Physio-chemical Characteristic of Red Dragon Fruit and Pineapple Jam

F P Nurani¹ and E K B Sulistyoningih¹
¹Universitas Pembangunan Nasional “Veteran” Jawa Timur
email: fesdila.tp@upnjetim.ac.id

Abstract. Red dragon fruit is one of fruit that easy to find in Indonesia. The availability of red dragon fruit is quite abundant, especially in harvest season. Sometimes, it became a problem when the fruit didn’t sell out and causing some change of quality. One way to extend the shelf life of red dragon fruit is by making jam. Jam is a gel-shape and semi solid food. The making of red dragon fruit jam was combined with the addition of pineapple that contain pectin which help the formation of gels. Sugar was added as sweetener and also as preservatives. On the other side, sugar have a role in gel formation with pectin. Commercial pectin was added to support gel formation in making jam. The factors observed in this study were concentrations of sugar (50,60,70%) and commercial pectin (0, 0.3, 0.5%) that might influence some quality parameters of jam such as spread ability, total soluble solid (TSS), pH, vitamin C and antioxidants value. The best characteristic of jam with spread ability 13.5, 70.5% of TSS value, pH was 4.39, vitamin C value was 0.81% and antioxidants value 19145.91 ppm was obtained with the addition of 50% sugar without the addition of pectin.

Keywords: jam, pectin, pineapple, red dragon fruit, sugar.

1. Introductions

Indonesia is a tropical country that has a high biodiversity, especially plants. Various types of fruit and vegetables can be easily found in almost all regions of Indonesia. One of the fruits that are easily found in Indonesia is red dragon fruit. The red dragon fruit itself comes from Brazil and then cultivated in Indonesia. There are four types of dragon fruit that cultivated in Indonesia, Hylocereus undatus (dragon fruit that contains red and white flesh), Hylocereus polyrhizus (dragon fruit that has red skin and purplish red flesh), Hylocereus costaricensis (dragon fruit that has a red fruit), and Selenicereus megalnthus (dragon fruit that has yellow skin and white flesh) [1].

Red dragon fruit has a high nutrient content. The main pigment on red dragon fruit identified as betacyanin. There are at least seven known betacyanins identified from this fruit, namely: betanin, isobetanin, phyllocactin, isophyllocactin, betanidin, isobetanidin and hylocerenin [2]. Red dragon fruit is generally consumed directly, or can be added in fruit cocktails. In the harvest season, the availability of red dragon fruit can be very abundant. It might cause the economic value of the fruit become very low. Dragon fruit has high water content that may cause some decay. The decay of the dragon fruit will cause decreasing in the quality and nutritional value in it. One way to extend the shelf life of red dragon fruit is by processing jam.

Jams is a fruit solid gel made from fruit pulp by boiling the pulp with other ingredients such as sugar (sucrose), pectin, and acid. Other ingredients such as preservatives, colorants, or flavoring
agents could be added for special purpose [3]. Jams should be spreadable and should be in reasonable consistency. Jam should contain minimum fruit content of 40% and the expected total soluble solid content should not less than 68% [4].

One of the fruits that have been known to have high enough pectin content is pineapple. Pineapple (*Ananas comosus*) contains many nutrients such as vitamin A, calcium, phosphorus, magnesium, iron, sodium, potassium, dextrose, sucrose (cane sugar), and bromelain which are 95%-mixed cysteine proteases [5], which can hydrolyze protein (proteolysis) and resistant to heat. According to [6], pineapple has been known contain 29% of pectin.

Besides pineapple, commercial pectin can also be added in making jam. Generally, the addition of commercial pectin is done if the pectin content found in the fruit to be processed into jam is quite low. Pectin is a polymer compound that can bind water, form a gel or thicken a liquid with sugar and acid. Low methoxyl (LM) pectins are often used in low-sugar products due to their gel-forming properties without or with a small amount of sugar and in the presence of Ca$^{2+}$ [7]. Besides having role on gel forming, pectin could retain anthocyanin and color of strawberry jams and spreads [8].

Other ingredients for making jam are sugar. Sugar can function as a sweetener and preservative. The addition of sugar is essential in order to preserve the jams satisfactorily [9]. In addition, sugar also contributes to the formation of gels in making jam. This was revealed by Siregar [10] which states that the addition of sugar will affect the balance of pectin and water, pectin will coagulate and form a fine fiber, continuity and density is determined by the amount of pectin and sugar used. The higher the levels of pectin and sugar, the denser the product produced.

The aim of this study was to determine the effect of the addition of pectin and sugar in the characteristic of red dragon fruit jam combined with pineapple. Some parameters observed were spread ability, TPT, pH, Vitamin C, and antioxidant value.

2. Materials and Methods

2.1. Materials

Materials that used in making red dragon fruit jams include: red dragon fruit, pineapple, sugar, pectin, iodine solution, DPPH.

2.2. Methods

Red dragon fruit and pineapple were taken from the flesh, cut, then crushed using a blender until pulp was obtained. The ratio of the red dragon pulp and pineapple used was 3:2. The pulp mixture was then added with pectin and sugar and then heated at 80-90°C until it thickened. The jams that obtained were kept in a jar that has been sterilized before.

Characteristics of red dragon fruit and pineapple jams were done by measuring the spread ability, TSS with a hand refractometer, pH with a pH-meter, Vitamin C by the iodometric titration method, and antioxidants activity by spectrophotometry

3. Results and Discussions

3.1. Spread ability

Spread ability is an important parameter for jam products. The good jam has a semi-solid properties and soft enough so could provide good spread ability. Some factors that affect the gel formation are pectin, the presence of acids and sugars. Both acids and sugars will synergize with pectin to form gel fibers in making jams. Jams that are too solid tend to be disliked because it is difficult to spread, on the other hand, jams that are too watery are also considered not to provide a good spread.
Table 1. Spread ability (cm) of red dragon fruit and pineapple jams with various concentration of sugar and pectin

| Sugar (%) | 0   | 0.3  | 0.5  |
|-----------|-----|------|------|
| 50        | 13.50 A | 9.35 A | 8.85 A |
| 60        | 14.15 A | 11.75 A | 10.00 A |
| 70        | 13.75 A | 13.60 A | 11.05 A |

Note: Capital letters are read vertically, lowercase letters are read horizontally. Each of the same letters does not show a real difference at the 5% level.

The highest spread ability was found in red dragon fruit and pineapple jams with addition of 60% sugar without the addition of pectin while the lowest spread ability was obtained in jams with 50% sugar and 0.5% pectin added at 8.85. Table 1 showed that there was no significant difference on spread ability of the red dragon fruit and pineapple jams. Both sugar and pectin did not give any difference to the parameter, and also, there was no interaction between the two factors.

3.2. Total Soluble Solid

Table 2. Total Soluble Solid (TSS) value of red dragon fruit and pineapple jams with various concentration of sugar and pectin

| Sugar (%) | 0 | 0.3  | 0.5  |
|-----------|---|------|------|
| 50        | 70.5 A | 69 A | 68 A |
| 60        | 69.5 A | 69 A | 69.5 A |
| 70        | 66 A | 68 A | 71 A |

Note: Capital letters are read vertically, lowercase letters are read horizontally. Each of the same letters does not show a real difference at the 5% level.

Table 2 showed that both of sugar and pectin did not give any significant difference to total soluble solid value. In the other side, there was interaction between the two factors. It means that the existence of both sugar and pectin influenced total soluble solid of red dragon fruit and pineapple jams. 95% addition of sucrose significantly affected the total value of dissolved solids (TPT) of kalamansi orange marmalade. This is presumably because pectin and sucrose are the constituent components of total dissolved solids [11]. Dissolved solids in a food material are strongly influenced by soluble pectin [12]. That the more pectin added the greater the total value of the solids contained in pineapple jam [13].

3.3. pH

pH value of the red dragon fruit and pineapple jams was about 3.22-4.39. There was no interactions between two factors, but the amount of pectin showed significantly different to the pH value. The pH
of jams influenced by pH of the ingredients such as red dragon fruit pulp and pineapple pulp. [14] stated that pH of red dragon fruit was 3.4-3.5, and [15] stated pH of pineapple pulp is 4.50. Based on the ANOVA, there was no interaction between pectin and sugar that might influence the pH of the jams, but, pectin showed differently significant to each amount of concentration.

**Table 3. pH of red dragon fruit and pineapple jams with various concentration of sugar and pectin**

| Sugar (%) | Pectin (%) |
|-----------|------------|
|           | 0          | 0.3        | 0.5        |
| 50        | 4.39 C     | 4.35 B     | 4.30 A     |
|           | a          | a          | a          |
| 60        | 3.73 C     | 3.98 B     | 3.27 A     |
|           | a          | a          | a          |
| 70        | 3.22 C     | 3.85 B     | 3.28 A     |
|           | a          | a          | a          |

Note: Capital letters are read vertically, lowercase letters are read horizontally. Each of the same letters does not show a real difference at the 5% level.

### 3.4. Vitamin C

Sugar and pectin didn’t show any significant difference on vitamin C. There was no interaction between the two factors. Ascorbic acid is component which takes the responsibility of vitamin C on red dragon fruit [16]. Low vitamin C levels, caused by the cooking process at high temperatures so that vitamin C is damaged. The higher the heating temperature with the same time the more vitamin C levels are found the more degraded by heat [17]

**Table 4. Vitamin C (%) of red dragon fruit and pineapple jams with various concentration of sugar and pectin**

| Sugar (%) | Pectin (%) |
|-----------|------------|
|           | 0          | 0.3        | 0.5        |
| 50        | 0.81 A     | 0.66 A     | 0.82 A     |
|           | a          | a          | a          |
| 60        | 0.77 A     | 0.60 A     | 0.78 A     |
|           | a          | a          | A          |
| 70        | 0.89 A     | 0.64 A     | 0.98 A     |
|           | a          | a          | a          |

Note: Capital letters are read vertically, lowercase letters are read horizontally. Each of the same letters does not show a real difference at the 5% level.

### 3.5. Antioxidants

Antioxidants value of red dragon fruit has been affected by betalain [18], in the other side, pineapple has a high vitamin C and total phenolic content [19]. Table 5 showed that sugar and pectin didn’t significantly different. There was no interaction between both sugar and pectin. It might cause sugar and pectin didn’t contain some antioxidants components.
3.6. Best Treatments

Determination of the best treatment was done by de Garmo effectiveness test (1984), by sorting variables based on priorities and contributions to results, weighting of each variable based on their contribution, and determining the value of effectiveness. In this study, sorting is based on the results of analyzes that are compared with the quality standards of jams based on Indonesia National Standards. The TSS value becomes the first priority because the value stated on the standard, jams contains at least 65% of total dissolved solids. Pectin content becomes the second priority followed by crude fiber content, water content and ash content. The results of calculations from 9 samples are then selected the highest value as the best treatment.

Based on the calculation of effectiveness test, red dragon fruit and pineapple jams with 50% sugar and no pectin addition has TSS value of 70.5%. The chemical characteristics that followed the jams from the calculation of the best treatment were spread ability of 13.5, pH 3.39, Vitamin C of 0.81%, and antioxidants activity of 19.15x10^{-3} ppm.

4. Conclusions

The spread ability of red dragon fruit and pineapple jam did not show any significantly difference. Addition of pectin and sugar showed interactions on the TSS value. The best treatment of red dragon fruit jam and pineapple was obtained from the addition of 50% sugar without the addition of pectin with a spread ability of 13.5cm, TSS value 70.5, pH 4.39, vitamin C 0.81% and antioxidants value 19, 15x10^{-3} ppm.

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