Sensory Properties Characterization of Freeze-Dried Strawberries

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Abstract. Strawberries (*Fragaria x ananassa* var. Mencir) are sub-tropical herbaceous fruits that are in great demand by the world community and have promising business opportunities, including perishable commodities, which are quickly damaged so they have a short shelf life. Therefore, it is necessary to use post-harvest handling technology, which is processed into freeze-dried strawberries. However, an improper process can cause several losses, such as a decrease in shape, appearance, and quality properties. Changes in product characteristics that may occur can affect consumer responses to freeze-dried strawberry products. The study aimed to determine the sensory characterization of freeze-dried strawberry products. Three samples were used, namely formulation, local, and imported. Data was collected by sensory testing on the attributes of shape, color, aroma, taste, texture, and overall using untrained panelists from 60 students who live in the Special Region of Yogyakarta. Sensory test data were processed statistically using the normality test, followed by the Kruskal-Wallis test because the assumption of normality was not met. Based on the sensory test, the sample with the highest level of preference for the attributes of shape, color, and aroma was the formulation sample. Meanwhile, the attributes of taste, texture, and overall are imported samples. From the results of the sensory and physical tests that have been carried out, it is known that the panelists like freeze-dried strawberries which have the shape, color, and aroma like fresh strawberries, sweet taste, and crunchy texture.

Keywords: *characteristics · freeze-dried strawberries · panelist · sensory test*

1 Introduction

Strawberry (*Fragaria x ananassa*) is a subtropical herbaceous fruit originating from Chile, America. The striking red color with a fresh sweet taste is the main attraction of strawberries. Strawberry production in tropical environmental conditions is constrained by post-harvest handling, namely picking, and storage. Strawberries are included in perishable commodities, which are quickly damaged so they have a short shelf life [5]. This is of course detrimental, especially in terms of quality. Therefore, it is necessary to use post-harvest handling technology to maintain the quality and shelf life of strawberries which are easily damaged.

One of the efforts that can be done to maintain the shelf life of strawberries is to be processed into freeze-dried strawberries. Freeze-dried technology is a food processing technology with non-thermal principles [11]. This strawberry drying uses a low temperature (-40°C). Among the available drying techniques, freeze drying is the most effective method because it allows high water removal while retaining most of the characteristics of fresh food [15]. The principle of freeze-dried is the removal of water content in food products through freezing which is then sublimated to change the solid phase (water) into the gas by controlling the temperature and pressure during processing. The advantage of freeze drying is that this technique can maintain product quality, both in terms of sensory characteristics, nutritional value, physical, and chemical when compared to ordinary drying [11]. However, an inappropriate freeze-dried process can cause several losses, including the shape, appearance, and quality properties that will decrease [2]. An example is an inappropriate pre-treatment process such as soaking in a baking soda solution to raise the pH of the fruit. This process is carried out due to adjustments to the use of tools. However, it turns out that this process can cause a change in the color of the product to purple and does not attract consumers' interest because it deviates from the original fruit color. Freeze dried is a fruit drying technology that is currently favored by consumers because it has the same taste, aroma, and color as the original fruit [1]. Another advantage of this product is that it can be eaten directly or used as food ingredients, such as cereals, desserts, and candies [6].

Changes in product characteristics that may occur can affect consumer responses to freeze-dried strawberry products. Decreasing product quality during the drying process can reduce the added value and acceptance of dried fruit products [14]. Sometimes not all food innovations can be accepted by consumers. This is due to concerns due to the uncertainty of the quality and health safety of innovative products. Therefore, consumer perceptions, including preference factors for the sensory characteristics of a food product, must be considered so that the product is attractive to consumers [2]. Sensory testing is important to determine consumer acceptance and the preparation of product characteristics based on consumer preferences. No matter how good the content of a product, if it is organoleptically not liked, then the product will not be in demand by consumers [1]. The results of this sensory test can be used as a basis for argumentation to state the importance of an innovative product that has the potential to have high commercial value [2].

One type of sensory test that is commonly used is the hedonic test which is a sensory test to measure the level of preference for a product, especially in the food industry [13]. The hedonic test is a test in sensory analysis that is used to determine the magnitude of the difference in quality between several similar products by providing an assessment or score on certain properties of a product and to determine the level of preference for a product [7]. The hedonic test can be done to find out consumer opinions on the freeze-dried strawberry products made in the study so that they can and out what improvements might be made to improve the sensory and physical quality of the product.

The objective of this study was to identify the sensory characteristics of freeze-dried strawberries based on the attributes of shape, color, aroma, taste, texture, and overall. The results of this sensory characterization can be used to assist business actors in designing and producing quality freeze-dried strawberry products by consumer preferences and this

sensory characterization is also expected to increase sales and income from freeze-dried strawberries.

2 Material and Method

2.1 Freeze-Dried Strawberries Product Sample Preparation

In this study, samples of freeze-dried strawberries were used which were already circulating in the local and imported markets. Samples of imported freeze-dried strawberries were obtained from the Wel-B brand imported diresctly from Thailand, obtained from the Tokopedia platform. There are various types of dried strawberries in circulation, such as freeze-dried strawberries, dehydrated strawberries, and dried strawberries. However, in this study, samples were taken as freeze-dried strawberries. When used for sensory testing, this sample has been packed for about one to two months. The expiry of the imported sample is 2024. This is about three years from the production date. Another comparison sample is a sample of local freeze-dried strawberries obtained from Frootifulfresh producers in South Jakarta, purchased through Instagram and WhatsApp social media. The sample used was in the form of a whole strawberry which was divided into two and four parts and the texture was like a candy (chewy). When used for sensory testing, the sample has been packed for about seven days. The expiration date of this local sample is approx one year from production date. All samples used in this study use 100% fresh strawberries without the addition of other ingredients. The product used for this sensory test is comparable because this product is freeze dried strawberries on the Indonesian market.

Freeze-dried strawberry production begins with picking fresh strawberries at Kebun Inggit, Magelang, Central Java. Fresh strawberries that have been picked are cleaned of leaves and washed using running water. Then the fresh strawberries were cut into two equal parts and weighed using an analytical balance (ACIS Digital Precision Balance AD-I series AD600i; Indonesia) weighing 70–80 g. After that, it was put in a 750 ml thin wall container for further storage in the freezer (modena power duo MD 10 W; Indonesia) at -18 °C for 4 d. Then the fresh strawberries that have been in the freezer are put into the freeze-dryer (SP VirTis Benchtop Pro with Omnitronics; USA) for 24 h. The sample made will later be referred to as the formulation sample, the sample can be seen in **Fig. 1.**

2.2 Sensory Test

Sensory testing was carried out by comparing samples of freeze-dried strawberry products with formulation samples with products already circulating in the Indonesian market. The comparison products used are imported products from Thailand and local products from South Jakarta. Three random numbers are assigned to each sensory test sample as follows: code 556 for the imported sample; code 313 for local samples; and code 299 for the sample formulation.

Sensory testing is done in the form of a hedonic test or preference test. Tests were carried out to obtain freeze-dried strawberry products that were acceptable and most
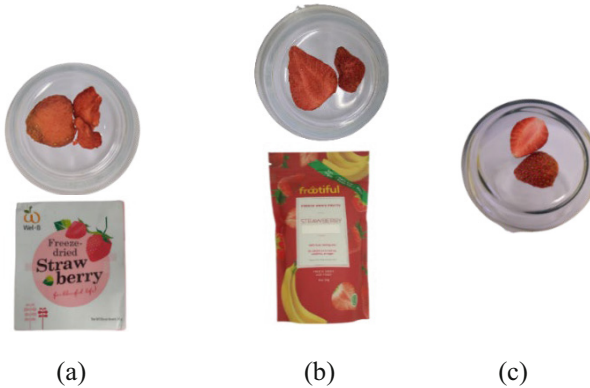
(a)   (b)   (c)

Fig. 1. Samples used in the study: (a) Imported samples and imported sample packaging (code 556), (b) Local samples and local sample packaging (code 313); (c) Formulation sample (code 299)

preferred by the panelists which were then tested for quality characteristics in the form of testing the shape, color, aroma, taste, texture, and overall of the product. The assessment uses a hedonic scale with a score of 1–7 (1: dislike very much; 2: dislike moderately; 3: Dislike; 4: Neither like nor dislike; 5: Like; 6: Like moderately; 7: Like very much). The 7-point scale describes in more detail compared to the preference value on a 5-point scale, and simpler than 9-point. The 7-point Likert scale minimizes measurement errors with higher precision when compared to the 5-point scale [9].

The hedonic test is a sensory test that is applied to see the preference for a product. This study used panelists with a total of 60 people who are students who lived in the Special Region of Yogyakarta (DIY), it can be categorized as a non-trained panelist. Students were selected as panelists in the sensory test because of Covid-19 conditions in the campus as a place for the sensory tes. Students who used to be panelists are undergraduate and postgraduate students. The panelists as non-trained panelists which are involved in this sensory test will be given general information about freeze-dried strawberry products.

2.3 Statistical Analysis

Sensory test results data were analyzed for data distribution using the Kolmogorov Smirnov normality test because the data was more than 50. In the normality test, a significance of 0.05 was used. Furthermore, because the normality of the data was not met, it was continued with the Kruskall-Wallis test as an alternative to the one way ANOVA test. The Kruskall-Wallis test using assymp. Sig 0.05 where if it is less than 0.05 then there is a significant difference between samples. If there is a significant difference, it is continued with the Pos Hoc Pairwise Comparisons test, and these all calculation were used SPSS for windows (IBM SPSS Statistics 25; Sydney, New South Wales).
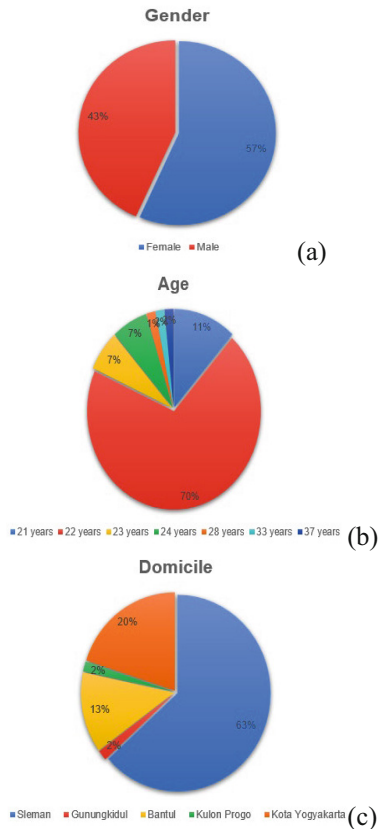
Gender

(a)

Age

(b)

Domicile

(c)

Fig. 2. Panelist prole data based on (a) Gender, (b) Age, and (c) Domicile

3 Results and Discussions

Sensory characterization was performed on three samples of freeze-dried strawberries to determine the best product based on the panelists' highest preference. From the sensory test that has been carried out, the panelist prole data based on gender, age, and domicile can be seen in **Fig. 2**. Of the total 60 panelists used, 34 panelists were women, or 57% of the total panelists. While 26 panelists were male or 43% of the total panelists. The age range of the panelists involved in this sensory test was 21 to 37 years. The panelists used are limited to students who live in the Special Region of Yogyakarta, which can be separated in detailed from five regency, such as 38 panelists from Sleman Regency, one panelist from Gunung Kidul regency and Kulonprogo regency, respectively, 8 panelists were from Bantul regency, and 12 panelists were lived in Yogyakarta City. The panelist must be checked to sensory test of food product in this case, several freeze-dried strawberries, sequentially to see – touch – inhale – and eat/chew [4].

In the shape, color, and aroma attribute, the panelist's highest preference is formulation sample. Shape is the external appearance of the product such as size, texture, and pattern that becomes the atrraction of purchase. Consumers will choose natural product
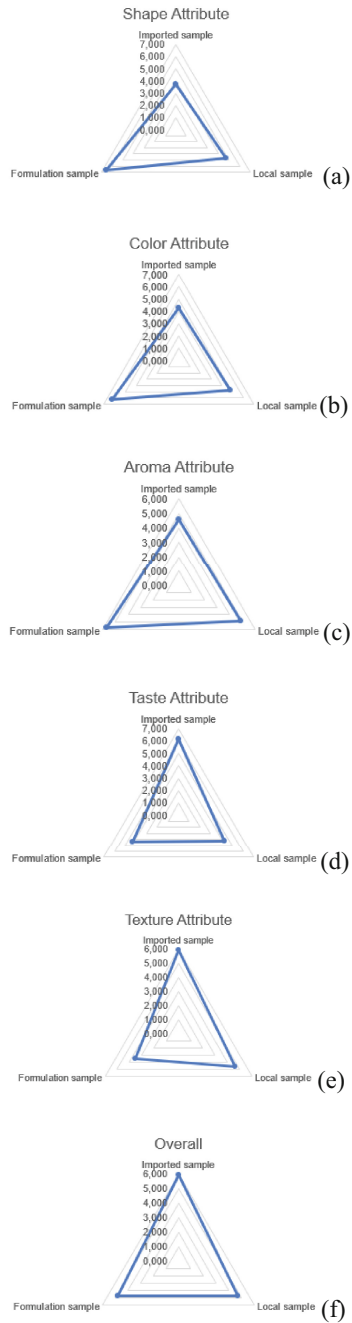
Fig. 3. Spider web chart of the sensory properties characterization of freeze-dried strawberries: (a) Shape Attribute, (b) Color Attribute, (c) Aroma Attribute, (d) Taste Attribute, (e) Texture Attribute, and (f) Overall.

forms [10]. The shape of this sample is a whole strawberry which is divided into two equal parts vertically. Determination of the quality of food ingredients depends on the color that has, the color that does not deviate will give a distinct impression by consumers [8]. The color of this sample is red like a fresh strawberry. Aroma is one of the attributes in subjective sensory that uses the sense of smell, the aroma that consumers like is when the products have a specific aroma [3]. The aroma contained in the sample is an aroma resembling fresh strawberries. Then, in the taste, texture, and overall attribute, the panelist's highest preference is imported sample.

Taste is a sensory atrribute that is received using the tongue and is very influential on consumer preferences. There are three flavors known in the food industry, namely sweet, sour, and bitter [12]. In this study, the taste in questions is sweetness which is the basic taste stimulated by sucrose and other sweeteners [4]. The taste of this sample is sweeter than the other samples. The resulting texture in a product is one of the physical properties that can determine the taste in food. The texture of this sample, hard and crunchy. Therefore, the order of attributes tested in this sensory test is a shape, color, aroma, taste, texture, and overall. On all existing sensory attributes, the normality test on all data did not meet the assumption of normality. Therefore, it was continued with the Kruskall-Wallis test with the use of assymptotic with significance 0.05. After the Kruskall-Wallis test, it was found that on all attributes there were significant differences between the three samples tested. Sensory test results for each attribute can be seen in **Fig. 3**.

4   Conclusions

Based on the results of the sensory test using a hedonic test or a preference test with an untrained panel of 60 students, a sample of freeze-dried strawberries was obtained with the highest level of preference by the panelists, namely imported samples and formulations. In the shape, color, and aroma attribute, the panelist's highest preference is formulation sample. Then, in the taste, texture, and overall attribute, the panelist's highest preference is imported sample. From the results of the sensory and physical tests that have been carried out, it is known that the panelists like freeze-dried strawberries which have the shape, color, and aroma like fresh strawberries, sweet taste, and crunchy texture. These results can be used by local producers as a reference in the manufacture of freeze-dried strawberries products that are in accordance with consumer preferences to increase income.

Authors' Contributions.   **Wahyu Wiliani:** Conducted experience – writing early manuscript. **Refika Melina Putri:** Supported conducted experience- supported writing manuscript. **Dyah Ismoyowati**: Supported conducted experienced **Mohammad Affan Fajar Falah:** Responsible for conducted experience, writing manuscript and project coordinator.

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