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Physicochemical and sensory analysis of coffee: A determination in different parts of the plant

Rachel Machado de Sousa[1], Leandro Carlos Paiva[1]

[1]Instituto Federal de Educação, Ciência e Tecnologia do Sul de Minas Gerais/IFSULDEMINAS, Campus Machado, Machado, MG, Brasil
Contact authors: rachelsmachado@uol.com.br; leandro.paiva@ifsuldeminas.edu.br
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ABSTRACT

The quality of the Arabica coffee drink (*Coffea arabica* L.) is the result of the interaction of several factors such as climatic conditions, terroir, altitude, nutritional factor, stage of fruit maturation, harvest, post-harvest, among others. The combination of all these factors is so complex that, even in a single coffee plant, there are variations in quality and flavors. The objective of research was to evaluate the physicochemical quality of coffee fruits through the soluble solids content of coffee beans in different parts of the plant in order to define which position/location in the plant is more promising to start harvesting the fruits and which location presents the best results in relation to the sensory attributes of the beverage. About 10% of the total mass of the composite sample was used for analysis of soluble solids (SS) in °Brix of cherry and raw coffee, mass of 1000 grains and sensory evaluation, stating that the Catuai IAC 144 variety showed better results compared to the Paraiso MG 419 variety - 1. Regarding electrical conductivity (EC), titratable acidity (TA) of raw coffee, pH, colouring, the results of the two varieties were representative for quality, where the values found in the analyzes are within the defined ranges. The experimental design used was in randomized blocks, where each variety Catuai IAC 144 and Paraiso MG 419-1 was harvested in three blocks. Each block consisted of a plant, and each plant was divided into twelve subdivisions. In order to carry out the physical-chemical analyses, a sample composed of the three blocks was carried out. Treatments were arranged in a 12x2x3 (12 treatments x 2 varieties x 3 repetitions) factorial and subjected to analysis of variance (ANOVA) and means compared by Scott Knott's post hoc test with significance level (p-value ≤ 0.05). It used the correlation matrix between the variables under study in order to verify whether there is a linear relationship or not between the variable's soluble solids ºBrix of cherry and raw coffee, aroma and body of the beverage with the average final score of the tasters. With interpretation by the generated equation there is an association between body and final score, when increasing a unit in the body of the drink, an increase of 2.21 in the final score is expected. The positions on the coffee plant, upper third and lower third in relation to the Catuai IAC 144 and Paraiso MG 419-1 varieties were the most promising from the perspective of the results found in the physical, chemical and sensory analysis.

Key words: Coffee growing; exposure face; sensory analysis-SCAA; *Coffea arabica* L.; soluble solids.

1 INTRODUCTION

Coffee growing is an important agricultural activity from an economic point of view. It is a source of income for hundreds of municipalities and is an important sector for job creation in agriculture.

Although coffee appears to be a simple product to consumers, the interaction of the entire process, from care in the field to transformation from seed to drink, involves controlled processes that require knowledge in order to achieve beverage quality standards. Coffee is a very complex beverage in terms of its chemical and sensory constitution (Ferrão et al., 2017).

One of the three main ways of assessing coffee quality is through physical analysis (related to the bean), sensory analysis (aspects of the drink in terms of taste, smell and appearance) and chemical analysis, since its composition is directly related to the quality of the drink (Cheng et al., 2016).

According to Pimenta (2003), physico-chemical attributes are influenced by crop management, harvesting and post-harvest practices. The genetics of the plant (varieties and clones), the growing conditions (shading, chemical and organic fertilization and irrigation) and the harvesting, drying and storage process directly affect the chemical composition of the coffee beans (Pereira et al, 2018).

According to Alves et al. (2011); Silveira (2016) coffee trees from colder regions or with a defined dry season ripen more slowly and have a greater accumulation of sugars in the beans and produce fuller-bodied, sweeter and more aromatic drinks, with notes of chocolate, caramel and nuts. The peculiarity of these coffees is due to the altitudes which vary between 700 and 1200m and temperatures between 18º and 22º C. At lower altitudes, where the temperature is generally higher, the fruit formation time is shorter and this can reduce the final quality of the drink (Zaidan et al., 2015). Sugars directly influence the quality of coffee, and their proportion depends on the species, maturing stage of the fruit of the coffee grower, place of growing, altitude, etc.

Alves et al. (2011) observed that coffee expresses itself differently depending on where it is planted. Scholz et al. (2011) found that environmental conditions act as factors that determine the chemical composition of coffee, which in turn defines the sensory quality of the drink after roasting.

The acidity and soluble solids content of coffee beans have been related to the quality of the product, indicating possible changes in the coffee fruit, such as the undesirable fermentation process that occurs pre and post-harvest, leading to product defects (Lima Filho et al., 2015). The soluble solids content of coffee has an impact both in terms of industrial performance and in terms of its contribution to ensuring the body of the drink, providing a good quality drink. The final characteristic of the drink is the result of the complex physical-chemical composition of the coffee, which defines its sensory characteristics (Pimenta, 2003). Alves (2020) observed in specialty coffees that beans with values above 22,00ºBrix, in relation to ripeness, resulted in higher quality fruit, which will give rise to special lots with higher added value.

Another important factor to be evaluated in coffee beans is electrical conductivity, which has proven to be a promising physicochemical attribute for distinguishing fine coffees from common coffees, since the higher this measure, the lower the quality, (Taveira et al., 2012).

In view of the above, the aim of this research was to evaluate the physical and chemical quality of coffee tree fruit, by assessing the soluble solids content of the beans in different parts of the plant, in order to define which position/location on the plant is the most promising to start harvesting the fruit and which location is the most complex in terms of the sensory attributes of the drink.

2 MATERIAL AND METHODS

The experiment was conducted at the Experimental Farm of the Agriculture Research Company of (EPAMIG), in Machado-Minas Gerais, Brazil. The city has the climatic characteristics of mountains. The region has a wavy relief topography and is located at an altitude of 900 m. The study area was located at 21° 41’ 48’’ S and 45° 52’ 54’’ W and had a latosol type of soil. According to the Köppen and Geiger (1928) classification, its climate is Cwa (humid temperate with dry winters and hot summers), with average temperatures from −3ºC to 18ºC. The coffee trees were grown under the same conditions of temperature, geographical coordinates, altitude and physical space. The plot of each variety was delimited, respecting the bord, three initial lines, after the “carrier” and three plants in “between the lines” to begin collecting the grains.

The Arabica coffee beans were harvested when most fruits on the coffee tree reached the optimal ripening stage (cherry) held in June 2022 (harvest year 2021/2022), considering the period of physiological ripening of the fruits, based on the recommendation of Camargo and Camargo (2001). At harvest, the average soluble solids content found in the fruit of the Catuai IAC 144 variety was between 13,00 and 27,00 ºBrix and for the Paraíso MG 419-1 variety the average was between 14,00 and 24,00 ºBrix.

The plants selected were more than six years old and planted in the East/West direction; the spacing between plants was 3.0 m x 0.80 m in full sun. The coffee varieties used in this study were Catuaí vermelho IAC 144 and Paraíso MG H 419 -1 amarelo, both belonging to the *C. arabica* species, and the coffee was harvested by hand.

Three plants of each variety were subdivided into 12 parts, and then, the samples were placed in a plastic bag and labeled according (Table 1 and Figure 1).

These samples were carried out at the Bromatology Laboratory, located of the Institute of Education, Science, and Technology of the South of Minas Gerais (IFSULDEMINAS), *campus* Machado - MG, for further analysis.

In the two varieties of coffee studied, to evaluate the soluble solids in °Brix and the mass of 1,000 grains, the harvested coffee was placed on the suspended ground and rolled four to five times per day until it reached a humidity of 12% wet base (w.b.). Above this percentage, the grains can whiten quickly, which increases the risk of deterioration and loss of quality (Ministério da Agricultura, Pecuária e Abastecimento - MAPA,

Table 1: Description regarding the location of the parts of the coffee tree in relation to the evaluated varieties Catuai IAC 144 and Paraiso MG 419, harvested at the Experimental Farm of (EPAMIG), in Machado-Minas Gerais, Brazil.

Place of collection/ Treatments	Abbreviations	Location on the plant
T1	TSPGO	Upper third west guide
T2	TSPGL	Upper third east guide
T3	TSBGO	Upper third base west guide
T4	TSBGL	Upper third base east guide
T5	TMPGO	Third medium tip west guide
T6	TMPGL	Third medium tip east guide
T7	TMBGO	Third medium base of the west guide
T8	TMBGL	Third medium base of the east guide
T9	TIPGO	Low third east pick of the guide
T10	TIPGL	Low third east leader stop
T11	TIBGO	Lower third base of the east guide
T12	TIBGL	Lower third base of the east guide

2009). Next, these samples were stored in coconut for 40 days and then peeled. The experiments were conducted in blocks (DBC), and each variety was harvested in three blocks. Each block consisted of a plant that was divided into 12 subdivisions; the blocks were considered to be two separate experiments in the factorial scheme (12 treatments x 2 varieties x 3 repetitions).

A sample composed of the three blocks was used to conduct physicochemical analyses. Approximately 10% of the total mass of the compound sample was used to determine the weight of 1000 grains, soluble solid content of the pulp of cherry grain and raw coffee, titratable acidity, pH, coloration (L, a, and b), and electrical conductivity. The experimental data were examined by analysis of variance (ANOVA), and the mean values were compared by the Scott-Knott post hoc test with a significance level of 5% ($p \leq 0,05$) using the Sisvar software version 5.6 (Ferreira, 2015).

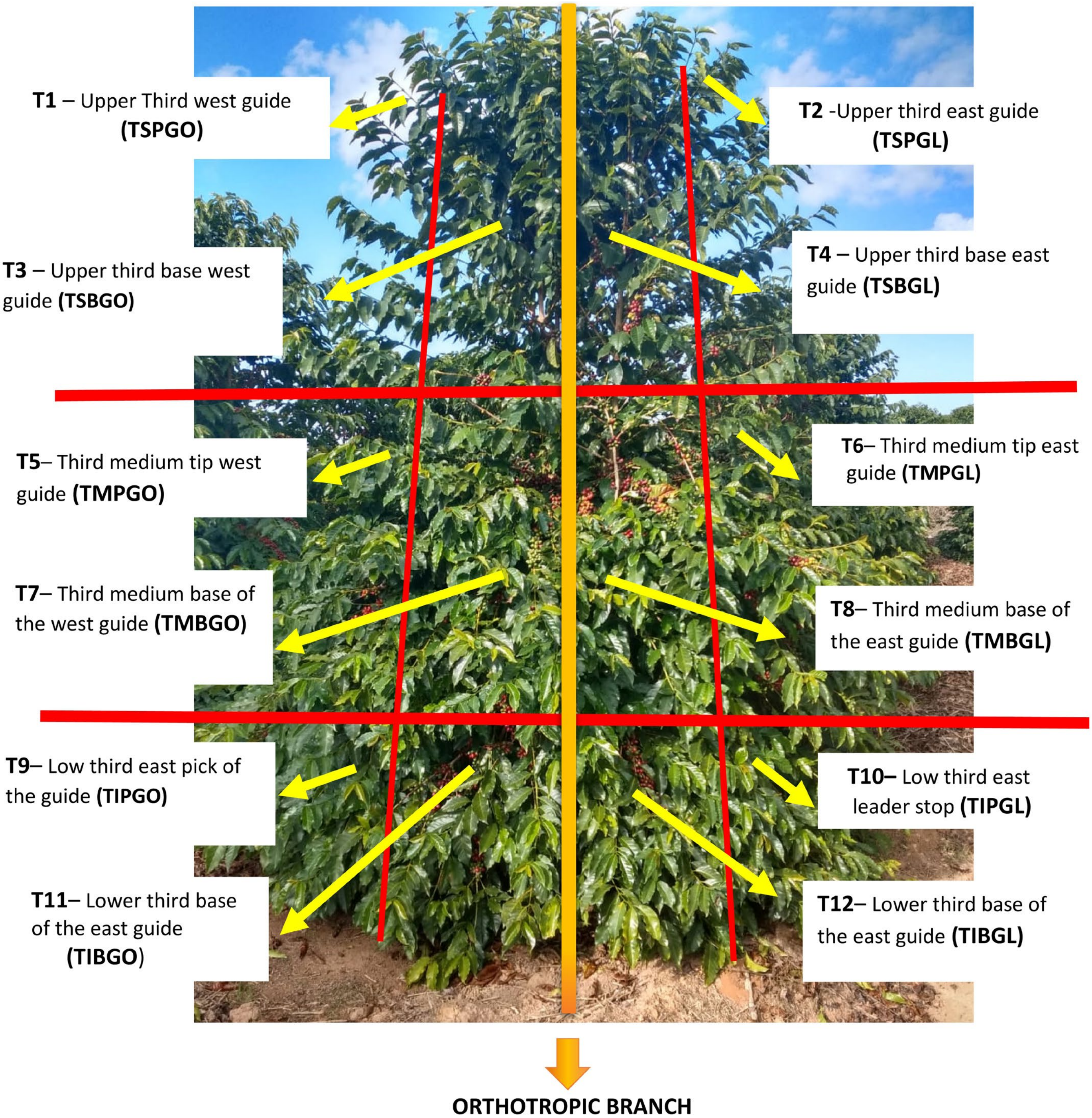


Figure 1: The different parts of the plant coffee tree from fruits the varieties Catuai IAC 144 and Paraiso MG 419-1 were collected at the Experimental Farm of (EPAMIG), in Machado-Minas Gerais, Brazil.

The soluble solids (SS) in °Brix of the grain pulp were evaluated by portable digital refractometer with a precision of ±0.0001 nD and 0.1% Brix. The results were expressed in % (°Brix), following the methodology proposed by the Association of Official Analytical Chemists (Association of Official Analytical Chemists - AOAC, 2005).

The results were expressed in °Brix with the reading corrected to (g)/ 100 g of sample. To determine the soluble solids content of the grain coffee, the extract was prepared from 1 g of the sample, diluted in 10 mL of distilled water and filtered through filter paper, using a bench refractometer to read the Brix level of the juice obtained by squeezing it.

The mass of 1000 grains (MMG) of cherry coffee and raw coffee was determined, following a factorial scheme of 12 ×2 x 3, the treatment indicated the different parts of the coffee plants from which the samples were collected.

The mass of one thousand grains was measured on raw coffee and cherry coffee and determined according to Brasil (2009) using eight samples of one hundred grains from each treatment. The beans were counted, weighed and then the mean, variance, standard deviation and coefficient of variation of these values were calculated. The determinations were made using an electronic scale with a resolution of 0.01g, and the results were expressed in grams (g)/100g.

Titratable acidity (TA) was determined by titration with NaOH (0.1 N/100 g), using a 1% phenolphthalein solution as an indicator, following the techniques described, according to the methodology quoted by the Association of Official Analytical Chemists, AOAC (1990), modified for coffee by Carvalho et al. (1994). Briefly, 2 g of the raw coffee sample was mixed with 500 mL of distilled water and shaken for 1 h at 150 rpm. Then, the contents were filtered using filter paper, and 5 mL of the filtered solution was placed in an Erlenmeyer flask; 50 mL of distilled water was removed. Next, three drops of phenolphthalein were added, followed by titration with NaOH (0.1N/100g). The acidity was measured by titrating with 0.1 N NaOH, and the result was expressed in mL of was expressed in NaOH (0.1 N/100g) of sample (AOAC, 1990). From the same extract, the pH was measured using a pH meter (AOAC, 1990). The data obtained were compared with the Scott-Knott test, at 5% significance, using the Sisvar software (Ferreira, 2015).

To determine the color, a Minolta® Chroma Meter CR-400 colorimeter (lighting D65, 2nd angle of observation and in the CIE color system L*a*b*) was used. The parameters “L” (luminosity), “a”, and “b” (chromaticity coordinates) were measured. In this system, “L” indicates the brightness (0 = black and 100 = white), while “a” and “b” indicate the directions that the color can take (positive and negative values of “a” indicate red and green, respectively; positive and negative values of “b” indicate yellow and blue, respectively), described by (Abreu et al., 2015). The samples were placed on Petri plates, and five readings were made at the four cardinal points and one at the central point of the plate for each repetition. (KONICA MINOLTA SENSING INC., 1998). The color characteristics were measured at each instance of experimental evaluation.

The electrical conductivity (EC) of raw coffee beans was determined following the methodology proposed by Malta, Pereira, and Chagas (2005). In short, three samples of 50 hulled coffee beans without defects, collected from each treatment group, were weighed and immersed in 75 mL of deionized water (in plastic cups with a capacity of 180 mL). Then, they were placed in a 25 °C ventilated greenhouse.

After the samples were boiled for 24 h, the solutions without the coffee beans were poured into another container, where the electrical conductivity was measured using a mod conductivity meter (portable digital CD-830). The results were expressed in $\mu S.cm^{-1}$. g^{-1} sample and compared using the Scott-Knott test at 5% significance using the Sisvar software (Ferreira, 2015).

The criteria used to roast the samples for sensory evaluation was the protocol of the Specialty Coffee Association of America (Specialty Coffee Association of America - SCAA, 2015). The panel was made up of three examiners accredited to evaluate specialty coffees (Q-Grader). The sum of the individual results for each attribute was considered the final result.

The data obtained during the sensory evaluation was recorded in the Cropster Cup software, and the final result was calculated instantly. Coffee shops that scored above 80 points are considered specialty, according to the SCAA (2015). Coffee houses that presented scores above 80 points are considered special, as per the SCAA (2015). The sensory characterization of the two cultivars was performed in this study to determine the relationship between the values found in soluble solids in °Brix and the flavor notes found for the attributes of coffee by the trained panel.

3 RESULTS

All variables for each treatment of the Catuaí IAC 144 and Paraíso MG 419–1 coffee varieties were analyzed. The results of the sensory analysis were presented using descriptive statistics and their interaction with the results of the physical-chemical analyses, through the values found in each treatment, and positions collected in the varieties of coffee cultivars Catuaí IAC 144 and Paraíso MG 419–1. To find consistent correlations and critically evaluate evaluate the results data, graphs and tables were constructed indicating the independent variables and the interactions between them. There were significant differences between the evaluated parameters of soluble solids of raw coffee, grain pulp, mass (g) of cherry and raw grain, pH, electrical conductivity (EC), colouring of raw coffee and sensory evaluation.

3.1 Soluble Solids (SS)

The variables evaluated regarding the content of SS differed significantly between the treatments/positions harvested in the plants of the varieties Catuaí IAC 144 and Paraíso MG 419–1. Although the interaction term was not significant, the terms variety and treatment were significant independent factors, as determined by the result of the post hoc test (Table 2).

Table 2: The results of the parameters evaluated in the 12 treatments for the varieties Catuaí IAC144 and Paraíso MG-419–1. Interaction between the factors for the soluble solid variables is presented.

Plant Parts / Treatment	Raw solid soluble coffee variety Catuai IAC 144 and Paraiso MG 419-1	
	Catuaí 144	Paraíso MG 419–1
T1	24.33 cA	23.90 aB
T2	25.87 bA	20.47 dB
T3	24.03 dA	22.83 bB
T4	26.63 aA	22.60 cB
T5	23.93 dA	20.50 dB
T6	19.80 gA	18.80 fB
T7	23.00 eA	23.00 bA
T8	20.80 fA	20.20 eB
T9	17.80 hA	13.13 iB
T10	18.00 hA	17.00 gB
T11	16.77 iA	15.77 hB
T12	13.37 jB	15.87 hA

Note: Averages followed by the same minuscule (column) and major (line) letters do not differ from each other by the Scott Knott test ($p \leq 0,05$).

The results of the analysis of variance for the soluble solid content of the grain pulp relative to the soluble solids of raw coffee for Catuaí variety IAC 144 are shown in Table 3.

Regarding the total soluble solid content of the grain pulp and raw coffee of the Paraiso MG 419–1 variety, the results varied significantly between the different stages of grain pulp ripening in terms of the treatments/positions from which the fruits were harvested, as determined by the Scott-Knott post hoc test ($p < 0.05$) (Table 4).

3.2 Mass of 1000 grains (MMG), pH, and chroma b

Regarding the mass of 1000 grains of the cultivar Catuaí IAC 144 red, Carvalho (2007), the average weight of the grains of this cultivar varied from 1,10 g to 1,23 g, and the average weight of 1000 seeds/grains varied from 102 g to 123 g. The difference between treatments was found to be significant, based on the Scott-Knott test ($p \leq 0.05$) (Table 5).

Table 3: Soluble solids in the pulp of cherry x raw coffee beans of the variety Catuaí IAC 144.

Soluble solids grain pulp x raw coffee Catuaí IAC 144	
FV	SS
Plant Location (A) / Treatment	**
T1	23.32 a
T2	23.72 a
T3	22.53 a
T4	24.28 a
T5	22.90 a
T6	16.00 b
T7	18.23 b
T8	18.52 b
T9	15.48 b
T10	16.47 b
T11	14.89 b
T12	12.06 c
Type of Coffee (B)	**
Pulp	16.87 b
Raw	21.19 a
A X B	ns
CV (%)	15.51

Note: Averages with equal letters do not statistically differ from each other by Scott Knott test (p-value <0,05); ns: Not significant. (SS) Soluble Solids. (FV) Source of Variation. (CV) Coefficient of Variation.

Table 4: Comparison between the soluble solids of cherry bean pulp and soluble solids of raw coffee of the Paraíso MG 419–1 variety.

Plant Parts / Treatment	Soluble solid of the Paraíso MG 419–1 variety	
	SS (°Brix) Pulp grain	Raw
T1	19.01 aB	23.90 aA
T2	13.25 bB	20.47 bA
T3	14.78 bB	22.83 aA
T4	11.02 cB	22.60 aA
T5	13.99 bB	20.50 bA
T6	11.74 cB	18.80 bA
T7	12.60 bB	23.00 aA
T8	11.00 cB	20.20 bA
T9	11.76 cA	13.13 dA
T10	9.43 cB	17.00 cA
T11	12.89 bB	15.77 cA
T12	11.94 cB	15.87 cA

Note: Averages followed by the same minuscule (column) and major (line) letters do not differ from each other by the Scott Knott test (p-value ≤ 0.05). (SS) Soluble Solids.

Table 5: The results of the parameters evaluated in the 12 treatments for the varieties Catuaí IAC144 and Paraíso MG- 419–1 are presented. The interaction between the factors for the variables mass, pH, and chroma b is shown.

Plant Parts / Treatment	Mass (g) cherry grain		pH		b*	
	Catuaí IAC 144	Paraíso MG 419–1	Catuaí IAC 144	Paraíso MG 419–1	Catuaí IAC 144	Paraíso MG 419–1
T1	123.7 dB	168.0 bA	5.95 eB	6.03 cA	16.76 cA	16.92 cA
T2	142.3 bB	165.0 bA	6.05 cA	6.05 cA	21.77 bA	15.38 dB
T3	132.7 cA	130.3 dA	6.19 aA	6.08 bB	10.93 dA	12.58 dA
T4	129.3 cA	135.6 dA	6.09 bA	6.09 bA	21.95 bA	19.39 cA
T5	115.7 dB	187.7 aA	6.13 bA	6.13 aA	14.55 cA	18.07 cA
T6	144.7 bA	131.3 dA	6.01 dB	6.10 bA	28.62 aA	21.01 bB
T7	135.3 cB	155.3 bA	6.05 cA	6.05 cA	12.87 dB	20.90 bA
T8	163.7 aA	145.3 cB	6.11 bA	6.11 aA	11.79 dB	26.43 aA
T9	145.7 bA	143.3 cA	6.11 bA	6.12 aA	12.82 dB	18.35 cA
T10	129.3 cA	123.0 dA	6.04 cB	6.12 aA	15.93 cA	18.32 cA
T11	133.0 cA	130.0 dA	6.11 bA	6.13 aA	25.19 aA	19.37 cB
T12	135.3 cA	127.3 dA	6.01 dB	6.13 aA	14.62 cA	16.43 cA

Note: Averages followed by the same minuscule (column) and major (line) letters do not differ from each other by the Scott Knott test (p-value ≤ 0.05). b* Color in the range from yellow (+b*) to blue (-b*). High L values represent lighter colors, and the opposite indicates darker colors.

For the cultivar Paraiso MG 419–1, no reference value was found in the literature for the average weight of the grains. Paraiso was formed by the artificial cross between yellow Catuaí IAC 30 and Timor Hybrid UFV 445–46.

Therefore, in this study, the average weight of the ripe fruit of yellow Catuaí was considered to be the mean weight of 1000 seeds of the flat type, from 112 g to 125 g for assessing the mass of 1000 grains. The weight of the fruits of the grains of cultivar Paraíso MG 419–1 was between 123,0 g and 187,7 g.

The pH values represented in table 5 were from 5,95 to 6,19 for the Catuai IAC 144 variety. In relation to the Paraiso MG 419-1 variety, the values found ranged from 6,03 to 6,13.

There was an interaction between the factors for the values of the b* chromaticity coordinate within the predefined range (Table 5).

3.3 Titratable Acidity (TA) and Coloring

The results of the analysis of titratable acidity (TA) of raw coffee showed that for the two varieties of coffee, the interaction was not significant ($p < 0.05$), as determined by the post hoc Scott-Knott test (Table 6).

The results of the quantitative color evaluation of the raw coffee beans, for the treatments of the varieties Catuaí IAC 144 and Paraíso MG 419–1, were expressed in terms of coordinates L* (luminosity), a*, and b* (chromaticity coordinates).

The interactions between the drying process, yield, and storage conditions did not significantly affect the coordinates a* and L*.

The types of processing and benefiting influenced the coordinate a values, as presented in Table 6.

3.4 Electrical conductivity (EC)

The electrical conductivity (EC) values found in the treatments of raw arabica coffee from the Catuaí IAC 144 and Paraíso MG 419-1 varieties reflected the quality of the drink (Table 7) and showed significant differences ($p < 0.05$) between the treatments/positions for the two varieties. The results obtained are within the parameters reported in the literature.

3.5 Sensory evaluation

The results obtained from the sensory evaluation of the varieties Catuaí IAC 144 and Paraíso MG 419–1 are described in Tables 8 and 9.

4 DISCUSSION

The content of soluble solids in raw coffee of the Catuaí variety IAC 144, as determined by the evaluated treatments, was between 13,37 and 26,63 ºBrix. The T4 treatment upper third base East guide (TSBGL) had the highest percentage of soluble solids (26,63 ºBrix), significantly higher than the soluble solids recorded in the other treatments. According to Alves (2020), the classification of the beverage is related to the degree of Brix. The author observed that beans with ripeness values above 22,00 ºBrix in specialty coffees provide higher quality fruit and specialty coffee lots with greater added value. The soluble solids content of treatments T1 to T5 and T7 are within this range.

Table 6: Titratable Acidity of Raw Coffee and Coloring.

FV	Acidity	L	a
Plant Location (A)	**	**	**
T1	198.00 a	29.99 a	0.22 b
T2	198.00 a	31.32 a	0.27 b
T3	181.50 a	28.82 a	0.29 b
T4	189.75 a	32.48 a	0.62 a
T5	189.75 a	30.30 a	0.21 b
T6	189.75 a	31.02 a	0.55 a
T7	189.75 a	33.32 a	0.51 a
T8	206.25 a	32.54 a	0.50 a
T9	189.75 a	31.15 a	0.72 a
T10	214.50 a	32.28 a	0.46 a
T11	189.75 a	30.88 a	0.41 b
T12	214.50 a	32.46 a	0.38 b
Varieties (B)	**	**	**
Catuaí 144	192.50 a	31.81 a	0.40 a
Paraíso MG 419–1	199.38 a	30.95 a	0.46 a
A X B	ns	ns	ns
CV (%)	13.64	10.90	54.50

Note: Averages with equal letters do not statistically differ from each other by Scott Knott test (p-value <0,05); ns: Not significant. L* Luminosity ranging from white (L = 100) to black; a* Color in the region from red (+a*) to green (-a*); b* Color in the range from yellow (+b*) to blue (-b*). High L values represent lighter colors, and the opposite indicates darker colors.

Table 7: The results of the parameters evaluated in the 12 treatments for the varieties Catuaí IAC144 and Paraíso MG-419–1. The interaction between the factors for the electrical conductivity variable is demonstrated below.

Plant Parts / Treatments	Electrical conductivity (μS cm-1 g -1).	
	Catuaí 144	Paraíso MG 419–1
T1	103.55 bB	117.16 bA
T2	114.75 aA	107.53 cA
T3	98.63 bA	96.65 dA
T4	96.92 bA	96.04 dA
T5	107.83 aB	119.20 bA
T6	111.92 aA	112.32 cA
T7	99.80 bB	133.14 aA
T8	109.56 aA	108.06 bA
T9	95.90 bA	92.93 dA
T10	118.88 aA	109.67 cA
T11	93.34 bA	93.74 dA
T12	116.01 aA	107.40 cA

Note: Averages followed by the same minuscule (column) and major (line) letters do not differ from each other by the Scott Knott test (p≤0,05).

In the variety Paraíso MG 419–1, the soluble solid content of raw coffee was between 13,13 and 23,90 ºBrix. The treatment/position T1 upper third tip of the west guide (TSPGO) had the highest soluble solid content (23,90 ºBrix), which was significantly different from soluble solids content of other treatments/positions, this position received higher solar irradiance.

The treatment/position T9 TIPGO had the lowest content of soluble solids, probably because it received less solar radiation than the other parts.

The fruits ripened faster in the areas that received the highest solar irradiance in the coffee grove. The morphological and physiological characteristics of leaves usually vary with the position on the cup, as different positions are associated with distinct light environments. Silva et al. (2015) showed that the higher availability of light increases the photosynthetic rate, which in turn induces the plant to produce more leaves. By absorbing light, these leaves can result in the morphological characteristics of plants. Thus, plants that receive more solar radiation, inside the shed, have higher productivity and quality of grains.

In specialty coffees, Alves (2020) found that grains with values above 22,00 °Brix of ripeness yield fruits of higher quality and batches of specialty coffees, with higher added value. The content of soluble solids in coffee is associated with the "body" attribute of the drink; thus, the higher the soluble solid content, the "full-bodied" the final drink will be. In some treatments/positions harvested, the SS content was above 22,00 ºBrix, and these coffee varieties can be used to produce a drink with a good "body" characteristic.

The uniformity of ripening is a highly desired characteristic by growers, as it facilitates the selection of the ideal time to harvest fruits, which is directly related to the quality of coffee (Coelho et al., 2020; Rodrigues et al., 2019).

The °Brix degree measures soluble solids, and as the fruits ripen, a significant increase in the content of these soluble solids: sugars, acids and salts, also other compounds present in the pulp, reaching a range of 12 and 24 °Brix, in fruits 210 and 224 days after flowering.

The soluble solid (SS) content in the grain pulp of the Catuaí IAC 144 variety was higher than that in the Paraíso MG 419–1 variety. The SS content varied significantly with respect to the ripening stage between the varieties.

The grains of the cultivar Paraíso MG 419–1 were harvested later than the grains of the cultivar Catuaí IAC 144 were harvested. Camargo and Camargo (2001) found that the fruits ripen in the fifth stage, normally in April, May, and June.

The content of soluble solids in raw coffee increased after drying in the suspended terrace, compared to the content of soluble solids in the grain pulp (Table 2). Loss of water and absorption of sugar occurred, which increased the concentration of soluble solids in raw coffee seeds. The greatest variation in sugar concentration in grains occurred while drying in a

Table 8: Sensory evaluation of the cultivar Catuaí IAC 144.

SENSORY PROFILE - Catuai IAC 144 variety														
	ATTRIBUTES										GENERAL INFORMATION			
Treatments	Fragrance	Aroma	Flavor	Acidity	Body	Uniformity	Clean cup	Aftertaste	Sweetness	Overall balance sheet	General Score	Description	General observations	Evaluation according to coffee aromatic groups	Drink
1-TSPGO	7.75	7.75	7.75	7.75	7.75	10.00	10.00	7.75	10.00	7.75	84.00	Caramel. Caramelized	Short finish. light harsh diluted	Group II - Aromas from sugar caramelization	soft
2-TSPGL	7.75	7.75	7.50	7.75	7.25	10.00	10.00	7.50	10.00	7.50	83.25	Caramel	Sweet finish. light and rough body	Group II - Aromas from sugar caramelization	soft
3-TSBGO	7.75	7.75	7.75	7.75	7.75	10.00	10.00	7.75	10.00	7.75	84.25	Caramel. Caramelized. Molasses	Sweet. long sweet finish. creamy body	Group II - Aromas from sugar caramelization	soft
4 - TSPGL	7.75	7.75	7.75	7.75	7.50	10.00	10.00	7.50	10.00	7.50	83.50	Caramel. Caramelized. Molasses	Smooth body. sweet flavor. mild acidity. short finish	Group II - Aromas from sugar caramelization	soft
5-TMPGO	7.75	7.75	7.75	7.75	7.50	10.00	10.00	7.50	10.00	7.50	83.50	Caramel. Caramelized. Molasses	Smooth body. sweet flavor. mild acidity. short finish	Group II - Aromas from sugar caramelization	soft
6-TMPGL	7.75	7.75	7.75	7.75	8.00	10.00	10.00	7.75	10.00	7.75	84.50	Caramel. Caramelized	Medium body. dry finish	Group II - Sugar caramelization aromas and Group I - Enzymatic aromas	soft
7-TMBGO	7.75	7.75	7.75	7.75	7.75	10.00	10.00	7.75	10.00	7.75	84.25	Caramel. Caramelized. Molasses	Diluted dry rough	Group II - Aromas from sugar caramelization	soft
8-TMBGL	7.75	7.75	7.75	7.75	7.75	10.00	10.00	7.75	10.00	7.75	84.25	Caramel. Caramelized. Molasses	Smooth diluted body. short finish	Group II - Aromas from sugar caramelization	soft
9-10 - TIBGO/ TIPGO	7.75	7.75	7.75	7.75	8.00	10.00	10.00	7.75	10.00	7.75	84.50	Caramel. Caramelized. Fruity	Medium body. dry finish	Group II - Sugar caramelization aromas and Group I - Enzymatic aromas	soft
11-12- TIPGL/ TIBGL	7.75	7.75	7.50	7.50	7.50	10.00	10.00	7.75	10.00	7.50	83.00	Caramel	Diluted dry rough	Group II - Aromas from sugar caramelization	soft

Note: The Final Score is calculated by first summing the individual scores given for each of the primary attributes in the box marked “Total Score.” Defects are then subtracted from the “Total Score” to arrive at a “Final Score. Total Score Quality Classification of 80-84.99 very good according to the SCAA Cupping Protocol (2015) Classification of sensory attributes according to quality scale 6.0 to 6.75 classified as good. 7.0 to 7.75 very good. 8.0 to 8.75 excellent and 9.0 to 9.75 exceptional SCAA (2015).

Table 9: Sensory evaluation of the cultivar Paraíso MG 419–1.

SENSORY PROFILE - Paraiso MG 419-1 Variety															
ATTRIBUTES											GENERAL INFORMATION				
Treatments	Fragrance	Aroma	Flavor	Acidity	Body	Uniformity	Clean cup	Aftertaste	Sweetness	Overall balance sheet	General Score	Description	General observations	Evaluation according to coffee aromatic groups	Drink
T1-TSPGO	7.75	7.75	7.75	7.50	7.50	10.00	10.00	7.50	10.00	7.75	83.25	Fruity, sweet	Short finish, light harsh diluted	Group I - Enzymatic aromas and Group II - Sugar caramelization aromas	soft
T2-TSPGL	7.75	7.75	7.75	7.75	7.75	10.00	10.00	7.50	10.00	7.50	84.25	Sweet, Toast	Sweet finish, light and rough body	Group II Aromas from sugar caramelization	soft
T3-TSBGO	7.75	7.75	7.75	7.75	7.75	10.00	10.00	7.75	10.00	7.25	83.25	Caramel, Caramelized	Long sweet finish, creamy body	Group II Aromas from sugar caramelization	soft
T4 - TSPGL	7.75	7.75	Ta	7.25	7.75	10.00	10.00	7.50	10.00	7.50	81.25	Caramel, Fruity	Smooth diluted body, short finish	Group II - Sugar caramelization aromas and Group I - Enzymatic aromas	soft
T5- TMPGO	7.75	7.75	7.50	7.75	7.50	10.00	10.00	7.50	10.00	7.75	83.50	Caramel	Smooth diluted body, slight harshness, low acidity	Group II Aromas from sugar caramelization	soft
T6-TMPGL	7.75	7.75	7.75	7.50	7.50	10.00	10.00	7.25	10.00	7.50	84.00	Caramel, dry wood, Fruity	Smooth body sweet short sweet finish	Group II Aromas from caramelization of sugars, Group III - Aromas from dry distillation and Group I - Enzymatic aromas	soft
T7- TMBGO	7.75	7.75	7.25	7.25	7.25	10.00	10.00	7.25	10.00	7.75	83.25	Caramel, Caramelized	Diluted dry rough	Group II Aromas from sugar caramelization	soft
T8- TMBGL	7.75	7.75	7.50	7.50	7.50	10.00	10.00	7.50	10.00	7.75	82.75	Caramel, dry wood, wood	Soft body sweet acidity slightly below	Group II - Aromas from caramelization of sugars and Group III - Aromas from dry distillation	soft
T9-10 - TIBGO/ TIPGO	7.75	7.75	7.25	7.75	7.75	10.00	10.00	7.50	10.00	7.50	82.75	Caramel, Caramelized, Molasses	Medium body, dry finish	Group II - Sugar caramelization aromas and Group I - Enzymatic aromas	soft
T11-12- TIPGL/ TIBGL	7.75	7.75	7.50	7.75	7.50	10.00	10.00	7.50	10.00	7.50	83.25	Caramel, Caramelized	Smooth diluted body, slight harshness, low acidity	Group II Aromas from sugar caramelization	soft

Note: The Final Score is calculated by first summing the individual scores given for each of the primary attributes in the box marked “Total Score.” Defects are then subtracted from the “Total Score” to arrive at a “Final Score. Total Score Quality Classification of 80-84.99 very good according to the SCAA Cupping Protocol (2015) Classification of sensory attributes according to quality scale 6.0 to 6.75 classified as good. 7.0 to 7.75 very good. 8.0 to 8.75 excellent and 9,0 to 9.75 exceptional SCAA (2015).

suspended terrace/greenhouse. The positions/treatments, with respect to the varieties, were close to the ranges indicated by the authors with regard to the increase in the sugar content.

In relation to soluble solids of the pulp of the grain x raw coffee Catuaí IAC 144 was observed in the treatments T1, T2, T3, T4, and T5. The same showed the highest results compared to the other treatments. These positions received greater solar radiation, which favored the ripening of grains. The other treatments/harvest positions received less sunlight, which resulted in delayed fruit maturation and lower content of SS in the fruits in the stage of ripening fruit harvesting green cane.

The values of soluble solids are directly proportional to the quality of coffee. Thus, a greater content of soluble sugars is expected in the raw grain, considering that the roast decreases its content (Celestino; Malaquias; Xavier, 2015).

The total acidity of the raw coffee for the Catuaí IAC 144 variety was 192,50 mL NaOH/100g and for the Paraíso MG 419-1 variety 199,38 mL NaOH/100 g, with no significant interaction between the treatments.

According to Borém et al. (2008), the average values of desirable titratable acidity in raw coffee beans are in the range of 171,33 mL NaOH/100g to 216,67 mL NaOH/100g in natural Arábica coffee. The acidity values found in the two coffee varieties are within the desirable range for raw beans.

Silva et al. (2019), acidity is an important indicator of coffee quality and indicates the presence of numerous organic acids that interfere with the sensory quality of the drink, and its variation is directly related to the ripeness of the fruit, place of origin, drying method, among other factors.

According to Batali et al. (2021), titratable acidity, and not pH, is positively correlated with the perceived acidity of the drink and can be a reliable parameter for determining different coffees.

Some factors (for example, titratable acidity) can influence the perception of fruit flavor. Titratable acidity has an inverse relationship with ripeness, as ripeness results in an increase in soluble solids and a reduction in total titratable acidity, which increases the ratio between soluble solids and titratable acidity. Thus, the stage of ripeness of the fruit and the genetic characteristics of the cultivars alter the sensory attributes (Pareek, 2016). In the sensory evaluation, acidity was classified as low, medium and very good.

The pH values shown in (Table 5) ranged from 5,95 to 6,19 for the Catuai IAC 144 variety, with the lowest value in the T1 TSPGO upper third west guide treatment, which had a pH range closer to the author's reference value. The values found in the other treatments did not affect the final quality of the drink.

For the Paraíso MG 419 -I variety, the pH ranged from 6,03 to 6,13. The lowest values were in the guide treatment T1 TSPGO Upper third west. Koskei, Patrick and Simon (2015) found pH values ranging from 5,91 to 6,11. The pH values may vary due to the type of processing they were subjected to and may be associated with the location of the region and climatological characteristics.

The results of the quantitative color assessment of the coffee beans were expressed in terms of L* (luminosity), a* and b* (chromaticity coordinates).

When analyzing the Catuaí IAC 144 and Paraíso MG 419-1 varieties, there was no significant interaction between treatments/positions, but the lowest a* value (0,40) found in the raw coffee beans was in the Catuaí IAC 144 variety. This factor also occurred in the L* coordinate (Table 6). When analyzing the value of the a* coordinate, it must be taken into account that values close to zero or negative tend towards a green color in the coffee beans (a desirable color for the product), while values increasing towards zero tend towards a green color in the coffee beans (a desirable color for the product).This result indicates an approximation to the desirable green color in coffee beans.

The L* coordinate, related to the luminance of the grains, corresponds to the greater or lesser whitening of the grains and its scale ranges from 0 to 100, corresponding to black and white, respectively.The lowest value of the L* coordinate was recorded in the Paraíso MG 419-1 variety (30,95) when compared to the L* value of the Catuaí IAC 144 variety (31,81). The results showed that the interaction of the factors affected the values of the chromatic coordinate b*. The T3 TSBGO treatment of the Catuaí IAC 144 variety showed the lowest value of the coordinate b* (10,93), compared to the same treatment of the Paraíso MG 419–1 variety, which had a lower value of this coordinate (12,58) (Table 5). The values of the b chromatic coordinate indicate lower results in relation to undesirable yellow coloration and closer to desirable blue coloration. In the literature, there are reports associating bluish coloration with better quality coffees than those with yellow coloration (Corrêa et al., 2002). Borém et al. (2013) related the change in the color of coffee from grey/blue/green to whitish-yellow to the occurrence of oxidative processes and natural enzymatic biochemical transformations.

Despite the significant difference in the values of electrical conductivity (EC), for Catuaí variety IAC 144, the electrical conductance (EC) ranged from 93,34 to 118,88 $\mu S\ cm^{-1}\ g^{-1}$ for different treatments/positions.

Treatment/position T11 TIBGO showed an (EC) of 93,34 $\mu S\ cm^{-1}\ g^{-1}$. Regarding sensory evaluation, the coffee in this range of electrical conductivity (EC) presented a soft drink with 84,5 points. It was within the range specified for special coffee, according to other studies on SCAA (2015).

In the variety Paraíso MG 419 –1, EC ranged from 92,93 to 119,20 $\mu S\ cm^{-1}\ g^{-1}$. The treatment/position T9 TIPGO presented an EC of 92,94 $\mu S\ cm^{-1}\ g^{-1}$. Regarding the sensory evaluation, according to the protocol of SCA, the coffee with this EC was considered to be a soft drink, and its overall rating was 83,5 points.

Despite the significant difference, for the varieties, treatments/harvesting positions, all results of EC matched the findings of the author. The coffee was classified as a soft drink and only soft, with the (EC) ranging from 88,24 to 119,07 µS cm^{-1} g^{-1}. The (EC) of hard drinks is between 53,80 and 227,58 µS cm^{-1} g^{-1} (Agnoletti et al., 2014).

Based on the results expressed in (Tables 8 and 9) in relation to the sensory evaluation of the Catuaí IAC 144 and Paraiso MG 419-1 varieties for the fragrance attribute, there was no significant difference between the scores for the treatments and varieties. The score found for this attribute was 7,75 classified as very good according to SCAA (2015).

In terms of taste, the Catuaí IAC 144 variety was better than the Paraíso MG 419-1. The lowest score found for this attribute in the Catuaí IAC 144 variety was in treatments/ positions T2 TSPGL and T11-T12 TIPGL-TIBGL and in the Paraíso MG 419-1 variety it was in treatment T7 TMBGO. Taste differed according to treatment and harvest position. The taste of coffee is a complex mixture that must have several compounds in balance (Sarrazin et al., 2000).

According to Medina Filho (2007), the main differences in the taste of the drink are due to the genetic makeup of the plant, which plays a fundamental role in determining taste and aroma.

The carboxylic acids that give quality to coffee mainly include organic citrus and malic. Acetic acid imparts an unpleasant sour taste, which occurs due to the fermentation of the fruits in the fields, leading to problems in the drying process in rainy regions (Aguiar; Celestino; Oliveira, 2021).

The acidity of coffee can be pleasant (bright acidity) or unpleasant, and the scores for this attribute in the treatments/ positions harvested show significant differences. Some treatments scored higher than others. The variety Catuaí IAC 144, treatment T11-12-TIPGL/TIBGL obtained the lowest score in the sensory evaluation of acidity. This result influenced the final score. In the Paraíso MG 419-1 variety, the lowest acidity values were recorded in treatments T4 TSBGL and T7 TMBGO.

The body of coffee represents the viscosity or texture of the drink and is associated with the concentration of soluble solids (SS). Higher values of SS indicate that the coffee is more pleasant. Proteins, acids, oils, and other substances constitute soluble solids (Aguiar; Celestino; Oliveira, 2021).

The content of soluble solids generally indicates the sweetness of the fruit, since 85% of the total SS is sugars, but other substances, such as organic acids, proteins, phenolics, minerals, and pigments, are also present (Magwaza; Opara, 2015; Opara; Pathare, 2014).

The body of the drink is related to the soluble solids content, so in the treatments/positions T6 TMPGL and T9-10 TIBGO/TIPGO of the Catuaí IAC 144 cultivar, the score obtained was 8,0 points; it was evaluated as excellent body, and the final score was 84,5 points, soft drink with sensory characteristics of caramel, caramelized, fruity, from the aroma wheel SCAA (2015). The T3-TSBGO treatment/ position of this variety had a creamy body classified as very good. The other treatments resulted in drinks with lower acidity, sweetness and less complex flavors, predominantly caramel flavors and medium to low body. It can be seen that the altitude/beverage body ratio can vary depending on the nature of the weight, the stage of ripeness of the fruit and its position on the plant.

In the evaluation of the Paraiso MG 419-1 variety, the lowest score obtained for the body attribute was in treatment T7 TMBGO with 7,25 and a final score of 83,25. The other treatments ranged from 7,50 to 7,75. The T3-TSBGO treatment/harvest position had very good body, creamy with an overall score of 84,25 points and soft drink SCAA (2015).

The uniformity and clean cup attributes performed better than the general the overall balance showed lower values. Overall balance is a sensory characteristic in which Q-Graders can apply higher or lower scores to define the coffees they are evaluating.

This reaction gives the coffee drink a balanced performance, taste, and softness. Low astringency is given a high score, and high astringency is given a low score because it is considered to be a defect.

After determining the sum of all sensory characteristics, the values of the overall score of the coffee varieties/ treatments were obtained by calculating the arithmetic means of the averages of the attribute notes (fragrance, aroma, flavor, acidity, body, uniformity, clean cup, sweetness, and aftertaste). The sum of all the sensory characteristics determines whether the coffees can be considered specialty or not according to the protocol SCAA (2015). The performance of the grades obtained between the Catuaí IAC 144 and Paraíso MG 419–1 varieties differed for the sensory characteristics of the beverage, as the ripening period of the coffee plants of these varieties was different. The aftertaste, balance, and uniformity were not significantly different with respect to the treatments/ harvest position of the fruits.

Based on the results of the analysis of the experimental data of the varieties of coffee Catuaí IAC 144 and Paraiso MG 419–1, we found that the response variables were associated with the soluble solids (°Brix) of coffee cherry/grain pulp, SS in raw coffee, aroma, and body. A correlation matrix between the variables was constructed to model the relationship and determine whether a linear relationship occurred between the soluble solid variables in ◦Brix of the coffee cherry/grain pulp, soluble solids content in raw coffee, aroma, and body with the final average score given by the testers for each sample.

Our results (Figures 2 and 3; Table 10) showed that the variables were significantly associated only with the body of the coffee.

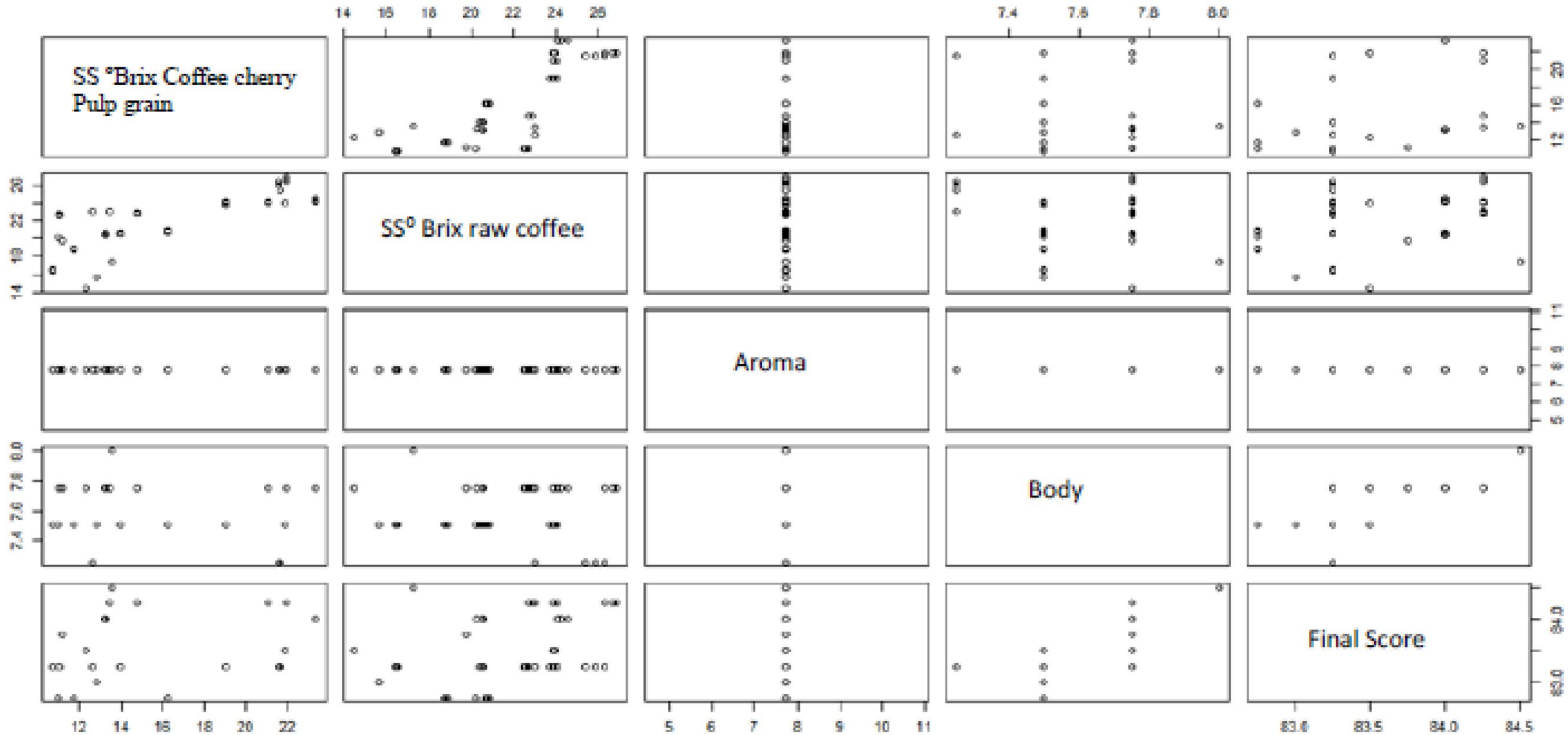


Figure 2: A matrix of the correlation between the variables for the varieties Catuaí IAC 144 and Paraíso MG 419–1.

Note: Looking at Figure 2 and Table 10, it can be seen that there is only one association between the variables and the final score, which is the body of the coffee. The simple linear regression model was then adjusted to find a statistical model to explain this correlation.

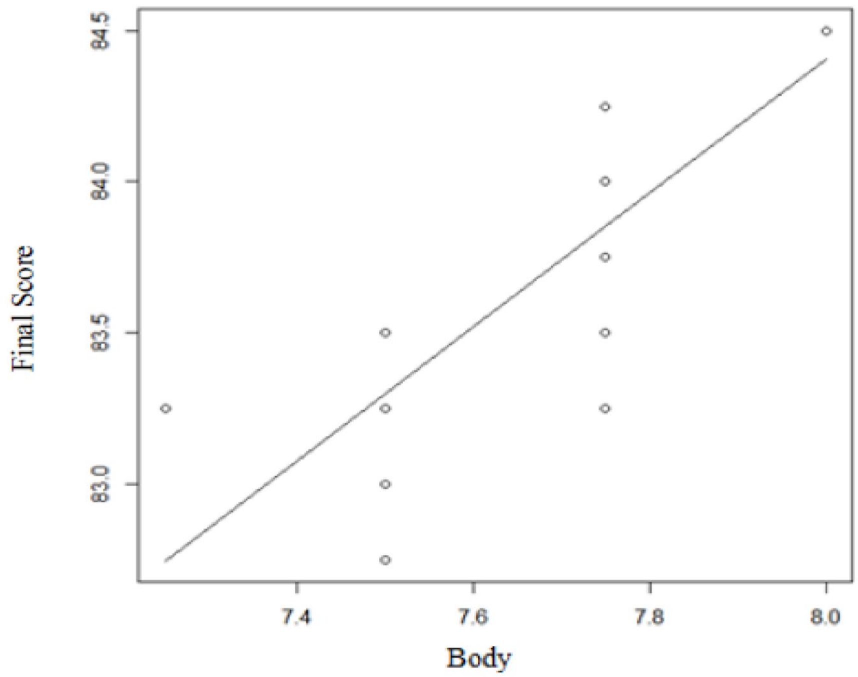


Figure 3: Evaluation in relation to the Body of the drink for the varieties, Catuai IAC 144 and Paraiso MG 419-1.

Note: Observed data and regression line of the final score in relation to the Body of the drink.

Table 10: Correlation between final score and other variables and varieties Catuai IAC 144 and Paraiso MG 419-1.

	Final Score
SS °Brix Coffee Cherry/grain pulp	0.32
SS Raw Coffee	0.28
Body	0.74
Flavor	NA

After evaluating the association between the variables, we tested whether a significant difference occurred between the two variables to make two distinct models, one for Catuaí IAC 144 and another for Paraíso MG 419–1. These models were verified at 5% significance. The two coffee varieties were statistically similar ($p > 0.05$), i.e., a single model could predict for both varieties (Figure 3).

Final score in relation to the body of the drink was determined according to Equation 1.

$$\text{Final score} = 66.72 + 2.21 * \text{Body}$$

The equation generated for the association between body and final score showed that a one-unit increase in body increased the final score by 2.21 units.

In the sensory evaluation, variation was observed between the results of the treatments where the parts of the coffee tree that are most exposed to sunlight, which are the tips of the plants and the tips of the intermediate branches, the fruits are more mature with a higher soluble solids content when compared to the lower third treatment that receives less solar irradiation. However, according to authors, the parts of the plant that are shaded from the fruit in the coffee tree have benefits such as reducing heat-induced plant stress and prolonging the ripening period, thus increasing the uniformity and quality of the coffee beans (Steiman et al., 2011).

In the variety Catuaí IAC 144, the treatment/position harvested of the grains of the east and west coffee tree T6 TMPGL and T9–10 TIBGO/TIPGO had the highest sensory score of 84,5, which was classified as coffee in the specialty category, as per the Coffee Standards of SCA (2021).

Coffee from the middle third and lower third parts of the plant were rated as specialty. These parts were characterized by lower sun irradiance and milder temperatures, with slower ripening and greater sugar absorption, which contributed to the body of the drink (Table 8). Somporn et al. (2012), explain that shading has an influence on the formation of sugars, chlorogenic acids and phenolics.

For the Paraíso MG 419-1 variety, the coffee collected from the T9-10 TIBGO/TIPGO Oeste harvest treatment/position had the highest sensory score (83,5) and was classified as special according to the SCA (2021) (Table 9).

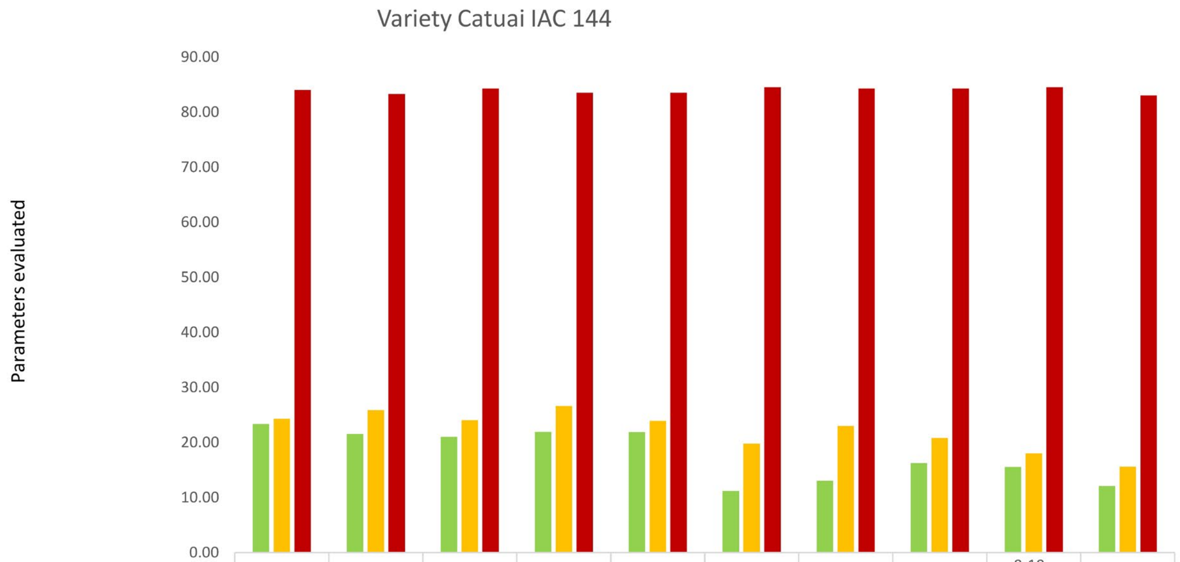
One of the three main ways of assessing coffee quality is through physical analysis (related to the coffee bean), sensory analysis (aspects of the drink in terms of taste, smell and appearance) and chemical analysis, since its composition is directly related to the quality of the drink (Cheng et al., 2016). Among these, sensory evaluation is the most important criterion, as it provides technical support for technical support for research, industry, marketing and quality control (Dutcosky, 2013).

The results of the physicochemical analysis of the two coffee varieties showed that the position of the fruit on the plant and the stage of ripeness can directly influence the results of the beverage.

The relationship between the treatments/harvest position of the Catuaí IAC 144 and Paraíso MG 419-1 varieties in relation to the soluble solids in °Brix of the cherry bean, raw coffee and the final score of the drink are shown in Figures 4 and 5.

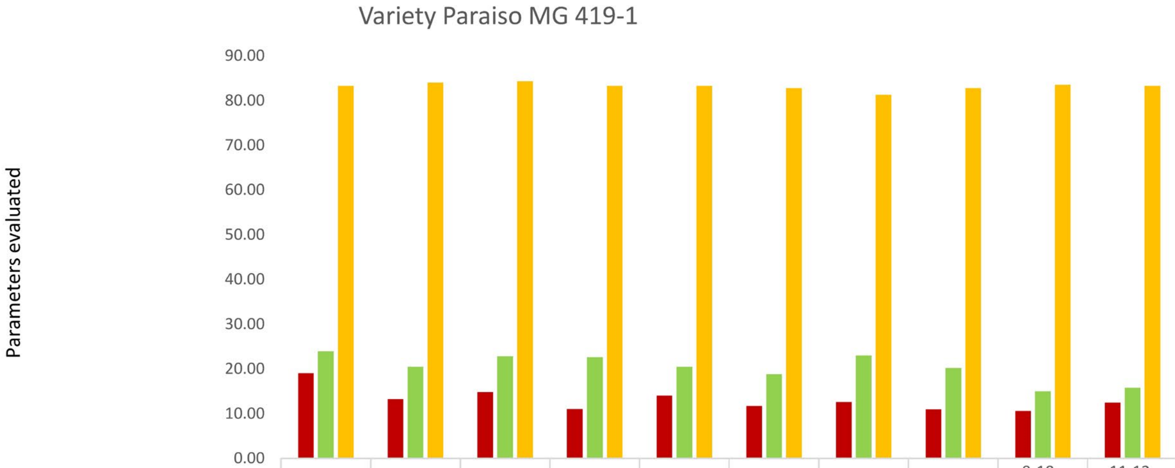
Santos, Chalfoun and Pimenta (2009) in his research evaluating the concentration of sugars in natural coffees during the drying process, found a great variation in the content of this component during the first 72 hours of drying. This can be seen in (Figures 4 and 5) for the Catuai IAC 144 and Paraiso MG 419-1 varieties, where there was an increase in soluble solids in the raw coffee after drying it in a suspended drying rack when compared to the pulp of the grain. Water loss and sugar absorption increased the concentration of soluble solids in the raw coffee bean/seed. Other authors have observed the sucrose levels found for raw beans, where they pointed to an increase at the beginning of processing, in the coffee yard and at the end of storage, reporting values of between 4.6% and 9.65% for raw beans (Toci et al., 2006; Murkovic; Derler, 2006; Alcázar et al., 2005; Knopp; Bytof; Selmar, 2005).

Therefore, considering the results obtained in this research, it was found that in the treatments for the variety Catuai IAC 144 T1 TSPGO to T5 TMPGO and in the variety Paraiso MG 419-1 the treatment T1 TSPGO. The values found for soluble solids in the pulp of cherry grains were higher. Fruits in the coffee tree receive more solar radiation, which favors ripening and consequently an increase in soluble solids in the Coffee beans. Silva et al. (2015), the greater availability of light increases the rate of consequently, the plant produces more leaves, which means that the levels of light absorption can lead to differences in the morphological characteristics of the plants. Therefore, plants that intercept a greater amount of solar radiation inside the canopy tend to have higher yields and grain quality.



	1-TSPGO	2-TSPGL	3-TSBGO	4 -TSBGL	5-TMPGO	6-TMPGL	7-TMBGO	8-TMBGL	9-10 - TIBGO/TIPGO	11-12- TIPGL/TIBGL
Catuai IAC 144 Soluble solids cherry grain pulp ºBrix	23.32	21.57	21.03	21.93	21.87	11.17	13.02	16.24	15.56	12.11
Catuai IAC 144 Soluble solids raw/processed coffee ºBrix	24.33	25.87	24.03	26.63	23.93	19.80	23.00	20.80	18.00	15.60
Catuai IAC 144 Final Score	84.00	83.25	84.25	83.50	83.50	84.50	84.25	84.25	84.50	83.00

Figure 4: Evaluation of SS and the sensory score of the Catuaí variety IAC 144 of harvested grains, in the positions/treatments T1 third top tip of the western guide, T2 top third top tip east, T3 top third base of the western guide, T4 upper third base eastern guidance, T5 middle third tip western guidance, T6 medium third tip east, T7 middle third base of Western guide, T8 middle third Base Eastern guide, T9 lower third bottom tip O, T10 lower third end of the eastern guide, T11 lower third base O test, and T12 lower bottom third base Eastern guide.



	1-TSPGO	2-TSPGL	3-TSBGO	4 -TSBGL	5-TMPGO	6-TMPGL	7-TMBGO	8-TMBGL	9-10 - TIBGO/TIPGO	11-12-TIPGL/TIBGL
Paraiso MG 419-1 Soluble solids cherry grain pulp ºBrix	19.01	13.25	14.78	11.02	13.99	11.74	12.60	11.00	10.60	12.45
Paraiso MG 419-1 Soluble solids raw/processed coffee ºBrix	23.90	20.47	22.83	22.60	20.50	18.80	23.00	20.20	15.00	15.80
Paraiso MG 419-1 Final Score	83.25	84.00	84.25	83.25	83.25	82.75	81.25	82.75	83.50	83.25

Figure 5: Evaluation of SS and sensory note variety Paradise MG 419–1 of harvested grains, in the positions/treatments T1 third top tip of the western guide, T2 top third top tip east, T3 top third base western guide, T4 upper third base eastern leader, T5 middle third tip western directory, T6 middle third end of the east side, T7 middle third base western manager, T8 bottom middle third base eastern manager, T9 bottom third tip O, T10 bottom third end eastern leader, T11 bottom third base O test, and T12 lower third base eastern directory.

5 CONCLUSIONS

There was a significant influence on the physicochemical properties in relation to the parameters soluble solids (SS) of the pulp of the cherry coffee and raw coffee, Mass of one thousand grains (MMG), pH index, colouring (chromaticity b). The analyses showed a significant difference between the treatments and the varieties Catuai IAC 144 and Paraiso MG 419-1.

In terms of electrical conductivity and pH index, the results were the most representative markers of quality and the values found in the analyses for the two varieties were within the ranges defined by the authors.

As for the titratable acidity, colouring (L) and (a) parameters, there were no significant differences between the treatments and varieties.

The results for the mass of 1000 grains for the varieties Catuaí IAC 144 and Paraiso MG 419-1 are close to the parameters found by Carvalho (2007).

In conclusion, the results of this study showed that the positions of the fruit in the upper third and lower third of the coffee tree, in relation to the two varieties Catuaí IAC 144 and Paraíso MG 419-1, were the most favorable in terms of physicochemical and sensory analysis. The body, acidity, sweetness and aftertaste of the coffee were the most significant in the final beverage quality score and indicated the highest sensory scores. It was found that there is an association between body and the final score, with a one-unit increase in body leading to a 2.21 increase in the final score. It was observed that the location of the fruit on the tree directly affects the quality of the drink, as does the stage of ripeness, which affects the ◦Brix of the coffee and the sensory quality of the drink.

6 AUTHORS' CONTRIBUTION

Conceptual Idea: Sousa, R.M.; Methodology design: Sousa, R.M.; Data collection: Sousa, R.M.; Data analysis and interpretation: Sousa, R.M.; Paiva, L.C.; Writing and editing: Sousa, R.M.

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