The effect of carboxy-methyl-cellulose (CMC) concentration on suspension stability of red guava syrup (Psidium guajava L) during storage

by Abu Amar

PAPER • **OPEN ACCESS**

The effect of carboxy-methyl-cellulose (CMC) concentration on suspension stability of red guava syrup (*Psidium guajava* L) during storage

To cite this article: A Amar *et al* 2020 *IOP Conf. Ser.: Earth Environ. Sci.* **472** 012005

IOP Conf. Series: Earth and Environmental Science **472** (2020) 012005 doi:10.1088/1755-1315/472/1/012005

The effect of carboxy-methyl-cellulose (CMC) concentration on suspension stability of red guava syrup (*Psidium guajava* L) during storage

A Amar[1], A Suryawati[2,3] and D Nurani[1]

[1] Agro-Industrial Technology Institut Teknologi Indonesia , Tangerang Selatan, Indonesia
[2] Alumni Agro- Industrial Technology, Institut Teknologi Indonesia, Tangerang Selatan, Indonesia.
[3] PT Marizarasa Sarimurni, Serang, Indonesia

e-mail : abu.amar@iti.ac.id or aamar3884biugm@yahoo.com

Abstract. The study aims to obtain the best CMC concentration and to maintain the stability of red guava syrup during storage. The experimental design used for analyzing the results of organoleptic data was Randomized Block Design (RBD) with one treatment, the concentration of CMC (A), consisting of 6 levels, 0%; 0.1%; 0.2%; 0.3%; 0.4% and 0.5%. The experimental design for data analysis results of viscosity, pH and total suspended solids were AxB in RBD factorial pattern (6x4). Factor A is a CMC concentration. Factor B is the length of storage consisting of 4 levels: 0 weeks, 2 weeks, 4 weeks, and 6 weeks. The analysis included organoleptic test, and physical analysis. The addition of CMC affected the total suspended solids, pH, viscosity, and stability of guava syrup and organoleptic test of guava syrup steeping (p=0.05). Using CMC did not have a positive effect on flavor but did affect the stability, color and taste (p=0.05).The results show that the addition of CMC of 0.3% in red guava syrup is the best treatment and able to maintain the stability of the product suspension during 6 weeks storage. The best syrup produced has an average (rather dislike – neutral) 4.9; 4.46; 4.90; and 4.5 in color, flavor, taste and stability respectively. The product has a range of viscosity values 1438-1516 cP, a pH value 7.51-7.73 and a total suspended solid value 5.95-6.09 mg / l during storage 6 weeks.

1. Introduction

Horticultural products are generally very easily damaged and rot both during and after harvest. This causes them to have a relatively low shelf life. One of the horticultural products with high damage level is red guava fruit with a potential shelf life of approximately 2-4 weeks after harvest [1]. The average production of guava in Indonesia in 2014 was 187,406 tons / Ha [2]. The limited shelf life of red guava fruit encourages efforts to process red guava fruit so that it can still be consumed. Red guava can be processed into various types of processed products, such as puree (guava porridge), fruit juice, taffy, juice, sweets, and also syrup, jams, ice cream [3]. The development of processing red guava into syrup products is very prospective, bearing in mind the superiority of red guava fruit both from its nutritional content and its health benefits. Besides consumed for drinks, red guava syrup can also be used to mix fruit ice, fruit soup, toppings, and puddings. Fruit syrup is syrup made from raw

materials of fruits. In contrast, for the use of syrup juice, it is not directly drunk but it must be diluted first. Dilution is needed because the levels of sugar in the syrup are too high at between 55% -65% [4]. The processing of fruit syrups in general faces the problem of the deposition of solids in the product produced during storage. To overcome this, stabilizers need to be added, one of which is carboxy-methyl cellulose (CMC). Previous studies on the use of CMC in salak bali syrup (*Salacca zalacca* var.Amboinensis) was 1.25% [5], in sweet starfruit syrup was 0.3% [6], and in cashew syrup (*Anacardium occidentale* L) was 1.5% [7]
In this research we make syrup from red guava, the problem is that the optimal CMC concentration to stabilize the suspension of red guava syrup during storage is not yet known . Syrup is beverage product made from mixture of water and sugar with minimum sugar content of 65% with or without other food ingredients and or additives that are permitted in accordance with applicable regulation [8]

The production process of guava begins with weighing red guava fruit, washing and stripping and then the flesh is cut into small pieces. Fruit flesh is crushed using blender, added with water in a ratio of 1:2, which was 1 part flesh and 2 parts water**.** Guava seeds are separated by filtering. The filtered juice is added with sugar, and citric acid, then the juice is heated until all the sugar and citric acid are dissolved and thickened. The heating process takes approximately 10 minutes. Red guava syrups is packaged using a glass bottle that has been sterilized before [9]. This principle of fruit syrup processing in general is extraction of fruit juice, by means of fruit destruction and filtering .The extract obtained is then added with sugar and heated until it thickens. The dominant component in fruit juice is generally in the form of soluble or insoluble fibers that pass the screening process. These components cause sedimentation so that the suspension of fruit syrup products becomes unstable during storage**.** Therefore, stabilizers are needed to prevent the formation of sediments, the stabilizer that will be used is CMC. The addition of CMC aims to form a liquid with a stable and homogeneous viscosity but it does not settle in relatively long time [10]. CMC can also affect the stability of syrup for up to 11 days of storage [11]. CMC is used as stabilizer because it is easy to obtain and the price is relatively cheaper [12]. It is also used in guava–based snack bar products [13].

2. Material ad methods

2.1 Material
The materials used in this experiment were red guava, sugar (gulaku), water, citric acid, and CMC, red guava fruits were obtained from Cikande Permai Market. Citric acid was obtained from PT Merck. The tools used in this study include scales, knives, blenders/ food processors, filter cloths, measuring cups, spoons, stirrers, gas stove, timers, aluminum pans, basin and syrups bottles.

2.2 Methods
This study aims to obtain the best CMC concentration and to maintain the stability of red guava syrups suspension during storage. The analysis included organoleptic analysis (color, flavor, taste, suspension stability) and physical analysis (viscosity, pH, total suspended solids) produced during storage. The research flow chart can be seen in Figure 1. Experimental design for organoleptic test data analysis used one factor randomized block design (RBD), namely CMC concentration (a) consisting of 6 levels, namely a1 = 05; a2 = 0,1%; a3 = 0,2%; a4 = 0.3%; a5 = 0.4%; a6 = 0.5%. Experimental design for the analysis of viscosity, pH and total suspended solid test data using a two factorial randomized block design. Factor A was CMC concentration consisting of 6 levels, namely a1= 0%, a2 = 0.1%, a3 = 0.2%, a4 = 0.3%, a5 = 0.4%, and a6 = 0, 5%. Factor B was the storage time which consisted of 4 levels, namely b1 = 0 weeks, b2 = 2 weeks, b3 = 4 weeks, and b4 = 6 weeks. The data obtained were statistically analyzed with ANOVA and continued with further test namely the Least Significant Difference Test, if the coefficient of diversity was below 10% and the Duncan Multiple Range test if the coefficient of diversity was above 10%.

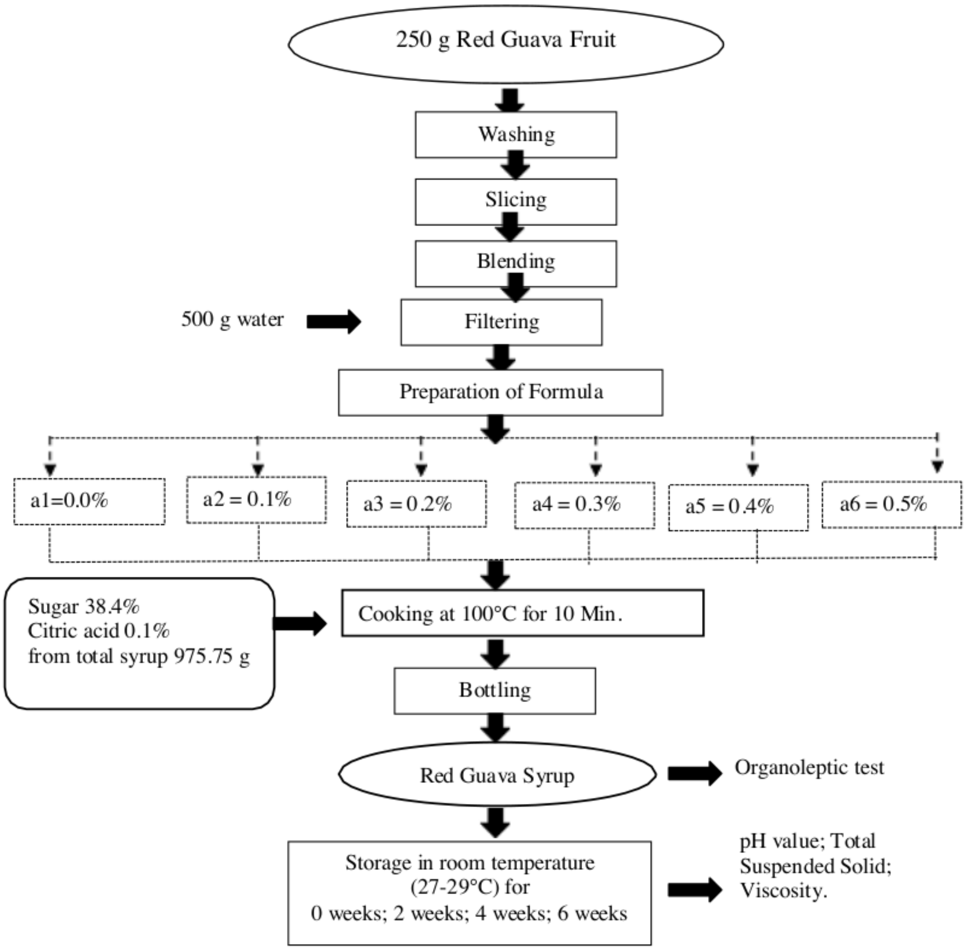

Figure 1. Flow chart of red guava syrup with 6 variation of CMC concentration and 4 variation of storage.

2.3 Preference test [14]

Preference test is a way of testing using the human senses as the main tool to assess product quality. The color, flavor, taste and stability of red guava syrup suspension before storage were tested organoleptically by knowing the panelists' preference level. Samples that had been given a specific code were presented to untrained panelists. A total of 30 panelists were asked to give their assessment based on the hedonic scale, namely: very like (7), like (6), rather like (5), neutral (4), rather dislike (3), dislike (2), very dislike (1).

2.4 Viscosity test [15]
The *Brookfield* viscometer was prepared along with the spindle. Then a sample was prepared which would be measured its thickness in a beaker. The sample was filled close to full, so that the spindle used to measure the liquid completely entered the spindle line limit. The spindle was dipped into the sample and press into button to start the measurement. The results of viscosity measurements could be read on the *Brookfield* viscometer screen.

2.5 Total suspended solid test [16]
Filter paper was put into a petri dish and dried at 105°C for 1 h in the oven. After drying for 1 h it was then put into the desiccator for 15 min. After 15 min, filter paper was removed and weighed with analytical scales the weight of the filter paper was noted. Then the sample weighed approximately 10 g was poured into filter paper for filtering for 2 h. After that, the filter paper was dried in the oven at 105°C for 1 h, cooled in a desiccator for 15 min and weighed until the weight was constant.

3. Results and discussion

3.1 The color of syrup
Based on the picture presented in figure 2, it can be seen that the addition of CMC at a concentration of 0.3% produced the color of red guava syrup is most preferred by panelist compared to other red guava syrup colors. This is significantly different (p=0.05). The color of red guava syrup that panelists liked was bright pink, while the color of red guava syrup that panelists disliked was dark pink and not bright. The pink color of red guava syrup comes from the lycopene compound found in red guava which plays an important role in determining the color of fruits [17]. When the CMC concentration is increased to 0.4% and 0.5% the panelist preference response to the syrup color decreases. CMC is a hydrocolloid material that can bind red pigment in making guava syrup, so that when the concentration of CMC is added more and more, the more red pigment that is protected by CMC during processing and the color of red guava syrup gets darker and darker.

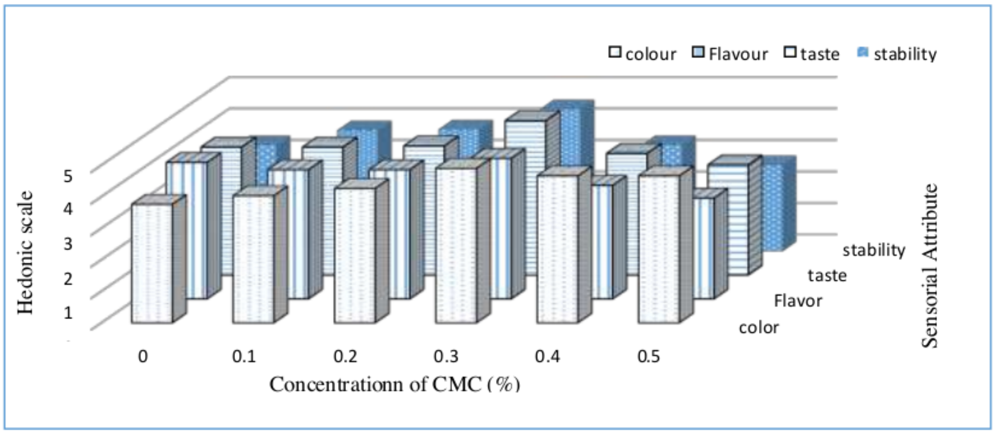

Figure 2. Panelist acceptance of sensorial attributes (color, flavor, taste and stability) on red guava syrup.

3.2 The flavor of syrup

In the fresh red guava fruit puree, terpenic hydrocarbons and 3-hydroxy-2-butanone are the most abundant components [18]. These component certainly affect the flavor of guava fruit as well as the syrup. Based on the picture presented in Figure 2, it can be seen that the addition of CMC at a concentration of 0.3% produced the flavor of red guava syrup which panelists preferred compared to the flavor of red guava syrup at different CMC concentration treatments, but not with 0.0% CMC (p=0.05). The addition of CMC does not have a positive effect on flavor. The product scent favored by panelists is the distinctive flavor of red guava. Increasing concentration of CMC makes the distinctive flavor of red guava increasingly disappears. This is because the CMC added to the guava syrup binds the particles containing the flavor to the red guava syrup so that the flavor in the red guava syrup decreases.

3.3 The taste of syrup

Taste of steeping syrup is shown on the picture presented in Figure 2, it can be seen that the addition of CMC at a concentration of 0.3% produced the most preferred syrup by panelists compared to the syrup at different CMC concentration treatments (p=0.05). The taste of steeping products that panelist liked was a special sweet taste of red guava.

3.4 Syrup suspension stability

Based on the picture presented in Figure 2, it can be seen that the panelist preference value on the stability of the syrup suspension was by increasing the addition of CMC up to a concentration of 0.3%. Red guava syrup products that panelists preferred was stable, non-settling and not too thick. The increase in the concentration of CMC added to the syrup not only improves the stability of the syrup suspension but also causes an increase in the thickness of the syrup so that when the CMC concentration is too high the syrup becomes thick.

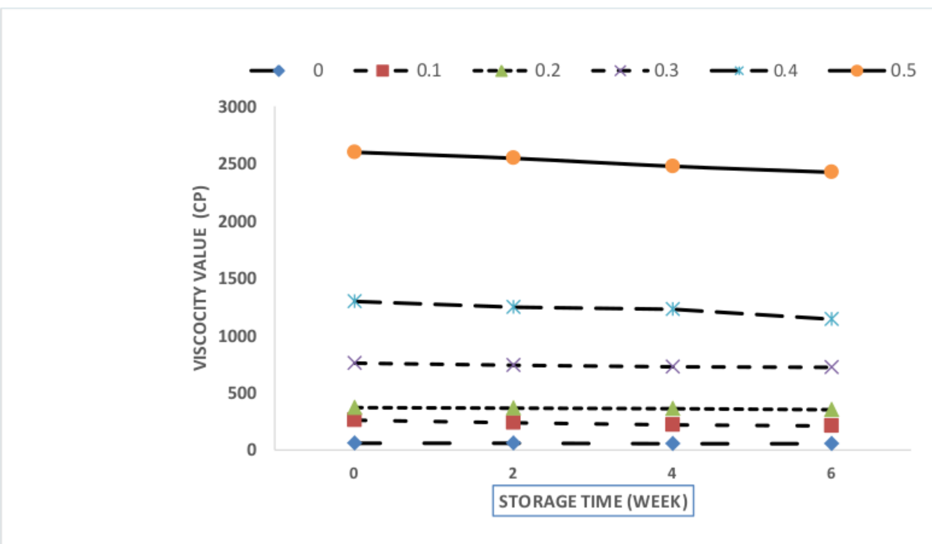

Figure 3. Curve effect of CMC concentration on viscosity value during storage time.

3.5 Viscosity test

The results show that the CMC concentration affected the viscosity value of red guava syrup, while the treatment duration of storage and interaction of CMC concentration treatment and storage duration did not affect the viscosity value of it. Based on the picture presented in Figure 3, it can be seen that the higher the concentration of CMC added, the higher the viscosity value of the resulting red guava syrup. The average value of red guava syrup viscosity ranges from 53 cP to 2600 cP.

During storage, the viscosity of the syrup decreased due to CMC oxidation or due to the influence of air, where oxygen molecules from the air can cause damage to the CMC colloidal dispersion system by breaking up the carboxyl group, so the viscosity of the syrup decreases [19]. In other research, the viscosity of Mulberry juice stored with xanthan and CMC stabilizers tends to decrease [20].

3.6 pH test

The results show that the treatment of CMC concentration, storage duration, and interaction of CMC concentration and storage duration affected the pH value of red guava syrup. Based on the picture presented in Figure 4, it can be seen that the higher the concentration of CMC added, the higher the pH value of the product produced. The average pH of red guava syrup in CMC concentration treatments ranged from 3.38 to 3.99. During storage the pH decreased. This is possible when pectin compounds or complex organic compounds that exist during storage are degraded to pectic acid or other organic acids that reduce pH.

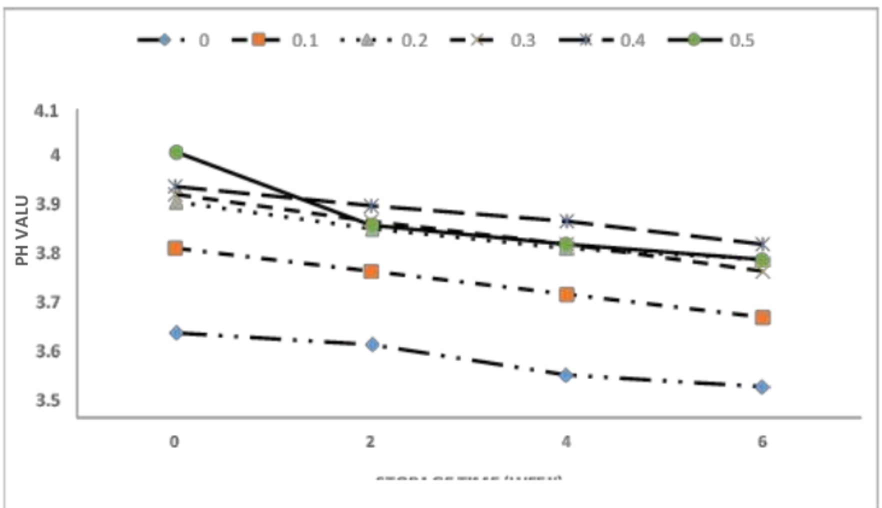

Figure 4. Curve effect of CMC Concentration on pH value during storage time.

3.7 The total suspended solid [TSS]

The results show that the CMC concentration treatment affected the total value of suspended solids of red guava syrup while the treatment of storage time and interaction of CMC concentration and storage time did not affect the total value of suspended solids of red guava syrup. Based on the picture presented in Figure 5, it can be seen that the higher the concentration of CMC added the less is the TSS value. That is because CMC would be dispersed in water, then the hydrophilic CMC grains would absorb water.

Water that was previously outside the granule and free to move, could not move freely anymore so that the solution was more stable. The average total value of suspended solids in the CMC concentration treatment ranged from 2.62 mg / l to 3.50 mg / l. Contrary to previous research on guava juice, the one heated by the *Ohmic method* of heating to a temperature of 95 ° C for several minutes with a predetermined voltage, the TSS of guava juice during storage increased. It is due to the process of cellulose degradation being dissolved or possibly organic acids turned into sugar through gluconeogenesis which will increase TSS [21]. This was different from this study using CMC guava syrup during storage where the TSS slightly decreased. This may be because any material that is hydrolyzed during storage will be captured by the CMC granules so that they are trapped in the CMC so they are not free to move.

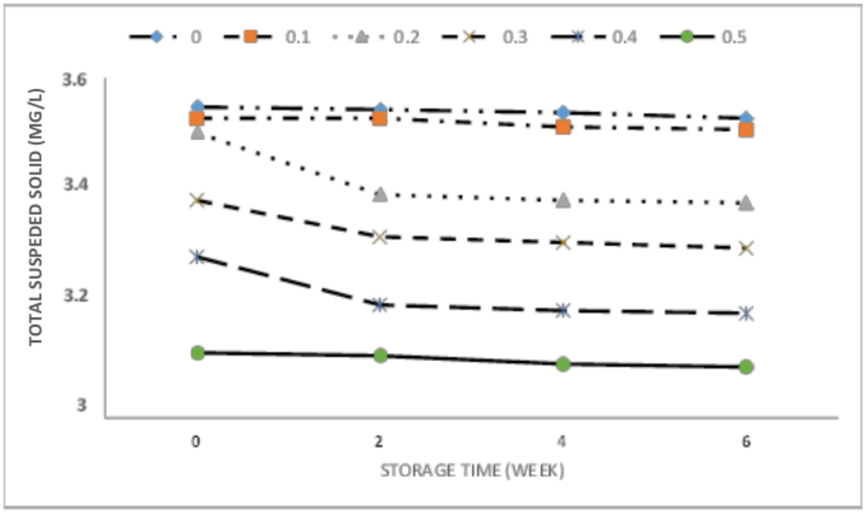

Figure 5. Curve effect of CMC concentration on total suspended solid of red guava syrups during storage time.

3.8 Justification of the best results

To determine the best results in this study, the thing to consider is to choose a red guava syrup product with organoleptic values, especially the preferred value of suspension stability and syrup color as high as possible and followed by the preferred value of taste and flavor of the product before storage. Besides that, another thing to consider is the stability of the best product during storage, which is determined based on the results of analysis of viscosity, pH and TSS value during storage. Data recapitulation for determining the best results is presented in Table 1. below.

Table 1. Recapitulation data for justification of best result.

Concentration CMC (%)	The average preferred value by panelist			
	Stability	Color	Taste	Flavor
0.3	4.50[a]	4.90[a]	4.90[a]	4.46[a]
0.2	3.86[b]	4.26[c]	4.10[b]	4.10[b]
0.1	3.83[c]	4.03[d]	4.06[b]	4.10[b]
0.0	3.36[d]	3.76[e]	4.06[b]	4.33[a]
0.4	3.36[e]	4.66[b]	3.86[b]	3.60[c]
0.5	2.73[f]	4.66[b]	3.50[c]	3.20[d]

values with different letters in the same column indicate significant differences (p=0.05)

4. Conclusion
Based on this research, the results obtained is that the addition of CMC of 0.3% in the manufacture of red guava syrup is the best treatment and can maintain the stability of the product suspension for 6 weeks of storage. The best syrup products produced has an average preference value of 4.90 (somewhat dislike - neutral); 4.90 and 4.46 in color, taste and flavor respectively. The product has a viscosity range of 719-758 cP, pH value 3.71-3.86 and total value of suspended solid of 2.79-3.04mg/l for 6 week storage.

5. References
[1] Idawanni 2016 Pasca Panen Buah Jambu Biji (*Psidium guajava L.*). http://nad.litbang.pertanian.go.id/ind/index.php/info-teknologi/798-pasca-panen-buah-jambu-biji-psidium-guajava-l. [05 April 2018]
[2] Direktorat Jendral Hortikultura, Kementrian Pertanian 2015 *Statistik Produksi Hortikultura Tahun 2014* (Jakarta: Kementrian Pertanian Jakarta)
[3] Jime'nes-Escrig A, Rinco'n M, Puido R and Saura-Calixt F 2001 *J. Agric. Food Chem.***49** 5489-5493
[4] Satuhu S 2004 *Penanganan dan Pengolahan Buah* (Jakarta: Penebar Swadaya)
[5] Rahmaningtyas E 2016 Pengaruh penambahan cmc terhadap karakteristik sirup salak bali (*Salacca zalacca var.* Amboinensis) selama penyimpanan (Denpasar: Universitas Udayana)
[6] Wati R 2016 *e-jurnal Boga* **5** (3) 54-62
[7] Manoi F 2006 *Bul. Littro* **2** (17) 1-7
[8] Standar Nasional Indonesia 2013 SNI Sirup Badan Standarisasi Nasional Jakarta
[9] Suyanti 2010 *Panduan Mengolah Dua Puluh Jenis Buah* (Jakarta: Penerbit PT Niaga Swadaya)
[10] Sopandi D H 1989 Pengaruh jenis dan konsentrasi penstabil terhadap mutu sari buah jambu biji (Psidium guajava L.) selama penyimpanan (Bogor: Institut Pertanian Bogor)
[11] Kamal N 2010 *Jurnal Teknologi* **1** (17) 78-84
[12] Nasar M 2004 Pengaruh penambahan Na-CMC (natrium carboxyl methyl cellulose) dan gula terhadap kualitas sirup nanas (Semarang: Universitas Muhammadiyah Semarang)
[13] Khan M, Ayub M, Durrani Y, Wahab S, Muhammad A and Ali S A A 2014 *WJPPS* **3** (5) 130-146
[14] Soekarto S T 1985 *Penilaian Organoleptik Untuk Industri Pangan dan Hasil Pertanian* (Jakarta: Bhatara Karya Aksara)
[15] Standar Nasional Indonesia 1992 *SNI Cara Uji Makanan dan Minuman* (Jakarta: Badan Standarisasi Nasional)
[16] Standar Nasional Indonesia 2004 *SNI Cara Uji Padatan Tersuspensi Total Secara Gravimetri* (Jakarta: Badan Standarisasi Nasional)
[17] Priam F, Marcelin O, Marcus R, Louis-Felix J and Smith-Ravin E J 2017 *IOSR J. Environ. Sci. Toxicol. Food Technol.* **11** (4) 67-73
[18] Jordan M J, Carlos A, Margari A, Shaw P E and Goodner K L, 2003 *J. Agric. Food Chem.* **51** 1421−1426
[19] Murrukmihadi M, Wahyuono S, Marchaban and Martono S 2011 *Majalah Obat Tradisional* **2** 101-108
[20] Akkarachaneeykorn S and Tinrat S 2 2015 *Food Sci. Nutr.* **3** 213-20
[21] Chakrabortya I and Athmaselvib K A 2014 *Journal of Ready to Eat Food* **1** 152-157

Acknowledgement
Thanks to Mr. Muchsin and Mrs. Alfiyah also PT Marizarasa Sarimurni in Serang for financial support during the research.

The effect of carboxy-methyl-cellulose (CMC) concentration on suspension stability of red guava syrup (Psidium guajava L) during storage

ORIGINALITY REPORT

6%	7%	6%	3%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	earchive.tpu.ru Internet Source	2%
2	journal.univetbantara.ac.id Internet Source	1%
3	www.myfoodresearch.com Internet Source	1%
4	1library.net Internet Source	1%
5	journals.tubitak.gov.tr Internet Source	1%
6	link.springer.com Internet Source	1%
7	repository.ipb.ac.id Internet Source	1%

Exclude quotes On

Exclude matches < 1%

Exclude bibliography On

The effect of carboxy-methyl-cellulose (CMC) concentration on suspension stability of red guava syrup (Psidium guajava L) during storage

GRADEMARK REPORT

FINAL GRADE

/0

GENERAL COMMENTS

Instructor

PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6

PAGE 7

PAGE 8

PAGE 9