/10.1016/j.postharvbio.2022.111963.

4. A. Khamidah and A. Krismawati, "Tingkat kesukaan jellydrink buah mangga dan melon dari berbagai konsentrasi pengental di desa Wonorejo, Kabupaten Madiun," *J. Pengkaj. dan Pengemb. Teknol. Pertan.*, vol. 23, no. 3, pp. 333–350, 2020.
5. B. B. A. Prasetyo, F. S. Pranata, and Y. R. Swasti, "Quality of fruit leather with combination of extract from watermelon albedo (Citrullus lanatus) and fruit flesh red melon (Cucumis melo L.) Sakata cultivars," *J. Ilmu Pangan dan Has. Pertan.*, vol. 4, no. 1, pp. 83–98, 2020, doi: https://doi.org/10.26877/jiphp.v4i1.6237.
6. M. N. Mohd Naeem *et al.*, "The nutritional composition of fruit jams in the Malaysian market," *J. Saudi Soc. Agric. Sci.*, vol. 16, no. 1, pp. 89–96, 2017, doi: https://doi.org/10.1016/j.jssas.2015.03.002.
7. H. Liu *et al.*, "Extraction, characterization and spontaneous gelation mechanism of pectin from Nicandra physaloides (Linn.) Gaertn seeds," *Int. J. Biol. Macromol.*, vol. 195, no. December 2021, pp. 523–529, 2022, doi: https://doi.org/10.1016/j.ijbiomac.2021.12.032.
8. F. Benmeziane, L. Djermoune-Arkoub, A. T. Boudraa, and S. Bellaagoune, "Physicochemical characteristics and phytochemical content of jam made from melon (Cucumis melo)," *Int. Food Res. J.*, vol. 25, no. 1, pp. 133–141, 2018.
9. R. Gómez-García, D. A. Campos, C. N. Aguilar, A. R. Madureira, and M. Pintado, "Valorization of melon fruit (Cucumis melo L.) by-products: Phytochemical and Biofunctional properties with Emphasis on Recent Trends and Advances," *Trends Food Sci. Technol.*, vol. 99, no. March, pp. 507–519, 2020, doi: https://doi.org/10.1016/j.tifs.2020.03.033.
10. A. Akesowan and A. Choonhahirun, "Optimization of sugar-free konjac gel texture containing erythritol-sucralose sweetener for producing healthy jam," *Food Res.*, vol. 3, no. 3, pp. 241–248, 2019.
11. D. Gawkowska, J. Cybulska, and A. Zdunek, "Structure-related gelling of pectins and linking with other natural compounds: A review," *Polymers (Basel).*, vol. 10, no. 7, 2018, doi: https://doi.org/10.3390/polym10070762.
12. Z. Raji, F. Khodaiyan, K. Rezaei, H. Kiani, and S. S. Hosseini, "Extraction optimization and physicochemical properties of pectin from melon peel," *Int. J. Biol. Macromol.*, vol. 98, pp. 709–716, 2017, doi: https://doi.org/10.1016/j.ijbiomac.2017.01.146.
13. R. Yunus, "Pengaruh penambahan sukrosa terhadap mutu Organoleptik dari selai langsat," *Gorontalo Agric. Technol. J.*, vol. 1, no. 1, p. 42, 2018, doi: https://doi.org/10.32662/gatj.v1i1.166.
14. M. F. Vargas-Torrico, E. von Borries-Medrano, S. Valle-Guadarrama, and M. A. Aguilar-Méndez, "Development of gelatin-carboxymethylcellulose coatings incorporated with avocado epicarp and coconut endocarp extracts to control fungal growth in strawberries for shelf-life extension," *CyTA - J. Food*, vol. 20, no. 1, pp. 27–38, 2022, doi: https://doi.org/10.1080/19476337.2021.2024607.
15. Y. Chen, J. G. Zhang, H. J. Sun, and Z. J. Wei, "Pectin from Abelmoschus esculentus: Optimization of extraction and rheological properties," *Int. J. Biol. Macromol.*, vol. 70, pp. 498–505, 2014, doi: https://doi.org/10.1016/j.ijbiomac.2014.07.024.
16. M. Bekele, N. Satheesh, and J. A. Sadik, "Screening of Ethiopian mango cultivars for suitability for preparing jam and determination of pectin, sugar, and acid effects on physico-chemical and sensory properties of mango jam," *Sci. African*, vol. 7, p. e00277, 2020, doi: https://doi.org/10.1016/j.sciaf.2020.e00277.
17. P. T. Huan, N. M. Hien, and N. H. T. Anh, "Optimization of alcoholic fermentation of dragon fruit juice using response surface methodology," *Food Res.*, vol. 4, no. 5, pp. 1529–1536, 2020, doi: https://doi.org/10.26656/fr.2017.4(5).125.
18. A. El Aziz, "the Effect of Direct Acidification By Different Acidulants on the Properties of Mozzarella Cheese," *J. Food Dairy Sci.*, vol. 5, no. 1, pp. 7–13, 2014.

19. D. T. Tandikurra, L. E. Lalujan, and M. F. Sumual, “Pengaruh penambahan sari jeruk nipis terhadap sifat sensoris selai tomat (Lycopersicum esculentumMill.),” *Teknol. Pertan.*, vol. 10, no. 2, pp. 52–62, 2019.
20. M. Shukla, Y. K. Jha, and S. Admassu, “Development of Probiotic Beverage from Whey and Pineapple Juice Development of Probiotic Beverage from Whey and Pineapple Juice,” *J. Food Process. Technol.*, vol. 4, no. 2, pp. 1–4, 2015, doi: https://doi.org/10.4172/2157-7110.1000206.
21. S. N. Chaudhari and A. H. Pathan, “Study of Development of Pomo-Lime Nectar Fortified with Sweet Lime Peel Powder,” *Int. J. Sci. Res.*, vol. 4, no. 10, pp. 2013–2016, 2015.
22. AOAC, “Official Methods of Analysis of the Association of Official Agricultural Chemists International,” *J. Assoc. Off. Agric. Chem.*, vol. 41, p. 12, 2005.
23. L. . Ho, S. R. R. I. Yasmira, and M. Norlia, “Proximate composition, physicochemical characteristics and sensory evaluation of reduced-calorie belimbi fruit (Averrhoa belimbi) jam with maltitol,” *Food Res.*, vol. 4, no. 5, pp. 1545–1553, 2020, doi: https://doi.org/10.26656/fr.2017.4(5).090.
24. A. M. S. Hussein, M. M. Kamil, N. A. Hegazy, K. F. Mahmoud, and M. A. Ibrahim, “Utilization of Some Fruits and Vegetables By-Products to Produce High Dietary Fiber Jam,” *Food Sci. Qual. Manag.*, vol. 37, no. 2007, pp. 39–45, 2015.
25. J. F. Hoffmann *et al.*, “Stability of bioactive compounds in butiá (Butia odorata) fruit pulp and nectar,” *Food Chem.*, vol. 237, pp. 638–644, 2017, doi: https://doi.org/10.1016/j.foodchem.2017.05.154.
26. F. C. Nissa, F. Arifan, R. Febrianto, W. Aditya, I. Hayu Dwimawanti, and R. Pramudyono Widyasmara, “Effect of sugar on nutrient composition and shelf life of red guava jams,” *IOP Conf. Ser. Earth Environ. Sci.*, vol. 406, no. 1, Dec. 2019, doi: https://doi.org/10.1088/1755-1315/406/1/012027.
27. N. Aini. *et al.*, “Siam orange (Citrus nobilis L .) nectar characteristics with variations in stabilizer and sucrose level,” *Food Res.*, vol. 6, no. June, pp. 315–323, 2022, doi: https://doi.org/10.26656/fr.2017.6(3).386.
28. K. Fibrianto, M. Anggara, and E. S. Wulandari, “The effect of sucrose and citric acid concentration of Candi banana peels jam on physico-chemical and sensory characteristics,” *IOP Conf. Ser. Earth Environ. Sci.*, vol. 475, no. 1, 2020, doi: https://doi.org/10.1088/1755-1315/475/1/012018.
29. V. R. De Souza, P. A. P. Pereira, A. C. M. Pinheiro, H. M. A. Bolini, S. V. Borges, and F. Queiroz, “Analysis of various sweeteners in low-sugar mixed fruit jam: Equivalent sweetness, time-intensity analysis and acceptance test,” *Int. J. Food Sci. Technol.*, vol. 48, no. 7, pp. 1541–1548, 2013, doi: https://doi.org/10.1111/ijfs.12123.
30. D. Rivera *et al.*, “Analysis of ‘Marrakesh limetta’ (Citrus × limon var. limetta (Risso) Ollitrault, Curk & R.Krueger) horticultural history and relationships with limes and lemons,” *Sci. Hortic. (Amsterdam).*, vol. 293, p. 110688, 2022, doi: https://doi.org/10.1016/j.scienta.2021.110688.
31. R. Shamsudin, N. A. Zulkifli, and A. A. Kamarul Zaman, “Quality attributes of fresh pineapple-mango juice blend during storage,” *Int. Food Res. J.*, vol. 27, no. 1, pp. 141–149, 2020.
32. L. Cervera-Chiner, C. Barrera, N. Betoret, and L. Seguí, “Impact of sugar replacement by non-centrifugal sugar on physicochemical, antioxidant and sensory properties of strawberry and kiwifruit functional jams,” *Heliyon*, vol. 7, no. 1, p. e05963, 2021, doi: https://doi.org/10.1016/j.heliyon.2021.e05963.
33. P. Naknaen and T. Itthisoponkul, “Characteristics of cantaloupe jams as affected by substitution of sucrose with xylitol,” *Int. J. Fruit Sci.*, vol. 15, no. 4, pp. 442–455, 2015, doi: https://doi.org/10.1080/15538362.2015.1031433.

34. R. Siti Rashima, M. Maizura, W. M. Wan Nur Hafzan, and H. Hazzeman, "Physicochemical properties and sensory acceptability of pineapples of different varieties and stages of maturity," *Food Res.*, vol. 3, no. 5, pp. 491–500, 2019, doi: https://doi.org/10.26656/fr.2017.3(5).060.
35. J. N. Musyoka *et al.*, "Effects of Acidification and Preservatives on Microbial Growth during Storage of Orange Fleshed Sweet Potato Puree," *Int. J. Food Sci.*, vol. 2018, pp. 1–11, 2018, doi: https://doi.org/10.1155/2018/8410747.
36. P. Naknaen and T. Itthisoponkul, "Characteristics of cantaloupe jams as affected by substitution of sucrose with xylitol," *Int. J. Fruit Sci.*, vol. 15, pp. 442–455, 2015, doi: https://doi.org/10.1080/15538362.2015.1031433.
37. M. A. Pistanty and K. Natassia, "Citric acid formulation on the quality of purple eggplant (Solanium melongenal) jam as an effort to food diversification," *CITR*, vol. 1, no. 1, pp. 71–81, 2021.
38. M. Padrón-Mederos, B. Rodríguez-Galdón, C. Díaz-Romero, M. G. Lobo-Rodrigo, and E. M. Rodríguez-Rodríguez, "Quality evaluation of minimally fresh-cut processed pineapples," *Lwt*, vol. 129, no. May, p. 109607, 2020, doi: https://doi.org/10.1016/j.lwt.2020.109607.
39. M. Mohd Ali, N. Hashim, S. Abd Aziz, and O. Lasekan, "Pineapple (Ananas comosus): A comprehensive review of nutritional values, volatile compounds, health benefits, and potential food products," *Food Res. Int.*, vol. 137, no. September, p. 109675, 2020, doi: https://doi.org/10.1016/j.foodres.2020.109675.
40. X. Sun *et al.*, "The effect of cultivar and processing method on the stability, flavor, and nutritional properties of winter melon juice," *Lwt*, vol. 97, no. May, pp. 223–230, 2018, doi: https://doi.org/10.1016/j.lwt.2018.06.059.
41. R. C. Rivero, C. Morel, and N. Sosa, "Development of a beverage based on citric juice with the addition of whey," *Brazilian J. Food Technol.*, vol. 23, pp. 1–10, 2020, doi: https://doi.org/10.1590/1981-6723.19118.

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