

*Full Length Research Paper*

# Sensory profile of coffees of different cultivars, plant exposure and post-harvest

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The processes of maturation, harvest and post-harvest coffee of are strictly related to the physical and chemical modifications that can affect the sensorial quality of the coffee, being decisive factors in the choice of the appropriate management to reach the desired quality standard. The objective of this research was to identify the sensorial attributes of the Coffee Association of American (SCAA) protocol of coffee cultivars grown in the same geographic space, with fruit collection on two faces of exposure to solar radiation from the same plants subsequent post-harvest processing by wet and dry route. The study was conducted in Minas Gerais, in the city of Monte Carmelo. Six cultivars of *Coffea arabica* L. species were evaluated. The fruit collection in two exhibitions faces the solar radiation from the same plants with subsequent post-harvest processing via wet and dry. In view of the results it can be concluded that there was a better discrimination of sensory attributes among postharvest cafes obtained in the sun face plant processes, the cultivar Obatã had the highest final score between the years of assessment and all cultivars showed potential for the production of specialty coffees, with the lowest scores attributed to genetic material Iapar-59.

**Key words:** *Coffea arabica* L., specialty coffees, sensory evaluation, specialty coffee association of America, quality.

## INTRODUCTION

The demand for specialty coffees in the market has increased much more compared to the commodity coffee and are characterized by high quality, excellent flavor potential after roasting, absence of any defects and their relation with specific origin, culture or genotypes. In order

to evaluate the quality of the samples, the quality of the samples was determined by genetic methods (Villarreal et al. 2009), environmental (Alonso-Salces et al., 2009) and postharvest (Duarte et al., 2010; Jöet et al., 2010a, b).

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The environmental, genetic and technological factors are related to the quality of the coffee, by the contribution in the formation of the sensorial attributes. It is important to emphasize that the planting direction of the coffee tree can alter the intensity of diseases in the aerial part, according to the exposure of the face of the plant to the solar radiation that modifies the period of wetting and shading of the leaves, causing quantitative losses in the production and quality of the final product (Custódio et al., 2010).

In the region of Cerrado Mineiro are produced very high-quality coffees, with different flavors and aroma. The increasing participation of specialty coffees in the national and international markets requires research that identifies the most promising cultivars and the best type of post-harvest processing that result in differentiated coffees with higher commercial value.

The processes of maturation, harvest and post-harvest are strictly related to the physical and chemical modifications that can affect the sensorial quality of the coffee, being decisive factors in the choice of the appropriate management to reach the desired quality standard. For the coffee, the quality of the beverage determines its desirability for consumption purposes and acts as a reference point for the determination of the price (Gimichu et al., 2012).

It is observed that, despite the different researches related to the description of the sensorial profile, the interaction of the different cultivars for the production of special coffees is not understandable, through the specific post-harvest processing, as well as, if the exposure side of the plants in relation to the nascent / west sun can influence the sensorial attributes of coffee.

In this context, the objective of this research was to identify the sensorial attributes of the Coffee Association of American (SCAA) protocol of coffee cultivars grown in the same geographic space, with fruit collection on two faces of exposure to solar radiation from the same plants subsequent post-harvest processing by wet and dry route.

## MATERIALS AND METHODS

The experiment was carried out in Minas Gerais, in the municipality of Monte Carmelo in the Brazil six cultivars of *Coffea arabica* L. (Iapar 59, Paraíso MG H 419-1, Obatã IAC 1669-20, Catuaí Vermelho IAC-144, Bourbon Amarelo and Topázio MG 1190) were evaluated in the years 2011 and 2012.

First, the boundary space was delimited in the field of each cultivar, with three initial lines after the "carrier" and three plants in the "interlining" to start the collection. Nine plant lines were demarcated with 30 m in length and every three lines corresponded to a field plot. The harvesting of the mature fruits was made selective and manual, in all cultivars, in a period of 48 h, only in the middle third of the plants, separating the exposure faces of the lines facing the morning sun from the faces facing the shade of the (planting in the North/South direction) and submitted to two post-harvest processes, via wet and dry, resulting in 72 samples (6 cultivars × 2

exposure faces × 2 processing). After harvesting the ripe, green and dry fruits the samples were transferred, removing the remaining green fruits, besides the hydraulic separation of the drier fruits in gallons of 100 L of water. Each plot resulted in 20 L of ripe fruit.

In the drying of the samples, suspended yards were used with 1.2 m of height to 804 m of altitude in relation to the level of the sea and with distributions for each sample. The natural and demucilated coffee were stirred 12 times a day (Malta, 2011). The drying layer for the natural coffee was from "fruit to fruit" in the first two days for the superficial dehydration and day after day the layers were folded up to the measure of 5 cm of height, with the fruits already in stage "passes" in the drying. After the fifth day of drying, the fruits received a covering consisting of raffia bag (for retention of condensed water by fruit mass) and canvas (thermal insulation), both cleaned (Malta, 2011). The same procedure was adopted for the natural coffees for the demucilated coffee samples, however, the folding of the layers and the covering began on the second day of drying. All samples were covered at 3:30 p.m. for the use of the heat retained in the mass of the fruits during the day in the evening and discovered at 08:00 p.m. to avoid absorption of local moisture by the fruits (Malta, 2011).

Such procedures were followed until the coffee samples reached the water content of 11% (b.u). The samples were collected, stored in coconut (natural coffees) and parchment (demucilated coffees) in paper bags covered with polyethylene plastic bags, for 60 days, in a storage room climatized at 15°C, free of light, located at the Pole of Technology in Coffee Quality - UFLA. After this period, the samples were carefully benefited at the Coffee Post-Harvest Technology Center - UFLA. For the sensorial analyzes only the grains retained in the 16/64 inch screen were used. All extrinsic and intrinsic defects were removed, in addition to the molasses grains, for better sample uniformity. The water content of the raw coffee beans was determined in an oven at 105 ± 1°C for 16±0.5 h, according to the international standard method of ISO 6673 (International Organization For Standardization - ISO, 1999).

Sensorial analyzes were carried out in the 2011/2012 and 2012/2013 agricultural crops, conducted by qualified and accredited tasters for the evaluation of specialty coffees (Q-Graders), using the methodology proposed by the American Association of Special Coffees - SCAA (Lingle, 2011).

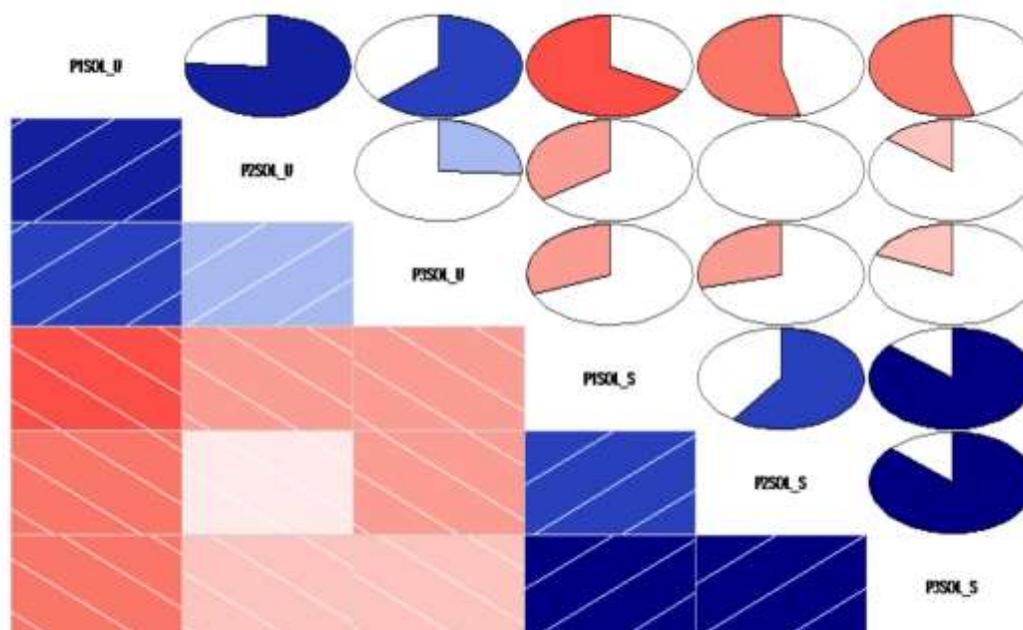
Firstly, a correlation matrix, organized in a graphical arrangement called the corgram, was evaluated in the experimental conditions (Face and Via) to verify the concordance of the tester's notes. The principal component analysis technique was used to eliminate highly correlated variables. Thus, for each year, the Biplots charts were constituted assuming the first two components.

Later, given the selection of the variables via biplots, for each sensory attribute, the effect of the cultivars was evaluated for the effects of each sensory attribute in relation to the annual average, using the main effects graphs whose interpretation is suggested in Montgomery (1997). Due to the fact that the experiment involves several factors, which would lead to an analysis of variance with interactions of order higher than three, we opted for graphic analysis of the effects.

Finally, in order to identify the cultivar that presented the best indexes for the sensorial attributes evaluated, we proceeded to use the multidimensional scaling technique given the formation of predictive axes built on the scale of each attribute. All statistical methods, used in the analysis of sensory data, were performed in Software R Core Team (2013).

## RESULTS AND DISCUSSION

The statistical model, expressed in graphs 1 and 2,



**Figure 1.** Graph of the correlation between the tasters' response to the final score in relation to the evaluated coffees fixed to the sun face. P1 - Tester 1; P2 - Tester 2; P3 - Tester 3; SOL\_U- Fruits of the sun face processed by Wet way; SOL\_S - Fruits of the Face Sun Processed by dry way.

makes it possible to verify the similarity between the scores given by the testers when setting one of the factors adopted in the field procedures. This fact is perceptible, when evaluating the coloration of the circular graphs in shades of blue, indicating a strong correlation in the final scores, as well as the representativeness in the clockwise direction of the color. The results showed that, for all evaluated coffees, the probes P1, P2 and P3 present similar responses in relation to the coffees that were submitted to the experimental conditions given by the humid way.

By isolating the scores given by the accredited evaluators between Umida and Seca process routes for sun face, there was lower concordance between the scores, visualized by the coloration in red tones, which, by presenting more intense tones in the anti-clockwise direction, parity between scores. These results express the reliability of the data because the different types of post-harvest processing contribute to the occurrence of various metabolic processes within the fruits of the coffee tree, significantly altering the chemical composition of the raw grain and, consequently, the sensorial attributes after (Bytof et al., 2007).

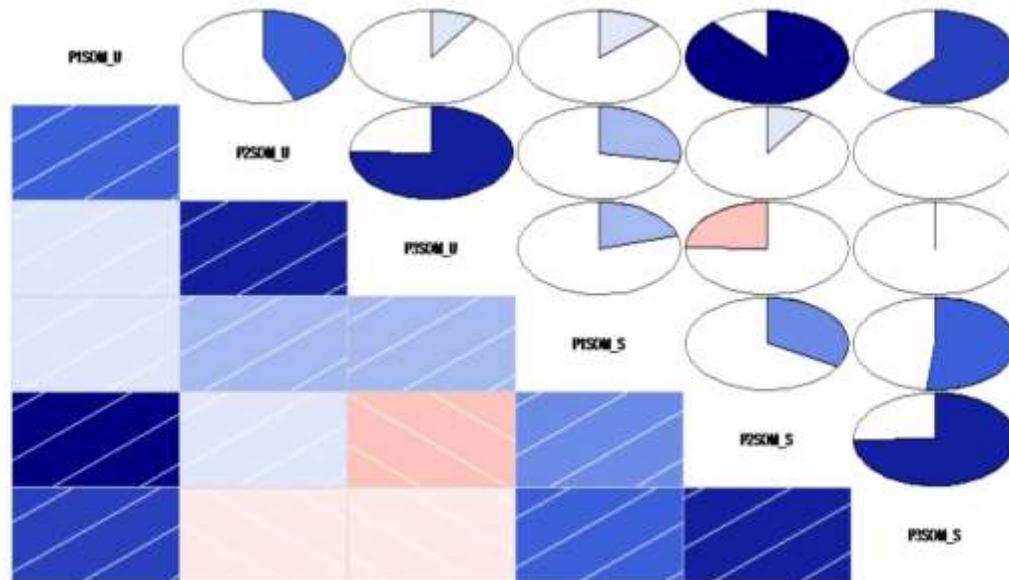
By keeping the shade face fixed, by means of the results shown in Figure 2, a discrimination of the tasters between the coffees produced in the wet and dry way again is observed, so that the final notes were strongly correlated and positive, a since the angle in the clockwise

direction is higher with greater blue color, with emphasis on the fittings P2 and P3.

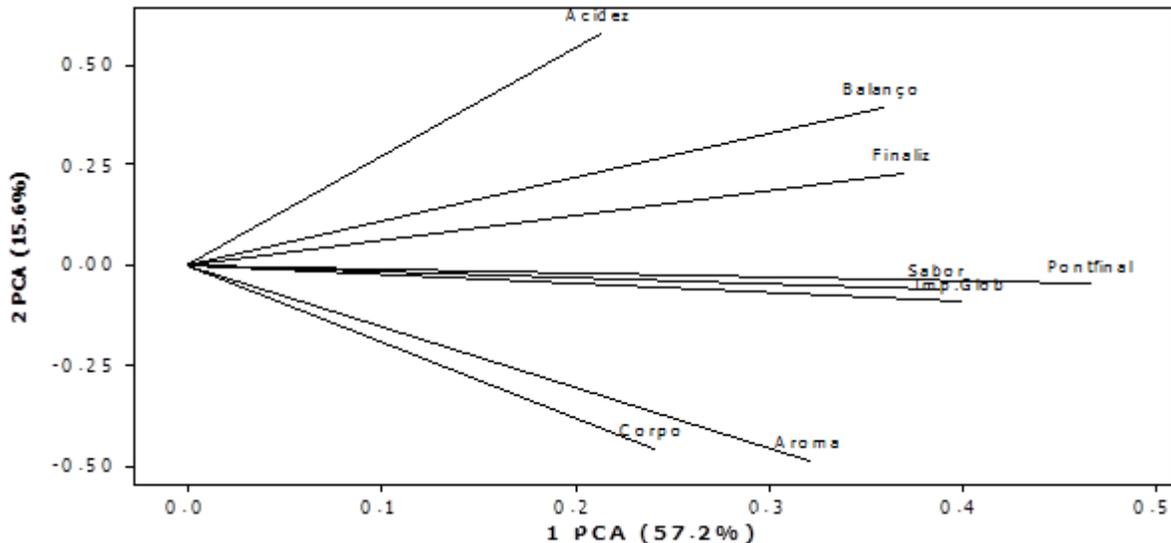
The biplots presented were constructed according to the first two main components obtained in relation to the sensorial attributes, results shown in Figures 3 and 4. Given this quality of fit considered adequate, it can be affirmed, through the values of the angles between the vectors, that the variable final score is highly correlated with flavor and overall impression. Similarly, the correlation between aroma and body, balance and finalization is noted.

All of the correlations, however were positive, indicating that all of the sensory attributes are important components in determining beverage quality, corroborating the results of several other studies of *C. arabica* genotypes (Kathurima et al., 2009; Sobreira et al., 2015a). However, these correlations are only indicative of associations among the various attributes and do not reveal cause and effect relationships. For this, analysis of the direct and indirect effects among the variables is required, in order to identify the most effective selection criteria.

The attribute of flavor represents the intensity, quality, and complexity of the combination of all of the attributes, whereas Ccp refers to the absence of negative impressions during ingestion and Swt refers to the pleasantness of the taste, which is the result of them presence of certain carbohydrates. Bitterness (or "green"



**Figure 2.** Graph of the correlation between the tasters' response to the final score in relation to the evaluated cavities fixed to the shadow face. P1 - Tester 1; P2 - Tester 2; P3 - Tester 3; SOM\_U - shade fruits processed by wet way; SOM\_S - shade fruits processed by dry way.



**Figure 3.** Biplots for the sensorial attributes for the year 2011.

flavor) in this context is the opposite of Swt (SCAA, 2014). Such terms are commonly used by both professional coffee tasters and researchers involved in analyses of the sensory qualities of coffee (Kitzberger et al., 2011; Gamboa et al., 2013).

As a function of the correlation analysis of the sensorial attributes made each year (Figures 3 and 4) in order to

evaluate the effect of exposure factors and processing pathway for each cultivar, it was decided to verify the effect of the variables: final score, balance, acidity and aroma/fragrance, since the other variables are strongly correlated with some of these variables, and it is therefore considered redundant to use them in the statistical analysis. In light of the aforementioned, the

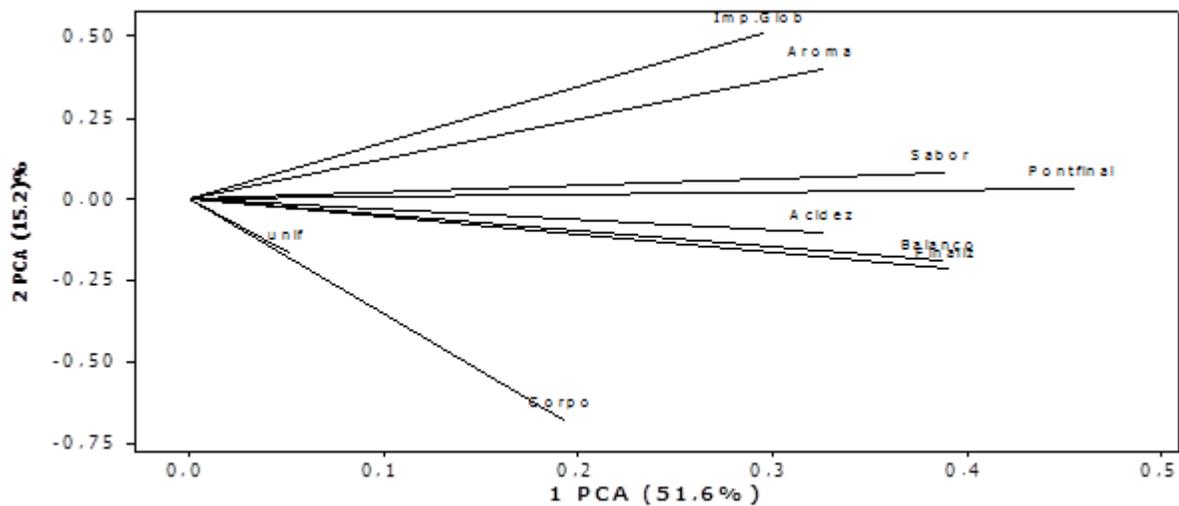


Figure 4. Biplots for sensory attributes for year 2012.

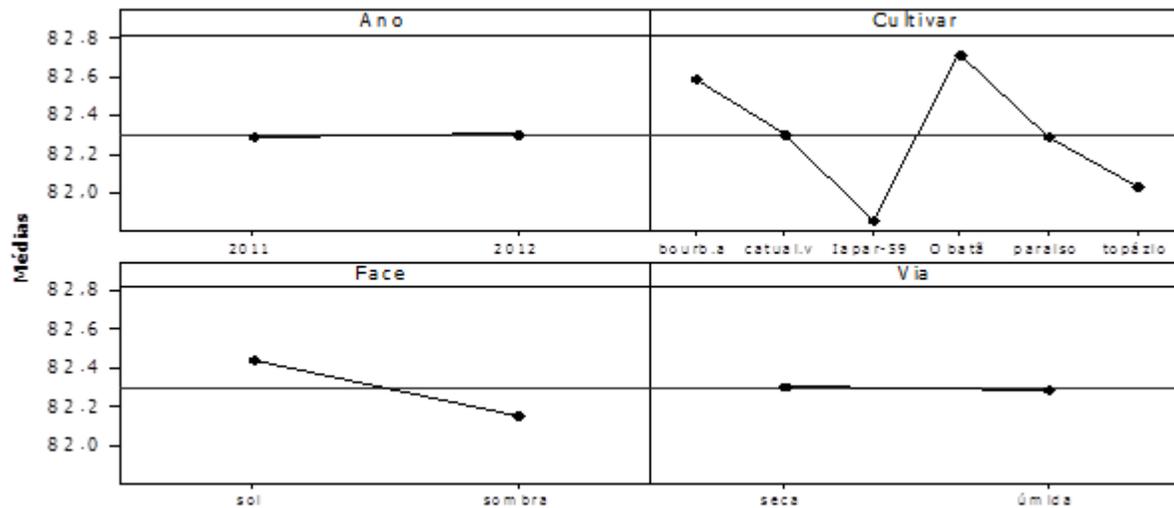


Figure 5. Graph of the main effects for the variable final score.

effects illustrated in Figures 5 to 8 were analyzed.

The results shown in Figure 5 show that the effect of the exposure faces was similar in relation to the annual average when addressing the variable final score, a fact that is verified by the similar distances of the points in relation to the central axis. It was observed that, for the average of the years, the cultivar effect was more pronounced for the final score, especially the cultivars lapar-59 and Obatã.

It should be emphasized that the quality of specialty coffees is related to the intrinsic characteristics of the grains, which have chemical compounds that, after

roasting, will provide aroma, flavor, acidity, sweetness and bitterness to the beverage, in addition to the synthesis, the accumulation and the degradation of the chemical compounds of the raw coffee grain, considered as precursors of the flavor and aroma of the beverage, depend on the genotype and environment interaction (Taveira et al., 2014).

In the same context, the main effects for the balance attribute are included (Figure 6), when observing the same genetic materials there was a grouped symmetry in relation to the distance of the mean axis. The cultivars, Obatã and lapar 59, Paraíso and Catuaí Vermelho,

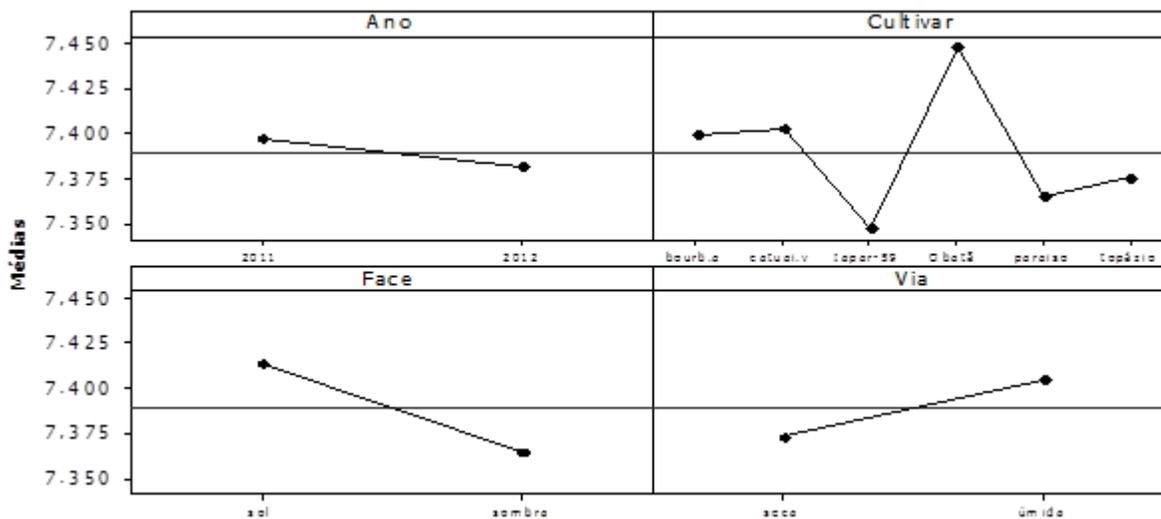


Figure 6. Graph of the main effects for the balance variable.

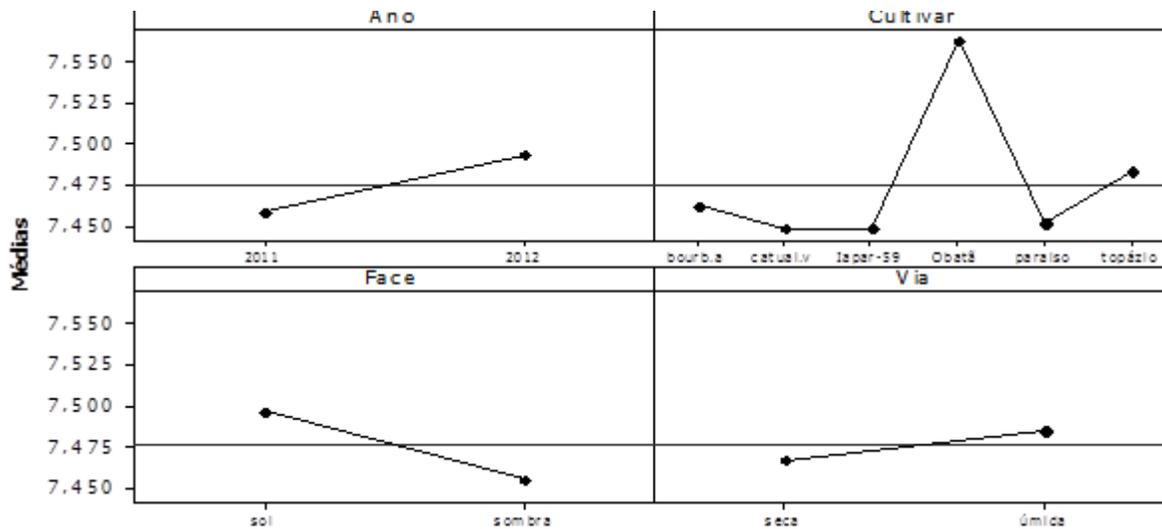


Figure 7. Graph of the main effects for the variable acidity.

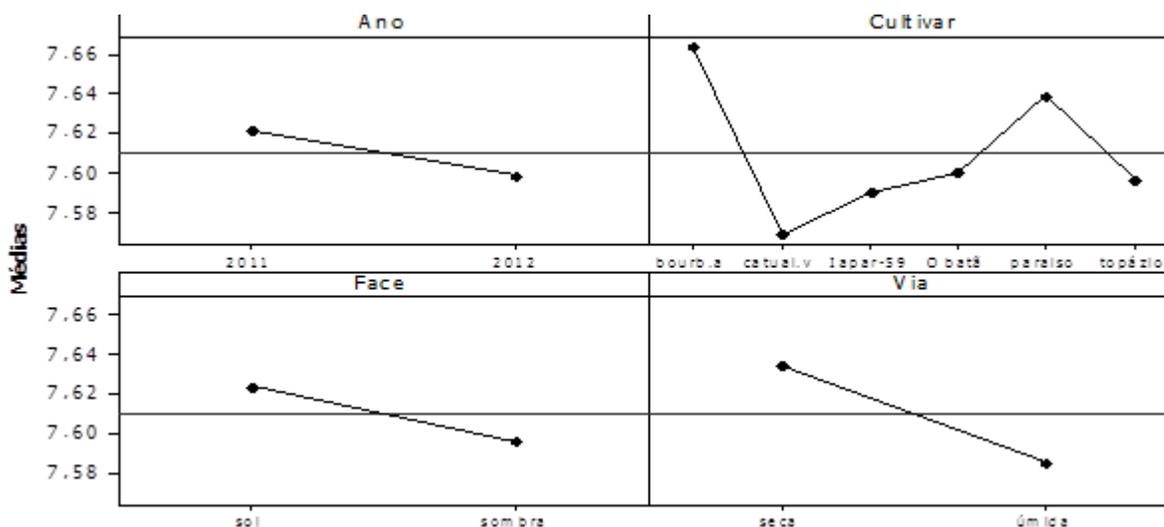
Topázio and Yellow Bourbon presented subtle similarity in relation to the distance of the average axis in relation to the annual average.

In Figures 7 and 8 the main effects for acidity and aroma/fragrance are, respectively expressed. The effects of wet/dry and sun/shade, also, were similar in relation to the year, however, the cultivars with the highest highlights were Obatã and Bourbon yellow, respectively. He verified in analyzes of the sensorial profiles of dry and wet processed coffee that the coffees processed by the humid route were more aromatic with fruity and acidic attributes and had less bitter, burnt and woody notes

(Duarte et al., 2010)

Both attributes are essential, when in adequate quality and intensity, to obtain special coffees. Possibly the altitude cultivation of 892 meters may have contributed with the highest acidity for the cultivar Obatã in relation to the other genetic materials. The coffee aroma is affected by several factors from the field to the cup (Sunarharum et al., 2014), however the post-harvest processing of coffee is another point that has a significant impact on the coffee aroma (Bhumiratana et al., 2011).

Sobreira et al. (2015b) divides the acidity category into the three subcategories alive, sweet, and undefined/



**Figure 8.** Graph of the main effects for the aroma/fragrance variable.

medium, flavor into chocolaty, fruity, and caramel, and aftertaste into long, refreshing, and pleasant. In this paper, these three categories; acidity, flavor, and aftertaste, were considered to be decisive in determining the final score of the beverage. Kathurima et al. (2009), in a study of 42 genotypes of *C. arabica* in Kenya, observed that aftertaste, acidity, and flavor correlated strongest with quality, a result similar to ours. Likewise, in a similar study, Sobreira et al. (2015a) observed that aftertaste and flavor correlated highly with quality for the germplasm Timor hybrid.

The results observed in the sensorial analyze of coffees cultivated at different altitudes in the municipality of Patrocínio - MG showed that the altitude increased the acidity profile of the beverage, which contributes to coffee quality.

The biplot with multidimensional scaling (Figure 9) shows that all the cultivars under study presented potential for the production of specialty coffees, since the final score given by the tasters according to the protocol of the Specialty Coffee Association of America was above 80 points.

According to the BSCA methodology, final scores must be higher than 80 for classification as specialty coffee (Chalfoun et al., 2013). Scores between 71 and 75 were assigned to hard beverage, 75 to 79 for only soft drink, 80 to 84 for soft drink, and above 85 for strictly soft drink (Martinez et al., 2014)

By the average of the treatments, according to the cultivar, the final scores, given by the tasters, were higher to grow Obatã. The cultivars Topázio, Paraíso, Catuai Vermelho and Bourbon Amarelo were awarded intermediate and increasing grades, which according to

Lingle (2011), according to the SCAA protocol, the coffees are considered as special.

Fassio et al. (2016), while assessing these same cultivars in Lavras and Patrocínio, gave Catiguá MG2, Paraíso MG H419-1, and Araçuaia MG1 the highest sensory scores, and Sobreira et al. (2015b) found that cultivars deriving from Timor hybrid de scored higher than traditional and Bourbon cultivars.

The highest acidity is observed in the beverage obtained by the cultivar Obatã, as well as for the balance attribute. It can be noticed that the attributes with the nearest median grades were for Catuai Vermelho, a genetic material widely cultivated in Brazil. The yellow Bourbon presented the highest notes of fragrance/aroma attribute and the lowest were found for the cultivar Iapar 59, when analyzing the average of all the treatments for the same genotype.

The quality of the beverage is the product of the sum of the sensory attributes of the coffee beans, and this is correlated with the geographical area where the plants are grown (Scholz et al., 2011), and all these factors give the product a unique identity that defines the final quality (Silva et al., 2015). Then, it can be considered that these plantations are areas with marked characteristics for the production (Gamonal et al., 2017), where special and high-quality coffees can be obtained.

For crops such as coffee, Zou et al. (2012) stated that the location where the crop is grown determines the final quality and defines the subsequent processes that the product needs to be subjected to before consumption. According to Rolle et al. (2012) by adding information on the geographical origin of an agricultural product facilitates its acceptance in the market.

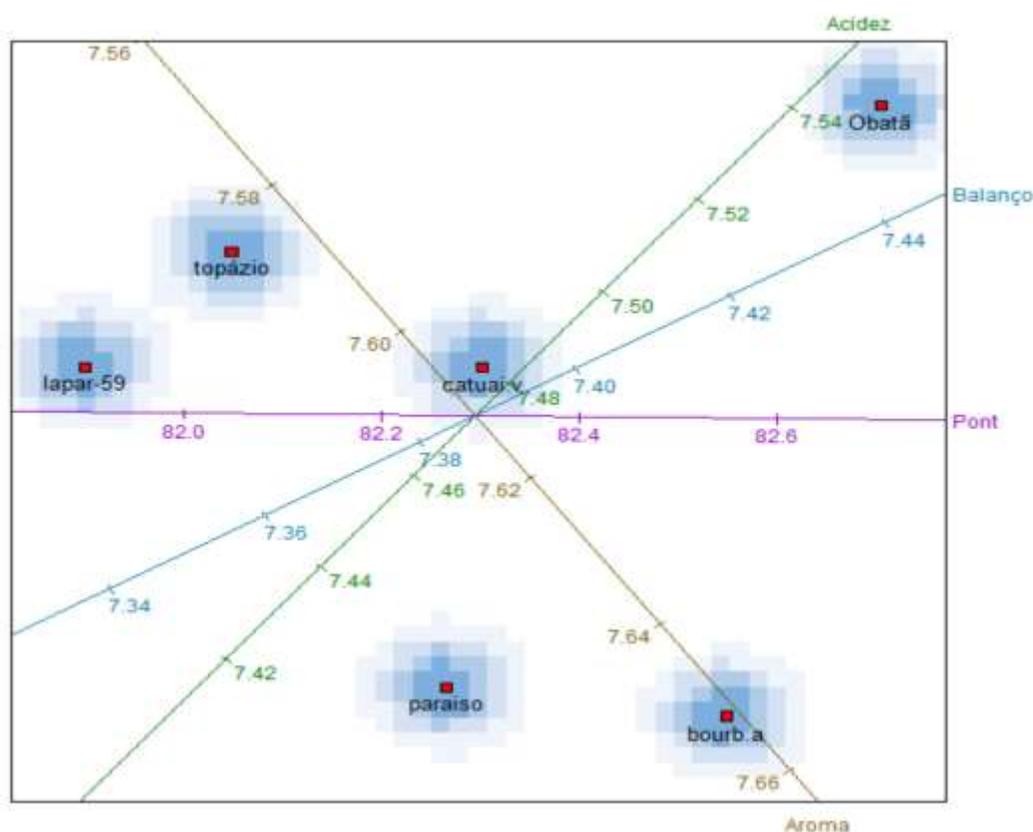


Figure 9. Biplot with multidimensional scaling for the cultivars as a function of the sensorial attributes.

## Conclusion

All cultivars presented potential for the production of specialty coffees with notes above 81 points by the SCAA protocol, with particularities differentiated between attributes in the context of quality, intensity and exoticity.

The main effects for final score and acidity, as well as balance and aroma/fragrance attributes were more expressive and pronounced for the cultivars Obatã, and Yellow Bourbon, respectively. The agreement between the final scores of the tasters was more noticeable when fixing the sun face in relation to the post-harvest processing.

## CONFLICT OF INTEREST

The authors have not declared any conflict of interest.

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