Physical and chemical characteristics of catarina silver banana in conventional and organic cultivation

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Gabriella Lorrane Faria[1], Jeisabelly Adrianne Lima Teixeira[2], Anne Karolina de Melo Souza[3], Luana de Jesus Silva[4], Lara de Jesus Silva[5], Cleiciane Faria Soares[6], Jaqueline Pereira Medeiros da Silva[7], Flávia Soares Aguiar[8], Sarah Nadja Araújo Fonseca[9] and Wlly Polliana Antunes Dias[10]

ABSTRACT

The characterization of the fruits plays a fundamental role in the recommendation of a new cultivar, since a good variety has to present good agronomic and post-harvest characteristics. Thus, this study aimed to evaluate and compare the physical and chemical characteristics of Prata Catarina banana in conventional and organic cultivation. A completely randomized experimental design was used, consisting of two treatments, with organic and conventional cultivation methods, with fourteen replicates per treatment and four fruits per experimental unit. The work was carried out at the Laboratory of Physiology and Post-Harvest of the Center for Exact Sciences of the State University of Montes Claros (UNIMONTES), where analyses were carried out to determine the physical and chemical characteristics of the banana, such as the average fruit weight, diameter, length, fruit firmness, color, pH, soluble solids, titratable acidity and SS/TA. The organic and conventional cultivation methods did not show significant differences in terms of firmness, luminosity and chromaticity. Regarding the variable total soluble solids, the values ranged from 25.90ºBrix to 24.80ºBrix. As for the pH, differences were observed between the cultivation methods, the conventional method presented average values of 4.49, while the organic method had an average value of 4.39.It is concluded that the organic and conventional cultivation systems do not differ significantly in relation to the physical characteristics, however they present little variation in the chemical characteristics, for the attributes pH, acidity and (SS/TA).

Keywords: *Musa spp.*, Quality, Cultivar, Silver banana.

[1] Graduated in Agronomy – State University of Montes Claros.
E-mail: gabriellalfra@gmail.com
[2] Master's students in Crop Production in the Semi-arid - State University of Montes Claros.
E-mail: jeisabellylima@gmail.com
[3] Master's students in Crop Production in the Semi-arid - State University of Montes Claros.
E-mail: annekarolina4@gmail.com
[4] Master's students in Crop Production in the Semi-arid - State University of Montes Claros.
E-mail: luana.silvaj.10@gmail.com
[5] Master's students in Crop Production in the Semi-arid - State University of Montes Claros.
E-mail: laradejesus98@gmail.com
[6] Master's students in Crop Production in the Semi-arid - State University of Montes Claros.
E-mail: cleicianeprof@gmail.com
[7] Master's students in Crop Production in the Semi-arid - State University of Montes Claros.
E-mail: jaqueagroinspire@gmail.com
[8] Master's Degree in Plant Production in the Semi-Arid Region - State University of Montes Claros.
E-mail: fsa.agronomia@gmail.com
[9] Dr. in Plant Production in the Semi-arid Region - State University of Montes Claros.
E-mail: sarah.nadja@hotmail.com
[10] Dr. in Plant Production in the Semi-arid Region - State University of Montes Claros.
E-mail: wllypolliana@hotmail.com

INTRODUCTION

Banana *(Musa spp.)* It is a very important tropical fruit in the human diet and has high nutritional value, as it is a source of vitamins and minerals. In Brazil, bananas have an annual per capita consumption of 28.99 kg (FAO, 2018). More than 125 countries are dedicated to the cultivation of this fruit, with the Asian continent being the leader in production. India ranks first followed by China, Indonesia and Brazil.

According to the Brazilian Fruit Yearbook (2018), according to the latest data from the World Agricultural Production (WFP) of the Brazilian Institute of Geography and Statistics (IBGE), in 2016 alone, 6,764,324 tons of the fruit were produced, in an area of 469,711 hectares, and more than 98% of the harvest supplies the domestic market.

Commercial banana cultivars originate from two species: *Musa acuminata* (genome A) and Musa balbisiana (genome B). The nomenclature of the genome establishes the varietal groups, which group cultivars with similar characteristics, the fruits of cultivars of type AA (Gold) and AAA (Nanica) are sweeter, while the silver banana belongs to the AAB group which has as a characteristic greater acidity, there are also of the AAB type that have higher starch content, such as Terra.

The cultivars of the Silver type are the ones that most please consumers, proven by the dominance of cultivation throughout the country. Regarding the great importance of the fruit, its cultivation faces problems related to the lack of commercial cultivars. The main characteristics in the choice of cultivars to be implanted are: a) market preference; b) adaptability to the site; c) price/productivity; d) tolerance to pests and diseases; e) postage, and f) shelf life. The cultivar Catarina (SCS451), from the silver group, was registered by Epagri (Agricultural Research Company of Santa Catarina) and has a lighter skin color, longer fruit length, and higher bunch weight compared to Prata-anã, which allows a higher percentage of fruits classified as "Extra" and "First". It has a higher tolerance to "Panama Disease" compared to dwarf silver and also has high resistance to cold and winds. The main benefit of the Catarina silver banana is the excellent productivity it offers, with an average higher than the dwarf silver, which was the most productive of the variety until then.

The objective of this study is to evaluate and compare the physical and chemical characteristics of Prata Catarina banana under conventional and organic cultivation.

MATERIALS AND METHODS

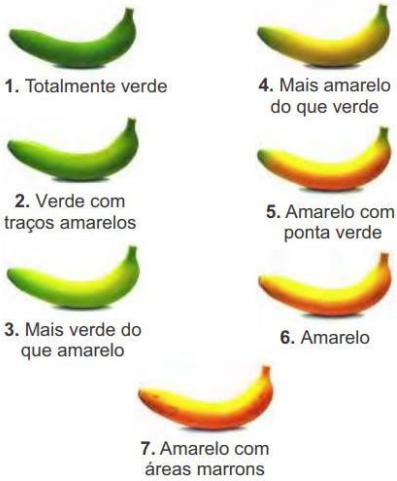
The study was carried out at the Laboratory of Physiology and Post-Harvest of the Center for Exact Sciences, Department of Agricultural Sciences, State University of Montes Claros - Campus Janaúba-MG. Bananas of the Prata Catarina cultivar from commercial plantation in the municipality of Verdelândia were produced in conventional and organic methods.

Fruit harvesting should be carried out at the coolest times of the day and products should be

kept protected from high temperatures, harvesting after heavy rains should be avoided, and boxes should be filled in the field. Therefore, harvesting requires some care to avoid damage and losses in the post-harvest, as some products are easily damaged, care must be redoubled so that mechanical damage does not occur that can affect the integrity and appearance of the product. The fruits had green skin with yellow traces, i.e., at maturity stage 2 according to the Von Loesecke scale (1950) (Figure 1), and were dropped and immersed in washing tanks containing water and neutral detergent to remove floral remains and eliminate latex. The analyses were performed when the fruits reached ripening stage 6 of the same scale (totally yellow skin).

The experiment was carried out in a completely randomized design, consisting of two treatments, with the cultivation methods adopted, organic and conventional, with fourteen replicates per treatment and four fruits per experimental unit.

FIGURE 1: Von Loesecke maturation scale (1950)



Fonte: VON LOESECKE (1950).

PHYSICAL ANALYSIS

For the physical analyses, samples formed by four fruits will be used.

Fruit Mass Loss

The fruits were weighed individually with the aid of an electronic scale with a precision of 0.1 g.

Fruit Dimensions

The diameter was determined using a caliper (mm) measuring the median region of the fruits, and the length was determined using a tape measure (cm) measuring the outside of the fruit, from the base of the peduncle to the other end.

Fruit firmness

Firmness was performed with a Brookfield CT3 10 KG digital texturometer. The measurements were performed in the median region of the fruit, and were determined by the penetration force, measured in Newton (N), necessary for the 4 mm diameter tip to penetrate the fruit pulp at a depth of 7 mm.

Colouring

Color analysis was performed using a Color Flex 45/0(2200) colorimeter, stdzMode:45/0 with direct reflectance reading of the coordinates L* (luminosity), a* (red or green hue) and b* (yellow or blue hue), from the Hunterlab Universal Software system, measured in the median region of the fruit. From the values of a* and b*, the hue angle (°h*) and the chroma saturation index (C*) were calculated.

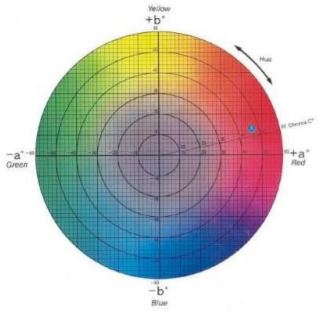
$$°h^* = \text{actg}\,(a^*/b^*)\,(-1) + 90 \text{ for } a^* \text{ negative}$$

$$°h^* = 90 - (\text{actg}\,(a^*/b^*)) \text{ for } a^* \text{ positive } C^* = \sqrt{(a^*)2 + (b^*)2}$$

The Hue angle is defined as starting at the + a axis and is expressed in degrees, where 0° corresponds to +a (red), 90° corresponds to +b (yellow), 180° corresponds to –a (green), and 270° corresponds to –b (blue).

Chromaticity: This value defines the intensity of the color, assuming lower values for more neutral colors (gray) and higher values for vivid colors.

FIGURE 2 - L, a, b Color Solid representation of the Hunterlab Universal Software system and description of Hue Angle (^{o}h*) and chroma saturation index (C*)



Source: Adapted by the authors, 2024.

CHEMICAL ANALYSIS

For the chemical analyses, samples composed of four crushed fruits were used.

Soluble Solids (SS)

Soluble solids were determined by refractometry, using an ATAGO optical benchtop

refractometer, model N-1α, with readings in the range of 0 to 95 °Brix and the result was expressed in °Brix (IAL, 2008).

Titratable acidity (TA)

Acidity was determined by titration using 10 g of pulp diluted in 90 mL of distilled water followed by titration with 0.1 M NaOH solution, using phenolphthalein as indicator. The result was expressed in grams of malic acid per 100 g of sample (IAL, 2008).

Soluble Solids to Acidity Ratio (RATIO)

The soluble solids/titratable acidity (SS/TA) ratio was obtained by means of the ratio between the soluble solids (SS) content and the titratable acidity (TA).

ph

pH was determined using a benchtop measuring device with a glass membrane electrode calibrated with pH 4.0 and 7.0 solutions (IAL, 2008).

STATISTICAL ANALYSIS

The data were submitted to analysis of variance using the F test at 5% probability, and the means were equal.

RESULTS AND DISCUSSION

PHYSICAL CHARACTERISTICS

According to the analysis of variance of the physical characteristics (Tables 1 and 2), it was found that there is no significant difference for the variables length, diameter, firmness, chromaticity and luminosity. Significant differences were observed only for the fresh mass and HUE angle variables.

The organic and conventional cultivation methods did not show significant differences in relation to firmness, with mean values of 5.71 N and 5.62 N, respectively. The results found in this study for the two cropping systems were lower than the values found by Silva et al. (2009) in bananas at stage 7 in Terra type banana fruits, whose mean value was equal to 8.8 N.

Based on the comparison between the means of the physical characteristics (TABLE 1), through the F Test at 5% probability, it was possible to observe that for the color of the fruits, only the Hue Angle presented significant differences, the mean values were 81.93 and 84.33, which characterizes the yellow color of the fruits.

The chromaticity values did not show significant differences, the values observed were high

in both cultivation systems, being 40.47 for the organic cultivation and 40.79 for the conventional cultivation, being close to vivid colors.

The luminosity values found in the conventional and organic methods were 58.88 and 58.46, respectively, and did not show differences in relation to the cultivation systems. The observed luminosity values characterize lighter colors because they are close to white.

The characteristics related to the color of the peel of the fruits such as Hue Angle, Chromaticity and Luminosity, it can be observed that there was a significant difference only for the variable Hue Angle.

TABLE 1 - Average values of physical characteristics evaluated in Prata Catararian banana Conventional and Organic system (2019)

		Physical Characteristics		
Cultivate	FIRMNESS	LUMINOSITY	HUE Angle	CHROMATICITY
Organic	5.71 to	58.46 A	84.33 to	40.47 to
Conventional	5.62 to	58.88 to	81.93 b	40.79 A
CV(%)	14,86	10,12	1,91	8,96
Means followed by the same letter do not differ statistically by the f-test at 5% probability.				

Source: AUTHORS, 2024.

Table 2 shows the length values, and the averages were similar in both cultivation methods, 19.09 in organic cultivation and 20.04 in conventional cultivation. Sarmento (2010), in studies carried out with the same cultivar, found lower values (18.4 cm). The results regarding the diameter obtained in this study were 37.14 mm in the organic system and 35.9 mm in the conventional system, when compared to the study by Sarmento (2010) showed that the values found were very close (37.3 mm).

According to Chitarra and Chitarra (2005), bananas of the Prata group are classified as Extra type when they have a minimum diameter of 28 mm and a minimum length of 15 cm, which indicates that the Prata Catarina within the two cultivation systems is included in this group.

Regarding the fresh mass variable, the organic system showed significant differences, with higher values (155.19 g) compared to the conventional system (140.30 g). For Chitarra and Chitarra (2005), size and mass are physical characteristics inherent to the species or cultivars, but they are used as quality attributes for the selection and classification of products according to the convenience of the consumer market.

TABLE 2 - Average values of physical characteristics evaluated in Prata Catararian banana Conventional and Organic system (2019)

		Physical Characteristics	
Cultivate	FRESH PASTA	LENGTH	DIAMETER
Organic	155,19 a	19,09 a	37,14 a
Conventional	140,30 b	20,04 a	35,9 a

Source: AUTHORS, 2024.

CHEMICAL CHARACTERISTICS

According to the analysis of variance of the chemical characteristics, it was found that there is a significant difference for the variables titratable acidity, pH and soluble solids/acidity ratio (RATIO). No significant differences were observed for the soluble solids variable.

Based on the comparison between the means of the chemical characteristics (TABLE 3), it was possible to observe that there were no significant differences in relation to the soluble solids variable for organic and conventional Catarina Silver, and the values ranged from 25.90ºBrix and 24.80ºBrix, respectively. Lopes (2011) studied Prata Anã bananas produced under conventional and alternative management, and found higher values, where he obtained the averages of 26.45ºBrix and 27.77ºBrix, respectively. Soluble solids indicate the amount of solids that are dissolved in the pulp and during maturation their content tends to increase due to the biosynthesis of soluble sugars or the degradation of polysaccharides (CHITARRA and CHITARRA, 2005)

Regarding the pH values, differences were observed between the conventional and organic cultivation methods, with mean values of 4.49 and 4.39, respectively. Similar values were found for the cultivar Pacovan, present in the study by Matsuura et al., (2002), which ranged from 4.30 to 4.50.

Regarding the titratable acidity variable, it was found that there was a statistical difference between the treatments (TABLE 3), the acidity values evaluated only by the conventional system were within the range suggested by some authors, which is between 0.22% and 0.65% (CHITARRA AND CHITARRA, 1994; MATSUURA et al., 2002). According to Carvalho (1989) the titratable acidity of bananas tends to increase during ripening and decreases when the fruit is very ripe, this variation occurs due to the consumption of acids during the respiratory peak characteristic of fruits in the senescence stage.

Regarding the SS/TA ratio (RATIO), significant differences can be observed between the cultivation methods (TABLE 3), Chitarra & Chitarra (2005) report that the high SS/TA ratio is very important and desirable, and is widely used for the evaluation of flavor in fruits, it is a more representative index than the isolated measurement of sugars or acidity.

TABLE 3 - Average values of the chemical characteristics evaluated in Prata Catararian banana Conventional and Organic system (2019)

Cultivate	Chemical Characteristics			
	SS	ph.	AT [1]	RATIO[2]
Organic	25.90 to	4.39 b	0.68 to	38.12 b
Conventional	24.80 a	4.49 to	0.59 b	43.05 to
CV(%)	5,99	2,44	11,44	14,19
[1] 100 g of malic acid per 100 ml of pulp [2] Brix and acidity ratio				
Means followed by the same letter do not differ statistically by the f-test at 5% probability				

Source: AUTHORS, 2024.

CONCLUSION

The organic and conventional cropping systems do not differ significantly in relation to physical characteristics, however they present little variation for chemical characteristics, such as pH, acidity and SS/TA.

The Catarina silver cultivar has characteristics that are important to producers, such as tolerance to Panama disease and good productivity, and to consumers who have a preference for large, sweet and low-acid fruits.

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