

The Effect of Sodium Alginate and Calcium Chloride Concentration on the Characteristics of Strawberry (*Fragaria ananassa* L.) Fruit Juice Boba Popping Using the Basic Spherification Method

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Abstract. This study aims to determine the effect of the ratio of sodium alginate and calcium chloride concentrations on the characteristics of strawberry (*fragaria ananassa* L.) fruit juice boba popping with the basic spherification method and determine the best treatment based on chemical and organoleptic properties. This research method is to determine the ratio of sodium alginate and calcium chloride concentrations on the best characterization of strawberry fruit juice boba popping with a randomized block design (RAK) method which includes 2 factors, namely factor A sodium alginate (A1: 0.47%, A2: 0.57%), factor B calcium chloride (B1: 0.5%, B2: 0.6%, B3: 0.7%) factorization pattern 2 X 3 with 4 repetitions. The results of preliminary research on strawberry fruit raw materials contain vitamin C levels of 57.7mg / 100mg with an IC50 value of 40.80 ppm (strong). The results of the main study showed that the highest average value of each parameter was known that strawberry fruit juice popping boba had a vitamin C value of sample C of 21.27 mg/100g, with an IC50 value of 1300ppm (very weak) color attribute of sample C 2.8%, texture attribute of sample C 2.3%, shape attribute of sample C 2.3%, taste attribute of sample E of 1.9% and aroma attribute of sample B 2.3%. The results showed that the comparison of sodium alginate and calcium chloride concentrations affected color, texture, shape and taste but did not affect vitamin C and aroma levels.

Keywords: Strawberry fruit, Popping boba, Spherification, Sodium Alginate, Calcium Chloride.

Introduction

Strawberries are a source of natural antioxidants, as they contain flavonoids, vitamins, and glutathione (Jin, 2011). Antioxidants protect the body against free radicals, including preventing the development of cancer cells. Strawberries' antioxidant function is also supported by their high vitamin C content. Strawberries contain 7.6 g of carbohydrates, 1.7 g of fiber, 0.8 g of protein, 0.5 g of fat, 58.2 mg of vitamin C, 140 kJ of energy, and 100 kcal of water.

90.6 g. In addition to its high nutritional content, strawberries also contain ellagic acid, which is an anti-toxin, anti-free radical, anti-carcinogenic, and anti-mutagen (Palupi, 2017).

Popping Bobais a dish that adds to the dish in the form of a semi-solid gel ball filled with sweet liquid with various flavors. The etymology of Popping from the word 'pop' is the sound that comes out when popping boba breaks in the mouth, and boba because of its round shape (Deddy, 2018). In making popping boba the method used is spherification. Spherification is a molecular gastronomy technique that involves a gelatinization reaction between alginate and calcium chloride ions that bind to each other to form a thin

membrane structure that encapsulates the liquid filler. Unlike most edible gels that have a very solid structure, spherification forms a solid gel membrane with a core that is still in liquid form inside (Lee, Rogers, 2013). Based on the manufacturing method, spherification is divided into two methods, namely basic spherification and reverse spherification. In basic spherification, a sodium alginate solution is injected into a calcium salt solution. This is causing calcium ions to diffuse into sodium alginate droplets and produce a calcium alginate gel membrane. Sodium alginate and calcium chloride are very influential in the process of making boba popping, but the use of these two ingredients does not require too large a concentration because boba popping actually only requires a concentration of sodium alginate and calcium chloride at the critical limit (Selvi, 2018). The greater the concentration of sodium alginate & calcium chloride used, the harder the boba popping will be (Lee, Roger, 2013). This is because the high concentration of sodium alginate & calcium chloride from the critical limit will cause the diffusion between Ca²⁺ and Na⁺ ions to take place perfectly, the boba popping gel membrane which should be thin actually becomes dense.

Methods

The treatment design in this stage of the research consisted of two factors, namely alginate concentration and calcium chloride concentration, which consisted of 6 levels of the multiplier base used to calculate the weight of the concentration of sodium alginate, calcium chloride and sucrose, which was 500 mL of water

The experimental design used in this study was a Randomized Block Design (RBD) consisting of 2 factors with 6 levels and 4 replications, resulting in 24 experimental units. This randomized design was chosen because the experimental units used in this study were not uniform, so it was necessary to group the data to obtain the results of the experimental analysis. Then an analysis design can be created using the Analysis of Variance (ANOVA) method to obtain conclusions regarding the effect of treatment.

Result and Discussion

The samples tested in this study were second-grade strawberries obtained from the Antapani fruit world. The Iodimetric Titration method was used because this technique is quite easy and can be used to examine samples in large quantities. The principle of iodimetric titration is that the I₂ solution will quantitatively oxidize the reducing agent until the equivalence point is reached. Before titration, the I₂ solution is standardized with sodium thiosulfate solution to determine the normality obtained from the preparation of the iodine solution. Because the Sodium thiosulfate solution is not a primary standard solution, the Sodium thiosulfate solution must be standardized first with the primary standard solution KIO₃. When the ascorbic acid is completely reduced, the I₂ solution will react with the starch indicator until the color of the analyte solution changes to blue. The results of the vitamin C level test can be seen in **Table 1**.

Table 1. Vitamin C content of strawberries (fragaria anannasa L)

Component	Mark	Library
Vitamin C	57.2 (mg/100g)	58.8 (mg/100g)

Source: USDA (United States Department of Agriculture)

Based on the results of the analysis of the vitamin C content of strawberry raw materials, it is smaller when compared to the literature. According to Putu Era Sandi Kusuma (2016), storage temperature and storage time can affect the vitamin C preparation. In this study, before the strawberries were tested, the fruit was first conditioned in the freezer (4°C) for 5 days. The presence of storage factors can be the cause of reduced vitamin C content. Popping boba strawberry juice fruit has an average value lower than control strawberries. The results of the analysis of vitamin C content in samples of popping boba strawberry juice with a comparison of sodium alginate and calcium chloride concentrations can be seen in **Figure 1**.

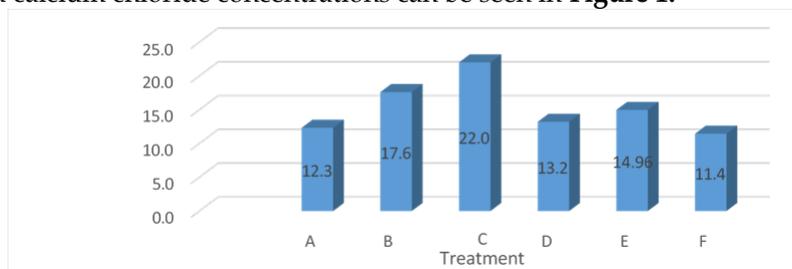


Figure 1. Vitamin C content in strawberry boba popping samples

In the further BNJ test, the results obtained showed that from 6 treatments, samples A (Sodium alginate 0.47%: calcium chloride 0.5%) and D (Sodium alginate 0.57%: calcium chloride 0.6%) were not different, samples E (Sodium alginate 0.47%: calcium chloride 0.7%) and F (Sodium alginate 0.57%: Calcium chloride 0.7%) were also not different, real differences were in samples B (sodium alginate 0.57%: calcium chloride 0.5%) and C. (Sodium alginate 0.47%: calcium chloride 0.6%).

The popping boba color pigment comes from the anthocyanin content of strawberries, strawberries have a red base pigment. The color change that occurs after the popping boba making process is due to the hydrophilic nature of anthocyanin which is easily soluble in water and other polar solvents, resulting in a color gradation of strawberries from red to pink due to soaking in solvent water.

The results table shows that of the 6 treatments, sample B (Sodium Alginate 0.57%: calcium chloride 0.5%) and C (Sodium Alginate 0.47%: calcium chloride 0.6%) were not significant, while significant differences were found in treatments A (Sodium Alginate 0.47%: calcium chloride 0.5%), D (Sodium Alginate 0.57%: calcium chloride 0.6%), E (Sodium Alginate 0.47%: calcium chloride 0.7%) F (Sodium Alginate 0.57%: calcium chloride 0.7%)

Based on the results of observations on chemical analysis and organoleptic analysis, it can be seen that the treatment with the best character and the relationship between the test results includes the highest average value of the vitamin C content parameter and the attributes of color, texture, shape, taste, and aroma. The matrix of the best character treatment and the relationship between the results of the chemical and organoleptic tests of strawberry juice popping boba with 6 treatments can be seen in **Table 2**.

Table 2. results of observation criteria and best treatment

Treatment	observation criteria					
	Chemical analysis	Organoleptic Analysis				
	Contents Vitamin C (mg/100g)	color	texture	Form	Flavor	Aroma
A	12.3	2.3	1.7	1.8	1.1	1.8
B	17.6	1.8	1.8	1.9	1.4	2.3
C	21.0	2.8	2.3	2.3	1.3	2.2
D	13.2	2.4	1.7	1.7	1.6	1.9
E	14.96	2.6	2.1	1.4	1.9	2
F	11.4	2.5	1.3	1.5	1.8	1.9

The table above shows that each of the six treatments has its own advantages with varying parameters. Sample C excels in vitamin C content, color, texture, and shape, while sample E excels in taste, and sample B excels in aroma. According to Selvi (2018), the main characteristics of popping boba are its round shape, breakable texture, and the presence of a liquid with a taste and aroma. Based on these parameters, the closest treatment is sample C.

Conclusion

The results of the parameter analysis in the iodimetry test produced the highest average value of vitamin C content, namely; sample C of 21.27 mg/100g, the two samples B of 17.6 mg/100g, the three samples E of 14.96 mg/100g, the four samples D of 13.2 mg/100g, the five samples A of 12.3 mg/100g and the six samples F of 11.4 mg/100g. Based on the results of the iodimetry test, the treatment with the best vitamin C characteristics was then further tested using the DPPH method. The test results showed that sample C as the treatment with the best vitamin C character had an IC50 value of 1300 ppm (very weak).

The samples with the best average color attribute values are; sample C at 2.8 second, sample E at 2.6, sample F at 2.5 third, sample D at 2.4 fourth, sample A at 2.3 fifth, and sample B at 1.8 sixth. The samples with the best average texture values are sample C at 2.3 second, sample E at 2.1 third, sample B at 1.8 fourth, sample D at 1.7 fifth, sample A at 1.7 sixth 1.3. The samples with the best average shape attribute values are sample C at 2.3 second, sample B at 1.9 third, sample A at 1.8 fourth sample D 1.7, the fifth sample F 1.5 and the sixth

sample E 1.4. The samples with the best average value of taste attributes are sample E at 1.9, the second sample F at 1.8, the third sample D at 1.6, the fourth sample B at 1.4, sample C at 1.3, and sample A at 1.1. The samples with the best average value of aroma attributes are; Sample B at 2.3, the second sample C at 2.2, the third sample E at 2.0, the fourth sample F at 1.9, the fifth sample D at 1.9, and the sixth sample A at 1.8. Based on the overall results of the chemical analysis and organoleptic analysis of this research, it can be concluded that the concentration of sodium alginate and the concentration of calcium chloride affect the color, texture, shape, taste, but do not affect the levels of vitamin C and aroma.

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