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## Cocoa and Chocolate Products: The Sensory Characteristics That Affect Consumers' Acceptance

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### Abstract

*This review describes the sensory characteristics of some cocoa and chocolate products which will later determine the acceptance of consumer. Cocoa beans are widely used as raw materials in many industrial sectors such as in food industries, cosmetics, and pharmaceutical. It will be further processed into several cocoa and chocolate products which performed certain characteristics. Relating to consumer acceptance, consumer will determine the product quality based on human senses. The evaluation of product using human senses is quite challenging since it present a set of particular and advantageous tools. Sensory evaluation promotes the scientific utilization and analysis of these tools. The aim of sensory evaluation in cocoa and chocolate product evaluation is to provide the information of the accepted characteristics based on human senses, which finally will contribute to the best quality of product expected by consumers.*

## Introduction

Cocoa has been widely marketed worldwide for its importance and popularity as raw material for food industries, cosmetics, and pharmaceuticals (Voora et al., 2019; Yolanda et al., 2022). Cocoa beans are the seeds of the cocoa pods of the cocoa tree. Raw cocoa beans are bitter, astringent, unpalatable, and unpleasant in taste. Therefore prior to processing into good taste and full flavored cocoa and chocolate, they must be cured, followed by drying of the fermented cocoa beans and roasting of the fermented dry cocoa beans (De Vuyst & Weckx, 2016). Furthermore, the roasted cocoa beans are processed into cocoa liquor, cocoa butter, cocoa powder, and final cocoa products such as chocolate bars, chocolate drinks, etc. (Hartatri et al., 2021).

The processed products of cocoa beans perform a unique and typical characteristic; thus, there was considerable research conducted to evaluate their qualities (Arunkumar & Jegadeeswari, 2019; Meulemans et al., 2013). More advanced methodologies are always being developed to investigate and improve the characteristics of cocoa products (Binh et al., 2012; Hii et al., 2011; Tardzenyuy et al., 2020). However, all the technological improvements can not be separated from the consumers' acceptance of the offered products since consumers' acceptance will determine the final decision to purchase the products (O'Cass, 2000; Pemani & Massie, 2017; Qazzafi, 2019; Rambli, 2015).

In order to evaluate the characteristics of cocoa and chocolate products using human senses, sensory evaluation is commonly applied. Some of the parameters to be used in the sensory evaluation of cocoa and chocolate products include flavor, taste, smell, oral somatosensations, visual appearance, and texture (Harwood & Hayes, 2017). Sensory characteristics describe

product profiles that can be perceived by the five human senses and will further affect product acceptance as expected by consumers (Apandi et al., 2016; Suryono et al., 2018; Tarwendah, 2017).

This review describes the sensory characteristics of some cocoa and chocolate products which will later determine the acceptance of consumer. This review is expected to provide a reference for readers who want to know the description of the characteristics of various quality cocoa and chocolate products that are preferred by panelists as representatives of the target consumers of chocolate connoisseurs.

## **Evaluation of Food Sensory Profiles**

Nowadays, consumers mainly consider to select and consume food products based on the eating quality parameters or product's palatability, and rarely considering other quality attributes such as healthiness and nutritional value. Since, when eating food products, consumers will perceive some sensory profiles of food such as aroma, taste, aftertaste, tactual traits and appearance. This perception, will lead the consumer whether they like or dislike it, thus they crave for more the accepted one. Therefore, if it is accepted that the quality of food is "most preferred by consumers" and that the level of quality is better understood by the level of desirable attributes and the absence of undesirable characteristics that are mainly detected by the sense organs of consumers, then a good method of determining food quality is through sensory evaluation (Singh-ackbarali & Maharaj, 2014).

Sensory evaluation is a scientific discipline used to evoke, measure, analyse and interpret responses to products as perceived through the senses of sight, smell, touch, taste and sound. In taking measurements, sensory evaluation is concerned with precision, accuracy, and sensitivity and with avoiding false-positive results. Reliable sensory evaluation is based on the skill of the sensory analyst in optimizing four factors such as definition of the problem, test design, instrumentation and interpretation of the results: 1) Definition of the problem: The component to be measured must be defined precisely; 2) Test design: The design must not only take into account unknown sources of bias, but must also minimize the number of tests required to produce the desired accuracy of results; 3) Instrumentation: The panellists must be selected and trained to give a reproducible results; 4) Intrepretation of the results: The analyst should select appropriate statistics based on the correct statistical assumptions and draw only those conclusions that are supported by the data (Choi, 2021).

During the sensory evaluation test, there are variables should be controlled thus we can obtain the valid and reproducible results. The variables should be considered are panel management, environmental controls and product controls. There are four level of measurement hierarchy such as nominal, ordinal, interval and ratio measurement. It is desirable to have a higher level of measurement (interval or ratio) rather than the lower level of measurement (nominal or ordinal) since at the higher level of measurement, assumption tends to be more restrictive and provides more sensitives data analysis. Common scales used is sensory testing are category scales, line scales and magnitude estimation scale. Each scales category will provide different style of how panellists measure the test, such as the magnitude estimation scale that instruct the panellists to define numbers to their sensation in proportion to how strong each sensations feels (Choi, 2021).

The three basic kinds of sensory tests are discriminative tests, descriptive tests, and affective test (Lawless, 2013; Rochmawati, 2019). The discriminative tests are used to determine whether there were differences between samples. The descriptive tests are used to determine the nature and intensity of the differences. Affective tests are based on the measurement of



likes (or acceptance) or measurement of relative preference. Panelists' personal feelings about the product will direct their responses (Piggott, 1988; Prawidya et al., 2017). Discriminative tests include of triangle test, duo-trio test, two-out-of-five-test, paired comparison test, ranking test (Friedman). Descriptive tests include of scaling methods and descriptive analysis methods. Affective tests include of paired comparison preference test, hedonic scaling test, and ranking test (Rochmawati, 2019).

However, over the time, the consumer perception could be changed. Different from traditional method that measure attribute intensities at the time of evaluation, the temporal methods study about the alteration of attributes over time, whether it is intensity or dominance. The way consumers perceive a product is closely related to their expectations, whether assumed from their enjoyment or satiety. The temporal method approach can be adapted to meet these expectations with diverse consumer preferences and eating behaviors during the tasting process. The sensory temporal methods are categorized into several tests such as Time-Intensity (TI), Temporal Dominance of Sensations (TDS), Temporal-Check-All-That-Apply (TCATA), Temporal Liking (TL), Temporal Dominance of Emotions (TDE), Hold-Down Temporal Dominance of Sensations and Emotions (HDTDSE), Free Comment Attack Evolution finish (FCAEF), and Projective Categorization (PC) (Marques et al., 2022).

## **Review on Sensory Profiles of Chocolate Bars**

Chocolate bars are categorized into three types such as dark chocolate, milk chocolate and white chocolate. Each types of chocolate is classified based on the composition of cocoa liquor, cocoa powder, cocoa butter, sugar, and milk powder used in its production (Cheng et al., 2009; Ramadhanti et al., 2021).

The sensory evaluation of chocolate bar produced using dried cocoa beans with various fermentation treatments had been reported. In this study, cocoa beans of varieties of Lindak were fermented using two treatments. The first treatment conducted by added the inoculum gradually and the second treatment conducted by added the inoculum simultaneously at the beginning of fermentation. The inocula added were *Sacharomyces cerevisiae* (FNCC 3056), *Lactococcus lactis* (FNC 0086) and *Acetobacter aceti* (FNCC 0016) with 120 hours of fermentation time. The cocoa beans obtained proceed into chocolate bars. The resulting chocolate bar was evaluated for the harsh taste, bitter taste and sour taste and overall acceptance using sensory analysis. The panellists were untrained panellists (30 persons). Descriptive rating scale including: 1 – very bitter; 2 – more bitter; 3 – bitter; 4 – neutral; 5 – slightly bitter; 6 – not bitter; 7 – not very bitter. Favourite rating scale including: 1 – least liked to 7 – most liked. Based on the sensory evaluation results, the chocolate bar produced from the first treatment (by added the inoculum gradually) showed the less acidic, bitter, and astringent taste and is more acceptable and preferred by the panellists than chocolate bars made from cocoa beans treated with control and the second treatment (by added the inoculum simultaneously at the beginning of fermentation) (Nurhayati & Apriyanto, 2021).

The sensory evaluation of chocolate produced from cocoa beans cultivars resistant to the disease caused by *Moniliophthora Perniciosa* mould had been reported. The cocoa beans used consisted of PH16, SR162 and conventional cocoa beans having no resistancy to *Moniliophthora Perniciosa* mould disease. The evaluation used was Quantitative Descriptive Analysis (QDA). QDA is a method that enable the trained panellists to describe all the detected aspects of products under guidance of a panel leader. Each chocolate made from different cultivars showed the special characteristics. The profiles of more darker brown color, more intense flavour and odor were performed by chocolate produced from PH16 cultivar. The profiles of higher sweetness and melting quality were performed by chocolate produced form SR162

cultivar. However, the chocolate bar produced from the conventional cocoa beans cultivar had performed an intermediate profiles between other two cultivars. All samples highly accepted by panellists, but the higher purchase intention scores were obtained from chocolate produced from PH16 and conventional cultivars (Leite et al., 2013).

The hedonic test of milk chocolate bar enriched with cinnamon essential oil were also studied. In this study, five attributes such as color, aroma, taste, appearance, overall acceptability were evaluated. The 30 random panellists varying in age between 18-22 years 30 were asked to give five point scoring scale: 1) Dislike, 2) Dislike moderately, 3) Neither like nor dislike, 4) Like moderately, 5) Like very much). Based on this study, the addition of 0,1% of cinnamon essential oil to milk chocolate bar showed the greatest acceptance compared to other treatments (0,3% and 0,5% addition of cinnamon essential oil) (Ilmi et al., 2017).

The nutritional values and sensory profiles of white chocolate enriched with *Arthrospira platensis* were reported. The treatments consisted of five designs: control; with addition of *Arthrospira platensis* of 0.5%, 1%, 2%, and 4%. Based on this study, there was no significant ( $p > 0.05$ ) difference in sensory scores between control chocolate and nutrient-enriched products (Özbal et al., 2022).

## **Review on Sensory Profiles of Chocolate Pralines**

Chocolate pralines are types of chocolate filled in the center with certain ingredients such as fruits, nuts, jams, creams, liquors, etc (Efendi et al., 2013; Popov-Raljić et al., 2010). The study of sensory profiles of chocolate pralines were not quite as much as sensory profiles of chocolate bar. However, this type of chocolate is also popular, thus it is interesting to observe its sensory characteristics.

The sensory evaluation of hand made pralines—containing dark chocolate with 60% of cocoa solids as shells, filled with different honey bee products (honey bee drone larvae, blossom honey and blossom honey/pollen mixture) were investigated. The net weight of each praline was 12 grams (7 grams the shell, and 5 grams the filling). The sensory test was conducted immediately after processing (day 0), and then after the storage of 30, 90 and 180 days at the room temperature using the scoring procedure. The basic sensory properties observed were appearance (form, color, brightness, surface); texture (structure, break, firmness); chewiness and other structural properties; Aroma (odor and taste) with score range from one to five. Category of quality of praline was determined depending on the score ranges; the products will be considered as unsatisfactory if the score evaluated less than 2.5 points, the good quality products have the scores within the 2.5–3.5 range, very good quality with score range of 3.5–4.5 and excellent products with score range of 4.5–5. Pralines made from dark chocolate with 60% of cocoa portions and filled with blossom honey performed the excellent sensory quality (appearance, texture and aroma) during the whole period of storage until 180 days (Popov-Raljić et al., 2010).

Sensory properties were also assessed on praline chocolate which was stored for three months. Measurements were started when fat bloom appeared on the surface of the chocolate praline. There are six variants of praline chocolate, namely pralines with a shell made of tempered dark chocolate and tempered milk chocolate pralines with fat content range from 32-33%. Each variant is filled with six different fillings, ranging from hazelnut oil with a low concentration (26% cocoa butter and 43% fat), hazelnut oil with a high concentration (30% cocoa butter, 43% fat), strawberry alcoholic with a high concentration (12.9% alcohol) and low concentrations of strawberry alcoholic (8.9% alcohol). Pralines were produced in three batches, where the first batch as a control (directly evaluated) and praline produced in the other batch were stored at

20°C and 23°C., respectively. Sensory profiling is done using the trained panelists so that this assessment can provide objective measurement results; thus the quantitative descriptive analysis method used will show the differences between the samples. Panelists were trained for 10-15 hours to carry out this analysis. For each attribute, the panelists rates the product on a 0-9 scale category, starting with 0 which means 'none' and 9 which means 'high'. Based on the results of this study, it was concluded that the appearance of fat blooms changed the sensory characteristics of praline chocolate. Each variant of praline chocolate showed changes in sensory characteristics, namely a decrease in quality (such as aroma, texture and appearance) (De Pelsmaecker et al., 2013).

## **Review on Sensory Profiles of Chocolate Beverages**

Cocoa-based drinks include powdered beverages, ready-to-drink beverages, and chocolate beverages (Hardiyanti & Sari, 2020). This cocoa-based beverages can also be mixed with milk, whey or other additives, so this type of products are called as dairy chocolate beverages (Eduardo et al., 2014).

The sensory profiles of developed product (low fat chocolate drink) compared to the four commercial drinks had been studied using Quantitative Descriptive Analysis (QDA). The samples were served to the 13 trained panellists to be observed for the attributes of appearance, odour, flavour, basic taste and texture. The low fat chocolate drink showed the characteristics such as cocoa aroma, cocoa flavour, sandiness, undissolved particles, colour, white-cream layer, thickness texture and bitter taste. These characteristics showed the similarity to the commercial chocolate drink 'A' in this research, thus the researcher suggest to adopt the profiles of commercial chocolate drink 'A' in order to develop a good quality of low fat chocolate drink (Mardiana et al., 2021).

The sensory characteristics of chocolate beverages produced from a mixture of commercial cocoa powder and non-fermented cocoa beans were also evaluated. The study was evaluated using the projective mapping method. This method is used to study the sensory properties of food products based on their attributes. The seventy five naive panelists position samples based on the similarity of their attributes. The given samples were consisted of five samples, namely benchmark product or commercial product and formula F1, F2, F3, F3 (the formulated beverages with composition variation of commercial fermented cocoa powder and unfermented cocoa powder). Based on this study, the sample benchmarking showed the dominant attributes of chocolate aroma, sweet taste, and sweet aftertaste. Samples F1, F2, F3 and F4 showed the dominant sensory attributes such as chocolate aroma, bitter taste, and bitter aftertaste. The level of panelists' preference for chocolate drinks decreased with the addition of unfermented cocoa powder due to the bitter taste and bitter aftertaste. In addition, the formula added with cocoa powder has not been able to compete with commercial products (Cempaka et al., 2021).

## **Factors Determining Consumers' Acceptance in Food Products**

Acceptance of food is directly related to the interaction of food with consumers at a certain time. Factors influencing food acceptance include consumers characteristics, sensory characteristics of food and enjoyment of food ('feel good' factor). Regarding the "consumers characteristics", it is reported that consumers have the tendency to correlate the assumptions they have on the sensory properties of food and the substantial properties delivered by the product. Consumers might compare the real product with the depiction given by the label on the package, how does its taste compare to the product description, how does its performance compare to the description indicated by the producer (Maina, 2018).

Regarding the “sensory characteristics of food”, it is reported that the sensory characteristics such as taste, aroma, texture, and appearance of food definitely affect the making of consumer’s choice regarding the preference of food materials. Once the product consumed by consumers, they can conclude and decide whether they like or dislike the product. Regarding the “enjoyment of food”, it is belief that the healthy and nutritional food are important for consumers. However, another important factor determining consumer acceptance but rarely considered by producers is a fact that consumer tends to consume the food they enjoy. Types of food offering enjoyment such as ice cream, coffee and chocolate usually consumed to enhance the positivity minds or to decrease the negativity minds. Although, it is still challenging for producers to formulate the pleasant food products yet healthy and nutritious (Maina, 2018).

In another study, in the food selection, it was reported that consumer beliefs, especially those related to taste improvement, are important factors to consider from new food products, followed by consumer beliefs about the effect of improving one's health. These consumer beliefs can successfully predict behavior in choosing food products. On the other hand, "Knowledge" refers to information that a person has such as the relationship between diet and health or about processed and packaged foods; which can be used as a basis for food selection. With regard to food, there is a positive relationship between consumers who have in-depth knowledge and consumer willingness to buy new products and also consumers' perceptions of the naturalness of the product with preference to buy (Grace et al., 2010).

## Conclusion

Nowadays, the cocoa products are becoming more varied in forms, functionalities and qualities due to the massive research to develop the new products. However those attributes can not be separated from the consumers’ view since consumers will determine the purchase decisions of the products. Consumers always demanding products which meet their expectation. The sensory evaluation can help the producers to make an approach in order to meet the expectation of consumers toward certain products. In conducted research and development of products, the standard designated of each cocoa product should always be referred too. Therefore besides fulfilling the product criteria of consumers, the new products are safe and standardized. The selection of sensory evaluation test should also be adjusted to the requirement of the desired results for product characterization. Thus, the whole description of products profile could be obtained in the objective way. This study argue that customers have a well-deserved reputation for being picky about receiving what they pay for. Performing sensory assessments may help manufacturers figure out how to better meet consumers' needs. Research and development on a cocoa product should always refer to the product's defined standard. Therefore, the new products are reliable, consistent, and suitable for consumers. To further characterize a product, we should choose a sensory evaluation test that takes into account the information we require.

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