Sensory Profile of Candied Tomatodates Using The Just About Right Method

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ABSTRACT

Candied tomato dates are processed candies made from tomatoes that are dried until they are shaped like dates. Sensory profiles are needed to obtain candied date tomatoes with the most optimal betel lime solution concentration treatment and blanching time based on penalty analysis methods (JAR and hedonic scales). This study used the just about right method combined with the hedonic scale (overall liking) in the treatment of candied date tomatoes with a concentration of betel lime solution (2%, 3% and 4% (b/b)) and blanching time (5 minutes, 10 minutes and 15 minutes). 17 sensory attributes have been tested through the assessment of the JAR scale and the hedonic scale (overall liking). The data obtained was then processed using XLSTAT 2024 software. Based on the results of the penalty analysis, it was shown that the most optimal candied date tomatoes were candied date tomatoes with a concentration treatment of 3% betel lime solution and a blanching time of 15 minutes where there were 14 insignificant test attributes or p-value≥0.05. Meanwhile, there are only 3 sensory attributes that need to be optimized or p-value<0.05, namely juicy texture (p-value = 0.002), sweet taste (p-value = <0.0001) and fruity taste (p-value = 0.017).

1. INTRODUCTION

1.1. Research Background

In Indonesia, consumer interest in sweets is very high. According to Riskesdas 2020, 40.1% of respondents consume sweets more than once a day, 47.8% consume them 1-6 times per week, and 12% consume them less than 3 times a month. Manisan, as a processed sweet food product from fruit with sugar as a sweetener and preservative, comes in the form of wet and dry manisan. Wet sweets are produced after draining the fruit from the sugar solution, while dry sweets are obtained from drying the wet sweets. The addition of sugar increases sugar content and decreases moisture content, inhibits the growth of pathogenic microbes, and extends shelf life [1].

Candied date tomatoes are now popular among various groups, from adults to children, and are usually consumed directly or as candy [2]. These sweets generally contain vitamin C which acts as a cofactor in various biochemical reactions [3]. Research showed that candied date tomatoes with blanching for 15 minutes obtained the best acceptance in appearance, texture, aroma, taste, and color attributes. Research reported that soaking in a 2% whiting solution for 12 hours produced candied tomatoes that were preferred by consumers in terms of color, texture, taste, and appearance [4].

Although the market for candied tomatoes is still limited, this product has potential as a typical souvenir. The development of candied tomatoes requires quality improvement in terms of taste, appearance, and marketing. Consumers generally want sweets with a slightly crunchy texture on the outside, soft on the inside, the right sweetness, and a sweet and fresh aroma typical of tomatoes. Sometimes, products do not meet consumer expectations due to sensory uncertainties [5].

To determine the optimal concentration of whiting solution and blanching duration, this study used the Just-About-Right sensory profiling method. This method is expected to assist producers in determining the sensory attributes of candied date tomatoes that most influence consumer acceptance and conduct further optimization. Sensory evaluation combines the Just-About-Right scale with a hedonic scale to attribute decreased consumer acceptance to attributes that are not at the ideal level [6]. This technique, which is popular in food product development, helps determine the optimal attribute intensity and

can be applied in the early stages of product development when resources are limited.

1.2. Literature Review

Manisan is a processed commodity that is preserved by giving high sugar content to provide sweetness while preventing the growth of microorganisms such as fungi. Microorganisms cause changes in color, texture, taste, and decay in these commodities. Candying not only uses sugar but also lime, salt and sulfur-containing ingredients. The purpose of giving these materials is the same as giving sugar, which means that the fruit will have a longer shelf life [7].

Tomatoes have good potential to be processed and developed in the form of dried sweets. This product has several advantages including longer shelf life, smaller volume and weight, making it easier to consume and saving space in packaging and transportation. Candied dried tomatoes are processed through preservation with sugar and drying. The quality and durability of candied dried tomatoes are strongly influenced by the accuracy of the ratio of the amount of sugar to tomatoes [8].

Sensory evaluation is a scientific method used to generate, measure, analyze and interpret the perceived response of a product through the human senses. Sensory evaluation can be divided into two categories, namely objective and subjective testing. Objective testing of product sensory attributes is evaluated by trained panellists, while subjective testing of product sensory attributes is measured by consumer panellists [9].

Penalty analysis combines Just About Right and hedonic testing to correlate decreased consumer acceptance with attributes that are not at the Just About Right level. The Just About Right scale is used to calculate the precision of the concentration of a specific attribute and determine the optimal level of a product [10]. The Just About Right scale provides information in the form of a description or explanation if the overall product comparison is lacking and Just About Right can work more optimally when combined with the hedonic method [11].

1.3. Research Objective

The purpose of this study was to determine the best formulation for making candied dates based on sensory evaluation using the penalty analysis method (JAR) and to determine the effect of sensory attributes on candied dates on consumers.

2. MATERIALS AND METHODS

2.1. Materials and Tools

The main ingredients used in making candied tomatoes are of course tomatoes obtained from the mangga dua market - in Surabaya City. Supporting materials used include sugar (sucrose) and lime water obtained from Krukah market - Surabaya City. The materials used in the sensory profile were candied date tomatoes of 9 different treatments and mineral water. Tools used in making candied date tomatoes include a stove, digital scale, pan, spoon, cabinet dryer, tray, spatula, and plate. The tools used in sensory evaluation are serving plates, label paper, stationery, and glasses.

2.2. Research Design and Implementation

The manufacture of candied date tomatoes in this study uses a formulation by combining the concentration of whiting solution (S) with the length of blanching (T), consisting of 9 treatment formulations: S1T1 (Concentration of 2% Betel Lime Solution (b/w) with 5 minutes blanching time), S1T2 (Concentration of 2% Betel Lime Solution (b/w) with 10 minutes blanching time), S1T3 (Concentration of 2% Betel Lime Solution (b/w) with 15 minutes blanching time), S2T1 (Concentration of 3% Betel Lime Solution (b/w) with 5 minutes blanching time), S2T2 (Concentration of 3% Betel Lime Solution (b/w) with 10 minutes blanching time), S2T3 (Concentration of 3% whiting solution (b/w) with 15 minutes blanching time), S3T1 (Concentration of 4% whiting solution (b/w) with 5 minutes blanching time), S3T2 (Concentration of 4% whiting solution (b/w) with 10 minutes blanching time), S3T3 (Concentration of 4% whiting solution (b/w) with 15 minutes blanching time).

2.2.1. Production of Candied TomatoDates

The production process of candied date tomatoes starts with sorting raw materials (I), then washing tomatoes to remove physical contaminants and removing tomato stalks (II), puncturing tomatoes to remove seeds (III), soaking tomatoes according to the concentration of lime solution for 12 hours (IV), washing tomatoes to remove residual sediment from the whiting solution (V), soaking in boiling water (blanching) for 5, 10, and 15 minutes (VI), heating the tomatoes with the addition of 25% (w/b) sugar concentration in a pan over medium heat until the water in the tomatoes comes out, thickens and caramelizes completely (VII), and finally drying the wet candied date tomatoes using a cabinet dryer for 16 hours at 60oC to produce dry candied date tomatoes (VIII).

2.2.2. Focus Group Discussion (FGD) Procedure

This research begins with determining the specific attributes that will be used in sensory evaluation because there are no attributes that can be a reference in the market. In determining the attributes of candied date tomatoes, the Focus Group Discussion (FGD) method was used. FGD activities were carried out using 10 analysts who aimed to discuss the intensity of the attributes available in consumer assessments. In addition, it can also be known and narrowed down the sensory attributes that need and do not need to be included in the sensory evaluation test questionnaire. The assessment in this FGD is to determine the intensity of the available attributes, where if no attribute is sensed then the intensity is considered 0 or none. On the other hand, if the panellist felt the attribute but it was not available, then the panellist could write it down and it would be discussed together in the discussion session.

2.2.3. Procedure for Sensory Profiles Using the JAR Method

The initial stage was carried out by screening panellists. Data filling was done with a Google form containing data in the form of name, gender, age, regional origin, and frequency of eating sweets. The selection of panellist criteria used is the age range of 18-24 years, all genders from various regions with the frequency of eating sweets sometimes too often. From the screening results, 100 consumer panellists were obtained.

Sensory testing was conducted with 100 untrained panellists who conducted two stages, namely just about right testing and hedonic testing (overall liking). Panelists will be asked to taste 9 samples with different treatments. Panellists were asked to rate the intensity of each sensory attribute resulting from the previous FGD consisting of 17 attributes namely red-brown, aspect (juicy, glossy, rough), aroma (candied, fruity, sweet, caramel), texture (stiff, soft, fibrous, hard, rough, juicy), taste (sweet, sour, fruity) presented on a 5-point scale consisting of "too low", "rather low", "just about right", "quite high", and "too high". Panellists were also asked to rate the liking of each sensory attribute (overall liking) on a 5-point scale consisting of "strongly dislike", "dislike", "fair/neutral", "like" and "strongly like". Panellists can rate each attribute listed in the questionnaire where the perceived attributes can be given a checklist according to the 5 points in the questionnaire, while if the attribute is not perceived in the sample, it does not need to be given a checklist or blank.

2.2.4. Data Analysis

The data obtained from the JAR scale and the hedonic scale (overall liking) will be analyzed using penalty analysis to identify attributes that may influence the decrease in overall liking. The software used is Ms. Excel 2019 and XLSTAT Statistical Software 2024 (Addinsoft, New York, NY, USA). The output produced from the penalty analysis includes the penalty analysis table and mean drops plot. The p-values of the JAR and Non-JAR attributes (Too Low and Too Much) from all Candied Tomatoes formulations can be analyzed for optimization urgency through the penalty analysis table, where attributes must be optimized if they have a p-value < 0.05 and a percentage response of panellists$> 20\%$. Additionally, there is an average value of the mean drops, which correlates with the hedonic scale assessment (overall liking) and is only present in the Non-JAR variables (Too Low and Too Much) in the penalty analysis table. This indicates that the higher the mean drop value of an attribute, the more important or influential that attribute is to the panellists' assessment of the hedonic scale (overall liking).

3. RESULT AND DISCUSSION

3.1. Analysis of Penalty Data for Candied Tomatoes Attributes

The sensory profile of candied date tomatoes was tested with the treatment of whiting solution concentration and blanching duration. There were nine samples tested, with variations in the concentration of 2%, 3%, and 4% whiting solution, and blanching duration of 5, 10, and 15 minutes. The method used for testing was Just About Right (JAR), which involved 100 panellists who were students of the National Development University "Veteran" of East Java, aged between 18-24 years. Panellists were instructed to evaluate 17 sensory attributes of candied date tomatoes, including brownish red color, juicy aspect, luster, roughness, candied aroma, fruit aroma, sweet aroma, caramel aroma, hard texture, soft, fibrous, rough, juicy, sweetness, sourness, and fruit flavor. The JAR assessment used a 5-point scale (1 = "no taste", 3 = "JAR", 5 = "too strong"), as well as an overall liking scale with the same range (1 = "strongly dislike", 5 = "strongly like"). The data obtained was processed using penalty analysis with XLSTAT 2024 software. This method combines the JAR scale with overall liking analysis to determine consumer preference or

acceptability of candied date tomatoes. Penalty analysis identifies attributes that are not at the JAR point, which according to [12], can affect product performance and consumer preferences.

3.1.1. Sensory Attribute Based on FGD

Sensory attributes are a set of data that can be used to describe the sensory characteristics of a food product. Sensory attributes need to be determined through the FGD process because there are no attributes that specifically describe the attributes possessed by candied date tomatoes. This shows that the FGD results for nine samples of candied date tomatoes are 17 sensory attributes.

Table 1. Sensory attributes of candied date tomatoes based on FGD

Attributes	Description
Red Brown Colour	The sample color looks brownish-red
Juicy Aspect	The watery appearance of candied tomato surface
Glossy Aspect	The shiny appearance of candied tomato surface
Rough Aspect	Rough appearance of candied tomato skin
Candied Aroma	Aroma character impression of the sample with heated sugar syrup
Sweet Aroma	Sweet sugar-like aroma
Fruity Aroma	Fresh aroma typical of tomato pulp
Caramel Aroma	Burnt sugar-like aroma
Stiff Texture	Stiff texture of candied tomato flesh
Soft Texture	The soft texture of candied tomato flesh
Fibrous Texture	The fibrous texture of candied tomato flesh
Hard Texture	The firm texture of candied tomato flesh
Rough Texture	The rough texture of tomato-candied meat
Juicy Texture	The juicy texture of candied tomato flesh
Fruity Taste	Fresh sweet taste like ripe fruit
Sweet Taste	Sweet taste like sugar
Sour Taste	Sour taste like fresh fruit

The attributes formed in candied date tomatoes are influenced by various processes and treatments used in making candied date tomatoes. In the caramel aroma attribute, the caramelization process of sugar added in cooking tomatoes produces a caramel aroma in candied date tomatoes. In addition, this caramelization process causes a change in the color of tomatoes to brownish red and affects the red-brown color attribute. The texture (hard, rough, stiff) and rough aspect are influenced by the process of soaking tomatoes in a whiting solution which causes the strengthening of fruit texture because the calcium compounds in the lime penetrate the fruit tissue so that the structure of the fruit tissue becomes more compact due to the new bond between calcium and the tissue in the fruit. In addition, the drying process also plays an important role in changing texture attributes to become harder due to the reduced water content in tomatoes [13].

The sensory attributes of sweet taste and sweet aroma are influenced by the addition of granulated sugar in the process of making candied date tomatoes. This sugar plays an important role in the appearance of sweetness and also as a preservative. According to [14], the addition of sugar with a high concentration can preserve the fruit because it prevents the proliferation of microorganisms in the osmosis process. The blanching process on

tomatoes affects the sensory attributes of the glossy aspect, fruity aroma, fruity taste, juicy aspect and juicy texture. This can happen because blanching causes the epidermis of tomatoes to come off so that during the cooking process, the sugars that have become caramelized are easier to penetrate the fruit tissue so that the tomato dates have a brighter color, smoother and shinier texture with a better aroma and taste

3.1.2. Penalty Table

The penalty analysis method will combine the use of the JAR scale with overall liking analysis, where this method is applied to determine consumer preferences or consumer acceptance of products based on attributes in candied tomatoes. This is following [15] which states that this method aims to measure how consumer preferences are reduced due to attributes that are not at the JAR point so that they affect product performance. Details of the penalty analysis results can be seen in Table 2.

Table 2. Result of Penalty Analysis for Attribute

VARIABEL	S1T1	S1T2	S1T3	S2T1	S2T2	S2T3	S3T1	S3T2	S3T3
				PENALTY ANALYSIS					
Red brown	0,112	0,346	0,58	0,002*	0,071	0,921	0,834	0,402	0,248
Juicy Aspect	0,001*	0,002*	0,892	0,69	0,013*	0,299	0,42	0,221	0,686
Glossy Aspect	0,141	0,006*	0,952	0,023*	0,109	0,841	0,001*	0,745	0,972
Rough Aspect	<0,0001*	0,008*	0,066	0,429	<0,0001*	0,727	0,768	0,345	0,021
Candied Aroma	0,742	0,009*	0,616	0,365	0,03*	0,136	<0,0001*	0,05	<0,0001
Fruity Aroma	0,009*	0,665	0*	<0,0001*	0,004*	0,077	0,835	0,142	0,005
Sweet Aroma	0,112	0,857	0,007*	0*	0,254	0,361	0,022*	0,199	0,042
Caramel Aroma	0,254	0,226	0,65	0,191	0*	0,137	0,302	0,362	<0,0001
Stiff Texture	0,104	0,013*	0,172	0,851	0,024*	0,998	0,008*	0,181	0,207
Soft Texture	0,004*	<0,0001*	0*	0,436	0,05	0,073	0,114	0,05	0,237
Fibrous Texture	0,837	0,351	0,003*	0,537	0,893	0,764	0,763	0,202	0,594
Hard Texture	0,968	0,001*	0,623	0,267	0,01*	0,051	0,094	0,005*	0,001
Rough Texture	0,002*	0,001*	0,945	0,053	0,598	0,113	0,766	0,037*	0,011
Juicy texture	0,086	0,05	0,627	0,72	0,268	0,002*	0*	<0,0001*	0,406
Sweet Taste	0,36	0,574	0,008*	0,006*	0,097	<0,0001*	<0,0001*	0,053	0,015
Sour Taste	0,027*	0,953	0,723	0,287	1	0,499	0,183	0*	0,044
Fruity Taste	0,003*	0,4	<0,0001*	0,979	0,029*	0,017*	<0,0001*	0,054	<0,0001

Note: The green color represents the most optimal formulation based on the penalty analysis result; asterisks (*) indicate attributes that need an optimization with a confidence interval of $=0{,}05$

Based on Table 2, it is known that the sample of candied date tomatoes with the treatment of soaking in 2% whiting solution concentration and blanching time for 15 minutes (S2T3) has the least attributes that fall into the significant category. There are only 3 other test attributes (juicy texture, sweet taste, fruity taste) that have a p-value<0.05, meaning that these 3 attributes are not optimal or have an effect on reducing consumer preference. Meanwhile, there are 14 test attributes (red-brown color, juicy aspect, glossy aspect, rough aspect, candied aroma, fruity aroma, sweet aroma, caramel aroma, stiff texture, soft texture, fibrous texture, hard texture, rough texture, sour taste) showing insignificant or optimal penalty results because the p-value≥0.05. This indicates that sample S2T3 is the most optimal sample because this sample has the least sensory attributes with p-value<0.05 among the other samples.

The results of the juicy texture attribute penalty (p-value = 0.002) and fruity taste (p-value = 0.017) showed that mean drops at the "too weak" level had a significant effect, but mean drops at the "too strong" level could not be detected because less than 20% of the panellists gave a rating at that level. Ref. [16] explained that the minimum threshold for the percentage of consumers rating the intensity of an attribute to describe the characteristics of the product being tested at the ideal level in the penalty analysis method is 20%. This shows that the juicy texture and fruity taste

attributes at the "too weak" level can affect the reduction of consumer preferences which causes the need for optimization of the two attributes.

The results of the sweet taste attribute penalty (p-value = <0.0001) showed that mean drops at the "too strong" level had a significant effect, but mean drops at the "too weak" level could not be detected because less than 20% of the panellists gave a rating at that level. Ref. [17] explained that the absolute minimum threshold of the percentage of consumers in assessing the intensity of attributes to describe the characteristics of the tested product at the ideal level in the penalty analysis method is 20%. This shows that the sweet taste attribute at the "too strong" level can affect the reduction of consumer preferences which causes the attribute to need further optimization.

The juicy texture, sweet taste, and fruity taste attributes are included in the attributes that are not yet optimal so it is necessary to make adjustments to the process of making candied date tomatoes. This includes adjustments to the provision of granulated sugar because sugar has an important role in reducing consumer preferences for sweet taste attributes [18]. As for the juicy texture and fruity taste attributes, adjustments can be made to the length of blanching used because the length of blanching affects the absorption of sugar into the tomato epidermis to produce candied date tomatoes that have a better texture and taste.

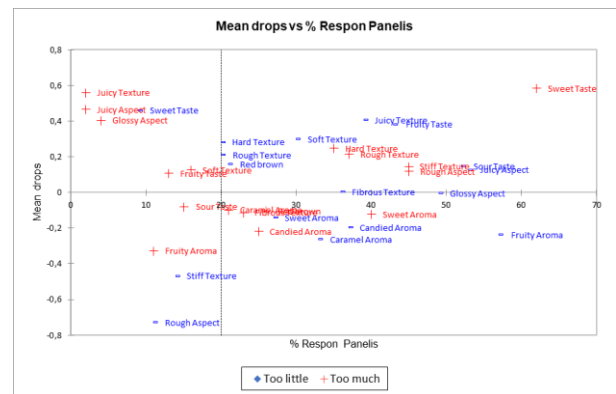### 3.1.3. Mean drops plot Analysis for Optimum Formulation

Figure 1. Mean drop plots for sample S2T3

Figure 1 shows the plot between mean drops and the percentage response of panellists to each test attribute. Ref. [19] and [20] explain that the upper right quadrant shows the response given by panellists is more than 20% and the value of the mean drop is more than 0, which is a quadrant that contains sensory attributes that need to be considered in product evaluation to increase consumer preference. The higher the mean drop value of an attribute, the more important it is. It can be seen that some sensory attributes such as juicy texture, fruity taste, and sweet taste are on the upper right side (quadrant II). This indicates that these attributes are at the "Too Low" level and the "Too Much" level are attributes that are considered important because more than 20% of respondents rated these attributes as having product intensity that is not in ideal conditions (JAR). samples with attributes in the upper right corner of the penalty plot are highly influential on overall liking and are considered worse than those with attributes in the lower left corner with less impact on overall liking.

4. CONCLUSION

The sample of candied date tomatoes (S2T3) treated with 3% whiting solution concentration and 15 15-minute blanching time is the most optimal based on the results of penalty analysis using the Just About Right (JAR) method. This sample showed 14 test attributes with p-values$\geq$ 0.05, which means it is not significant or has achieved optimization. However, some sensory attributes in this sample still need to be optimized, namely juicy texture (p-value = 0.002), sweet taste (p-value < 0.0001), and fruity taste (p-value = 0.017), because these attributes affect consumer acceptance.

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