



The Effect of Sugar Solution Concentration on Characteristics of Candied Dried Tomatoes (*Solanum lycopersicum L.*)

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Abstract

Tomatoes are a type of food that has high production and is a perishable food. In addition, the utilization of processed tomatoes as a food source is still not optimal. So, it is necessary to do the right food processing on tomatoes, one of which is processed into dried candied. The purpose of this study was to determine the concentration of sugar solution, so as to produce dried candied with good characteristics. The research was conducted at the Chemistry Laboratory and Food Processing Laboratory, Faculty of Agriculture, Ma'soem University from May to July 2022. The method used is the old experimental method, namely the Randomized Block Design (RBD) consisting of 6 (six) treatments and each repeated 4 (four) times. The treatments given were concentration A (40%), B (45%), C (50%), D (55%), E (60%), F (65%). The analysis in this study included water content, total dissolved solids. Meanwhile, organoleptic testing was carried out on the color, aroma, taste, and hardness of the dried candied produced. The results showed that the concentration of sugar solution had a significant effect on water content, total dissolved solids, and organoleptic properties. Only partially significant influenced the organoleptic properties of the dried candied produced. The results of the study can be concluded that the concentration of 55% sugar solution produces good characteristics of candied dried tomatoes, this determination is based on the level of color preference of 3.97, aroma of 4.38 and taste of 4.48 from a maximum value of 5.00, moisture content of 9.04% and total dissolved solids content of 62.80%.

Keywords: Tomatoes, Candied Characteristics, Sugar Solution, Total Dissolved Solids

1. Introduction

Tomato (*Solanum lycopersicum L.*) is a crop that bears fruit throughout the year. Tomatoes are a commodity that is widely consumed by the community as well as ingredients, juice, and sauce. Tomatoes are a commodity that is needed by the community every day. However, these tomatoes deteriorate quickly and rot. Tomatoes can deterioration due to physical, chemical, and microbiological damage during transportation and storage. Tomato production in West Java is quite high compared to other regions (Quinet et al., 2019). Tomato production in 2019 reached 284.948 tons and in 2021 increased to 292.309 tons (BPS-Statistics Indonesia, 2022). As a foodstuff, the nutritional content of tomatoes for natural medicine therapy, has properties to prevent and treat appendicitis, help heal wounds, treat acne, prevent the formation of gallstones in the urinary tract, maintain body stamina, and treat diseases caused by vitamin C deficiency.

Minimizing unutilized and wasted tomato, it is necessary to diversify processed tomatoes. One of them is processed into dried candied. Dried candied are one form of processed food that is much liked, simple processing, but has good market potential (Umesh Hebbar, 2008). Candied fruits that are soaked in a sugar solution for some time. Preserving fruits with sugar soaking has been practiced for a long time. By soaking with a sugar solution above 50, the activity of microorganisms will be inhibited, especially spoilage microorganisms. The sugar content in fruit increases and the water content decreases, which inhibits activity (Bau et al., 1997; Buntaran et al., 2011).

2. Materials and Methods

2.1. Materials

The materials used in this study were sugar, water, lime betel, and tomatoes obtained from the Rancaekek traditional market (Dangdeur). The equipment used in this research are stove, pan, oven, knife, cutting board, tray,

analytical balance, basin, spoon, sieve, ladle, handrefractometer, plastic, measuring cup, baking paper, aluminum cup, dropper pipette, stationery, and label paper.

2.2. Methods

The method used in this research is Randomized Block Design (RBD), each treatment is repeated four times. The treatments that tried consisted of:

The concentration of sugar solution:

- K1 = 40%
- K2 = 45%
- K3 = 50%
- K4 = 55%
- K5 = 60%
- K6 = 65%

The linear model of the experimental design is:

$$X_{ij} = U + t_i + r_j + E_{ij}$$

Description:

- X_{ij} = the measured response
- U = a general average
- t_i = the effect of 'i' solution concentration
- r_j = the effect of the 'j' replication
- E_{ij} = the effect of random factors associated with the 'i' and 'j' replicate treatments

Table 1: table of variance

Source of Variety	DB	JK	KT	F count	F table
Repeat	r-1 =3	$\sum X_{.j}^2/6 - X_{...}^2/24$	JK U/t	KT U / KT G	
Treatment	t-1 =5	$\sum X_{.i}^2/4 - X_{...}^2/24$	JK P/r	KT P / KT G	
Error	15	JK T - JK U - JK P	JK G/15		
Total	23	$\sum X_{ij}^2 - FK$			

If there are differences between treatments, then testing between treatments tests were carried out with the Duncan (Duncan multiple range test) at a level of real level of 5%. The formula used is as follows:

$$S_x = \sqrt{KT \text{ galat} / r}$$

$$LSR = SSR \times S_x$$

2.2.1. Criteria of Observation

To determine the effect of solution concentration on the characteristics of candied produced, then in this study observations were made on chemical properties and organoleptic properties. Chemical analysis included water content and total dissolved solids. Organoleptic testing includes color, aroma, taste, and hardness using 15 panelists.

2.2.2. Preliminary Research

Preliminary research is basic research that aims to determine or establish treatment factors in the major research. The preliminary research that was attempted was to determine the concentration of the solution to be used. The concentrations of sugar solution tried were 20%, 25%, 30%, 35%, 40%, 45%, 50%, 55%, 60%, 65%, 70%, 75%, and 80%. Then observations were made organoleptic properties of jam, namely color, aroma, taste, and texture of hardness. The results of preliminary research at concentrations of 20%, 25%, 30%, and 35% produced candied that were too mushy.

2.2.3. Major Research

In the major research, the raw material of tomato was determined by adding a solution of sugar solution with concentrations of 40%, 45%, 50%, 55%, 60%, and 65%.

2.2.4. Research Procedure

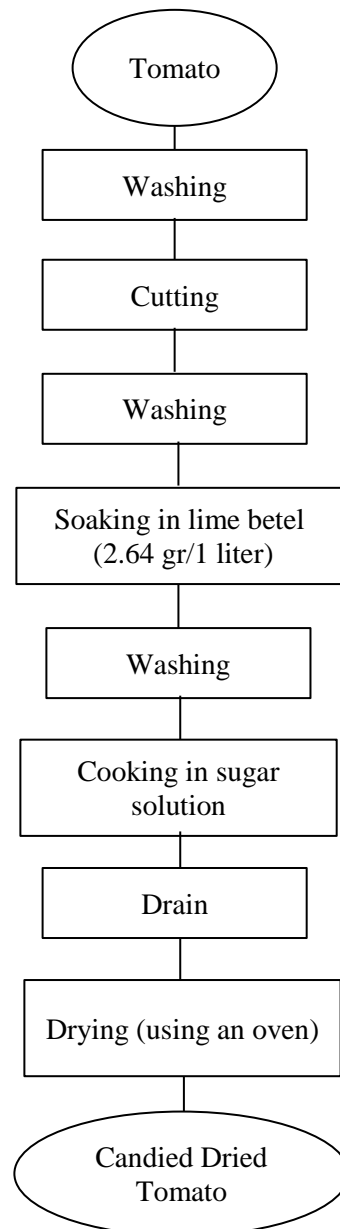


Figure 1: Research procedure

2.2.5. Organoleptic Observation

The organoleptic test was conducted by 15 panelists. A hedonic scale was created five levels of assessment, starting from 5 (very like), 4 (like), 3 (ordinary), 2 (dislike), 1 (strongly dislike). The organoleptic assessment was conducted on the color, taste, texture, and aroma of the candied.

3. Results and Discussion

3.1. Water Content

Table 2: The Effect of Sugar Solution Concentration on the Water Content of Candied Dried Tomatoes (%bk)

Treatment	Average Value	Notation
A = 40%	16.08	f
B = 45%	11.17	e
C = 50%	9.55	d
D = 55%	9.04	c
E = 60%	6.03	b
F = 65%	4.47	a

As the concentration of sugar solution increases, the water content decreases. The highest water content was produced by the 40% sugar solution concentration and was significantly different from 45%, 50%, 55%, 60%, and 65%. Each concentration of sugar solution is significantly different from the water content produced. The water content produced has met the SNI quality standard for dried candied. The concentration of sugar solution can cause a decrease in A_w (water activity), which can inhibit the growth of microorganisms, especially bacteria this is due to the hygroscopic nature of sugar which can attract water from foodstuffs. When sugar is added to food at high concentrations (at least 40% soluble solids), some of the water bound by the sugar becomes unavailable for the growth of microorganisms and the water activity (a_w) of the food is reduced (Troller, 2012). The relationship between water content and water activity (a_w) is shown by the tendency of that the higher the water content, the higher the a_w value. The water content is expressed in percent (%) on a scale range of 0-100, while the a_w value is expressed in decimal numbers on a scale range of 0-1.00 (Pomeranz, 2013).

3.2. Level of Total Dissolved Solids

Table 3: The Effect of Sugar Solution Concentration on Total Dissolved Solids Content of Candied Dried Tomatoes (%bk)

Treatment	Average Value	Notation
A = 40%	59.50	a
B = 45%	61.33	b
C = 50%	62.33	c
D = 55%	62.80	d
E = 60%	63.53	e
F = 65%	64.05	f

The highest total dissolved solids were obtained at 65% sugar solution concentration, significantly different from 60%, 55%, 50%, 45% and 40%. The highest total dissolved solids were obtained at 65% sugar solution concentration, significantly different from 60%, 55%, 50%, 45% and 40%. Each concentration of sugar solution is significantly different from the total solids of the resulting solution. Based on the SNI standard quality requirements for dried candied, total dissolved solids produced have met the minimum limit that must be 40% (SNI, 1998). Total dissolved solids indicate the content of ingredients dissolved in solution. The components contained in fruit consist of water-dissolved components, such as glucose, fructose, sucrose, and water-dissolved proteins (pectin). According to Rakhmawati & Gz, (2022) cited by Simpson (2012).

3.3. Level of Color Preference

Table 4. The Effect of Sugar Solution Concentration on Color Preference Level of Candied Dried Tomatoes (%bk)

Treatment	Average Value	Notation
A = 40%	3.68	a
B = 45%	3.75	a
C = 50%	3.82	a
D = 55%	3.97	a
E = 60%	3.90	a
F = 65%	3.90	a

Table 4, the results of the analysis show that the treatment of sugar solution concentration was not significantly different from the color of the candied dried tomatoes produced. This result based on Duncan's multiple range test which showed that the panelists level of preference for color was not significantly different.

3.4. Aroma Level of Favorability

Table 5: The Effect of Sugar Solution Concentration on Aroma Level of Candied Dried Tomatoes (%bk)

Treatment	Average Value	Notation
A = 40%	3.58	a
B = 45%	3.78	a
C = 50%	3.72	a
D = 55%	4.38	b
E = 60%	4.39	b
F = 65%	4.53	c

The sugar solution concentrations of 40%, 45% and 50% were not significantly different respectively, but significantly different from 55%, 60%, and 65% sugar solution concentrations on the aroma of candied dried tomatoes. While the concentration of 55% and 60% sugar solution respectively not significantly different, but significantly different from the concentration of sugar solution 65%. The higher concentration of sugar solution, the more favorable the aroma of candied dried tomatoes.

3.5. Level of Taste

Table 6: The Effect of Sugar Solution Concentration on Taste Level of Candied Dried Tomatoes (%bk)

Treatment	Average Value	Notation
A = 40%	3.55	a
B = 45%	3.57	a
C = 50%	4.22	b
D = 55%	4.48	b
E = 60%	3.88	a
F = 65%	3.63	a

The sugar solution concentrations of 40%, 45%, 60% and 65% were not significantly different from each other, while when compared to the sugar solution concentrations of 50% and 55%, they were significantly different. The highest level of flavor preference was obtained at a sugar solution concentration of 50% and 55% with values of 4.22 and 4.48 respectively from a maximum value of 5.00. It could be that the panelists liked the taste of candied dried tomatoes at 50% and 55% sugar solution concentrations at the optimal level of taste, not too sweet. The flavor of food ingredients (fruits) is greatly influenced by the nutrients they contain, especially the ratio between sugar and acid.

3.6. Level of Texture Hardness

Table 6: The effect of Sugar Solution Concentration on the Level of Hardness of Candied Dried Tomatoes (%bk)

Treatment	Average Value	Notation
A = 40%	3.37	a
B = 45%	3.53	a
C = 50%	3.72	a
D = 55%	3.78	a
E = 60%	3.98	a
F = 65%	3.72	a

The sugar solution concentrations of 40%, 45% and 50% were not significantly different from each other, but significantly different from sugar solution concentrations of 55%, 60% and 65% in terms of aroma of candied dried tomatoes. While the concentration of 55% and 60% sugar solution respectively not significantly different, but significantly different from the concentration of sugar solution 65%. The higher concentration of sugar solution, the more favorable the aroma of candied dried tomatoes.

4. Conclusion

From the results of the research and discussion, it can be concluded that the concentration of sugar solution has a significant effect on water content, total dissolved solids, flavor, and aroma. And no significant effect on color and

hardness. Based on testing the best results obtained at a concentration of 55% for color and taste, 60% for aroma and hardness. The lowest water content was obtained at 40% concentration and continued to decrease as the concentration of sugar solution used increased. The highest total dissolved solids were obtained at concentration of 65%, the total soluble solids obtained are directly proportional to the concentration of sugar solution used.

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