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Effect of various sugar solution concentrations on characteristics of dried candy tomato (*Lycopersicum esculentum*)

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Abstract. *Buntaran W, Astirin PA, Mahajoeno M. 2009. Effect of various sugar solution concentrations on characteristics of dried candy tomato* (Lycopersicum esculentum). *Nusantara Bioscience 2: 55-61.* The aims of the research were to study the effects of sugar syrup concentration on dried candy tomato characteristics and to determine the proper sugar solution concentration that gives the best characteristics of dry candy tomatoes. The research used Randomized Block Design Method with four treatments and six times repetitions. The treatment that be used was immersing the tomato in sugar solution, with concentration of A (40%), B (50%), C (60%), and D (70%) group in 18 hours. The variables measured were water content, ash, vitamin C and organoleptic tests include flavor, color, flavor and texture test. Data were analyzed using ANOVA test (Analysis of Variance) followed by DMRT (Duncan Multiple Range Test). The result showed that sugar solution concentration had different effect on water content, ash content, vitamin C content, texture, and organoleptic test for color, taste, and flavor of the dry candy tomato. The best characteristics of dry tomato candy was obtained on A (40%) group, with water content of 24.20%, ash content of 0.62%, and vitamin C content of 31.15 mg/100 g. Standard quality of water content for dry fruit candy was maximal 25% (SII No.0718-2003) and maximally allowed ash content for food materials was 1.0% (SII 0272.90). Vitamin C content was not much decreased compared with ripe tomato, i.e. 30-40 mg/100. Organoleptic tets result indicated that A (40%) group get the highest score, i.e. 3,98 for taste, 3,89 for flavor, and 3,98 for color.

Keywords: sugar, candy/candied, tomato, *Lycopersicum esculentum*.

Abstrak. *Buntaran W, Astirin PA, Mahajoeno M. 2009. Pengaruh konsentrasi larutan gula terhadap karakteristik manisan kering tomat* (Lycopersicum esculentum). *Nusantara Bioscience 2: 55-61*. Tujuan penelitian ini untuk mempelajari pengaruh perendaman dalam larutan gula terhadap karakteristik manisan tomat kering dan untuk menetapkan konsentrasi larutan gula yang tepat sehingga dihasilkan manisan tomat kering dengan karakteristik yang baik. Rancangan percobaan yang digunakan adalah Rancangan Acak Kelompok (RAK) yang terdiri dari empat perlakuan dengan enam kali ulangan. Perlakuan yang digunakan adalah konsentrasi larutan gula dimana untuk kelompok A (40%), B (50%), C (60%) dan D (70%), selama 18 jam. Variabel yang diamati adalah kandungan air, abu, vitamin C dan uji organoleptik meliputi rasa, warna, aroma serta uji tekstur. Data dianalisis menggunakan Anova (Analisis of Variance) dilanjutkan dengan uji DMRT (Duncan Multiple Range Test). Hasil penelitian menunjukkan bahwa konsentrasi larutan gula berpengaruh terhadap kandungan air, kandungan abu, kandungan vitamin C, tekstur serta warna, rasa dan aroma manisan. Manisan tomat kering kelompok A (40%) relatif lebih baik dengan kandungan air 24,20%, kandungan abu 0,62% dan vitamin C 31,15 mg/100 g. Syarat mutu kandungan manisan kering buah-buahan maximal 25% (SII No.0718-2003), kandungan abu bahan makanan maximal 1,0% (SII 0272.90) dan dan kandungan vitamin C tidak banyak berkurang dimana pada tomat adalah 30-40 mg/100 g. Hasil uji organoleptik menunjukkan bahwa kelompok A (40%) mendapat nilai tertinggi terhadap rasa (3,98), aroma (3,89) dan warna (3,98).

Kata kunci: larutan gula, manisan, tomat, *Lycopersicum esculentum*.

INTRODUCTION

Fruits and vegetables are agricultural products that function as efficient public nutrition support and the source of income for farmers when cultivated intensively. Fruits and vegetables are rich in nutrients, namely vitamins and minerals that are needed by the human body because it can launch a regulator of metabolism as well as substances required by the human body such as tomatoes, because of tomatoes including the group of fruits and vegetables.

Tomato (*Lycopersicum esculentum* Mill.) Many people love it because it feels good, fresh and slightly acid. In addition, tomatoes contain vitamins and minerals that are useful for the health of the body. Vitamins are contained in tomatoes are vitamin A, vitamin B and vitamin C (Rismunandar 1984). In Indonesia, there are many tomatoes in the markets, and the price is relatively cheap at the time of harvest. The production centers of tomatoes as vegetables are generally located in cool climates, such as in West Java are in Ciwidey, Pangalengan, Cipanas, and Garut, in there in Wonosobo, Central Java, in Sumatra there are at Berastagi, Bukittinggi and in eastern Indonesia there Lombok and others.

Tomato's production in Indonesia is still low compared with other countries, that is only 6.3 tons/ha, while Taiwan, Saudi Arabia, and India respectively 21 tons/ha, 13.4

tons/ha and 9.5 tonnes/ha (Kartapradja and Djuariah 1992). In 1998-2002, Indonesia's tomato plantation productivity increased from 7.1 tons/ha to 8.0 tons/ha, with total production increased from 333,729 tons to 396,208 tons or about 0.5% of the world tomato crop (Adiyoga 2004). The low production of tomatoes in Indonesia is probably due to unsuitable varieties planted, technical culture which is not good or eradication of pests/diseases that are less efficient (Wijayani and Widodo 2005).

Fruits and vegetables generally do not survive in long storage, as well as with tomatoes that are vulnerable to damage, other problems that often arise is the tomato fungal growth on the surface of tomatoes. People need to make tomatoes more durable. Making candied tomato is one of the alternative processing of tomatoes and the preservation methods that are easy, no need to use high technology and can use a simple facility (Apandi 1994). Fresh tomatoes have resistance of 3-4 days, whereas with made candied the endurance is longer about 3 weeks. This is because the sugar solution can reduce the oxidation process so that it will prevent the relationship between fruit with external oxygen where oxygen is required for necessities of life harmful microbes, other ways sugar can inhibit the growth of plasmolysis of microbial cells with a lower water content is minimized so that the availability of water for the activity of microbial life there.

Candied is one type of snacks that normally use sugar as a sweetener. To obtain a fairly stable level of hardness, it is soaking in a solution of calcium chloride (CaCl2) thus obtained candied tomatoes are not easily damaged, the color is attractive and meets the quality requirements specified (Ekani 1995). Making candy is done by wet and dry way, wet candied are products made from fresh ingredients and soaked in sugar solution whereas the candied dried products made from fresh ingredients, soaked in a solution of sugar or sugar sprinkled thinly over and over again and then dried (SII 0718-83).

The utilization of tomatoes made sweets, in addition, to be more durable, tomatoes can also add value to confectionery manufacturers themselves, for consumers, of course, eat candied dried tomatoes would be more attractive because it is more practical to live to eat that will ultimately benefit the health of consumers themselves. Today in Indonesia candied tomato processing has not been produced on a large scale, however, with increasingly conscious of health by consuming fruits, particularly tomatoes, the needs of consumers of confectionery continue to rise. In 2010, it is estimated 40% of Indonesia's population will consume processed from fruits including candied, because the Indonesian people are generally fond of foods that are practical and instant (Sutrisno 2007). Candied tomatoes are also required to be exported because there are some overseas countries like sweets, such as Japan, Korea, and several Middle Eastern countries so they can bring in foreign exchange earnings and profits for the state amid the world economic situation is not stabilized. According to Directorate General of Processing and Marketing of Agricultural Products, Department of Agriculture (2007), candied fruit exports in 2006 amounted to 1024.77 tons, of which 50% were candied mango and barking, the rest is the nutmeg, tomatoes and others who predicted every year would increase.

Looking at the economic prospects of candied dried tomatoes, it needs to be done research on making it, because consumers' demand will increase every year to these confectionery products. Candied dried tomatoes sold in traditional markets and supermarket is generally made without beans, but it is not intact forms of sweets. Candied dried tomatoes carefully made in full one fruit and without seeded tomatoes. Candied dried tomatoes enveloped by contained vitamin C and other substances, i.e., lycopene and β-carotene are very beneficial to health. That's what separates candied dried tomato products we make and our perusal.

This study aims to: (i) Determine the influence of sugar solution on the characteristics of candied dried tomatoes. (ii) specify the concentration of sugar solution appropriate to produce candied dried tomatoes with good characteristics.

MATERIALS AND METHODS

Time and place of study

The research was conducted in August-December 2008, at the Quality Testing Laboratory, Center for Development, Empowerment and Education Education Personnel (P4TK) Agriculture, Cianjur, West Java.

Raw tomatoes

The tomatoes used to make candied tomatoes 1 kg so that each test for each treatment takes 6 kg, where the materials were purchased from markets around Cipanas, Cianjur District, West Java. The tomatoes used were local varieties because it is usually a lot on the market and the price is relatively cheap. The sampling technique selected ripe tomatoes where a minimum of 80% red color, uniform size, are still fresh and clean (free from dirt, twigs, soil, dust, etc.), then weighed for each treatment.

Research design

The experimental design using randomized block design (RAK) consists of four treatments and six replications: (i) Group A, soaking in sugar solution concentration of 40%. (Ii) Group B, soaking in sugar solution concentration of 50%. (Iii) Group C, soaking in sugar solution concentration of 60%. (Iv) Group D, soaking in sugar solution concentration of 70%. All the above treatments were given as much as 0.2% $CaCl_2$ as preservatives which can absorb the remaining water.

Procedures

Making candied dried tomatoes. Making candied fruits begins by choosing a ripe and fresh tomato, and then wash it to clean the dirt that is still attached, then boiled at a temperature of 70-80^{o}C for 5 minutes, followed by stripping the skin. After that, the material is soaked in a solution of calcium chloride 0.2% for 1-2 hours, followed by washing to rinse the residual calcium chloride solution is still attached to the outside of tomato fruit. Further

material soaked in sugar solution, 40%, 50%, 60%, and 70% for 18 hours, followed by draining to reduce water attached to the candied tomatoes, then dried at 60 º C, to obtain the moisture content of certain (± 25%) as a condition of candied dried tomatoes.

Determination of water content (SNI 01-2891-1992). 1-2 g samples were inserted in the cup that has been known weight, then dried in an oven temperature of 105 ˚ C for 3 hours, and cooled in exicator for 15-30 minutes, then the cup and its contents were weighed and dried again for 1 hour, and chill in exicator, weigh again. This process is repeated until a constant weight obtained. Water content was calculated using the formula:

$$\text{Water content: } \frac{W1-W2}{W0} \times 100\%$$

Cup + W1 = Weight of sample before being dried
Cup + W2 = Weight of sample after drying
W0 = sample weight

Determination of ash content (SNI 01-2891-1992). 1-2 g samples were inserted in the cup that has been known to weigh, and then burnt in the flame until it becomes charcoal, and burned again in Pengabuan furnace at 550 ˚ C to ashes, then cool in exicator for 15-30 minutes and weighed cup and ashes. Ash content was calculated using the formula:

$$\text{Ash content: } \frac{W2-W1}{W0} \times 100\%$$

W0 = Weight of sample
W1 = Weight empty cup
W2 = Weight + ash cup

Determination of vitamin C (SNI 01-2891-1992). 10-25 g samples were crushed and included in the 250 mL measuring flask, then added distilled into water, then shaken until homogeneous and filtered, then put into a tube of filtrate of 25 mL, included in Erlenmeyer, added 1-2 mL of starch 1%, then titrated with 0.01 N iodine solution to obtain blue color. Change is not lost for 10 seconds, where 1 mL titer 0.01 N iodine is equivalent to 0.88 mg of ascorbic acid. Vitamin C content was calculated using the formula:

$$\text{Vitamin C content: } \frac{\text{mL iodine titer} \times N \times 0.88 \times Fp \times 100}{\text{Sample weight}}$$

Fp = dilution factor

Determination of texture with a Penetrometer (Model PNR 10). The test sample in the form of candied tomato fruit for each replication. The penetrometer is set ignited and the sample on the basis of the tools, just below the needle gauge the level of hardness. Gauge needle attached to the right must be ensured on the surface of the sample, then the start button is turned to start the measurement, automatically within 5 seconds the needle will measure the hardness or texture sample. The texture of the sample can be read on the scale with units of mm (needle prick them), so the texture (hardness and elasticity) material is expressed in (mm/50 g/5 sec) (Dixon and Parekh 1980).

Organoleptic test (hedonic methods). Organoleptic test is conducted to determine the level of preference or acceptance of product's panelists for candied dried tomatoes. This test is performed towards color, flavor, and aroma. Panelists consisted of 15 persons; the criteria that are measured the level of preference is as listed in Table 1.

Data analysis

From the results of chemical analysis of the quantitative data obtained from each treatment. The data in the form of quantities of water content, ash content and content of vitamin C. The organoleptic test panelists found the amount of data is a preference level of taste, color, and aroma, the texture test results by using data obtained well penetrometer magnitude of the level of hardness and tenderness. Next, the data were analyzed using ANOVA (Analysis of Variance), followed by a DMRT (Duncan Multiple Range Test) to determine the real differences among the treatments.

RESULTS AND DISCUSSION

The results influence the concentration of sugar solution to some of the characteristics of candied dried tomatoes, where the parameters of observation consists of chemical analysis (water content, ash, vitamin C) and texture (the level of hardness and tenderness materials) and organoleptic test the level of liking for flavor, color, and aroma. Statistical analysis showed that each of attempted different treatment effects on water content, ash, vitamin C, and the texture and the organoleptic (color, flavor, and aroma) (Table 2).

Chemical constituent

Water content

Chemical test results of water content followed by ANOVA statistical test for each treatment with six replicates among treatments showed no effect on the characteristics of candied dried tomatoes (Table 2). The highest water content in dried candied tomatoes at 24.20% was obtained in treatment A (soaking in sugar solution concentration 40%) and lowest 20.82% was obtained on treatment D (immersion in sugar solution concentration 70%). Water content showed significant differences among the treatments, treatment A with 24.20% moisture content was significantly different from treatment B and treatment C 23.25%, 21.36% and 20.82% D treatment.

There is a tendency that increasing concentration of sugar results in decreasing water content (Table 2), it is because tomatoes are soaked in sugar solution will experience osmotic pressure is the pressure of sugar molecules on the cell wall (extra cell) fruit until the sugar solution enter into it, as a result of water within the cells of fruit out. The difference of water flow out and flow of incoming sugar will cause the cell structure and texture of

the fruit become hard, because of the higher flow of sugar into the osmotic pressure and consequently the stronger the water will more and more that comes out of the material (Apriyantono 2000).

Water content in food ingredients affects the durability of food against the microbial attack. The higher the water content, the more likely the food is easily damaged, where microorganisms can utilize the high water content, especially mold to grow and multiply to endanger the health of the body due to poisoning (Fellows and Hampton 1992; Astaman 2007;). Drying of food can lead to impaired growth of microorganisms decay (Kolawole et al. 2009).

In addition, water content in food or food ingredient may affect the texture, taste, freshness, durability of materials and consumer acceptance (Winarno 1981). In determining the standard of food that is used, water content is one of the criteria that usually determines the maximum and minimum limits for water content of food or processed food.

Determination of water content needs to be done to determine the condition of food or food ingredient that compared with standard conditions, for example in terms of quality dried candied fruits (SII 0525-2008), the maximum water content of 25% and was the result of research on the manufacture of candied dried tomatoes from all treatment showed meets the standards for being in the range of less than 25% after going through the process of drying for 24 hours at 60°C.

Ash content

Chemical Test Results ash content, followed by Anova statistical test for each treatment with six repeated experiments showed no effect among the treatments on the characteristics of candied dried tomatoes (Table 2). The highest ash content on dry candied tomatoes at 0.80% was obtained at D treatment (soaking in sugar solution concentration 70%) and the lowest 0.62% obtained in treatment A (soaking in sugar solution concentration 40%). Ash content showed significant differences among treatments, treatment A with 0.62% ash content was significantly different from treatment B and treatment C 0.70% 0.75% and 0.80% D treatment. Ash is combustion of organic substances. Ash content is related to the minerals, including Mg, Na, Ca and phosphorus (Sudarmadji et al. 1996).

The existence of ash content comes from the tomato itself, where according to Cahyono (1996), ash content in tomato reached 32.05 mg/100 g. While real differences of various treatments more likely are caused by ash content of sugar which contains 92 mg/100 g ash (Brautlecht 1953), so it can be assumed that the higher concentration of sugar solution used, the higher ash content will be (Table 2) and on the contrary the lower the concentration of sugar solution used the lower the ash content contained in these candied dried tomatoes.

Chemical test results showed that ash content in dry candied tomatoes from all treatments are still relatively safe or meets standards based on the SII 0272.90 permitted where the ash content of food permitted for a maximum of 1.0%. Ash is the remnant of food that are not needed by the body because the ash is a waste, even need to watch out because the high ash content in food or food ingredient can cause damage to the intestine (Riyada 2007).

Table 1. Parameters/criteria for testing the level of preference (Hedonic Method 2000)

Favorite level	Parameters/criteria		
	Color	Flavor	Aroma
1= Not like	Red charred	Less sweet, typical tomato missing	The smell of charred
2= Somewhat like	Dark red/brown	Sweet, typical tomato missing	The smell of sugar is still strong
3= Regular	Red fade	Sweet, typical weak tomato	Tomato aroma less
4= Like	90% red tomato	Sweet, typical of pristine tomato	Moderate tomato aroma, the smell of sugar less
5 = Very like	Red tomatoes (original)	Sweet, typical of pristine tomato	Strong tomato aroma, the scent of sugar or less

Table 2. Water content of dried candied tomatoes

Treatment of sugar conc. (%)	Chemical constituent			Organoleptic			Texture (mm/50 g/5 sec)
	Water (%)	Ash (%)	Vitamin C (%)	Flavor	Color	Aroma	
A: 40	24.20±0.01472 ^{d}	0.62±0.01633 ^{a}	31.15±0.16293 ^{d}	3.98±0.14729 ^{d}	3.98±0.12139 ^{c}	3.89±0.06812 ^{c}	4.03±0.09459 ^{d}
B: 50	23.25±0.01871 ^{c}	0.70±0.01472 ^{b}	30.17±0.20047 ^{c}	3.55±0.10488 ^{c}	3.85±0.07941 ^{b}	3.79±0.07118 ^{c}	3.81±0.06314 ^{c}
C: 60	21.36±0.01871 ^{b}	0.75±0.01472 ^{c}	28.86±0.10741 ^{b}	3.18±0.07528 ^{b}	3.75±0.04215 ^{a}	3.62±0.08894 ^{b}	2.98±0.06250 ^{b}
D: 70	20.82±0.02160 ^{a}	0.80±0.01472 ^{d}	27.62±0.08116 ^{a}	2.93±0.08165 ^{a}	3.73±0.04401 ^{a}	3.38±0.10073 ^{a}	2.68±0.07414 ^{a}

Note: different letters in the same column indicate significant differences ($P \leq 0.05$); numbers above are the mean ± SD.

Vitamin C content

Chemical test results in vitamin C, followed by Anova statistical test for each treatment with six repeated experiments showed no effect among the treatments on the characteristics of candied dried tomatoes (Table 2).

Vitamin C is classified as soluble in water. Vitamin C can be shaped as L-ascorbic acid and L-dehydroascorbic acid; both have activity as vitamin C (Winarno 1997). Ascorbic acid is easily oxidized in a reversible become L-dehydroascorbic acid. Dehydroascorbic acid is chemically very unstable and can undergo further change to acid L-diketogluconate who do not have a more active vitamin C (Miller 1992).

Levels of vitamin C that was determined using the iodometric iodine (I2) as titer vitamin C in the example is a strong reductant will be oxidized by I2 in an atmosphere of acid and iodide ion reduces to I2. The indicator used is the kanji with a blue endpoint and not lost for 10 seconds and then calculated how many mL titration of I2 is used as the basis for calculating vitamin C (Slowinski and Wolsey 2008).

The highest vitamin C content in dried candied tomatoes amounted to 31.15 mg/100 g of material obtained in treatment A (soaking in sugar solution concentration 40%) and the lowest was 27.62 mg/100 g of material obtained in treatment D (immersion in sugar solution concentration 70%). Vitamin C content among the treatments showed significant differences, treatment A with the content of vitamin C 31.15 mg/100gram significantly different materials with treatment B 30.11 mg/100 g and 28.86 mg/100 g treatment C and treatment materials D 27.62 mg/100 g of material. The higher concentration of sugar solution is attempted, the lower its vitamin C content (Table 2). The loss of vitamin C is believed due to a change in the structure of fruit tissue, where the higher the sugar solution is added then lead to more water molecules to move (diffuse) out of the material and water to dissolve the vitamin C, vitamin C and ultimately reduced materials (Hui et al. 2006).

The content of vitamin C and other vitamins in food or food ingredients, including dried tomatoes in the candied, are very much needed by the body, because the vitamin serves as regulator and protector of the body from disease and can launch your metabolism.

Organoleptic

Flavor

The organoleptic test the panelists to think that continued with Anova statistical test for each treatment with six replicates an effect among the treatments on the characteristics of candied dried tomatoes (Table 2). Organoleptic test of the flavor is intended to determine the extent of consumer acceptance of a food product. This taste test conducted by a number of panelists (15 people trained panelists) in which each panelist gives value to the candied dried tomato flavor, the total value of flavor from the panelists will determine the quality or acceptance of products tested.

The highest values organoleptic test results to the taste of candied dried tomatoes for 3.98 obtained in treatment A (soaking in sugar solution concentration 40%) and the lowest 2.93 obtained in treatment D (immersion in sugar solution concentration 70%). Value taste test showed significant differences among treatments, treatment A with a value of 3.98 was significantly different from treatment B and treatment C value of 3.55 and treatment D value of 3.18 with a value of 2.93.

Flavor including the important factor of a food product in addition to color and flavor, these flavors can be derived from properties of the materials used or when the processing is another ingredient that is added, so that the original sense can be reduced or increased depending on the compound supporters, such as the addition of sugar can provide a sweet taste in food products including confectionery tomato itself.

Candied dried tomatoes in treatment A (soaking sugar concentration 40%) are the most preferred product the panelists, this is possible because the beautiful or unique flavor of tomatoes still feels fresh and it's not too sweet, there is a tendency that the higher the concentration of the sugar tested, then beautiful tomato flavor is replaced by the less because of the sweetness of sugar, so that the panelists liked it less and gave a low value. To give a distinctive flavor can be added to synthetic or artificial flavors, although the results do not like the taste of the original.

Color

Organoleptic test results to the color of the panelists, followed by Anova statistical test for each treatment with six replications, not all treatments showed no significant effect on the characteristics of candied dried tomatoes (Table 2). Color is one determinant of quality of food products in addition to the nutritional value itself. The visual assessment of color usually comes first, because the color is a view that can attract consumers so that there are many terms of the color of love. In addition, color can be used as an indicator of freshness or maturity (Winarno 1997).

The highest values organoleptic test results of color in dry candied tomatoes at 3.98 obtained in treatment A (soaking in sugar solution concentration 40%) and the lowest 3.73 obtained in treatment D (immersion in sugar solution concentration 70%). Color test value among the treatments does not all show significant differences. Treatment A with a value of 3.98 was significantly different from treatment B value of 3.85 but treatment C and treatment D value of 3.75 with a value of 3.73 was not significantly different.

A treatment based on test results of the panelists' favorite level is the most color of the preferred candied dried tomatoes. Red color is thought the still beautiful because of immersion in a solution of sugar which is not too high so as not to damage the tomato flesh tissue in which the pigments or dyes contained therein. There is a tendency of higher concentrations of sugar, then red with dark red and even black due to the caramelization so unpopular with the panelists.

Aroma

The organoleptic test of the scent of the panelists, followed by Anova statistical test for each treatment with six replications, not all treatments showed no significant effect on the characteristics of candied dried tomatoes (Table 2). The highest values organoleptic test results against the candied dried tomato aroma of 3.89 obtained in treatment A (soaking in sugar solution concentration 40%) and the lowest 3.38 obtained in treatment D (immersion in sugar solution concentration 70%). Color test value among the treatments does not all show significant differences, treatment A with a value of 3.89 was not significantly different from treatment B value of 3.79 but treatment C and treatment D value of 3.62 with a value of 3.38 was significantly different.

Based on the appraisal of the panelists on the aroma and after anova was statistically tested treatment A and treatment B was not significantly different, this is possible because of differences in sugar concentration among the treatments are not so high, so the typical tomato aroma that is still felt in treatment A (soaking in a solution sugar concentration 40%) still the same typical tomato flavor in treatment B (soaking in sugar solution 50%).

The real difference between treatment B to C (soaking in sugar solution 60%) and treatment C to D (immersion in sugar solution 70%) this is due to the high concentration of sugar into the tomato tissue resulting in water molecules within cells more tomatoes out (diffuse) that allegedly participated soluble tomato aroma. Also the smell is a volatile compound, so that in conditions of immersion in the solution and drying of high sugar loss smells more and more possibilities.

Treatment A candied dried tomatoes (soaked in sugar concentration 40%) and treatment B (immersion in 50% sugar concentration), is candied dried tomato aroma most preferably where the panelists, it is believed that soaking in a low-sugar solution is not too damaging aroma tomato so beautiful aroma of fresh tomatoes still smells.

Texture material

Texture is a trait or a physical condition and morphology of agricultural products which includes the level of hardness, tenderness, flexibility, elasticity, roughness, and smoothness of materials. Texture has to do with maturity level of the material itself (the fruit), in which fruits are low or level of maturity of crude has a higher level of hardness compared with fruits that are ripe texture is more soft or mushy (Baedowi 1980). Texture in terms of the level of hardness and tenderness materials related to the amount of water content, where the number of high water content in a material of agricultural products will be more tender texture than the low water content (Winarno 1990).

Data analysis for the candied dried tomato texture consists of the level of hardness and tenderness of materials, measurements using a penetrometer PNR model 10 which is electrically automatic penetrometer with a level of accuracy 4 (four), decimals, measurements were taken six replications of each treatment, then treated with test ANOVA statistics so generated data (Table 2).

The highest value of the texture of the dried candied tomatoes at 4.03 which means the texture is more tender than the material or other candied dried tomatoes obtained in treatment A (soaking in sugar solution concentration 40%), and the lowest is 2.68, which means harder texture compared with the material or other candied dried tomatoes obtained in treatment D (immersion in sugar solution concentration 70%). Value of material texture test showed significant differences among treatments, treatment A with a value of 4.03 was significantly different from treatment B value of 3.81 as well as with treatment C and treatment value of 2.98 D with a value of 2.68 was significantly different.

According to Apandi (1994), that the network changes, especially in the cell wall and the progressive dissolution of pectin substances can occur because of the enzyme activity that causes changes in texture in fruits and vegetables. Texture with a lower value means the texture of material harder than the other sample and vice versa texture with a higher value means the texture is more tender than the other samples, this is caused due to a variety of treatments of soaking in sugar solution different.

With the drying of water in the evaporated material, but instead of sugar that is in suspended cells, presumably the higher the concentration of sugar solution is attempted, the more sugar molecules that enter and the more sugar is retained inside the cells of tomato fruit, causing the texture of harder, so does that happen in treatment A (soaking in sugar solution concentration 40%) produces a more tender texture than treatment B, C and D that produce harder texture. The existence of a solution of sugar in the material with the lowest sugar concentration of 40% dissolved solids will cause harder material (Purnomo 1995).

CONCLUSION

Soaking in a solution of sugar concentration of 40%, 50%, 60% and 70% affects on moisture content, ash content, vitamin C, the results of organoleptic test taste, flavor, color and texture (the level of hardness and tenderness materials). Immersion in 40% sugar solution produced candied dried tomatoes with the best characteristics. Taste sweet enough, the typical tomato flavor is still felt, the aroma is not lost and the color is not broken, where the sense of (3.98), aroma (3.89) and color (3.98).

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