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The Effects of Heating Temperatures on Passion Fruit Juice's Ascorbic Acid and Total Phenol Levels

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Abstract

The Passiflora edulis f. flavicarpa, a yellow passion fruit, is known for its distinctive aroma and tart flavor. The pulp of the yellow passion fruit can be used to make tea, jam, and syrup commercially. Commercial items are processed using oven heating, which involves prolonged exposure to high temperatures. As a result, fruit content, particularly water content, may alter. The benefit of reducing the water content is that less microbial growth medium means the product has a longer shelf life. However, fruit flesh's nutritional composition will also change due to the ascorbic acid and phenolic compounds' thermolability and other factors. In this study, the yellow passion fruit pulp juice is heated in a controlled manner at 60°C, 70°C, and 80°C for 7 hours using an oven. The purpose is to assess changes in the amounts of ascorbic acid and total phenol that occurred. A paired T-test was used to assess the association between weight loss, ascorbic acid levels, and phenolic levels in the control and treatment groups. The amount of ascorbic acid was determined using the 2.6 dichloroindophenol titrimetry method, and the amount of phenol was determined using the Folin-Cioceltau method and UV-Vis spectrophotometry. According to this study, increasing the temperature to 60 °C or 80 °C significantly reduces weight and ascorbic acid levels. Also, the heating temperature unaffected the amount of phenol in each group.

Keywords: ascorbic acid; heating temperature; phenolic; yellow passion fruit

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INTRODUCTION

Passion fruit is a native South American plant widely grown in Indonesia.[1] The varieties of passion fruit grown in Indonesia are erbis (*Passiflora quadrangularis*), konyal (*Passiflora lingularis*), yellow passion fruit (*Passiflora edulis var. flavicarpa*), and purple passion fruit (*Passiflora edulis var. edulis*).[2] Indonesia is Asia's largest exporter of passion fruit and the third largest in the world.[1] Ice cream, jelly, yogurt, tea, jam, vinegar, soft drinks, and wine are all commercial products derived from passion fruit. In addition, it is used as an active ingredient in traditional medicine and cosmetics. In China and Brazil, for instance, it treats coughs, sore throats, dysentery, constipation, and insomnia.[3] Passion fruit flesh is rich in antioxidants, including phenolic compounds, flavonoids, and carotenoids.[1] This compound has anti-inflammatory, anti-cancer, and cardiovascular disease prevention

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properties, as demonstrated by a one-month reduction in cholesterol levels in diabetic rats administered passion fruit juice.[4] In particular, yellow passion fruit is rich in vitamin C and tocopherol.[5]

The most straightforward technique for preparing passion fruit pulp into commercial products is heating it in an oven. However, the heating procedure will result in physical and chemical changes that alter the texture and nutritional value of the ingredients, particularly the vitamin content and antioxidant activity.[6] From 50°C to 70°C, the dehydration of simplisia from passion fruit rind will be significantly reduced,[7] with a heating duration of 7 hours.[8] Regarding phenolic compounds, there is a contradiction regarding the effect of temperature on phenolic compound concentrations. Reis et al. reported that a heating temperature of 80°C would produce a more significant amount of total phenolic than 60°C and 70°C due to the increased penetration of phenolic compounds caused by cell membrane degradation at higher temperatures.[9] According to Oliveira et al., protracted heating at 60°C reduces the total phenolic content of yellow passion fruit skin.[10] The yellow passion fruit's skin has been extensively studied, but the juice has not received as much attention. This investigation aimed to determine how ascorbic acid levels and total phenolic levels in yellow passion fruit juice were affected by heating temperature.

METHOD

Materials

The yellow passion fruit used in this study originated in Probolinggo, East Java. We used only the fruit's pulp juice. Chemical reagents also used are analytical grade ascorbic acid, acetic acid glacial, 96% ethanol, analytical grade gallic acid, 7% Na_2CO_3 solution, Folin-Cioceltau reagent and distilled water.

Methods

The yellow passion fruit used in this study originated in Probolinggo, East Java. The fruit used ranged in weight from 50 to 100 grams and was in good condition. The pulp and seeds were gathered, strained, and filtered to get the juice, then heated in the oven. In an oven, passion fruit juice was heated for seven hours at three different temperatures 60, 70, and 80°C. Before and following heating, the juice's weight was measured. In addition, the levels of ascorbate and total phenolics were measured. For this experiment, Oven MEMMERT® was used. The amount of ascorbic acid was determined using the 2.6 dichloroindophenol titrimetry method, and the amount of phenol was determined using the Folin-Cioceltau method and UV-Vis spectrophotometry. A statistical test, the paired T-test, was used to determine whether the effect of heating temperature on the average weight, TAA levels, and TPC levels was significant.

RESULTS AND DISCUSSION

Effects of the juice

Yellow passion fruit from Probolinggo, East Java, has been sorted, and the average weight of the fruits was 69.88 ± 12.9 grams. The color and fragrance of the juice are orange-yellow and aromatic, respectively. After being heated in the oven, the average weight of each group was plotted against the treatment temperature (Fig 1). The graph illustrates that as the heating temperature increases, the weight decreases. Then, a paired T-test was conducted to determine the difference between heating effects at each temperature. The heating temperature at 60°C, 70°C, and 80°C had a significant effect ($p<0.05$) and substantially differed between groups regarding the mean weight.

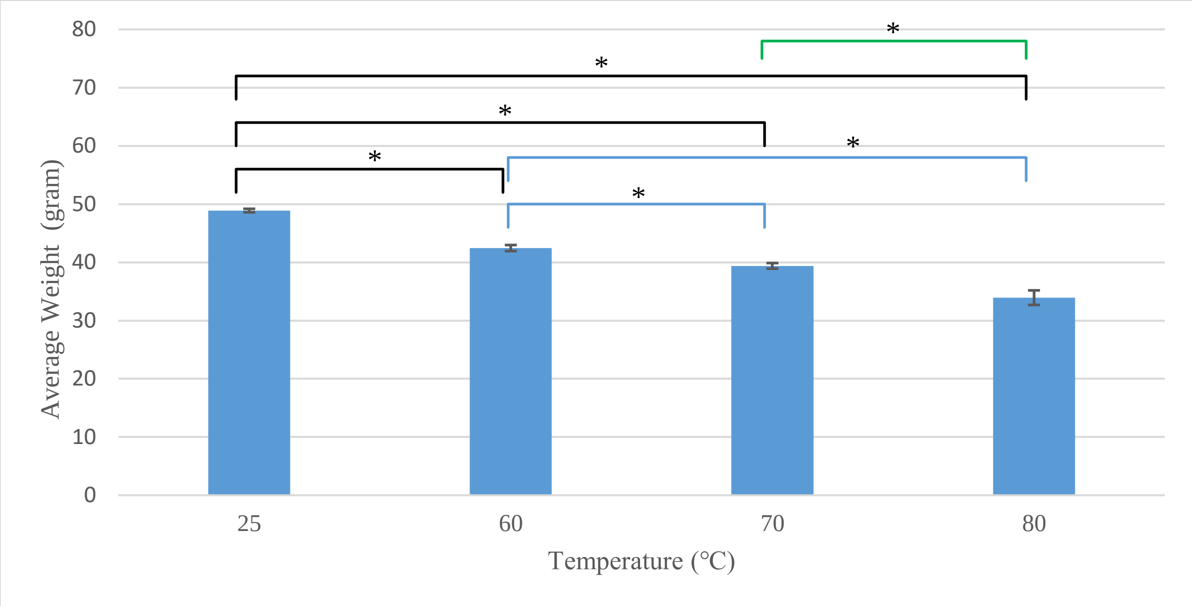

Figure 1 The effect of heating temperature on the average weight of passion fruit juice after 7 hours of treatment. The symbol (*) denotes a significant effect ($p<0.05$) on the paired T-test

Figure 1 shows a decreasing trend between the weight of the samples and the heating temperatures (60, 70, and 80 °C). Therefore, it is possible to conclude that weight loss and heating temperature are strongly correlated. The most weight loss occurs at the highest heating temperature of 80°C. Similar findings were found in several other investigations.[11,12] There, a high heating temperature will cause a high surface evaporation rate. This evaporation could affect how quickly water is removed.[12] The fact that each treatment group's results are significantly different from the others suggests that the higher the temperature, the more dramatic the impact on the decline in humidity and water activity.[13]

Yellow passion fruit juice can be preserved to extend its shelf life before being utilized as a food component. Heating is one technique that can be used. One benefit of heated food is the inactivation of pathogenic microorganisms involved in food deterioration. Additionally, it can lessen the flavor alterations brought on by lipase and proteolytic activity. However, heating also has disadvantages, such as causing physical alterations and chemical processes like protein denaturation and starch gelatinization that will alter the food's sensory qualities, including flavor, texture, and color. Additionally, it alters the nutritional content.[14] High heating temperatures and extended heating times may increase water evaporation and reduce humidity, resulting in weight loss.[15]

Effects on ascorbate acid content

Furthermore, the 2,6 dichloroindophenol titration method was used to measure the ascorbic acid concentration. The concentration of ascorbic acid is then plotted against the temperature of heating (Fig 2). The graph illustrates that ascorbic acid levels decrease with increasing heating temperatures. The data was then analyzed using a paired T-test. Each treatment group differed significantly from the control group. No significant difference existed between the ascorbate levels in the 60°C and 70°C groups. These results indicate no significant difference between the effects of 60 °C and 70 °C heating on ascorbic acid concentrations.

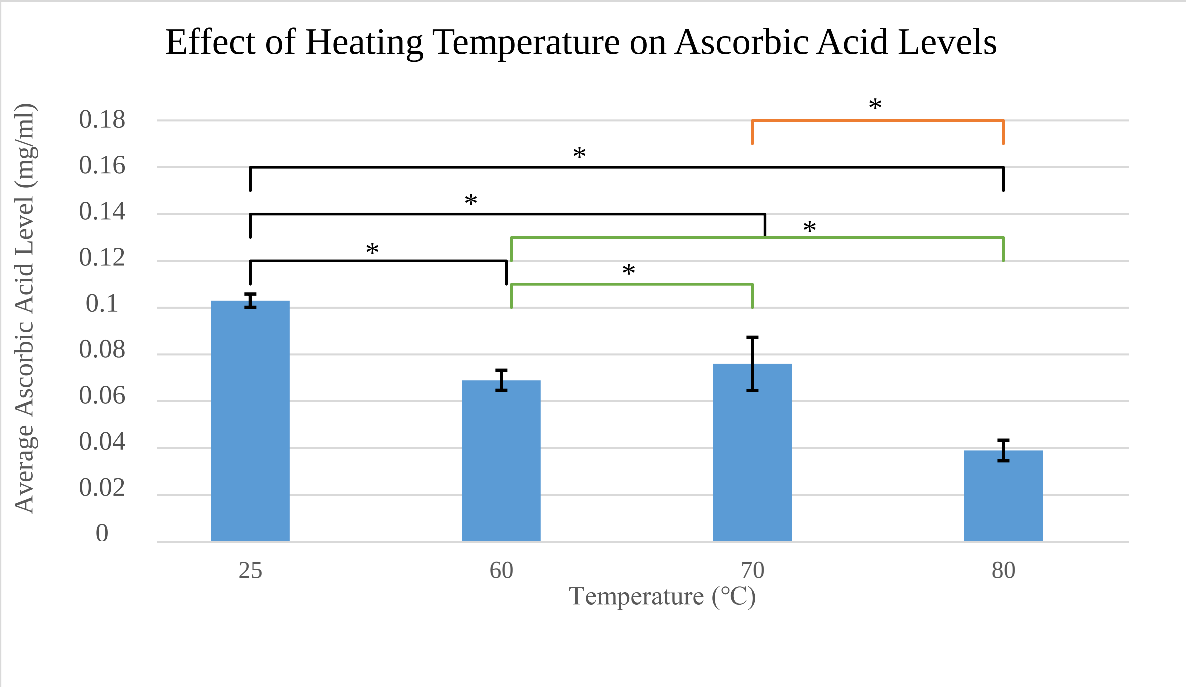

Figure 2. The effect of heating temperature on the average weight of passion fruit juice after 7 hours of treatment. The symbol (*) denotes a significant effect ($p<0.05$) on the paired T-test

One of the components of passion fruit, ascorbic acid, is crucial to the food industry. A substance that acts as an antioxidant is ascorbic acid. Ascorbic acid is vulnerable to oxidation because of light, oxygen, and metals.[16] Ascorbic acid quickly oxidizes at high heating temperatures (over 50 °C).[17,18] This condition may result in a drop in ascorbic acid levels.

Further research is required to determine the cause of the phenomena where the ascorbic compound breakdown at 60°C heating is not significantly different from that at 70°C heating. As a result, in practice, a heating temperature of 70°C can be considered for use instead of 60°C while making simplified extract because using a heating temperature of 70°C will cause the water content to fall more than using one of 60°C, and the harm to the ascorbic acid compound will be reduced.

Effects on total phenolic content

The majority of plant chemicals belong to the phenolic class. Quercetin, rutin, 4-hydroxybenzoic, chlorogenic, ferulic, p-coumaric acid, and vanillic acid are the primary phenolic chemicals discovered in passion fruit (3). Light, pH, and temperature all impact the stability of phenolic compounds.[19] When a heating temperature is present, the total phenolic content may be affected by some processes, such as hydrolysis, oxidation, and degradation.[20] The degradation of total phenolic content accelerates with increasing heating temperature.[19]

Then, a graph of the heating temperature versus the average phenolic content is constructed. However, trend data is absent from the graph because the resultant phenolic content data is volatile. After comparing phenolic levels in each treatment group using the paired T-test, passion fruit juice's phenolic levels were not substantially affected by heating temperature.

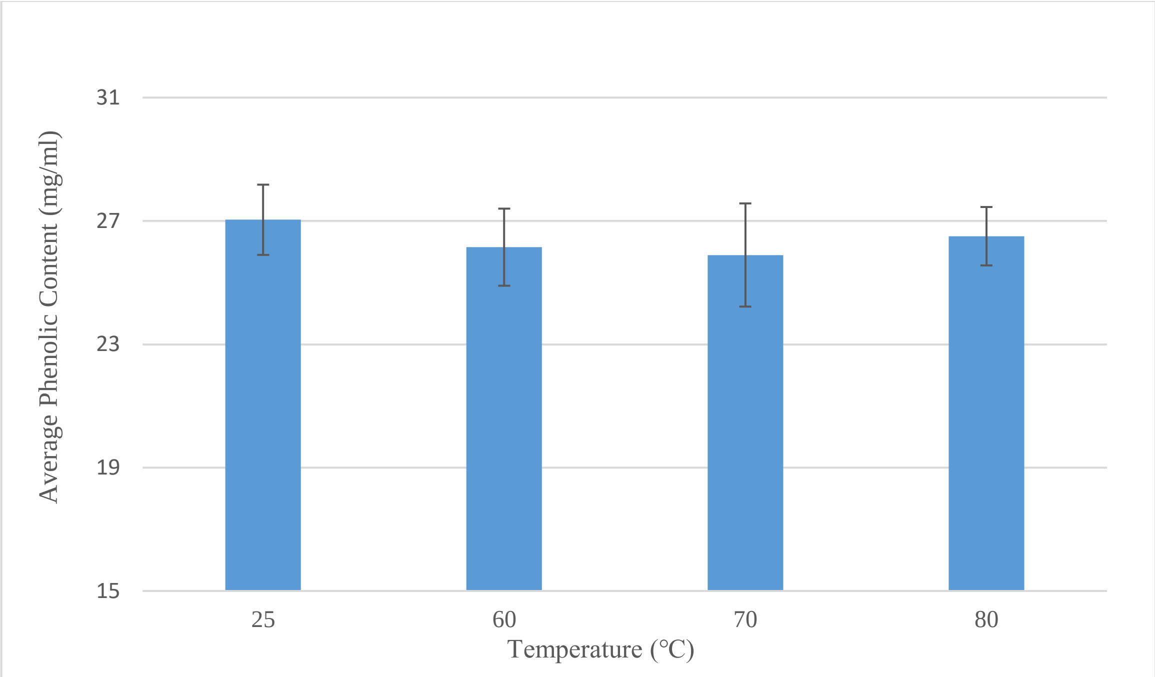

Figure 3. The influence of temperature on the average phenolic content of passion fruit juice after seven hours of heating. There was no significant effect of heating temperature on the average phenolic content of all groups

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CONCLUSION

The average weight decreases with increasing thermal temperatures. Temperature increases have a significant impact on the average weight of all categories. As the heating temperature increases, the concentration of ascorbic acid decreases. At 60°C and 80°C, the heating temperature significantly affects ascorbic acid levels. In all categories, the heating temperature had no significant effect on the phenolic content. Future research suggests identifying the phenolic components found in passion fruit juice and the phenolic components lost during heating.

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