

# Evaluation of Chemical-Physical Properties in Nanche (*Byrsonima Crassiflora* L.)

## Evaluación de propiedades químico-físicas en nanche (*Byrsonima crassiflora* L.)



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**ABSTRACT:** The objective of this paper was the evaluation of chemical- physical properties of nanche and the determination of the quality in its fruit. Nanche fruit has food and agroindustry potential due to its chemical properties, with ° Brix percent between 10,03 and 10,35, pH values in fruit in the range of 3,83 to 5,27 and citric acid percent between 1,24 and 1,75. The results show that the polar and equatorial diameters of the fruits ranged between 1,41 and 1,98 cm, and 1,46 and 2,29 cm, respectively. The maturity or ripen index ranged between 5,73 and 8,18 as average, classifying red and green fruits as acid and the yellow fruit as bittersweet.

**Keywords:** Postharvest, Fruit's Quality.

**RESUMEN:** El objetivo del presente trabajo fue la evaluación de propiedades químico-físicas del nanche y la determinación de la calidad en frutos. Los porcentajes de °Brix oscilaron entre 10,03 y 10,35, el pH entre 3,83 y 5,27 y porcentaje de ácido cítrico entre 1,24 y 1,75. El fruto del nanche tiene potencial alimenticio y en la agroindustria, por sus propiedades químicas. Los diámetros polar y ecuatorial de los frutos oscilaron entre 1,41 y 1,98 cm y 1,46 a 2,29 cm respectivamente, siendo los frutos de color amarillo los de mayores diámetros. El índice de madurez o sabor osciló entre 5,73 y 8,18 como promedio, clasificando como ácidos a los frutos rojos y verdes y agridulces a los de color amarillo.

**Palabras clave:** Postcosecha, calidad de los frutos.

### INTRODUCTION

Nanche (*Byrsonima crassifolia* (L.) H. B. K., is found from South to North America according to [Martínez et al. \(2008\)](#), where it is native. It is differently named depending on the country or region where it grows: nance, nancite (Central America), peralejo (Cuba), nanche, nanchi, changunga (Mexico), indano (Peru), muricí (Brazil), golden spoon or golden cherry (USA). *Byrsonima crassifolia* is a species native to Mexico and Central America, belonging to the Malpighiaceae family ([CONABIO-Mexico, 2022](#)).

It is adapted to drought conditions and soil rusticity ([Maldonado et al., 2018](#)).

The fruits are globose, climacteric drupes according to [Carvalho et al. \(2016\)](#) that present heterogeneous shape, color, flavor and size, in addition to a short shelf life. It is used as human and animal food,

medicine, fuel, dye, tanning and in beekeeping, among others ([Guzmán et al., 2013](#)). It has a bittersweet and intrinsic flavor and important nutraceutical properties ([Seabra et al., 2019](#)).

[Yirat \(2009\)](#); [Yirat et al. \(2009\)](#); [Rangel et al. \(2010\)](#) point out that the study of the physicochemical properties not only makes it possible to assess the fruits in the ripening stage on the tree or at the time of harvest, but also allows the study of external and internal changes when passing through the different states of maturation during storage. Studying these changes can be done under different conditions, depending on the interest of the research and must meet specific requirements like being free of cracks in the shell, bruises, putrefaction or deterioration and being harvested in its original state and optimal maturity.

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Although there are previous quality studies on these fruits, they are still insufficient. Taking into account the above, the present work is developed with the objective of evaluating some chemical-physical variables in three nanche phenotypes and determining the quality of the fruits for a later study of shelf life.

## MATERIAL AND METHODS

The study was conducted in Ribera Miguel Hidalgo Community, in Copainalá Municipality, Chiapas, Mexico, during the months of August and September 2019. It is located at 17°13'16"N 93°21'08"W.

The chemical properties total soluble solids (TSS), total acidic ph, maturity index and physics size were evaluated for three green, yellow and red nanche phenotypes.

The sample size was obtained from a pre-experiment with 45 fruits, preventing them from having bruises or decomposing portions. The procedures were carried out applying the methodology proposed by [Luyarati \(1997\)](#).

$$n_m = \frac{t_s^2 \cdot \sigma^2}{\Delta a^2} \quad (1)$$

Where:

$\sigma$  - typical or standard deviation

$t_s$  - coefficient that depends on the level of confidence and on the number of samples, it is determined for a t of student distribution

$\Delta a$  - maximum permissible error of the mean or random error

To determine the content of total soluble solids (TSS) of the fruits, a drop of their pulp was placed on the prism of the surface of a calibrated refractometer brand CIVEQ CVQ-4013, with measurement range characteristics: 0 to 90% °Brix, precision: 0.5%, size (mm): 27x40x160, weight: 175 g. and the measurement was recorded in °Brix, as described in the Mexican standard [NMX-F-103-1982 \(1982\)](#).

For the pH analysis, a potentiometer or pH-meter (pH 600, pH Meter) was used with an electrode previously calibrated with buffer at pH 7 and pH 4. A sample of 20ml of pulp was taken, the electrode was introduced in the center of the sample with constant stirring and the reading was recorded.

For titratable acidity, citric acid was measured; 30 g of pulp were weighed and diluted in 200 ml with distilled water, an aliquot of 20 ml was taken and titrated with 0.1 N NaOH, until pH 8.3, which is the turning point of the phenolphthalein indicator, the consumption reading was recorded, as described in the Mexican standard [NMX-F-102-2010 \(2010\)](#).

The classification of the fruit flavor was carried out, taking as reference the scale proposed by [Medina et al. \(2015\)](#), based on the °Brix/AC ratio, such as: acid (5.1-8.1), bittersweet (8.1 -10.1) and sweet (>10.1).

The equatorial (DE) and polar (DP) diameter of the fruits were determined using a caliper or Vernier with

0 to 150 ± 0.05 mm precision. The DP was determined from the apical end to the base, while the DE was measured in the middle portion of the fruit. The shape was determined according to the index obtained by dividing the DP/DE ([Alia et al., 2012](#))

The results obtained were tabulated and evaluated with a descriptive analysis. Mean tests were performed using the Tukey method (0.05) to compare the differences between groups. These analyzes were performed with the statistical package Statgraphics Centurion XVII (StatPoint Technologies Inc., Warrenton, VA, E.U).

## RESULTS AND DISCUSSION

### Total Soluble Solids Content (TSS) °Brix in Nanche Fruits

[Figure 1](#) shows the comparison of the average SST values, which were between 10.03 and 10.35° Brix, the highest concentration was obtained in green fruits with an average of 10.35° Brix, in contrast with the range of 8.93 to 15.99 ° Brix reported by [Medina et al. \(2015\)](#); slightly lower (7.6 - 12.2 °Brix) than those obtained by [Medina et al. \(2015\)](#) and higher than the range of 3.2 to 7.9 °Brix ([Martínez et al., 2008](#); [Maldonado, 2015](#)). [Maldonado et al. \(2018\)](#) reported much higher average values (11.76 ° Brix) in yellow fruits.

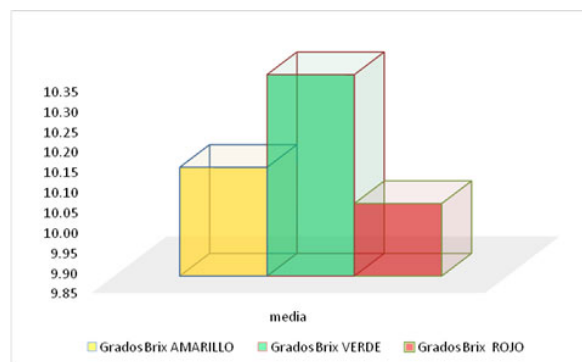


FIGURE 1. Average values of Total Soluble Solids (TSS) ° Brix, in fruits.

### Pulp pH for Studied Phenotypes

[Ladaniya \(2010\)](#) affirms that acidity is a useful characteristic to know the state of maturation of the fruits. [Figure 2](#) shows the pH values obtained for the three nanche phenotypes studied. The average acidity values ranged from 3.83 to 5.27, being higher than the 3.50 - 4.38 range obtained by [Martínez et al. \(2008\)](#) and those reported by [Medina et al. \(2015\)](#) from 2.6 to 4. [Munoz de Chavez et al. \(2002\)](#) pointed out that on average in 100 g of nanche pulp the pH can be 2.8, so taking into account the previous results, the values obtained can be assumed to be within the permissible range and confirm what was stated by [Maciel et al.](#)

(2010) that organic acids are responsible for the acidity and the particular aroma of the fruits.

Sensory acidity is not directly correlated with the pH of a product, a fruit may not feel so acid, but have a high pH and vice versa; this depends on the buffering capacity of the pulp at low pH and on the combination of acids present in the product. For this reason, it is important to determine the percentage of acidity in a fruit, which considers the possibility that the presence of the main acid is not that of citric acid.

### Titrateable Acidity in Nanche Fruits (Percentage of citric acid)

As a result of the determination of the titrateable acidity (percentage of citric acid AC) it was obtained that it fluctuated between 1.02 and 1.92% (Table 1), the maximum value obtained is in the range of the maximum (1.3 and 2.6%) reported by Martínez et al. (2008) and is lower than the 2.45% obtained by Muñoz de Chávez et al. (2002).

In the same table, it is noted that the average values of the highest percentage of acidity are found in red fruits, followed by green fruits and in lower amount, yellow fruits with 1.75; 1.49; 1.24, respectively. Regarding yellow fruits, Maldonado et al. (2018) obtained values of only 0.64%. Taking into account these percentages of citric acid, it is possible to classify this fruit as bittersweet because it is in the range between (0.6-1.9) according to the classification of Medina et al. (2015).

### Ripeness or Flavor Index (°Brix/AC)

On °Brix/AC, it is observed (Figure 3) that the yellow fruits presented the highest index with 8.18, followed by the green and red fruits with 6.93 and 5.73, respectively. The variability in the results obtained between the different phenotypes, since this variable is linked to harvest time and environmental factors

Taking into account the results obtained and considering the scale proposed by Medina et al. (2015), in relation to the classification of the fruits according to the flavor index, it can be stated that the red and green fruits are acidic, while the yellow fruits can be considered as bittersweet.

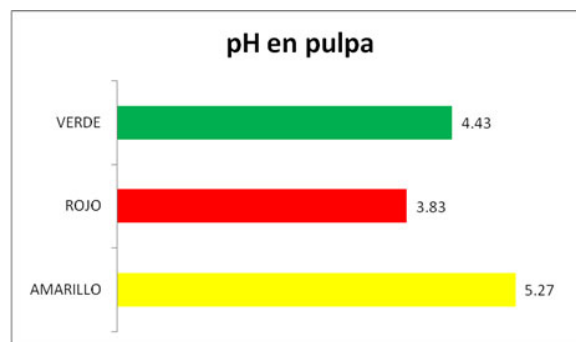


FIGURE 2. pH values in pulp in phenotypes Studied.

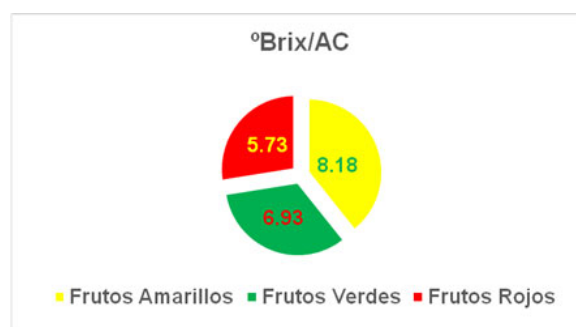


FIGURE 3. Ripeness or flavor index.

In Table 2, it is observed that the polar or longitudinal diameter of the evaluated fruits ranged between 1.41 and 1.98 cm, results that differ from those obtained by Sauri (2001), who obtained longitudinal diameters between 1.5 and 2 cm. Niembro et al. (2004) in their study mention dimensions of 1.7 to 2 cm while Medina et al. (2015) reported values between 1.41 and 2.44 cm when evaluating 41 nanche genotypes. These differences may be due to the fact that the fruits harvested in the research come from wild plants.

The equatorial diameter ranged from 1.46 to 2.29 cm, lower results than those obtained by Medina et al. (2015) from 1.68 to 2.48 cm; as well as those of Martínez et al. (2008) and Medina et al. (2015) who found diameters between 1.75 to 2.55 cm and 1.75 to 2.5 cm, respectively. The yellow fruits were those with the largest diameter, both polar and equatorial.

TABLE 1. Percentage of citric acid in pulps of nanche

Samples	Total Acids					
	Yellow		Green		Red	
	Consumption NaOH (ml)	Acid%	Consumption NaOH (ml)	Acid %	Consumption NaOH (ml)	Acid %
1	11.00	1.41	9.00	1.15	12.00	1.54
2	10.00	1.28	12.00	1.54	15.00	1.92
3	8.00	1.02	14.00	1.79	14.00	1.79
Means		1.24		1.49		1.75

TABLE 2. Fruits dimensions

	Green fruits		Yellow fruits		Red fruits	
	Ø Polar (cm)	Ø Equat. (cm)	Ø Polar (cm)	Ø Equat.(cm)	Ø Polar (cm)	Ø Equat. (cm)
Average Recount	3,50	3,50	3,50	3,50	3,50	3,50
	1,56	2,00	1,69	2,03	1,61	1,72
DP/DEindex	0,76		0,83		0,94	
Stand.dev	0,72	0,76	1,13	1,07	0,80	0,84
Var. coeff	0,05	0,04	0,07	0,05	0,05	0,05
Minimum	1,42	1,82	1,46	1,84	1,41	1,46
Maximum	1,75	2,15	1,98	2,29	1,74	1,89
Est. bias	1,51	-0,55	0,52	1,04	-1,44	-1,47
Est. kurtosis	0,95	0,05	0,37	-0,34	0,11	1,92

The analysis of the DP/DE relationship showed an index between 0.76-0.94, indicating that the polar diameter of the fruits is less than the equatorial one and that they have an oblate shape. Values between 0.84 to 1.0 were reported by [Medina et al. \(2015\)](#) and [Maldonado et al. \(2016\)](#), demonstrating the existing variability in nanche fruits.

The red fruits, among the three phenotypes, have the smallest size with average equatorial and polar diameter between 1.72 and 1.61 cm, respectively, while the largest dimensions are shown in the yellow fruits (2.03 and 1.69cm). This characteristic affects the quality of the fruits for their acceptance by consumers.

### CONCLUSIONS

- The fruit of nanche has nutritional potential and in the agribusiness, due to its chemical properties, with a percentage of ° Brix between 10.03 and 10.35; pH between 3.83 and 5.27 and percentage of citric acid between 1.24 and 1.75, for which it is considered as sweet and sour fruit in a general sense.
- The ripeness or flavor index ranged between 5.73 and 8.18 on average, classifying red and green fruits as acidic and yellow fruits as bittersweet.
- The physical property evaluated showed that nanche is a species of great variability, the polar and equatorial diameters of the fruits ranged between 1.41 and 1.98 cm and 1.46 to 2.29 cm, respectively, being yellow fruits those with larger diameters.

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