Sriwijaya FoodTech Journal, Vol 01 No 01 Tahun 2024 p ISSN xxxx-xxxx
Program Studi Teknologi Hasil Pertanian Universitas Sriwijaya e ISSN xxxx-xxxx

Effect of Citric Acid Concentration and Boiling Time on Physicochemical Properties of Passion Fruit Jelly Drink

Pengaruh Perbedaan Konsentrasi Asam Sitrat dan Lama Perebusan terhadap Sifat Fisikokimia Minuman Jelly Buah Markisa

Merynda Indriyani Syafutri[1*], Herlianah[1], Tri Wardani Widowati[1], Friska Syaiful[1], Eka Lidiasari[1], Anny Yanuriati[1], Citra Pratiwi Prayitno[1]

[1]Program Studi Teknologi Hasil Pertanian, Fakultas Pertanian, Universitas Sriwijaya,
Jl. Palembang Prabumulih KM 32, Ogan Ilir, Sumatera Selatan, Indonesia
*Korespondensi email: merynda@fp.unsri.ac.id

Tanggal submisi: 20 November 2024; Tanggal penerimaan: 21 Desember 2024

ABSTRACT

The objective of this research was to learn the physical and chemical properties of passion fruit jelly drink with difference of citric acid concentration and boiling time. This research used a Factorial Completely Randomized Design with two treatment factors and three replications. First factor was the concentration of citric acid and second factor was boiling time. The observed parameters were physical properties (texture, viscosity, color), and chemical properties (total acidity, total dissolved solids, flavonoid, pH). The results showed that the concentration of citric acid significantly decreased value of texture, viscosity and pH, and increased value of chroma, total acidity and total dissolved solids. Boiling time had significant effects on increased value of texture, viscosity, total acidity and total dissolved solids. The interaction of citric acid concentration and boiling time had significant effect on increased value of total acidity. The best treatment was passion fruit jelly drink with a concentration of 0.3% citric acid addition, and a boiling time of 10 minutes.

Keywords: boiling; citric acid; jelly drink; passion fruit

ABSTRAK

Tujuan penelitian adalah untuk mempelajari sifat fisik dan kimia minuman jelly buah markisa dengan perbedaan konsentrasi asam sitrat dan lama perebusan. Penelitian menggunakan Rancangan Acak Lengkap Faktorial dengan dua faktor perlakuan dan pengulangan sebanyak tiga kali. Faktor pertama adalah konsentrasi asam sitrat dan faktor kedua adalah lama perebusan. Parameter yang diamati berupa sifat fisik (tekstur, viskositas dan warna) dan sifat kimia (total asam tertitrasi, total padatan terlarut, flavonoid dan pH). Hasil penelitian menunjukkan bahwa konsentrasi asam sitrat berpengaruh nyata terhadap penurunan tekstur, viskositas, dan pH, serta peningkatan *chroma*, total asam tertitrasi dan total padatan terlarut. Lama perebusan berpengaruh nyata terhadap peningkatan tekstur, viskositas, total asam tertitrasi dan total padatan terlarut. Interaksi kedua faktor berpengaruh nyata terhadap

peningkatan total asam tertitrasi. Perlakuan terbaik yaitu minuman jelly buah markisa dengan konsentrasi penambahan asam sitrat 0,3%, dan lama perebusan 10 menit.

Kata kunci: perebusan; asam sitrat; minuman jelly; markisa

INTRODUCTION

Passion fruit (*Passiforaceae*) is one type of creeping plant that grows in the tropics. There are 3 types of passion fruit found in Indonesia, namely sour passion fruit with purple skin (*Passiflora edulis f. edulis Sims*), sour passion fruit with yellow skin (*Passiflora edulis Sims f. flavicarpa Deg*.), and sweet passion fruit or konyal passion fruit (*Passiflora ligularis Juss*) (Marpaung et al., 2016). Konyal passion fruit is a type of passion fruit that is widely found in South Sumatra Province, but its utilization has not been maximized so it needs to be developed. According to Ratule *et al*. (2024), in 2020 passion fruit productivity in Indonesia reached 82.27 kg/tree, and productivity in South Sumatra Province reached 35.65 kg/tree.

Konyal passion fruit has a sweet taste and soft pulp texture (Fera *et al*., 2022). Passion fruit has health benefits because it contains active compounds that are antioxidants such as carotenoids, polyphenols, ascorbic acid, harmin, harman, harmol, harmalin, vitexin, isovitexin, and chrysin. In addition, passion fruit juice also contains a lot of passiflorine, which is a substance that can calm the nerves (Kaswar *et al*., 2020).

Passion fruit can be used as raw material for jelly beverage products. Jelly drink is a type of drink that has a high viscosity made from fruit, especially those that contain pectin with the addition of sugar and acids needed in gel formation (Utami and Kristiastuti, 2016). Ekafitri *et al*. (2016) added that jelly drinks can be an alternative to delaying hunger when you are busy. Jelly drinks are favored by all age groups, but the consumption level of jelly drinks is still below other beverage products such as tea, coffee, milk, and youghurt. According to Widawati and Hardiyanto (2016), a good jelly drink has good characteristics if it has a steady texture, easily crushed when consumed using the help of a straw, but the gel shape is still felt in the mouth. Wibawanty (2019) added that the viscosity of jelly drinks has a viscosity between fruit juice and jelly, but the consistency or strength of the gel is weaker when compared to agar jelly.

One of the factors that affect the texture of jelly drinks is pectin. Pectin comes from various types of fruits, especially in the fruit skin which is 14% (Sarandi *et al*., 2015), but passion fruit skin is not used in the process of making passion fruit jelly drinks so it is necessary to add a gelling agent. This is in line with the statement of Widawati and Hardiyanto (2016) that a good jelly drink gel structure and easy to suck can be formed by adding a gelling agent.

Agustin and Putri (2014) added that gelling agents that can be used are hydrocolloid compounds such as agar, locust bean gum, pectin, gelatin, and carrageenan. According to Martiyanti (2019), carrageenan is widely used in jelly beverage research because of the stable physical properties of carrageenan in neutral conditions so that it is compatible with raw materials. The concentration of carrageenan added will affect the gel characteristics of the resulting jelly drink and is closely related to stability (Vania *et al*., 2017). Wicaksono and Zubaidah (2015) stated that the best concentration of carrageenan in making soursop leaf jelly drink is 0.3%.

Passion fruit contains high citric acid, which is 2.4% to 4.8% (Halawa *et al*., 2023). Deshmukh *et al*. (2017) added that the citric acid content in passion fruit juice ranges from 25g/L to 50 g/L. This shows that passion fruit is quite acidic, so it is necessary to know the right amount of acidity regulating ingredients in making jelly drinks so as not to overdo it. One of the acidity regulators used in making jelly drinks is citric acid (Harnowo and Yunianta, 2015). Citric acid is a weak organic acid that can act as a good natural preservative, and is used as a regulator of acidity in food and beverage products. The use of citric acid in food tends to be safe because it is easily metabolized and excreted by the body (Ovelando *et al*., 2013).

One of the process stages in making passion fruit jelly drink is heating (boiling). During the boiling process, the material is in direct contact with heat, so the cell wall and plasma membrane will be damaged. After going through the boiling process, the percentage of free radical inhibition decreases so there is a possibility that antioxidant activity also decreases (Palimbong *et al*., 2020). There are several factors that need to be considered during boiling, including the type of ingredients, the length of the boiling process, the tools used, and the boiling conditions that use a tool cover or not. Closed boiling can minimize the contact between cooked ingredients and oxygen, so as to reduce the risk of oxidation (Wiyono, 2017). Some phenolic compounds are very sensitive to changes in temperature, and the results will be different in each type of plant (Wicaksono and Zubaidah, 2015). Dewata et al. (2017) added that phenol compounds will be damaged by heating at 85ºC for 5 minutes, and will be degraded at 90ºC for 4 minutes. This research aims to study the effect of different concentrations of citric acid used as an acidity regulator and the duration of boiling on the physical and chemical properties of passion fruit jelly drink.

RESEARCH METHODS

Materials

The materials used in this study consist of materials used in the manufacture of passion fruit jelly drinks such as water, citric acid, passion fruit (*Passiflora ligularis Juss*), granulated sugar, and carrageenan (kappa carrageenan type) "IndoGum", and chemicals for analysis.

Tools

The tools used in this study are: 1) glassware for analysis, 2) color reader, 3) juicer "Philips HR1821", 4) hand-refractometer, 5) hot plate "Cimarec, US", 6) analytical balance "Ohaus, USA", 7) pH meter, 8) pan, 9) knife, 10) pipette, 11) spatula, 12) spectrophotometer "Jenway, UK", 13) stopwatch, 14) thermometer, 15) texture analyzer "Brookfield", 16) viscometer "Brookfield", 17) plastic cup container, and 18) vortex "Waxi II, type 3760, Germany".

Methods

The study used a Completely Randomized Factorial Design (CRD) with two factors, namely citric acid concentration (A) consisting of three treatment levels (A1=0.1%; A2=0.2%; A3=0.3%), and boiling time (B) consisting of two treatment levels (B1=10 minutes; B2=15 minutes), resulting in 6 treatments. Each treatment was repeated 3 times. Data on physical and chemical properties obtained were processed by analysis of variance (Anova), data that had a significant effect were continued with the 5% level of Honest Real Difference test.

Passion Fruit Jelly Drink Making

The process of making passion fruit juice referred to Sugiarso and Nisa (2015) which has been modified. Passion fruit was taken that ripe with the characteristics of a yellow color with a distinct passion fruit aroma and the surface of the skin is good and not bruised. Passion fruit was washed with water. The stove was turned on to low heat, then blanching the passion fruit in a pot of water at 80°C for 3 minutes. The skin of the passion fruit was peeled using a knife and the contents were extracted. Passion fruit juice was obtained using a juicer.

Passion fruit juice (200 mL) was diluted by adding 1000 mL of water (material:water = 1:5). The diluted passion fruit juice was taken as much as 200 mL, then other ingredients were added, namely sugar (10%), carrageenan (0.3%) and citric acid (0.1%, 0.2% and 0.3% b/v). The stove was switched on low heat, then the pan was filled with 500 mL of water and heated until the temperature reached 100°C. The mixture of ingredients was cooked in a pan placed on a pan filled with water at 100°C according to the treatment (10 minutes and 15 minutes). The

mixture was put into a plastic cup (diameter ± 5 cm; height ± 5 cm). The mixture was then cooled to room temperature (± 37°C) for 30 minutes until a jelly drink was formed.

Parameters

The observed parameters included physical and chemical properties. Physical properties consisted of texture (Simorangkir *et al*., 2017), viscosity (Syaiful *et al*., 2020), and color (Nabilah *et al*., 2022), while chemical properties consisted of total titratable acid (Rizqiati *et al*., 2019), total soluble solids (Bayu *et al*., 2017), pH (AOAC, 2005), and flavonoid qualitative test (Haeria *et al*., 2018).

RESULTS AND DISCUSSION

Texture

Texture will affect the shape or form caused by the material (Aliputty *et al*., 2020). Engelen (2017) added that texture is determined by the response of food ingredients to the force applied. The average texture value of passion fruit jelly drink was 44.67 gf to 73.80 gf (Table 1). The texture value of A3B1 passion fruit jelly drink (0.3% citric acid concentration; 10 min boiling time) was similar to the texture value of commercial jelly drink (45.27 gf to 47.13 gf), while the texture values of other treatments were above the texture value of commercial jelly drink.

The results showed that the higher the concentration of citric acid (up to 0.3%), the lower the texture value of passion fruit jelly drink, and the longer the boiling time (up to 15 minutes), the higher the texture value of passion fruit jelly drink. The results of the analysis of variance showed that citric acid concentration and boiling time had a significant effect on the texture value of passion fruit jelly drink, while the interaction of the two treatment factors had no significant effect.

The results of advanced test (α 0.05) on the effect of citric acid concentration on texture value showed that the texture value of passion fruit jelly drink with citric acid addition concentration of 0.1% to 0.3% was significantly different. The addition of citric acid per 0.1% significantly reduced the texture value of passion fruit jelly drink. Citric acid acts as an acidulant (acidic chemical compound) that can reduce pH. The element that causes the sour taste is the H^+ ion or hydrogenium ion H_3O^+ (Fajarwati *et al*., 2017). A good gel texture in the manufacture of jelly drinks using hydrocolloid compounds in the form of carrageenan can be obtained if the appropriate proportion between carrageenan, sugar, and acid in water is achieved. The added carrageenan acts as a gelling agent in the acid-sugar medium, while sugar acts as a dehydrating

agent that can bind water and form a firmer gel texture, and acid acts as a pH regulator to stabilize carrageenan in solution. High acidity can cause an increase in syneresis because the acid will cause hydrolysis of the bond between water and hydrocolloids. The lower the pH value of the product, the higher the chance of syneresis (Yanto *et al*., 2015; Hardoko *et al*., 2019). The texture value of passion fruit jelly drink decreased along with the high concentration of citric acid added. A low pH will increase the chance of syneresis. Widyawati *et al*. (2020) stated that higher syneresis will damage the gel in the product and cause the texture of the jelly drink to become softer.

The results of further test (α 0.05) on the effect of boiling time on texture value showed that the texture value of passion fruit jelly drink with a boiling time of 10 minutes and 15 minutes was significantly different. The addition of boiling time for 5 minutes could significantly increase the texture value of passion fruit jelly drink. The longer the boiling time, the more the texture value of passion fruit jelly drink increases. The longer the boiling time, the amount of water will decrease (Hutagalung *et al*., 2018), so the solution will be more concentrated. The amount of water gives a negative correlation to the texture of the product. According to Fajarwati *et al*. (2017), the lower the amount of water, the harder the texture.

Viscosity

Viscosity is the degree of viscosity of a food product (Widjaja *et al*., 2019). The higher the viscosity value, the higher the viscosity level (Yanto *et al*., 2015). The average viscosity value of passion fruit jelly drink ranged from 3720.00 mPa.s to 6006.67 mPa.s (Table 1). The viscosity values of passion fruit jelly beverage samples A2B1, A3B1 and A3B2 were in the range of viscosity values of commercial jelly beverages (3693.00 mPa.s to 4760.00 mPa.s), while the viscosity values of passion fruit jelly beverage of other treatments were above the viscosity values of commercial jelly beverages. The higher the concentration of citric acid (up to 0.3%), the lower the viscosity value of passion fruit jelly drink, and the longer the boiling time (up to 15 minutes), the higher the viscosity value of passion fruit jelly drink samples.

The results of the analysis of variance showed that citric acid concentration and boiling time had a significant effect on the viscosity value of passion fruit jelly drink, but the interaction of the two factors had no significant effect. Based on further test (α 0.05), the viscosity value of jelly drink with different concentrations of citric acid is significantly different. The addition of citric acid concentration per 0.1% significantly decreased the viscosity value of passion fruit jelly drink. The lower the pH, the lower the viscosity value of passion fruit jelly drink. This is supported by the statement of Widjaja *et al*. (2019) that a solution will decrease in viscosity if

the pH is lowered. A decrease in pH causes hydrolysis of the glycosidic bond of sucrose which results in a decrease in viscosity.

The results of further test (α 0.05) also showed that the viscosity value of passion fruit jelly drink with a boiling time of 10 minutes and 15 minutes was significantly different. The addition of 5 minutes of boiling time significantly increased the viscosity value of passion fruit jelly drink. Boiling for 15 minutes resulted in a decrease in water that is more compared to boiling for 10 minutes. According to Cahyono *et al*. (2015), the longer the boiling, the amount of water will decrease due to the process of evaporation of water in the material in contact with the heating medium, thus increasing the viscosity value.

Color

The color measurement of passion fruit jelly drink consists of three attributes, namely L* (Lightness), C* (Chroma) and h* (hue). Lightness shows the brightness value with a range of values from 0 (dark/black) to 100 (bright/white) (Fajarwati *et al*., 2017). The lower the lightness value (close to 0), the darker the product color (black), while the higher the lightness value (close to 100), the brighter the product color (white) (Chandra et al., 2014). The lightness value of passion fruit jelly drink ranged from 29.44% to 34.46% (Table 1).

The higher the concentration of citric acid (up to 0.3%) and the longer the boiling time (up to 15 minutes), the lower the lightness value of passion fruit jelly drink. Citric acid works as a catalyst in the formation of browning because citric acid increases inversion sugars. If the inversion sugar is further degraded, it will form a brown 5-hydroxymethyl 2-furfural (HMF) compound. The higher concentration of citric acid results in a decrease in pH, thus causing an increase in the inversion reaction of sucrose into glucose and fructose. The more glucose and fructose will affect the level of brightness due to the formation of brown 5-hydroxymethyl 2-furfural compounds (Fajarwati *et al*., 2017).

Boiling time can also cause hydrolysis of sucrose into glucose and fructose. Boiling the sugar solution using an acid catalyst can hydrolyze sucrose and result in discoloration of the solution due to the formation of 5-hydroxymethyl 2-furfural due to dehydration of fructose (Razak *et al*., 2012). In addition, Cahyono *et al*. (2015) stated that longer boiling will evaporate the water contained in the product and reduce the lightness value. Based on the analysis of variance, the two treatment factors and their interactions had no significant effect on the lightness value of passion fruit jelly drink.

Chroma indicates color intensity. The average chroma value of passion fruit jelly drink ranged from 8.32% to 9.46% (Table 1). The results showed that the higher the concentration of

citric acid and the duration of boiling, the chroma value of passion fruit jelly drink will increase. The results of the analysis of variance showed that citric acid concentration significantly influenced the chroma value of passion fruit jelly drink, but the boiling time factor and the interaction of the two treatment factors had no significant effect.

The results of further test (α 0.05) on the effect of citric acid concentration on chroma value stated that passion fruit jelly drink with the addition of 0.3% citric acid was significantly different from the other treatments. The higher the concentration of citric acid, the higher the color intensity of passion fruit jelly drink products. Fajarwati *et al*. (2017) stated that citric acid acts as a catalyst for the formation of a brown 5-hydroxymethyl 2-furfural compound. Boiling time also increases the chroma value of passion fruit jelly drink. This is in accordance with the statement of Chandra *et al*. (2014) that the higher the temperature and duration of boiling, the chroma value increases.

Table 1. Physical properties of passion fruit jelly drink with different concentrations of citric acid and boiling time

Treatment	Texture (gf)	Viscosity (m.Pas)	*Lightness* (%)	*Chroma* (%)	*hue* (º)
A_1B_1 (Citric acid 0.1%; Boiling time 10 minutes)	55.13	5280.00	34.46	8.32	180.67
A_1B_2 (Citric acid 0,1%; Boiling time 15 minutes)	73.80	6006.67	30.70	8.67	181.25
A_2B_1 (Citric acid 0,2%; Boiling time 10 minutes)	52.87	4693.33	31.71	8.73	182.09
A_2B_2 (Citric acid 0,2%; Boiling time 15 minutes)	68.13	5373.33	29.70	8.82	182.30
A_3B_1 (Citric acid 0,3%; Boiling time 10 minutes)	44.67	3720.00	30.41	9.10	183.78
A_3B_2 (Citric acid 0,3%; Boiling time 15 minutes)	63.00	4380.00	29.44	9.46	185.18

The hue value is the dominant spectrum color based on its wavelength (Priandana *et al*., 2014). The hue value of passion fruit jelly drink ranges from 180.67º to 185.18º (Table 1). Based on the color histogram, the hue value of passion fruit jelly drink is included in the green color (Fajarwati *et al*., 2017). The higher the concentration of citric acid added (up to 0.3%) and the longer the boiling (up to 15 minutes), the hue value will decrease. The results of the analysis of variance showed that the citric acid concentration factor and the boiling time factor, as well as the interaction of the two factors had no significant effect on the hue value of passion fruit jelly drink.

Total Acid Titrated

The value of total acid titrated includes the measurement of total dissociated and undissociated acids (Angelia, 2017). The average total acid titrated of passion fruit jelly drink ranged from 1.65% to 4.34% (Table 2). The higher the citric acid concentration (up to 0.3%) and the longer the boiling time (up to 15 minutes), the higher the total titratable acid value. The results of the analysis of variance showed that citric acid concentration, boiling time, and the interaction of the two factors had a significant effect on the value of total titratable acid in passion fruit jelly drink.

The results of further test (α 0.05) on the effect of citric acid concentration on the value of total titratable acid showed that each addition of citric acid as much as 0.1% can significantly increase the value of total titratable acid. According to Fajarwati *et al*. (2017), the more citric acid added, the pH will decrease. Jelly drink with 0.3% citric acid concentration has the highest total titratable acid value (3.43%) and has the lowest pH (4.72). Ovelando *et al*. (2013) added that passion fruit contains naturally citric acid of 2.4%-4.8%, with a pH ranging from 4.0-5.5.

The results of further test (α 0.05) also showed that the value of total titratable acid in jelly drinks with a boiling time of 10 minutes and 15 minutes was significantly different. The difference in the addition of 5 minutes could significantly increase the value of total titratable acid. The longer the boiling, the higher the total acid value of passion fruit jelly drink. According to Widjaja *et al*. (2019), hydrolysis of ingredients will occur along with an increase in temperature and heating time, thereby increasing total acid.

Konyal passion fruit contains 13.8% glucose (Ovelando *et al*., 2013). In addition, in the manufacture of passion fruit jelly drink, sugar is also added as much as 10%. According to Osvaldo *et al*. (2012), the heating process can hydrolyze glucose into 5-hydroxymethyl 2-furfural compounds which when decomposed further will form levulinic acid compounds and formic acid so that it can increase the total acid value.

The results of further test (α 0.05) also showed that passion fruit jelly drink with A1B2 treatment (0.1% citric acid concentration and 15 minutes boiling time) was significantly different from the other treatments, but not significantly different from sample A1B1 (0.1% citric acid concentration and 10 minutes boiling time) and sample A2B1 (0.2% citric acid concentration and 10 minutes boiling time). The citric acid concentration factor and the boiling time factor have a positive correlation. The higher the concentration of citric acid and the longer the boiling time, the value of total titratable acid of passion fruit jelly drink will increase. Acidic conditions caused by the addition of citric acid will accelerate the process of glucose hydrolysis

into acidic compounds during boiling. This is in line with the statement of Mardina *et al*. (2014) that acid functions as a catalyst that helps water work in the hydrolysis process with the longer the reaction time.

Total Dissolved Solids

Total dissolved solids of passion fruit jelly drink ranged from 13.67ºBrix to 22.77ºBrix (Table 2). The higher concentration of citric acid (up to 0.3%) and the longer boiling time (up to 15 minutes) caused an increase in the total dissolved solids value of passion fruit jelly drink. Based on the results, the concentration of citric acid and boiling time had a significant effect on the total dissolved solids value of passion fruit jelly drink, but the interaction of the two treatment factors had no significant effect.

The results of further test (α 0.05) showed that the total dissolved solids value of passion fruit jelly drinks with various concentrations of citric acid (0.1% to 0.3%) were significantly different. The addition of citric acid concentration per 0.1% could increase the total dissolved solids value significantly. The increasingly acidic solution conditions will facilitate hydrolysis so that the total dissolved solids value will increase. This is in accordance with Harijono *et al*. (2001) which states that an increase in the total dissolved solids value is followed by a decrease in pH and an increase in the amount of reducing sugar.

The results of further test (α 0.05) showed that the total dissolved solids value of passion fruit jelly drinks with a boiling time of 10 minutes and 15 minutes were significantly different. Increasing the boiling time for 5 minutes could significantly increase the total dissolved solids value. The longer the boiling, the more sucrose content is hydrolyzed, both added and in the passion fruit, into glucose and fructose. According to Angelia (2017), the increase in the total dissolved solids value is caused by the hydrolysis of carbohydrates into glucose and fructose compounds.

pH

The degree of acidity is an indicator used to indicate the level of acidity or alkalinity of a solution (Karangan *et al*., 2019). The pH value of passion fruit jelly drinks ranges from 4.72 to 5.22 (Table 2). The higher the concentration of citric acid added (up to 0.3%), the lower the pH value of the passion fruit jelly drink. The results showed that the pH value of sample A1B1 (citric acid concentration of 0.1% and boiling time of 10 minutes) and sample A1B2 (citric acid concentration of 0.1% and boiling time of 15 minutes) were close to the pH value of commercial jelly drinks (5.15 to 5.22), while the pH values of other treatments were below the pH value of commercial jelly drinks.

The results of the diversity analysis showed that the citric acid concentration factor significantly affected the pH value of the passion fruit jelly drink, while the boiling time factor and the interaction of the two factors had no significant effect. The results of the BNJ further test (α 0.05) showed that the pH value of the jelly drink with a citric acid concentration of 0.1% was significantly different from other treatments. A significant decrease in the pH value of the passion fruit jelly drink occurred with the addition of 0.2% citric acid. The pH value of carrageenan ranged from 9.5-10.5. According to Nastiti (2019), yellow passion fruit has a fairly acidic pH (3.0-4.5), but this pH is still not enough to lower the pH of carrageenan. In addition, in the process of making jelly drinks, dilution is carried out in passion fruit juice. The optimum pH for the formation of carrageenan gel is 3.0-4.0. The average pH value of the passion fruit jelly drink samples is above the optimum pH value of the jelly drink, so the consistency of the gel formed is not firm. This is in accordance with the results of the texture and viscosity parameters, the values of which are decreasing due to the pH of the passion fruit jelly drink not being at the optimum pH of the jelly drink.

Table 2. Chemical properties of passion fruit jelly drink with different concentrations of citric acid and boiling time

Treatment	Total Acid Titrated (%)	Total Dissolved Solids (ºBrix)	pH
A_1B_1 (Citric acid 0.1%; Boiling time 10 minutes)	1.65[a]	13.67	5.22
A_1B_2 (Citric acid 0,1%; Boiling time 15 minutes)	1.74[ab]	19.33	5.17
A_2B_1 (Citric acid 0,2%; Boiling time 10 minutes)	2.44[b]	15.27	4.98
A_2B_2 (Citric acid 0,2%; Boiling time 15 minutes)	3.65[c]	20.11	4.96
A_3B_1 (Citric acid 0,3%; Boiling time 10 minutes)	4.10[c]	16.60	4.76
A_3B_2 (Citric acid 0,3%; Boiling time 15 minutes)	4.34[c]	22.77	4.72

Numbers followed by the same letter in the same column are not significantly different

According to Agustin and Putri (2014), pH is affected by the addition of acidic substances added to water which results in an increase in H^+ ions in water, so that the pH of a substance will decrease. Fajarwati *et al.* (2017) added that the more citric acid added, the higher the total acid, thus lowering the pH. Passion fruit jelly drinks for each sample entered the threshold for acidic drinks (pH 3.5) (Yanto *et al.*, 2015). In addition, the boiling time can

hydrolyze glucose into 5-hydroxymethyl 2-furfural compounds which, if further decomposed, will form acidic compounds that can lower the pH (Osvaldo *et al*., 2012).

Semi Qualitative Flavonoid Test

Semi-qualitative flavonoid test was observed qualitatively from the color intensity that appeared after adding several reagents including 95% ethanol, concentrated HCl and Mg powder for the detection of flavonoid compounds. The results of the semi-qualitative flavonoid test of passion fruit jelly drinks are presented in Table 3. Each sample of passion fruit jelly drinks experienced a color change to yellowish which indicated that the sample contained flavonoids in it, but the intensity of the color change in the samples varied. The intensity of the color change is expressed in + (little), ++ (quite a lot) and +++ (a lot). The occurrence of oxidation in flavonoid compounds during heating is thought to be the cause of the decrease in color intensity.

Table 3. The effect of citric acid concentration and boiling time on the semi-qualitative test of flavonoids in passion fruit jelly drinks

Treatment	Results	Absorbance	Description
A_1B_1 (Citric acid 0.1%; Boiling time 10 minutes)	√	0.114	+
A_1B_2 (Citric acid 0,1%; Boiling time 15 minutes)	√	0.228	++
A_2B_1 (Citric acid 0,2%; Boiling time 10 minutes)	√	0.212	++
A_2B_2 (Citric acid 0,2%; Boiling time 15 minutes)	√	0.257	++
A_3B_1 (Citric acid 0,3%; Boiling time 10 minutes)	√	0.243	++
A_3B_2 (Citric acid 0,3%; Boiling time 15 minutes)	√	0.312	+++

Absorbance 0,100-0,199 = + (little); Absorbance 0,200-0,299 = ++ (quite a lot); Absorbance 0,300-0,399 = +++ (a lot)

The results of the semi-qualitative flavonoid test showed that each sample of passion fruit jelly drink contained flavonoid compounds. Information on the amount of flavonoids was obtained from the absorbance value measured using a spectrophotometer with a wavelength of 435 nm. According to Handayani and Rahmawati (2012), the solution of flavonoid compounds is colorless or pale yellow. The increase in absorbance value is in line with the change in the color of the sample to a more yellow color (Asmorowati and Lindawati, 2019). Ramadhani et al. (2020) added that the increase in absorbance value is followed by the large amount of flavonoids in the sample. Qualitative flavonoid tests by adding magnesium powder and HCl showed changes in the presence of foam. This is in accordance with the opinion of Khanifah *et al*. (2021) that a positive qualitative flavonoid test is indicated by the presence of an orange color and the appearance of foam. It is because there is a reduction reaction with magnesium and HCl. The presence of hydroxyl groups (-OH) in flavonoids causes the formation of

hydrogen bonds so that they are polar. The occurrence of this reaction is marked by the formation of a yellow color or a yellow gradient color such as dark yellow or orange. According to Tandi *et al*. (2020), the purpose of adding Mg and HCl metals is to reduce the benzopyrone core contained in the flavonoid structure so that a flavylium salt is formed.

The addition of citric acid increases the color intensity in the qualitative flavonoid test, indicating that there are more flavonoid compounds in the passion fruit jelly drink sample. Handayani and Rahmawati (2012) stated that increasing the concentration of citric acid provides higher levels of flavonoids. Citric acid functions to damage plant cell membranes so that flavonoid compounds can exit the cells. The boiling time can reduce the flavonoid content in passion fruit jelly drinks, but the results showed no decrease. It is because the sample is in an acidic condition and the passion fruit has been blanched before being processed into a jelly drink product, so it is suspected that the flavonoid compounds in passion fruit are more stable.

CONCLUSION

The concentration of citric acid significantly affected the decrease in texture, viscosity, and pH values and increased the chroma value, total titrated acid and total dissolved solids. The boiling time significantly affected the increase in texture, viscosity, total titrated acid and total dissolved solids values. The interaction between citric acid concentration and boiling time significantly affected the increase in total titrated acid values. The best treatment of passion fruit jelly drink was A3B1 (citric acid concentration 0.3% and boiling time 10 minutes) with a texture value of 44.67 gf, viscosity 3720.00 mPa.s, and total acid titrated 4.1%.

REFERENCES

Agustin, F. & Putri, W. D. R. (2014). Making of Jelly Drink Averrhoa Blimbi L. (Study About Belimbing Wuluh Proportion: the Water and Carrageenan Concentration). *Jurnal Pangan dan Agroindustri*, 2(3), 1-9.

Aliputty, A. C., Leiwakabessy, F., & Pattipeilohy, M. (2020). Uji Kualitas Organoleptik dan Kadar Serat pada Produk Pangan *Jelly Drink* Berbahan Dasar Buah Aren (*Arenga pinnata* Merr) serta Implikasinya pada Masyarakat Taniwel. *Biopendix: Jurnal Biologi, Pendidikan dan Terapan*, 6(2), 62-67.

Angelia, I. O., (2017). pH Content, Total Acidified Acid, Dissolved Solids and Vitamin C in Some Horticultural Commodities. *Journal of Agritech Science*, 1(2), 68-74.

AOAC. (2005). *Official Methods of Analysis. Association of Official Analytical Chemistry.* Washington DC: United State of America.

Asmorowati, H., & Lindawati, N. Y. (2019). Penetapan Kadar Flavonoid Total Alpukat (*Persea americana* Mill.) dengan Metode Spektrofotometri. *Jurnal Ilmiah Farmasi,* 15(2), 51-63.

Bayu, M. K., Rizqiati, H., & Nurwantoro. (2017). Total Dissolved Solid, Acidity, Lipid, and Degree of Viscosity Analysis of Kefir Optima at Different Fermentation Duration. *Jurnal Teknologi Pangan,* 1(2), 33-38.

Cahyono, M. A., & Yuwono, S. S. (2015). Pengaruh Proporsi Santan dan Lama Pemanasan terhadap Sifat Fisiko Kimia dan Organoleptik Bumbu Gado-Gado Instan. *Jurnal Pangan dan Agroindustri*, 3(3), 1095-1106.

Chandra, L., Marsonoa, Y., & Sutedja, A. M. (2014). Sifat Fisikokimia dan Organoleptik Flake Beras Merah dengan Variasi Suhu Perebusan dan Suhu Pengeringan. *Jurnal Teknologi Pangan dan Gizi.,* 13(2), 57-68.

Deshmukh, N. A., Patel, R. K., Okram, S., Rymbai, H., Roy, S. S., & Jha, A. K. (2017). Passion fruit (*Passiflora spp.*). *Magnesium,* 100(44), 979-1005.

Dewata, I. P., Wipradnyadewi, P. A. S., & Widarta, I. W. R. (2017). Pengaruh Suhu dan Lama Penyeduhan terhadap Aktivitas Antioksidan dan Sifat Sensoris Teh Herbal Daun Alpukat (*Persea americana* Mill.). *Jurnal ITEPA*, 6(2), 30-39.

Ekafitri, R., Kumalasari, R., & Desnilasari, D. (2016). Pengaruh Jenis dan Konsentrasi Hidrokoloid terhadap Mutu Minuman *Jellymix* Pepaya (*Carica papaya*) dan Nanas (*Ananas comosus*). *Jurnal Penelitian Pascapanen Pertanian*, 13(3), 115-124.

Engelen, A. (2018). Analisis Kekerasan, Kadar Air, Warna dan Sifat Sensori pada Pembuatan Keripik Daun Kelor. *Journal of Agritech Science*, 2(1), 10-15.

Fajarwati, N. H., Parnanto, N.H. R., & Manuhara, G. J. (2017). Effect of Citric Acid Concentration and Drying Temperature on the Physical, Chemical and Sensory Characteristics of Dried Candied Chayote (*Sechium edule Sw*.) Soaked in Natural Dyes from Dark Red Roselle (*Hibiscus sabdariffa L*.) Extract (*Hibiscus sabdariffa L.*). *Jurnal Teknologi Hasil Pertanian,* 10(1), 50-66.

Fera, O., Zaunit, M. M., & Mardatila, A. (2022). Uji Aktivitas Antibakteri Ekstrak Etanol Kulit Buah Markisa Konyal (*Passiflora ligularis* Juss) Terhadap *Staphylococcus epidermidis* dan *Escherichia coli*. *Jurnal Katalisator*, 7(2), 213-226.

Haeria, Tahar, N., & Munadiah. (2018). Penentuan Kadar Flavonoid dan Kapasitas Antioksidan Ekstrak Etanol Kulit Batang Kelor (*Moringa oleifera* L) dengan Metode DPPH, Cuprac dan Frap. *Jurnal Farmasi FIK UIN Alauddin Makassar,* 6(2), 88-97.

Halawa, N.S., Widyasaputra, R., & Adistya. 2023. Pembuatan Saribuah Campuran Parijoto "*Medinilla magnifica*" dengan Sari Buah Markisa "*Passiflora ligularis*" sebagai Perasa Alami. *Agroforetech*, 1(1), 506-519.

Handayani, P. A., & Rahmawati, A. (2012). Pemanfaatan Kulit Buah Naga (*Dragon Fruit*) Sebagai Pewarna Alami Makanan Pengganti Pewarna Sintetis. *Jurnal Bahan Alam Terbarukan*, 1(2), 19-24.

Hardoko., Tajuddin, K. J., & Halim, Y. (2019). Subtitution of Agar in Making Jelly Drink Green Cincau (*Cyclea barbata*) to Reduce Syneresis. *Jurnal Sains dan Teknologi*, 3(2), 45-56.

Harijono, Kusnadi, J., & Mustikasari, S. A. (2001). Pengaruh Kadar Karaginan dan Total Padatan Terlarut Sari Buah Apel Muda terhadap Aspek Kualitas Permen *Jelly*. *Jurnal Teknologi Pertanian*, 2(2), 110-116.

Harnowo, I., & Yunianta. (2015). The Effect of Addition of Betel Nut Seed Extract and Citric Acid to the Characteristic Properties of Star Fruit Juice. *Jurnal Pangan dan Agroindustri,* 3(3), 1241-1251.

Hutagalung, F. S., Dewi, K. H., & Sidebang, B. (2018). Effect of Heating and Sugar on the Quality of Hard Candy made of Syrup Kalamansi Sideproduct. *Jurnal Agroindustri,* 8(2), 97-104.

Karangan, J., Sugeng, B., & Sulardi. (2019). Uji Keasaman Air dengan Alat Sensor pH di STT Migas Balikpapan. *Jurnal Keilmuan Teknik Sipil*, 2(1), 65-72.

Kaswar, A. B., Risal, A. A. N., Fatiah, & Nurjannah. (2020). Klasifikasi Tingkat Kematangan Buah Markisa menggunakan Jaringan Syaraf Tiruan Berbasis Pengolahan Citra Digital. *Journal of Embedded Systems, Security and Intelligent Systems (JESSI) Universitas Negeri Makassar*, 1(1), 1-8.

Khanifah, F., Puspitasari, E., & Awwaludin, S. (2020). Uji Kualitatif Flavonoid, Alkaloid, Tanin pada Kombinasi Kunyit (*Curcuma longa*) dan Coklat (*Theobroma cacao* L). *Jurnal Sains dan Terapan Kimia*, 15(1), 91.

Utami, L. S., & Kristiastuti, D. (2016). Pengaruh Penambahan Jumlah Sari Tomat (*Lycopersicum esculentum* Mill) dan Sari Temulawak (*Curcuma xanthorhiza*) terhadap Sifat Organoleptik Jelly Drink. *e-journal Boga*, 5(1), 158-167.

Mardina, P., Prathama, H. A., & Hayati, D. M. (2014). Pengaruh Waktu Hidrolisis dan Konsentrasi Katalisator Asam Sulfat terhadap Sintesis Furfural dari Jerami Padi. *Konversi*, 3(2), 37-44.

Marpaung, A. E., Karsinah, dan Karo, B. B. (2016). Characterization and Evaluation of Passion Fruit Acid Hybrid from Purple and Red Passion Fruit Acid Crossing (*Passiflora sp.*). *Jurnal Hortikultura*, 26(2), 163-170.

Martiyanti, M. A. A. (2019). Karakteristik Fisik dan Tingkat Kesukaan Minuman *Jelly* Jagung Manis Variasi Pengenceran dan Konsentrasi Karagenan. *Jurnal Pertanian dan Pangan*, 1(1), 15-22.

Nabilah, T. A., Anjliany, M., & Syafutri, M. I. (2022). Variation of Pectin and Sugar Concentration on The Characteristic of Passion Fruit Gummy Candy. *Indonesian Food Science and Technology Journal*, 6(1), 19-26.

Nastiti, D. P. B. (2019). *Pegaruh Pemberian Sari Buah Markisa Kuning (Passiflora edulis Var. Flavicarpa) terhadap Kadar SGOT dan SGPT Mencit Diabetes yang Diinduksi Aloksan*. Skripsi. Fakultas Famasi Universitas Jember.

Osvaldo, Z. S., Panca, P. S., & Faizal, M. (2012). Pengaruh Konsentrasi Asam dan Waktu pada Proses Hidrolisis dan Fermentasi Pembuatan Bioetanol dari Alang-Alang. *Jurnal Teknik Kimia,* 2(18), 52-62.

Ovelando, R., Nabila, M. A., & Surest, A. H. (2013). Fermentasi Buah Markisa (*Passiflora*) Menjadi Asam Sitrat. *Jurnal Teknik Kimia*, 15-21.

Palimbong, S., Mangalik, G., & Mikasari, A. L., (2020). The Effect of Boiling Time on Against Inhibition of Free Radicals, Viscosity and Sensory Sapanwood Syrup (*Caesalpinia sappan* L.). *Jurnal Teknologi Pangan,* 11(1), 7-15.

Priandana, K., Zulfikar, A., & Sukarman. (2014). Android-Based Mobile Munsell Soil Color Chart by Using HVC Color Model Histogram with KNN Classification. *Jurnal Ilmu Komputer Agri-Informatika,* 3(2), 93-101.

Ramadhani, N., Samudra, A. G., & Pratiwi, L. W. I. (2020). Analisis Penetapan Kadar Flavonoid Sari Jeruk Kalamansi (*Citrofortunella microcarpa*) dengan Metode Spektrofotometri UV-VIS. *Jurnal Mandala Pharmacon Indonesia*, 6(1), 53-58.

Ratule, M. T., Susilawaty, Sulastri, Sa'i, N., Kurniawati, D., Bardosono, A., & Triyono, A. (2024). *Buku Atap Hortikultura 2023*. Direktorat Jenderal Hortikultura Kemeterian Pertanian. Jakarta.

Razak, A. R. Sumarni, N. K., & Rahmat, B. (2012). Optimalisasi Hidrolisis Sukrosa menggunakan Resin Penukar Kation Tipe Sulfonat. *Jurnal Natural Science,* 1(1), 119-131.

Rizqiati, H., Nurwantoro., & Susanti, S. (2019). Analisis Total Asam, Kadar Protein, Kadar Lemak, dan Kadar Laktosa Kefir Susu Kerbau dengan Lama Fermentasi yang Berbeda. Purwokerto: *Prosiding Seminar Nasional dan Call For Papers*, 20 November 2019.

Sarandi, R. R., Alhusna, Y., & Pandia, S. (2015). Pembuatan Pektin dari Kulit Markisa Kuning (*Passiflora edulis flavicarpa*) yang Dimodifikasi. *Jurnal Teknik Kimia USU*, 4(4), 71-76.

Simorangkir, T. R. S., Rawung, D., & Moningka, J. (2017). Pengaruh Konsentrasi Sukrosa terhadap Karakteristik Permen Jelly Sirsak (*Annona muricata* Linn). *COCOS*, 1, 1-13.

Sugiarso, A., & Nisa, F. C. (2015). Pembuatan Minuman Jeli Murbei (*Morus alba* L.) dengan Pemanfaatan Tepung Porang (A. *muelleri Blume*) sebagai Pensubtitusi Karagenan. *Jurnal Pangan dan Agroindustri,* 3(2), 443-452.

Syaiful, F., Syafutri, M. I., Lestari, B. A., & Sugito. (2020). Effect of Turmeric Juice Addition on Physical and Chemical Properties of Pineapple Juice Beverage. Palembang: *Prosiding Seminar Nasional Lahan Sub Optimal ke-8,* 373-381.

Tandi, J., Melinda, B., Purwantari, A., & Widodo, A. (2020). Qualitative and Quantitative Analysis of Secondary Metabolites in Ethanol Extract of Okra (*Abelmoschus esculentus* L. Moench) Fruit with UV-Vis Spectrophotometry Method. KOVALEN: *Jurnal Riset Kimia*, 6(1), 74-80.

Vania, J., Utomo, A. R., & Trisnawati, C. Y. (2017). Effect of Carrageenan Concentration on the Physicochemical and Sensory Properties of Papaya Jelly Drink. *Jurnal Teknologi Pangan dan Gizi*, 16(1), 8-13.

Wibawanty, D. (2019). *Variasi Perbandingan Sari Wortel (Daucus carota L.) dengan Sari Terung Belanda (Solanum betaceaum Cav.) dan Konsentrasi Karagenan terhadap Karakteristik Produk Jelly Drink.* Tugas Akhir. Fakultas Teknik Universitas Pasundan.

Wicaksono, G. S., & Zubaidah, E. (2015). Pengaruh Karagenan dan Lama Perebusan Daun Sirsak terhadap Mutu dan Karakteristik *Jelly Drink* Daun Sirsak. *Jurnal Pangan dan Agroindustri*, 3(1), 281-291.

Widawati, L., & Hardiyanto, H. (2016). The Effect of Carrageenan Concentrationon Physical, Chemical and Organoleptic Of Pineapple Jellydrinks (*Ananas comosus* L. Merr). *Jurnal Agribisnis dan Teknologi Pertanian*, 2(2), 144-153.

Widjaja, W. P., Sumartini, & Salim, K. N. (2019). Karakteristik Minuman Jeli Ikan Lele (*Clarias sp.*) yang dipengaruhi oleh Pemanis dan Karagenan. *Pasundan Food Technology Journal*, 6(1), 73-82.

Widyawati, P.S., Ristiarinia, S., Darmoatmodjoa, L. M. Y. D., Siregara, C. P., & Lianela, A. L. (2020). The Effect of Pluchea indica Less Brewing Using to Physic and Chemical Properties Changes in Pluchea Jelly Drink. *Jurnal Teknologi Pangan dan Gizi*, 19(1), 44-51.

Wiyono, T.S. (2017). Pengaruh Metode Ekstraksi Sari Nanas Secara Langsung dan Osmosis dengan Variasi Perebusan terhadap Kualitas Sirup Nanas (*Ananas comosus* L.). *Jurnal Ilmiah UNTAG Semarang*, 6(2), 108-118.

Yanto, T., Karseno, & Purnamasari, M. M. D. (2015). Effect of Type and Concentration of Sugar on Physicochemical and Sensory Properties Jellly Drink. *Jurnal Teknologi Hasil Pertanian*, 8(2), 123-129.