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Selection Of Applicants To Create A Panel Of Expert Evaluators For Cocoa Liquor Evaluation: Phase I

Selección De Candidatos Para Crear Un Panel De Evaluadores Expertos Para La Evaluación Del Licor De Cacao: Fase I

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RESUMEN

El panel de evaluación sensorial es una herramienta analítica de gran importancia para la valoración de los atributos de los genotipos de cacao cultivados en Colombia. El objetivo de este trabajo es establecer la metodología para la fase I, correspondiente a la preselección y selección de un grupo de candidatos a evaluadores sensoriales, a través de un proceso sistematizado de preselección, selección y de entrenamiento permanente, con el propósito de evaluar muestras de licor de cacao de distintos materiales genéticos

e identificar atributos particulares de interés para la industria del cacao y el chocolate. El cacao de Colombia es catalogado por la ICCO como fino de sabor aroma, el identificar estas características permite el reconocimiento de varios atributos en genotipos del país. Con los resultados de la fase I se consolido el proceso de preselección, selección y entrenamiento del panel de evaluación sensorial del centro de investigación la Suiza con el adecuado uso de los órganos de los sentidos, la normatividad en análisis sensorial vigente, los conceptos sobre el cacao en grano y los atributos sensoriales básicos, específicos y adquiridos para el cacao.

Palabras clave: Análisis sensorial, Evaluador, Panel, Preselección, Selección.

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ABSTRACT

The sensory evaluation panel is an analytical tool of great importance for the evaluation of the attributes of cocoa genotypes grown in Colombia. The objective of this work is to establish the methodology for Phase I, corresponding to the pre-selection and selection of a group of candidates for sensory evaluators through a systematized process of pre-selection, selection, and permanent training. The purpose is to evaluate cocoa liquor samples from different genetic materials and identify particular attributes of interest for the cocoa and chocolate industry. Colombian cocoa is classified by the ICCO as fine in flavor and aroma; identifying these characteristics allows for the recognition of various attributes in Colombian genotypes. Therefore, the process of pre-selection, selection, and training of the sensory evaluation panel at the La Suiza research centre was consolidated

thanks to the results of Phase I. This was done with the appropriate use of sensory organs, adherence to current sensory analysis regulations, understanding of cocoa bean concepts, and recognition of the basic, specific, and acquired sensory attributes for cocoa.

Key words: Sensory analysis, Evaluator, Panel, Pre-selection, Selection.

INTRODUCTION

The formation of the first sensory panel was begun in the department of Santander, in 2010, led by the National Open and Distance University (UNAD) in cooperation with the National Federation of Cocoa Growers (Fedecacao). Afterwards, the second one was done in alliance with with the National Learning Service (SENA) C.A.S.A in 2017. Lately, the establishment of a third sensory evaluation panel for cocoa liquors obtained from different planting models began in early 2019 with the Colombian Agricultural Research Corporation (AGROSAVIA). The aim was to characterize the flavour and aroma attributes of special cocoa genotypes.

Sensory evaluation of food is a science that intends to determine the organoleptic characteristics of a food and its acceptance by consumers; It draws on various sciences such as psychology, physiology, biology, and statistics to scientifically verify the assessments made by a sensory evaluation panel. (Alcázar-Orozco, et al., 2024; Luna-García et al., 2024; Parada et al., 2020).

Sensory evaluation is inherent to human beings, who, like many other living creatures, assess food using their senses—interpreting smells, tastes, textures, colors, and sounds before consuming it. This sensory information allows people to choose diets according to their preferences, nutritional content, caloric intake, and the cultural tradition or memories associated with food. With the industrialization and mass production of food, there also arose the need to establish sensory evaluation methodologies that objectively provide information on food preference trends and the special attributes of a food product.

A sensory evaluator is an individual who shares interests related to activities associated with a food product. In the specific case of characterizing cocoa

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genotypes produced in Colombia, the sensory evaluation panel is formed around workers at La Suiza research center of Agrosavia, the productive sector, universities, and communities interested in valuing the sensory attributes of this food matrix. Then, a sensory evaluation panel is an analytical instrument that evaluates the attributes of food, providing sufficient information through easily interpretable mathematical algorithms for decision-making (Bonilla y Vera, 2019).

In Colombia, cocoa cultivation is experiencing a boom due to the increase in exported tons, and its classification by the ICCO as one of the finest in flavour and aroma (MADR 2021). Currently, the cultivated area contains various genotypes whose flavour and aroma attributes vary from one genetic material to another, influenced by agroecological regions, agroecological management, and post-harvest handling.

This dynamic leads to the sensory evaluation of the attributes of cocoa produced in Colombia and continuous improvements associated with the processes of selecting varieties for cultivation, maintaining crops, harvesting, post-harvest (fermentation and drying), and even roasting and grinding to obtain "cocoa liquor."

The main transformation process can be ensured through sensory evaluation, identifying relevant positive and negative aspects that support the quality improvement of cocoa cultivation. Cocoa cultivation is a traditional crop in the Santander region, and it has expanded as a promising crop across different regions of the country. For this reason, it is important to implement a sensory evaluation laboratory to assess the genetic materials of cocoa from the departments of Santander, Boyacá, and Sucre that contributes to the identification of varieties with commercial attributes of interest and, moreover, for the chocolate industry in general, which is experiencing significant growth worldwide due to the so-called special cocoas.

In this process, the selection of sensory evaluators was validated following Colombian technical standards and guidelines for sensory analysis, regulations that in Colombia are adopted, evaluated, and approved by the Colombian Institute of Technical Standards and Certification - ICONTEC.

The methodology for the sensory evaluation panel was established in two phases: In

Phase I, which covers pre-selection and selection; candidates were surveyed in order to gather information related to age, formal education, eating and drinking habits, willingness to receive training, availability to participate in panel activities, product preference, and training in basic sensory aspects. On the other hand, Phase II consisted of specific training and evaluation of training related to the relevant food matrix. This paper presents the development of Phase I. (Parada et al., 2020)

In PHASE I, the pre-selection survey is administered to a group of workers and collaborators at the La Suiza Research Center who expressed interest in participating in the sensory evaluation project for cocoa liquor. The participants, who have other job functions within the organization, will be part of the sensory evaluation panel to assess cocoa liquor samples of interest from the departments of Santander, Boyacá, and Sucre in Colombia. (Fedecacao & Min-Agricultura, 2013)

The pre-selection process in Phase I is supported by rigorous tests aimed at verifying the sensory abilities of each participant to determine specific characteristics such as taste, color, and aroma, as well as the differences or attributes of a food product, in this case, special genotypes of cocoa, through the application of discriminative tests. (Quintana Fuentes & García Jerez, 2021)

The objective of this work was the pre-selection and selection of a group of candidates for sensory evaluator through a systematic process of pre-selection, selection, and ongoing training that can establish the sensory profiles of cocoa liquor. The importance of the Sensory Panel lies in the potential of cocoa production in Colombia, considered fine-flavored and aromatic cocoa at 85%.

MATERIALS AND METHODS

This research was conducted with personnel working at the La Suiza Research Center of the Colombian Agricultural Research Corporation (AGROSAVIA), located in the municipality of Rionegro in the department of Santander, Colombia (coordinates: N 7°22'12" W 73°10'39").

The research center La Suiza has emphasized scientific work on the cocoa specie, that includes areas the genetic materials improvement from various genotypes of interest to the region and Colombia itself; this research center houses the national germplasm bank, which is a

source for selecting attributes of interest related to cocoa of special flavor and aroma. Furthermore, Its research also focuses on developing genetic materials or cocoa varieties with high yield per hectare, disease resistance, and superior physical, chemical, and sensory quality.

This research is quantitative, experimental, and descriptive which included statistical methods for the pre-selection and selection of sensory evaluators; these statistics were also applied during the training phase. Within this methodology, a panel leader was designated to be responsible for the success of this activity and to evaluate and determine the continuity of candidates, providing feedback on the selection process for all participants at each stage. Therefore, the evaluation through sequential probability ratio test (SPRT) analysis has a high reliability level by designating the best candidates for the panel to be formed.

The methodology used is supported by Colombian technical standards and guidelines from the Colombian Institute of Technical Standards and Certification (ICONTEC), which us the national standardization institution in Colombia. For this research, technical standards and guidelines available in the databases of the UNAD library and the Colombian Agricultural Library of AGROSAVIA were used. Table 1 describes some of the main documents used in Phase I.

In the selection of personnel in Phase I, the project was socialized with the community (AGROSAVIA workers, the productive sector, teachers, and students), a factor that contributed to the success in the establishing of a group of evaluators associated to a sensory analysis laboratory. (GTC 165, 2014).

Table 1. Main documents of technical guides and standards from ICONTEC for sensory evaluation.

Number And Dat	Title
Gtc 165: 2014	Análisis Sensorial. Metodología. Guía General
Ntc 5278: 2004	Análisis Sensorial. Metodología. Análisis Secuencial
Gtc 280 :2017	Análisis Sensorial. Directrices Para La Selección, Entrenamiento Y Seguimiento De Evaluadores Sensoriales Seleccionados Y Expertos
Ntc 3929: 2021	Análisis Sensorial. Metodología. Métodos Del Perfil Del Sabor
Ntc 3501:2008	Análisis Sensorial. Vocabulario
Ntc 3883:2021	Análisis Sensorial. Metodología. Prueba Dúo-Trio
Ntc 2681: 2004	Analisis Sensorial. Metodologia. Prueba Triangular.

Ntc 2680:2005	Análisis Sensorial. Metodología. Prueba De Comparación Pareada

Project Socialization The project socialization was an ideal opportunity to apply the pre-selection survey, which aimed to identify five criteria for pre-selection: health status, eating and drinking habits, willingness to participate in the training and evaluation process, availability of time, and taste for cocoa according to the methodology established in the Colombian technical guide GTC 165 of 2014 and GTC 280 of 2017, where the importance of establishing these criteria for pre-selection is described (Figure 1).

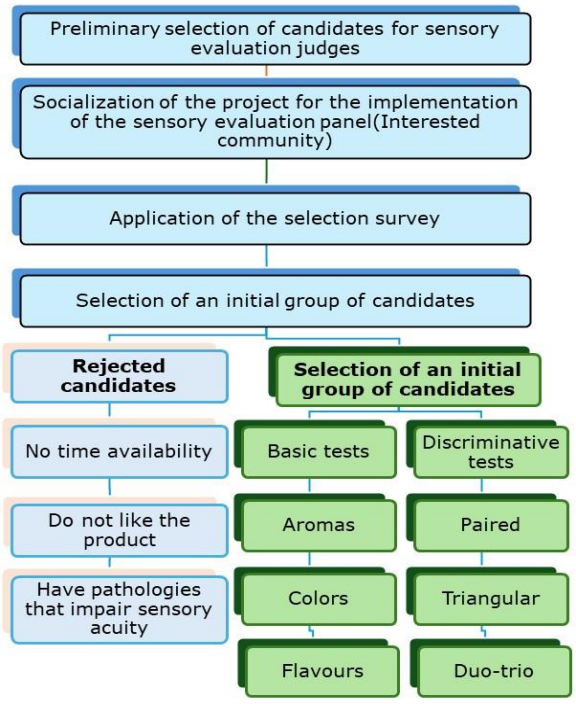

Figure 1. Importance of establishing these criteria for pre-selection is described.

Survey Application

The pre-selection of candidates for sensory evaluators was carried out with the consolidated results of the survey. The pre-selected group of candidates was subjected to basic taste tests according to GTC 280 of 2017 and NTC 3915 of 2012, color tests, and aroma tests according to NTC 4503 of 2011. Discriminative tests such as paired comparison for three selected food products were also conducted as established in NTC 2680 of 2013, the duo-trio test for three products according to NTC 3883 of 2021, and the triangular test for three products according to NTC 2681 of 2006. Each candidate judge completed a total of 25 tests. (NTC2681, 2006)

The paired comparison test was applied to determine an attribute of a food product. Two coded samples were presented to the panelists, and they were asked, for example, "Which of the two samples is sweeter?" The samples were presented to each panelist coded and accompanied by a form for recording their assessment in a written way. (NTC 2680, 2013)

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The triangular test was conducted with three samples, two of them were identical and the other one different. The samples were coded with three digits. The panelist chose the sample that was different from the other two. The samples were presented with a form for recording the assessment in a written way.

In the duo-trio tests, two coded samples were presented along with a third reference sample marked with the letter "R." The question asked to participants was, "Which of the two samples is the same as 'R'?" (NTC-3883, 2006)

The tests for each candidate were performed in triplicate, facilitating the interpretation of results and validating them when presented statistically through sequential analysis, contributing to more representative outcomes.

For the tests, commercial products such as ketchup, mayonnaise, jams, or processed juices among others were used. The information obtained was analyzed using the sequential analysis method according to NTC 5278 of 2004 (ICONTEC 2004), which evaluates the candidate's ability to discriminate attributes present within a wide range of Flavors and smells. In this process, confidence limits were established in the selection, assigning reliability percentages—45% for the lower limit and 70% for the upper limit. A 5% error was assigned. The data were processed to generate the corresponding graph and visually determine each candidate's performance and position in the acceptance, follow-up, or rejection zone. (NTC 5278, 2004)

In Phase I, the selection of candidates and ongoing training allowed the group to be consolidated with the aim of reinforcing learning and motivation, leading to the understanding of concepts, the application of techniques, and the evaluation of performance results both for the group as a whole and for each individual member. (Gallerani, 2000)

RESULTS AND DISCUSSION

Results of the Pre-selection Survey in Phase I

The pre-selection survey was applied to candidates for sensory evaluators at the La Suiza Research Center of AGROSAVIA, located in the municipality of Rionegro, department of Santander. The target population consisted of 78 candidates, including scientific, administrative, and operational staff at the center, as well as

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strategic collaborators such as academia, the productive sector, and various local and departmental government entities interested in the project, as shown in Table 2. The data analysis yielded the following results for each survey question.(Fernando et al., n.d.)

Table 2. Age range of participants who responded to the pre-selection survey

Age Range	21 30	to 31 40	to 41 50	to 51 55	to Total
Years	31	26	16	5	78

The age range of 20 to 50 years is ideal for candidates as sensory evaluators. Somatosensory receptors' thresholds increase with age, meaning a loss of sensory acuity (Severiano 2021). In addition to age, the threshold increase in sensory organs may be due to consumption habits that decrease the perception capacity of various receptor cells, such as the consumption of spicy or hot foods. The majority participation, with 39%, was in the 21 to 30-year age range, with 32 participants, strengthening the group with individuals in ages where perception thresholds are higher to sensory stimuli. (Martínez-García et al., 2018)

Candidates aged 31 to 40 years also stood out, with 26 applicants, corresponding to 33%. The 41 to 50-year age range had 16 participants, representing 20%. The smallest age range was those over 51 years old, with six people, representing 8% of the participants.

Table 3. Visual impairments of the surveyed population

Age Range (Years)	21 to 30	31 to 40	41 to 50	51 to 55	Total
Hyperopia	1	3	2	1	7
Astigmatism	1	3	3	2	9
Myopia	15	2	0	0	17
Glaucoma	0	0	0	0	0
Cataracts	0	0	0	2	2
Color Blindness	0	0	1	0	1
Presbyopia	0	0	4	0	4
None	14	18	6	0	38
Total	31	26	16	5	78

The previous information highlights that 38 people do not have visual impairments, with 36% corresponding to the 21 to 30-year age range, and 47% to the 31 to 41-year age range. It is also important to note that only one participant has color blindness or color vision deficiency. All participants have corrected visual impairments, except for the person who is colorblind.

Health Status of Olfactory and Auditory Sensory Organs

Table 4. Health status of olfactory and auditory sensory organs.

Age Range (Years)	21 to 30	31 to 40	41 to 50	51 to 55	Total
Respiratory Disease	9	4	5	2	20

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Hearing Loss	1	3	1	0	5

Table 4 presents information related to respiratory diseases among 20 candidates, broken down as follows: 5 respiratory allergies, 1 tonsillitis, 2 frequent colds, 11 rhinitis, and 1 sinusitis. This corresponds to 25% of the candidates who completed the survey. In terms of hearing loss, 5 candidates reported this condition.

The respiratory health of participants in the sensory evaluation panel is directly associated with their capacity to perceive the sensory attributes of a food product. Some respiratory diseases can affect perception and may cause anosmia (inability to perceive aromas), while alterations in mouth and tongue receptors can cause ageusia (inability to perceive taste).

Substances like capsaicin from chili peppers, alcohol, and cigarette tar alter mouth and olfactory bulb receptors over time. This condition prevents the detection of food molecules or requires higher concentrations of these molecules to be able to identify them. Upper respiratory tract diseases affecting the nose, nasal cavity, mouth, and throat (pharynx) can communicate with the middle ear and paranasal sinuses. These structures are prone to respiratory diseases caused by viruses, bacteria, fungi, and allergens found in air pollution.

Consumption Habits of the Candidates

Table 5. Consumption habits of the candidates.

Age Range (Years)	21 to 30	31 to 40	41 to 50	51 to 55	Total
Smoking	1	3	0	0	4
Alcohol Consumption	3	5	0	0	8
Coffee Consumption	18	21	15	17	71
Spicy Food Consumption	14	17	12	1	44

The information in Table 5 highlights the consumption of cigarettes by only 4 candidates, and alcohol consumption is low in general terms, with 8 participants consuming it once a month or on weekends. This result indicates a group with healthy habits, in addition to the ideal age range (over 21 years to 50).

It is notable that 71 candidates consume coffee daily as a hot beverage. This preference is part of Colombia's cultural consumption, which, according to various studies by the National Federation of Coffee Growers, has been a deeply rooted habit since the 1980s. Coffee consumption in the morning before breakfast is present in 97% of households, with the number of coffee cups consumed throughout the day varying

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between 12 cups per household on average.

Coffee is a stimulating beverage containing antioxidants, which have been shown to be beneficial to health when consumed in one or two cups a day. However, for sensory evaluators, it affects the detection of basic flavors like bitterness and sweetness. For this reason, it is not recommended to consume coffee before sensory evaluation panel tests.

Education Level of the Participants. The importance of this aspect lies in the planning of training activities. 66% of the participants are professionals, technicians, and technologists, and 28% with undergraduate degrees, resulting in 94% with adequate educational backgrounds.

These values help identify a sample of participants with sufficient and homogeneous educational levels for the educational processes planned, enabling participants to acquire the necessary competencies throughout the training process.

Availability, Willingness, and Liking for the Product. To build a strong group of sensory evaluators, it is important to consider aspects of availability—understood as the time a candidate can dedicate to each of the activities programmed by the sensory evaluation panel leader. Table 6 presents information by age range and options according to group behavior. Individuals who indicated no availability were automatically excluded from the selection process for sensory evaluators.

Table 6. Availability, willingness, and liking for the product.

Age Range	Yes	No	Number of Responses
21 to 30	29,8076923	1,19230769	31
31 to 40	25	1	26
41 to 50	15,3846154	0,61538462	16
51 to 55	4,80769231	0,19230769	5
Total	75	3	78

The 21 to 31-year age range had the highest number of responses, with 31, representing 29% of all candidates, strengthening the group with young individuals who provide sensory acuity. The 25% corresponds to the 31 to 40-year age range, representing young adults. These two age ranges account for 54.8% and ensure the success of forming a group of sensory evaluators in training, allowing the incorporation of new candidates as part of the dynamic of maintaining the sensory evaluation panel over time.

Availability, willingness, and liking for the food product are crucial aspects of Phase I of establishing a sensory evaluation panel. For these variables, it is expected that more than 95% of participants will positively express their intentions according to the chi-square test, posing the hypothesis:

- **Ho**: Availability, willingness, and liking for the product do not influence the pre-selection of Phase I candidates for sensory evaluators.
- **H1**: Availability, willingness, and liking for the product influence the pre-selection of Phase I candidates for sensory evaluators.

With a chi-square value of 1.43768917 and a reliability of 95%, it is determined that the determining aspects of pre-selection are associated with availability, willingness, and liking for the product. Phase I began with a group of 75 candidates for sensory evaluators, and by the end of the process, 25 participants remained, representing 18% of the candidates accepted who completed the pre-selection survey.

Basic Taste Tests. The basic taste tests were conducted using patterns of sucrose for sweetness (10 g/L), citric acid for sourness (0.3 g/L), caffeine for bitterness (0.3 g/L), and sodium chloride for saltiness (2 g/L). The test was presented to the candidates under coded conditions and an environment that allowed participants to concentrate.

This test was presented to 35 individuals, which corresponds to 46% of the total surveyed for pre-selection. Table 7 presents the information on candidates who correctly identified the basic tastes at low concentrations in sugar, sodium chloride, citric acid, and caffeine solutions.

Table 7. Identification of Basic Tastes.

Basic Tastes	Sweet	Salty	Bitter	Sour
Candidates who Identified Basic Tastes	31	34	34	31
Candidates who Did Not Identify Basic Tastes	4	1	1	4

Only 30 people identified all four basic tastes. Four candidates could not identify the sweet and sour tastes, and one person could not identify the salty and bitter tastes.

Color Perception. Color is defined as the sensation from the spectral range (visible light from 380nm to 780nm). The light reflected by different objects is received through the eye structure, where two types of retinal receptors, cones, and rods, capture the various wavelengths of light. This information is transmitted to the brain, where it is interpreted as image and color. The rods handle monochromatic light and are abundant in the retina's periphery, while

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the cones are responsible for color perception (green, red, and blue).

This test was presented to 35 individuals, of whom 33 had normal color vision. One candidate had color blindness, and another did not complete the test.

Aroma Detection. Fresh and processed foods, as well as various household substances, contain a large number of volatile molecules that give them their characteristic smell and allow them to be identified. The composition of these molecules includes aliphatic, alicyclic, and heterocyclic structures, with their relationships to multiple functional groups that can change position within the molecule. More than 10,000 such substances have been identified. The aroma test was conducted with 22 individuals, representing 33% of the pre-selected candidates. Only seven candidates successfully identified all the samples of cinnamon, chocolate, coffee, banana, clove, and soap. Table 8 shows the results of the test.

Table 8. Basic Aroma Test.

Basic Aromas	Cinnamon	Chocolate	Coffee	Banana	Clove	Soap
Candidates who Identified All or Some Basic Aromas	16	13	16	14	16	12
Candidates who Did Not Identify All Basic Aromas	6	9	6	8	6	10
% of Correct Responses	64	52	64	56	64	48

The candidates identified the aromas of common food and non-food products by evoking memories to identify a coded sample. The most used products in the test were cinnamon, coffee, and clove, whose aromas are easily identified by most participants. The chocolate used (a mixture of cocoa liquor and 70% sugar) had less intense molecules, making identification more difficult. (NTC4503, 2011)

Performance in Discrimination Tests. Discrimination tests are analytical (paired comparison, duo-trio, and triangular) and allow to determine the particular attributes of a food product that distinguish it from other formulations of the same raw material.

This test was presented to 24 individuals from the initial group of 75, representing 32%. The test was conducted in triplicate: three paired comparison tests (P_1-2-3), three duo-trio tests (D_T 1-2-3), and three triangular tests (T_1-2-3). Table 9 presents the detailed information, highlighting that only one candidate correctly answered all

the tests using commercial food products such as mayonnaise, ketchup, jams, juices, among others. These tests involved detecting small differences between samples related to sweet, salty, bitter, or sour flavors, or other attributes of interest.

Table 9. Paired Comparison, Duo-Trio, and Triangular Tests.

Number of Correct Responses Observed	Paired Comparison	Duo-Trio	Triangular
1	11	19	22
2	22	13	10
3	17	15	18

The paired comparison, duo-trio, and triangular discrimination tests presented a high degree of difficulty, with overall approval percentages as follows: 34.01% for the paired comparison test, 31.97% for the duo-trio test, and 34.01% for the triangular test. The probability of approval among the 22 candidates was 9.4, with a chi-square value of 89385.

Table 10. The paired comparison, duo-trio, and triangular discrimination.

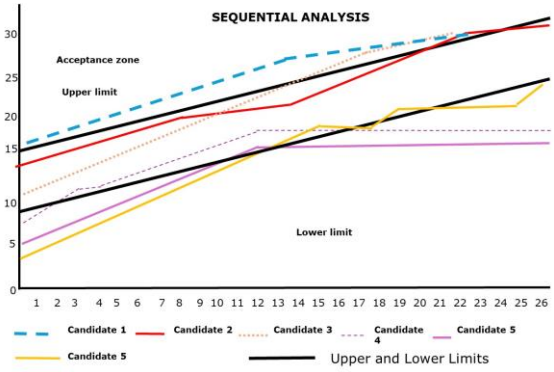
Percentage of Approval	Paired Comparison	Duo-Trio	Triangular
1	17,6870748	16,6258503	17,6870748
2	15,3061224	14,3877551	15,3061224
3	17,0068027	15,9863946	17,0068027
Total	50	47	50

The samples were coded with three digits to eliminate possible interpretation leading to errors. Additionally, each test was conducted in cubicles isolating the candidate from other environmental factors that could reduce concentration during sample evaluation.

Application of Sequential Analysis Tests – Selection. Figure 2 presents the selection information according to sequential analysis. The interpretation is based on two lines called the lower limit (LL) and upper limit (UL), with a percentage range of 45% to 70% to broaden the approval options. The data above the upper limit correspond to accepted candidates; for example, Candidate 1 passed all the tests conducted. Candidate 2 was rejected because they were below the lower limit, and the area between the two limits corresponds to candidates continuing in training and education. The performance of five

candidates is shown in Figure 2 to illustrate detailed behavior during the tests. Figure 2 does not show the performance of all 22 candidates to avoid overlapping the lines on the graph.

Figure 2. Process Control for Selection According to Sequential Analysis.



Phase I concludes with this selection process of 22 out of 25 projected candidates who completed the paired comparison, duo-trio, and triangular discrimination tests. Fourteen candidates continue with the training and education process in the next phase. The eight candidates rejected based on performance may undergo retraining to be included in a new selection process.

Phase I marks the beginning of the permanent establishment of a sensory evaluation panel, a decision made by the business organization with the goal of working on the integral quality aspects of cocoa. During this phase, a process based on learning and training is implemented for the interpretation and evaluation through the senses, supported by a methodology that collects assessments and transforms them into easily interpretable graphs and estimates for decision-making. The cocoa cultivated in Colombia belongs to various genetic materials with fine sensory attributes of flavor and aroma. In the development of this project, the sensory evaluation panel will be composed of personnel from Agrosavia and interested community members (universities, farmers, and students) to characterize the cocoa crops from the departments of Santander, Boyacá, and Sucre.

Discussion. In the food industry, constant efforts are made to satisfy the diverse preferences for the consumption of a particular food product. Understanding the attributes of a food item is of great importance in marketing strategies, and it is through sensory evaluation, using the sensory evaluation panel as an analytical tool, that the extent of consumer preference can be determined.

The formation of a sensory evaluation panel is an application within the field of Research, Technological Development, and Innovation - I+D+i-.This relationship primarily occurs within the framework of integration between

the government, industry, and academia, with the aim of characterizing a food product, defining the specific characteristics of the cultivation location, and determining the consistent quality derived from sanitary, physical, chemical, and sensory aspects required by markets and consumers. (Lawless, 1993)

The results obtained in Phase I are consistent with other studies conducted with the National Federation of Cocoa Growers (Fedecacao) and the UNAD in the municipality of San Vicente de Chucurí, department of Santander, which currently has a laboratory and a panel of sensory evaluation experts. In this context, this research project will identify the sensory properties of cocoa cultivated in the five agroforestry regions of the country, following national and international protocols and guidelines for the comprehensive quality of cocoa. This initiative is supported by multiple stakeholders in the cocoa sector, highlighting that cocoa crops in the country are classified as fine in flavor and aroma, a distinction held by only 5% of the world's cocoa beans according to the International Cocoa Organization (ICCO, 2020).

The group of sensory evaluators in training that was formed, which in this research is a mixed sensory evaluation panel, is composed of people who work within the organization and who, as a complementary part of their functions, join the panel. Additionally, due to their professional, cultural, and residential backgrounds, they are familiar with the cultivation, commercialization, and transformation of cocoa beans into chocolate.

The expertise of each sensory evaluator is a project that requires time, involving continuous learning processes that are founded in Phase I, with ongoing training in flavor, color, and texture. The teaching and learning program focuses on the technical aspects of the senses, knowledge of standards and technical guidelines, and intrinsic knowledge of cocoa cultivation and transformation. This is aimed at identifying both positive and negative sensory characteristics that affect the quality of cocoa beans and are associated with poor harvesting and processing practices, which are detected through sensory evaluation.

In Phase I, the process of recognizing and learning about the sensory characteristics of cocoa genotypes begins, encompassing several agroecological zones in the country, to determine the attributes of cocoa and

create a library of smells and flavors associated with each genetic material.

The creation of a sensory evaluation panel is based on an institutional decision that recognizes the importance of characterizing a food product to promote cultivation and commercialization with the best economic and social outcomes. This is a continuous process that begins with a group of people interested in joining the panel, and through years of continuous selection and training programs, they achieve recognition in the sector as expert sensory evaluators. The methodology for learning and training is based on ICONTEC standards and other international guidelines from associations in Europe, Asia, and the United States.

The sensory evaluation panel is led by a leader, with the participation of a minimum of five sensory evaluators. The dynamic actions within the panel involve constant plans for selection, training, and academic development, as well as the incorporation of new sensory evaluators to strengthen the core group.

CONCLUSIONS

The selection tests for basic tastes, colors, aromas, and discrimination (paired comparison, duo-trio, and triangular) are part of Phase I, as well as the training process. The greatest difficulty was observed in the discrimination tests, with an approval rate of 34.01% for the paired comparison test, 31.97% for the duo-trio test, and 34.01% for the triangular test. During this stage, maintaining group cohesion is essential, a primary task for the person or group leading the panel.

Phase I concludes with 14 candidates selected as sensory evaluators, representing 18% of those initially selected. This process was completed over five months. The individuals who are part of this select group not only actively participated in the training and education process but also have the availability and willingness to be part of the sensory evaluation panel at the AGROSAVIA laboratory.

The sensory evaluation panel project, initiated by AGROSAVIA and UNAD, aims to support the improvement of the quality of cocoa genotypes harvested in Colombia by identifying sensory attributes and thus promoting the genetic materials that offer the best profitability to the cocoa-growing community. This project has a social component that seeks to help farming families dedicated to this activity increase

their economic benefits by producing special cocoas, thereby contributing to the social stability of rural communities.

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