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# Quality assessment of coffee grown in Campos Gerais, Minas Gerais State, Brazil

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**ABSTRACT.** The objective of this work was to evaluate the quality of 6 samples of Arabica coffee (Red Catuaí/144, new World 4/376, new World Acaiá 19/474, Yellow Catuaí/62, new World 9/375, new World 19/379), subjected to medium roasting, cultivated in the municipality of Campos Gerais, Minas Gerais State. It was used fruit harvested in 2012, acquired in a farm in the region of Capoeirinha. For physical and chemical analysis (pH, moisture, total titratable acidity, total soluble solids, and caffeine) and for sensory analysis, it was used 4 replications of each sample. Results from physical and chemical analysis indicated that all the samples can be cultivated in the municipality, since they were within the quality standards for roasted coffee. Coffee of the cultivars New World 4/376, New World acaiá 19/474, Yellow Catuaí 62 and New World 19/378 and New World 9/375 have been classified as non-special coffees, with scores below the special grade. The cultivar Red Catuaí 144 presented lower values of total titratable acidity and the best values of pH, parameters responsible for aroma and flavor of coffee, and therefore classified as a high quality coffee (premium coffee; 80 to 84.99 points).

**Keywords:** Arabica coffea, physical and chemical analysis, sensory analysis.

## Avaliação da qualidade de cafés cultivados em Campos Gerais, no Estado de Minas Gerias, Brasil

**RESUMO.** Este trabalho teve como objetivo avaliar a qualidade de seis amostras de café arábica (Catuaí vermelho/144, Mundo novo 4/376, Mundo novo Acaiá 19/474, Catuaí amarelo/62, Mundo novo 9/375, Mundo novo 19/379), submetidos à torra comercial média, cultivadas no município de Campos Gerais, Estado de Minas Gerias. Foram utilizados frutos provenientes das safras 2012, adquiridos em uma fazenda situada na região da Capoeirinha. Para as análises físico-químicas (pH, umidade, acidez total titulável, sólidos solúveis totais, pH e cafeína) e sensoriais foram utilizadas quatro repetições de cada amostra. Os resultados obtidos para as análises físico-químicas demonstram que todas as amostras podem ser cultivadas no município, pois estavam dentro dos padrões de qualidade estabelecidos para café torrado. Conclui-se que os cafés das cultivares Mundo novo 4/376, Mundo novo Acaiá 19/474, Catuaí amarelo 62, Mundo novo 19/379 e Mundo novo 9/375 foram classificados como cafés não especiais com pontuação abaixo do grau de especial (< 80). E a cultivar Catuaí vermelho 144 obteve baixos teores de acidez total titulável e foi a que apresentou os melhores valores para o parâmetro de pH, atributos responsáveis pelo aroma e sabor do café. Consequentemente considerado um café muito bom classificado como especial (80 a 84,99 pontos).

**Palavras-chave:** cofé arábica, análise físico-química, análise sensorial.

## Introduction

Coffee is a beverage accepted worldwide because of its unmistakable flavor and aroma (LEROY et al., 2006). Moreover, it is a very natural product, considered beneficial to human health, and used in drugs and cosmetics due to its chemical potential closely related to the good quality of coffees (PASIN et al., 2011).

The Brazilian climate has benefited the increase of its cultivation in the country, highlighting the states of Minas Gerais, São Paulo, Espírito Santo and Paraná (CAMARGO, 2010; MALERBO-SOUZA; HALAK, 2012). Arabica coffee had a production estimated at 37.95 million bags in 2012, representing 75.2% of the national production. The Minas Gerais state is the largest producer in the country with a production of 26.63 million bags of coffee. Among the regions in the state, stand out the cities of Três Pontas, Três Corações, Boa Esperança, Machado and Campos Gerais, where the economy is nearly all dedicated to the coffee sector (BARBOSA et al., 2012).

The search for a high quality coffee is constant among farmers, because the better the flavor the higher the commercial value (ISQUIERDO et al., 2012). The good quality of coffee is associated with its species, environmental and genetic factors, harvesting and drying methods, storage and chemical composition (FARAH et al., 2006). Given the above, this study evaluated some parameters of physicochemical and sensory quality of 6 samples from the 2012 harvest of Arabica coffee acquired on a farm in the region of Capoeirinha in the municipality of Campos Gerais, Minas Gerais State, in order to contribute with farmers in the choice of the best species to be grown in the municipality.

## Material and methods

### Raw material

Fruit of Arabica coffee harvested in 2012 were acquired in a farm in the region of Capoeirinha, municipality of Campos Gerais, Minas Gerais State were used in this study. Grains were received dry (dry processing) and taken to the Cooperativa dos Cafeicultores de Campos Gerais e Campo do Meio, Minas Gerais State, Coopercam, for commercial medium roasting (55-65 Agtron). Sensory analyses were undertaken at Coopercam, and physical and chemical analyses in the laboratory of biochemistry and food science from the Faculdade de Ciências e Tecnologias de Campos Gerais - Facica.

### Experimental Design

It was a completely randomized design made up of 6 coffee samples (Red Catuaí/144, new World 4/376, new World Acaiá 19/474, Yellow Catuaí/62, new World 9/375, new World 19/379) with four replications for each physical, chemical, and sensory analysis.

### Statistical analysis

Results were subjected to Analysis of Variance, by means of the statistical software Sisvar (FERREIRA, 2011). Also, a tukey's test at 5% probability was applied.

### Preparing the samples

Samples were ground in a Wiley-type mill and stored in amber flasks, hermetically sealed and kept in a dry, ventilated and dark environment.

### Determination of moisture

The moisture content was determined according to the gravimetric method of the Association of Official Analytical Chemists-AOAC (2005), which consists of loss of water by dehydration, at 100-105ºC.

### Chemical analysis

### Color index

Samples of ground coffee were weighed (2 g) and placed in Erlenmeyer flasks, added with 50 mL distilled water and stirred for one hour in horizontal shaker. Subsequently, samples were filtered through filter paper. Of this filtrate, 5 mL were taken and 10 mL distilled water were added, and left to stand for 20 minutes. The reading was carried out in spectrophotometer at 425 nm absorbance, with distilled water as a blank, according to the methodology described by Silva et al. (2009). Results were expressed in CI (color intensity) at 425 nm.

The rest of the extracts were used to evaluate pH, total soluble solids and titratable acidity.

### Determination of pH

The pH was determined by glass electrode potentiometry, using a Quimis digital pHmeter, according to the technique of AOAC (2005).

### Total titratable acidity

The total titratable acidity was determined by titration of the filtrate, with a standardized solution of NaOH at 0.1 M, according to the technique of AOAC (2005). Results obtained were expressed in g of total acids per 100 g coffee powder.

### Total soluble solids

Total soluble solids were determined using a digital refractometer (Atago, PR-100 Palette) with automatic temperature setting. Results were expressed in percentage of soluble solids per 100 g coffee powder, according to AOAC (2005).

### Determination of Caffeine

Caffeine was determined by acid extraction, that is, there is a selective carbonization of organic matter in the sample with sulfuric acid releasing caffeine that was later extracted using chloroform according to the method of AOAC (2005). Results were obtained by spectrometer at 320 nm and expressed in mg caffeine per 100 g solution.

### Sensory analysis (cup test)

The conventional sensory analysis was conducted by a professional team of the Coopercam-Cooperativa dos Cafeicultores de Campos Gerais e Campo do Meio, Minas Gerais State, comprised of Judges Certificates accredited by the Specialty Coffee Association of America (SCAA).

To evaluate the coffee beverage using the range of values, it was used the methodology published by

the Specialty Coffee Association of America (SCAA) (CQI, 2009). This ranks coffee as below the special grade (classified as non-special) - with scores below 80 points; very good coffee (classified as special) - with scores from 80 to 84.99 points, excellent coffee (classified as of special origin) - with scores from 85 to 89.99 points; model coffee (classified as rare and special) - with score from 90 to 100 points.

## Results and discussion

### Total titratable acidity

The perceived acidity in coffee is an important attribute for sensory analysis. The increase in acidity has been associated with coffee fermentation during the drying process, with an inverse relationship with the quality, the higher the acidity the worse the coffee quality (MARTINEZ et al., 2013).

Mean values of total titratable acidity (NaOH 0.1 M 100 $g^{-1}$) of samples studied have no significant changes as observed in Table 1.

**Table 1.** Mean content of total titratable acidity (NaOH 0.1 M 100 $g^{-1}$) in the different cultivars of coffee roasted.

| Cultivar | Total acidity | Standard Deviation |
|---|---|---|
| Red Catuaí 144 | 1.12 A | 0.10 |
| New World 4/376 | 1.12 A | 0.10 |
| New World Acaiá 19/474 | 1.33 A | 0.27 |
| Yellow Catuaí 62 | 1.12 A | 0.10 |
| New World 9/375 | 1.12 A | 0.10 |
| New World 19/379 | 1.23 A | 0.14 |
| Standard Deviation | | 0.14 |

*Mean values followed by different uppercase letters in the columns are significantly different by tukey's test at 5% probability.

Silva et al. (2009) evaluated the chemical and sensory characterization of coffees from Chapada de Minas, in order to determine the final quality of coffees of some producer municipalities and found results (1.20-1.66 NaOH 0.1 M 100 $g^{-1}$) similar to those of the present study (1.12-1.33 NaOH 0.1 M 100 $g^{-1}$).

### pH

It is well known that pH is an indicative of eventual changes in the coffee fruit, such as undesirable fermentation that occur before or after harvesting (FRANCA et al., 2005).

According to Martinez et al. (2013) and Sivetz and Desrosier (1979) pH variations can be of great importance in product acceptance by consumers. It is recommended a pH between 4.95 to 5.20, making the coffee palatable, without excessive bitterness or acidity.

The values of pH are listed in Table 2. Only the cultivars New World 9/375 and New World 19/379 presented pH above the indicated value (5.28 and 5.30, respectively), and this coffee may present a slight excess of bitterness or acidity. The cultivar with the lowest pH was Red Catuaí 144 with 5.06.

**Table 2.** Mean values of pH in the different cultivars of coffee roasted.

| Cultivar | pH | Standard Deviation |
|---|---|---|
| Red Catuaí 144 | 5.06 A | 0.0 |
| New World 4/376 | 5.19 C | 0.0 |
| New World Acaiá 19/474 | 5.13 B | 0.0 |
| Yellow Catuaí 62 | 5.18 C | 0.0 |
| New World 9/375 | 5.28 D | 0.0 |
| New World 19/379 | 5.30 D | 0.0 |
| Standard Deviation | | 0.0 |

*Mean values followed by different uppercase letters in the columns are significantly different by tukey's test at 5% probability.

Fernandes et al. (2003) analyzed chemical constituents and contents of aqueous extract of roasted Arabica (*Coffea arabica*) and conilon coffee (*Coffea conilon*), and verified pH values between 5.87 and 6.03, all above the values found in the present study (5.06-5.30).

### Moisture

Moisture values registered herein (0.24 to 1.20%) are within the standards set by the National Agency of Sanitary Surveillance (BRASIL, 2005), which has standardized for roast coffee at most 5.0% (wb) moisture. The moisture content ranged from de 0.24% (wb), in the cultivar New World 9/375, to 1.20% (wb) in the cultivar New World 4/376, as observed in Table 3.

**Table 3.** Moisture percentage (%) in the different cultivars of coffee roasted.

| Cultivar | % moisture | Standard Deviation |
|---|---|---|
| Red Catuaí 144 | 1.00 C | 0.07 |
| New World 4/376 | 1.16 C | 0.14 |
| New World Acaiá 19/474 | 0.42 A | 0.15 |
| Yellow Catuaí 62 | 0.33 A | 0.10 |
| New World 9/375 | 0.24 A | 0.15 |
| New World 19/379 | 0.89 B | 0.12 |
| Standard Deviation | | 0.12 |

*Mean values followed by different uppercase letters in the columns are significantly different by tukey's test at 5% probability.

Fernandes et al. (2003) investigated chemical constituents and contents of aqueous extract of roasted Arabica (*Coffea arabica*) and conilon coffee (*Coffea conilon*), and verified moisture values ranging from 1.54 to 2.55%, presenting thus greater moisture in grains than in the present study (0.24 to 1.20%).

### Total soluble solids

The content of total soluble solids indicates the amount of sugars in the coffee, considering that other compounds, even at low proportions, also take part, such as for instance, organic acids, vitamins, amino acids and some phenolic pectins (KLEINWÄCHTER; SELMAR, 2010). The content

of total soluble solids provides the sweetness of coffee and is an important attribute in determining its flavor (CAMPA et al., 2004; JOET et al., 2010).

Mean content of total soluble solids in the present study are presented in Table 4, and varied from 10 to 37.5%. The result found for the cultivar New World 19/474 (30%) is close to that observed by Fernandes et al. (2003) who analyzed chemical constituents and content of aqueous extracts of roasted Arabica (*Coffea arabica*) and conilon coffees (*Coffea conilon*), and achieved 31.39% of total soluble solids.

**Table 4.** Mean content of total soluble solids (%) in the different cultivars of coffee roasted.

| Cultivar | % soluble solids | Standard Deviation |
|---|---|---|
| Red Catuaí 144 | 20.0 B | 0.0 |
| New World 4/376 | 37.5 D | 0.08 |
| New World Acaiá 19/474 | 30.0 C | 0.0 |
| Yellow Catuaí 62 | 20.0 B | 0.0 |
| New World 9/375 | 10.0 A | 0.0 |
| New World 19/379 | 37.5 D | 0.08 |
| Standard Deviation | | 0.03 |

*Mean values followed by different uppercase letters in the columns are significantly different by tukey's test at 5% probability.

Mendonça et al. (2005) investigated chemical parameters of raw and roasted coffee cultivars (*Coffea arabica*) and recorded values of total soluble solids between 24.05 and 27.89%.

Results of Mendonça et al. (2005) differ from our results (10.0-37.5%), probably due to the form of roasting the beans.

## Caffeine

The caffeine acts on the central nervous system, by stimulating the heart, by increasing its working capacity, dilating peripheral vessels (MACHADO et al., 2010). It also acts on basal metabolism and favors the production of gastric juice, aiding in digestion of food in the stomach (BAUMANN, 2006).

Lowest mean contents of caffeine were found in the cultivars Yellow Catuaí 62 and New World 9/375, both with content of 0.38%, and the highest mean content was registered in the cultivar New World 4/376 (0.50%), presented in Table 5.

**Table 5.** Mean content of caffeine (%) in the different cultivars of coffee roasted.

| Cultivar | % caffeine | Standard Deviation |
|---|---|---|
| Red Catuaí 144 | 0.40 B | 0.0 |
| New World 4/376 | 0.50 E | 0.01 |
| New World Acaiá 19/474 | 0.45 D | 0.01 |
| Yellow Catuaí 62 | 0.38 A | 0.0 |
| New World 9/375 | 0.38 A | 0.01 |
| New World 19/379 | 0.41 C | 0.0 |
| Standard Deviation | | 0.0 |

*Mean values followed by different uppercase letters in the columns are significantly different by tukey's test at 5% probability.

According to the Ordinance 377 (BRASIL, 1999), the minimum limit of caffeine for roasted coffee is 0.7%, the sample with mean content values closer to this limit was the cultivar New World 4/376 with 0.5% caffeine.

The caffeine content observed in this study can be consumed by people sensitive to caffeine, because this substance can cause agitation, anxiety, headache, and insomnia, contraction of veins and arteries, which hinders blood circulation and accelerates the heartbeat. In pregnant women, it is recommended to take little or none coffee, since it may cause fetal malformations (DESLANDES et al., 2004; MATIJASEVICH et al., 2005; SANTOS et al., 1998).

## Color index

A better quality coffee presents a high color index and a worse quality coffee has values lower than 0.70, as reported by Martinez et al. (2013).

Mean values of color index in this study ranged from 1.10 to 2.04, indicating good quality beverages (Table 6).

**Table 6.** Color index at 425 nm (CI) in the different cultivars of coffee roasted.

| Cultivar | Color index | Standard Deviation |
|---|---|---|
| Red Catuaí 144 | 1.10 A | 0.02 |
| New World 4/376 | 1.61 B | 0.06 |
| New World Acaiá 19/474 | 2.04 C | 0.01 |
| Yellow Catuaí 62 | 1.19 A | 0.02 |
| New World 9/375 | 1.16 A | 0.03 |
| New World 19/379 | 2.01 C | 0.05 |
| Standard Deviation | | 0.03 |

*Mean values followed by different uppercase letters in the columns are significantly different by tukey's test at 5% probability.

Silva et al. (2009) analyzed the chemical and sensory characterization of coffees from Chapada de Minas, aiming to determine the final quality of coffee and obtained values varying from 1.18 to 1.37, similar to those found in the present study for cultivars Yellow Catuaí 62 (1.19) and New World 9/375 (1.16).

## Sensory analysis

Significant differences were detected in sensory quality of coffee samples, as shown in Table 7.

The coffee with the lowest score was the New World 9/375 (73.5 points) followed by New World 19/379 (75.0); New World 4/376 (77.0); Yellow Catuaí 62 (79.5) and New World Acaiá 19/474 (79.5), considered as non-special coffees with scores below the special grade (< 80). The cultivar Red Catuaí 144 achieved the best result (81.5), being thus considered a very good coffee classified as special (80 to 84.99 points).

**Table 7.** Sensory analysis in the different cultivars of coffee roasted.

| Cultivar | Score | Standard Deviation |
|---|---|---|
| Red Catuaí 144 | 81.5 E | 0.0 |
| New World 4/376 | 77.0 C | 0.01 |
| New World Acaiá 19/474 | 79.5 D | 0.01 |
| Yellow Catuaí 62 | 79.5 D | 0.01 |
| New World 9/375 | 73.5 A | 0.01 |
| New World 19/379 | 75.0 B | 0.0 |
| Standard Deviation | | 0,0 |

*Mean values followed by different uppercase letters in the columns are significantly different by tukey's test at 5% probability.

## Conclusion

Coffee of the cultivars New World 4/376, New World Acaiá 19/474, Yellow Catuaí 62, New World 19/379 and New World 9/375 were classified as non-special coffees with scores below the special grade (< 80). Nevertheless, all samples presented a satisfactory quality for marketing.

The cultivar Red Catuaí 144 presented lower values of total titratable acidity and the best values of pH, which are attributes responsible for aroma and flavor of coffee. Consequently, it was considered as a very good coffee with high quality, classified as a premium coffee (80 to 84.99 points).

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