



TECHNICAL NOTE:

SENSORY AND PHYSICOCHEMICAL EVALUATION OF TRADITIONAL POWDER COFFEE

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Keywords:

coffee growing
consumer
internal preference map
quality

ABSTRACT

Coffee is one of the most important products for the Brazilian economy. Due to this fact, its sensory acceptance is extremely important for both the consumer and the producer. The objective of this study was to evaluate the acceptance of six brands of traditional roasted coffee in the southern region of Minas Gerais. The samples were evaluated by 124 consumers through the following tests: acceptance for appearance, aroma, taste, texture and overall impression, ideal for bitter taste and body and, finally, purchase intention. In addition, colorimetric and soluble solids analyses were performed. According to the results obtained, sample D had the highest frequency of positive purchase intention, while sample A had the highest frequency of negative purchase intention. Sample F had the closest ideal bitter taste and, in relation to the body of the drink, sample C was considered the closest to the ideal. Sample F presented the highest acceptance for all attributes evaluated in the acceptance test.

Palavras-chave:

mapa de preferência interno
cafeicultura
qualidade
consumidor

AValiação sensorial e físico-química de amostras comerciais de café em pó tradicional

RESUMO

O café é um dos produtos mais importantes para economia brasileira. Frente a este fato, sua aceitação sensorial é de extrema importância tanto para o consumidor quanto para o produtor. O presente estudo teve como objetivo verificar a aceitação de 6 marcas de café torrado tradicional na região do Sul de Minas Gerais. As amostras foram avaliadas por 124 consumidores por meio de testes de: aceitação para aparência, aroma, sabor, textura e impressão global, ideal para gosto amargo e corpo e, por fim, intenção de compra. Além disso, foram realizadas análises colorimétricas e de teor de sólidos solúveis. De acordo com os resultados obtidos, a amostra D obteve maior frequência de intenção de compra positiva, enquanto a amostra A, a maior frequência de intenção de compra negativa. A amostra F apresentou o gosto amargo mais próximo do ideal e quanto ao corpo da bebida a amostra C foi considerada a mais próxima do ideal. A amostra F apresentou maior aceitação para todos os atributos avaliados no teste de aceitação.

INTRODUCTION

Coffee is a product that actively participated in the economic development of Brazil, which has always been recognized as the world's largest exporter and producer of this product (PAIVA, 2005). Its production provides the generation of income and jobs, also contributing to the country's social development throughout history (RUFINO, 2006) and to family farming as well (PAIVA, 2005). There are many hypotheses about its origin, but in fact, coffee has been modified over the centuries to suit the taste of the consumer, thus becoming one of the most popular drinks in the world (GALANAKIS, 2017). The sensory quality of coffee becomes of great interest to the coffee agribusiness producer, as it will directly affect the quality and value of the drink.

Because information and knowledge about food is more accessible nowadays, the consumer market has increasingly demanded good quality products and, consequently, standardization guarantees commercial security and customer loyalty (PAIVA, 2005). The standardization of coffee depends on several factors such as, for example, the species and ripeness of the fruits and their homogeneity, the soil, production site and the available resources (GALANAKIS, 2017), as well as the post-harvest sanitary hygienic situation. In addition, the quality of the drink depends on the physical-chemical parameters that are determined through processing, such as the adequation of the roast, and the composition and purity of the raw material. The aroma, taste and appearance - sensory attributes - of the product will be directly affected by the conditions described above. These sensory attributes stand out as the most important and determinant on sensory quality, acceptance and, therefore, commercial value of the drink. Although the consumers have a greater knowledge about coffee today, many of them still maintain their sensory preference linked to customs and cultural heritage (PAIVA, 2005).

A very efficient and accurate way to assess the preference and acceptance of the consumer is to perform sensory tests. These tests are defined by ABNT (1993) as the scientific study used to evoke, measure, analyze and interpret reactions caused in humans by the characteristics of the food and the materials as they are perceived by the senses,

that is, by smell, vision, taste and touch. The tests can have as their objective to accept and evaluate a food, raw material or solutions, in the same way that they can be used to discover ideal formulations and for the improvement or development of new products (TEIXEIRA, 2009).

According to the Instituto Adolfo Lutz (2008), the ideal test verifies, from a hedonic scale, how close or distant from the ideal to the taste of the taster is the analyzed attribute. The acceptance test, in the case of the hedonic scale, allows the consumer to express in a global way or in relation to a specific attribute, the degree of liking or disliking the sample. Finally, the purchase intention test allows to verify, through attitude scales, the consumer's willingness to buy and consume the product.

In order to verify the preference and acceptance of different brands commonly sold in the south of Minas Gerais, this study was carried out based on tests of the ideal for the attributes of bitter taste and body of the drinks in question. In addition, the purchase intention, acceptance, and the physical-chemical aspect of the beverages were investigated regarding soluble solids - °Brix - and color.

MATERIAL AND METHODS

This experiment evaluated six commercial samples of 100% Arabica ground coffee, pure drink, dark roast and distinct brands, where, all were within the expiration date, stored in a dry and fresh environment and all the roasted and ground coffee samples evaluated in this work had roasted and ground coffee as their only ingredient. The samples used were produced in the cities of Barueri- SP, Ouro Fino- MG, Três Pontas- MG, Varginha- MG, Jundiá- SP and Belo Horizonte- MG in supermarkets in the cities of Itajubá and Inconfidentes in the State of Minas Gerais and later coded from A to F at random. (BRAZIL, 2010. Technical Regulation for Coffee Roasted in Grain and Coffee Roasted and Ground, Brasília, DF, November 2019).

SAMPLE PREPARATION

The coffees were strained according to the measures and preparation instructions contained

in each package. Three 1-L bottles of coffee from each sample were prepared, in which 1L of water were for the amounts of coffee powder oriented per each brand. Table 1 indicates the amount of traditional roasted and ground coffee used for each brand. Strained coffees were stored in thermo flasks and used for sensory analysis.

Table 1. Amount of coffee powder for each liter of water used following preparation instructions.

Brand	Quantity of coffee powder (g)
A	80
B	120
C	100
D	100
E	80
F	80

Source: authorial, 2019.

SENSORY ANALYSIS

Sensory analysis was carried out at the Federal Institute of Education, Science and Technology of the South of Minas Gerais – Inconfidentes campus, with the participation of 124 consumers, 45 of whom were male and 79 were female aged between 14 and 53 years old. They participated in the analysis on a voluntary basis.

The consumers performed the tests in individual booths, where they evaluated the samples and answered the available form according to what was proposed. Approximately 20 ml of each sample were served, at a temperature of approximately 70°C, in 50-ml plastic cups coded with 3 digits and with previously balanced codings. The samples of roasted and ground coffee were served without adding any sucrose or sweetener, therefore, 5-g sugar sachets as well as sweetener bottles were made available to the tasters who were instructed to sweeten the coffee samples or not, according to their preference. Consumers also had a 200-mL glass, served just over half with filtered water at room temperature used to rinse their mouths between samples.

The acceptance test was applied to the tasters

with attributes such as appearance, aroma, flavor, texture and global impression with a 9-point structured hedonic scale, the ends of which correspond to disliked very much (1) and liked very much (9) (LIM, 2011; DUTCOSKY, 2013). The ideal test was applied to evaluate the attributes bitter taste and body, evaluated by means of the structured scale (where -4 corresponded to extremely less than the ideal and +4 to extremely more than the ideal) (STONE; SIDEL, 2004). The purchase intention test was also carried out, using a structured five-point scale ranging from “I certainly would not buy it” to “I would certainly buy it” (MEILGAARD *et al.*, 2016).

PHYSICO-CHEMICAL ANALYSIS

COLOR

The analysis to quantify the color of the coffee samples (strained) was carried out in the Sensory Analysis Laboratory of the Federal Institute of Education, Science and Technology of the South of Minas Gerais – Inconfidentes campus. The analysis was performed using the colorimeter CM-2300 Konica Minolta model previously calibrated with D65 illuminant, on a white surface. The results were obtained from the CIE System ($L^*a^*b^*$), where L^* represents the luminosity, varying from black to white (values from 0 to 100), a^* varies from green to red (values from -120 to 120) and b^* varies from blue to yellow (values from -120 to 120). Color analyses were performed in triplicate for each sample.

TOTAL SOLUBLE SOLIDS (TSS)

The analysis of the total soluble solids content was also carried out at the Federal Institute of Education, Science and Technology of the South of Minas Gerais – Inconfidentes *campus*, in the bromatology laboratory on the strained coffee samples and carried out using the refractive index of each sample, in °Brix. The soluble solids content was measured with an Atago digital refractometer

(Pocket Refractometer PAL-1). With the aid of a dropper, approximately 2 drops of each sample were added to the refractometer reader and the reading proceeded. The TSS analyses were performed in triplicate for each sample and the refractometer reader was washed with distilled water.

STATISTICAL ANALYSIS

The analysis of the results of the sensorial analysis and of the physical chemical analysis, was applied to the software Sensomaker® (PINHEIRO *et al.*, 2013). The software then provided the data analyzed using the Tukey's Test at the level of 5% significance and the external preference map that correlates the results of the physical-chemical analyses and the overall impression with the samples of traditional powdered coffee.

RESULTS AND DISCUSSION

Table 2 shows the means, the standard deviation and the differences in the results at the 5% level of significance by the Analysis of Variance (ANOVA) and the test of Tukey, according to the scores given by the tasters regarding the attributes appearance, aroma, flavor, texture and overall impression.

As for appearance, sample C showed the highest average value, therefore it was the most accepted by the tasters, whereas sample D showed the lowest acceptability. Samples A, B, E and F showed no difference at the 5% level of significance ($p \leq 0.05$) for appearance. Sample E presented the highest mean for acceptance, out of the values attributed

by consumers, for the aroma attribute, and the lowest mean given by the tasters was for sample C; samples D, E, and B did not present significant difference between them. As for flavor, sample E had the highest acceptance among tasters, on the other hand, sample C had the least accepted flavor. Regarding texture, there was no significant difference ($p \leq 0.05$) for samples A, B, C, D, E and F, however, sample B presented the highest mean in relation to this attribute.

The overall impression is the parameter referring to the general aspect of all attributes evaluated by the tasters during the sensory analysis. The D and E brands had the highest average overage impression values; therefore, they were the most accepted samples regarding this attribute. According to Passos *et al.* (2015) the flavor and aroma attributes have the greatest influence on the overall impression of coffee drinks. Comparing the statement by Passos *et al.* (2015) with the present work, a conformity between these parameters is observed since the brands with the highest values for aroma and flavor have the highest scores in the global impression.

The results obtained through the purchase intention test, which was carried out using a structured verbal scale, are plotted in the Figure 1 below, where the percentages found for each sample for the hedonic scale parameters are indicated.

It should be observed the sample that obtained the highest frequency of positive purchase intention was that referring to brand D, which pointed out

Table 2. Data obtained through Analysis of Variance (ANOVA) and the test of Tukey for parameters of appearance, aroma, flavor, texture and overall impression.

Samples	Appearance	Aroma	Flavor	Texture	Overall impression
A	7.200±2.121 ^{ab}	6.447±2.987 ^{abc}	5.488±5.072 ^{abc}	6.097±3.909 ^a	6.145±3.296 ^a
B	6.840±2.681 ^{ab}	6.065±3.880 ^{ab}	5.276±5.267 ^{ab}	6.976±3.845 ^a	5.774±4.355 ^a
C	7.380±2.258 ^a	5.805±4.289 ^c	5.146±5.028 ^c	6.260±3.099 ^a	5.750±4.059 ^a
D	6.590±2.931 ^b	6.634±3.332 ^{bc}	5.959±5.892 ^{bc}	6.274±3.420 ^a	6.322±3.586 ^a
E	7.050±1.785 ^{ab}	6.894±2.767 ^a	6.146±4.584 ^a	6.411±3.252 ^a	6.387±3.670 ^a
F	7.070±2.389 ^{ab}	6.569±2.263 ^{bc}	5.740±4.424 ^{abc}	6.363±3.339 ^a	6.218±3.001 ^a

*Means followed by at least one equal letter in the same column do not differ from each other the level of 5% ($p < 0.05$) of significance by the test of Tukey.

Source: authorial, 2019.

the highest occurrence of “certainly would buy” and “probably would buy”, totaling 42.752%. The brand referring to sample B was the one that obtained the highest occurrence of “certainly would not buy” and “probably would not buy” during the acceptance test, presenting a total of 50.806%. It can also be seen through the graph that sample A was the one that had the highest occurrence of “maybe buy”, indicating indecision among the tasters.

As it was previously mentioned, sample D showed the highest positive purchase intention and also had the second highest average in the acceptance test in the overall impression parameter,

that is, the acceptance of a given product is related to the purchase intention in the consumer market. This result was also found by researchers who applied the purchase intention and acceptance test (ESCOPELLI *et al.*, 2016).

The results of the Analysis of Variance (ANOVA) and the test of Tukey, according to the test of the ideal are plotted in Table 3, which shows the values of the means, the standard deviation, in addition to the differences at the level of 5% of significance among the samples.

As for the ideal bitterness, samples F and A showed no difference at the level of 5% of significance ($p \leq 0.05$). These samples were those that obtained mean values closer to zero, indicating

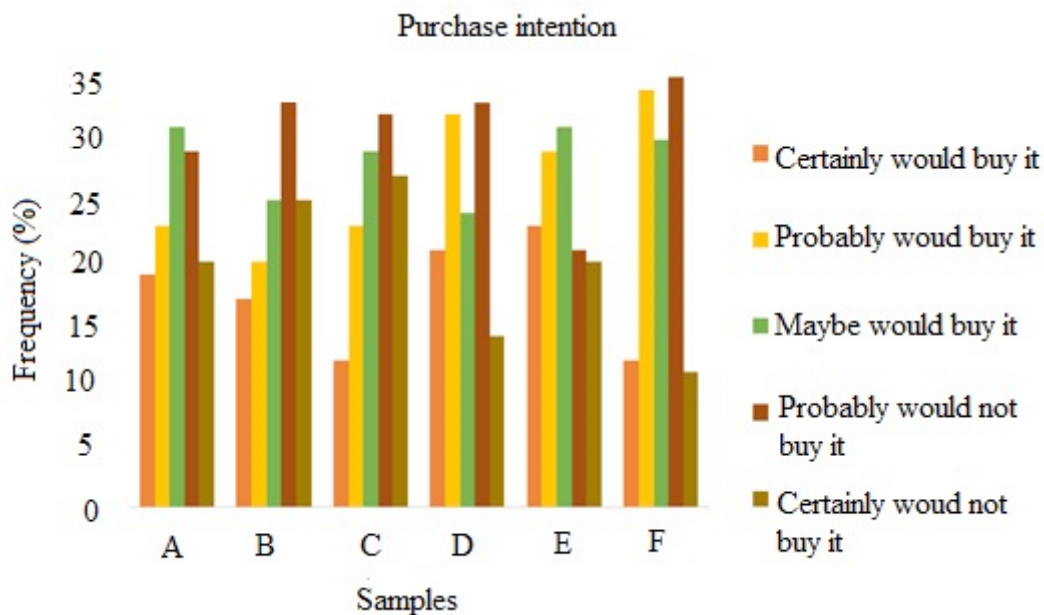


Figure 1. Distribution of the frequency of intention to purchase samples of commercial coffee.

Table 3. Data obtained through the results of the Analysis of Variance (ANOVA) and the test of Tukey, according to the test of the ideal.

Samples	Ideal Bitterness	Ideal body
A	0.258± 3.510 ^b	-0.629± 2.235 ^a
B	0.476± 4.560 ^{ab}	-0.661± 2.746 ^a
C	1.000± 5.089 ^a	-0.145± 3.832 ^a
D	0.363± 3.810 ^{ab}	-0.653± 2.505 ^a
E	0.411± 3.333 ^{ab}	-0.548± 2.428 ^a
F	0.202± 3.349 ^b	-0.621± 2.221 ^a

*Means followed by at least one equal letter in the same column are not different from each other at the 5% significance level ($p \leq 0.05$) by the test of Tukey.

Source: authorial, 2019.

greater proximity to the ideal bitter taste. On the other hand, sample C obtained the highest average among the samples, distancing itself from the ideal bitterness required by the tasters. All samples showed positive values, indicating bitter taste above the ideal.

According to Arruda *et al.* (2009), the negative evaluation of flavor is related to the bitter taste of coffee. Regarding the flavor attribute, sample C presented the lowest mean by the test of Tukey, so it was the sample with the least accepted flavor among consumers, and in relation to ideal bitterness, sample C showed the greatest distance from the ideality.

Although the samples did not differ significantly ($p \leq 0.05$) by the test of Tukey, for the ideal body, the sample that came closest to ideality was sample C, as it obtained the mean closest to zero. Samples B, D, A and F obtained means that were more distant from zero, indicating less ideality regarding the coffee body. The negative values of the means show that the tasters considered the samples with bodies less than the ideal.

Sample C was the closest to ideality in relation to the body. This fact may be related to the high content of lipids in Arabica beans, which, together with protein macromolecules, contribute to the development of the body, indicating a good quality coffee (AZEVEDO, 2013).

PHYSICOL-CHEMICAL ANALYSIS

The mean values of the parameters found through the analysis of the samples in colorimeter and soluble solids are shown in Table 4.

For all obtained L* parameters, it was not possible to observe significant differences ($p \leq 0.05$). The coffees are classified as traditional. According to Schmidt, Milioranza and Prudêncio (2008), traditional coffees have a medium dark roast. According to Pires (2017), these luminosity values refer to the degree of average roasting, in addition, the literature reports that there is an inverse relationship between the values of L* and the roasting degree.

The direct association of the parameters a* and b* should not be directly correlated, since the polar coordinates L*, C* and H* allow a more adequate interpretation of the color variation (EUGÊNIO, 2010).

The C* parameter refers to the color intensity. According to the results obtained, the values are between 0.819 to 6.178. In the dissertation written by Eugênio (2010), the color intensity for roasted and ground coffee ranges from 26 to 29. The monochromatic intensity is given by the value of H*. According to Oliveira, *et al.* (2014) the values found for this parameter of *Coffea arabica* with moderately dark roasting were between 24 to 41.

The average values of the parameters found through the analysis of soluble solids are shown in Table 5.

Table 4. Mean values and standard deviation of parameters L*, a*, b*, C* and H of the samples.

Sample	L*	a*	b*	C*	H*
A	24.467 ± 0.001 ^a	1.243 ± 0.013 ^e	-0.163 ± 0.008 ^d	1.254	-7.463
B	24.780 ± 0.024 ^a	2.703 ± 0.021 ^d	0.610 ± 0.007 ^c	2.771	12.735
C	24.390 ± 0.000 ^a	0.757 ± 0.008 ^f	-0.313 ± 0.000 ^d	0.819	-22.441
D	25.170 ± 0.031 ^a	4.080 ± 0.008 ^b	1.217 ± 0.000 ^b	4.258	16.278
E	25.870 ± 0.003 ^a	5.680 ± 0.004 ^a	2.430 ± 0.004 ^a	6.178	23.171
F	26.650 ± 9.728 ^a	3.337 ± 0.096 ^c	1.153 ± 0.160 ^b	3.531	19.086

* Means followed by at least one same letter in the column are not significantly different from each other at the level of 5% of significance ($p < 0.05$) by the test of Tukey.

Source: authorial, 2019.

Table 5. Mean values and standard deviation of soluble solids ($^{\circ}$ Brix).

Samples	Total Soluble Solids ($^{\circ}$ Brix)
A	2.000 \pm 0.000 ^a
B	1.433 \pm 0.093 ^{ab}
C	1.633 \pm 0.143 ^{ab}
D	1.500 \pm 0.090 ^{ab}
E	1.033 \pm 0.003 ^b
F	1.400 \pm 0.070 ^{ab}

* Means followed by at least one same letter in the column do not differ from each other at the 5% significance level ($p < 0,05$) by the test of Tukey.

Source: authorial, 2019.

The highest mean obtained for total soluble solids was for sample A and sample E had the lowest mean value. Samples B, C, D and F showed no significant difference ($p < 0,05$) between themselves and samples A and E. While samples A and E, at the 5% level of significance, differed from each other.

The data found by Faria (2010) through the determination of soluble solids, at an approximate temperature of 10 $^{\circ}$ C, was 17.9 $^{\circ}$ Brix, on average. The variation between the data obtained in this work and those found in the reference can be related to the concentration used in the infusion and the degree of roasting of the analyzed coffee, where the relationship between the number of soluble solids and degree of roasting is inversely proportional.

According to Durán *et al.* (2017), melanoidins are from proteins or amino acids and reducing sugars or from carbohydrate dehydration followed by polymerization reaction. Melanoidins are brown-

colored macromolecular pigments and products of the Maillard reaction. A large part of the mono and disaccharides and some of the polysaccharides of the green coffee bean are degraded by the heating in the production of roasted coffee.

PREFERENCE MAP

The reference map of the coffee samples is represented in Figure 2, where the samples are identified with their respective numerations.

Through the preference map, it was possible to observe that the sample that presented the most preference among those consumed was the sample F, since it was the one that remained closest to the highest concentration of the vectors, which represent the consumers. Samples D, E and A showed an intermediate distance and samples B and C were the most distant from the vector concentration.

According to Mamede (2010), the countries have

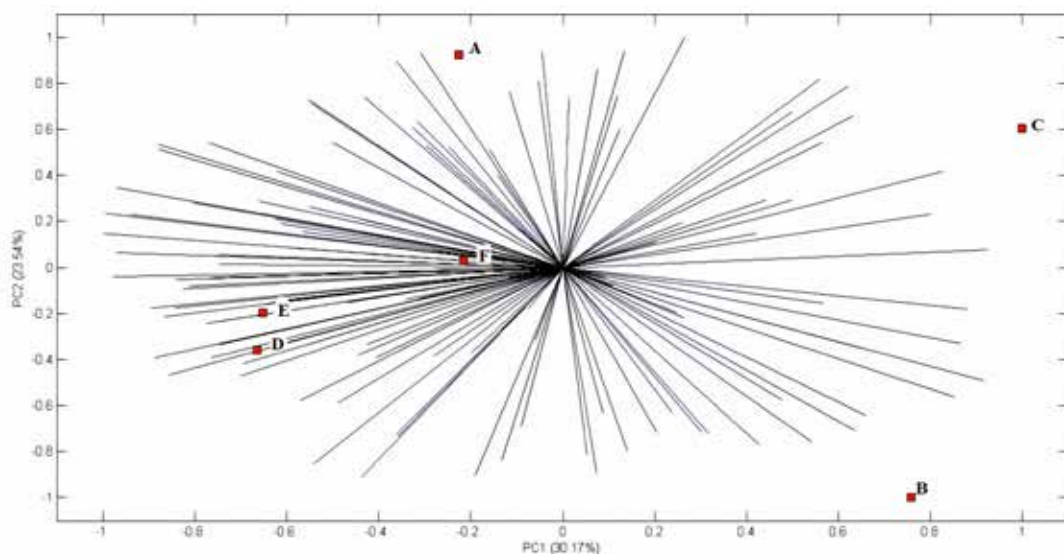


Figure 2. Reference map for coffee samples.

their specific consumer market and consequently their own appreciated particularities. Thus, through the comparison of the ideal bitterness together with the built preference map, consumers preferred the sample F, which has the closest ideal bitterness and located in the region closest to the concentration of vectors. In contrast, samples B and C, which had the most distant bitterness, were the samples that most distanced themselves from the concentration of vectors, thus being the least preferred samples among consumers

CONCLUSION

- It can be concluded from the analysis of the results that the sample E was the one that presented the highest average in the attributes flavor and aroma, which are the factors of greatest influence in the overall impression, consequently in the acceptance;
- Through the purchase intention test, it can be analyzed that the brand referring to sample D was the one that obtained the most favorable frequency of purchase. In contrast, sample A showed a higher negative frequency of purchase;
- It can also be concluded that all samples were below the ideal for body and above the ideal for bitter taste;
- It can be seen Through the preference map that the sample that obtained the highest preference index was sample F.

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