Sensory Analysis of Dehydrated Pineapple (ANANAS COMOSUS L.) as a Sweetener in Corn Drink

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Abstract – *Students of the Industrial Processes Manufacturing Area and members of the Academic staff of Process Engineering of the Technological University of Tlaxcala carried out a sensory analysis of three types of corn-based drinks, one of them sweetened with sugar and two with pineapple flour as a sweetener. To carry out the study, an ANOVA analysis was carried out with the records of the evaluations of the tasters on the drinks. To carry out this research, different concentrations of raw materials were considered in the production process, and as a result it was found that there is a significant difference in color between beverages prepared with sugar and those prepared with dehydrated pineapple flour, while, in appearance, smell and taste, the three types of drinks are similar and accepted, achieving a new sweetener alternative (dehydrated pineapple flour instead of sugar).*

Key Words: *Sensory analysis, dehydrated pineapple, drink, sweetener, ANOVA analysis, corn.*

1.INTRODUCTION

The human being requires to be nourished correctly, of certain minimum amounts of calories, proteins, vitamins and other nutrients that, if not covered, can cause malnutrition [1]. In the case of children in Mexico and around the world, the preferred foods are sugary foods, so consuming this type of food in excess causes diseases such as diabetes and obesity, which leads to health problems, therefore, alternatives should be sought so that food intake is healthy. Therefore, the academic staff of Process Engineering and students incorporated into the research, both of them from the Technological University of Tlaxcala, are interested in proposing to society a new healthy corn-based drink, due to its low sugar content, using dehydrated pineapple as a sweetener in its formula. To carry out this project, a solar dehydrator from the Technological University of Tlaxcala was used to dehydrate the pineapple and thus obtain the sweetener that was used in the preparation of a corn and milk drink with dehydrated pineapple as a substitute for sugar.

The process of making the drink was carried out at the home of Victoria Esmeralda Figueroa Canseco, a student of the Industrial Processes Manufacturing Area major, in the city of Huamantla, Tlaxcala, to eight kilometers from the Technological University of Tlaxcala. This production process was carried out in a hygienic manner, complying the safety and hygiene care of beverages, established by the Mexican standard NOM-218-SSA1-2011. We emphasize that the process was not carried out at the institution facilities because they were closed due to the second wave of the COVID-19 pandemic in Mexico. For this reason, it was utilized the living room of the same address, where the process of tasting tests was carried out with 20 random voluntary people, from 10 to 60 years old, of both sexes, all of them with good health, since at the time of the test, anybody was under any medical treatment.

The activities were carried out under the advice and supervision of the members of the Process Engineering academic staff of the Technological University of Tlaxcala.

1.1 Advantages of pineapple

Pineapple has a high content of vitamin C that acts as an antioxidant to protect cells against damage caused by free radicals, it also contains fructose with slow assimilation metabolism to gain the energy that the human body needs to later convert it into glucose, also pineapple has a high sweetening power, mostly in its ripening stage [2].

Consuming dehydrated pineapple in corn-based drinks and milk as a dietary supplement strengthens the diet in people due to its high content of carbohydrates, calcium and vitamin C. Table 1 shows the nutritional content of the pineapple as a percentage ingested of the recommended daily dose for an average healthy adult in 100 grams RDD [3].

Table 1 Nutritional content of pineapple

Nutritional information 100 gr of pineapple contains

Component	Amount	Units	% **RDD**
Energy	50	Kcal	2.29
Protein	< of 1 gram	G	0.8
Fat	0	--	--
Carbohydrates	14	G	--
Fiber	--	G	--
Vitamin A	5	ug	<2
Vitamin C	61	mg	102

Calcium	18	mg	2
Phosphorus	8	mg	<2
Iron	0.5	mg	4

Source: (Arias, 2010)

1.2 Materials

For the process of making corn-based beverages, pewter cooking pots with a capacity of three liters, a simmering stove, wooden spoons, a knife, a small board to cut the pineapple, glass jugs, cups, a soup plate to store pineapple flour and sugar, a digital weight scale with a capacity of three kilos for weighing raw materials, a blender to grind pineapple and a family solar dehydrator that belongs to the Technological University of Tlaxcala were used. Before making the beverages, the raw materials such as corn starch flour, lactose-free milk, sugar, cinnamon, corn dough and dehydrated pineapple were arranged.

2. Components

To prepare the beverages, some mixtures were made with different concentrations of cornstarch, dough, lactose-free milk, cinnamon, sugar and dehydrated pineapple.

Table 2: Materials for corn-based beverages

Raw material	Sample 1 %	Sample 2 %	Sample 3 %
Dough	0.00	0.00	8.3
Cornstarch	8.88	8.3	0.00
Cinnamon	1	0.5	0.5
Lactose-free milk	88.88	83	83
Dehydrated pineapple flour	0.00	8.2	8.2
Sugar	1.33	0.00	0.00
Total	100	100	100

Source: Process engineering academic staff, 2021 (PEAS)

For the elaboration of the corn-based drinks, of samples 1, 2, 3, the raw materials were prepared in a plastic tray, where they were mixed according to the specified quantities as shown in Table 2 with cornstarch flour, cinnamon, milk and sugar, dough, and pineapple flour.

The lactose-free milk and the cinnamon pieces are poured into the pewter pot, with the stove over low heat for 10 minutes or until it starts to boil, after that time the cornstarch and sugar are added for the sample 1, pineapple flour instead of sugar for sample 2 and dough and pineapple flour for sample 3, stirring with a wooden spoon to avoid sticking or lumps in the drink, after others 8 minutes of constant stirring, the stove fire is turned off and the drink is ready to serve. A sensory study was made with this drink, so 20 people tasted each one of the 3 samples, in order to evaluate color, appearance, smell and flavor.

2.2 Pineapple dehydration process

The pineapple flour was processed with the dehydrators of the Process Engineering Academic Staff (PEAS) from the Technological University of Tlaxcala. Where the solar energy is used through these conventional flat surface dehydration equipment [4]. The equipment consists of a dehydration tunnel protected by a glass cover, in order to isolate the food from dust and insects, with a metal grid where the product to be dehydrated is placed. The conditions in the dehydration tunnel on a sunny day are: air heating (50° C ± 5° C) by thermal solar energy and natural convection [5]. Figure 1 shows the cutting of the pineapple into slices, the placement of the pineapple on the tray and the pineapple in the dehydrator where the solar dehydration process begins.

Figure 1: Cutting and Process of solar dehydration of pineapple

Source: Own elaboration, 2021

In Figure 2 the dehydrated pineapple is shown, as well as the powdered flour to be used as a sweetener to make the drinks

of the second and third samples.

Figure 2: Dehydrated pineapple flour

Source: Own elaboration, 2021

2.3. Preparation of corn-based beverages

Figure 3 shows the elaboration of the corn-based drinks in sample 1 with cornstarch, cinnamon, sugar and milk. The milk and cinnamon are poured into a saucepan and boiled on a stove over low heat, and after 10 minutes, add the cornstarch and sugar, all it stirs with a wooden spoon for 8 minutes continuously to avoid lumps, after that time the stove is turned off and the drink is ready to be served.

Figure 3: Corn and sugar drink

Source: Own elaboration, 2021

In Figure 4, samples 1, 2 and 3 are presented, where the yellowish color is observed in the last two samples, due to the fact that dehydrated pineapple flour was added instead of sugar as a sweetener.

Figure 4: Drink with pineapple flour as a sweetener in samples 2 and 3

Source: Own elaboration, 2021

3. Methodology

After preparing the drinks, the sensory evaluation was carried out, these tests are decisive for the development of the food, because it is not enough that they are nutritious, microbiologically safe, with a long shelf life, easy to prepare and reduced cost, if its sensory properties are not suitable for the consumer's senses. [6]. The sensory analysis was carried out using the following methodology. Figure 5 shows the flow diagram of the sensory analysis process.

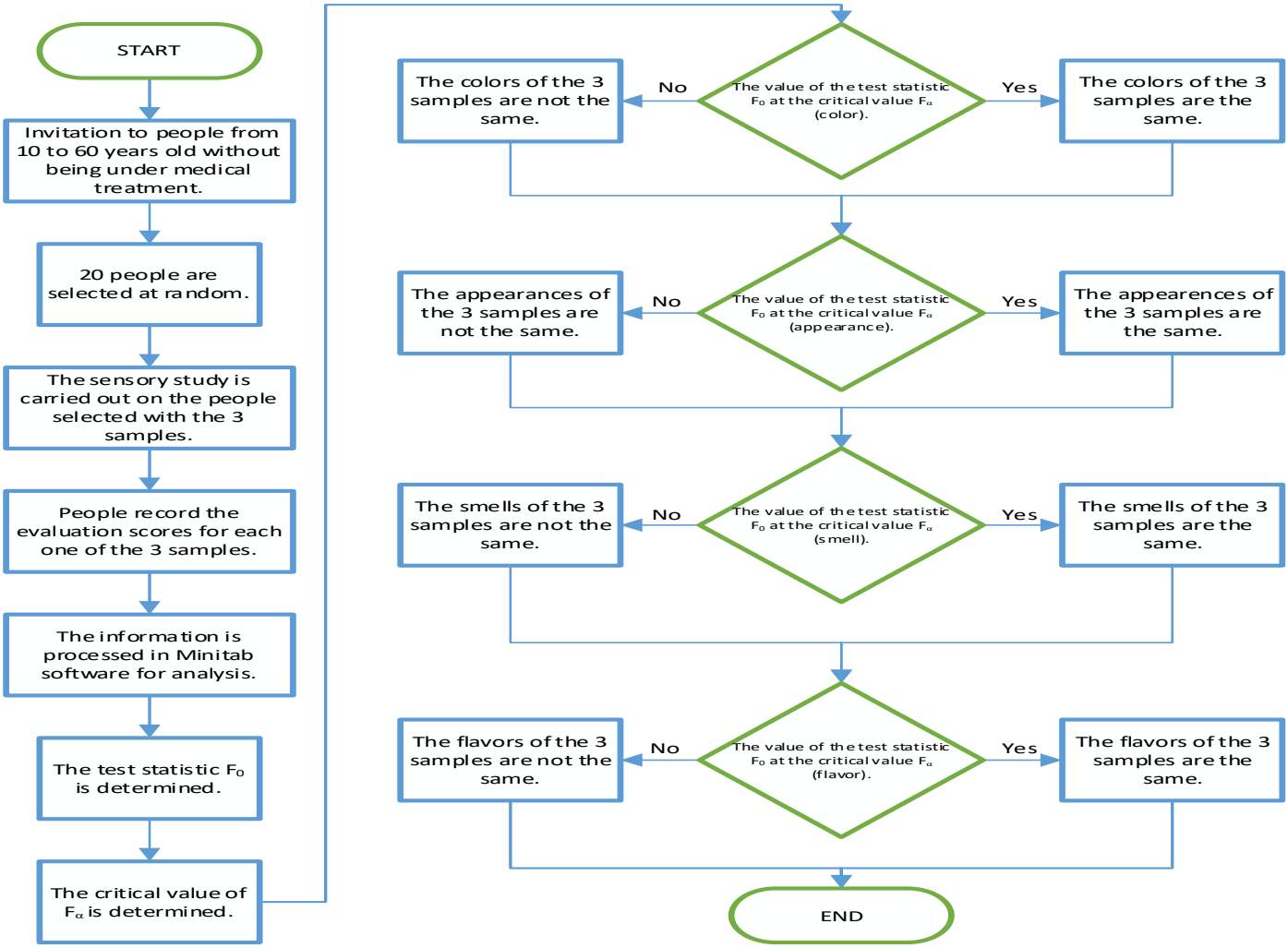

Figure 5: Sensory evaluation flow chart
Source: Own elaboration, 2021

3.1 Sensory evaluation using the hedonic scale or Likert scale

The sensory evaluation was carried out by the Hedonic scale method, that varies between 1 and 9, these values correspond to the minimum and maximum acceptance degrees respectively; the value 5 separates the acceptance and rejection zones.

Table 3 specifies the weightings in order to evaluate the sensory characteristics ranging from 1 to 9 for each evaluated characteristic.

Table 3: Hedonic scale rating weighting

Score	
5 Neither like or dislike 4 Little dislike 3 Moderately dislike 2 Very dislike 1 Extremely dislike	9 Like extremely 8 Like very much 7 Like moderatly 6 like a little

Source: Hedonic Scale, 2021 year

For the elaboration of the drinks, each one of the three samples were coded to identify them, assigning them the numbers 1, 2 and 3 respectively. For the sensory tests, the records of the tasters' weights for each type of drink were considered according to the types of components of each sample. The characteristics evaluated were: color, smell, appearance and taste.

3.2 ANOVA analysis of sensory characteristics

With the records obtained from the evaluations made to the tasters, the ANOVA analysis was determined by their sensory preferences regarding the color, appearance, smell and taste of the three types of beverages, as well as compliance with the normality and homoscedasticity of the record of the data. Figure 6 shows the behavior of the sensory tests of the three samples.

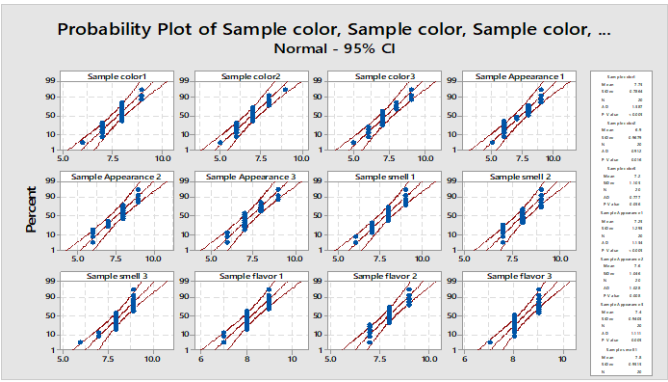

Figure 6: Normality of the three types of beverages samples

Source: Own elaboration, 2021

Due to this study pretends to demonstrate, if there is equality between the means and variances of three samples, the ANOVA analysis was chosen as statistic test to verify that the three samples are similar in their sensory characteristics.

3.3 Values of the test statistic Fo of the sensory characteristics

Tables 4, 5, 6, 7 show the results of the ANOVA analysis of each one of the sensory characteristics of color, appearance, smell and flavor respectively.

Table 4: ANOVA analysis, color of the drinks

Source	DF	ADJ SS	ADJ MS	F_0 Value
Factor	2	7.433	3.7167	**4.02**
Error	57	52.750	0.9254	
Total	59	60.183		

Source: Own elaboration, 2021

Table 5: ANOVA analysis, appearance of the drinks

Source	DF	ADJ SS	ADJ MS	F_0 Value
Factor	2	1.233	0.6167	**0.51**
error	57	69.350	1.2167	
Total	59	70.583		

Source: Own elaboration, 2021

Table 6: ANOVA analysis, smell of the drinks

Source	DF	ADJ SS	ADJ MS	F_0 Value
Factor	2	1.600	0.800	**1.08**
error	57	42.400	0.7439	
Total	59	44.00		

Source: Own elaboration, 2021

Table 7: ANOVA analysis, flavor of the drinks

Source	DF	ADJ SS	ADJ MS	F_0 Value
Factor	2	2.033	1.0167	**2.15**
error	57	26.950	0.4728	

Total	59	28.983		

Source: Own elaboration, 2021

4. RESULTS AND DISCUSSION

4.1 Sensory Analysis results

The results of the ANOVA analysis are shown in Tables 4, 5, 6 and 7 of the test statistic F_0 of each one of the sensory characteristics analyzed, where they are compared with the critical value of Fα = 3.159, obtained from F-Fisher Table with a significance level of 0.05, with 2 degrees of freedom in the numerator and 57 degrees of freedom in the denominator, (0.05,2,57), and because the color test statistic is F_0 = 4.02> of Fα = 3.159, we conclude that there is significance in the samples, that is, there is a difference in the color of the beverages, in at least one of the samples; in this case it is from sample 1 that does not contain dehydrated pineapple flour. Figure 7 shows the critical value that is the division point to accept or reject the value of the test statistic, in this case, as F_0 = 4.02> of Fα = 3.159

It is concluded that the colors of the three drinks are statistically different, and this is due to the process that was used of solar dehydration by natural convection gradually drying the pineapple, causing a yellowish color. Therefore, during the color comparison of the beverages without sugar and with dehydrated pineapple flour, samples 2 and 3 were darker as shown in Figure 4, but with a pleasant taste in the 3 types of beverages; if the process had been forced dehydration, a lighter color would be preserved [7].

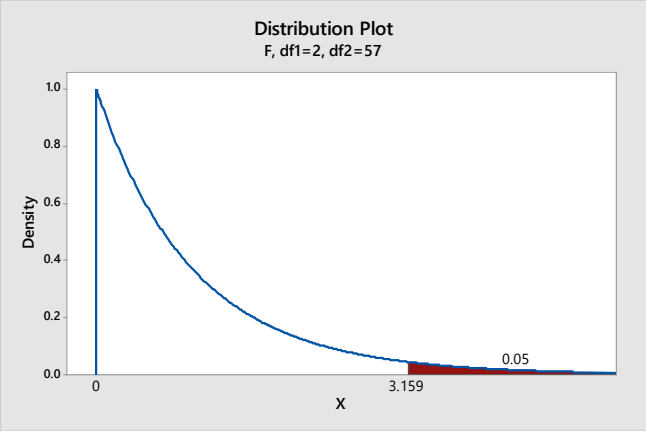

Figure 7: Critical value F_α to compare the test statistic F_0
Source: Own elaboration, 2021

Regarding the values of the test statistic on appearance F_0 = 0.51, smell F_0 = 1.08 and taste F_0 =2.15 are less than the critical value Fα = 3.159, which is the division point between the region in which the null hypothesis is rejected. and the region in which it is not rejected [8], that is, in this study, it is the area where the values of the test statistic are within the acceptance area, statistically demonstrating that the three beverages are accepted for their sensory characteristics of appearance, smell and taste; therefore, there is no significant difference, which makes it possible to affirm that the drink with sugar as well as the two drinks prepared with dehydrated pineapple flour are pleasant and accepted in the same way.

5. FUTURE WORK

In this study, it was found that beverages based on corn with sugar are pleasant, as well as with beverages accompanied by pineapple flour as a sweetener. For future work, it is necessary to experiment on strawberries, oranges, peaches, pears, guavas among other fruits, as well as perform chemical tests to know the nutritional content of each drink prepared, after verifying with this sensory study that the drinks with dehydrated pineapple flour are accepted.

6. CONCLUSION

Regarding the sensory tests of the corn-based drinks, it was found that the three types of drinks are accepted, both in appearance, smell and taste, as for the color in sample 1 it is significantly different from the two samples that contain dehydrated pineapple flour as a sweetener, but the color does not detract from the preference of the drinks.

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