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Analysis of quality of coffee subjected to semi-carbonic fermentation

Analise da qualidade do café submetido a fermentação semi carbônica

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ABSTRACT

The objective of this this work was to evaluate semi-carbonic fermentation as a post-harvest treatment of coffee subjected to different processing types on the coffee qualities and on the incidence of fungi. The experiment was conducted in IFSULDEMINAS Campus Inconfidentes, Brazil, in a randomized block design. It was carried out in 9 treatments considering the fruits in different fermented and non-fermented phenological stages. The coffee physical, chemical, and microbiological parameters and sensorial quality were analyzed. The sensorial quality of green + ripe, and light green coffee cherries was significantly improved, presenting decreases in incidence of *Cladosporium* fungi. The fermented coffee presented more reddish hues. The fermentation process improves the quality of light green and green + ripe coffee cherries. Semi-carbonic fermentation process affects resulting in coffee cherries with reddish hues. Semi-carbonic fermentation reduces the incidence of *Cladosporium* fungi, without altering the coffee quality.

Keywords: Green cherries, *Cladosporium*, sensorial profile, electrical conductivity.

RESUMO

O objetivo deste trabalho foi avaliar a fermentação semi-carbônica como tratamento pós-colheita de café submetido a diferentes tipos de processamento sobre a qualidade do café e sobre a incidência de fungos. O experimento foi conduzido no IFSULDEMINAS Campus Inconfidentes, Brasil, em delineamento em blocos ao acaso. Foi realizado com 9 tratamentos considerando os frutos em diferentes estádios fenológicos fermentados e não fermentados. Foram analisados os parâmetros físicos, químicos, microbiológicos e a qualidade sensorial do café. A qualidade sensorial dos cafés cereja verde+maduro e verde claro melhorou significativamente, apresentando diminuição na incidência dos fungos *Cladosporium*. O café fermentado apresentou tonalidades mais avermelhadas. O processo de fermentação melhora a qualidade dos grãos de café verde claro e verde + maduro. O processo de fermentação semi-carbônica afeta resultando em cerejas de café com tons avermelhados. A fermentação semi-carbônica reduz a incidência de fungos *Cladosporium*, sem alterar a qualidade do café.

Palavras-chave: Frutos verdes, *Cladosporium*, perfil sensorial, condutividade elétrica.

INTRODUCTION

The production of special coffees is very dynamic, with significant advances in the last years, since a thoroughly reviewing of processing is occurring, through information and introduction of new fermentation techniques (Brioschi Junior *et al*., 2021).

Therefore, research has been carried out focused on evaluating the action of microorganisms under different edaphoclimatic conditions and altitude (Veloso *et al*., 2020), and different fermentation methods, including carbonic fermentation (Brioschi Junior *et al*., 2021). These studies have found positive responses regarding the sensorial profile and quality of coffee.

This high diversity of processing and environments that coffee is subjected to modifies its chemical composition and quality, making the replication of results difficult, since the microbiota in the environment and coffee cherries may vary between years and regions (Veloso *et al*., 2020). As this process is very dynamic, the obtaining of coffee with the same standard over the years became a limitation for coffee growers. However, the maintenance of the local microbiota during fermentation allows the coffee to express the terroir of the environment, making it unique in the space and time.

Fermentation is a differential for small coffee growers focused on finding specific markets for very high-quality coffee, considering that there is no need for acquisition of external inputs, using those naturally available in the environment.

Therefore, the use of fermentation of coffee by small growers should involve available technologies, since carbonic fermentation consists in injection of CO_2 in the environment to be fermented; this technology is often not accessible for coffee growers. In this sense, semi-carbonic fermentation would be an option; it is very used for production of wines, since CO_2 will be produced during the fermentation, expelling oxygen from the environment. This process also enables to control temperature and moisture and determine the °Brix and pH in which the process should be ended, allowing a higher repeatability of results, preventing that undesirable conditions compromise the beverage quality (Cândido *et al*., 2019).

All studies on coffee fermentation encompass ripe cherries, since it is a favorable stage for growth of microorganisms; however, not all growers can harvest or process coffee at the adequate maturation stage. In addition, the occurrence of green cherries that can compromise the coffee quality can be found even under manual or mechanic selective harvest. However, the effect of semi-carbonic fermentation on unripe coffee cherries is still not known.

A hypothesis is that anaerobic fermentation through enzymes can act on unripe cherries, modifying the sensorial profile and improving the coffee quality. Therefore, the objective of this this work was to evaluate semi-carbonic fermentation as a post-harvest treatment of coffee subjected to different processing types on the coffee sensorial, physical, and chemical qualities and on the incidence of fungi.

MATERIAL AND METHODS

The experiment was conducted in the 2020/2021 crop season at the Coffee Sector of the Federal Institute of Education, Science, and Technology of the South of Minas Gerais (IFSULDEMINAS) Inconfidentes campus, in Inconfidentes, MG, Brazil (22°19’01’’S, 46°19’40’’W, and altitude of 896 meters). The experiment area had 0.3 ha. Seeds of the Acauã coffee cultivar were planted in January 2017, with spacing of 2×1 m. A randomized block design was used, with 9 treatments and three replications.

The treatments consisted of processing types: unwashed unfermented coffee cherries direct from the field (1); washed unfermented green cherries manually separated from ripe cherries (2); washed fermented ripe cherries manually separated from green cherries (3); washed unfermented green (10%) + ripe (90%) cherries (4); washed unfermented floating cherries (5); washed ripe cherries manually separated from unfermented green cherries (6); washed fermented green cherries manually separated from ripe cherries (7); washed fermented green (10%) + ripe (90%) cherries (8); and washed fermented light-green cherries manually separated from greener cherries (9).

Coffee cherries were harvested by manual chop on a cloth on June 16, 2021. The coffee was fanned out and placed into raffia bags with the upper part open and kept under shade. The cherries were harvested with mean °Brix of 16.44%. The maturation stages at harvest were: 9.95% dry cherries, 16.75% light green cherries, 36.65% green cherries, and 36.65% ripe cherries.

The coffee cherries remained for six hours in the field after harvest and then were taken to a processing facility at the Coffee Sector of the IFSULDEMINAS. When the coffee cherries arrived to the sector, a sample was separated to compose the treatment with unwashed cherries. The remaining fruits were placed into a box with water for washing and, then, for hydraulic separation of ripe, green, and floating cherries, with the aid of a shading screen.

The cherries were manually separated for the treatments, according to their corresponding maturation stages. The fruits for treatments without fermentation process were directly placed on an above ground yard for drying. The fruits for treatments with fermentation process were placed in fermentation/maturation buckets with a useful capacity of 12 liters, containing an air lock valve type "S" on the lid and a faucet on the bottom for fluid sampling and °Brix and pH measurement. These measurements were carried out daily or when the liquid was obtained. After the buckets were filled with coffee, the lids were closed, ensuring no entry of air. The buckets were placed in a closed shed with mean air temperature of 24.22 °C and mean relative air humidity of 48.54%.

The monitoring of °Brix and pH started at twelve hours after the closure of the buckets; when the liquid was present, 10 to 15 mL were withdrawn for evaluation. The fermentation was stopped when the pH reached 4 to 4.2, and the coffee fruits were withdrawn from the buckets and dried in an above ground yard.

The fruits of all treatments (fermented and not fermented) were subjected to the same processing during the drying period, remaining in the same above ground yard. Each plot had 1 m^2 in the above ground yard, separated from each other by wood slats; each experimental unit was represented by eight liters of coffee.

A fine layer of fruits was arranged, without overlap the grains in the yard; the turning started at the fourth day, with 5 turnings a day, until the fruits reach 11.2% to 11.6% moisture. Environmental air temperature and relative humidity in the yard were monitored daily at 01:00 p.m., using a digital thermo-hygrometer (Minipo, MTH-1300). The mean air temperature in the above ground yard was 26.78 °C, with mean relative humidity of 33.34% during the drying period (55 days). The temperature of the coffee cherries was evaluated with a compact professional thermographic camera (Flir, C2).

The coffee layer was doubled three times during drying; the first time was carried out at the third day of drying, the second at the sixth, and the third at the tenth day of drying.

When the fruits reached the half dry stage (< 28% moisture), during the period that the fruits remained in the above ground yard, they were covered with jute bags under a tarpaulin at 3:00 p.m. and uncovered at 8:00 a.m. of the following day. When they reached 11.2% to 11.6% moisture, they were placed in jute bags, using one bag per treatment with the three replications, separated into plastic mesh bags, identified, and stored for 21 days in wood containers in the Coffee Sector of the IFSULDEMINAS.

The incidence of fungi in the samples was evaluated by the filter paper method (blotter test), as described in Brasil (2009). A total of 150 fruits of each treatment were evaluated; they were arranged in plastic boxes with 25 fruits on 2 blotter paper sheets. The plastic boxes were randomly distributed in a Biochemical Oxygen Demand (BOD) incubation oven at 20 °C. After seven days of incubation, the fruits were examined individually with the aid of a stereoscopic microscope and an optical microscope for visualization and identification of fungal structures.

Physical and chemical analyses consisted of evaluations of pH, ethereal extract, and protein, according to the methodology of the Association of Official Agricultural Chemists - AOAC (1990). Electrical conductivity was evaluated using the methodology of Prete and Abrahão (1995). Grain color was evaluated using a colorimeter (Konica

Minolta, CM - 2300 Iluminante D65). Seventy grams of grains of each sample were randomly collected and six points of each sample were measured for later calculation of means of the coordinates obtained.

The color reading values were presented as coordinate of the scales L*, a*, and b* that were representative regarding color and lightness. L* represents the lightness of the color in a scale from 0 to 100 (light to dark); a* represents the position between green and red (negative values indicate green and positive values indicate red); and b* represents the position between blue and yellow (negative values indicate blue and positive values indicate yellow).

Coffee grains were classified by type, according to the Normative Instruction no. 8, of June 11, 2003 (Brasil, 2003). Sensorial analyses were carried out by trained and qualified tasters accredited for evaluating special coffees (QGraders), using the methodology proposed by the SCAA (2015).

The data were subjected to analysis of variance (ANOVA) followed by Scott and Knott (1974) clustering analysis at $p<0.05$. The statistical analyses were carried out using the statistical software Sisvar (Ferreira, 2019).

RESULTS AND DISCUSSION

The duration of the dry semi-carbonic fermentation process was 15 days. Schwan *et al*. (2012) reported that dry fermentation processes are slower due to specificities of the process, as the main carbon source for bacteria is the pulp pectin and the low moisture condition favors the growth of fungi and yeasts, which is consistent with the results found in the present study.

°Brix and pH were evaluated at the end of fermentation (Table 1). The higher the maturation stage, the higher the °Brix. Lower °Brix and higher pH were found in light green cherries. However, the pH of all treatments was between 4.04 and 4.23. Velmourougane (2013) found that degradation of mucilage into simple sugars occurs during the fermentation, causing decreases in pH to 5.54 for arabica and 4.05 for robust coffee.

Table 1 - Mean °Brix and pH of the resulting liquid collected at the final stage of the fermentation of coffee fruits. Inconfidentes, MG, Brazil, 2021

Treatment	°Brix	pH
Fermented ripe cherries	12.66	4.04
Fermented green (10%) + ripe (90%) cherries	10.26	4.07
Fermented light green cherries	9.33	4.23

The treatments presented significant differences in type classification; fermented and unfermented ripe cherries had higher results (Table 2). This better type classification in these treatments was due to the fruit composition at the ripe stage, with fewer defects due to the hydraulic separation, which results in lower equivalence.

This parameter is important for marketing because coffee is evaluated through sensorial analysis and type for price formation; thus, the better these parameters, the higher the valuation. Treatments 8 and 9 presented sensorial grade statistically equal to treatments 3 and 6 (Table 2); however, the typification increased due to the higher presence of green cherries, which may result in a lower valuation.

The sensorial analysis showed that the best treatment was the fermented green (10%) + ripe (90%) cherries, followed by the unfermented ripe, fermented ripe, and fermented light green cherries, which statistically differed from the others (Table 2). The grades reached in these treatments classified the coffees as very good or special (SCAA, 2015).

The treatments with unwashed unfermented berries direct from the field and unfermented green (10%) + ripe (90%) cherries presented the second-best result. Whereas the treatments with fermented green, unfermented floating and unfermented green cherries presented the worse grades (Table 2). The treatment with unwashed unfermented berries direct from the field, which consisted of 36.65% green and 16.75% light green cherries, had good grades in the sensorial analysis, which can be attributed to the drying in the above ground yard (Table 2).

Table 2 - Type, grade in the sensorial analysis, and sensorial profile of coffee in different treatments during the drying as a function of post-harvest processing. Inconfidentes, MG, Brazil, 2021

Treatments	Type	Grade (SCAA)	Sensorial profile
1	7.33 b	81.33 b	Green, cereal
2	7.33 b	76.66 a	Green, bitter
3	6.33 a	83.58 c	Caramel, sweet, fruity
4	8.00 b	80.08 b	Green, bitter
5	7.33 b	77.33 a	Medicinal, bitter, dry
6	5.66 a	84.00 c	Caramel, chocolate
7	8.00 b	77.41 a	Herbaceous, caramel, chocolate.
8	7.66 b	84.08 c	Fruity, red fruits
9	7.33 b	83.41 c	Fruity, red fruits
CV (%)	9.79	1.90	

Means followed by the same letter in the columns are not different from each other by the Scott-Knott clustering test at $p<0.05$. 1 = Unwashed unfermented cherries direct from the field; 2 = Washed unfermented green cherries; 3 = Washed fermented ripe cherries; 4 = Washed unfermented green (10%) + ripe (90%) cherries; 5 = Washed unfermented floating cherries; 6 = Washed ripe cherries; 7 = Washed fermented green cherries; 8 = Washed fermented green (10%) + ripe (90%) cherries; 9 = Washed fermented light-green cherries.

The results found for fermented coffees were not too higher when compared to those found for not fermented ones; however, the grades of the treatments with fermented green (10%) + ripe (90%) and fermented light green cherries were expressive, contrasting with that of fermented ripe cherries, which had sensorial grade equal to that of not fermented ripe cherries.

Brioschi Junior *et al*. (2021) found a grade of 85.15 in the SCAA (2015) scale for fermented ripe coffee cherries by the carbonic maceration technique, using the time of 120 hours at 38 °C; and a grade of 81.16 when using 24 hours of fermentation at 38 °C. They also found that the time of 120 hours at 38 °C allowed to change the sensorial profile of the product; these results are similar those found for the treatments 2 and 7, and 4 and 8, without or with fermentation (Table 3). Lee *et al*. (2015) found that fermentation improves the coffee quality, which is attributed to modifications in the composition of precursors of aroma of coffee.

The improvement in quality of treatments 8 and 9, which had green and light green cherries, can be advantageous to growers because the crop has heterogeneous maturation and limitations for harvesting or separation of ripe cherries. Another inconvenient is that there is always presence of fruits at the light green stage, even when using selective harvest, mainly for cultivars with yellow fruits, since distinguishing fruits by maturation stage is difficult.

The highest percentage of incidences of *Cladosporium* fungi in the fruits were found in the treatments with unfermented green (10%) + ripe (90%) cherries, unfermented green cherries, unfermented floating cherries, unfermented cherries direct from the field, and unfermented ripe cherries (Table 3). Brioschi Junior *et al*. (2021) reported that the growth of fungi and bacteria change over time due to temperature and fermentation time. Similar results were found in the present study, considering that the maceration decreased the quantity of *Cladosporium* fungi (Table 4). However, the

Table 3 - Incidence (%) of *Cladosporium* and *Fusarium* fungi by the blotter test as a function of different post-harvest processing of coffee cherries. Inconfidentes, MG, Brazil, 2021

Treatments	*Cladosporium*	*Fusarium*
1	95.33 c	16.66 a
2	97.33 c	61.33 c
3	6.66 a	82.66 d
4	98.66 c	42.66 b
5	96.66 c	78.00 d
6	80.66 c	57.83 c
7	17.33 a	98.66 d
8	16.00 a	58.66 c
9	31.33 b	40.66 b
CV (%)	15	19.23

Means followed by the same letter in the columns are not different from each other by the Scott-Knott clustering test at $p<0.05$. 1 = Unwashed unfermented cherries direct from the field; 2 = Washed unfermented green cherries; 3 = Washed fermented ripe cherries; 4 = Washed unfermented green (10%) + ripe (90%) cherries; 5 = Washed unfermented floating cherries; 6 = Washed ripe cherries; 7 = Washed fermented green cherries; 8 = Washed fermented green (10%) + ripe (90%) cherries; 9 = Washed fermented light-green cherries.

sensorial quality found in the treatments 8 and 9 did not decrease due to decreases in *Cladosporium* fungi (Tables 2 and 3), as these fungi are associated with quality of coffee (Angélico *et al*., 2017).

The highest incidence of *Fusarium* fungi was found in the treatment with fermented ripe and fermented green cherries; thus, the processing and maturation stage can increase the incidence of this fungus, without compromising the quality of fermented ripe cherries. The second highest incidence was found in treatments 4 and 9, and the third highest in the treatments 2, 6, and 8. The lowest incidence of *Fusarium* fungi was found in the treatment with unfermented cherries direct from the field (Tables 2 and 3). The higher incidence of *Fusarium* fungi in washed cherries is probably connected to the water used for hydraulic separation, as unwashed cherries direct from the field presented the lowest incidence.

Several studies have highlighted that the incidence of *Fusarium* fungi is connected to the post-harvest processing and affect the beverage quality. Iamanaka *et al*. (2014) evaluated coffee fruits from different phases of post-harvest processing and found that 45% of samples had fungal infection higher than 70%, which resulted in 50% of samples with negative sensorial analysis due to *Fusarium lateritium* colonisation.

Basalong *et al*. (2020) found that different coffee processing types affect the incidence of fungi at the post-harvest stage; they found *Cladosporium* and *Fusarium* species in green peeled coffee cherries, *Cladosporium* fungi were found in the wet and dry basis processing and *Fusarium* fungi were found only in the dry basis processing.

Silva *et al*. (2022) highlighted that bacterial and fungal communities, as well as the coffee sensorial profile is dependent on the fermentation conditions and process of coffee cherries, and the exclusion of floating cherries in the fermentation process can be used as a strategy for obtaining coffee with grades higher than 80 points in the SCAA (2015) scale. Unwashed coffee cherries direct from the field had grade of 81.33 (Table 2), high incidence of *Cladosporium*, and lower incidence of *Fusarium* (Table 3), which resulted in the obtaining of special coffee, according to the SCAA (2015) scale.

Significant differences between treatments were found in the test of means for pH (Table 4). The treatments with unwashed unfermented cherries direct from the field, unfermented green cherries, and fermented green cherries had the highest pH. These differences can be due to the processing type and the maturation stage of the samples, since green cherries presented higher pH values (Scholz *et al*., 2011).

Pereira *et al*. (2020) evaluated different post-harvest processing types for coffee in different altitudes and found that the altitude of 893 meters (similar result to that of the present study) presented variations in pH, according to the fermentation method; coffees fermented with yeast presented the highest pH and those fermented without addition of water had the lowest pH.

The results found for the ethereal extract of samples were not statistically different from each other (Table 4). Cruz and Muñoz (2019) conducted an experiment at an altitude of 1,656 m in Colombia and found that coffee cherries subjected to 12 hours of fermentation with a rate of 60 mL of yeast (*Saccharomyces* sp.) presented ethereal extract, protein, and pH of 7.85%, 16.41%, and 5.01, respectively. They highlighted that the coffee presented a grade of 84 points in the sensorial analysis, similar to those found in the treatments 8 and 9, however, with a shorter fermentation time due to the inoculation with yeasts.

The electrical conductivity showed significant difference between treatments; the highest mean was found in the treatment with fermented green, followed by unfermented green, fermented light green, fermented ripe, and fermented green (10%) + ripe (90%) cherries. The treatments with unfermented floating cherries, unwashed unfermented cherries direct from the field, unfermented green (10%) + ripe cherries, and unfermented ripe cherries presented the lowest means (Table 4).

Malta *et al*. (2013) found that high electrical conductivity values are found in natural coffees due to their high sensitivity during drying. In the present study, the fermentation process increased these values (Table 4); however, it did not affect the beverage quality. It was probably due to changes in the sensorial profile (Table 2) during the fermentation process, which impacted the quality positively.

Table 4 - Mean pH, ethereal extract (EE), electrical conductivity (EC), and gross protein (GP) of coffee cherries as a function of post-harvest processing. Inconfidentes, MG, Brazil, 2021

Treatments	pH (%)	EE (%)	EC µS cm^{-1} g^{-1}	GP (%)
1	6.14 b	10.52 a	82.76 a	12.41 a
2	6.44 b	10.22 a	136.27 b	12.21 a
3	5.95 a	9.32 a	119.03 b	11.81 a
4	5.93 a	10.30 a	81.99 a	10.35 a
5	5.94 a	9.35 a	86.07 a	12.12 a
6	6.03 a	5.19 a	59.66 a	10.85 a
7	6.26 b	11.00 a	245.16 c	11.84 a
8	5.88 a	11.36 a	109.48 b	11.82 a
9	5.8 the	13.30 a	125.51 b	10.61 a
CV (%)	2.86	25.05	17.48	12.27

Means followed by the same letter in the columns are not different from each other by the Scott-Knott clustering test at p<0.05. 1 = Unwashed unfermented cherries direct from the field; 2 = Washed unfermented green cherries; 3 = Washed fermented ripe cherries; 4 = Washed unfermented green (10%) + ripe (90%) cherries; 5 = Washed unfermented floating cherries; 6 = Washed ripe cherries; 7 = Washed fermented green cherries; 8 = Washed fermented green (10%) + ripe (90%) cherries; 9 = Washed fermented light-green cherries.

Protein contents presented no significant differences between treatments (Table 4). The color parameters, evaluated using the L*, a*, and b* coordinates (Table 5) showed no statistical differences between fermented and not fermented treatments for the L* coordinate. This coordinate is connected to the lightness, showing the higher or lower whiteness of grains in a black-white scale varying from 0 a 100; the whiter the grains, the higher the L* coordinate, consequently, the darker the grains, the lower the L*.

The absence of differences between treatments regarding the L* coordinate is explained by the fact

Table 5 - Mean lightness (L*), green-red (a*), and blue--yellow (b*) color parameters of coffee samples as a function of post-harvest processing types. Inconfidentes, MG, Brazil, 2021

Treatments	L*	a*	b*
1	35.59 a	2.81 a	32.06 a
2	39.57 a	2.32 a	29.69 a
3	40.18 a	5.48 b	36.26 b
4	40.65 a	2.80 a	33.28 a
5	40.25 a	3.33 a	30.88 a
6	39.87 a	3.58 a	32.34 a
7	36.52 a	5.01 b	35.03 b
8	38.99 a	5.31 b	36.37 b
9	40.61 a	4.47 b	33.98 b
CV (%)	10.24	27.16	4.55

Means followed by the same letter in the columns are not different from each other by the Scott-Knott clustering test at p<0.05. 1 = Unwashed unfermented cherries direct from the field; 2 = Washed unfermented green cherries; 3 = Washed fermented ripe cherries; 4 = Washed unfermented green (10%) + ripe (90%) cherries; 5 = Washed unfermented floating cherries; 6 = Washed ripe cherries; 7 = Washed fermented green cherries; 8 = Washed fermented green (10%) + ripe (90%) cherries; 9 = Washed fermented light-green cherries.

that the coffee cherries remained stored for the same period and are from the same crop season. According to Ribeiro *et al*. (2011) and Borém *et al*. (2013), variations in coffee grain color indicate the occurrence of oxidative processes and natural enzymatic biochemical changes that modify the composition of precursors responsible for flavor and aroma of coffee grains, resulting in decreases in the beverage quality. Based on this attribute, the present study presented a good color, considering that the cherries remained stored for 21 days.

The results found for the a* coordinate of the treatments with fermented ripe, fermented green (10%) + ripe (90%), fermented green, and fermented light green cherries presented the highest means, denoting increases for this coordinate due to the semi-carbonic fermentation. It is explained by characteristics of the fermentation process, which results in coffee cherries with more reddish hues.

The lower the b* coordinate, the higher the intensity of the blue color, which is also considered for coffees of higher quality (Afonso Júnior and Corrêa, 2003). The results obtained showed that the fermentation also increased the values of the b* coordinate; the treatments with fermented green (10%) + ripe (90%), fermented ripe, fermented green, and fermented light green cherries presented the highest means.

Despite the changes in color during the fermentation processes, good grades were found in the sensorial analysis and for the sensorial profile, denoting that the increases in the a* and b* coordinates, although undesirable when presenting high values, did not decrease the quality of cherries in treatments with fermentation (Table 2). Brioschi Junior *et al*. (2021) found that fermentation strategies promote different biochemical interactions, resulting in changes in the sensorial, chemical, and microbiological profile of coffee, which is consistent with the results found in the present study.

CONCLUSION

The use of semi-carbonic fermentation as a post-harvest treatment affects the sensorial quality of coffee. The fermentation process improves the quality of light green and green + ripe coffee cherries. The semi-carbonic fermentation process affects pH, electrical conductivity, and color (a* and b*), resulting in coffee cherries with reddish hues. Semi-carbonic fermentation reduces the incidence of *Cladosporium* fungi, with no chances in coffee quality.

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