INFLUENCE OF SOLAR INCIDENCE ON SENSORY EVALUATION OF FERMENTED ARABICA COFFEE

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ABSTRACT

This study explores the relationship between the notes and sensory descriptors of coffees from the same batch fermented with different methodologies, correlating them with solar incidence and strategic fermentation positions. For this, approximately four thousand liters of coffee cherry of the Paraíso variety were used, where they were subjected to four fermentation methodologies, namely traditional volcano, pallet volcano, tilted cart in the sun and tilted cart in the shade. All treatments underwent 36 hours of fermentation and after this period all were processed and subjected to cup testing by five certified Q-Graders. The highest sensory score was assigned to sample VT-S2 (84,25 ± 0,65)[b], regarding the lowest scores were assigned to the samples VP-S7 (81,44 ± 1,03)[a] and CSm-S4 (81,19 ± 1,45)[a]. The VT-S2 sample presented complex descriptors compared to the other samples, however, they all shared descriptors such as citrus acidity, caramel, chocolate, floral and orange. Although the samples showed sensorial differences, further clarification and analysis are necessary to understand and correlate the effect of solar incidence on the samples during fermentation.

Keywords: Sensory analysis. Special Coffee. Natural coffee Fermentation. Sensory descriptors.

1 INTRODUCTION

Recently, the physical and sensory quality of coffee has been the focus of attention among consumers, as their preferences have changed over the years. This phenomenon directly reflects on the increase in the production and consumption of specialty coffees, thereby driving the transformation and expansion of coffee markets[1,2,7,8].

According to the Specialty Coffee Association (SCA), specialty coffee refers to a beverage obtained from superior quality coffee beans, free from impurities and defects, achieving a score of 80 points or higher on the classification scale. It is noteworthy that specialty coffees distinguish themselves from conventional products due to their superior quality. This information is communicated to consumers through a detailed sensory characterization, which includes aroma and flavor descriptors, along with scoring obtained through sensory analysis, following the standards established by the SCA [6].

In this way, the score has a substantial influence on the perceived quality of coffee, thereby affecting both market valuation and the sales of bags. Thus, this work aimed to evaluate the sensorial quality of natural *Arabica coffee* (cv. Paraíso) fermented in different treatments.

2 MATERIAL & METHODS

In this study, coffee cherries from the 2023/2024 harvest were used. The arabica coffees of the Paraíso variety were grown in Patos de Minas (MG), Brazil, in the Kaízen farm, with an average altitude of 1050 meters.

The fermentation processes were carried out for 36 h, with four thousand liters of coffee cherries in four different treatments, namely the traditional volcano (VT), pallet volcano (VP), sun cart (CS) and shadow cart (CSm). In volcano-style fermentations, the coffees were stacked in a mountain-like shape, with the highest peak in the center. The traditional volcano was placed directly on the asphalt floor, while the pallet volcano was placed on a wooden pallet. For cart fermentations, the coffees were added to inclined carts, with metal floors and sides and an open lid. The solar cart was positioned in a strategic location to receive sunlight and the shade cart was positioned in a shaded area. The fermentations were prepared shortly after harvesting the fruits, as illustrated in Figure 1.

All treatments were subjected to temperature monitoring at strategic points, according to Figure 2, using electronic devices "dataloggers", throughout the fermentation period. After 36 hours of fermentation, the coffees were separated into different samples according to the location of each sensor. Then, they were washed in running water and sent for drying in suspended terraces, where they remained until the beans reached a moisture content of approximately 12%. Sequentially, the grains were stored and subjected to a 25-day rest period. After this period, coffees were processed and sent for sensory analysis.

Figure 1 Methodology for fermenting coffees (A- Traditional volcano; B- Pallet volcano; C and D- carts).

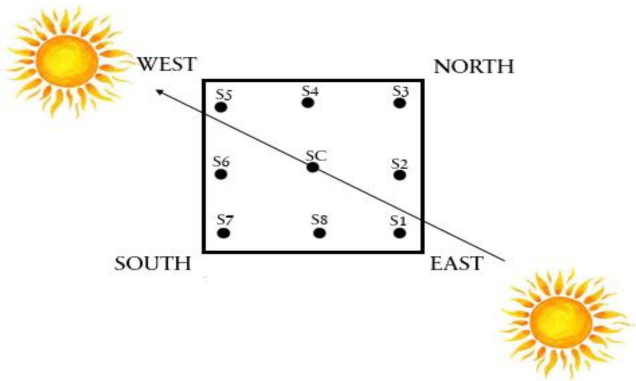

Figure 2 Solar incidence and position of sensors.

For sensory analysis, 100 g of coffee beans were roasted 24 h before the cupping tests, in accordance to the specification standards of SCA. Subsequently, samples were sent to Cerrad Coffee & company, where they were ground and used to prepare beverages in the proportion of 9.35 g/170 mL (coffee/water).Sequentially, coded samples were placed in five cups, which were subjected to sensory analysis performed by a panel of five certified Q-graders. Using Cropster® software, they evaluated sensory aspects such as fragrance, aroma, uniformity, absence of defects, sweetness, flavor, acidity, body, finish, balance and general evaluation.

3 RESULTS & DISCUSSION

The scores obtained in sensory analysis, expressed as means, are detailed in Table 1.

Table 1 Scores obtained in sensory evaluations of coffees fermented by different processes

Sample	Final score	Sample	Final score
VT-S0	83,38 ± 0,60^{ab}	CS-S0	83,31 ± 0,66^{ab}
VT-S1	82,38 ± 0,43^{ab}	CS-S1	82,31 ± 0,55^{ab}
VT-S2	84,25 ± 0,65^{b}	CS-S2	83,44 ± 1,14^{ab}
VT-S3	82,75 ± 0,35^{ab}	CS-S3	82,19 ± 0,72^{ab}
VT-S4	83,38 ± 0,14^{ab}	CS-S4	83,75 ± 0,89^{ab}
VT-S5	83,38 ± 0,92^{ab}	CS-S5	82,63 ± 0,97^{ab}
VT-S6	83,38 ± 0,52^{ab}	CS-S6	83,56 ± 0,85^{ab}
VT-S7	83,31 ± 1,18^{ab}	CS-S7	83,63 ± 0,83^{ab}
VT-S8	82,88 ± 0,72^{ab}	CS-S8	83,75 ± 0,71^{ab}
VP-S0	82,88 ± 0,88^{ab}	CSm-S0	82,06 ± 0,77^{ab}
VP-S1	83,13 ± 0,85^{ab}	CSm-S1	83,25 ± 1,17^{ab}
VP-S2	82,75 ± 0,79^{ab}	CSm-S2	82,88 ± 1,09^{ab}
VP-S3	83,25 ± 0,89^{ab}	CSm-S3	82,88 ± 1,39^{ab}
VP-S4	82,00 ± 1,43^{ab}	CSm-S4	81,19 ± 1,45^{a}
VP-S5	83,63 ± 1,61^{ab}	CSm-S5	83,06 ± 1,75^{ab}
VP-S6	82,69 ± 1,23^{ab}	CSm-S6	82,13 ± 0,14^{ab}
VP-S7	81,44 ± 1,03^{a}	CSm-S7	83,75 ± 1,37^{ab}
VP-S8	81,75 ± 1,19^{ab}	CSm-S8	81,50 ± 1,02^{ab}

Means that do not share the same letter are significantly different ($p \leq 0.05$).

When observing the values described in Table 1, the VT-S2 treatment presented the highest sensory score among all treatments. Therefore, it becomes possible to assess that its position favorably influenced the effectiveness of the fermentation process, since there was greater exposure to sunlight. Thus, this fact could be confirmed by evaluating the temperature of the fermentation process at S2 position, which initially was 22.20°C and, after 36 hours of fermentation, it was found to be 41.1°C in the lower part of the volcano and 28.1°C in the upper part. That is, there was effectiveness in the fermentation process indicated by the rise in temperature, which is a crucial factor for microbiological development, as well as their respective metabolic activities responsible for the attributes and sensorial quality of the coffee [3,4]. Furthermore, it is noted that the traditional volcano methodology allowed temperature retention in the lower part due to the direct contact of the coffee with the asphalt terrain, which consequently retained the temperature released by the exothermic reactions of the fermentation process.

On the other hand, the lowest sensory scores were attributed to treatments VP-S7 and CSm-S4 ($p \leq 0.05$). When observing the VP-S7 sample, it was not in a coordinate with effective exposure to sunlight, which could be confirmed by the temperature variation, which initially was 21.7°C and, after 36 hours of fermentation, it presented a value of 16.9°C for the lower part of the volcano and 18.3°C in the upper part. Those temperatures suggested an inefficiency in the fermentation process since the ideal temperature for coffee fermentation varies between 25 to 30°C [5]. Furthermore, it is noteworthy that the arrangement of the volcano on the pallet allowed air flow to occur beneath the coffee beans, resulting in a greater loss of temperature and, consequently, a greater reduction in the growth kinetic of microorganisms, impacting coffee sensory profile. For the CSm-S4 sample, although this experiment was conducted under light, fermentation developed since the initial temperature was 22.5°C and the final temperatures were 32.9°C and 28°C for the bottom and top of the experiment, respectively. However, when evaluating the sensory descriptions of this fermentation process, it is noted that it was not possible, during a 36-hour fermentation, to produce complex sensory precursors that would positively influence the final score of the coffee.

As for sensory descriptors, both the VT-S2 sample and the VP-S7 and CSm-S4 samples presented common descriptors such as citrus acidity, caramel, chocolate, floral and orange. However, for the VT-S2 sample there was a variation in the complexity of the descriptors, presenting brown sugar, almonds, hazelnuts, honey nuts, molasses, pepper and rapadura, making it better scored. Furthermore, undesirable sensory descriptors for VP-S7 were roughness accompanied by a long and heavy finish, whereas for the CSm-S4 treatment Q-graders identified an immature, immature finish, consequently impacting the quality and final note of the coffee.

4 CONCLUSION

The use of different fermentation methodologies employing coffee fruits from the same harvest resulted in coffees exhibiting score discrepancies of up to 3.05 points, along with distinct sensory descriptors. Furthermore, it was possible to evaluate that, even within the same treatment, samples can benefit sensorially if fermentation is carried out at strategic points. However, for greater contributions and clarifications, it is necessary to carry out more analyses, such as substrates and metabolites determinations. Then, it will be possible to correlate physicochemical composition with the position of the samples, so that the best fermentation condition and the best position of the samples can be predicted.

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