Indonesian Journal of Agricultural Research Vol. 06, No. 03, 2023 | 168 – 181

talenta PUBLISHER

InJAR

Indonesian Journal of Agricultural Research

Papaya Peel Extract and Citric Acid Addition on the Quality of Guava Jelly

Sofia Winnie Kosasih, Terip Karo-Karo, and Nauas Domu Marihot Romauli*

Department of Food Technology, Faculty of Agriculture, Universitas Sumatera Utara, Indonesia

Abstract. The aim of this study was to determine the quality of guava jelly after the addition of papaya peel extract and citric acid. The study used a two-factor, randomized factorial design. The first factor was the addition of papaya peel extract (P): (2%;4%;6%;8%), while the second was the addition of citric acid (A): (1%;1,5%;2%;2,5%). The parameters analyzed were moisture content, ash content, total soluble solids, vitamin C content, crude fiber content, degree of acidity (pH), and total acid. According to the results, the addition of papaya peel extract had a highly significant effect on the water content, crude fiber content, degree of acidity, and total acid, and had a different significant effect on ash content and total dissolved solid. The addition of citric acid also had a highly significant effect on the total dissolved solids, the content of Vitamin C, the degree of acidity, the organoleptic test of taste, and had a different significant effect on water content and total acid. The interaction between the addition of papaya peel extract and citric acid had a highly significant effect on the degree of acidity. Guava jelly with 8% papaya peel extract and 2% citric acid had the optimum quality characteristics.

Keywords: citric acid, guava, jelly, papaya peel extract

Received 25 February 2023 | Revised 19 January 2024 | Accepted 03 February 2024

1. Introduction

Red guava (*Psidium guajava L.*) is a climatic fruit that has a bright, thick, fragrant, and fresh flesh color that adds value to its distinctive taste and aroma. Red guava fruit contains high levels of vitamin C compared to other fruits, which is 87 mg/100 grams. Vitamin C in red guava functions as an antioxidant that can ward off free radicals in the body [1]. In addition, red guava contains fiber that can smooth the digestive system, and protect the intestinal mucous membrane which can reduce the adverse effects of toxins [2]. On the other hand, red guava has a perishable characteristic. To reduce this damage, red guava can be processed into various kinds of processed fruits such as juice, jelly, and dodol [3].

Jelly is generally a dessert because it has a sweet taste. Jelly consists of a mixture of fruit juice, sugar, pectin, and acid. Jelly has many benefits, namely that it can reduce bad cholesterol, increase

*Corresponding author at: Departement of Food Technology, Universitas Sumatera Utara, Jl. Prof A Sofyan 3, Medan, Indonesia

E-mail address: nauas.romauli@usu.ac.id

p-ISSN: 2622-7681 | e-ISSN: 2615-5842 | DOI 10.32734/injar.v6i3.11367
Journal Homepage: https://talenta.usu.ac.id/InJAR

immunity, smooth the skin, and most importantly facilitate digestion. Making jelly is also a form of preservation of horticultural products that can increase their use value. In making jelly, the fruit used becomes the main key to the success of the product. If the fruit used is morphologically mature, the aroma and flavor produced will be very good.

Cooking time on jelly affects the final result and quality of the jelly obtained. Heating the jelly for too long can cause the sugar to caramelize and cause pectin hydrolysis and a reduction in organoleptic properties such as color and taste, while heating the jelly too quickly can cause the gel structure in the jelly to not be formed completely and still contain liquid so that the final result or quality obtained is not good. Papaya production in Indonesia according to the Indonesian Central Bureau of Statistics in 2022 reached 1,089,578 tons. In general, people will throw away the skin and seeds of papaya and only consume papaya fruit meat so further utilization and processing of papaya is needed so that it has a use value and can reduce problems that disturb the environment such as landfill [4].

Papaya plants with high nutritional value can grow in tropical and subtropical areas, in wet and dry places, and in plains as well as in mountains [5]. Papaya peel is referred to as waste from papaya fruit that has been consumed. Papaya peel has the advantage that the high pectin content, which is around 14%, can be used as raw material in the manufacture of pectin. Pectin is widely used in the food industry as a functional component because it can form a thin gel and as a protein stabilizer. In addition, pectin is also used as a thickening agent in the manufacture of jelly, marmalade, and other low-calorie foods [6]. The combination of gelatin, acid, and sugar will determine the successful process of making jelly. To get a good jelly structure, it is necessary to use pectin. The concentration of acid and sugar added becomes an important rule that can influence the form of a gel by pectin. The process of making jelly using papaya peel will affect the characteristics of the jelly produced. Therefore, this study aimed to determine the effect of adding papaya peel extract and citric acid on the quality characteristics of guava jelly so that the resulting product is a functional food and also serves as food innovation.

2. Materials and Methods

The materials used in this study were California papaya peel (*Carica papaya* L), morphologically mature red guava fruit, and sugar obtained from Padang Bulan Medan traditional market as well as carrageenan and citric acid. The reagents used in this study were 0.1 N NaOH, ascorbic acid, 2% metaphosphoric acid solution, 1.25 N NaOH, 2,6-dichlorophenol indophenol solution, 0.325 N sulfuric acid solution, 1% phenolptalein (pp) indicator, and aquadest.

2.1. Making of Papaya Peel Extract

Riped Papayas were sorted, washed, cut, and peeled off the skin from the pulp with a stainless steel knife with a peel thickness of 0.5 mm. The papaya peel was washed under running water. Then blended with the ratio of papaya peel and water is 1:2. Then filtered with a filter cloth [7].

2.2. Making of Red Guava Juice

Morphologically mature red guavas were sorted, washed, and cut. Then crushed the fruit using a blender with a ratio of red guava fruit and water 1:2. Then juice was obtained by filtering the fruit pulp using a filter cloth.[3].

2.3. Making Red Guava Jelly

The resulting red guava juice was heated at 60°C for 2 minutes and then added 40% sugar from 100 ml of red guava juice and added the percentage of papaya peel extract as much as P_1 (2%), P_2 (4%), P_3 (6%), P_4 (8%) and the percentage of citric acid addition as much as A_1 (1%), A_2 (1.5%), A_3 (2%), A_4 (2.5%). 1% carrageenan was added. The mixture was stirred by heating until reached the gel consistency according to the spoon test method. Then the mixture was molded on polypropylene plastic's mold and cooled in the refrigerator for 2 hours [8].

2.4. Data Analysis

This study used a factorial completely randomized design consisting of two factors, which were the ratio of papaya peel extract (P): (2%, 4%, 6%, 8%), and citric acid addition (A): (1%, 1.5%, 2%, 2.5%). The number of treatment combinations (Tc) is 4 x 4 = 16, with 2 replications in each treatment. Parameters of moisture content, ash content, total soluble solids, vitamin C content, crude fiber content, degree of acidity (pH), and total acid were analyzed.

2.4.1. Moisture content

Samples weighing as much as 5 g were put into an aluminum cup that had been dried for 1 hour at 105°C and had known weight. The sample was heated at 105°C for three hours. Then the sample was cooled in a desiccator until it was cold and then weighed. Heating and cooling are repeated until a constant sample weight is obtained [9].

$$\text{Moisture content (\%)} = \frac{\text{initial sample weight (g)} - \text{final sample weight (g)}}{\text{initial sample weight (g)}}\ x\ 100\% \qquad (1)$$

2.4.2. Ash content

Samples that have been dried to a constant weight are then weighed as much as 5 g. Then the porcelain cup as an ashing container is weighed and included with the weighed sample, then put in the furnace and burned for five hours, namely at 100°C for one hour, increasing the temperature to 300°C for two hours and then the last two hours at 500°C. After burning for five hours, the porcelain cup and the material that has become ash are cooled and removed from the furnace and put in a desiccator to cool again for 15 hours. After burning for five hours, the porcelain cup and the material that had become ash were cooled and removed from the furnace and then put in a desiccator to cool again for 15 minutes. After cooling, the cup and the ash sample were weighed [10].

$$\text{Ash content (\%)} = \frac{\text{ash weight (g)}}{\text{initial sample weight (g)}}\ x\ 100\% \quad (2)$$

2.4.3. Total soluble solids

The material to be tested was mashed and then weighed as much as 5 g and put into a beaker glass. Then diluted with 20 ml of distilled water and stirred until evenly distributed. One drop of solution was taken and then placed in a handrefractometer. Read the measurement results shown on the refractometer screen [11].

$$\text{Total soluble solids (°Brix)} = \text{handrefractometer number x dilution factor} \quad (3)$$

2.4.4. Vitamin C content

Determined the amount of vitamin C with colourimetric method [12].

a. Preparation of dye solution

100 mg of 2,6-dichlorophenol indophenol was weighed then added 50 ml of aquadest that has been boiled as much as 50 ml and 84 mg of sodium bicarbonate, then it was poured into a 100 ml tera flask. Diluted then the solution was added to aquadest until it reached a volume of 100 ml. The solution was filtered, then 25 ml was taken then in a 500 ml flask poured and diluted with aqaudest to the limit.

b. Making standard curve

100 mg of standard ascorbic acid was weighed carefully. After that, it was poured into a 100 ml volumetric flask, and then dissolved using 2% HPO_3 to a volume of 100 ml. The ascorbic acid solution was transferred to a 5 ml volumetric flask as 40 µL, 80 µL, 100 µL, 120 µL, and 160 µL, thus obtaining concentrations of 0.008 mg/ml, 0.016 mg/ml, 0.020 mg/ml, 0.024 mg/ml, and 0.032 mg/ml and diluted with 2% HPO_3 to a volume of 5 ml. The solution was transferred to a test tube and 10 ml of dye solution was poured in, and the absorbance was measured using a wavelength of 518 nm. A blank solution was made by mixing 5 ml of 2% HPO_3 with 10 ml of dye solution. The absorbance of the blank was observed using a wavelength of 518 nm. Connecting the absorbance with the concentration of ascorbic acid is a way of making a standard curve of ascorbic acid.

c. Vitamin C content measurement

A total of 10 g sample was weighed and placed in a 100 ml tera flask. Diluted using 2% HPO_3 to the limit. The solution was filtered and 5 ml of sample was taken and poured into a test tube, then quickly added 10 ml dye solution. The absorbance of the material was measured with a wavelength of 518 nm and the absorbance results were recorded.

$$\text{Vitamin C content (mg/g)} = \frac{\text{ascorbic acid concentration} \times \text{dilution factor} \times 100}{\text{sample weight (g)}} \quad (4)$$

2.4.5. Crude fiber content

A sample of 2 g was put into a 300 ml erlenmeyer then added 100ml of 0.325 N H_2SO_4. Hydrolyzed with an autoclave for 15 minutes at 105°C. After cooling the sample, 50 ml of 1.25 N NaOH was added, then hydrolyzed again for 15 minutes. The sample was filtered using Whatman No. 41 filter paper. The filter paper was washed successively with 10 ml of hot aquadest then 25 ml of 0.325 N H_2SO_4, then with 10 ml of hot aquadest and finally with 25 ml of 96% ethanol. Filter paper was dried in an oven at 105°C for one hour, drying continued until constant weight [9].

$$\text{Crude fiber content (\%)} = \frac{\text{final weight (g) – initial paper weight (g)}}{\text{sample weight (g)}} x100\% \quad (5)$$

2.4.6. Degree of acidity (pH)

Testing the pH value can be done using a pH meter that is cleaned first with aquadest, and then wiped using a tissue. Furthermore, the pH meter is calibrated with pH 4 buffer solution and pH 7 buffer. The electrode on the pH meter is dipped into the material and then waited until the pH value appears on the pH meter screen [12].

2.4.7. Total acid

The 10 g of crushed sample put into a beaker glass with 10 ml of aquadest and stirred until evenly distributed. Then the mixture sample was filtered with filter paper and put into a measuring flask, then added 100 ml of aquadest until the mark and the color of the sample is clear. Then the filtrate was taken as much as 10 ml and put into an erlenmeyer and added 1% phenolptalein solution as much as 2-3 drops. Then titrated with 0.01 N NaOH. Titration process was stopped when a stable pink color appeared [13].

$$\text{Total acid (\%)} = \frac{\text{NaOH volume N NaOH x dominant acid molecular weight x dilution factor}}{\text{sample weight (g) x 1000 x acid valence}} x\ 100\% \quad (6)$$

3. Results and Discussion

In general, the results of this study showed that the addition of papaya peel extract and citric acid gave an effect on the parameters observed in Table 1 and Table 2.

Table 1. Addition of Papaya Peel Extract to Observed Parameters of Guava Jelly

Parameters	Addition of papaya peel extract			
	P_1 2%	P_2 4%	P_3 6%	P_4 8%
Moisture content (%)	51.99^{cB}	55.04^{bcAB}	57.08^{abA}	59.52^{aA}
Ash content (%)	0.45^{b}	0.46^{b}	0.47^{ab}	0.50^{a}
Total soluble solids (°Brix)	38.46^{b}	40.97^{ab}	41.18^{ab}	42.58^{a}
Vitamin C content (mg/100g)	7.65	7.73	7.59	7.46
Crude fiber content (%)	1.76^{cC}	2.25^{bB}	2.34^{bAB}	2.62^{aA}
Degree of acidity (pH)	2.91^{aA}	2.72^{bB}	2.63^{cC}	2.43^{dD}
Total acid (%)	2.85^{dD}	4.90^{cC}	6.10^{bB}	8.24^{aA}

Notes: Different letter notations in the same row show significantly different effects at the 5%level (lower case) and are very significant different at 1% level (upper case)

Table 2. Addition of Citric Acid to Observed Parameters of Guava Jelly

Parameters	Addition of citric acid			
	A_1 1%	A_2 1,5%	A_3 2%	A_4 2,5%
Moisture content (%)	53.44^{b}	55.07^{ab}	56.62^{ab}	58.50^{a}
Ash content (%)	0.46	0.49	0.46	0.47
Total soluble solids (°Brix)	38.06^{cB}	39.90^{bcAB}	42.01^{abAB}	43.21^{aA}
Vitamin C content (mg/100g)	7.30^{cB}	7.55^{bcAB}	7.69^{abAB}	7.90^{aA}
Crude fiber content (%)	2.27	2.09	2.27	2.33
Degree of acidity (pH)	2.85^{aA}	2.75^{bB}	2.60^{cC}	2.50^{dD}
Total acid (%)	4.98^{b}	5.52^{ab}	5.58^{ab}	6.01^{a}

Notes: Different letter notations in the same row show significantly different effects at the 5%level (lower case) and are very significant different at 1% level (upper case)

3.1. Moisture Content

The results showed that addition of papaya peel extract had a highly significant effect ($P<0.01$) on moisture content of red guava jelly. The treatment that has the highest moisture content is treatment P_4 (8%) at 59.5244% and the P_1 (2%) treatment is 51.9932% which is the lowest moisture content. The higher addition of papaya peel extract will increase the moisture content of red guava jelly because it has a large amount of pectin. Pectin is able to form a gel if water, sugar, and acid are added so that water will be trapped to form a gel [14]. Pectin resembles a sponge filled with water so that the more pectin added, the more water is bound by pectin [15]. Correlation of papaya peel extract on moisture content of *guava* jelly can be seen in Figure 1.

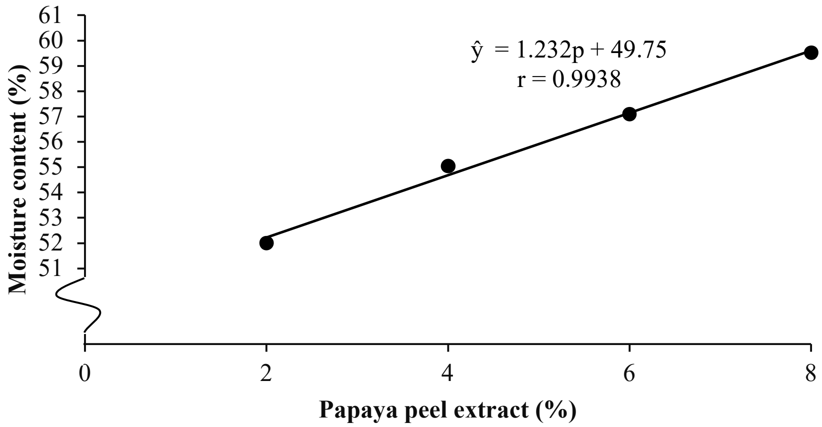

Figure 1. Correlation of Papaya Peel Extract on Moisture Content of Guava Jelly

The addition of citric acid had a significant effect ($P<0.05$) on moisture content of red guava jelly. The highest moisture content is 58.5040% which is the treatment of A_4 (2.5%) and the lowest is 53.4415% which is the treatment of A_1 (1%). The results showed that the addition of citric acid will increase the moisture content of red guava jelly. Citric acid can bind water so that the higher the concentration of citric acid, the water content also increases. The addition of more citric acid can form a strong gel and the higher the ability to bind water [16]. Correlation of citric acid on moisture content of guava jelly can be seen in Figure 2.

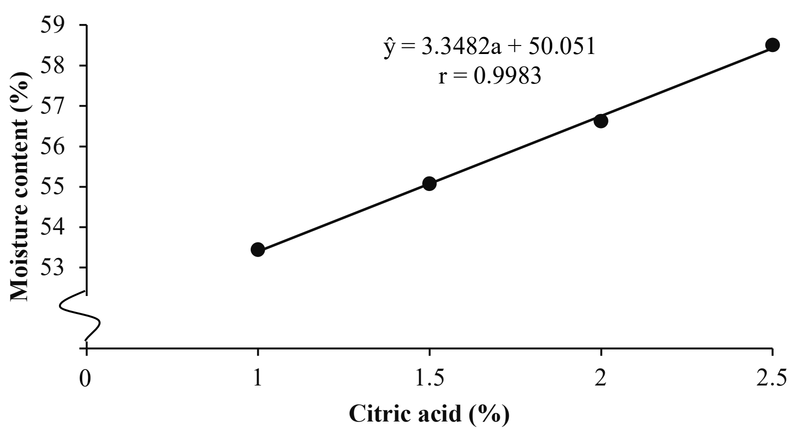

Figure 2. Correlation of Citric Acid on Moisture Content of Guava Jelly

3.2. Ash Content

The addition of papaya peel extract gave a significantly different effect ($P<0.05$) on the ash content of red guava jelly. The highest ash content is found in P_4 (8%) which is 0.5016% and the lowest ash content is found in P_1 (2%) which is 0.4472%. This shows that the addition of papaya peel extract increases the ash content of red guava jelly, which is due to the mineral composition of papaya peel. The ash content of a food ingredient shows the mineral content contained in the food ingredient, the higher the ash content, the higher the mineral content [17]. Correlation of papaya peel extract on ash content of guava jelly can be seen in Figure 3.

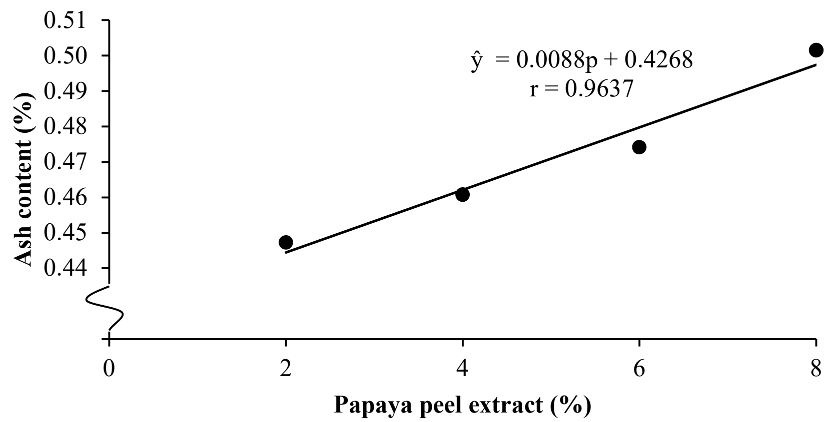

Figure 3. Correlation of Papaya Peel Extract on Ash Content of Guava Jelly

3.3. Total Soluble Solids

The addition of papaya peel extract gives a significantly different effect ($P<0.05$) on the total soluble solids of red guava jelly. The highest total soluble solids is P_4 (8%) which is 42.5768°Brix and the lowest total soluble solids is P_1 (2%) which is 38.4567°Brix. Total soluble solids will increase along with a high amount of pectin because pectin is a constituent component of total soluble solids. The content of total soluble solids of an ingredient contains reducing sugar, non-reducing sugar, pectin, and protein [18]. Correlation of papaya peel extract on total soluble solids of guava jelly can be seen in Figure 4.

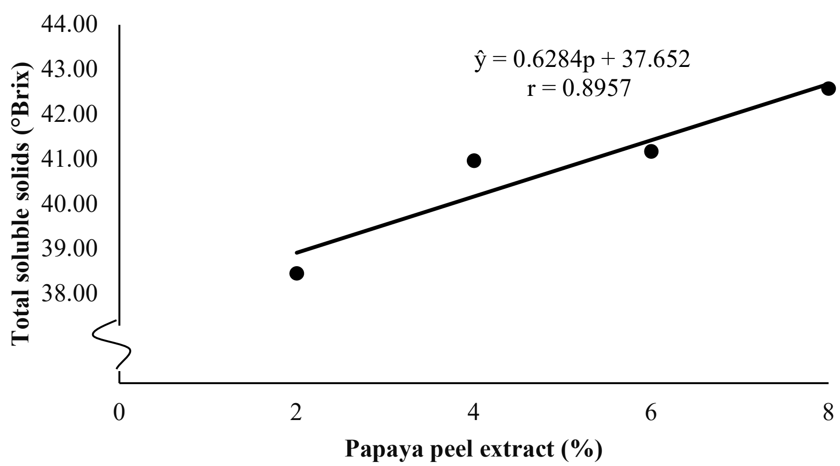

Figure 4. Correlation of Papaya Peel Extract on Total Soluble Solids of Guava Jelly

Based on the analysis of variants, it can be observed that citric acid gives a very significantly different effect ($P<0.01$) on the total soluble solids of red guava jelly. The highest total soluble solids is A_4 (2.5%) which is 43.2084°Brix and the lowest total soluble solids is A_1 (1%) which is 38.0643°Brix. This shows that the more citric acid is added, the higher the total soluble solids of red guava jelly. The use of citric acid with higher concentrations will increase the total soluble solids because citric acid is an organic acid that has properties easily soluble in water so that the acid produced can increase the total soluble solids [19]. Correlation of citric acid on total soluble solids of guava jelly can be seen in Figure 5.

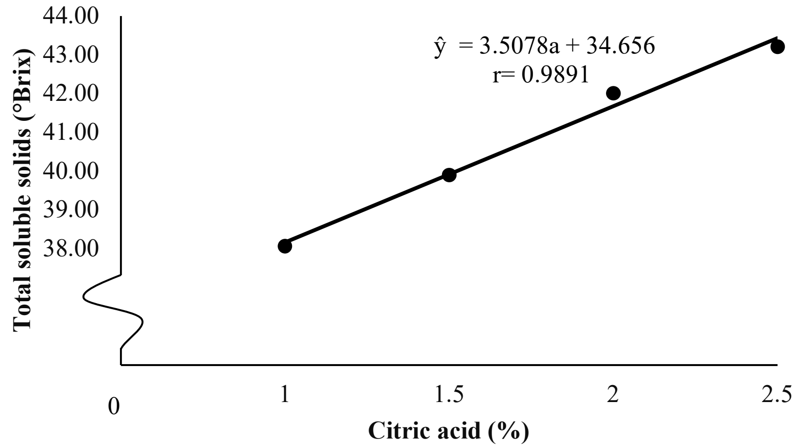

Figure 5. Correlation of Citric Acid on Total Soluble Solids of Guava Jelly

3.4. Vitamin C Content

It can be observed that the addition of citric acid produces a very significantly different effect ($P<0.01$) on the levels of vitamin C in red guava jelly. The highest amount of vitamin C is found in A_4 (2.5%) which is 7.8967 mg/100g and the lowest amount of vitamin C is found in A_1 (1%) which is 7.2996 mg/100g. The addition of high citric acid will increase vitamin C levels because the higher the concentration of citric acid added will cause acidic conditions that can maintain the stability of vitamin C and can inhibit oxidation of the material [19]. Correlation of citric acid on vitamin C content of guava jelly can be seen in Figure 6.

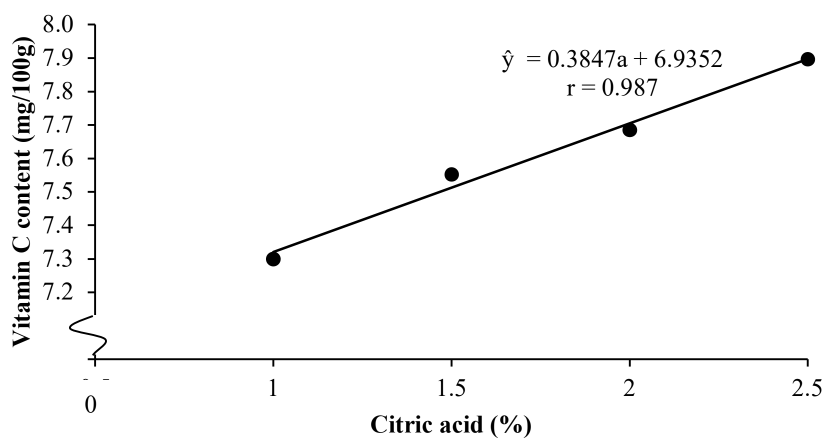

Figure 6. Correlation of Citric Acid on Vitamin C Content of Guava Jelly

3.5. Crude Fiber Content

It can be seen that the papaya peel extract added shows a very significant different effect ($P<0.01$) on the crude fiber content of red guava jelly. The crude fiber content of treatment P_4 (8%) which is 2.6237% is the highest and the lowest in P_1 (2%) with crude fiber content of 1.7560%. The addition of papaya peel extract increased the crude fiber content of red guava jelly. One of the constituent components of fiber is pectin which is a class of polysaccharides so that the higher the addition of pectin, the crude fiber content will also increase. Crude fiber content in food does not have to be much but must be present because it works in the process of excretion of food waste [18]. Correlation of papaya peel extract on crude fiber content of guava jelly can be seen in figure 7.

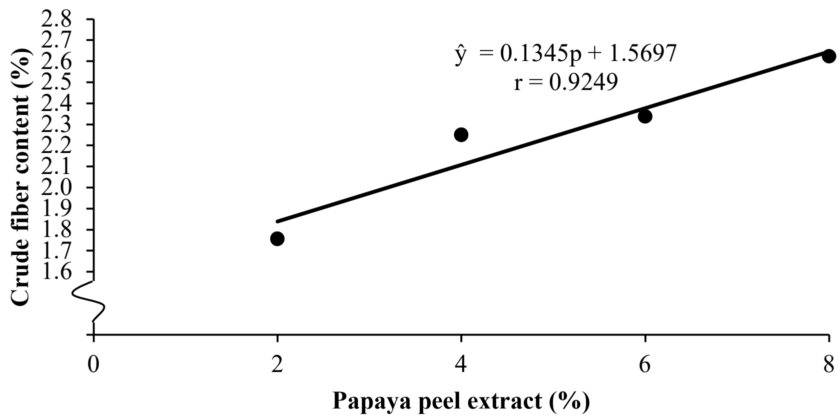

Figure 7. Correlation of Papaya Peel Extract on Crude Fiber Content of Guava Jelly

3.6. Degree of Acidity (pH)

The addition of papaya peel extract gives a very significantly different effect (P<0.01) on the acidity (pH) of red guava jelly. The highest degree of acidity (pH) is found in P_1 (2%) which is 2.9100 and the lowest degree of acidity is found in P_4 (8%) which is 2.4313. Pectin in papaya peel extract will hydrolyze into pectic acid and pectinic acid so that the higher the concentration of pectin, the higher the acid produced and the pH will decrease [20]. Correlation of papaya peel extract on degree of acidity of guava jelly can be seen in Figure 8.

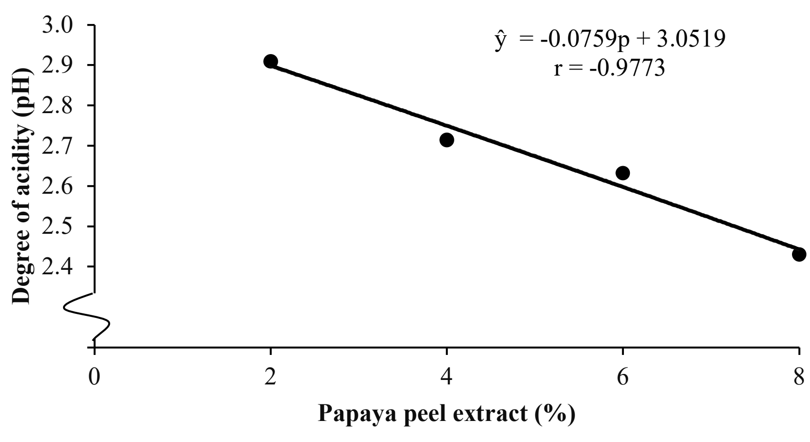

Figure 8. Correlation of Papaya Peel Extract on Degree of Acidity of Guava Jelly

Based on the analysis of variants, it can be seen that the addition of citric acid gives a very significant different effect (P<0.01) on the degree of acidity (pH) of red guava jelly. The highest degree of acidity (pH) is found in A_1 (1%) which is 2.8463 and the lowest degree of acidity is found in A_4 (2.5%) which is 2.4975. Citric acid functions as an acidifier so that the higher the concentration of citric acid, the greater the H^+ ions released so that the pH will decrease [21]. Correlation of citric acid on degree of acidity of guava jelly can be seen in Figure 9.

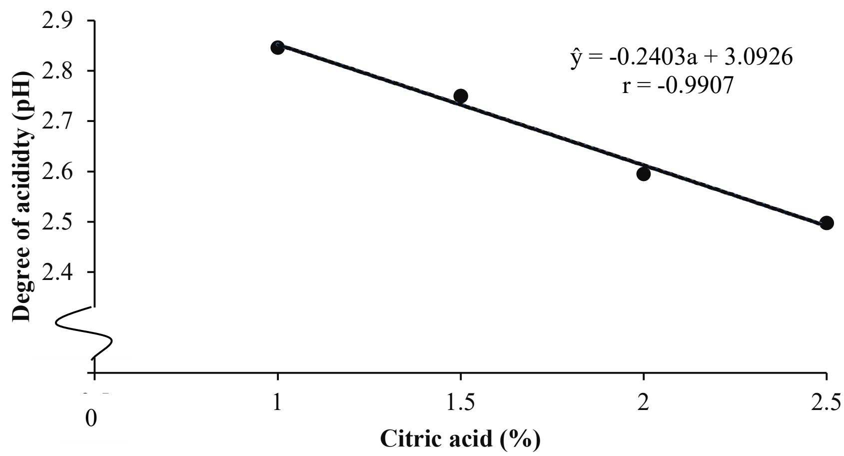

Figure 9. Correlation of Citric Acid on Degree of Acidity of Guava Jelly

Based on the analysis of variants, it can be observed that the interaction of the addition of papaya peel extract and citric acid gives a very significant effect (P<0.01) on the degree of acidity (pH) of the red guava jelly. The highest degree of acidity (pH) is found in the treatment P_1A_1 (2% papaya peel extract, 1% citric acid) which is 3.1400. The lowest degree of acidity (pH) was in the treatment P_4A_4 (8% papaya peel extract, 2.5% citric acid) which was 2.3300. The higher the addition of papaya peel extract and citric acid causes the acidity (pH) of red guava jelly to decrease. The addition of more acid causes the acidity degree (pH) value to decrease so that the acidity level is high. In making jelly, pectin will hydrolyze into pectic acid and pectinic acid so that the acid produced is higher and the pH decreases [22]. Interaction of papaya peel extract and citric acid on degree of acidity of guava jelly can be seen in Figure 10.

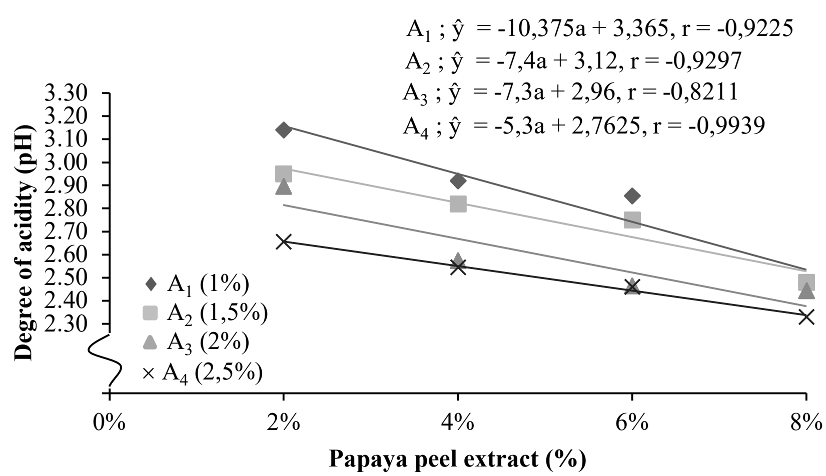

Figure 10. Interaction of Papaya Peel Extract and Citric Acid on Degree of Acidity

3.7. Total Acid

The lowest total acid was in the treatment of 2% papaya peel extract (P_1) is 2.8456% and the highest total acid was in the addition of 8% papaya peel extract (P_4) is 8.2367%. The higher addition of papaya peel extract will increase the total acid of red guava jelly. A high amount of pectin will cause an increase in total acid. This can occur because pectin is acidic and has the ability to bind sugar, water, and soluble solids such as acids in the material [15]. Correlation of papaya peel extract on total acid of guava jelly can be seen in Figure 11.

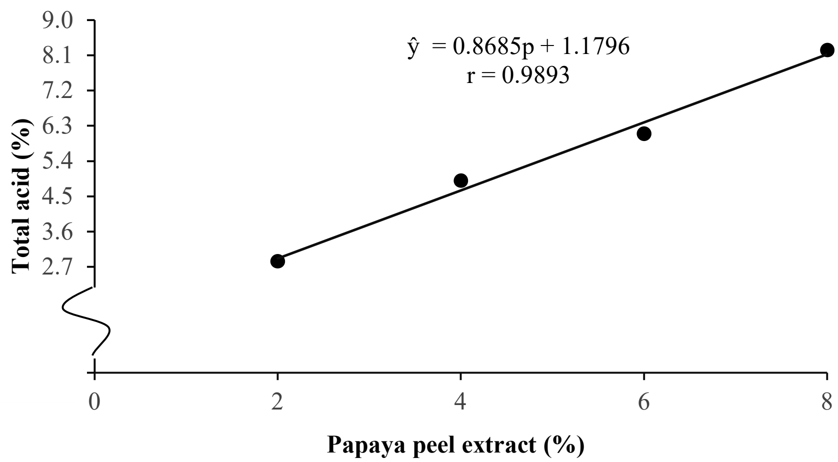

Figure 11. Correlation of Papaya Peel Extract on Total Acid

Based on analysis of variants, it can be seen that citric acid added gives a very significant different effect ($P<0.01$) on the total acid of red guava jelly. The lowest total acid was in the treatment of 1% citric acid (A_1) is 4.9774% and the highest total acid was in the addition of 2.5% citric acid (A_4) is 6.0102%. The total acid increases with the increase of citric acid added because citric acid is a type of organic acid that is easily soluble in water [19]. Correlation of citric acid on total acid of guava jelly can be seen in Figure 12.

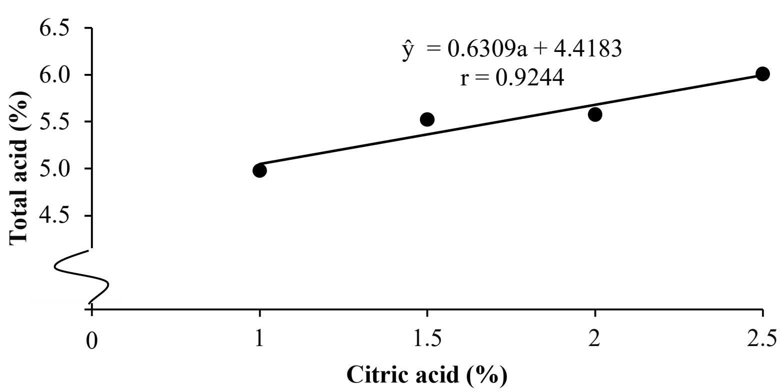

Figure 12. Correlation of Citric Acid on Total Acid of Guava Jelly

4. Conclusion

Determination of the best treatment is based on the De Garmo method from the parameters of vitamin C content, hedonic taste, acidity, total soluble solids, total acid, moisture content, crude fiber content, ash content, hedonic texture, and hedonic aroma and obtained the best treatment of red guava *jelly* in is the treatment of adding papaya peel extract 8% (P_4) and citric acid 2% (A_3).

REFERENCES

[1] S. A. Padang and R. M. Maliku, "Penetapan Kadar Vitamin C Pada Buah Jambu Biji Merah (Psidium guajava L.) dengan Metode Titrasi Na-2,6 dichlorophenol indophenol (DCIP)," *Media Farmasi*, vol. 13, no. 2, p. 1-6, May 2019.

[2] H. Sunarjono, *Pengenalan Jenis Tanaman Buah-buahan Penting di Indonesia*. Bandung: Penerbit Sinar Baru Algensido, 2004.

[3] D. M. Salimah, T. Lindriati, and B. H. Purnomo, "Sifat fisik dan kimia puree jambu biji merah (Psidium guajava L.) dengan penambahan gum arab dan gum xanthan," *Jurnal Agroteknologi*, vol. 9, no. 2, pp. 145–155, 2015.

[4] H. Sofiana, K. Triaswuri, and S. B. Sasongko, "Pengambilan pektin dari kulit pepaya dengan cara ekstraksi," *Jurnal Teknologi Kimia dan Industri*, vol. 1, no. 1, pp. 482–486, 2012.

[5] N. Nurviani, S. Bahri, and N. Ketut Sumarni, "Online Jurnal of Natural Science," *Ekstraksi dan karakterisasi pektin kulit buah pepaya (Carica papaya L.) varietas cibinong, jinggo, dan semangka*, vol. 3, no. 3, pp. 322–330, 2014.

[6] K. Krisnayanti and S. Ab, "Pengaruh suhu ekstraksi kulit buah papaya dengan pelarut Hcl 0,1n pada pembuatan pektin," *Jurnal Konversi*, vol. 2, no. 2, pp. 47–56, 2013.

[7] M. Miranti, S. Wardatun, and A. Fauzi, "Aktivitas antioksidan minuman jeli sari buah pepaya california (*Carica papaya* L.)," *Jurnal Ilmiah Farmasi*, vol. 6, no. 1, pp. 39-51, 2016.

[8] S. Wulandari, I. Kadekoh, and N. Alam. "Sifat fisik kimia dan organoleptik jelly pada berbagai rasio gula pasir-daging buah naga (Hylocereus polyrhizus Britt and Rose*)," Jurnal Agrotekbis,* vol. 6, no. 6, pp. 789-797, 2018.

[9] AOAC. *Official Methods of Analysis of The Association Agricultural Chemist*. AOAC International 10th Ed., Washington DC, 2012

[10] S. Sudarmadji, B. Haryono and Suhardi. *Analisa Bahan Makanan dan Pertanian*. Yogyakarta: Penerbit Liberty, 1997

[11] T. R. Muchtadi dan Sugiyono. *Ilmu Pengetahuan Bahan Pangan*. Pusat Antar Universitas. Institut Pertanian Bogor, 1992.

[12] A. Apriyantono, D. Fardiaz, N. L. Puspitasari, Y. Sedarnawati and S. Budianto. *Petunjuk Laboratorium Analisis Pangan*. Pusat Antar Universitas, Institute Pertanian Bogor, Bogor, 1989

[13] J. D. Fox. *Food Analysis a Laboratory Manual*. Department of Animal Science, University of Kentucky, 1981

[14] R. Yulistyani, Murtiningsih, and M. Mahmud, "Peran pektin dan sukrosa pada selai ubi jalar ungu," *Jurnal Teknologi Pangan*, vol. 1, no. 1, pp. 114–120, Feb. 2013.

[15] M. Miranti, "Jurnal Wahana Inovasi," *Pengaruh varietas mangga dan jumlah pektin terhadap mutu selai mangga*, vol. 10, no. 1, pp. 153–162, 2021.

[16] M. T Siringoringo, A. Sihotang, D. R. Sihombing, R. Tampubolon, M. Pandiangan, P. Sibuea, D. Panjaitan, S. Yanti and D. V. Tambunan., "Effect of citric acid and sucrose concentration on the quality of passion fruit jelly with dutch eggplant," *IOP Conference Series: Earth and Environmental Science*, vol. 205, no. 1, pp. 1-6, Dec. 2018.

[17] F. G. Winarno, *Kimia Pangan dan gizi*. Jakarta: P.T. Gramedia, 2008.

[18] R. Rianto, R. Efendi, and Y. Zalfiatr, "Pengaruh penambahan pektin terhadap mutu selai jagung manis (Zea Mays.L*)," JOM Faperta*, vol. 4, no. 1, pp. 1–7, Feb. 2017.

[19] R. Yulistiani, R. Rosida and K. W. Lia, "Pembuatan puree jambu biji merah (kajian asam sitrat dan lama penyimpanan pada suhu kamar)," *Jurnal Teknologi Pangan*, vol. 2, no. 2, pp. 20–29, 2008.

[20] D. Simamora and E. Rossi, "Penambahan pektin dalam pembuatan selai lembaran buah pepada (Sonneratia caseolaris)," *Jurnal Online Mahasiswa Fakultas Pertanian*, vol. 4, no. 2, pp. 1–14, Oct. 2017.

[21] N. H. Fajarwati, N. H. R. Parnanto, and G. J. Manuhara, "Pengaruh konsentrasi asam sitrat dan suhu pengeringan terhadap karakteristik fisik, kimia dan sensoris manisan kering labu siam (Sechium edule Sw.) dengan pemanfaatan pewarna alami dari ekstrak rosela ungu (Hibiscus sabdariffa L.)," *Jurnal Teknologi Hasil Pertanian*, vol. 10, no. 1, pp. 50–66, 2017.

[22] L. Fachruddin, *Membuat Aneka Selai*. Kanisius, Yogyakarta, 1997.