SENSORIAL CHARACTERISTICS OF COFFEE (*Coffea arabica* L.)VARIETIES IN THE ALTO PARANAÍBA REGION

Sara Maria Chalfoun[1], Marcelo Cláudio Pereira[2], Gladyston Rodrigues Carvalho[3], Antonio Alves Pereira[4], Taciana Villela Savian[5], Deila Magna dos Santos Botelho[6]

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ABSTRACT: The objective of this study was to verify the sensorial characteristics of grains of 21 Coffea arabica L. cultivars obtained from EPAMIG Experimental Farm in Patrocínio, Minas Gerais, in the Alto Paranaíba Region. The coffee cherries were husked and dried in wooden trays, until 11 to 12% humidity and sent to three Brazilian Specialty Coffee Association BSCA accredited professional coffee tasters. The data were statistically evaluated by multivariate analysis to compare the cultivars and group them. The following cultivars, listed in decreasing order according to the first principal component with scores above 80 points, thus considered to produce superior beverage based on the attributes with the highest scores (flavor, sweetness, balance, acidity, clean beverage and aspect), for the two methods, during the two –year study was cultivar H419-6-2-5-2. The ascendancy of the cultivars and progenies tested, whether derived or not from the Timor Hybrid, did not affect their qualitative performance.

Index terms: Quality; husked coffee cherry, processing, specialty coffee.

CARACTERÍSTICAS SENSORIAIS DE CULTIVARES DE CAFÉ (*Coffea arabica* L.) NA REGIÃO DO ALTO PARANAÍBA

RESUMO: Objetivou-se, neste trabalho, verificar as características sensoriais dos grãos de 21 cultivares de café (Coffea arabica L.), provenientes do ensaio de melhoramento da EPAMIG, Fazenda Experimental de Patrocínio em Minas Gerais, na Região do Alto Paranaíba. Frutos cerejas após o descascamento foram secos em bandejas de madeira , com fundo telado de 1 m², até atingirem de 11 a 12% de umidade (b.u.). Após a secagem , os frutos foram encaminhados para três provadores credenciados pela BSCA. Procedeu-se à avaliação estatística multivariada dos dados, com o objetivo de estabelecer comparações entre as cultivares e realizar os agrupamentos das mesmas. As cultivares em ordem decrescente segundo a primeira componente principal , com notas acima de 80 pontos-portanto consideradas como de bebida superior , de acordo com os atributos-com os maiores escores (sabor, doçura, balanço, acidez, bebida limpa e aspecto), durante os dois anos estudados foi apenas a cultivar H419-6-2-5-2. A ascendência das cultivares e progênies testadas, oriundas ou não do Híbrido Timor, não afetou o desempenho qualitativo das mesmas.

***Termos para indexação:** Qualidade, cereja descascado, processamento, cafés especiais.*

1 INTRODUCTION

Since the late 20th century, most breeding programs implemented in coffee-producing countries (Brazil, Colombia, Kenya, Costa Rica, Honduras) have transferred resistance to rust (*Hemileia vastatrix* Berk. and Br.), root-knot nematodes (Meloidogyne sp.) and Coffee Berry Disease (*Colletotrichum kahawae* sensu Hindorf) from the Timor Hybrid to *C. arabica* cultivars. The amount of foreing genetic material introgressed in many Arabica lines ranges from 8 % to 27 % of the *C. canephora* Pierre genome (LASHERMES et al., 2000).

However, there are doubt related to the quality of some hybrid varieties derived from the crossing of Arabica with robusta and other species (CARVALHO et al., 2000; CASTILLO,

[1]Empresa de Pesquisa Agropecuária de Minas Gerais/EPAMIG - Cx. P. 176 - 37.200-000 - Lavras-MG chalfoun@epamig.ufla.br
[2]Instituto Nacional Ciência e Tecnologia do Café- INCT CAFÉ - Rua Marechal Deodoro da Fonseca,86 Lavras-MG - 37.200-000 - marceloclaudio@posgrad.ufla.br
[3]Empresa de Pesquisa Agropecuária de Minas Gerais/EPAMIG - Cx. P. 176 - 37.200-000 - Lavras-MG carvalho@epamig.ufla.br
[4]Empresa de Pesquisa Agropecuária de Minas Gerais /EPAMIG - Cx. P. 176 - 37.200-000 - Lavras-MG pereira@epamig.ufv.br
[5]Escola Superior de Agricultura "Luiz de Queiroz/ESALQ - Avenida Pádua Dias, 11- Piracicaba-SP tacianavillela@gmail.com
[6]Empresa de Pesquisa Agropecuária de Minas Gerais/EPAMIG- Cx. P. 176 - 37.200-000 - Lavras-MG deilamagna@hotmail.com

1990; MORENO; MORENO; CADENA, 1995; PUERTA, 2000).

Good quality coffee requires special care from pre-harvest throughout harvest and post-harvest, as several factors may cause changes that may lead to low-quality beverage (BORÉM, 2008). Better quality coffee production brings better price and, consequently, greater profit for the producer.

Coffee quality is directly related to several physical, physicochemical and chemical properties, responsible for the characteristic appearance of the roasted bean, beverage flavor and aroma, such as the volatile and phenolic (chlorogenic acid) components, fatty acids, proteins, and some enzymes, whose presence confers coffee its peculiar flavor and aroma (PEREIRA et al., 2010).

Coelho and Pereira (2002) define the following as determining factors affecting coffee quality in a broad sense: a) the chemical composition of the beans, determined by genetic, environmental, and cultural factors and, mainly, by the interaction between them; b) harvesting, processing, and storage methods, and c) roasting and beverage preparation. These authors found that roasting and beverage preparation have an effect on the chemical composition changes undergone by the beans, stressing that such changes are dependent on their original chemical composition.

Coffee beverage quality is intimately related to its flavor and aroma, generating consumer satisfaction. Mendonça, Pereira and Mendes (2005) believe that beverage quality is mainly associated to consumer satisfaction with a balanced combination of flavors and aromas (*Flavor*), perceptible only after roasting, which is dependent on the chemical composition of the raw bean.

Malavolta (2000) considers coffee quality a combination of sensorial characteristics of the beans or the beverage, conferring a commercial value. Defining coffee quality is not easy, especially because of the fact that coffee has been consumed for a long time but only recently has gained importance for its differentiated characteristics, which remain unknown to most consumers.

Besides the physical, chemical, and sensorial attributes frequently cited in the literature, the hygienic-sanitary attributes must also be considered important for the production of quality coffees and consumer satisfaction.

The global quality of gourmet coffee is a combination of flavor, body, and aroma, absence of BIS (black, immature, and sour) beans, fermented flavor, rotten or black-immature beans, and beverage balance and harmony, leading to a pleasant sensation during and after consumption (MORI et al., 2003).

According to Flament (2002), the aroma of non-roasted coffee and the flavor of roasted coffee are a function of their volatile and non-volatile components, with some of the non-volatile constituents resisting roasting conditions, and, consequently, more or less contributing to the organoleptic quality of the final beverage, as in the particular case of the multifunctional acids and phenols.

Pimenta (2003) points out that adequate harvesting and coffee preparation techniques are very important, improving the quality of coffee, facilitating its commercialization and providing higher economic returns. According to this author, adequate harvesting season is indispensable not only to allow perfect drying, avoiding fermentation, but also to produce coffee with an adequate chemical composition and fewer undesirable biochemical changes that harm beverage quality.

Historically, two basic systems have been used to process coffee cherries: the wet and the dry processing methods. In the dry processing, whole coffee cherries are used, producing dried beans known as natural coffee (BORÉM, 2008). The Alto Paranaiba region, characterized by climatic conditions of low humidity during fruit maturation and post-harvest, presents favorable conditions for this type of processing, allowing a high quality final product with differentiated coffee characteristics via wet processing, as well.

Arabic coffee presents superior quality attributes compared to robusta, thus having a higher commercial value. It is the major variety cultivated in the state of Minas Gerais, mainly because of the favorable climatic conditions. Mendonça, Pereira and Mendes (2005) emphasize the importance of knowing the quality of different cultivars through the evaluation of the chemical composition of the beans, as they have a great potential to produce special coffees.

Aware of the recent changes in coffee beverage production, the Brazilian Association of Coffee Industry, understands that the main alternative to overcome the obstacles inhibiting competition with other beverages is to continue to increase consumption offering diversified, high quality products. The international market has become more demanding for better coffee quality. Brazilian coffee, traditionally known for its good quality, has maintained its sales leadership in countries such as Germany, Italy and Japan. According to Vegro (1994), coffee is one of the few agricultural products in Brazil whose price is associated to qualitative parameters, i.e., higher commercial value with quality. By implementing the Coffee Quality Program (CQP), aims to change the popular belief that all coffees are the same.

As reported by several authors, better quality coffees are obtained when coffee is processed at the cherry stage, when the beans present an adequate chemical composition (PIMENTA; VILELA, 2003).

According to Borém (2008) appearance or increase of astringency in coffee beverage is mainly due to the presence of immature beans, harvested when the fruit were still green. Thus, special coffee should not contain immature beans.

Borges, Jorge and Noronha (2002) evaluated the effect of age of coffee plant of the same variety and maturation stages of beans (dried, cherry and green) on the commercial classification and quality of coffee beverage, concluding that, overall, younger coffees presented the best characteristics. In addition, these authors verified that in the classification by size and determination of medium–sized sieve, the 12-year batches with medium sieve 15, presented a result inferior to that obtained by the 3-year batches, with medium sieve 16. For commercial and beverage classification, better results were obtained, overall, for the 3-year batches, in different mixtures, without the influence of different stages of maturation. In this work, a 12-year-old and a 3-year-old Cafe arabica, Catuaí variety areas were used.

This study was carried out to evaluated the relationship between different cultivars and coffee quality, aiming to make a sensorial characterization of 21 coffee cultivars in the Alto Paranaíba region, one of the major coffee-producing areas in the country. This region was chosen based on its highly productive and technological standard of coffee cultivation as well as favorable environmental conditions to obtain high quality coffee.

2 MATERIALS AND METHODS

This work was carried out at the EPAMIG Experimental Station located in Patrocínio, State of Minas Gerais, Brazil.

2.1 Experimental characteristics

The coffee used in the analysis originated from the following cultivars and progenies: Acaiá Cerrado MG 1474; Bourbon Vermelho DATERRA; Catiguá MG 1; Catiguá MG 2; Catuaí Amarelo IAC 62; Catuaí Vermelho IAC 15; H 419-3-1-4-2; H 419-6-2-5-2; H 419-6-2-5-3; H 419-6-2-7-3 Vermelho; H 493-1-2-10; H 514-7-10-1 Vermelho; H 514-7-10-6; H 515-4-2-2; H 518-3-6-1; Icatú Amarelo IAC 3282; Mundo Novo 379-19; Mundo Novo IAC 376-4; Rubi MG 1192; Sacramento MG 1;and Topázio MG 1190.

2.2 Preparation of dehusked cherry coffee

The fruits from each plot were manually picked from the trees, and later dehusked, during the cropping years 2005/2006 and 2006/2007.

Twenty liters of dehusked coffee of each cultivar were dried on wooden trays, until 11 to 12% humidity (b.u.) for approximately 15 days. After drying and processing, the coffee beans were sent to Dr. Alcides de Carvalho, at the Coffee Quality Laboratory of EPAMIG, for physicochemical and chemical analyses.

2.3 Evaluation of the sensorial attributes

Sensorial analysis was conducted by three professional tasters using methodology proposed by the Brazilian Specialty Coffee Association (BSCA). Based on this methodology, each attribute evaluated (coffee beverage, sweetness, acidity, body, flavor, after taste, balance or/ and aspect) was given a score from 0-8, according to the intensity in the samples, thus being more objective than the conventional cupping test. The sum of all the scores corresponded to the final beverage classification. Each sample started with a pre-established scale of 36 points, to which the scores given to each attribute were incorporated, with those higher than 80 being classified as special coffees.

2.4 Experimental design and statistical nalysis

For the final coffee beverage classification (variable G), the experiment was arranged in a randomized block design with 21 treatments (21 cultivars) and three repetitions (3 tasters). The cultivar means were differentiated by the Scott-Knott test with a nominal significance of 5%. Univariate statistical analysis was conducted using SISVAR software.

The statistical model used was:

$y_{ij} = \mu + c_i + p_j + \varepsilon_{ij}$, where y_{ij} is the value of the response-variable of the i-nth cultivar attributed by the j-nth taster ; μ is a constant inherent to each observation; c_i is the effect of the i-nth cultivar, with i = 1, ..., 21; p_j is the effect of the j-nth taster, with j= 1, 2, 3; ε_{ij} is the independent experimental error and identically distributed of a Normal with a zero mean and σ^2 variance.

For the characteristics evaluated in the sensorial analysis (clean beverage, sweetness, acidity, body, flavor, after taste, balance, and aspect), A principal components analysis was carried out using the proc princomp procedure of the SAS statistical package (STATISTICAL ANALYSIS SYSTEM INSTITUTE - SAS INSTITUTE, 1999). The 21 coffee cultivars used in this study were ranked in Patrocínio, during the cropping years 2005/2006 and 2006/2007, according to the dehusked coffee cherry preparation method.

3 RESULTS AND DISCUSSION

3.1 Principal components analysis for the sensorial analysis variables used for the Patrocínio region cultivars and dehusked coffee Incherry method in the cropping year 2005/2006.

Interpretation of sensorial analysis data using the principal components analysis (PCA) is a clear example of the versatility of this method, as shown in similar studies (MAEZTU et al., 2001). Sensorial analysis is a scientific method used to measure, analyze and interpret the reactions to food characteristics, as perceived by vision, smell, taste, touch and hearing organs. Thus, sensorial analysis is directly related to acceptance or rejection of a particular product. PCA allows the visualization of complex multidimensional data, extracting maximum relevant information.

The first two principal components combined explained 62.91% of the variability in the samples, with 45.39 and 17.52% of the variation explained by the first and the second principal components, respectively.

The first principal component reflects a global index of coffee quality. This index is influenced mainly by the attributes clean beverage, aspect, balance, acidity, and flavor, confirmed by the high coefficients of correlation of these attributes with the principal component (Table 1).

TABLE 1 – Coefficients of the principal components (and correlations), percentages of the total and explained variation accumulated by the components for the cropping year 2005/2006.

Variable	1st PC	2ndPC
Clean beverage	0.55 (0.88)*	-0.21 (-0.21)
Sweetness	0.07 (0.19)	-0.27 (-0.44)*
Acidity	0.33 (0.71)*	-0.11 (-0.14)
Body	0.22 (0.42)	0.53 (0.64)*
Flavor	0.32 (0.57)*	0.21 (0.23)
After taste	0.02 (0.08)	0.24 (0.53)*
Balance	0.39 (0.62)*	0.55 (0.54)*
Aspect	0.53 (0.85)*	-0.43 (-0.43)*
Explained variation	0.4539	0.1752
Accumulated variation	0.4539	0.6291

The results presented in Table 2 and Figure 1 show that the cultivars indexed by numbers 8 (H 419-6-2-5-2), 3 (Catigua MG 1), 2 (Bourbon Vermelho DATERRA), 10 (H 419-6-2-7-3 Vermelho) and 15 (H 518-3-6-1) obtained higher scores than the other cultivars, according to the first principal component, in the attributes clean beverage, aspect, balance, acidity and flavor.

However, for coffee to be classified as special coffee, according to the BSCA methodology, it must present a score higher than 80, obtained only by the cultivars cited above.

The second principal component describes the coffee cultivars mainly in relation to the attributes body, after taste, balance (positively correlated), sweetness, and aspect (negatively correlated). The results presented in Table 3 and Figure 2 show that for all the coffee cultivars, the attributes body, after taste, and balance surpassed the attributes sweetness and aspect, since the scores were all positive.

Based on the first principal component, one can calculate the scores for each coffee cultivar and classify them according to the global quality presented. The cultivars with the best attributes of body, after taste and balance are those indexed by numbers 20 (Sacramento MG1), 5 (Catuaí Amarelo IAC 62), 14 (H 515-4-2-2), 12 (H 514- 7-10-1 Vermelho) and 21 (Topázio MG 1190), although these cultivars did not reach a score higher than 80 points, special coffee, according to BSCA.

3.2 Principal component analysis for the sensorial analysis variables of the coffee cultivars in the Patrocínio region and dehusked coffee cherry method in the cropping year 2006/2007.

The first two principal components combined explain 84.71% of the variation, explained by the first principal component 77.14, and 7.57% of the variation explained by the second principal component.

TABLE 2 – Global score indices of coffee quality based on the first principal component and Scott-Knott test for the general variable of sensorial analysis for the cropping year 2005/2006.

Cultivar	First principal component score	Rank	Scott-Knott for G
1. Acaiá Cerrado MG 1474	12.4211	13º	77 b
2.Bourbon Vermelho DATERRA	**14.2101**	**3º**	**82 a**
3. Catigua MG 1	**14.2187**	**2º**	**82 a**
4. Catiguá MG 2	12.9717	8º	76 b
5.Catuaí Amarelo IAC 62	13.1309	7º	79 b
6. Catuai vermelho IAC 15	12.4211	13º	78 b
7. H 419-3-1-4-2	13.5003	6º	80 b
8. H 419-6-2-5-2	**14.5408**	**1º**	**83 a**
9. H 419-6-2-5-3	12.2021	15º	78 b
10. H 419-6-2-7-3 Vermelho	**14.1531**	**4º**	**82 a**
11. H 493-1-2-10	12.4211	13º	78 b
12. H 514- 7-10-1 Vermelho	12.3471	14º	78 b
13. H 514-7-10-6	12.4211	13º	77 b
14. H 515-4-2-2	12.8088	9º	78 b
15. H 518-3-6-1	**13.8880**	**5º**	**83 a**
16.Icatu Amarelo IAC 3282	12.7076	12º	78 b
17. Mundo Novo 379/19	12.2021	15º	77 b
18. Mundo Novo IAC 376/4	12.4211	13º	78 b
19. Rubi MG 1192	12.2021	15º	78 b
20. Sacramento MG1	12.7348	11º	78 b
21. Topázio MG 1190	12.7432	10º	78 b

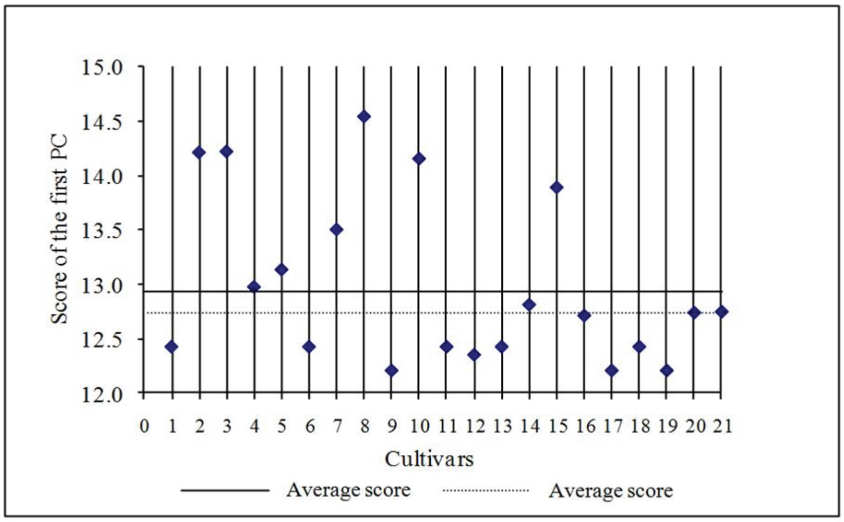

FIGURE 1 – First principal component scores for each coffee cultivar in the Patrocínio region using dehusked coffee cherry in the cropping year 2005/2006.

TABLE 3 – Global scores indices of coffee quality, based on the second principal component for the cropping year 2005/2006.

Cultivar	Second principal component score	Ranking
1. Acaiá Cerrado MG 1474	3.2887	8º
2. Bourbon Vermelho DATERRA	3.3979	6º
3. Catigua MG 1	3.0858	10º
4. Catiguá MG 2	3.0731	11º
5. Catuaí Amarelo IAC 62	**4.0426**	**2º**
6. Catuai vermelho IAC 15	3.2887	8º
7. H 419-3-1-4-2	2.6440	14º
8. H 419-6-2-5-2	3.2923	7º
9. H 419-6-2-5-3	2.7572	12º
10. H 419-6-2-7-3 Vermelho	2.7449	13º
11. H 493-1-2-10	3.2887	8º
12. H 514- 7-10-1 Vermelho	**3.5624**	**4º**
13. H 514-7-10-6	3.2887	8º
14. 14.H 515-4-2-2	**3.8361**	**3º**
15. H 518-3-6-1	3.1914	9º
16. Icatu Amarelo IAC 3282	2.0864	15º
17. Mundo Novo 379/19	2.7572W	12º
18. Mundo Novo IAC 376/4	3.2887	8º
19. Rubi MG 1192	2.7572	12º
20. Sacramento MG1	**4.1098**	**1º**
21. Topázio MG 1190	**3.4952**	**5º**

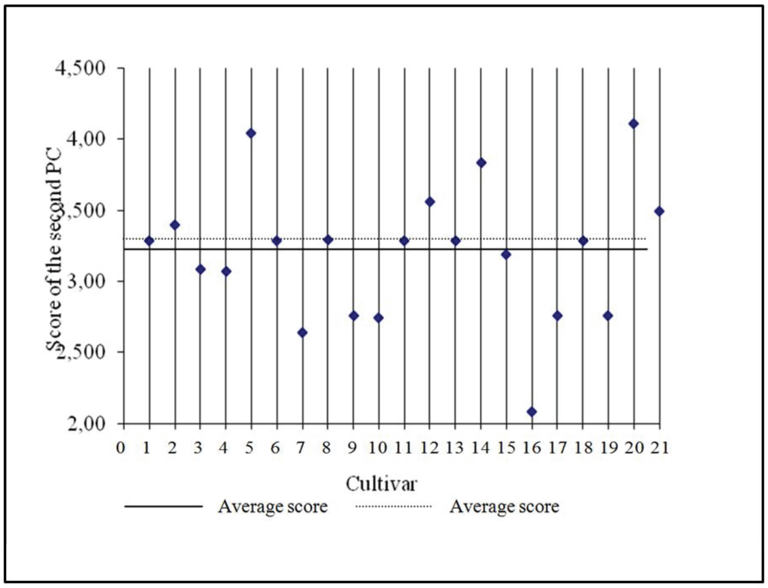

FIGURE 2 – Second principal component scores for each coffee cultivar in the Patrocínio region using dehusked coffee cherry in the agricultural year 2005/2006.

The highest contributions for this component are the variables sweetness and flavor, although all of them are significantly correlated with the first principal component (Table 4).

TABLE 4 – Coefficients of the principal components (and correlations), percentages of the total and explained variation accumulated by the components for the cropping year 2006/2007.

Variables	1st PC	2nd PC
Clean beverage	0.31 (0.85)*	0.53 (0.46)*
Sweetness	0.48 (0.95)*	0.15 (0.09)
Acidity	0.38 (0.88)*	-0.45 (-0.32)
Body	0.35 (0.91)*	-0.21 (-0.18)
Flavor	0.44 (0.87)*	-0.38 (-0.24)
After taste	0.23 (0.77)*	-0.03 (-0.03)
Balance	0.31 (0.87)*	0.19 (0.16)
Aspect	0.24 (0.77)*	0.51 (0.51)*
Explained variation	0.7714	0.0757
Accumulated variation	0.7714	0.8471

Although all the variables are significantly correlated with the first principal component, the results presented in Table 5 and Figure 3 show that the variables sweetness and flavor obtained the highest scores for cultivar Catiguá MG 2 with 96 points, followed by Rubi MG 1192 with 93 points; H 514-7-10-6, with 92 points and cultivars H 419-3-1-4-2 and H 419-6-2-5-2 with 91 points. Although statistically inferior in relation to the first group of cultivars, these cultivars obtained scores ranging from 80 to 89 points and, according to BSCA, can all be classified as special coffees.

The second principal component describes the main varieties of coffee especially in relation to the attributes related to clean beverage and aspect (positively related).

According to Table 6 and Figure 4, all varieties of coffee clean beverage the attributes and appearance attributes exceeded acidity, flavor and body (negatively correlated). Cultivars with the best attributes and appearance are clean beverage: Catiguá MG1; H 514-7-10-6; Sacramento MG1; Ac aia Cerrado MG 1474; Mundo Novo IAC 376 / 4 and Catuai Amarelo IAC 62.

TABLE 5 – Global score indices of coffee quality based on the first principal component and Scott-Knott test for the general variable of sensorial analysis for the cropping year 2006/2007.

Cultivar	First principal component score	Rank	Scott-Knott for G
1. Acaiá Cerrado MG 1474	16.1037	14	83 d
2.Bourbon Vermelho DATERRA	15.1220	20	80 d
3. Catigua MG 1	17.7126	8	87 c
4. Catiguá MG 2	**20.9697**	**1**	**96 a**
5. Catuaí Amarelo IAC 62	16.5629	12	84 c
6. Catuai vermelho IAC 15	15.7877	17	82 d
7. H 419-3-1-4-2	**18.9685**	**4**	**91 b**
8. H 419-6-2-5-2	**18.9214**	**5**	**91 b**
9. H 419-6-2-5-3	17.3419	9	86 c
10. H 419-6-2-7-3 Vermelho	16.3400	13	84 d
11. H 493-1-2-10	18.2147	6	89 b
12. H 514- 7-10-1 Vermelho	17.7221	7	87 c
13. H 514-7-10-6	**19.1718**	**3**	**92 b**
14. H 515-4-2-2	16.7956	11	*85 c*
15. H 518-3-6-1	15.8322	16	82 d
16. Icatu Amarelo IAC 3282	15.4747	18	81 d
17. Mundo Novo 379/19	16.1037	15	83 d
18. Mundo Novo IAC 376/4	15.1159	21	80 d
19. Rubi MG 1192	**19.4480**	**2**	**93 b**
20.Sacramento MG1	17.1977	10	86 c
21.Topázio MG 1190	15.3412	19	81 d

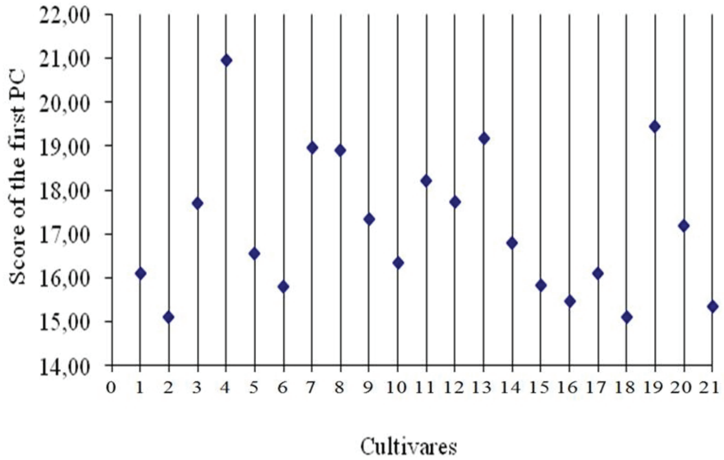

FIGURE 3 – First principal component scores for each coffee cultivar in the Patrocínio region using dehusked coffee cherry in the cropping year 2006/2007.

TABLE 6 – Second principal component scores and ranking for the cropping year 2006/2007.

Cultivar	Second principal component score	Ranking
1. Acaiá Cerrado MG 1474	**1.9384**	**5**
2. Bourbon Vermelho DATERRA	1.5242	16
3. Catigua MG 1	1.4341	18
4. Catiguá MG 2	1.5361	15
5. Catuaí Amarelo IAC 62	1.8408	7
6. Catuai vermelho IAC 15	1.7660	12
7. H 419-3-1-4-2	1.6391	14
8. H 419-6-2-5-2	1.8366	8
9. H 419-6-2-5-3	1.8040	9
10. H 419-6-2-7-3 Vermelho	**1.9783**	**3**
11. H 493-1-2-10	1.4824	17
12. H 514- 7-10-1 Vermelho	1.7231	13
13. H 514-7-10-6	1.9190	6
14. H 515-4-2-2	1.7720	10
15. H 518-3-6-1	**2.0870**	**1**
16. Icatu Amarelo IAC 3282	1.7668	11
17. Mundo Novo 379/19	**1.9384**	**5**
18. Mundo Novo IAC 376/4	**1.9539**	**4**
19. Rubi MG 1192	**2.0685**	**2**
20.Sacramento MG1	1.3453	19
21.Topázio MG 1190	1.2780	20

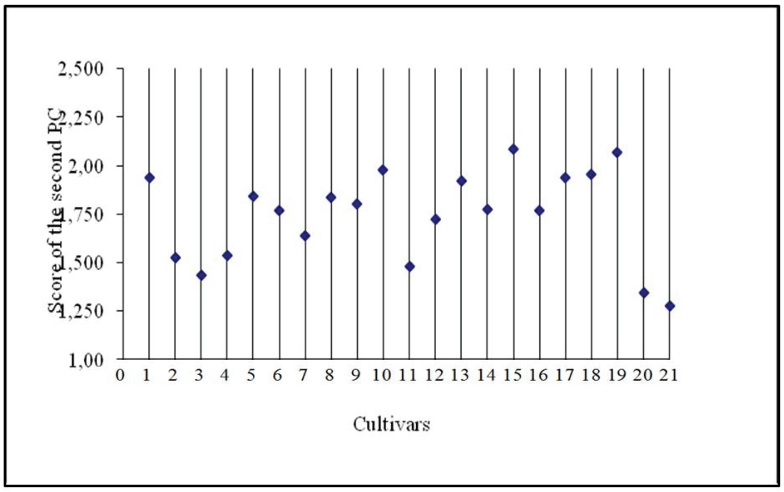

FIGURE 4 – Second principal component scores for each coffee cultivar in the Patrocínio region using dehusked cherry coffee in the cropping year 2006/2007.

4 CONCLUSIONS

According to the first principal component, the cultivar with scores above 80 and thus, considered as producing special coffee beverages, based on the attributes with the highest scores (clean beverage, acidity, flavor, balance and aspect) for the husked coffee cherry preparation method during the two years studied, was H419-6-2-5-2.

The ascendancy of the cultivars and progenies tested, derived or not from the Timor Hybrid, did not affect their qualitative performance.

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