

Acceptance, purchase intent and preference of semi-industrial chocolate

Pérez-Obrador, Christian Asur¹, Herrera-Corredor, Jose Andres^{2*}, Córdova-Ávalos, Víctor¹, Solana-Villanueva, N.¹, Zaldívar-Cruz, J. M.¹; García-Alamilla, P.³

¹ Colegio de Postgraduados Campus Tabasco. Periférico Carlos A. Molina S/N Km. 3, Periférico Carlos A Molina SN, Ranchería Río Seco y Montaña, 86500 Cárdenas, Tab. México.

² Colegio de Postgraduados Campus Córdoba. Cordoba - Veracruz Km. 348.5 Venta Parada 11, 94500 Córdoba, Ver.

³ Universidad Juárez Autónoma de Tabasco. División Académica de Ciencias Agropecuarias. Km. 25. Carretera Villahermosa-Teapa, Teapa, Tabasco.

* Correspondence: jandreshc@colpos.mx

ABSTRACT

Objective: To determine consumer liking for three types of semi-industrial chocolate and identify the critical attributes for acceptability, purchase intent, and preference among local consumers.

Design/methodology/approach: The affective testing method was conducted with 60 regular consumers in the region, who evaluated acceptability on appearance, color, aroma, flavor, aftertaste, and texture using a nine-point hedonic scale. Data were analyzed using analysis of variance. Acceptance and purchase intent were measured using a binomial scale (yes/no), and preference was measured using a three-point ordinal scale.

Results: Analysis of variance revealed that consumers liking was significantly different among the three types of chocolate, with overall liking scores ranging from 6.18 to 8.10 on the hedonic scale. The sample with the highest liking was milk chocolate, and the lowest was dark chocolate. Flavor and aftertaste were the key attributes for overall acceptability and purchase intent. Preference analysis indicated that milk chocolate was the most preferred.

Limitations on study/implications: The findings are limited to local consumers in the region and therefore cannot be nationally generalized.

Findings/conclusions: This study highlighted that the most important sensory attributes for local consumers when choosing chocolate products were flavor, aftertaste, and texture.

Keywords: consumer, chocolate, preference, cocoa. liking.

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INTRODUCTION

The global chocolate market is anticipated to reach \$145.17 billion in retail sales by 2026 (Toma & Săseanu, 2020). In Mexico cacao (*Theobroma cacao* L.) holds significant cultural and economic importance, particularly in the southeast region, where it is considered part of the regional heritage (Camacho-Gómez, 2019). However, cocoa production has been undermined by the multiple problems in cacao cultivation, such as insecurity, pod theft, increased diseases, and low yields caused by climate change (Tadeo-Sánchez &



Tolentino-Martínez, 2020). As a result, many cacao producers are moving towards small chocolate manufacture aiming to increase their participation in the value chain, even they face financial and technical challenges for product development (Martínez-Salvador & Martínez-Salvador, 2020). Understanding consumer preferences is essential for producers involved in adding value to cacao as it helps them choose formulations that are more likely to succeed in the market (Jaramillo, 2016).

Modern technology such as motor mills to grind cocoa beans has replaced the use of labor. This and other innovations have scaled up chocolate production to an industrial level (Fins, Somarriba & Quesada, 2013). Integrating chocolate processing along with cacao production opens an opportunity for a more profitable business for small producing farms. This would improve traceability, agroecological management, and production of healthier dark chocolates (Charry, Torres, & Narjes, 2023).

The wide variety and production of fine, aromatic chocolates have created diverse market niches that demand attention. Humans have an evolutionary preference for sweetness and an aversion to bitterness. Food acceptance or rejection is largely influenced by sensory factors, primarily taste, followed by smell and appearance (Contreras, 1995). Research on food consumption and acceptability has relied on studies involving consumers as well as on studies conducted by manufacturers to meet customer needs (Costell, 2001). The objective of the study was to assess consumer liking for three types of commercial chocolate, identify key attributes influencing acceptability and purchase intent based on consumer perception, and determine preferences.

MATERIALS AND METHODS

Location of the study area.

The research was conducted at Campus Tabasco of the Colegio de Postgraduados, located at Huimanguillo, Tabasco, coordinates: 17° 58' 34" N, 93° 23' 11" W. Huimanguillo belongs to the Chontalpa region of Tabasco. It is the second largest region in the state, with a land area of 8,407.74 Km² (García-Sánchez, 2014; Ayuso, 2023). Agriculture is among the main economic activities, with cacao cultivation accounting for 48,436 hectares, and 9,975 families depend on this crop (Córdova-Lázaro *et al.*, 2018).

Sample size determination (n)

The sample size was calculated using a simple random sampling design, considering a binomial categorical variable, and a total population of 152 individuals. In the study, random tests were conducted with 60 consumers from the Tabasco Campus, which represents 40%. According to the Universidad Popular Autónoma Estado de Puebla (2014), for affective testing, the minimum recommended sample size is 30 untrained consumers.

Chocolate samples

Three chocolate samples of each of the available types on the market were prepared: milk chocolate, semisweet chocolate and bitter chocolate (Table 1). The samples were prepared in the chocolate school at Colegio de Postgraduados, Campus Tabasco, México.

Table 1. Formulations for each type of chocolate.

Ingredients	Type of chocolate		
	Milk	Semi-bitter	Dark
Cocoa paste	30%	50%	70%
Brown sugar	28%	30%	20%
Cocoa butter	20%	20%	10%
Whole milk powder	20%	-	-
Natural vanilla extract	2%	-	-

Cacao was purchased from a local producer at “Hacienda La Ceiba”, located at 31° 12' 49" N y 110° 13' 27" W. The beans were roasted in batches (5 Kg each) for approximately 30 min using a 5 Kg roaster (MICRON, México). The grain was dehulled using mechanical equipment (model CACDES003, Citlali, México), and the cocoa nibs were then ground in a pulverizer mill (Pulvex 200, Pulvex, México). Finally, the cocoa paste was refined in a 5 Kg-capacity refiner operating at 1,400 rpm for 8 h (SANTHA 20 LBS, SANTHA, USA). During this process, all ingredients were mixed according to the formulation and then molded into pieces of approximately 8-10 g. The pieces were placed in a freezing display case (TEM-150, TORREY, Mexico) to crystallize at 4-5 °C. The samples were wrapped in wax paper, sealed in small glass jars, and stored refrigerated at 4 °C until they were evaluated by consumers. Each sample was assigned a random three-digit code, generated using the free R Studio software.

Questionnaire and consumer study (techniques)

Participants (n=60) were asked to complete a questionnaire written in Spanish comprising three sections: 1) demographic information, including name, sex, age, place of birth, monthly income, chocolate consumption frequency, consumption way, preferred type of chocolate and the main sensory characteristic that most affects its acceptability. 2) liking was measured for each attribute (appearance, color, smell, flavor, aftertaste and texture when chewing (UPAEP, 2014) using a 9-point scale (1=I dislike it very much, 5=I neither like it nor dislike it, 9=I like it very much). Consumers were asked whether the sample was acceptable (yes/no), as well as their purchase intent (yes/no). 3) preference was measured asking consumers to order the samples from 1 to 3, where “1” was the most preferred and “3” the least preferred sample (Ramírez, 2012; Cárdenas-Mazón *et al.*, 2018).

The laboratory was equipped with air conditioners, white lights and cabins to avoid bias in the experiment. Within each cubicle, the participants were randomly presented with the three coded samples, the questionnaire, a napkin and a pen to respond. A brief introduction to sensory evaluation and the senses was given, as well as the handling of samples for evaluation. Each consumer received three samples in a completely random order. In this study each treatment was evaluated 60 times. Water was provided for palate cleansing in between trials (Díaz, Pinoargote & Castillo, 2012).

Consumer profile

The age of most of the participants was between 18 and 54 years old (95%) distributed in 55% women and 45% men. The majority of consumers were originally from Tabasco (88.3%). The majority regularly consume chocolate (55%) while the remaining 45% indicated that they consume it occasionally. Within the consumption presentation, the majority indicated that they prefer to consume it solid (65%). Regarding the type of chocolate, the majority preferred milk chocolate 58.3%, whereas 33.3% preferred semisweet chocolate and the remaining 8.4% preferred bitter or dark chocolate. Finally, before tasting the samples, participants indicated that flavor (48.3%), aroma (16.7%) and appearance (11.7%) as the main attributes of chocolate that affect its overall acceptability.

Statistical analysis

Frequency tables were constructed from the demographic data. Analysis of variance (ANOVA) was used to identify significant differences in liking among the three sample treatments. Multiple logistic regression was used to find the key attributes for overall acceptance and purchase intent. The K-fold Cross-validation technique (no pre-processing, resampling=10 fold) was used to validate the logistics models. A Friedman's test and the analogue of the least significant difference were used to identify which of the three treatments was the most preferred. Finally, principal component analysis (PCA) was used to reduce dimensions and construct a biplot of product-attributes to observe the correlation among attributes and multivariate product similarities. Data were analyzed with R software version 4.0 using an $\alpha=0.05$.

RESULTS AND DISCUSSION

Differences between treatments

ANOVA results indicated a significant difference in liking based on sensory attributes among the three types of chocolate (Table 2).

According to the averages for liking on the hedonic scale by attribute, milk chocolate scored 7.6-8.10, being the treatment with the highest scores. Dark chocolate had the lowest scores overall, ranging from 6.18-7.83. However, it is worth mentioning that liking for all attributes by treatment was higher than the midpoint of the scale. Ramírez-Navas *et al.* (2014) analyzed manjar blanco, a typical Colombian dessert, using a nine-point hedonic scale, evaluating color, smell, flavor, and texture in four treatments (A, B, C, D). They found that treatment D obtained the best scores for smell (6.07 ± 1.86), flavor (6.79 ± 2.01),

Table 2. Chocolate liking across sensory attributes.

Treatments	Appearance	Color	Aroma	Flavor	Aftertaste	Texture
Milk chocolate	7.85±1.47a	8.00±1.12a	7.87±1.27a	8.10±1.08a	7.62±1.58a	7.76±1.48a
Semi-bitter chocolate	7.63±1.13a	7.63±1.28a	7.43±1.38a	8.10±1.08a	6.72±1.88b	7.35±1.44ab
Dark chocolate	7.70±1.23a	7.83±1.14a	7.70±3.69a	6.32±2.00b	6.18±2.06b	6.82±1.95b
p-value	0.64	0.237	0.607	2.56e-07 ***	0.000161 ***	0.00787 **

*Mean values \pm standard deviation on the hedonic scale (n=60). Means with the same letter in the same column are not significantly different according to the Tukey test ($\alpha=0.05$).

and texture (6.53 ± 2.06), whereas the color of sample C was the most pleasant (6.72 ± 1.96). They conclude that brand D was superior to the other brands in terms of consumer liking because it had a soft, smooth texture on the inside and a sandy and cracked texture on the surface. Regarding the results of the hedonic scale of dark chocolate, this seemed to be a little less pleasing, with a score of 6.32 different from the other treatments that obtained a value of 8.10. Similarly, Díaz, Pinoargote and Castillo (2012), they found significant differences among treatments compared to their white chocolate in terms of aroma, flavor, astringency, and acidity among other attributes. Their results indicated a higher score for their treatments with enzymes after roasting at 140 °C, which enhanced flavor and improved acidity, as well as reduced astringency.

In terms of aftertaste, milk chocolate stood out as it obtained a liking score of 7.62, higher than semi-sweet chocolate with 6.72 and dark chocolate with 6.18. Finally, in terms of texture, it was found that both milk chocolate and semi-sweet chocolate obtained similar texture scores between 7.35 and 7.76 points respectively, whereas dark chocolate obtained a lower score (6.82) although similar to the semi-sweet treatment. Pieracci *et al.* (2021), pointed out that texture and aftertaste are negatively affected by factors such as fat level, particle size and effects of poor chocolate tempering such as “sugar bloom” or “fat bloom”, the latter, for example, is the migration of fat to the surface, dragging cocoa butter crystallizing on the surface, which generates a bad appearance for the consumer. The same with sugar, only this effect is produced by humidity (Beckett, 2019 p.21).

Critical sensory attributes for acceptability and purchase intent

Metrics for the acceptability logistic model (ROC=0.92; sensitivity=0.61; specificity=0.94; and AIC=103.29) indicated the strong ability of the model to discriminate between acceptability and rejection. Table 3 shows the results from the multiple logistic regression analysis. Based on the p-values for the attribute coefficients it was found that the critical attributes impacting overall acceptability (independently of the formulation) were flavor ($p=0.0475$) and aftertaste ($p=0.0247$).

Despite consumers initially responded (prior trying the chocolate samples) the most important sensory attributes affecting overall acceptability were flavor, aroma and

Table 3. Key attributes for overall acceptability according to multiple logistic regression analysis.

Attribute	Coefficient	Pr(> z)
Appearance	-0.2526	0.3512
Color	-0.3132	0.3552
Aroma	0.3140	0.1675
Flavor	0.5244	0.0475 *
Aftertaste	0.6324	0.0247 *
Texture	0.1537	0.4839

* Pr(> |z|) values that indicate the significance of the coefficient in the multiple logistic regression and allow identifying the critical attributes for product acceptability.

appearance, results from logistic regression indicated that taste perception provided more information regarding consumer liking or overall acceptability. The most significant sensory attributes were flavor, aftertaste, and texture perceived in the mouth. Indiarito *et al.* (2025) in their study with different vegan milk chocolates, they found no significant differences in color, appearance, and texture, but they did find differences in aftertaste, flavor, brightness, and aroma. Richter and Lannes (2007) found that a dietary chocolate formulation similar to the commercial ones, obtained a higher score in flavor and texture, with a significant difference to the control. In their study, consumers valued the smooth flavor, the texture of the filling and a pleasant sweet flavor. Pérez-Obrador *et al.*, (2025) evaluated consumer preferences for three types of chocolate, where the sweet milk treatment was preferred for its sweetness, smoothness and cultural evocations as well as pleasant sensations. However, there is a growing acceptance of dark chocolate among adults who associate it with higher quality and health benefits (Córdova *et al.*, 2023).

Eating is an act that involves different dimensions, such as cultural, biological, economic, and psychological. Therefore, the act of choosing or accepting a food is usually influenced by consumer attitudes, acquired habits, previous experiences with food, appetite, mood, and many other factors that affect food choice (Téllez, 2019). Flavor and aftertaste are essential attributes in determining food acceptance, as they relate to the senses of taste and touch within the oral cavity. These sensory experiences begin to develop in the last weeks of gestation, continue when consuming certain foods during infancy and further develop food acceptance criteria (González & Reyes, 2023).

Purchase intent followed a similar pattern as acceptability. Metrics for the logistic model (ROC=0.91; sensitivity=0.68; specificity=0.93; and AIC=124.17) for purchase intent indicated the strong ability of the model to discriminate purchase intent. Table 4 shows the key attributes for purchase intent for all treatments: flavor ($p=0.00294$) and aftertaste ($p=0.00930$).

These attributes can be focused on developing chocolates that producers, small micro-entrepreneurs, or other interested parties can exploit by generating attractive products that ensure a place in the product range offered, in an attempt to offer differentiated products of sensory quality to the local or national market.

Table 4. Key attributes for purchase intent according to multiple logistic regression analysis.

Attribute	Coefficient	Pr(> z)
Appearance	-0.0839	0.7305
Color	0.2040	0.4764
Aroma	0.0954	0.2661
Flavor	0.6907	0.0029 **
Aftertaste	0.6098	0.0093 **
Texture	0.1090	0.5763

* Pr(> |z|) values that indicate the significance of the coefficient in the multiple logistic regression and allow identifying the critical attributes for the purchase intent of the product.

In Figure 1, the milk chocolate treatment was oriented towards the positive side of variable axes demonstrating higher values in liking (according to the hedonic scale).

Regarding variable correlation, there were two correlated variable groups: 1) aroma, appearance and color, and 2) flavor, aftertaste and texture.

The first attribute subgroup is associated with organs based on visual or external phenomena, whereas the second variable subgroup is based on mechanical stimuli in the corresponding organs (Braun, 1997). Among the three treatments, the profile of milk chocolate was sweeter, less acidic, light brown, and reduced in shine, in contrast to dark chocolates, which have a more intense, bitter flavor, greater shine, and a dark brown color (Bartkiene *et al.*, 2021; Pieracci *et al.*, 2021). The treatments for dark and semi-sweet chocolate were similar between them but differed from the milk treatment. Milk chocolate was the most accepted among the three treatments. This is likely due to the innate preferences for sweet taste, which is formed by the consumption of breast milk during the first stages of infancy (González & Reyes, 2023). As Dip (2019) pointed out, eating behavior is closely related to perceived flavor.

Preference

The result from the Friedman test indicated that the preference differed ($p < 0.0003$) among chocolate types. The post-hoc test carried out with the analogue of the least significant difference based on the comparison of rank sums for each treatment indicated that the most preferred chocolate was milk chocolate, followed by semi-sweet chocolate and finally bitter chocolate (Table 5).

Consumers tend to consume food according to their tastes and needs as well as their preference for food. It is understandable that with the increasing per capita consumption of sugary foods, the palates of those accustomed to these foods tend to prefer them (Kamil

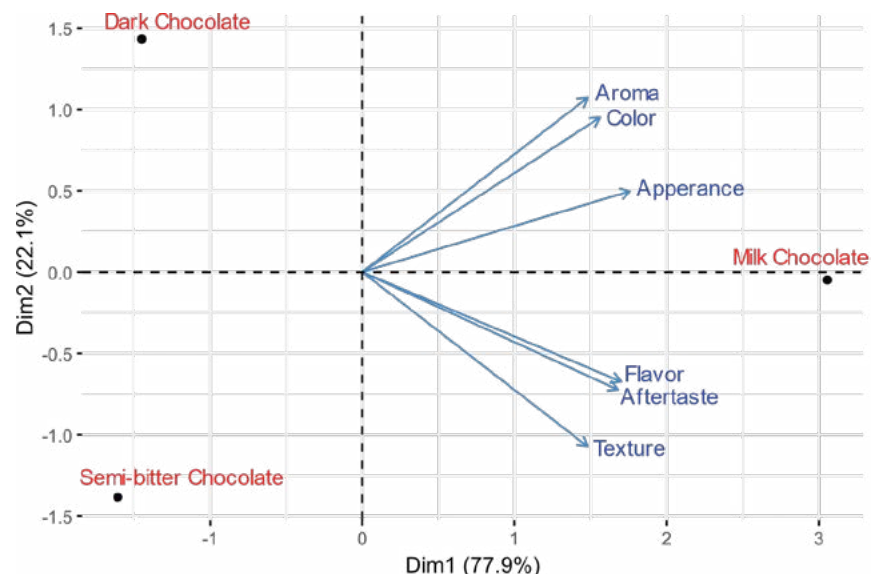


Figure 1. Biplot involving chocolate treatments and sensory attributes.

Table 5. Differences in preference of chocolate samples.

Treatments	Rank sum	Letter grouping
Dark chocolate	150	a
Semi-bitter chocolate	120	b
Milk chocolate	90	c
LSD	18.94	

*LSD=Least significant difference.

& Wilson, 2021). Consumers tend to consume foods according to their tastes and needs (Brambila, 2006); just as their (emotional) preference for foods leads to many nuances that can be explored from different perspectives and disciplines (Vélez & García, 2003).

CONCLUSIONS

Consumer satisfaction with chocolates in Tabasco was influenced by taste and touch: flavor, aftertaste, and texture were the critical sensory attributes. Consumer preference for chocolates tended toward sweet chocolate flavors, with milk chocolate being the most preferred. This is due to the fact that, on a sensory level, dark chocolate offers a more intense profile, with bitter, astringent flavors that tend to be rejected by most palates or those accustomed to sweet tastes. Regarding overall acceptability and purchase intent, flavor was the most determining attribute, followed by aftertaste. These attributes are detectable in the mouth and are the most important factors in determining whether we accept and purchase such products.

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