Obtaining a sugar syrup from the use of the extract of the guácimo fruit (Guazuma ulmifolia lam)

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Abstract. The main objective of this work was to elaborate a sugary syrup from the use of Guácimo fruit extract (Guazuma Ulmifolia Lam) using the leaching method (solid-liquid), which can be used as a partial or total substitute for sugar. The experimental design that was applied for the extraction process was a factorial design 23; the data obtained were evaluated with the software Statgraphics. Once the extracts were obtained, physico-chemical tests were carried out and reductive sugars and dextrose equivalent were determined in each one. To obtain the syrup, the four extracts having the highest % ED were concentrated at constant temperature and time (50 °C and 4 hours); The determination of the presence of reducing sugars was done using the techniques of colorimetric analysis (miller’s method) and chromatography (HPLC). The products that were obtained during the process were extreme conversion syrups with a range of dextrose equivalents of 90.13% - 98.27%. The syrup that obtained the highest percentage of equivalent dextrose (J3) was subjected to a sensory hedonic test, which consisted of 3 samples of sweetened coffee at different concentrations of sweet sugar syrup and sugar (sucrose), where M1 contained 80% sugar syrup of guácimo and 20% of table sugar. M2 contained 50% guácimo sugar syrup and 50% table sugar. M3 contained 100% sugar guacimo syrup and 0% table sugar. The results showed that the mixture that obtained the highest organoleptic acceptance was M2, followed by M3, which states that the syrup can substitute partially the common sugar. The above data allow the guácimo fruit to be taken into account as an alternative raw material for the production of sugar syrups and other products aimed at human consumption.

1. Introduction
The use of sweeteners is important in products and markets around the world, because in most edible products and most of the pharmaceuticals are used sweeteners to increase the degree of acceptance of these by the consumer, this situation has become a necessity that has generated a great impact due to the chemical components that the sugars possess and that leads to the exploration of new substances or species [1].

In most industrial processes of foods, sweeteners of various types are used in a great proportion, such as sucrose, glucose, lactose, fructose, and others produced by the mixture of the aforementioned or another agent that produces a Pleasant palate sensation in ready-to-eat products. These sugars or
sweeteners are used in order to improve the organoleptic characteristics of each product and also preserve their properties [2].

Nowadays, due to the high market cost of these sugars, it has been decided to investigate and focus their needs on the production, generation and development of substitutes for common sugars, which is why they have obtained positive results, among these are the natural sweeteners and artificial or synthetic. Within the natural sweeteners we find the honey of bee, the corn syrup rich in fructose; and the artificial ones are saccharin, Aspartame “Nutrasweet”, among others [3].

In this way, the proposed study will provide a set of knowledge applied to obtaining sweeteners from a raw material that is cultivated naturally, artisanal and wild without any industrialization or technological application for its use. The guácimo, which predominates in the livestock areas of the department of Cesar, and is only used for feeding and shady livestock by means of live fences in the paddocks where they are present [4].

Likewise, the fruit of the guácimo is not taken into account in the region for the agro-industrial use or the production of food destined for human consumption, so it is intended with this work to provide a method, technique and procedure for its processing, in order that value can be added to the large number of fruits produced by guácimo trees in Valledupar since the extraction of a sweetening agent [5].

Being thus feasible to the markets and therefore would be benefiting directly with this product to people with metabolic diseases where sugar levels are very high, secondly, companies that produce low-calorie foods will benefit. As well as companies producing soft drinks, confectioneries, dessert creams, ice cream, etc [6].

In this sense, this research aims to encourage the use of guácimo as a key alternative for the production of natural sweeteners that can be used as a natural substitute for some sugars. In addition, motivate agro-industry researchers to use the guácimo fruit and its components as raw material for the production of products and by-products for direct human consumption, given its diverse physicochemical and nutritional composition [7].

Guácimo (guazuma ulmifolia Lam) is produced wild without any control, it has been used for animal consumption and traditional uses; similarly, no research is known in the region concerning or oriented towards the use of guácimo for the consumption of people. The investigations that have been carried out are aimed at the consumption of minor species [8]. In this regard it is convenient to say that, in the surrounding areas of Valledupar, the guácimo tree adapts easily thanks to the properties offered by the soils and the climatic conditions of the department.

At present the interest in sweeteners is gaining strength, it is opting for it as a substitute for common sugars, which have been causing damage to health. Sweeteners have been taken into account as a viable alternative in the food industry worldwide [9]. The existing interest for sweeteners opens space, and serves as a platform to share information on species never explored for these products, to take as alternatives for use and exploitation, as a form of sustainable development that can be consumed in Colombia and the entire world. This work is carried out in search of alternatives for the use of the guácimo fruit, for the obtaining of by-products, and the elaboration of food products aimed at human consumption. At the same time, this research is intended to encourage the use of guácimo as a key ingredient for the production of sugar syrups that can be used as a substitute for sugars and in turn give value to the crop.

2. Experimental
2.1 Experimental Design
To obtain guácimo extract, for the measurement of the causes and effects, and to be able to carry out the fulfillment of the objectives of this work, a factorial experimental design was carried out (23) because the factorial designs of two levels or 2k have the quality of proposing processes in all combinations of factor variables, which indicates that factor takes 2 different values, that is, when the number of factors is k, then the number of experiments will be 2k [10], where it was manipulated 3 independent variables such as: solvent ratio (water) - solid (guácimo), temperature and time; the
variations of the effects or consequences expressed as dependent variables were observed, which are: extract yield (%), concentration (Brix), and dextrose equivalent.

For the realization of this design, eight (8) runs were required each in triplicate of which the effects of each of them were measured at the end. In the process, time and temperature were strictly controlled, since the effects in each process could vary or change depending on the manipulation given to these variables. In Table 1, the experimental design model is shown.

| Levels | Relationship | Temperature | Time (min) |
|--------|--------------|-------------|------------|
| G1     | [4:1]        | Ambient     | 20         |
| G2     | [5:1]        | Ambient     | 20         |
| G3     | [4:1]        | 37          | 20         |
| G4     | [5:1]        | 37          | 20         |
| G5     | [4:1]        | Ambient     | 30         |
| G6     | [5:1]        | Ambient     | 30         |
| G7     | [4:1]        | 37          | 30         |
| G8     | [5:1]        | 37          | 30         |

The syrup was then obtained, taking into account the four best variables of the extract responses, and they were concentrated at a constant temperature of 50 °C and a time of 4 hours, then the physicochemical characteristics of each of the syrups were determined.

2.2. Sample / Population
Guacimo fruits were collected in the zones located between the road that goes from Valledupar to the dry river township, as well as between the output of Valledupar. These zones are similar in terms of climate and distribution of trees, so two lots were taken from each area (population); from each batch 8 trees were chosen and from each tree a kilogram of fruit, thus obtaining 8 kilograms per batch, obtaining a total of 32 kilograms of guácimo that were used deliberately in the process of obtaining the syrup.

2.3. Characterization of the fruit
Guácimo fruit harvest: Guacimo fruits were collected in places near the municipality of Valledupar, where two zones with similar characteristics regarding climate and distribution of trees were taken. Taking two lots from each zone, 8 trees were selected from each batch and 1 kg of fruit per tree, thus obtaining 8 kg per batch, for a total of 32 kg of guácimo.

Selection and classification of the raw material: For the selection and classification of the guácimo fruit, the objective was to discard the green and damaged fruits, in order to obtain a fruit in optimum conditions, which were used for the process. Once the fruits were selected, the classification was carried out, for this activity a small pulp was obtained, which is irregularly opened by 5 seed pores, which were removed as the heart of the fruit.

Storage of the fruit: already having the previously selected fruits, classified and cut, they were later stored to preserve the characteristics of the fruit and avoid any type of contamination.
2.4. Determination of the physicochemical characteristics of the fruit

Total soluble solids (Degrees Brix): the determination of Brix degrees of the guacimo fruit, because it is a dried fruit, which said composition is to have a low percentage of water. It was made by means of a material balance, for this, 20 grams of fruit were weighed and diluted in 200 ml of water, having a ratio of 1:10 and kept under constant agitation for 30 minutes, after this time it was filtered with the help of a vacuum pump thus obtaining a yield of 129 ml of extract (64.5%), then 250 ml of distilled water was added, the Brix degrees were measured in the aqueous solution with the help of a portable refractometer, mark ATAGO model PAL-1 with precision of 0.1 ° Brix, already known the values of SST, the balance of matter was made to obtain the Brix of the fruit.

Reducing sugars: Miller's method was used to determine reducing sugars. For which a glucose calibration curve (standard) was made, then the glucose standards.

For the determination of reducing sugars present in the fruit; the solution of 250 mL of extract mentioned in the previous point was started and dilutions were prepared in triplicate in a ratio of 1:100 because the sample is quite dark, and it was subjected to react with the DNS at high temperatures to then measure absorbances at 540 nm, and thus be able to make the calculation and obtain the value of reducing sugars, in addition, a moisture test was carried out on the fruit to extract by difference the percentage of the dry substance, which serves to determine the dextrose equivalent.

Humidity and Dry Substance: To determine the humidity, different amounts of fruit were crushed, and dried in porcelain pots at 105 ° C. Once the percentage of humidity was obtained, it was possible to obtain, by difference, the% of dry substance (% SS = 100 -% Humidity).

2.5. Obtaining and characterization of the guácimo extract

Crushing the guácimo fruit: Initially, the fruit already selected was crushed, classified and stored under optimum conditions to reduce the particle size and facilitate the extraction process, taking into account the relationship or scale (water: guacimo).

Obtaining the extract: After the fruit was crushed, it was taken to a container that carried water (solvent) at a scale of 4: 1 and 5: 1 for each run respectively, to carry out the extraction method by solid-liquid leaching, each run was kept in constant agitation for different times of 20 and 30 minutes (according to the corresponding run), then it was filtered using lilycloth cloth, the extract was centrifuged for 20 minutes, to clarify and eliminate unwanted particles. Subsequently, samples were taken for the characterization of the extract. For which physicochemical tests were carried out (pH, Acidity, Brix), the percentage of reducing sugars and dextrose equivalent were also determined, these analyzes were carried out taking into account what is described in point 8.6.4, which deals with the methods of analysis physiochemical.

2.6. Characterization of the sugar syrup obtained

Obtaining the syrup: Obtained and analyzed the extracts, we proceeded to choose the ones with the best physicochemical conditions and the highest equivalent dextrose value, in this case were the extracts G1, G3, G4 and G7, then these were concentrated at a temperature of 45 ± 50 ° C and 4 hours’ time, with constant agitation controlling the physicochemical characteristics every 2 hours; Once that time had passed, the syrup was centrifuged for 20 minutes to separate dissolved solids in the product, thus obtaining the product of interest, from which the samples were taken to perform the corresponding physicochemical tests (pH, Brix, acidity and organoleptic aspects) and the content of reducing sugars and dextrose equivalent was determined.

2.7. Methods of physicochemical analysis

Determination of pH: For the determination of pH, the requirements of the standards were taken into account: ISO 1842: 1991 (US ISO; 1991), NTC 4592 (ICONTEC; 1999) and AOAC method 981.12 (AOAC, 2005). pH meter OHAUS brand model STARTER 3100 with precision of 0.01. For the implementation of the pH-meter, a sample of 15 ml of each sample was taken in a Beaker, and the pH-meter was introduced into it, to finally read and record the pH value.
Determination of total soluble solids or Brix degrees: ISO Standard 2173: 2003. (US ISO; 2009), NTC 4624 (ICONTEC; 1999) and the AOAC method 932.14 (AOAC, 2005). For this test a portable ATAGO brand Refractometer model PAL-1 with precision of 0.1 ° Brix was used, where 5 drops of sample were placed in the refractometer lens to then star and start reading.

Determination of reducing sugars (RA), total (AT) and dextrose equivalent (ED): For the characterization of sugars, the method of MILLER (DNS), NTC 1779 (ICONTEC, 1997), Method of AOAC 923.09 (AOAC, 2005) was used. THERMO SPECTRONIC 4001/4 spectrophotometer at 540 nm using a calibration curve with a glucose standard. HPLC 1200 Agilent; Mobile phase [11].

Titratable acidity determination: The requirements of the Colombian standard NTC 4623 (ICONTEC, 2000) and NTC 4803 (ICONTEC, 2016) were implemented. One ml of extract was taken and 10 ml of water were added with distilled water, 3 drops of phenolphthalein were added and the mixture was stirred. Then a 0.1 N standardized NaOH base solution was added by means of a graduated burette, until the mixture turned to an opaque pink color. The titratable acidity was expressed as% citric acid.

Moisture Determination: The gravimetric method described by AOAC was used; 2005.

2.8. Application and measurement of organoleptic acceptability of sugar syrup as a partial or total substitute for sugar

Application of sugar syrup as a partial or total substitute for sugar: For the application the syrup produced in this project was used as a standard sample of sweetened coffee at different concentrations of syrup and table sugar (sucrose), as follows:

- Sample No. 1 contained 80% sugar guacimo syrup and 20% table sugar.
- Sample No. 2 contained 50% sugar guacimo syrup and 50% table sugar.
- Sample No. 3 contained 100% guácimo sweetened syrup and 0% table sugar.

Obtaining thus, a partial and total substitution of sugar (sucrose) for sugary syrup obtained from the guácimo fruit; in this way to perform the calculations of the sweetener, they were made by the trial method, where guácimo syrup and sugar (sucrose) were weighed little by little, and then tested until an acceptable coffee sweetness was found; at the end a quantity of sugary syrup of 22.25 grams was weighed, equivalent to 79.6% and 5.7 grams of table sugar which is equivalent to 20.4% in the total sweetener mixture. Measurement of the organoleptic acceptability of sugar syrup as a partial or total substitute for sugar: To measure the degree of acceptance of sugar syrup, a sensory analysis was implemented, such as the hedonic, technical and analytical tasting. This test consisted of 3 samples of sweetened coffee to different concentrations of sugar syrup obtained from the guácimo fruit and sugar (sucrose), and they were given a survey format to each evaluator, so that this could give their opinion about the product, this person should observe, smell and test each of the samples, and then be able to evaluate the sensory attributes of the product (taste, smell, texture and acceptance) taking into account that the rating goes from 1 to 5, where "1 is equal to dislike me a lot" and "5 is equal to I like it a lot".

3. Results and discussion

3.1 Physicochemical characteristics of fruit

The fruits used in this work were collected on the road connecting Valledupar; for the characterization of the fruits, a selection and subsequent classification was carried out in order to proceed with the respective physicochemical tests (acidity, pH, Brix). In Table 2, the physicochemical characterization of the guacimo fruit is presented.
Table 2. Physicochemical characteristics of the fruit

| Characteristics          | Percentage (%) |
|--------------------------|----------------|
| Humidity                 | 15,6           |
| Brix                     | 28,5           |
| Reducing sugars          | 15,98          |
| Equivalent dextrose      | 18,94          |
| Dry material             | 84,4           |

It is evident that the guacimo fruit has a percentage of total soluble solids (Brix degrees) of 28.5%, and a percentage of reducing sugars of 15.98%; It should be clarified that in the bibliographic sources referring to the fruit of guácimo or other species belonging to the family of the malvaceae, no information was found about the content of Brix degrees and the% of reducing sugars of interest for this research, however, there are jobs where they use fruits, tubers and / or other raw materials that can be very important to compare the data; Beltrán (2014) [12] reports a percentage of Brix degrees of 15%, whose value is lower than those shown in this research; and referring to reducing sugars, Gerena (2013) [13] reported higher values (16,876% - 19,277%) in different mixtures of orange and potato.

Regarding the MS% it can be said that those obtained in this research are very similar to those reported by Queiroz et al. (2019) [14], who obtained a dry matter% value of 85.17%, and in this work 84.4% ; which also states that the percentage of humidity are similar.

3.2. Characterization of the extract obtained from the use of the guácimo fruit

According to the applied methods, in Table 3, it is observed that a detailed characterization was made to the extract, where the variables are: yield, pH, total soluble solids, humidity%, reducing sugars., Thus obtaining the response variable of the extract (the Dextrose equivalent).

Table 3. Physicochemical and bromatological characteristics of the extract.

| M   | Solvent Relationship: Guácimo | T °C | t(min) | % R | pH  | Acidity | Brix | %H | %S | %A |
|-----|--------------------------------|------|--------|-----|-----|---------|------|----|----|----|
| G1  | [4:1]                          | Ambient | 20     | 61  | 4,55| 0,098   | 9,16 | 94,37 | 5,63 | 4,62 |
| G2  | [5:1]                          | Ambient | 20     | 66,8| 4,58| 0,084   | 7,34 | 94,37 | 5,63 | 2,72 |
| G3  | [4:1]                          | 37     | 20     | 60  | 4,57| 0,133   | 9,63 | 94,37 | 5,63 | 4,47 |
| G4  | [5:1]                          | 37     | 20     | 67,5| 4,59| 0,098   | 8,27 | 94,37 | 5,63 | 4,85 |
| G5  | [4:1]                          | Ambient | 30     | 60,1| 4,5 | 0,091   | 9,65 | 94,37 | 5,63 | 3,82 |
| G6  | [5:1]                          | Ambient | 30     | 64,7| 4,49| 0,067   | 7,75 | 94,37 | 5,63 | 2,51 |
| G7  | [4:1]                          | 37     | 30     | 6,2 | 4,45| 0,091   | 9,83 | 94,37 | 5,63 | 4,46 |
| G8  | [5:1]                          | 37     | 30     | 65  | 4,57| 0,094   | 8,39 | 94,37 | 5,63 | 3,16 |

Table 3 shows a higher% Reduction Sugars in samples G1, G3, G4 and G7 that range from 4 to 5, whose range is lower than those reported by Gerena (2013) [13]. It is intuited that the components of the guácimo fruit extract have the potential for the production of a sweetening agent. Analysis of the dextrose equivalent obtained from the guácimo fruit extract: The percentage of dextrose equivalent (ED) of the guácimo fruit extract is shown in Table 4.
Table 4. Experimental matrix of the results obtained from dextrose equivalent.

| Cumsots | Relationship Solvent: Guácimo | Temperature °C | Time (Minute) | Equivalent Dextrose (%) |
|---------|-------------------------------|----------------|--------------|------------------------|
| 1       | 4                             | 25             | 20           | 92.04                  |
| 2       | 5                             | 25             | 20           | 49.05                  |
| 3       | 4                             | 37             | 20           | 91.75                  |
| 4       | 5                             | 37             | 20           | 76.93                  |
| 5       | 4                             | 25             | 30           | 74.32                  |
| 6       | 5                             | 25             | 30           | 50.5                   |
| 7       | 4                             | 37             | 30           | 85.94                  |
| 8       | 5                             | 37             | 30           | 48.47                  |
| 9       | 4                             | 25             | 20           | 92.33                  |
| 10      | 5                             | 25             | 20           | 49.05                  |
| 11      | 4                             | 37             | 20           | 87.1                   |
| 12      | 5                             | 37             | 20           | 94.94                  |
| 13      | 4                             | 25             | 30           | 70.54                  |
| 14      | 5                             | 25             | 30           | 54.86                  |
| 15      | 4                             | 37             | 30           | 89.42                  |
| 16      | 5                             | 37             | 30           | 47.89                  |
| 17      | 4                             | 25             | 20           | 92.33                  |
| 18      | 5                             | 25             | 20           | 86.81                  |
| 19      | 4                             | 37             | 20           | 81.58                  |
| 20      | 5                             | 37             | 20           | 72                     |
| 21      | 4                             | 25             | 30           | 54.57                  |
| 22      | 5                             | 25             | 30           | 87.39                  |
| 23      | 4                             | 37             | 30           | 51.37                  |

For the dextrose equivalent, the statistical model obtained presented three significant terms: A, B and C with p values of 0.0000, 0.0191 and 0.0052 respectively, the correlation coefficient (R²) can explain 80.6941% of variability in the dextrose equivalent in the response variable analyzed and a standard deviation of 9.86466. In addition, the adjusted R² was 70.3977%. This value is the most suitable to compare models with different numbers of variables.

The percentage of dextrose equivalent obtained in the different extraction conditions are influenced in the relationship of time and temperature, where it can be observed that the behavior of this is reflected in the combinations of levels that maximize the response variable as the water ratio: Guácimo 4: 1, time 20 minutes and temperature of 37 ° C to these conditions is where the optimum value of equivalent dextrose (95.7783%) is obtained, when applying a time of 30 minutes in the same temperature ranges it is obtained as result a lower% ED. And with regard to the 4: 1 and 5: 1 relationship it can be observed that at a lower (water: Guácimo) ratio, the extract will be more concentrated.

3.3. Physicochemical characterization of the sugar syrup

The syrup obtained in this work presented a brown color, flavor and sweet smell characteristic of guácimo, texture a little dense. The results obtained in the physicochemical characterization of the syrups with respect to yield, Brix degrees and reducing sugars are shown in Table 5; it is observed that the yield is between a range of 62% - 76.8%, also a total soluble solids concentration between 13.7 - 18.2 is evidenced, the previous Brix range is inferior to those reported by Kumar & Gurunani (2019) [15] who uses Stevia leaf, and concentrates at a temperature of 70 ° C; As for the yield of the syrup, this was superior to that of Stevia. Likewise, a production of reducing sugars (%) is observed from 6.89 to 7.52; The range discussed above regarding reducing sugars are lower than those reported by different authors Gerena (2013) [13] and Vidal (2011) [11] who use orange, potato and yam starch residues.
Table 5. Physicochemical characteristics of sugar syrup.

| N°  | Extraction | T°C | Time (horas) | Perce nt age (%) | Brix | %H | %SS | % AR |
|-----|------------|-----|--------------|------------------|------|----|-----|------|
| J1  | [4:1]      | 50  | 4            | 62,4             | 10,0 | 12,9| 14,8| 92,35 |
| J3  | [5:1]      | 50  | 4            | 62               | 10,3 | 15,3| 18,2| 92,35 |
| J4  | [4:1]      | 50  | 4            | 76,8             | 8,3  | 12,3| 13,7| 92,35 |
| J7  | [5:1]      | 50  | 4            | 68               | 10,6 | 15,4| 17,3| 92,35 |

Based on the above, the quantification of reducing sugars expressed as glucose (g/L) and fructose (g/L) present in guácimo syrups, where it is evident that J3 was the one with the highest glucose concentration (5.99) % followed by J7 with 5.395%, J1 4.835% and J4 3.384%; and regarding the quantification of fructose, it is evident that J1 and J3 had values of 4.633% and 6.992% respectively, while J4 and J7 did not show fructose concentrations.

It can be seen that the syrups obtained have a% ED of 93.32 for J1, 98.27 for J3, J4 with 90.13 and 93.32 for J7; these values are higher than those reported by Gerena (2013) [13] in the hydrolysis of orange and potato residue (21.7 - 67.3% ED); the hydrolysis of yam starch that obtained a dextrose equivalent between 18.82% and 78.99% reported by Vidal (2011) [11]. But it is within the ranges of those reported by Salcedo et al. (2010) [1] who obtained 96.84 - 98.28%; Roncallo & Rodríguez (2013) [10], who reported 95.32 and 94.12 units of ED, before converting glucose to fructose.

From the above it can be inferred that the results obtained in the characterization indicate that guácimo contains a potential as a raw material for the production of sugar syrups or sweetening agents; it is evident that syrup J3 had the best values under all conditions and response variables (% Brix, reducing sugars, glucose, fructose and dextrose equivalent), showing difference compared to the other syrups. Thus, with respect to the dextrose equivalent it can be said that an extreme conversion syrup was obtained [2,3], and it can be used in industries for the production of beer, soft drinks, juices, jams, etc. [7].

3.4. Result of the hedonic test of the sugar syrup obtained

To determine the degree of acceptability of guácimo syrup, the attributes of the guacimo syrup were analyzed by means of a survey, which allows to have information of each one of the proposed attributes, as shown in Table 6.

Table 6. Organoleptic characteristics of sugar syrup

| Attributes       | Syrups          |
|------------------|-----------------|
|                  | Sample 1        | Sample 2        | Sample 3        |
| Taste            | 2.91 ± 1.08 σ   | 3.91c ± 0.66 σ  | 1.91a ± 0.79 σ  |
| Odor             | 4.0b ± 0.85 σ   | 3.91b ± 0.66 σ  | 2.75a ± 1.21 σ  |
| Texture          | 3.33ab ± 1.07 σ | 3.75b ± 0.62 σ  | 2.83a ± 0.93 σ  |
| General acceptance | 3.10b ± 0.83 σ | 3.91c ± 0.51 σ  | 2.08a ± 0.79 σ  |

a-b-c Socks with the same letters between columns do not show significant differences. (p≥0.05).

The acceptance analysis for the sugar syrup in terms of taste showed statistically significant differences (P <0.05), with a confidence level of 95.0%, in relation to syrups M1, M2 and M3, presenting M2 higher score 3.91c ± 0.66 σ, placing itself within the "like" scale, which reflects that the product has a suitable flavor for consumption.

For the smell attribute, when comparing the three samples, statistically significant differences were found (p <0.05) with a confidence level of 95.0% for M3, in relation to samples M1 and M2, which
did not present significant differences in between, the ratings were; 4.0b ± 0.85 σ and 3.91b ± 0.66 σ respectively, placing the samples within the "like" scale, which reflects that the product has a pleasant smell.

In the same sense, for the texture, the observation given by the tasters in this investigation shows that there is no statistically significant difference between the texture mean (P ≥ 0.05) between one level of treatments and another, with a level of 95.0% confidence. Appreciating that the data obtained for this attribute, M1, is related to treatments, for samples M2 and M3 which are different, with M2 showing the highest grade 3.75b ± 0.62 σ.

For the general acceptance, lower grades were presented (p <0.05) clarifying that there is a significant difference between the means, with a confidence level of 95.0% between the syrups M1, M2 and M3, see Figure 1, obtaining the syrup M2 the highest rating, these values are consistent with the previous characteristics where M3 presented the lowest rating with respect to the overall rating in the flavor, smell and texture attributes.

![Figure 1. General acceptance diagram of the syrup.](image)

For the syrup obtained from the guácimo fruit extract it is important to point out that of the points of the scale used for the evaluation, most of the qualifications that were obtained are between M1 and M2 higher points, which shows that in general These two types of syrups would have good acceptance by consumers.

4. Conclusions

Physicochemically characterizing the guácimo fruit (Guazuma ulmifolia lam), achieved a Brix degree value of 28.5%, 15.98% reducing sugars and 18.94% equivalent dextrose; which states that the fruit has basic components when producing sugar syrups or other products intended for human consumption.

The physicochemical analysis that was carried out on the different extracts allowed us to choose the four that have the highest percentage of dextrose equivalent, since they obtained values of 80.27% - 94.45%, which indicates that there is a product of high conversion and not it is necessary to concentrate to obtain a product with a high concentration of sugar, although its content of reducing sugars is between 4 and 5. However, it was concentrated to obtain higher dextrose equivalent values (90.13 ± 98.27).

The results obtained in the characterization indicate the potential of guácimo as a raw material for the production of sugar syrups; they reflect that the syrup J3 had the highest values in all the conditions and variables of responses (° Brix, reducing sugars, glucose, fructose and dextrose equivalent), showing difference before the other syrups. Thus, with respect to the dextrose equivalent (90.13 ± 98.27) it can be said that an extreme conversion syrup was obtained due to its high content of glucose and fructose, and it can also be used in the industries for the production of beer, soft drinks, juices, jams, etc.
The acceptance of the product was measured using a sensory hedonic scale, using a survey format, and the sugary syrup produced in a sample of sweetened coffee was applied at different concentrations of syrup and table sugar (sucrose), where it was determined that the mixture had greater organoleptic acceptability was M2 (50% syrup and 50% sugar), which indicates that the sugar syrup obtained from the guácimo fruit can be used partially in the diet of the person.

Conflict of Interest.
The authors report there are no conflicts of interest.

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