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Do consumers perceive sensory differences by knowing information about coffee quality?

Carla Martino Bemfeito *, Angélica Sousa Guimarães, Alberto Lima de Oliveira, Bruna Fernandes Andrade, Luiza Maria Amaral Frossard de Paula, Carlos José Pimenta

Federal University of Lavras, Department of Food Science, DCA/UFLA, Lavras, MG, Brazil

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ABSTRACT

Coffee is a very complex drink, with different sensory characteristics, which directly influences in its acceptance. In general, the coffee quality assessments by experts do not correspond to consumer preferences. This study aimed to assess consumers' sensory response to coffee treatments classified as special and non-special (by *cuppers*), with different roasts (light and dark), in sensory tests with and without information about quality, type of roasting and price of coffees. *Check-All-That-Apply* (CATA) and acceptance tests were performed to evaluate the treatments. In CATA analysis, without information, only one attribute was significant to differ the treatments ($p < 0.05$). Contrastly, in CATA analysis with information, nine attributes were detected that contributed to the differentiation between the special coffees with light roasting and the other coffees. There was no significant difference between the treatments ($p > 0.05$) in the acceptance tests without information, for the flavor and overall acceptance attributes. In general, the scores assigned to special coffees were higher than those assigned to non-special coffees, in the acceptance tests with information. Therefore, the characteristics of special coffees can be used as a marketing strategy by industries, to increase theirs sales and to optimize the consumers' sensory experience with the drink.

1. Introduction

Coffee is a drink of extreme global and cultural economic importance (Belchior, Botelho, Oliveira, & Franca, 2019) and chemical and perceptibly very complex, since it is estimated to contain around 1000 volatile aromatic compounds. Factors such as plant variety, processing methods, speed and level of roasting, among others, directly insert sensory attributes to coffee, producing a variety of characteristics in terms of body, aroma and flavor (Carvalho & Spence, 2018; Di Donfrancesco, Guzman, & Chambers, 2014).

The physical aspects of the beans and the sensory quality are decisive for the classification of coffees. The physical aspects are related to the defects of the beans, foreign matter, unpleasant odor, color, size and shape of the beans. Sensory quality is associated with the attributes of the drink, which is differentiated by the sensorial sensitivity of expert tasters (called *cuppers*), using specific methods and protocols (Belchior et al., 2019). The classification of sensory quality consists of tasting three to ten cups of coffee, prepared under standard conditions, and assigning a score ranging from 0 to 10 for the attributes of flavor, aftertaste, aroma/fragrance, acidity, body, balance, uniformity, clean cup, sweetness, defects and global assessment (Giacalone et al., 2019; Iso, 2008; Scaa, 2009).

However, despite the wide application of these methods and sensory protocols established for the classification of coffees, the consumer does not always choose coffees with the highest quality. For the sensory quality of food in general, empirical evidence points to the disconnect between consumer preferences and the assessment of quality by food professionals. Consumers often like products that specialists consider to be of low quality (Delgado & Guinard, 2011; Sáenz-Navajas, Ballester, Pêcher, Peyron, & Valentin, 2013; Sáenz-Navajas et al., 2015). This is probably because average consumers may not have access to or experience with more refined and sophisticated examples of specific products and, therefore, may not have the frame of reference needed to assess food quality (Lawless, 1995). Thus, the specialized sensory technique for the classification of coffee has been questioned, since the coffee quality assessments by experts do not necessarily correspond to consumer

* Corresponding author. Department of Food Science, Federal University of Lavras, University Campus, Postal Code 3037, CEP 37200-900, Lavras, Minas Gerais, Brazil.
E-mail address: carlamartinobemfeito@gmail.com (C.M. Bemfeito).

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preferences (Giacalone et al., 2019; Giacalone, Fosgaard, Steen, & Munchow, 2016).

In addition, the multisensory experience encompasses the integration of information from all the senses, involving what we see, hear, touch and smell orthonically. Therefore, both the physical-chemical characteristics of the food such as color, shape and texture, and the extrinsic characteristics, such as packaging, influence the hedonic judgments (Carvalho & Spence, 2018).

According to Chen and Hu (2010), coffee consumption is not just a matter of getting functional value, but also symbolic value. Although the traditional customer value judgment on attributes of quality of service based on functional value are important, customers also realize the symbolic value that reflects the social, emotional, aesthetic and reputation aspects of quality of service attributes during coffee consumption in a coffee outlet. Therefore, for marketers to ensure positive customer perceived value, it is important to gain knowledge of what customers deem as important when evaluating the coffee consumption experience.

In this context, it is important to carry out further studies to prove whether consumers really have greater acceptance for coffees considered to be of lower quality, as well as assessing which sensory attributes are important in this choice and whether informations about quality and price of coffees can interfere in the acceptance of these products.

Therefore, this study aimed to assess consumer acceptance for coffees produced from beans with different qualities and submitted to different roasting times; characterize the sensory profile of coffees using the descriptive method Check-All-That-Apply (CATA); and assess consumer behavior when receiving information about the quality, type of roasting and price of coffees.

2. Materials and methods

The experiment was carried out in the quality laboratory of the company Café Campos Altos, located at Fazenda Serrinha, in Campos Altos, Minas Gerais, Brazil and in the laboratories of Sensory Analysis and Development of New Products, of the Department of Food Science, from the Federal University of Lavras (UFLA), Lavras, Minas Gerais, Brazil.

2.1. Coffee production and processing

The samples of green coffee were obtained from a producer in the region of Campos Altos/MG, Brazil, all referring to arabica coffee from the 2018 harvest.

The coffees were processed in the quality laboratory of the company Café Campos Altos, located at Fazenda Serrinha, in Campos Altos/MG, Brazil.

The roasting process was carried out in a roaster, 5 kg Gold model (Atilla, Belo Horizonte, Brazil), equipped with a film collecting cyclone and a heat suction turbine. The temperature was set at 150 °C for the inlet and at 200 °C for the outlet of the roaster. The roaster was set to 200 °C, and the coffee beans were added when the temperature reached 150 °C in the drum. After the roasting process, the beans were cooled by the suction turbine until reaching a temperature of 36 °C and were left to stand at room temperature for 24 h. The beans were then ground in a mill (Carmomaq, Espírito Santo do Pinhal, Brazil), all of which were set to medium bean size. The first 15 g of ground coffee that left the mill were discarded, to ensure the purity of each treatment.

2.2. Sensory classification of coffees by cuppers

The coffee produced at Café Campos Altos company were subjected to sensory evaluation for classification into special and non-special coffees. This sensory evaluation was carried out by 4 trained specialists and the classification of the coffees followed the SCAA (Specialty Coffee Association of America) protocol (Scaa, 2009).

According to this protocol, 11 sensory attributes of coffees were evaluated: fragrance and aroma; flavor; aftertaste; acidity; body; balance; sweetness; clean cup; uniformity; overall; defects. A score was assigned for each evaluated attribute. The values assigned to the positive atributes (fragrance and aroma; flavor; aftertaste; acidity; body; balance; sweetness; clean cup; uniformity; overall) were added to obtain the total score. Then, the value assigned to the Defect attribute was subtracted from the total score, to obtain the final score. The coffee must reach the minimum final score of 80 points to be considered special.

2.3. Experimental treatments

The experimental treatments consisted of four types of coffee, including two different levels of quality (special coffee and non-special coffee) and two different levels of roasting (light roasting and dark roasting).

The coffees with different levels of quality (special and non-special), were obtained by the selection of coffees that had been submitted to sensory evaluation in the company Café Campos Altos, according to the methodology described in section 2.2 (sensory classification of coffees by cuppers). The special coffee selected for this study obtained a final score equal to 85 and the non-special coffee obtained a final score equal to 73. The scores assigned to each sensory attribute of the special and non-special coffees were shown in Table 1.

The two different levels of roasting (light roasting and dark roasting) were obtained by varying the heating time during the coffee roasting process (according to the methodology described in section 2.1 - coffee production and processing). The coffee with light roasting was obtained after a 9 min roasting process and the coffee with dark roasting was obtained by going through a 14 min roasting process.

The four treatments were evaluated twice by consumers: in the first moment, blind tests (without information about the treatments) were carried out and, in a second moment, sensory tests were carried out with information related to the quality of the coffee (special or not), type of roasting (light or dark) and estimated price (USD 1.68/500 g for non-special coffee and USD 3.35/500 g for special coffee). These values were defined based on the commercialization of this product by local producers.

2.4. Preparation of coffee samples

The preparation of coffee samples for each treatment was carried out by percolation, using a paper filter, following the ratio of 50 g of coffee powder to 0.5 L of mineral water at 92 °C, as described in the ABIC PQC quality method (Abic, 2018).

During the performance of sensory tests, coffee samples from different treatments were served at a temperature ranging from 60 to 70 °C, as several studies revealed that most consumers prefer to consume coffee in this temperature range (Borchgrevink, Susskind, & Tarras, 1999; Lee & O'Mahony, 2002).

Table 1
Scores assigned to each sensory attribute evaluated for the special coffee and non-special coffee analysed in this study.

Attributes	Special coffee	Non-special coffee
Fragrance and aroma	8.00	6.75
Flavor	8.00	6.75
Aftertaste	8.00	6.25
Acidity	7.75	7.00
Body	7.75	6.75
Balance	8.25	6.75
Sweetness	9.00	8.00
Clean cup	10.00	10.00
Uniformity	10.00	8.00
Overall	8.25	6.75
Defects	0.00	0.00
Final Score	**85**	**73**

2.5. Sensory analysis: Check-All-That-Apply (CATA) and acceptance test

The project was previously approved by the Human Research Ethics Committee of Federal University of Lavras/MG, Brazil (number: 13106219.8.0000.5148). A consent was obtained for experimentation with human subjects. The privacy rights of human subjects were observed.

The *Check-All-That-Apply* (CATA) and the acceptance tests were performed according to Jorge et al. (2015), with some modifications. The survey of the CATA attributes was defined in a focus group, performed with 12 regular coffee consumers (minimum consumption frequency: at least once a day), who identified the coffee's attributes, grouped by appearance, aroma and flavor. For the focus group, the treatments referring to special coffee with light roasting and non-special coffee with dark roasting were evaluated. Subsequently, the list of the most relevant attributes cited in the focus group was complemented with some attributes raised by Giacalone et al. (2019) (Table 2).

About 106 coffee consumers were recruited to perform the CATA and acceptance tests. The recruitment goal was to only include regular consumers of coffee (consumption frequency: at least once a day), over the age of 18, and with an interest in participating in the study. Consumers were recruited either by being personally invited or through posters pasted on murals at the Federal University of Lavras. The number of consumers that participated of this study seems reasonable for obtaining a reliable characterization and the acceptance scores for the samples, since it was aligned with the usual number of consumers considered in hedonic tests (100–120) (Hough et al., 2006) and in highly reproducible CATA tests (100–200) (Ares et al., 2014).

The tests were conducted in a single session, in individual booths with proper lighting and with absence of interferences such as noise and odors. Initially, blind tests were performed, without providing information on differences in quality, type of roasting and price of the four treatments. Subsequently, the tests were performed again, providing information regarding the drink (coffee quality: special and non-special; type of roasting: light and dark; and price). Among the sensory tests, tasters were asked to clean the palate with water and wait for the time necessary to eliminate any residual flavor from the drink. The tasters evaluated the samples referring to the four treatments (about 40 mL each), placed in plastic cups encoded with three-digit numbers, presented in a monadic manner and according to the balanced order proposed by Wakeling and Macfie (1995).

Before beginning the analysis, the tasters were instructed to read the list of attributes present in the sensory analysis form. Then, after tasting the samples of the treatments, they were asked to point out the attributes that, in their judgment, were appropriate to describe each treatment in terms of appearance, aroma and flavor. It was emphasized to the tasters that there was no fixed number of attributes to be selected, and one or more attributes could be assigned, according to their opinion (Varela & Ares, 2012). Along with the CATA test, they were also asked to evaluate how much they liked or disliked the samples, in terms of appearance, aroma, flavor and overall acceptance, through the acceptance test, using a 9-point structured hedonic scale, ranging from 1 (I really disliked it) to 9 (I really liked it) (Stone & Sidel, 2006).

Table 2
List of atributes raised for use in the CATA sensory test (term in the original language (Portuguese) provided to the consumers, followed by the term in English).

Aparência - Appearance	Aroma - Aroma	Sabor - Flavor
Cor marrom - Brown color	Queimado - Burnt	Gosto doce - Sweet taste
Uniforme - Uniform	Torrrado - Roasted	Gosto ácido - Sour taste
		Gosto amargo - Bitter taste
		Sabor residual - Aftertaste
		Sabor adstringente - Astringent flavor
		Sabor químico (medicamento) - Chemical flavor (medicine)
		Sabor frutado - Fruity flavor
		Sabor fermentado - Fermented flavor
		Sabor de chocolate - Chocolate flavor
		Sabor de terra - Earthy flavor
		Sabor suave - Mild flavor
		Sabor intenso - Intense flavor

2.6. Statistical analysis

For the analysis of CATA data, the frequency of citing each characteristic within each attribute (appearance, aroma and flavor) was verified by counting the number of times that each characteristic was used by consumers for each treatment, generating a contingency matrix. The significant differences between treatments for each characteristic were found in the contingency matrix, using the Cochran's Q test (Meyners, Castura, & Carr, 2013).

The correspondence analysis was calculated in the contingency matrix in order to determine the similarities and differences between the treatments, with a two-dimensional representation of the treatments and the characteristics associated with the appearance, flavor and aroma attributes being constructed. These analyzes were performed using the XLSTAT software (Addinsoft).

The acceptance test data was evaluated by analysis of variance, followed by the Scott-Knott test at 5% probability level ($p < 0.05$), to verify whether there was a difference between treatments, in blind tests and in tests with information. Data analysis was performed using the SISVAR 5.6 software (Ferreira, 1998, p. 19).

3. Results and discussion

3.1. Sensory analysis

3.1.1. Check-All-That-Apply (CATA)

Table 3 represents the Contingency Table with the frequency of

Table 3
Contingency table for the treatments in the blind tests, with p value of the Cochran's Q test for the attributes.

Attributes/ Characteristics	Treatments[a]				p value
	S-LR-b	S-DR-b	NS-LR-b	NS-DR-b	
Appearance					
Brown color	69	70	76	70	0.615
Uniform	60	64	60	67	0.585
Aroma					
Burnt	18	26	24	28	0.321
Roasted	51	50	50	46	0.883
Flavor					
Sweet taste	17	10	12	11	0.407
Sour taste	16	13	21	23	0.144
Bitter taste	58	62	63	62	0.882
Aftertaste	18	25	24	25	0.494
Astringent flavor	10	10	9	12	0.909
Chemical flavor (medicine)	16	8	9	12	0.257
Fruity flavor	9	9	2	5	0.110
Fermented flavor	8	4	7	5	0.611
Chocolate flavor	21	13	2	2	<0.0001*
Earthy flavor	8	9	10	7	0.881
Mild flavor	27	20	22	17	0.378
Intense flavor	26	31	27	29	0.840

* Indicates significant difference at 5% ($p < 0.05$).
[a] Treatments: S-LR-b: Special Light Roasting without information (blind test); S-DR-b: Special Dark Roasting without information; NS-LR-b: Non-Special Light Roasting without information; NS-DR-b: Non-Special Dark Roasting without information.

citing the attributes and the p value of the Cochran's Q test ($p < 0.05$) for the treatments in the blind tests, without information about the coffees.

According to Cochran's Q test (Table 3), there was no significant difference ($p > 0.05$) for 15 of the 16 characteristics referring to the attributes listed in the CATA (Table 2), not contributing to discriminate the treatments without information about quality, type of roasting and price of the coffees. Only the sensory characteristic "chocolate flavor" showed a significant difference ($p < 0.05$) between the treatments, being most frequently cited for the special coffee with light roasting, followed by the special coffee with dark roasting. Non-special coffees, however, presented a lower frequency of citing this characteristic (Table 3).

In the results of CATA test without information (Table 3), consumers used some characteristics that are considered defects by specialists to describe the special coffees, which reinforces the idea that the specialized sensory classification can be questioned and, many times, does not correspond to consumer preferences (Giacalone et al., 2016, 2019).

When consumers tasted the samples again and received information about the quality, type of roasting and price of the coffees, there was a change in their descriptions for the CATA test.

Table 4 shows the frequency of citing the attributes (Contingency Table) and the p value of the Cochran's Q test ($p < 0.05$) for the treatments in the tests with information about the coffees.

According to Cochran's Q test (Table 4), there was no significant difference ($p > 0.05$) between treatments for 7 characteristics of the evaluated attributes, which did not contribute to differentiate the treatments. Contrastly, there was a significant difference between treatments for 9 characteristics of the attributes listed in CATA ($p < 0.05$), with one characteristic of the aroma attribute (burnt), eight of the flavor attribute (sweet and bitter taste, aftertaste, chemical, fruity, chocolate, mild and intense) and no characteristic of the appearance attribute.

Fig. 1 shows the correspondence analysis graph applied to the Contingency Table (Table 4), using only the significant attributes for the treatments discrimination, in the tests with information. The first and second dimensions represented, respectively, 82.14% and 15.22% of the variability of the experimental data (97.36% in total). The aroma and flavor attributes were relevant to describe and discriminate the treatments.

Table 4
Contingency table for the treatments in the tests with information, with p value of the Cochran's Q test for the attributes.

Attributes/ Characteristics	Treatments[a]				p value
	S-LR-i	S-DR-i	NS-LR-i	NS-DR-i	
Appearance					
Brown color	74	74	76	67	0.347
Uniform	64	66	54	67	0.077
Aroma					
Burnt	14	23	23	42	<0.0001*
Roasted	41	58	47	50	0.076
Flavor					
Sweet taste	32	14	17	7	<0.0001*
Sour taste	21	18	16	21	0.791
Bitter taste	38	58	63	68	<0.0001*
Aftertaste	20	20	27	35	0.018*
Astringent flavor	7	8	11	13	0.381
Chemical flavor (medicine)	8	5	17	13	0.020*
Fruity flavor	22	9	9	2	0.000*
Fermented flavor	5	5	4	8	0.484
Chocolate flavor	33	14	2	1	<0.0001*
Earthy flavor	3	6	7	4	0.528
Mild flavor	47	19	31	15	<0.0001*
Intense flavor	20	43	21	38	<0.0001*

* Indicates significant difference at 5% ($p < 0.05$).
[a] Treatments: S-LR-i: Special Light Roasting with information; S-DR-i: Special Dark Roasting with information; NS-LR-i: Non-Special Light Roasting with information; NS-DR-i: Non-Special Dark Roasting with information.

Consumers were able to detect sensory differences between treatments, separating them into two groups along the first dimension: one group with special coffees with light roasting (S-LR-i treatment) and the other group, with special coffees with dark roasting and non-special coffees with light and dark roasts (treatments S-DR-i, NS-LR-i and NS-DR-i) (Fig. 1).

The special coffee with light roasting was characterized by a sweet taste; mild, fruity, and chocolate flavors (Fig. 1). The second group, including the special coffee with dark roasting and non-special coffees with light and dark roasts, was characterized by a burnt aroma; bitter taste, and aftertaste; intense, and chemical (medicine) flavor (Fig. 1).

After informing consumers about the treatment related to the special coffee with dark roasting (S-DR-i), this treatment was grouped with non-special coffees. This is possibly justified by the dark roasting, which may have masked some characteristics of the coffee. Roasting is one of the most complex stages of coffee production, as it involves several chemical reactions that alter the organoleptic properties of the drink, such as aroma and flavor. The thermal treatment of the beans leads to Maillard reactions, occurring the formation of compounds called melanoidins, which influence the sensory characteristics of coffee. These compounds produce flavors (malt, caramel, roasted, etc.) and pleasant aromas, but also some unpleasant flavors and aromas (bitter, burnt, etc.) (Kucera, Papousek, Kurka, Barták, & Bednár, 2016).

Therefore, when consumers received informations about the treatments, they performed a sensory evaluation of the products in a more judicious way and some characteristics that were previously unnoticed become striking to differentiate the quality between coffees. According to Carvalho and Spence (2018), both the physical-chemical characteristics of the food, such as color, shape and texture, and the extrinsic characteristics, such as packaging, influence the hedonic judgments. This justifies the influence that the informations about coffees had on consumers' sensory evaluation.

3.1.2. Acceptance test

There was a significant difference ($p < 0.05$) between treatments in blind tests, without information (S-LR-b; S-DR-b; NS-LR-b; NS-DR-b), for the acceptance of the attributes of appearance and aroma. However, there was no significant difference ($p > 0.05$) between treatments for the acceptance in relation to the attributes of flavor and overall acceptance, in the blind tests (Table 5).

In general, when the tasters did not know the information about the quality, type of roasting and price of the coffees, they evaluated the treatments in a similar way, with no evidence of differences between them in terms of flavor and overall acceptance. This result is in line with the CATA descriptive test (Table 3), in which most of the characteristics of the attributes were mentioned in a similar way for all treatments.

Regarding the acceptance of the appearance attribute, the NS-DR-b treatment, related to the non-special coffee, submitted to the slowest roasting process (dark roasting), was the one that obtained the least acceptance, when compared to the acceptance scores obtained by the other treatments. Regarding the acceptance of the aroma attribute, the S-LR-b treatment, referring to the special coffee, submitted to the fastest roasting process (light roasting), was the one that obtained the greatest acceptance.

The lowest average score obtained by the NS-DR-b treatment (non-special coffee with dark roasting, in the blind test, without information), in relation to the acceptance of the appearance attribute, when compared with the scores of the other treatments in the blind tests, possibly was due to the perception of some characteristic related to the slower roasting process. However, this result was different from that obtained by Monteiro, Minim, Da Silva, and Chaves (2010), who perceived a greater consumer preference for dark-roasted coffee than for light-roasted coffee, in relation to the attributes of color, aroma, flavor and overall acceptance, when evaluating the influence of roasting on coffee acceptance.

The greater acceptance obtained by the S-LR-b treatment (special

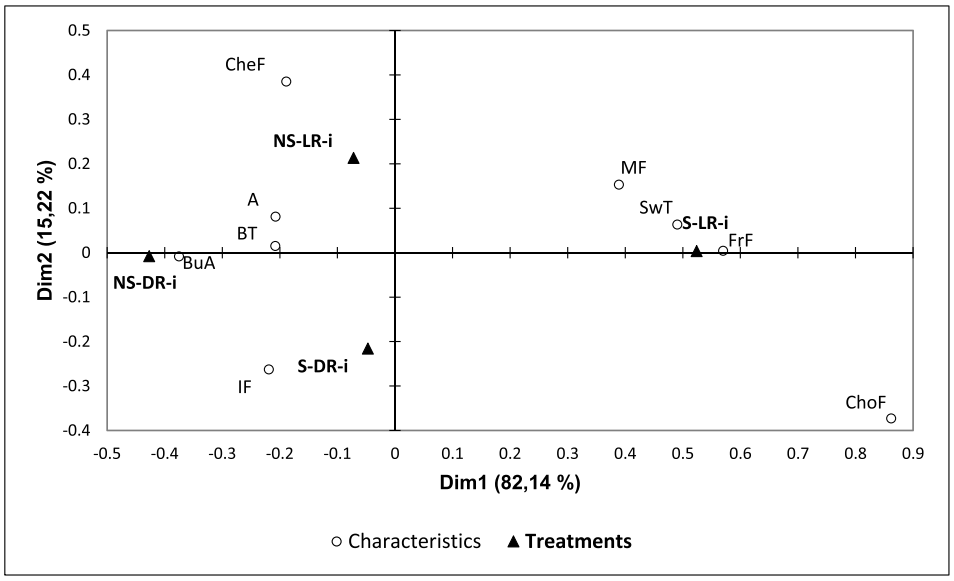

Fig. 1. Representation of the characteristics and treatments with information, obtained through the correspondence analysis of CATA data.
Legend: Treatments: S-LR-i: Special Light Roasting with information; S-DR-i: Special Dark Roasting with information; NS-LR-i: Non-Special Light Roasting with information; NS-DR-i: Non-Special Dark Roasting with information. Characteristics - BuA: Burnt Aroma; SwT: Sweet Taste; BT: Bitter Taste; A: Aftertaste; CheF: Chemical Flavor; FrF: Fruity Flavor; ChoF: Chocolate Flavor; MF: Mild Flavor; IF: Intense Flavor.

Table 5
Average values of acceptance scores for the experimental treatments.

Treatments[x]	Attributes[y]			
	Appearance	Aroma	Flavor	Overall acceptance
S-LR-b	6,97 a	6,60 b	5,43 b	5,83 c
S-DR-b	6,96 a	6,08 c	5,07 b	5,42 c
NS-LR-b	7,08 a	6,26 c	5,17 b	5,45 c
NS-DR-b	6,86 b	6,25 c	5,17 b	5,53 c
S-LR-i	7,23 a	7,07 a	6,53 a	6,70 a
S-DR-i	6,98 a	6,62 b	6,08 a	6,25 b
NS-LR-i	6,78 b	5,97 c	5,26 b	5,45 c
NS-DR-i	6,65 b	5,91 c	4,99 b	5,25 c

[x] Treatments: S-LR-b: Special Light Roasting without information (blind test); S-DR-b: Special Dark Roasting without information; NS-LR-b: Non-Special Light Roasting without information; NS-DR-b: Non-Special Dark Roasting without information; S-LR-i: Special Light Roasting with information; S-DR-i: Special Dark Roasting with information; NS-LR-i: Non-Special Light Roasting with information; NS-DR-i: Non-Special Dark Roasting with information.

[y] Averages followed by the same letters in the column do not differ by the Scott-Knott test ($p > 0.05$).

coffee, light roasting, without information) for the aroma attribute, demonstrates that consumers presented responses similar to that of specialists for the acceptance of this attribute.

As mentioned, consumers showed no difference in their responses for the acceptance of the atributes of flavor and overall acceptance between the treatments, in the blind tests. This demonstrates that, in terms of flavor and overall acceptance, the consumer is unable to differentiate coffees with scores equal to 73 or 85, according to the Scaa classification (2009), and coffees that have undergone to the roasting processes lasting 9 min or 14 min. This result corroborates with the results found in the CATA test, in which all attributes, except chocolate flavor, were used with similar frequencies to characterize the four treatments in the blind tests. In addition, this result is similar to those obtained by Giacalone (2016), who performed blind tests and realized that consumer preferences were equally distributed among coffee samples that presented high and low quality.

In general, these results demonstrate that the consumer does not always choose the highest quality coffees and that there is a disconnect between consumer preferences and the evaluation of coffee quality by specialists, as reported by Delgado and Guinard (2011), Sáenz-Navajas et al. (2013) and Sáenz-Navajas et al. (2015). However, contrary to what was predicted by these authors, consumers do not necessarily choose coffee that specialists classify as low quality.

Possibly, the similar scores given by consumers for the different treatments in relation to the acceptance of the attributes of flavor and overall acceptance, in the blind tests, occurred because the scores among the treatments, according to the Scaa classification (2009), are still relatively close and can make it difficult to perceive differences in quality between them, since consumers are not familiar with this type of evaluation.

There was a change in consumer responses to the acceptance tests, when they tasted the samples of the treatments again and received information about their quality, type of roasting and price. There was a significant difference ($p < 0.05$) between treatments in the tests with information (S-LR-i; S-DR-i; NS-LR-i; NS-DR-i), for the acceptance of all evaluated attributes (appearance, aroma, flavor and overall acceptance) (Table 5).

The treatments S-LR-i (special coffee, light roasting, with information) and S-DR-i (special coffee, dark roasting, with information) received higher acceptance scores for the attributes of appearance and flavor than the treatment NS-LR-i (non-special coffee, light roasting, with information) and the treatment NS-DR-i (non-special coffee, dark roasting, with information), in the tests with information. There was no significant difference ($p > 0.05$) between the NS-LR-i and NS-DR-i treatments for the acceptance of the attributes of appearance and flavor.

Regarding the acceptance of the attributes of aroma and overall acceptance, in the tests with information, the treatment S-LR-i (special coffee, light roasting, with information) obtained the highest average score, followed by the treatment S-DR-i (special coffee, dark roasting, with information), and finally by the treatment NS-LR-i (non-special coffee, light roasting, with information) and the treatment NS-DR-i (non-special coffee, dark roasting, with information). There was no significant difference ($p > 0.05$) between the NS-LR-i and NS-DR-i treatments for the acceptance of the attributes of aroma and overall acceptance. The information about the coffee also influenced the CATA test, in which about 9 characteristics of the listed attributes showed significant differences ($p < 0.05$) between the treatments.

Comparing the scores obtained for the treatments between the blind tests and the tests with information, the results revealed that consumers, in general, gave higher acceptance scores for the treatments related to the special coffees, when they received information about the quality, type of roasting and price of coffees (S-LR-i and S-DR-i), than when they did not have this information (S-LR-b and S-DR-b). This behavior was observed for the acceptance scores of the aroma, flavor and overall

acceptance attributes. Therefore, in general, consumer attitudes are influenced by information about quality, roasting and price of coffees.

There was no significant difference ($p > 0.05$) between the treatments related to the non-special coffees in the blind tests (NS-LR-b and NS-DR-b) and in the tests with information (NS-LR-i and NS-DR-i), for the acceptance of the aroma, flavor and overall acceptance attributes. There was a significant difference ($p < 0.05$) between the treatment related to the non-special coffee with light roasting in the blind test (NS-LR-b) and in the test with information (NS-LR-i), only for the acceptance scores of the appearance attribute. The acceptance score was lower when the consumer received information about this treatment.

Upon receiving information about the quality and prices of coffees, consumers generally presented greater acceptance for special coffees, which have higher prices, than non-special coffees, which have lower prices. In the CATA test, when consumers received information about the coffees, they evaluated these products more carefully, demonstrating that sensory analysis is a multisensory experience, which also takes into account the way of presenting the product, such as information exposed in its packaging. In general, these results can encourage industries to expose the characteristics of the special coffees in their packaging as a marketing strategy, in order to increase sales of these products and to optimize the consumers' sensory experience with the drink.

4. Conclusion

The results of the present study demonstrated that the consumers' sensory evaluation differs from the evaluation carried out by experts in relation to the types of coffee and that the information about the product has an impact on the characterization and hedonic judgments made by consumers.

When consumers know the information about the quality, type of roasting and price of coffees, they begin to perceive attributes that differentiate special coffees from non-special coffees, and also the type of roasting (light or dark), favoring the acceptance of special coffees. Therefore, the disclosure about the different characteristics present in special coffees can be used as a marketing strategy by industries, to increase sales of these products and/or to optimize the consumers' sensory experience with the drink.

CRediT authorship contribution statement

Carla Martino Bemfeito: Formal analysis, Writing - original draft, Writing - review & editing, designed the study, conducted the experiment, statistical analysis, and interpretation of the data, wrote and edited the manuscript. **Angélica Sousa Guimarães:** Data curation, Writing - original draft, designed the study, conducted the experiment, interpretation of the data and wrote the manuscript. **Alberto Lima de Oliveira:** Formal analysis, conducted the experiment and statistical analysis. **Bruna Fernandes Andrade:** Writing - original draft. **Luiza Maria Amaral Frossard de Paula:** Writing - original draft, conducted the experiment and prepared the manuscript. **Carlos José Pimenta:** oriented and designed the study.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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