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Effects of the Orientation of the Mountainside, Altitude and Varieties on the Quality of the Coffee Beverage from the "Matas de Minas" Region, Brazilian Southeast

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Abstract

Based upon qualitative parameters experiments, this study aims to investigate how the elements of the environment, where the coffee is produced, contribute to the final quality of the product. For the analyses, it was used approximately one kilogram of coffee cherry samples collected in 14 municipalities previously chosen on the East side of the Minas Gerais State, Brazil. The coffee cherry samples were collected and analyzed for each of the two varieties in four levels of altitude for each exposure side of the mountain in relation to the Sun. The quality of the coffee was evaluated through the analysis of its physical characteristics and sensory analysis, popularly known as "Test of drink or Cupping" carried out by three tasters that belonging to the group of Q-Graders, according to the rules of national and international competitions of the Brazilian Association of Special Coffees (BSCA). Were performed analysis by means descriptive statistics, analysis of variance and multivariate analysis, all of them aiming to study the individual sensory characteristics of quality of the coffee beverage from the "Matas de Minas" region. Path coefficient analysis also was carried out for the partition of the phenotypic correlation coefficients into measures of direct

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and indirect effects, in order to determine the individual sensory characteristics that played a major role in the beverage final score. The results demonstrate that it is not possible to conclusively establish the differences among coffees evaluated with basis on varieties and environmental factors previously cited. It can be concluded that it is not recommended to associate the quality of coffee only to a specific factor whether from the environment or being it a specific of the culture of coffee. However, the cafes that were evaluated had intrinsic quality, which were derived from the specific characteristics of the "Matas de Minas" region where they were grown.

Keywords

Top Quality Coffee, Mountain Coffee, Coffee Cherry

1. Introduction

Due to massive consumption in many countries, coffee is a commodity with big international market in which this drink is valued based on qualitative parameters. Thereby, produce superior quality coffees is a strategic issue for the coffee growing. According to [1], the adoption of techniques that aim to add value to the coffee can bring numerous benefits to coffee growing, because, it is a crop of high revenue per area, being its price based on the quality of the grains.

For [2], for example, claim that the knowledge of different quality standards of an agricultural product allows addressing the existing natural diversity in producing regions, especially through some critical choices, particularly as regards the selection of varieties to grow and the adoption of management practices appropriate for each unit, allowing to obtaining better qualitative results.

According [3], the possibilities of differentiation and segmentation of coffee allow the conscious exploitation of the immense diversity in production systems, directing the production to meet the specific markets and increasing the competitiveness of this commodity.

Besides the importance of the quality of the coffees, [4] mention that it is important to define how the various topographic, environmental and administrative factors influence the quality of that product. According to [5], the definition of the relationship between agricultural product and its production site represents direct improvement of acceptance of these by the consumers. [6] affirm that the local for agricultural production influences not only the final product, but also the entire chain for industrialization of it.

The researchers [7] carried out an example of these studies with vines, in which the results indicated that, the altitude and position of the vines, among the numerous factors were the ones that most influenced the quality of the grapes. The researchers [8] state that this occurs because these variables have greater continuity when compared to others of greater variability, which results in more homogeneous influence over the landscape. It can be still stated that, several studies such as those conducted by [9]-[14] have emphasized the positive effect of factors such as the altitude on the overall quality of the coffee.

Understanding how the elements of the environment where the coffee is produced contribute to the final quality of the product becomes crucial for the production of top quality coffee. For [15], knowing the environment in which the coffee is insert enables better planning of production, aiming at sustainable development and the achievement of higher quality products.

According to [16], the differentiation in the quality of coffees must obey criteria and consider series of attributes that include its physical characteristics (origin, variety, color and size), their peculiar sensory characteristics (sweetness, body, acidity and aroma, for example), and even environmental and social concerns with the production systems and the conditions of crops.

The environment of production influences the characteristics of the coffee beans and the quality of the coffee beverage is closely related to the characteristics of the grains. The final quality of the coffee beverage is due to the balance of all the individual sensory characteristics of this beverage. Considering this, this work was carried out in order to verify the influence of environmental factors such as "altitude and side of the mountain where it is installed the coffee plantation", in the coffee quality. This work also aims to examine if there is influence of the Red Catuai and Yellow Catuai varieties on the individual characteristics of the coffee beverage produced in the region of "Matas de Minas"—Brazil.

2. Material and Methods

2.1. Experimental Site and Collected Material

The experimental field was composed by 14 municipalities situated in the Atlantic Forest region, on the East side of the State of Minas Gerais (**Figure 1**) that presents very bumpy relief with great variation in altitude (**Figure 2**).

The coffee was collected in 301 georeferenced points (latitude, longitude and altitude), with a GPS, in 14 municipalities previously chosen with basis on the elements considered as those that have the greatest influence on the quality of the coffee. Were then, considered the two main varieties of *Coffea arabica* planted in the region, which are the red and yellow Catuai. Were also considered the four different levels of altitude of the crop, which are: below 700 m, between 700 m and 825 m, above 825 m o 950 m and above 950 m; and theside of the mountain where the crop is in relation to the Sun, *i.e.*, Sunny "Soalheira" or Norway "Noruega". These sides of the mountains are represented in **Figure 3** in which, according to [17] the quadrants where are the signs (+, +) represent the position of the slope where the highest average values of air temperature are achieved, with the slope "Soalheira" NW the hottest side among the four. The quadrant where are the signs (−, −) represent the face of exposure where the lowest average values of air temperature occur due to lower incidence of solar radiation throughout the year and the highest incidence of direct solar radiation by the morning, thus being, the slope side "Noruega" SE, the coldest among the four.

In the other quadrants presented in **Figure 3**, which represent the NE side of the hillside "Soalheira" and the SW side of the hillside "Noruega", the effect of the incident solar radiation on the air temperature is symbolized by the signs(+, −), meaning that the intermediate values of temperature are predominant in these mountain sides. However, when compared to each other, the slopes SW have, on average, milder temperatures than the slopes NE, which is mainly because this side receives lower incidence of direct solar radiation during the year.

Approximately one kilogram (1 kg) of coffee cherry samples were collected and analyzed for each of the two varieties (VAR) in four levels of altitude (LA) for each exposure side (ES) of the mountain in relation to the

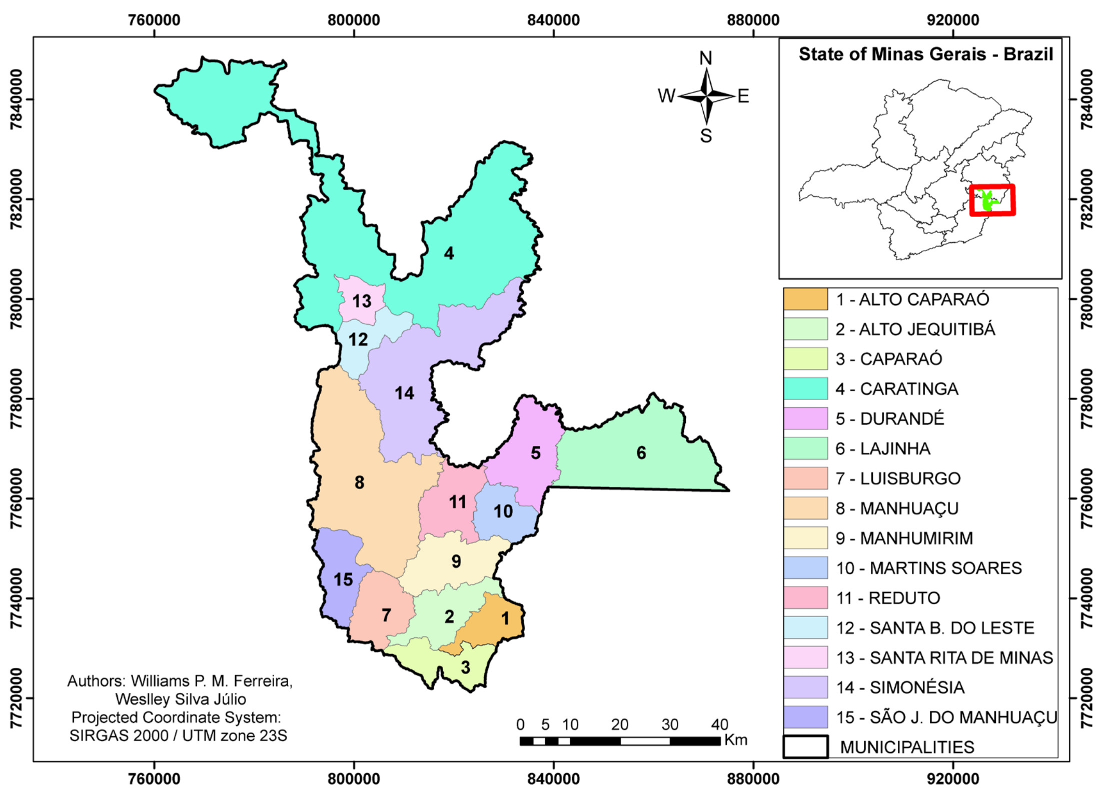


Figure 1. Municipalities where data were collected to the study the effect of the slope of the mountain, altitude and varieties on the quality of the coffee produced in the "Matas de Minas" region, Southeast of Brazil.

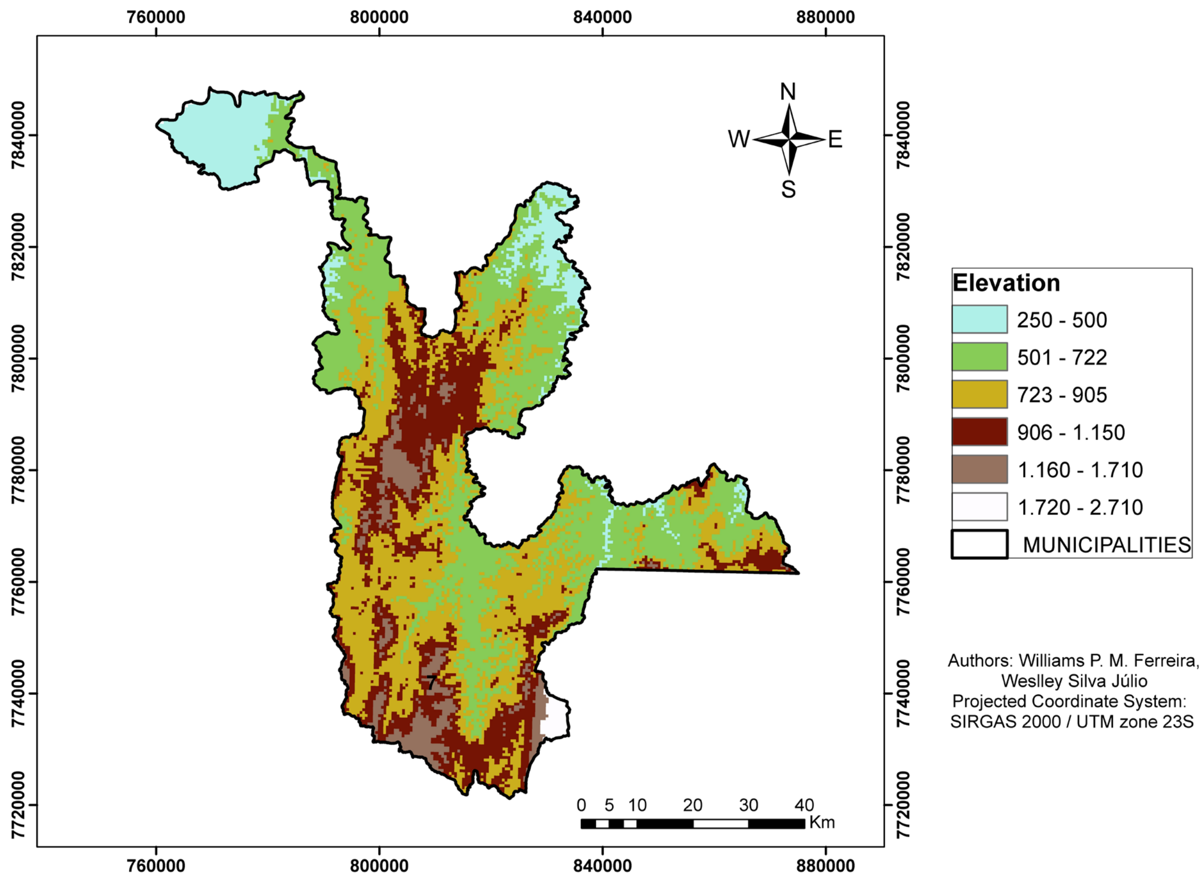


Figure 2. Altitude of the municipalities in the region covered by this study.

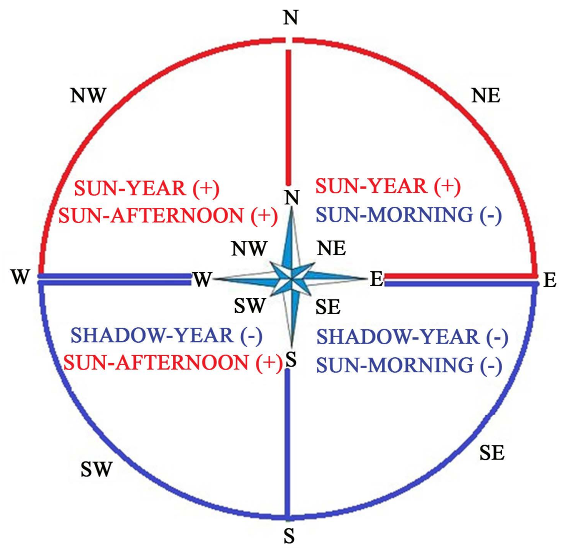


Figure 3. Position of the positive and negative signals representing the effect of the solar radiation on the air temperature in the distinct faces of exposure of the slopes, being such ones represented for the Northeast (NE), Southeast (SE), Southwest (SW) and Northwest (NW) quadrants, related to the cardinal points.

Sun. Still in the field, the coffee samples were identified and for all of them it was made a record containing information about other characteristics of each sample point.

2.2. Coffee Acquisition and Analysis Procedure

Randomly it were selected approximately 30 plants of *Coffea arabica* per hectare, for the manual harvesting of cherry fruits produced in four branches, being such branches also randomly chosen, one pair on each side of the plant, directed toward each between two lines of plants. This procedure was adopted to ensure that the coffee fruits chosen were representative of the plant and of the plot.

After harvested, the fruits were grouped in a composite sample per each experimental area. These samples were then carried to the processing unit located in the municipality of Manhumirim, Minas Gerais state, Brazil, where they were processed, benefited and dried.

2.3. Initial Processing and Coffee Refining

The fruits were peeled in a manual pulper with continuous water flow and subsequently, they were dried at 40˚C in a fixed bed samples dryer with gas burner, until they reached the water content of approximately 11%, wet based [18].

2.4. Coffee Quality Analysis

The quality of the coffee was evaluated through the analysis of its physical characteristics and sensory analysis, popularly known as "Test of drink or Cupping". Before the sensory analysis of quality, the coffee samples were classified according grain size (sieves) and number of defects.

The analyzes were performed according to the rules of national and international competitions of the Brazilian Association of Special Coffees (BSCA) by the "Cup of Excellence" (CoE methodology) adopted in the national competitions of the BSCA which has a specific way of sensory evaluation of coffee that follows the model of the Specialty Coffee Association of America (SCAA).

Three tasters belonging to the group of Q-Graders carried out the sensory test, being that each one of them made only one determination per sample. Each sample was composed of five cups, which were analyzed for attributes: Clean Cup (BL), Sweetness (DOC), Acidity (AC), Body (COR), Flavor (SAB), Aftertaste (RET), Balance (BAL) e Overall (GER). The adopted methodology was too much detailed to allow differentiation between cafes beverages of high quality and very similar, aiming at defining characteristics inherent to the location in which the coffee was produced [19].

The average values attributed to each quality criteria were calculated, obtaining in this way a single grade per sample of beverage. The analysis of this set of criteria of quality contributed in the determination of the value of the global final grade of each sample.

2.5. Statistical Analysis

Were performed analysis by means descriptive statistics, analysis of variance and multivariate analysis, all of them aiming to study the individual sensory characteristics of quality of the coffee beverage from the "Matas de Minas" region.

In order to evaluate the 903 experimental units, it was considered the completely randomized design (CRD), unbalanced, arranged in a factorial scheme 2 × 4 × 2 (2 hillsides—"Soalheira" and "Noruega", 4 levels of altitude-below 700 m, between 700 m and 825 m, above 825 m up to 950 m, and above 950 m-and 2 varieties of *Coffea arabica*-Yellow Catuaiand Red Catuai).

It was adopted the fixed model:

$$Y_{ijkm} = \mu + F_i + A_j + V_k + FA_{ij} + FV_{ik} + AV_{jk} + FAV_{ijk} + e_{ijkm}$$

where Y_{iikm} is the value of the dependent variable of the *i*-th side of exposure of the slope of the mountain, in the *j*-th level of Altitude, of the *k*-th variety, and *m*-th repetition. On the model, μ is a constant inherent in the given data; F_i is the effect of the *i*-th hillside, with *i* = 1, 2; A_i is the effect of the j-th level of altitude, with *j* = 1, 2, 3, 4; V_k is the effect of *k*-th variety, with *k* = 1, 2. The parameters FA_{ii}, FV_{ik}, AV_{ik} and FAV_{iik} correspond to the effects of its interactions: $e_{...}$ is the experimental error identically and normally distributed with average equal to zero and common variance σ^2.

Univariate analysis was performed for eight of the characteristics associated with the quality of the beverage: "BL, DOC, AC, COR, SAB, RET, BAL and GER". The assumptions of ANOVA were evaluated using the Lilliefors and Bartlett tests. The average factors and significant interactions were differentiated by means the Tukey's test ($p = 0.05$). Univariate Statistical analyzes were carried out using the free software R [20].

2.6. Analysis of the Pathway and of the Main Components

Path coefficient analysis was carried out for the partition of the phenotypic correlation coefficients into measures of direct and indirect effects, in order to determine the individual sensory characteristics that play a major role in the beverage final score.

Was considered the diagram of single chain for determination of the direct effects of the individual characteristics of quality in the final grade (NF) of the beverage, calculated by

$$NF = 36 + \sum_{i=1}^{8} X_i$$

where X_i is the grade for "*i*" individual characteristic [19] [21].

The main components analysis was also carried out to study of the behavior of the individual characteristics of the coffee beverage quality and for the determination of groups of data by means, the factors studied. The software GENES [22] and [20] carried out the statistical analyses.

3. Results

In order to analyze the positive attributes of coffee beverage quality were utilized descriptive statistics, being considered the eight individual sensory characteristics that determine the final quality of this kind of beverage, as can be shown in the **Table 1**.

Analyzes of variance of the individual scores of quality that contribute to the overall score of the beverage were carried out and the results are shown in **Table 2**.

The average tests appropriate for the individual characteristics that had statistical significance in the analysis of variance were carried out and the results for the analysis of the individual sensory characteristics, considering the "NA" factor, are presented in **Table 3** and those ones concerning to the interactions "FE-VAR, NA-VAR and FE-NA", are in **Tables 4-6**, respectively.

The correlation analysis was proceeded considering all measurements of individual scores, with the estimates of phenotypic correlations, which is presented in **Table 7**.

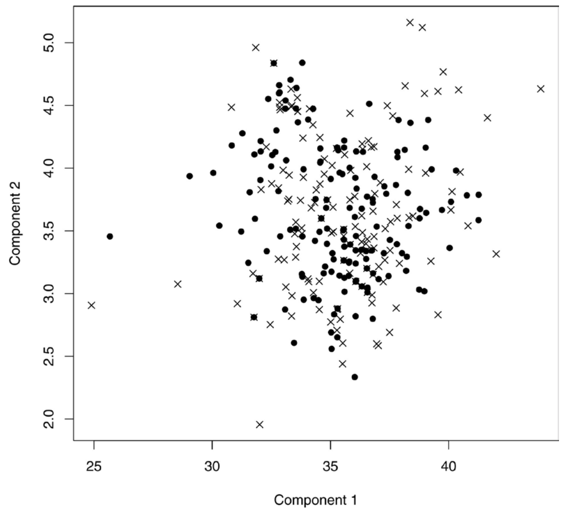
In order to verify the direct influence of individual sensory characteristics, was performed the path coefficient analysis whose results are presented in **Table 8**.

The results of the main components estimated from eight individual sensory characteristics of coffee beverage quality of "Matas de Minas" are presented in **Figure 4**, and the estimates of eigenvalues and their respective proportions, in **Table 9**.

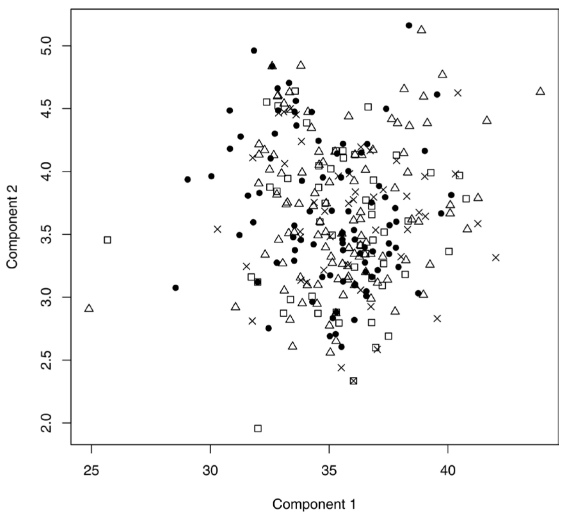
Table 1. Descriptive Statistics of individual sensory characteristics associated with the quality of the beverage.

	BL	DOC	AC	COR	SAB	RET	BAL	GER
Min.	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Max.	7.00	8.00	8.00	8.00	7.50	8.00	7.00	8.00
1st Qu.	5.00	5.00	6.00	6.00	5.00	5.00	5.00	5.00
Median	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
Mean	5.71	5.80	5.92	6.01	5.76	5.79	5.74	5.82
3rd Qu.	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
S^2	0.32	0.37	0.34	0.24	0.41	0.47	0.31	0.40
CV:	9.87	10.45	9.79	8.03	11.06	11.66	9.62	10.67

Min.—minimum value for a specific attribute; Max.—maximum value for a specific attribute; 1st Qu.—first quartile; Median—median for a specific attribute; Mean—average for a specific attribute; 3rd Qu.—third quartile; S2—variance for a specific attribute, CV—coefficient of variation.



(a)



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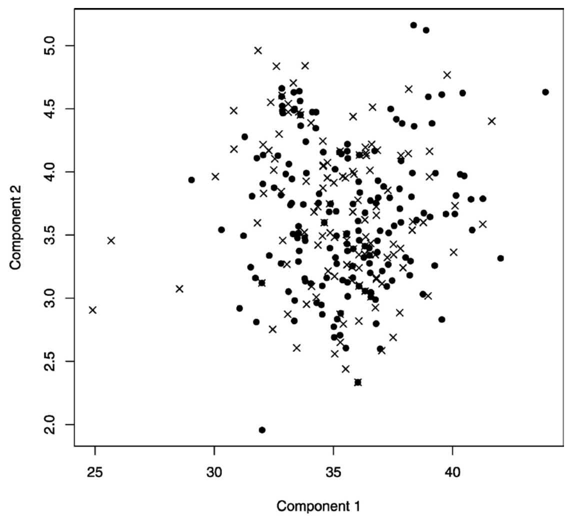

(c)

Figure 4. Graphic dispersion of the first and second main components estimated from the eight individual sensory characteristics of beverage quality. (a) "Hillside Exposure" factor: (×)—"Soalheira" (•)—"Noruega". (b) "Altitude Level" factor: (×)—below 700 m, (•)—between 700 and 825 m, (Δ)—above 825 and below 950 m, (□)—above 950 m. (c) "Variety" factor: (×)—Yellow Catuai, (•)—Red Catuaí.

Table 2. Analysis of variance of individual characteristics associated with the quality of the beverage.

		QM								
	gl	BL	DOC	AC	COR	SAB	RET	BAL	GER
FE	1	0.0225	0.0001	0.6813	0.1590	0.0138	0.5300	0.0497	0.049
NA	3	1.2161**	1.8925	1.0911*	0.3761	2.3764***	2.519***	1.3558**	2.814***
VAR	1	0.1464	0.3432	0.0657	0.2122	0.0649	0.166	0.193	0.098
FE:NA	3	0.6642	0.3889	0.9322*	0.363	0.7625	1.835**	0.6166	0.816
FE:VAR	1	0.7683	0.8258	0.5892	1.9374**	0.5611	4.641**	1.5574*	4.966***
NA:VAR	3	0.6626	0.3594	0.4476	0.8104*	0.3803	1.3700*	0.7889	1.486**
FE:NA:VAR	3	0.6465	0.3055	0.0746	0.1227	0.8756	0.429	0.3655	0.325
Error	887	0.317	0.3677	3357	0. 0.2332	0.4054	0.455	0.3052	0.386

***—$p < 0.001$; **—$p < 0.01$; *—$p < 0.05$.

Table 3. Result of the test for comparison the averages for the factor "level of altitude" performed for the significant individual sensory characteristics in the analysis of variance.

Altitude levels	BL		DOC		SAB		BAL	
<700 m	5.72	ab	5.91	a	5.80	a	5.78	ab
700 m - 825 m	5.76	ab	5.84	ab	5.83	a	5.80	a
825 m - 950 m	5.62	b	5.70	b	5.64	b	5.65	b
>950 m	5.77	a	5.84	ab	5.82	a	5.79	a

Lower case letters compare results within the same column according to Tukey's test ($p < 0.05$).

Table 4. Result of the test for average comparison for the interaction FE-VAR.

	COR		RET		BAL		GER	
VAR.	C. Am.	C. Verm.	C. Am.	C. Verm.	C. Am.	C. Verm.	C. Am.	C. Verm.
FE	5.92 Bb	6.05 Aa	5.65 Bb	5.83 Aa	5.66 Bb	5.78 Aa	5.70 Bb	5.88 Aa
	6.05 Aa	5.99 Aa	5.86 Aa	5.76 Aa	5.77 Aa	5.72 Aa	5.89 Aa	5.77 Bb

Lower case letters compare results within the same column, and upper case letters compare results within the same row according to Tukey's test ($p < 0.05$). C. Am.—Yellow catuaí; C. Verm.—Red catuaí.

Table 5. Result of the test for average comparison for the interaction NA-VAR.

		COR		RET		GER	
VAR.	Altitude levels	C. Verm.	C. Am.	C. Verm.	C. Am.	C. Verm.	C. Am.
	<700 m	6.10	Aa	5.99	Ba	5.94	Aa
A	700 m - 825 m	6.00	Aab	6.06	Aa	5.76	Bbc
	825 m - 950 m	5.90	Bb	6.01	Aa	5.67	Ac

Lower case letters compare results within the same column, and upper case letters compare results within the same row according to Tukey's test ($p < 0.05$).

Table 6. Result of the test for average comparison for the interaction FE-NA.

		AC				RET			
NA.		<700 m	700 m - 825 m	825 m - 950 m	>950 m	<700 m	700 m - 825 m	825 m - 950 m	> 950 m
FE.	Soalheira	6.05 Aa	6.02 Aa	5.79 Ba	6.03 Aa	5.93 Aa	5.85 Aa	5.55 Ba	5.88 Aa
	Noruega	5.90 Aa	5.93 Aa	5.88 Aa	5.83 Aa	5.81 Aa	5.88 Aa	5.77 Aa	5.72 Aa

Means followed by at least one letter in the column do not differ significantly among them by Tukey's test ($p < 0.05$). Means followed by the same lowercase letters VERTICALLY do not differ statistically by Tukey's test ($p < 0.05$).

Table 7. Phenotypic correlations of individual sensory characteristics that characterize the quality of the beverage.

	BL	DOC	AC	COR	SAB	RET	BAL	GER	Score
BL	1.0000	0.6598	0.5844	0.4978	0.6344	0.5328	0.4993	0.5192	0.7958
DOC		1.0000	0.5439	0.5185	0.6278	0.6132	0.4604	0.5211	0.8045
AC			1.0000	0.5392	0.5396	0.4977	0.4611	0.4223	0.7384
COR				1.0000	0.4422	0.5164	0.4109	0.4409	0.6910
SAB					1.0000	0.5753	0.6127	0.6091	0.8241
RET						1.0000	0.4609	0.6197	0.7932
BAL							1.0000	0.6252	0.7320
GER								1.0000	0.7798
Score									1.0000

Table 8. Path coefficient analysis showing direct and indirect effects of individual sensory characteristics on beverage final score. The values in the columns correspond to the effects on the individual sensory characteristics arranged in lines (in rows).

	BL	DOC	AC	COR	SAB	RET	BAL	GER
BL	0.1536	0.1093	0.0924	0.0657	0.1103	0.0991	0.0757	0.0897
DOC	0.1014	0.1656	0.0860	0.0684	0.1092	0.1141	0.0698	0.0900
AC	0.0898	0.0901	0.1580	0.0712	0.0938	0.0926	0.0699	0.0729
COR	0.0765	0.0859	0.0852	0.1320	0.0769	0.0961	0.0623	0.0761
SAB	0.0975	0.1040	0.0853	0.0584	0.1739	0.1070	0.0929	0.1052
RET	0.0819	0.1016	0.0787	0.0682	0.1001	0.1860	0.0699	0.1070
BAL	0.0767	0.0763	0.0729	0.0542	0.1066	0.0857	0.1517	0.1080
GER	0.0798	0.0863	0.0667	0.0582	0.1059	0.1153	0.0948	0.1727

Table 9. Estimates of eigenvalues of the main components estimated from the eight individual sensory characteristics of beverage quality are presented the proportion of variance explained by each component and the proportion of accumulated variance.

Mean square	Proportions of the explained variance (%)	Proportions of the accumulated variance (%)
6.51	81.39	81.39
0.33	4.16	85.55
0.26	3.31	88.86
0.25	3.15	92.01
0.20	2.55	94.56
0.16	1.99	96.55
0.14	1.80	98.35
0.13	1.65	100.00

4. Discussions

It is noted that one of the procedures for evaluating the quality of the coffee is the sensory evaluation, which is performed in a descriptive quantitative way. According [23], this technique has great application in the process of determination of acceptability of the product by the consumer. However, identify and quantify how a specific individual characteristic contributes to the final quality of the coffee beverage is not a simple process. According to [24], such identification is difficult because each person perceives the stimuli differently and tends to synthesize or integrate the perception of different characteristics, making more difficult the fractional description of distinctive characteristics.

From the **Table 1**, it can be observed amplitude of similar variation when are considered data without stratification in relation to the factors. The coefficients of experimental variation (CV) of all characteristics were lower than 12 %. Although there are few references about this statistic for beverage quality characteristics, these values can be considered low and therefore adequate.

According **Table 2**, analyses of variance of the individual scores of quality that contribute to the overall score of the beverage were carried out indicating significance ($p < 0.05$) only for the factor “NA” and for the individual sensory characteristics “BL, DOC, AC, SAB, RET, BAL and GER”; and various interaction effects (FE-VAR, for COR, RET, BAL and GER; NA-VAR, for COR, RET and GER; FE-NA, for AC and RET).

Considering that the quality of the beverage is a complex and multivariate characteristic, it is important to understand how each nuance that characterizes the quality of it, behaves in relation to each of the other ones. With this aim, the correlation analysis was proceeded considering all measurements of individual scores, with the estimates of phenotypic correlations. As it can be noted in the **Table 7** all the individual sensory characteristics showed significant correlation coefficients ($p < 0.001$) with the use of the "t test". The lowest estimate correlation was 0.4109, between the individual sensory characteristics COR and BAL; and the largest was 0.6598 between the individual sensory characteristics BL and DOC. These estimates of correlations can be considered moderate. Still, the phenotypic correlations among the nuances and the final score ranged from 0.6910 (moderate correlation) to 0.8241 (strong correlation).The estimates of the correlation coefficients are related just to the relations between the final grade of the beverage and the associated individual sensory characteristics, without presenting however, the direct and indirect effects of the individual sensory characteristics by themselves.

The path coefficient analysis method, shown in the **Table 8**, as proposed by [25], specifies the effective measure of direct and indirect causes of association and depicts the relative importance of each individual sensory characteristics involved in contributing to the beverage final score. These results show that all variables had positive direct effects, associated with moderate correlation values (>0.40) to strong (>0.70). The direct effects of the considered individual sensory characteristics were always higher than the indirect effects, indicating that all of them have importance in the final grade of the beverage. For the "Matas de Minas" coffee's, however, is highlighted the "RET" characteristic, with the greatest direct effect (0.1860) associated with a correlation of 0.79, and the characteristic "COR", with less direct effect (0.1320), associated with the correlation coefficient of 0.69.The results of estimates of direct effect, associated with the estimates of correlation, in fact reflect a difficulty that the genetic plant breeder has with this culture, which is to produce any variety that stands out in one or in few nuances. Although this is not a concern for the scope of this work, this result provides valuable information that can help guiding the selective processes aiming the "manufacture" of varieties of premium coffee. Still, gives us information about the quality of the beverage derived from varieties of coffees of the "Matas de Minas", which stand out, mainly due to its RET. Whereas the quality of the beverage is a complex characteristic, was performed the main components technique in order to investigate the behavior of the averages of the samples in relation to the factors Side of exposure, Level of altitude and Variety. The main components technique, originally described by [26], constitutes, according to [27], of a multivariate statistical technique widely used in many areas of science.

The results provided by the main components technique showed that it is not possible conclusively to discriminate the coffees evaluated in relation to the factors evaluated (FE, NA and VAR). These facts reflect the difficulty in discerning quality coffees, when contrasted in relation to factors "Hillside of Exposure" (**Figure 4(a)**), "Level of Altitude" (**Figure 4(b)**) and "Variety" (**Figure 4(c)**), and consequently, associate them with these factors. This factor is evidenced through the dispersion of the first two main components, which represent more than 85% of the variation observed in original variables (**Table 9**).

In fact, there must be other factors not considered which are more decisive in the quality of the beverage. The researchers [28] and [29] reported the nutritional status of the plant as a determinant for high productivity and quality of the coffee beverage. The researcher [30] reports that the soil fertility is also a great influence on the productivity and quality of coffee beans. The researcher [14] reported that the altitude and climate elements, such as the rainfall, the photoperiod and the wind, have great influence on the quality of the grains, and the quality of the beverage. Are needed, therefore, complementary studies that include these aspects and allow more conclusively identify factors and conditions that affect the quality of the beverage.

Still, other factors such as crop management, care in harvesting, drying, processing and storage can affect the final quality of the coffee and its production.

In this case it should be noted that in the social context that involves the mountain coffee, characterized by production in small scale which differs this production segment from the large agri-food chains, the coffee farmer of the "Matas de Minas Gerais" maintains particular organization of production in the characteristics of the product and in the relationship with the Territorial and Cultural Identity of the coffees produced in that region. This traditional practice seeks to assure the differentiation of production, establishing an intimate relationship of coffees with their place of origin, through a production with human dimensions, in which are kept the traditional cultivation practices, the passion and love in dealing with the coffee.

Although access to new technologies that facilitate the production of coffee, are some details that differentiate the final product, *i.e.* is in the productive process, which is obtained the DNA of regional beverage. These details, in addition to making the coffee beverage valued by specificities, also values the social subjects who toil daily in rural areas, making it, in the end, difficult to change deeply the production process of the cafes in that region.

From the results obtained based on the factors considered in the present study, it is evident the need for further research involving additional factors that were not considered in here. Factors such as nutritional status, which according to [27] and [28] provides high productivity and quality of the coffee beverage, and soil fertility, which according [29] influences the productivity and quality of coffee, should be included in future researches. Factors like altitude and climate elements such as rainfall, photoperiod, wind, among others, according to [14], also influence the quality of the coffee. Other factors such as crop management, care in harvesting, drying, processing and storage may affect the final quality of coffee beverage as well as the production.

5. Concluding Remarks

Using the descriptive statistical analysis applied to the behavior of the data, considering both sides of the exposure of the mountains, the individual sensory characteristics were similar, with emphasis on the "aftertaste" characteristic that presented the highest range of variation.

The results provided by the technique of principal components showed were not possible to conclusively establish the differences among coffees evaluated with basis on the "side" of the exposure of the mountain, the "altitude" level and "varieties" analyzed.

Although it is not recommend associating the quality of the "Matas de Minas" coffee only to one factor, *i.e.*, "side of the exposure of the mountain", the "level of altitude" and "varieties" analyzed; the cafes evaluated presented intrinsic quality that was derived from the joint action of specific characteristics of the region.

Further research should be carried out considering new environmental and plant factors in addition to those already analyzed in this work.

Considering the difficulty inherent in the process of evaluating the quality of the coffee beverage, which is the result of a set of individual characteristics of the beverage, and considering the results obtained, it is not recommended to associate the quality of coffee only to a specific factor whether from the environment or being that a specific of the culture of coffee.

On the other hand, it can discourage the studies that seek the improvement of an individual characteristic within the set of distinct characteristics that contribute to the overall grade of a beverage. On the other hand, based on the results obtained, it can be considered that despite the variance associated with the individual characteristics of beverages analyzed in this study, the cafes that are evaluated have intrinsic qualities, which are derived from the specific characteristics of the "Matas de Minas" region where they are grown.

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Conflict of Interest

The authors declare that they have no conflict of interest.

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