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Physical and Chemical Characteristics Marmalade of Rimau Gerga Lebong with Addition of Citrus Kalamansi

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ABSTRACT

Rimau Gerga Lebong (RGL) and kalamansi are two types of oranges typical of Bengkulu. Both types of oranges can be developed into processed products such as marmalade. This study aimed to obtain the effect of the addition of kalamansi and sugar on the physical and chemical characteristics of marmalade. This study used a randomized block design (RBD) method with two factors, namely the RGL-kalamansi ratio (1:0 ; 1:1 ; 2:1 ; 3:1; 4:1) and the addition of sugar (55, 65, and 75%). Anova and Tukey are the tools used in data analysis. The results showed that using the RGL-kalamansi ratio of 4: 1 produced the highest vitamin C. Making marmalade by combining two types of Bengkulu typical citrus can improve the properties of marmalade, especially water content and vitamin C.. The addition of sugar can increase the total value of dissolved solids and reduce water content. Utilization of the typical local oranges of Bengkulu is expected to increase the added value of this commodity.

***Keywords**: marmalade, RGL, kalamansi, sugar*

1. INTRODUCTION

Bengkulu Province has several types of superior citrus, including Kalamansi orange and RGL (RGL). Rimau Gerga Lebong (RGL) is one of the potential commodities of Lebong Regency because it has a competitive advantage, namely a large fruit size of 200-350 grams, thick fruit skin with yellow-orange color, orange flesh color with a sweet, sour, fresh taste [1]. RGL orange variety has been designated as a national superior variety in 2012, with Decree No. 2087 / Kpts / SA.120 / 6/2021. Other potential oranges in Bengkulu Province are kalamansi oranges. Kalamansi orange (*Citrofortunella microcarpa*) is a type of citrus fruit that grows rapidly in the Bengkulu area. Kalamansi oranges have a distinctive aroma and a sour taste when ripe and bitter when they are still raw.

Gerga lebong oranges and kalamansi oranges have the potential to be developed into processed products to increase their value and shelf life. One of the alternatives for citrus processed products is marmalade. Marmalade is a semi-wet food made from orange juice with the addition of orange peel slices [2]. Kalamansi orange marmalade using 95% sugar resulted in total dissolved solids ranging from 44.45% -65.32%, having a distinctive aroma, and unfavorable color [3]. Whereas RGL marmalade using 75% sugar yields total dissolved solids between 65.82-72.7% [4]. The total dissolved solids that have been determined by BSN is at least 65% [2]. The combination of gerga lebong oranges and kalamansi oranges in the manufacture of marmalade is expected to produce better marmalade characteristics. The preparation of marmalade by mixing several types of ingredients has been done by many previous researchers [5]–[8]. This aims to improve the characteristics of the resulting marmalade.

Sugar is an important additive needed in making marmalade. The addition of sugar in food processing will form a flavor and color at the time and can act as a good preservative [9]. The innovation of marmalade processing from rimau gerga lebong and kalamansi oranges needs to be done so that it can become an alternative product in the development of processed citrus as a superior local product of Bengkulu Province. This study aimed to determine the effect of using kalamansi orange and the addition of sugar in marmalade production on the physical and chemical properties of marmalade.

2. METHOD

2.1 Material Preparation

The main ingredients used were small size rimau gerga lebong (RGL) and kalamansi oranges. Kalamansi oranges are obtained from community plantations in the city of Bengkulu. RGL was obtained from community plantations in Lebong Regency. The RGL used was the lowest grade RGL (diameter ± 5 cm). Orange juice was obtained by manual pressing. The marmalade mixture uses kalamansi orange peel that has been boiled for 5 minutes at 90ºC and then thinly sliced. Boiling the peel aimed to get rid of the bitterness in the orange peel.

2.2 Research design

The design used in this study was a Randomized Block Design (RBD) with two factors, namely the addition of sugar (55%, 65%, 75%) and the ratio of rimau gerga lebong & kalamansi oranges (1: 0; 1: 1; 2: 1; 3: 1; 4: 1). Each treatment combination was repeated 3 times.

2.3 Procedure marmalade production

The first stage is making a combination of rimau gerga lebong (RGL) and kalamansi orange juice (according to the research design) with a total juice weight of 200g, and preparing the sugar to be added (according to the research design). Orange juice and sugar were put in a saucepan with the addition of 100g of water. Then the material is heated at 80ºC for 20 minutes and stirred until blended. Pectin 6,125g and 50g orange peel slices were added while stirring. After 20 minutes the marmalade was removed and cooled.

2.4 Analysis of physical and chemical properties

Observations made on marmalade samples included water content [10], pH [11], total dissolved solids [2], vitamin C [11], and spreadability [12].

2.5 Data analysis

The data obtained from the test will be processed statistically using the ANOVA (Analysis of Variance) test at the 5% level, if there is a significant difference, the analysis will be continued with the Tukey Test and presented in tables and graphs.

3. RESULT AND DISCUSSION

3.1 The Effect of RGL and Kalamansi Ratio on Moisture Content, pH, Vitamin C, Total Dissolved Solids, and Spreadability

The ratio of RGL and kalamansi had a significant effect on the parameters of water content, pH, and vitamin C and had no significant effect on total dissolved solids and spreadability. The highest water content was obtained from the RGL-Kalamansi 1: 0 ratio of 47.339%. The RGL-Kalamansi 1: 0 and 1: 1 ratios were significantly different with all treatments, while the 2: 1, 3: 1, and 4: 1 ratios were not significantly different from each other. The addition of the greater the amount of RGL had an effect on decreasing the water content (Fig. 1). This was thought to be because the presence of kalamansi oranges can increase the discharge of marmalade water during the processing process.

The high RGL ratio resulted in an increase in the pH of the resulting marmalade (Fig. 2). The highest pH was obtained from the treatment of the RGL-Kalamansi ratio of 1: 0, while the lowest pH was at a 2: 1 ratio. The combination of low Kalamansi pH, namely 2.4 [13] and higher RGL pH (± 3.9), gave relatively good pH results of marmalade, ranging from 3.2-3.5. Kalamansi orange which has a more acidic taste has a higher / stronger acidity than RGL. This result is in accordance with the research of Novita et al., [3] where the pH of the kalamansi orange marmalade ranges from 2.3-2.5 lower than the pH value of the RGL orange marmalade in Zainudin's study [4] which ranges between 3.45-3.84.

Vitamin C RGL-Kalamansi orange marmalade ranges from 11.53-14.34 mg / 100g. A 2: 1 RGL-Kalamansi ratio provides the lowest vitamin C. The results of Anggreani and Yeni's research [14] showed that vitamin C of Kalamansi oranges was 3.863 mg / 100g higher than vitamin C RGL, which is 3.102 mg / 100g. The vitamin C of Kalamansi orange marmalade produced by Perawati et al. [15] ranges from 5.66-8.61 mg / 100g. Meanwhile, vitamin C marmalade RGL produced in Zainuddin's research [4] was 10.56 mg / 100g. The vitamin C value of the RGL-Kalamansi blend of marmalade is better than the kalamansi orange marmalade or RGL alone. The greater the RGL-Kalamansi ratio can increase the vitamin C value of marmalade.

Table 1. Physical and chemical properties of marmalade at various RGL - Kalamansi ratios

RGL – Kalamansi Ratio	Moisture content	pH	Vit C	TDS	Spreadability
1:0	47,669^{C} ± 0,394	3,821^{e} ± 0,029	13,298^{bc} ± 0,349	60,053^{ns} ± 0,352	7,633^{ns} ± 0,186
1:1	46,018^{b} ± 0,394	3,508^{c} ± 0,029	12,418^{ab} ± 0,029	59,453^{ns} ± 0,352	7,797^{ns} ± 0,352
2:1	44,369^{a} ± 0,394	3,188^{a} ± 0,029	11,538^{a} ± 0,029	58,852^{ns} ± 0,352	7,960^{ns} ± 0,352
3:1	44,011^{a} ± 0,394	3,369^{b} ± 0,029	12,438^{ab} ± 0,029	58,983^{ns} ± 0,352	7,863^{ns} ± 0,352
4:1	44,375^{a} ± 0,394	3,691^{d} ± 0,029	14,343^{c} ± 0,029	59,496^{ns} ± 0,352	7,687^{ns} ± 0,352

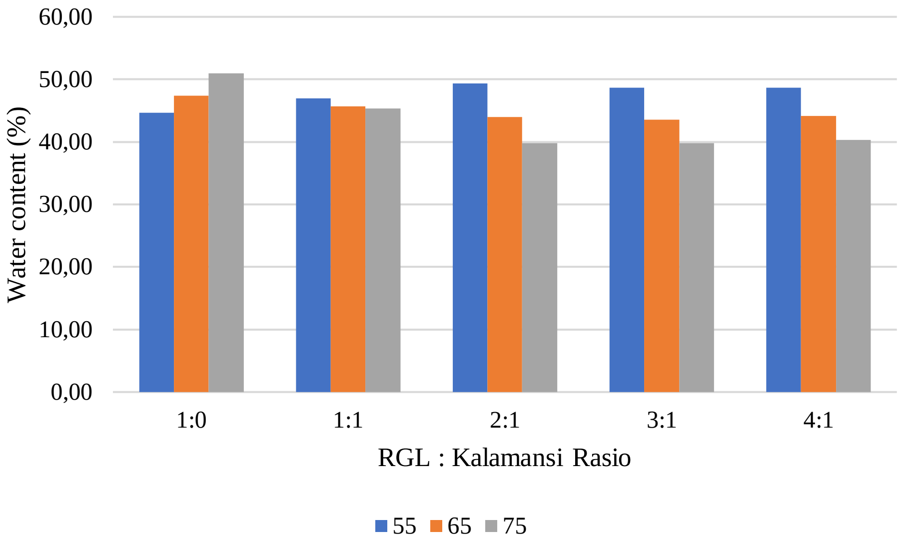

Figure 1. Water content marmalade

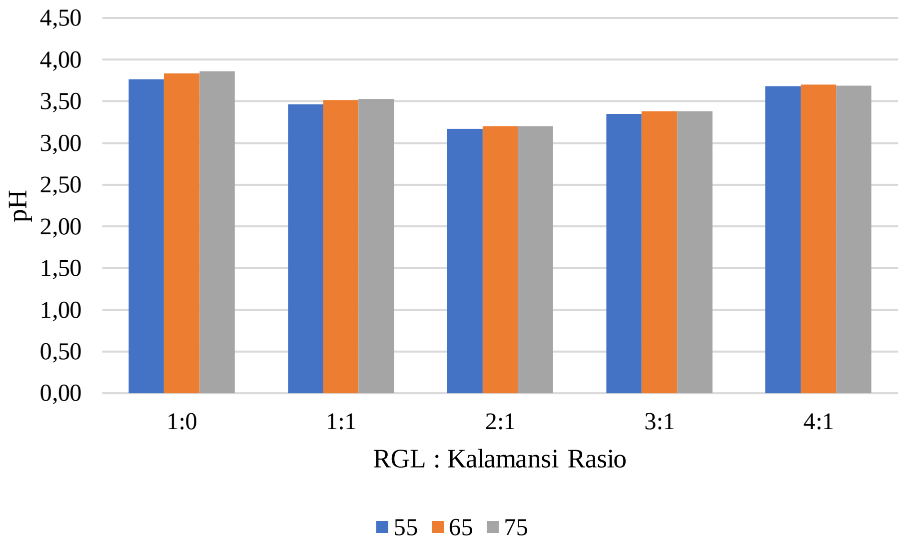

Figure 2. *pH Marmalade*

3.2 Effect Of Added Sugar On Moisture Content, Spreadability, Vitamin C, Ph, And Total Dissolved Solids

The use of sugar in food products serves to improve taste as well as a natural preservative with the aim of inhibiting bacterial growth. Sugar is involved in the preservation and manufacture of various food products such as marmalades, jams, jellies, syrups and others. When sugar is added to food in a high enough concentration (at least 40%) some of the available water becomes unavailable for the growth of microorganisms and reduces aw in foodstuffs [16].

The addition of sugar to the RGL-Kalamansi marmalade had a significant effect on the parameters of water content, vitamin C, total dissolved solids, and spreadability, but had no significant effect on pH (Table 2). The use of more sugar resulted in lower marmalade water content (Fig. 1). Sugar is one of the organic materials dissolved in food, so the more sugar you add, the higher the dissolved solids in the food product, which will reduce the water content of the food product. Nurani [17] states that sucrose is hygroscopic (binds water) so that the addition of sucrose, which increases its concentration, causes most of the free water to be bound. The high use of sugar in the manufacture of marmalade causes marmalade formation to accelerate, due to a synergistic effect between hydrocolloids [5]. The addition of sugar will affect the existing pectin-water balance and negate the stability of the pectin, because the toughness of the fibers in gel formation by pectin is influenced by sugar content and acidity [9].

Table 2. Physical and chemical properties of marmalade in various variations of adding sugar

Sugar	Moisture content	pH	Vit C	TDS	Spreadability
55%	47,661[c] ± 0,305	3,487[ns] ± 0,023	15,195[c] ± 0,27	53,693[a] ± 0,273	6,533[a] ± 0,144
65%	44,961[b] ± 0,305	3,527[ns] ± 0,023	12,861[b] ± 0,27	58,797[b] ± 0,273	8,074[b] ± 0,144
75%	43,242[a] ± 0,305	3,531[ns] ± 0,023	10,365[a] ± 0,27	65,613[c] ± 0,273	8,757[c] ± 0,144

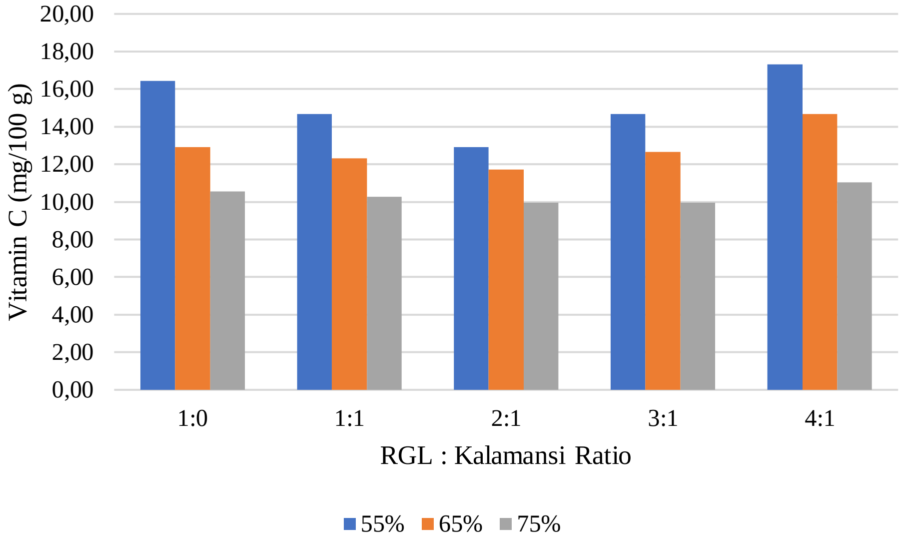

Figure 3. *Vitamin C Marmalade*

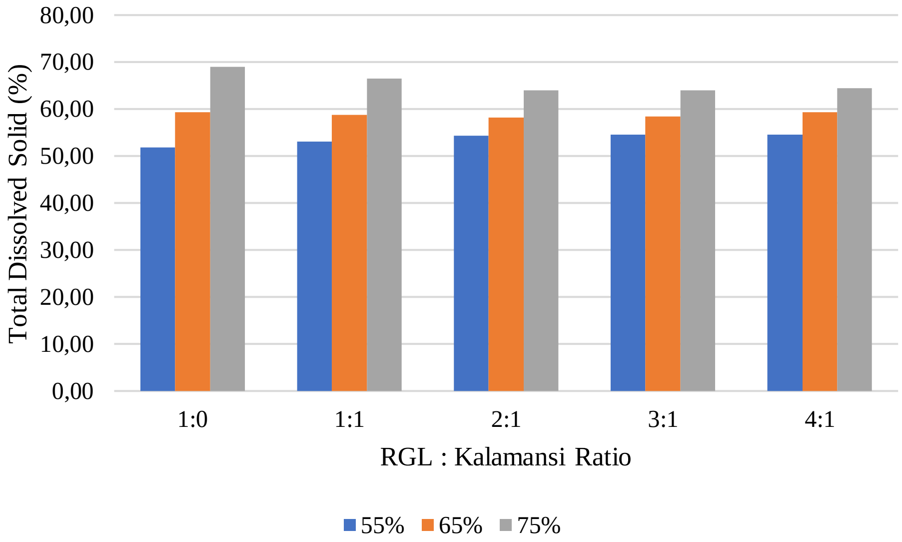

Figure 4. *Total Dissolved Solids Marmalade*

The vitamin C content of marmalade decreases with increasing sugar addition (Fig. 3). The more sugar, the water content retained by the pectin structure will decrease [9], the reduced moisture content, so vitamin C also tends to decrease due to the nature of water-soluble vitamin C. The addition of a high proportion of sucrose (sugar) also causes the water-soluble fraction to increase so that the measured vitamin C levels tend to decrease. This result is in line with the research of Adityas et.al [5] where high sugar use tends to reduce the value of vitamin C.

The addition of sugar to the RGL-Kalamansi marmalade resulted in an increase in the total dissolved solids value (Fig. 4). An increase in the total value of dissolved solids was also produced in the study by Novita, et al. [3] on kalamansi orange marmalade and Zainudin's research on RGL marmalade [4]. This is due to the water-soluble sucrose. The more sugar components that dissolve, the more dissolved organic matter will be, so the total amount of dissolved solids will also be higher. The quality standard of marmalade according to SNI Marmalade 01-4476-1998 [2] is at least 65%. The still low total dissolved solids can be caused by the high water content and the presence of quite a lot of total insoluble solids (orange peel slices).

The spreadability of RGL-Kalamansi marmalade is influenced by the addition of sugar. The spread power of marmalade ranges from 6.53 cm to 8.75 cm. The spreadability of the marmalade is getting longer as the sugar is added. The best (longest) spreadability in this study was the spreadability with the addition of 75% white sugar, which showed that the resulting marmalade texture was not too hard or runny. The results of this study are in line with research conducted by Novita [3] on the manufacture of kalamansi orange marmalade, where the higher the sucrose and pectin are added, the longer the marmalade spread power is produced. According to Winarno [18], the more sugar components dissolved, the more dissolved organic substances were, so that the total dissolved solids were higher.

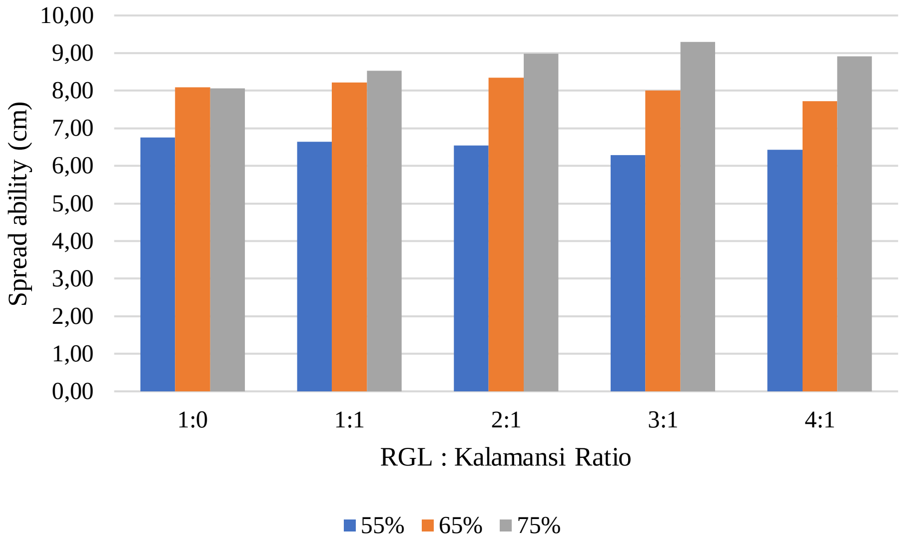

Figure 5. *Spreadability Marmalade*

4. CONCLUSION

Making marmalade by combining two types of Bengkulu typical citrus can improve the properties of marmalade, especially water content and vitamin C. Using the RGL-kalamansi ratio of 4: 1 produces the highest vitamin C. The addition of sugar can increase the total value of dissolved solids and reduce water content. Utilization of the typical local oranges of Bengkulu is expected to increase the added value of this commodity.

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