Physical, chemical and sensory characteristics of red guava (Psidium guajava) velva at different fruit ripening time

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Abstract. This study purposed to determine the effect of red guava fruit ripening time on the physical (overrun and melting rate), chemical (vitamin C, pH, total dissolved solid) and sensory (color, taste, aroma, texture, and overall compare to control (without ripening) velva) characteristic of red guava velva. Red guava fruits were harvested at 90 days after flowering, ripened and then processed into velva. This research used Completely Randomized Design with fruit ripening time (without ripening, 4 days, and 6 days) as single factor. The research was conducted in triplicate. Chemical and physical characteristic data was analysed using One Way Analysis of Varian whether sensory characteristic data was analyzed using Independent Sample T-test. The result showed that fruit ripening time significantly affected the physical, chemical and sensory characteristic of the velva. Vitamin C, pH, and total solid of the velva were increased as the ripening time prolonged. In other hand, increasing of fruit ripening time decreased the overrun and melting rate of the velva. Red guava velva made from 6 days ripening had better sensory characteristics compared to velva made from red guava fruit without ripening or 4 day ripening. This research conclude that 6 days ripening time gives better chemical, physical and sensory characteristics of the velva compare to 4 days ripening time. Red guava fruits ripened for 6 days were recommended as raw material in velva making.

Keywords: velva, ripening time, red guava

1. Introduction
Indonesia is one of the tropic countries with a huge diversity of fruits. One of the popular fruits is guava. Central Bureau Statistics of Indonesia [1] reported that in 2014 guava production in Indonesia was 187406 ton while Java island produced 121.273 ton of guava, and Central Java produced 40.462 ton of guava in a year. Due to the high production of guava in every season, the processing of guava into food products is necessary to increase the farmer income. Some food products generated from red guava such as jam [2], jelly [3], and fruit leather [4]. Other promising food product developed from red guava is velva.

Velva is one of frozen dessert which was produced from fruits and contains less fat due to non milk fat utilization. Velva is also nutritious due to high content of vitamin from the fruits as ingredient. Velva production requires the high total solid compounds of fruits to produce a good texture of velva. Every fruits contained high total solid compound could be produced into velva [5]. Several fruits have been manufactured into velva such as pineapple, honeydew, soursop and guava.

Red guava contains 80.8 g water; 68 kcal energy; 2.55 g protein; 0.95 g fat, 14.32 g carbohydrate; 5.4 total dietary fiber; 8.92 g total sugar; 25 μg total carotene; 1.39 g ash; 374 μg β-carotene; 5.204
lycopene µg [6]; and 87 mg vitamin C [7]. The total soluble solid content of red guava was quite high (8.5-11.4%) [6]. Therefore, red guava potentially developed into velva.

The texture of velva is also affected by stabilizer agents [8]. 0.5% gelatin has been selected as stabilizer that could produce velva with 33.91% overrun [5]. While, red guava velva produced from ingredients that contain 1% CMC as stabilizer revealed velva with 15.21% overrun and 2.68 min/g melting rate [9].

Guava is a climacteric fruits with moderate natural ethylene production. Climacteric fruits can be harvested at early physiology maturity state and storage for several days before it sold or consumed as ripened fruits. During maturity state, starch converse into sugar that revealed sweeter and softer fruits at ripening state [10]. Fruit color changes and vitamin and volatile compounds formation also occurs during maturity state [11].

Guava has a rapid maturation rate and the shelf life after harvest is relatively short ranging from 3 to 8 days [12] or 5 to 8 days [13] depending on the variety, harvest time, and environmental conditions. The guava reaches its climacteric peak between the 4th day and the 5th post-harvest day (mature-green harvested fruit) and then decreases [12] or the 4th day to the 6th day followed by rapid changing of fruit color and firmness [13]. Synthesis of ethylene increase until 8 days when fruits spoiled [14]. This indicated that difference ripening time will perform different characteristics of fruits.

Furthermore, this study aimed to investigate the effect of ripening time of red guava on the characteristics of red guava velva. Ripening time of samples varied on 0, 4, and 6 days. The chemical (total soluble solid, vitamin C, pH), physical (overrun, melting rate) and sensory characteristics of red guava velva will determine to select the suitable ripening time of red guava to produce velva.

2. Material and Method
Red guava fruits were harvested from farmer group farms at Dusun Candi, Desa Jatirejo, Kecamatan Ngargoyoso, Kabupaten Karanganyar, Central Java at 90 days after flowering. Firm, glossy, round, not rotten and not defect fruits were selected to follow ripening process. Ripening process was carried out at ambient temperature for 0 (without ripening), 4, and 6 days in an air circulated basket (Figure 1). Ten red guava fruits was used for each ripening treatment. The basket was kept away from direct sunlight and each red guava fruit was wrapped using polyethylene plastic. Ripened red guava fruits for 0 (without ripening), 4, and 6 days are shown in Figure 2.

Figure 1. Ripening process.
Ripened red guava fruits were washed, sliced, and crushed to get red guava puree. Cane sugar (25% w/w), gelatin (0.5% w/w), citric acid (0.1% w/w) and water (50% v/w) were added into red guava puree and mixed homogenously. The homogenous mix was refrigerated for 24 hours at 5-6°C followed by agitation for 30 minutes at 4°C using Ice Cream Maker (Delonghi Gelatiao ICK6000). Agitated mix was frozen at -20°C for 24 hours to obtain the red guava velva and kept in the freezer until being analyzed.

2.1. **Determination of vitamin C.** Velva samples was diluted in aquades into 100mL solution and filtered. 25mL aliquots was transferred into Erlenmeyer, added with 1% starch solution, and then titrated using Iodin solution. Vitamin C calculated as (Iodine solution volume x vitamin C molecular weight)/samples weight [15].

2.2. **Determination of pH.** Velva pH values was measured using digital laboratory pH meter with glass electrode.

2.3. **Determination of total dissolved solids.** Velva total dissolved solid was measured using hand refractometer.

2.4. **Determination of overrun.** Homogenous mix samples was weighed, frozen into velva, and then the velva samples was weighed. The weighing procedure was conducted at the same volume. Overrun calculated as [(velva weight – mix weight)/ mix weight] x 100% [16].

2.5. **Determination of melting rate.** 100 grams velva samples was placed on the wire mesh (10 mesh) and let to melt at room temperature. The dripped portion passing the wire mesh was weighed every 10 minutes for 120 minutes. The time was plotted against the dripped portion weight to determine the slop that calculated as melting rate of the velva (grams/minutes) [16].

2.6. **Sensory analysis.** Sensory characteristic of the velva was tested using multiple comparison test [17]. Velva made from red guava fruit without ripening process was carried out as control sample whether velva made from ripened red guava fruit for 4 days and for 6 days as test sample. 25 untrained panels were involved sensory test. Sensory parameters being observed were color, aroma, taste, texture and overall.

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**Figure 2.** Ripened red guava fruits.
The analysis was conducted in triplicate. Chemical characteristic data and physical characteristic data was analysed using One Way Analysis of Variance followed by Duncan Multiple Comparison Test if there was a significant different between treatment. Sensory characteristic data was analysed using Independent Sample T-test.

3. Results and Discussion

3.1. Vitamin C
Vitamin C of the red guava velva increased due to fruit ripening prior to velva processing and ripening time seem significantly affected the vitamin C content of the velva (Table 1). Highest vitamin C content was found in velva made from ripened red guava fruit for 6 days (76.85 mg/100 g), followed by velva made from ripened red guava fruit for 4 days (68.05 mg/100 g) and without ripening (59.25 mg/100 g). The difference of vitamin C content was suggested have correlation with vitamin C biosynthesis from simple sugar as starch degradation product during fruit ripening [18]. Ripening process was reported promote the vitamin C content up to 35% [19].

Red guava velva in this research contained higher vitamin C compare to papaya velva and tomato velva. Papaya velva contained vitamin C 46.20 mg/100 g [20] and tomato velva that contained vitamin C 27.13 mg/100g [21].

| Ripening time (days) | Vitamin C (mg/100 g) a,b |
|----------------------|--------------------------|
| Without ripening     | 59.25 ± 5.18             |
| 4                    | 68.05 ± 2.87             |
| 6                    | 76.85 ± 4.54             |

*Values are means ± standard deviation.

Mean values followed by different superscripts are significantly different at α 0.05.

3.2. pH
Table 2 showed that the acidity of the red guava velva was decreased as the ripening time prolonged. This phenomena probably similar to the white guava acidity changes. White guava had a certain trend of pH development during ripening process related to organic acid content. White guava at mature stage would have a pH ascending and organic acid descending [22].

The pH of the red guava velva in this research was ranged from 4.09 – 4.60. It is similar to the previous report that using 10% carboxyl methyl cellulose (CMC) as stabilizer in the red guava velva processing [9].

| Ripening time (days) | pH a,b          |
|----------------------|-----------------|
| Without ripening     | 4.09 ± 0.77     |
| 4                    | 4.28 ± 0.08     |
| 6                    | 4.60 ± 0.22     |

*Values are means ± standard deviation.

Mean values followed by different superscripts are significantly different at α 0.05.
3. 3. **Total Dissolved Solids**

Total dissolved solids of red guava velva was significantly increased with ripening time increase (Table 3). Velva made from red guava fruit ripened for 6 days got the highest total dissolved solid. The increasing of total dissolved solids also found in the olive sherbet as the olive maturity increase [23].

Total dissolved solids increase in the velva had correlation with maturity development of red guava fruit. Starch hydrolysis by enzymes into simple sugars during ripening caused total dissolved solids increase. This enzymatic starch hydrolysis was ascending significantly in the fourth day after harvesting [24]. Total dissolved solid of red guava velva in this research (19.80 – 21.95ºBx) was higher than tomato velva (17.67ºBx) [21] and papaya velva (19.33ºBx) [20], but lower than orange sweet potato velva (26.13ºBx) [25].

**Table 3. Total Dissolved Solids of Red Guava Velva Made from Different Fruit Ripening Time.**

| Ripening time (days) | Total Dissolved Solids (ºBx)\(^a,b\) |
|----------------------|--------------------------------------|
| Without ripening     | 19.80\(^a\) ± 0.79                   |
| 4                    | 20.33\(^b\) ± 0.81                   |
| 6                    | 21.95\(^b\) ± 0.47                   |

\(^a\)Values are means ± standard deviation.
\(^b\)Mean values followed by different superscripts are significantly different at α 0.05.

3. 4. **Overrun**

High overrun in frozen dessert production, including ice cream and velva, is profitable. However, consumer preference related to frozen dessert quality such as melting rate and sensory parameter should be compromised with high overrun.

Table 4 showed that red guava fruit ripening time affected the velva overrun. As the ripening time prolonged, the velva overrun was decrease significantly. This trend was contrast to the total dissolved solids shown in Table 3. The increasing of total dissolved solids would inhibit the mix to trap air so the overrun would decrease [26]. Overrun of the red guava velva in this research (46.64 – 55.64%) was higher than the red guava velva in the previous report (33.91%) [5]. It probably caused by the difference of the red guava cultivar or the processing method used.

**Table 4. Overrun of Red Guava Velva Made from Different Fruit Ripening Time.**

| Ripening time (days) | Overrun (%\(^a,b\)) |
|----------------------|----------------------|
| Without ripening     | 55.64\(^a\) ± 1.29   |
| 4                    | 52.97\(^b\) ± 0.39   |
| 6                    | 46.64\(^b\) ± 0.26   |

\(^a\)Values are means ± standard deviation.
\(^b\)Mean values followed by different superscripts are significantly different at α 0.05.

3. 5. **Melting Rate**

Melting rate of the red guava velva could be seen in the Table 5. Ripening time significantly affected the velva melting rate. Longer ripening time would cause lower melting rate. Lower melting rate was preferable to the consumer because the velva would not melt easily.

The melting rate of the velva was inversely proportional to the total dissolved solids (Table 3) but was proportional to the overrun (Table 4). It was similar to ice cream phenomena. Ice cream with high overrun would melt slowly because the heat transfer rate was decline due to air trapping and zigzag path which the melting fluid must flow [16, 27]. Red guava velva made from ripened fruit for 6 days...
got the best melting rate compared to the two others. It also got better melting rate than papaya velva (1.41 grams/minutes) [20], orange sweet potato velva (1.61 grams/minutes) [25] and tomato velva (1.63 grams/minutes) [21].

**Table 5. Melting Rate of Red Guava Velva Made from Different Fruit Ripening Time.**

| Ripening time (days) | Melting Rate (grams/minutes)\(^a,b\) |
|---------------------|-------------------------------------|
| Without ripening    | 0.40C ± 0.03                        |
| 4                   | 0.36B ± 0.01                        |
| 6                   | 0.33A ± 0.02                        |

\(^a\)Values are means ± standard deviation.

\(^b\)Mean values followed by different superscripts are significantly different at \(\alpha\) 0.05.

3. 6. **Sensory Characteristic**

Table 6 showed that either velva made from ripened fruit for 4 days or for 6 days had better score compared to control (velva made from fruit without ripening) in all sensory parameters. Ripening time did not affect the score of aroma and texture but affected the score of color, taste, and overall. Red guava velva made from ripened fruit for 4 days got better score for those color, aroma, and overall parameter than velva made from ripened fruit for 6 days. Velva made from ripened fruit for 6 days had stronger red color than the other one (Figure 3).

**Table 6. Multiple Comparison Score of Red Guava Velva Made from Different Fruit Ripening Time.**

| Sensory Parameter | Ripening time (days)\(^a,b\) |
|-------------------|-----------------------------|
|                   | 4                           | 6                           |
| Color             | 2.08B ± 0.64                 | 1.40A ± 0.50                 |
| Aroma             | 3.20A ± 1.15                 | 2.44A ± 1.75                 |
| Taste             | 3.44B ± 1.44                 | 2.40A ± 1.08                 |
| Texture           | 3.16A ± 1.17                 | 2.76A ± 1.30                 |
| Overall           | 2.72B ± 0.79                 | 1.92A ± 0.75                 |

\(^a\) Values are means ± standard deviation. Mean values followed by different superscripts in the same row are significantly different at \(\alpha\) 0.05.

\(^b\) 1=very much better than R; 2=much better than R; 3=better than R; 4=slightly better than R; 5=equal to R; 6=slightly worse than R; 7=worse than R; 8=much worse than R; 9=very much worse than R

R is control (without ripening)

![Figure 3. Velva made from ripened red guava fruits](image-url)
4. Conclusion
Fruit ripening time did affect the vitamin C, pH, total dissolved solids, overrun, melting rate and sensory characteristics of the red guava velva produced. Highest vitamin C content, highest total dissolved solids, worst overrun, and best melting time was found in the velva made from fruit ripened for 6 days. Sensory characteristics of the velva made both from fruit at 4 dan 6 days ripening time were better than velva made from fruit without ripening. Therefore, making velva from fruit ripened for 6 days is recommended to be applied.

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