EFFECT OF DRYING AND STORAGE CONDITIONS ON THE QUALITY OF NATURAL AND WASHED COFFEE[1]

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ABSTRACT: The objective of the work was to evaluate alterations in the quality of natural and washed coffee under different drying conditions (coffee drying yard, temperature of 40ºC and 60ºC) and storage conditions at 60% of relative humidity, with controlled temperature of 23ºC, at 90 and 180 days. The work was carried out in the Engineering Department and in the Coffee Post-Harvest Technology Pole of the Federal University of Lavras. The manual harvest of the coffee (*Coffea arabica* L.), Topázio variety, was selective. Part of the coffee was pulped and the other part was processed in the natural form. A portion of each type of coffee was submitted to drying on the yard and two other samples were processed in a mechanical dryer, at temperatures of 40ºC and 60ºC. After drying, the coffee was stored in an air-tight room, in which a stable relative humidity of 60% was maintained with a solution of magnesium nitrate. Quality evaluation, sensorial analyses, electric conductivity and potassium leaching tests, total titrable acidity, fatty acidity and total and reducing sugars determinations were carried out. The results showed that the coffee dried at 60ºC, after 90 days storage, presented the poorest quality. The physical-chemical evaluations of the drying and storage conditions showed that washed coffee presents better quality when compared to the product in its natural form.

Key words: *Coffea arabica*, drying, storage, quality.

EFEITO DAS CONDIÇÕES DE SECAGEM E ARMAZENAMENTO SOBRE A QUALIDADE DO CAFÉ NATURAL E DESPOLPADO

RESUMO: *Objetivou-se com o presente trabalho avaliar as alterações na qualidade dos cafés natural e despolpado nas condições de secagem (terreiro, temperatura de 40ºC e 60ºC) e armazenamento de 60% de umidade relativa com temperatura controlada de 23ºC, aos 90 e 180 dias. O trabalho foi realizado no Departamento de Engenharia e no Pólo de Tecnologia em Pós-Colheita do Café da Universidade Federal de Lavras. A colheita manual do café (Coffea arabica L), variedade Topázio, foi seletiva. Parte do café foi despolpado e outra parte, processada de forma natural. Uma parcela de cada tipo de café foi submetida à secagem em terreiro e as outras duas, às temperaturas de 40ºC e 60ºC em secador mecânico. Depois da secagem, o café foi armazenado em ambiente hermético, mantendo-se constante a umidade relativa de 60%, com solução de nitrato de magnésio. Para avaliação da qualidade, foram realizados análise sensorial, testes de condutividade elétrica e lixiviação de potássio, determinações de acidez titulável total, acidez graxa, açúcares totais e redutores. Pelos resultados obtidos, conclui-se que os cafés submetidos à secagem com temperatura de 60ºC e armazenados a partir de 90 dias apresentaram as piores características de qualidade; as avaliações físico-químicas para as condições de secagem e armazenamento mostram que o café despolpado apresentou melhor qualidade, quando comparado com o produto na sua forma natural.*

Palavras-chave: Coffea arabica, secagem, armazenamento, qualidade.

1 INTRODUCTION

Coffee (*Coffea arabica* L) production in Brazil has increased significantly in the last few decades, with an increase of the production areas and the utilization of new technologies. The greatest difficulty found in the coffee production chain today is its great variation of prices (PINTO, 2006). Producing high quality coffee in Brazil is not only a demand but an opportunity for the sector and a decisive factor also in the product's exportation.

Brazilian coffee exportation has been decreasing in the past decades, due partly to the increase of coffee production in other countries, but also to the poor quality of the Brazilian product sold

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in the external markets. The growing demand for quality, associated to the reduction of production costs, are stimulating both producers and researchers to develop new technologies more suited to the productive system.

Coffee's commercial quality is associated to a set of factors that involve physical-chemical and sensorial aspects which, in turn, depend on the products' drying and storage conditions (AFONSO JÚNIOR, 2001; NOBRE, 2005). During the drying process, variations in the structure of the beans (color, aspect, defects, buquet and flavor, etc) can occur, affecting the quality of the beverage. External factors, such as temperature, relative humidity and mechanical damage can alter the structure of the membranes, leading to a loss of their organization and selectivity (AMORIM et al., 1978), reducing coffee's quality potential.

Corrêa et al. (1994), Sfredo et al. (2005) e Souza (2000), studying coffee drying, concluded that, to obtain a good quality product and a soft beverage, the drying temperature must be maintained around 40º C. However, to preserve coffee's initial qualities, correct drying is not enough. The adequate storage is also important.

In order to store coffee for longer periods of time and maintain its initial chemical, physical and sensorial characteristics, the temperature and the relative humidity of the environment must be monitored. Afonso Júnior (2001) observed a decrease in the composition of reducing sugars in coffee beans and grains as storage time in higher relative humidity conditions increased.

Considering the effect of drying and storage on the quality of coffee pre-processed in different ways, the objective of this work was to evaluate alterations in the quality of natural and washed coffee submitted to different drying conditions (yard, temperature of 40ºC and 60ºC) and stored at 60% of relative humidity, with controlled temperature of 23ºC, for 180 days.

2 MATERIAL AND METHOD

Location of the experiment

The work was carried out in the Engineering Department and in the Coffee Post-Harvest Technology Pole of the Federal University of Lavras, state of Minas Gerais, in Brazil.

Coffee pre-processing

The coffee was harvested manually and only the cherry beans were removed from the plant. For the three repetitions, 2400 L of coffee, Topázio variety, were harvested. For each repetition, 150 L of coffee cherry beans were spread directly on the yard, constituting the natural coffee portion, and another 150 L were separated for mechanical drying. To obtain the washed coffee, 500 L of coffee cherry beans were used. The coffee was pulped in a fermentation tank, where it was revolved for 20 hours. A sample of the pulping water was collected to determine pH and temperature, in order to avoid fermentation problems and interferences in the coffee's quality. After 20 hours, the coffee was washed to remove the mucilage and pre-dried.

Drying

After pulping, a portion of the coffee was pre-dried on a yard, where it remained for 1 day, and then placed in a mechanical drier. The remaining portion continued drying on the yard until 11% (wet basis). The natural coffee was also pre-dried on a yard, but for a period of 2 days. During drying on the yard, both the washed (8 days) and the natural coffee (13 days) were revolved every half-hour during the day (8 hours per day) and the temperature and relative humidity were monitored using a thermohigrograph. At night, the coffee was placed on trays in thin layers and protected from the effects of temperature and relative humidity.

Mechanical drying was done in two fixed layer prototypes with electrically heated air. To obtain air flow a diaphragm with a controled opening at the entrance of the fan was used. The average speed of the air was measured using a digital anemometer with rotating blades at the entrance of the drying chamber. The air flow was regulated at $20 m^3 min^{-1} m^{-2}$.

During drying, the temperature of the coffee grains, the environmental temperature and the relative humidity of the air were measured periodically. The temperature of the coffee grains was measured every 30 min using type J thermocups placed at the center of the granular mass in each division of the drying chamber. To minimize any possible differences in temperature between the four divisions, due to the positioning of the electric resistances in the plenum, the apparatuses containing the samples were rotated every hour until drying of 11% (wb).

The samples used to determine the water content of the coffee in the yard were taken at the end of the morning and of the afternoon during the first 5 days, and then daily at the end of the afternoon. To determine the water content of the coffee in the mechanical drier, 100g samples were taken every hour. The water content was determined by the oven method at 105 $\pm$ 3ºC (BRASIL, 1992), until 11% (wb). A digital G-800 model moisture measurer was used to determine when to interrupt drying (11% wb).

Storage

Once drying was interrupted at 11% (wb) of humidity, the coffee in the drier was cooled and conditioned in 5 kg jute bags and later hermetically stored in a container. The cooling process was not repeated with the coffee in the yard due to the low temperature in the granular mass. During the whole storage period, relative humidity was controlled at 60% and temperature was maintained at 23ºC.

To maintain storage temperature at 23ºC air conditioning, regulated accordingly, was used. To control the relative humidity, a salt solution (magnesium nitrate, Mg $(NO_3)_2$) was used (Dhingra & Sinclair, 1995). The air inside the storage system circulated continuously in a closed system, passing through the grains and the magnesium nitrate until they were in balance. This condition remained constant throughout the whole storage period.

Temperature and relative humidity were measured daily in the morning during the 6 months of storage. To measure and control the storage system (humidity and temperature) a digital thermohigrometer model Higrotemp 90 was used.

Charactetization of coffee quality

Sensorial analysis

The sensorial analysis of the coffee was carried out at the Monte Alegre S/A farm in Alfenas, MG. Coffee samples of 300g were prepared, for each repetition, by removing the defective beans . The samples were coded and analyzed by three qualified tasters of the "Brazil Specialty Coffee Association" (BSCA).

The methodology used was the "Cup of Excellence" (CoE), suggested by Howell (1997), in which each sensorial attribute (body, aroma, acidity, sweetness, balance and characteristic flavor) received a score according to its intensity in the samples, making this methodology more objective than cup test. For each sensorial attribute the samples received a score on a scale of 0 to 8 (BSCA, 2006).

The tasters evaluated the coffee's buquet in three parts: dry powder, crust and infusion and noted, in a space reserved for personal observations, the nuances and distinct aromas observed. The attributes clean beverage, sweetness, acidity, body, flavor, remnant flavor, balance and general score were then evaluated, resulting in a final score count that indicated the higher and poorer quality coffees.

Electric conductivity

The electric conductivity of the raw beans was determined by adapting the methodology recommended by Kryzyanowski et al. (1991). Fifty beans with no visible defects from each sample were used. The beans were weighed (0,001g precision) and immersed in 75 mL of deionized water inside plastic cups with a capacity of 180 mL. These recipients were placed in a ventilated oven regulated to 25ºC for 24 hours. The solution's electric conductivity was measured by the CD-20 Digimed apparatus. From the results obtained, electric conductivity was calculated and the results were expressed in ìS cm^{-1} g^{-1} of sample.

Potassium leaching

Potassium ion leaching in the raw beans was done according to the methodology proposed by Prete (1992). After the electric conductivity readings, the amount of leached potassium ions in the solutions was determined. This reading was done in a Digimed NK-2002 flame photometer. With the data obtained, the potassium leached was calculated and the result was expressed in ppm/g.

Total titrable acidity

The total titrable acidity was determined by titration with NaOH 0,1 N, adapting the methodology cited by AOAC (1990). 50 mL of distilled water were added to 2 g of ground sample coffee and the solution was revolved for 1 hour. The solution was then filtered using a paper filter and 5 mL were mixed in an erlenmeyer with 50 ml of distilled water. 3 drops of phenolftalein were added and the solution was titrated until turning point with NaOH 0,1N. The results were expressed in mL of NaOH 0,1 N per 100g of sample.

Fatty acidity

Fatty acidity was determined by titration according to the 02-02 A or quick fatty acidity method described by the AACC (1995). 40 g of the ground sample coffee were weighed, dissolved in 100 mL of toluene and shaken for 1 hour and 30 minutes. The solution was then filtered. In a bequer, 25 mL of the filtered solution were mixed with 25 mL of alcohol and phenolftalein. The solution was titrated with KOH until reaching the turning point. The fatty acidity results were expressed in mL of KOH per 100g of dry matter (DM), calculated according to equations 1 and 2.

$$DM = (1 - M\,(db)) \times 40g \qquad \text{equation 1}$$

where:

DM – mass of dry sample (g);
M (db) – dry base moisture content

$$FA = \frac{V \times 100}{DM} \qquad \text{equation 2}$$

where:

V – volume of KOH used to titrate the solution (extract + indicator) in mL;
FA – fatty acidity (mL of KOH/100 g of dry matter).

Total and reducing sugars

The total and reducing sugars were extracted according to the Lane-Enyon method described by the AOAC (1990). The values were expressed in percentage.

Treatments and statistical design

The statistical design used was a split-plot in time, in a 2 x 3 x 3 factorial scheme with three repetitions. The treatments correspond to two types of coffee (natural and washed), three drying systems (yard, temperatures of 40 ºC and 60ºC) and three storage periods (0, 90 and 180 days).

The data obtained were analyzed by the Sisvar 4.0 computer program, according to Ferreira (2000) and the means were compared through the Tukey test.

3 RESULTS AND DISCUSSION

The mean temperature and relative humidity values at the start of the drying process in the mechanical driers and the initial and final water content of the coffee dried on the yard and at 40ºC and 60ºC for each treatment, in the three repetitions, are presented in Table 1.

The mean temperature and relative humidity values refer to the mean values collected daily during mechanical drying with the air in the coffee grains heated to 40ºC and 60ºC. Table 1 shows that the mean relative humidity and temperature values were similar in all the tests, varying from 49% to 61% (wb) and from 20,23°C to 23, 43°C, respectively. The temperature and relative humidity values for drying on a yard varied from 20,53ºC to 24,1ºC and 46% to 66% (wb), respectively, in all the repetitions.

Table 1 shows that the initial water content of washed coffee varied from 50,78% to 57,66% (wb) and that, after drying, the water content was 10,15% (wb). The water content of natural coffee, at the beginning of the drying process, varied from 58,60% to 65,60% (wb), arriving finally at the mean storage level of 12% (wb).

Before drying at 40ºC and 60ºC, the washed coffee was pre-dried on a yard for 1 day and the natural coffee for 2, so that both would begin drying in the same conditions, losing, in average, 5% of their moisture content. The natural coffee began drying in the drier with a water content varying from 43,08% to 50,95% (wb), reaching mean storage level at 11,03% (wb). The washed coffee started out with moisture content around 38,71% to 40,42% (wb), reaching mean storage level at 10,56% (wb).

The mean temperature and relative humidity values during storage of washed and natural coffee dried on a yard and at 40ºC and 60ºC are presented in Table 2.

Table 2 shows that, during the storage period, the temperatures at the beginning and ending of storage remained between 22,8ºC and 23,5ºC, varying on average 0,7ºC. The relative humidity in storage remained between 63,8% and 64,6% for the equilibrium condition of 60% of relative humidity. These results are similar to those found by Afonso

Table 1 – Mean values of the product and surrounding air conditions in all the treatments, in the three repetitions.

Repetitions	Coffee Processing	Drying processing temperature (ºC)	Moisture content (% wb)		Average air condition at the entrance of the drier and yard	
			Initial	Final	Temperature. (ºC)	RH (%)
I	Washed	60	41,34	11,35	20,76	61
	Natural		50,11	11,15	20,76	61
	Washed	40	41,34	12,00	20,23	59
	Natural		50,95	12,22	20,23	59
	Washed	Yard	50,78	9,33	24,10	46
	Natural		61,38	11,79	23,51	50
II	Washed	60	40,12	9,33	21,54	55
	Natural		43,08	9,49	21,54	55
	Washed	40	38,71	11,12	21,89	54
	Natural		43,87	12,22	21,89	54
	Washed	Yard	51,97	10,74	21,34	57
	Natural		58,60	12,94	22,42	56
III	Washed	60	41,76	9,12	23,22	49
	Natural		45,72	11,81	23,22	49
	Washed	40	40,42	11,27	23,43	51
	Natural		46,07	12,57	23,43	51
	Washed	Yard	57,66	11,04	20,53	66
	Natural		65,60	11,65	21,50	58

Table 2 – Mean temperature and relative humidity values obtained during 180 days of storage.

Storage temperature		Relative humidity 60%	
Entrance	Exit	Entrance	Exit
22,8 ºC	23,5ºC	63,8%	64,6%

Júnior (2001), who evaluated the equilibrium moisture content of parchment, washed and harvested coffee.

The electric conductivity and potassium leaching values, due to the effects of the different drying, pre-processing and storage processes, are presented in Tables 3 and 4.

As shown in Tables 3 and 4, in most of the storage and pre-processing combinations, the electric conductivity and potassium leaching values increased significantly ($P<0,05$) as the temperature of drying increased (Table 1). According to Prete (1992), coffee's deterioration and quality loss is directly related to the higher potassium leaching values that occur due to the degeneration of the cellular membranes (LIN, 1988; MARCOS FILHO et al., 1990; SCHOETTLE & LEOPOLD, 1984; WOODSTOCK, 1973).

The highest electric conductivity and potassium leaching values, independent of drying and pre-processing, were found for the longer storage periods. Despite the 60% relative humidity conditions recommended for storing agricultural products, at 180 days high electric conductivity and potassium leaching values were observed, corroborating the results found by Coelho et al. (2001) and Silva et al. (2001). Amorim (1978), studying water absorption in beans stored at 60% of relative humidity, observed a greater metabolic activity, which lead to the deterioration of the coffee and a loss of its quality.

Tables 5 and 6 present the mean total and reducing sugars values, according to the type of drying, pre-processing and storage time.

Table 3 – Mean electric conductivity values (μScm^{-1}g^{-1}) in storage conditions of 60% of relative humidity and temperature of 23ºC, according to drying, pre-processing and storage time.

Drying processing condition	Time (0 days)		Time (90 days)		Time (180 days)	
	Pre-processing		Pre-processing		Pre-processing	
	Natural	Washed	Natural	Washed	Natural	Washed³
Yard²	114,0 A b	85,6 A a	115,2 A a	109,2 A a	143,6 A a	142,1 B a
40ºC	130,0 B b	93,3 A a	126,6 B b	110,6 A a	146,8 A b	128,0 A a
60ºC	230,0 C b	215,0 B a	235,1 C b	215,1 B a	240,0 B b	225,8 C a

Means followed by the same letter, small in the lines for each storage time and capitalized in the columns for each type of pre-processing, did not differ, at a 5%probability, through the Tukey test.

Table 4 – Mean potassium leaching values (ppm/g), in storage conditions of 60% of relative humidity and temperature of 23ºC, according to drying, pre-processing and storage time.

Drying processing condition	Time (zero days)		Time (90 days)		Time (180 days)	
	Pre-processing		Pre-processing		Pre-processing	
	Natural	Washed	Natural	Washed	Natural	Washed
Yard	26,6 A a	23,3 A a	37,2 B b	22,5 A a	43,2 B b	33,7 A a
40ºC	40,0 B b	35,0 B a	27,4 A a	28,4 B a	38,1 A a	40,2 B a
60ºC	66,3 C a	68,3 C a	72,22 C a	75,3 C a	75,0 C a	75,7 C a

Means followed by the same letter, small in the lines for each storage time and capitalized in the columns for each type of pre-processing, did not differ, at a 5%probability, through the Tukey test.

Table 5 – Mean reducing sugars values (%), in storage conditions of 60% of relative humidity and temperature of 23ºC, according to drying, pre-processing and storage time.

Drying processing condition	Time (zero days)		Time (90 days)		Time (180 days)	
	Pre-processing		Pre-processing		Pre-processing	
	Natural	Washed	Natural	Washed	Natural	Washed
Yard	0,85 C b	0,47 C a	0,75 C b	0,37 C a	0,64 C b	0,38 B a
40ºC	0,64 B b	0,35 B a	0,62 B b	0,32 B a	0,58 B b	0,25 A a
60ºC	0,57 A b	0,27 A a	0,47 A b	0,19 A a	0,45 A b	0,22 A a

Means followed by the same letter, small in the lines for each storage time and capitalized in the columns for each type of pre-processing, did not differ, at a 5%probability, through the Tukey test.

Table 5 shows that the reducing sugars values decreased as drying temperature and storage time increased, independent of the type of processing.

Table 6 presents a reduction of the total sugars as drying temperature increased. The lowest values, when compared to the type of processing, were found in the washed coffee. The natural coffee presented approximately twice the amount of total and reducing sugars in relation to the washed coffee. This is due to the fact that a large part of the sugars in coffee are located in the husk and mucilage (LOPEZ et al., 2000).

The low reducing sugars content in the coffee beans is associated to the low electric conductivity and potassium leaching values observed in Tables 3 and 4, probably due to the drying temperature.

Afonso Júnior (2001) observed a decrease in the reducing sugars content as storage time increased,

Table 6 – Mean total sugars values (%), in storage conditions of 60% of relative humidity and temperature of 23ºC, according to drying, pre-processing and storage time.

Drying processing condition	Pre-processing	
	Natural	Washed
Yard	7,64 B b	6,96 B a
40ºC	7,88 B a	7,54 C a
60ºC	7,23 A b	6,44 A a

Means followed by the same letter, small in the lines for each storage time and capitalized in the columns for each type of pre-processing, did not differ, at a 5%probability, through the Tukey test

concluding that any probable effects would be due to the greater metabolic activity in the beans during storage.

The low reducing sugars content is related to the loss of quality in the coffee beans. However, to better understand the relation between reducing sugars and the effects of drying and pre-processing during storage, it would be necessary to study separately the glucose, frutose, arabinose, manose, galactose, ribose and ramose quantities, as they contribute to the formation of the reducing sugars in the product.

The variations of the mean total titrable acidity values, in the different types of drying and storage, are presented in Table 7.

According to the data presented in Table 7, the highest total titrable acidity values were observed in drying at 60ºC. During storage, these values tended to be more similar independent of the drying process. The higher total titrable acidity values observed in drying at 60ºC are due to the fermenting processes that occur in the husk and the pulp (LEITE et al., 1998).

Acidity is one of the characteristic attributes of coffee sensorial analysis. Its intensity varies, predominantly, according to the stage of maturation of the beans, pre-processing and drying. Storage, however, also influences coffee acidity (COELHO et al., 2001). These values may be linked to the increase of potassium leaching and electric conductivity, both of which demonstrated a degeneration of the cellular membranes. In this work, storage led to greater acidity, in other words, the effect of drying was minimized throughout storage time.

Table 8 presents the fatty acidity results, according to drying, pre-processing and storage, during 180 days at 60% relative humidity and 23°C temperature conditions.

Table 8 shows that the fatty acidity values increased with an increase of the drying temperature and of storage time.

Higher drying temperatures in longer storage periods, with relative humidity at 60%, may be related to the degeneration of the cellular membranes and, consequently, to the leaking of the oils that participate in the chemical composition of the beans. These oils can oxidize the structure of the coffee beans, affecting the quality of the product (AFONSO JÚNIOR, 2001). Esteves (1960) observed that, as the storage time increases, the oils become more acid and the quality of the product becomes poorer.

The pre-processing of the coffee also influenced the fatty acidity values. Table 8 shows that at the beginning of storage the natural coffee presented higher acidity values when compared to the washed coffee. This process could be due to the degradation of the coffee, caused by the high drying

Table 7 – Mean total titrable acidity values (NaOH 0,1N/100g), in storage conditions of 60% of relative humidity and temperature of 23ºC, according to drying and storage time.

Drying processing condition	Storage Time		
	Zero	90 days	180 days
Yard	177,50 A a	216,67 B b	207,50 A b
40ºC	175,50 A a	191,67 A b	198,33 A b
60ºC	212,50 B a	212,50 B a	210,00 A a

Means followed by the same letter, small in the lines for each type of drying and capitalized in the columns for each storage time did not differ, at a 5%probability, through the Tukey test.

temperature, which could be damaging the structure of the cellular membranes and leaking the constituting oils. These oils would enter a process of permanent oxidizing.

However, with the longer storage period, the effects of pre-processing are balanced and deterioration is caused, generally, by the combination between 60% of relative humidity and storage temperature of 23ºC, independent of drying.

The mean sensorial analysis values, according to drying, pre-processing and storage, are presented in Table 9.

Table 9 shows that, in general, sensorial analysis had the greatest effects, according to drying temperature and pre-processing. The increase of drying temperature in natural coffee led to the lowest sensorial attributes scores while, in the washed coffee, the increase of temperature had no significant influence over the values obtained. The drying on a yard had the best scores, independent of the type of pre-processing. Storage time, in the conditions studied, did not alter the sensorial characteristics of the product.

The washed coffee presented the best scores (Table 9) in all the storage periods, when compared to the natural coffee, independent of the types of drying.

These sensorial analysis results are consistent with the electric conductivity, potassium leaching, total titrable acidity, fatty acidity and total and reducing sugars results discussed above.

Table 8 – Mean fatty acidity values (KOH 0,1N/100g), in storage conditions of 60% of relative humidity and temperature of 23ºC, according to drying and storage time.

Drying processing condition	Natural Time			Washed Time		
	Zero	90 days	180 days	Zero	90 days	180 days
Yard	0,77 A a	1,49 A b	2,70 A c	0,77 A a	1,29 A b	3,44 A c
40ºC	1,27 B a	1,85 B b	5,51 B c	1,08 A a	1,30 A a	5,22 B b
60ºC	2,63 C a	3,55 C b	5,74 B c	1,54 B a	2,30 B b	5,78 B c

Means followed by the same letter, small in the lines for each type of processing and capitalized in the columns for each storage time did not differ, at a 5%probability, through the Tukey test.

Table 9 – Mean sensorial analysis scores, in storage conditions of 60% of relative humidity and temperature of 23ºC, according to drying, pre-processing and storage time.

Drying processing condition	Time (zero) Pre-processing		Time (90 days) Pre-processing		Time (180 days) Pre-processing	
	Natural	Washed	Natural	Washed	Natural	Washed
Yard	74,3 B a	80,8 A b	73,3 B a	80,3 A b	74,1 B a	80,8 B b
40ºC	72,2 A B a	81,3 A b	73,5 B a	80,2 A b	73,4 B a	77,4 A b
60ºC	68,1 A a	79,6 A b	70,8 A a	81,0 A b	70,8 A a	78,0 A b

Means followed by the same letter, small in the lines for each storage time and capitalized in the columns for each type of pre-processing, did not differ, at a 5%probability, through the Tukey test.

4 CONCLUSIONS

The coffee dried at 60ºC and stored for 180 days presented the worst electric conductivity, potassium leaching and fatty acidity results.

The total and reducing sugars content was greater for the coffee dried on a yard during the first 90 days of storage.

After 90 days of storage, the total titrable acidity values increased as drying temperature was elevated.

The sensorial analysis values of natural coffee were negatively affected by the increase of drying temperature.

The physical-chemical analyses in the drying and storage conditions studied showed that washed coffee presented the highest quality in comparison to the natural product.

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