

SENSORY QUALITY OF ROASTED COFFEE BEANS UNDER DIFFERENT STORAGE CONDITIONS

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ABSTRACT: Roasted coffee is subject to loss of quality due to aging, and the intensity of these losses is influenced by packaging. The objective in this study was to evaluate the possible losses in the sensory quality of a specialty roasted coffee, stored in beans for 150 days in different packages and storage temperatures. The experiment was carried out in the Coffee Classification and Industrialization Laboratories of IFSULDEMINAS Campus Muzambinho. The coffee was roasted and after 48 hours it was packed in three different packages and kept stored at room temperature and refrigerated at $18^{\circ}\text{C} \pm 1^{\circ}\text{C}$ for 150 days, with evaluations every 50 days, starting from zero time. The experimental design used was entirely randomized with 3 repetitions. Sensory evaluation was performed by three Q-Grader judges, according to the SCAA protocol. The data were evaluated using the SISVAR software, and when significance between treatments was detected, the regression and Scott-Knott tests were applied at the 5% probability level. The packaging used for storage did not interfere in the quality of the coffee. There was an interaction between temperature and storage time for the sensory attribute “body”. The quality decreased linearly with the storage time, from 86 to 80 points, to 84 days of storage.

Index terms: Packaging, temperature, specialty coffee.

1 INTRODUCTION

The production of specialty coffees is differentiated from others by the place of cultivation, cultivar, superior beverage quality, bean aspect, in addition to the economic, environmental and social sustainability of production and product traceability (GIOMO; BORÉM, 2011). Clemente et al. (2015), also highlight the conditions of production, fruit selection, processing, drying, and storage, as crucial factors in obtaining these coffees. These characteristics imply adding value to the final product since the consumer market is willing to pay more for a differentiated beverage.

Coffee is a drink highly appreciated by consumers due to its peculiar aroma and flavor, with unique perceptible nuances, either by the traditional method of filtered preparation or by other more sophisticated, such as pressed and espresso, with the use of coffees with superior quality, the perception of pleasant and accentuated sensory attributes is noticeable. For the extraction of espresso coffee and other methods, it has been widely used roasted coffee beans, which are ground at the time of preparation, in order

to maintain for a longer period the organoleptic characteristics of the beans, when compared with roasted and ground coffee.

The roasting process is one of the most important steps for the development of coffee flavor and aroma, which are conferred by volatile and non-volatile compounds present in the beans before and/or after roasting. During this process, the beans suffer some essential chemical reactions for the formation of the sensorial quality, as well as physical alterations, occur whose greater influence is due to the degree of roasting (MENDONÇA; PEREIRA; MENDES, 2005).

Coffee beans are subject to a decrease in the intensity of sensory attributes over the “shelf life”, however, to a lesser extent than roasted and ground coffee. It is therefore essential that its storage promotes the reduction of losses for as long as possible. Some authors reported that the storage time of roasted coffee affected the physical properties (CORRÊA et al., 2016a), water content and resting angle of the coffee (CORRÊA et al., 2016b).

Considering the care with the production and preparation of a differentiated roasted coffee, it is

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fundamental the type of packaging of the product and, for this, it has several packaging systems that protect and ensure its transport, preserving for more or less time the desirable characteristics of the coffee until the consumption, depending on the system adopted (OLIVEIRA; ALVES, 2004).

According to Moritz et al. (2011) after long periods of storage, coffee is subjected to physical-chemical reactions that result in loss of quality, with reduced intensity of sensory attributes and in some cases result in the appearance of bitterness in the beverage. According to Cardelli and Labuza (2001), every 10°C increase in storage temperature, the shelf life of roasted and ground coffee is reduced by 20%.

When relative humidity is controlled, the ambient temperature and the presence of light prevent the loss of quality of roasted coffee beans and ground coffee. To meet this objective, the market finds several varieties of packaging for whole and/or ground roasted coffee, there are materials with plastic films with multiple layers, that is, composed of more than two plastics (BAPTESTINI, 2011).

Given the above, the objective in this study was to evaluate the possible losses in the sensory quality of a specialty roasted coffee, stored in beans for 150 days in different packages and storage temperatures.

2 MATERIAL AND METHODS

The experiment was carried out in the Coffee Classification and Industrialization Laboratories of IFSULDEMINAS Campus Muzambinho, using Arabica coffee, Obatã cultivar, pulped processing, sieve 16 and above, classified with 86 points according to the protocol of the American Specialty Coffee Association (SCAA) (LINGLE, 2011).

The coffee was roasted in fractions of 20 kilos, in a rotating roaster of the brand Carmomaq, model TCE30 Ecological, with capacity for 30 kg. The roasting point was considered according to the SCAA, whose indicated color is 55# to 65# on the Agtron scale (Figure 1). The coffees were kept stored in polypropylene boxes for 48 hours for the removal of gases produced during roasting and then were submitted to treatments.

The experimental design used was entirely randomized (ERD) with 3 replicates in factorial scheme 3 x 2 x 4. The first factor corresponds to

the 3 types of packages with capacity for 250g (Figure 2), characterized as follows:

1) Fanfolded silver: in 12-micron polyester (17 g) + metallization in aluminum + lamination adhesive based on 2g per m² + low-density polyethylene w/ linear with 50 microns (46g) for the welding of packages.

2) Fanfolded matt black: in 12-micron polyester (17 g) + metallization in aluminum + lamination adhesive based on 2g per m² + low-density polyethylene w/ linear with 60 microns (55g) for welding the packages.

3) Fanfolded Kraft: Kraft paper (40g) + aluminum 19g + lamination adhesive based on 2g per m² + low-density polyethylene w / linear with 35g for welding the packages.

The second factor refers to the 2 storage environments, where the samples were kept at room temperature and cooled to 18°C ± 1°C. The third factor consists of the 4 evaluation periods: 0, 50, 100, and 150 days after conditioning, totaling 72 experimental plots. Each experimental plot consisted of a package of roasted coffee beans.

At each time, the samples were sensorially classified by three calibrated Q-Grader judges, according to the SCAA protocol, with 5 cups per sample. The attributes fragrance/aroma, flavor, finish, acidity, body, balance, clean cup, sweetness, uniformity and overall impression were evaluated with scores from 6 to 10 points. The final score was calculated corresponding to the sum of all attributes, less the value corresponding to the presence of defects when incidents in the beverage, considering its intensity and the number of defective cups (LINGLE, 2011).

For statistical analysis, the SISVAR software version 5.6 (FERREIRA, 2014) was used, being performed the analysis of variance with the average grades of the three Q-Grader judges for the sensory attributes and the final grade. When significance was detected by the F test (p<0.05), the regression and Scott-Knott tests were applied at the 5% probability level. The sensory attributes of the coffees were also evaluated in a Radar diagram (graphical scale), called "Sensogram", according to the mean score of the sensory attributes in time "0 days" and "150 days" to facilitate the visualization of the quality behavior during the period in which the coffee was stored.

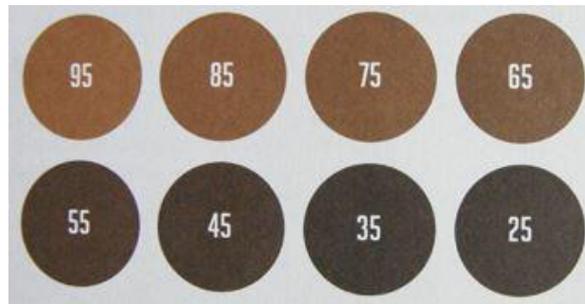


FIGURE 1 - SCAA Roast classification color disk.



FIGURE 2 - Packages used in the experiment.

3 RESULTS AND DISCUSSION

There was no interaction between the packages with the other factors under study, as well as no significance was observed among the tested packages (Table 1), either for final grade or for all sensory attributes evaluated. This result corroborates Baptestini (2011), who observed that the types of films used in the composition of the packaging material did not affect the final quality of roasted coffee beans and ground in three degrees of grinding.

There was an interaction between temperature and storage time only for the sensory attribute “body”. At room temperature, it is noted that the score decreased up to 100 days of storage and maintained up to 150 (Figure 3), while about the refrigerated environment, the drop in the score was linear during the 150 days of storage (Figure 4). The tasters’ perception of the decrease in the intensity of the body attribute occurs when the coffee no longer presents a full-bodied beverage, causing a sensation of “watery” beverage. This attribute refers to the sensation in the mouth, caused by the “weight” of the drink on the palate, which is favorable to the quality of the coffee, which can be low, medium or high (HALAL, 2008).

Regarding the storage period, there was a linear reduction in the final grade and attributes of aroma, taste, acidity, finish, and balance throughout the period. These results are similar to those found by Moritz et al. (2011), where tasters observed a marked decrease in the intensity of all sensory attributes evaluated in roasted coffees, after 28 days and packaged at 10°C and 35°C.

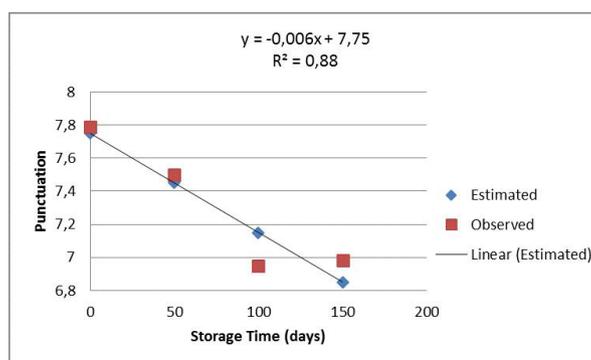
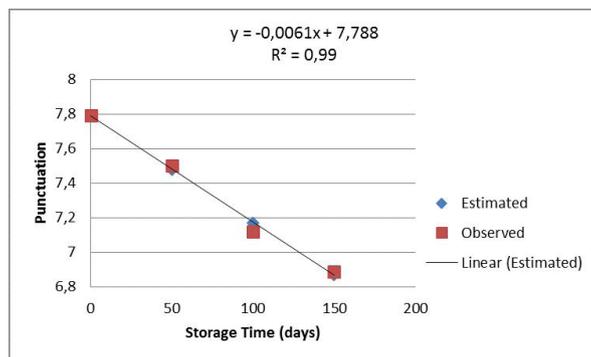
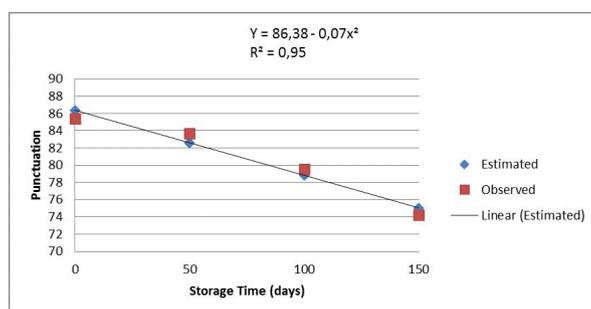
According to the SCAA, coffee is classified as “special” when the sum of the scores of its attributes is equal to or greater than 80 points (LINGLE, 2011). The coffee used in this work, in the time “0 days”, was scored with 86 points. With the storage time, there was a significant loss of quality, reaching the minimum score (80 points) at 84 days of storage, according to the equation of the line (Figure 5).

According to the methodology proposed by SCAA (LINGLE, 2011), the grades of the attributes: aroma, flavor, finish, acidity, body, balance and overall impression vary from 6 to 10. Thereby, the minimum threshold for a coffee of special quality should be 7.14 points in these attributes, since, in the case of specialty coffees, the other sensory attributes (uniformity, sweetness and clean cup) have a maximum grade of 10. points, thus totaling the 80 points.

TABLE 1 - Averages of final grades (FINAL), aroma (AR), flavor (FL), acidity (AC), body (BO), finishing (FIN), balance (BA), uniformity (UN), clean cup (CC) and global impression (GI), for the three evaluated packages.

Packages	FINAL	AR	FL	AC	BO	FIN	BA	UN	CC	GI
F. Silver	81,42 a	7,57 a	7,47 a	7,57 a	7,32 a	7,29 a	7,17 a	9,92 a	9,92 a	7,28 a
F. Matt black	80,63 a	7,46 a	7,40 a	7,54 a	7,33 a	7,19 a	7,13 a	9,79 a	9,79 a	7,19 a
F. Kraft	80,06 a	7,53 a	7,42 a	7,57 a	7,30 a	7,24 a	7,16 a	9,54 a	9,54 a	7,22 a
CV%	4,05	2,90	2,30	2,10	1,50	2,06	2,43	10,37	10,37	2,68
Average	80,71	7,51	7,43	7,56	7,32	7,24	7,15	9,75	9,75	7,23

Means followed by the same letter in the columns belong to the same group by the Scott-Knott test at 5% probability.

**FIGURE 3** - Means of the sensory attribute Body of coffee samples during storage at room temperature.**FIGURE 4** - Means of the sensory attribute Body of coffee samples, during storage at a refrigerated temperature of 18°C ± 1°C.**FIGURE 5** - Means of the final grade of coffee samples during storage.

The aroma attribute score reached the minimum threshold at 131 days of storage, according to the equation of the line (Figure 6). After this period, in the description of the coffee aroma, the terms caramel, citrus, honey, chestnut, and milk were replaced by aromas linked to dust, rubber, rancidity, paper, and there was a decrease in the intensity of the caramel notes.

Studies on coffee beverage quality indicate that tasters use terms based on previous experience in the sensory description of coffee (NEBESNY; BUDRYN, 2006). Kitzberger et al. (2011), when characterizing the sensory profile of coffee cultivars, identified that the testers used 8-23 terms in the sensory description of the evaluated sample and that some terms were used by several testers.

Similarly to the aroma attribute, the acidity attribute reached the minimum score (7.14) at 131 days of storage, according to the equation of the line, and reduced until the end of storage (Figure 7). This drop in score is due to the decrease in acidity intensity, but even so, the coffee remained acidic. This can be explained by physicochemical changes that occur during the storage period of roasted coffee, which negatively reflects the sensory quality of the beverage (MORITZ et al., 2011).

The flavor score decreased from 8.25 in “0-day” time to 7.14 to 107 days of storage, according to the equation of the line (Figure 8). Agwanda et al. (2003) indicated this attribute as one of the main criteria for obtaining gains in beverage quality. The perception of flavor was altered from citrus notes, milk and chocolate at the beginning, to flavor resembling paper, wood, rancidity and an intense bitterness at the end of the evaluations.

Nadaleti (2017) also found the same initial sensory profile of this study for a special coffee from the Obatã cultivar. According to Marin et al. (2008), factors such as water activity, oxygen and temperature are determinant on the intense loss of coffee aroma and flavor quality.

In the time “0 days” the beverage was characterized as a sweet, intense finish, reminiscent of mint and chocolate. At 88 days (according to the equation of the line) it was detected astringency as well as a remarkable bitterness, time in which for the coffee score was assigned value less than 80 points. These undesirable characteristics were intensified up to 150 days, causing the score of this attribute to fall by up to 6.71 points (Figure 9). Padua et al. (2003) report that the storage time of roasted coffee has a significant effect on quality due to changes in physical, chemical and sensory characteristics.

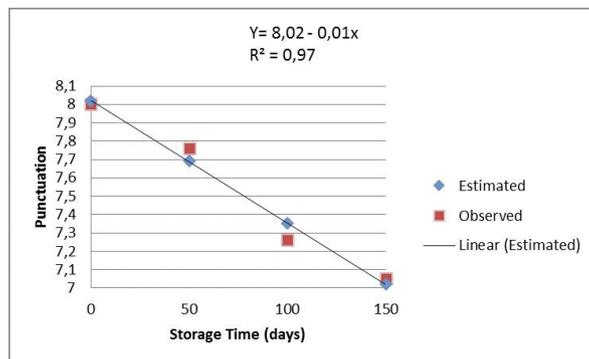


FIGURE 6 - Means of the attribute Aroma of coffee samples during storage.

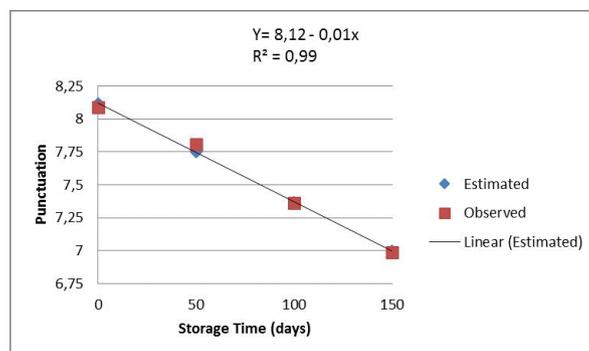


FIGURE 7 - Means of the attribute Acidity of coffee samples during storage.

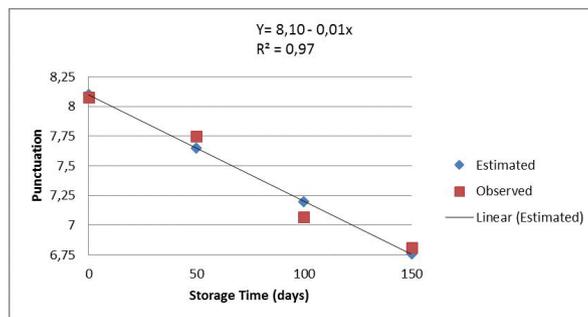


FIGURE 8 - Means of the attribute Flavor of coffee samples during storage.

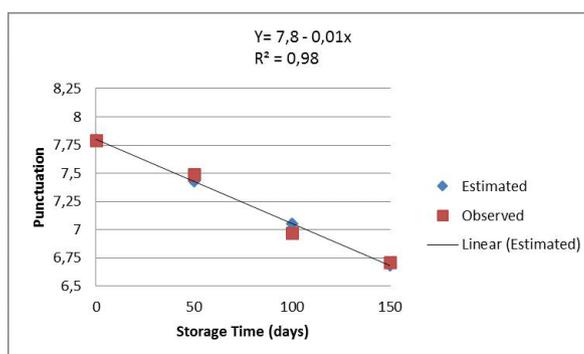


FIGURE 9 - Means of the attribute Finishing of coffee samples during storage.

Coffee is also scored for the balance of sensory attributes assessed, for which a reduction was also observed as a function of storage time (Figure 10).

The uniformity attribute refers to the behavior of the five evaluation cups within the same sample. Coffee remained at the maximum score (10 points) up to 100 days of storage, followed by a reduction at 150 days due to the identification of a sensory defect in one of the cups evaluated (Figure 11).

The appearance of this defect is related to undesirable flavors in the drink such as paper, vinegar and intense bitterness. These negative nuances may be related to the oxidation of substances responsible for the aroma and flavor of coffee during storage.

The score for the clean cup attribute consists of the presence or absence of defects since, at 150 days of storage, a defect was found in some evaluation cup, implying a reduction in the score from 100 to 150 days of storage (Figure 12).

For the attribute Sweetness, there was no significant effect, and even with the appearance of a sensory defect, the samples remained sweet, presenting the maximum score (10 points) in all evaluations.

The last attribute to be evaluated by the tasters is the overall impression of the samples. It is important to note that the score for this attribute was 7.14 points over the same period (84 days), with a final score of 80 points, which is the limit for maintaining the standard as specialty coffee (Figure 13). This period was determined from the equation generated by the regression at the 5% significance level.

For better visualization of the coffee quality reduction after the storage period, Figures 14 and 15 (sensograms) are presented, containing the sensory attributes aroma, flavor, finish, acidity, body, balance and global impression, in the time "0 days" and after the 150 storage, respectively. It is observed that the decrease in quality is related to the linear reduction of all sensory attributes evaluated.

According to Sobreira et al. (2015), the use of the Sensogram and content analysis are methodologies that complement the current specialty coffee scoring scale, subject to use in the sensory characterization of specialty coffees concerning quality and intensity of nuances. According to Scholz et al. (2013), due to the complexity and diversity of terms related to the nuances, they are rarely analyzed by any method.

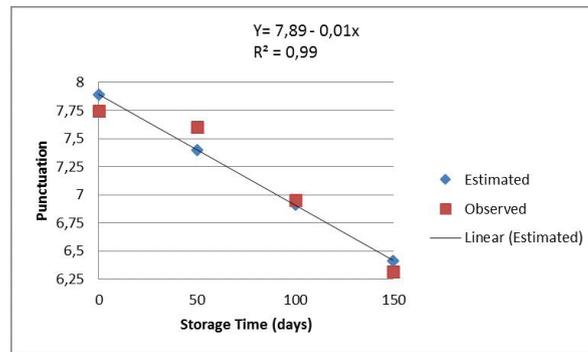


FIGURE 10 - Means of the attribute Balance of coffee samples during storage.

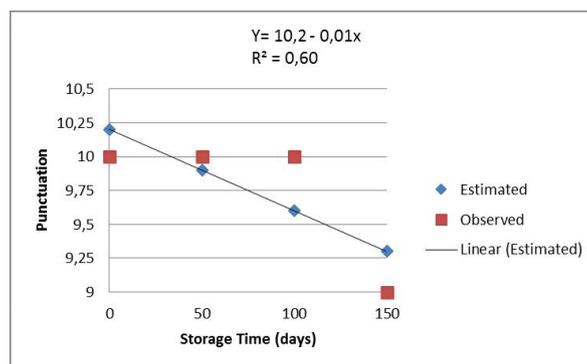


FIGURE 11 - Means of the attribute Uniformity of coffee samples during storage.

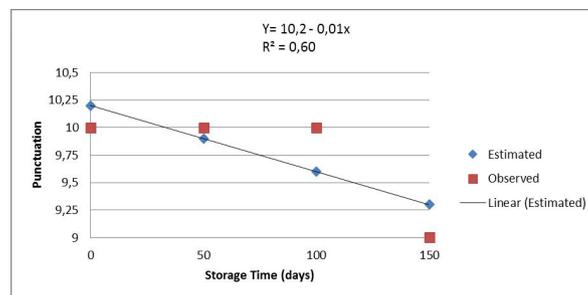


FIGURE 12 - Means of the attribute Clean Cup of coffee samples during storage.

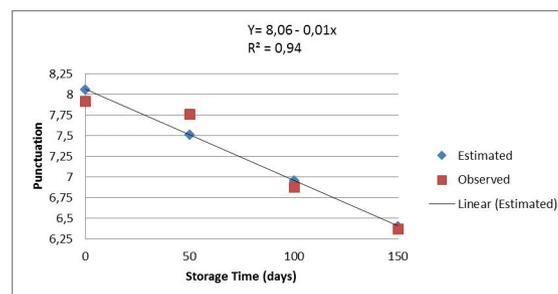


FIGURE 13 - Means of the attribute Global Impression of coffee samples during storage.



FIGURE 14 - Sensogram for the sensory attributes of an 86-point speciality coffee at 0 days of storage.



FIGURE 15 - Sensogram for the sensory attributes of an 86-point speciality coffee after 150 days of storage.

4 CONCLUSIONS

The packaging used for storage did not interfere with the quality of the coffee.

There was an interaction between temperature and storage time for the “body” attribute.

Quality reduced linearly over storage time from 86 to 80 points at 84 days of storage.

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