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Effect of storage on the concentration of total phenolic compounds in Brazilian green coffee

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Abstract

The aim of the current study is to determine the effect of storing green Brazilian coffee in open conditions on the concentration of phenolic compounds. The moisture content of the coffee was adjusted to 5, 10, and 15%, then cardamom was added in the following concentrations: 0, 0.5, and 1.5%. The control treatment was free of cardamom powder. Samples were then stored for periods of 2, 4, and 6 months. The temperature and relative humidity of the samples were measured during storage periods relative to their monthly averages. Total phenolic compounds were determined for all coffee treatments. The results showed that the monthly averages of temperature and relative humidity during storage periods varied from one month to another and the averages ranged between 28.55 - 38.17 °C and 44.85 - 55.28%.

Keywords: storage, phenolic compounds, green coffee.

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تأثير التخزين على تركيز المركبات الفينولية الكلية في القهوة الخضراء البرازيلية

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المستخلص

الهدف من الدراسة الحالية هو تحديد تأثير تخزين القهوة البرازيلية الخضراء في ظروف مفتوحة على تركيز المركبات الفينولية. تم ضبط نسبة الرطوبة في القهوة إلى 5، 10، 15%، ثم أضيف الهيل بالتراكيز التالية: 0، 0.5، 1.5%. وكانت معاملة المقارنة خالية من مسحوق الهيل. ثم تم تخزين العينات لفترات 2 و 4 و 6 أشهر. تم قياس درجة الحرارة والرطوبة النسبية للعينات خلال فترات التخزين بالنسبة لمعدلاتها الشهرية. تم تحديد إجمالي المركبات الفينولية لجميع معاملات القهوة. أظهرت النتائج أن المتوسطات الشهرية لدرجة الحرارة والرطوبة النسبية خلال فترات التخزين تباينت من شهر إلى آخر وتراوحت المتوسطات بين 28.55 – 38.17 درجة مئوية و44.85 – 55.28%.

الكلمات المفتاحية : التخزين، المركبات الفينولية، القهوة الخضراء

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معلومات البحث

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Introduction

The coffee plant belongs to the family Rubiaceae, and within this family is the genus Coffea. The scientific name of the Arabica coffee plant is Coffea arabica [1, 2].

Green coffee is coffee prepared from raw, unroasted coffee and has many benefits because it contains antioxidants such as chlorogenic acid, caffeine, volatile substances, soluble fiber, and phenolic compounds [3].

Coffee contains many other important compounds, such as cellulose, minerals, sugars, fats, tannins, phenolic substances, and chlorogenic acid, and

coffee storage methods greatly affect these active components, such as chlorogenic acid, caffeine, and phenolic compounds [4].

Plant phenolic compounds are one of the most important primary antioxidants, including the phenolic compounds in coffee beans, which are rich in these compounds, especially the Arabica and Busta species [5].

The aim of this study is to identify the changes that occur in the phenolic compounds of Brazilian coffee during six-month storage in the presence of standardized moisture content and cardamom powder percentages.

Research materials and methods

Green coffee samples: Green coffee samples (Brazilian origin) were obtained from the local markets of the city of Mosul. They are of the Brazilian coffee type C. arabica, produced in 2017, and cardamom samples were from the local markets in the city of Mosul.

Moisture adjustment: The coffee moisture was adjusted to a moisture content of 5, 10, and 15%, as the results indicated a high convergence in moisture content, up to ± 0.5%.

Storing the coffee: The coffee was stored by distributing it into clean, sterilized plastic containers at a rate of 205 g/box, then cardamom powder was added in concentrations of 0, 0.5, and 1.5%, mixed with the sample, and stored for periods of 2, 4, and 6 months. Temperatures and relative humidity were estimated daily. Chemical tests were conducted on the concentrations of phenolic substances.

Measuring the temperature and relative humidity in the warehouse: The temperature and relative humidity in the warehouse atmosphere were measured daily using a Swiss-made Irox Easy 49 device, and the monthly average for the workers was calculated.

Determination of total phenols in coffee: Phenols in coffee were estimated using Folin Gicocalten solution (Folin reagent), and the absorbance was measured at 760 nm with a spectrophotometer with a blank sample (methanol). After that, a standard curve was made for galic acid using a spectrophotometer [6].

Statistical analysis: The data (results of the study) were analyzed using the ready-made statistical program [7] on the basis of a completely randomized design (C.R.D). Then, Duncan's test was conducted to compare the means to determine the significance of the differences for the factors affecting the studied traits using alphabetical letters at the probability level of 0.05≥P . as shown in Figure (1).

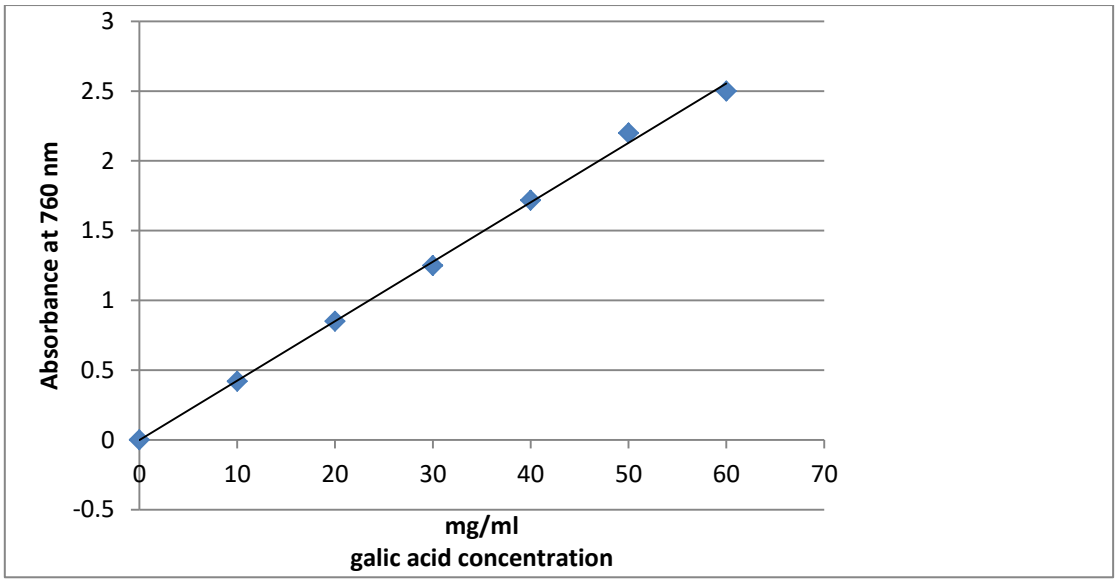

Figure (1): Standard curve of total phenolic substances estimated as gallic acid (mg/g)

Average temperatures during coffee storage:

The average temperatures during coffee storage are shown in Figure (2), as each column shows the monthly average storage temperature of Brazilian coffee, as the beginning of storage was on (4/10/2018) and the end after 6 months of storage (10/10/2018). The average temperature during the first month of storage reached 28.55°C, and the average increased with prolonged storage periods, reaching 38.17°C in the fourth month. This increase occurred during the summer months, and then temperatures decreased, especially during the last days of storage (the end of September and the beginning of October). As the temperature reached 28.79°C, these temperature levels affected many of the coffee's microbial properties (fungal growth and toxin secretion), as well as the moisture content rates and total solids concentration of the two types of coffee.

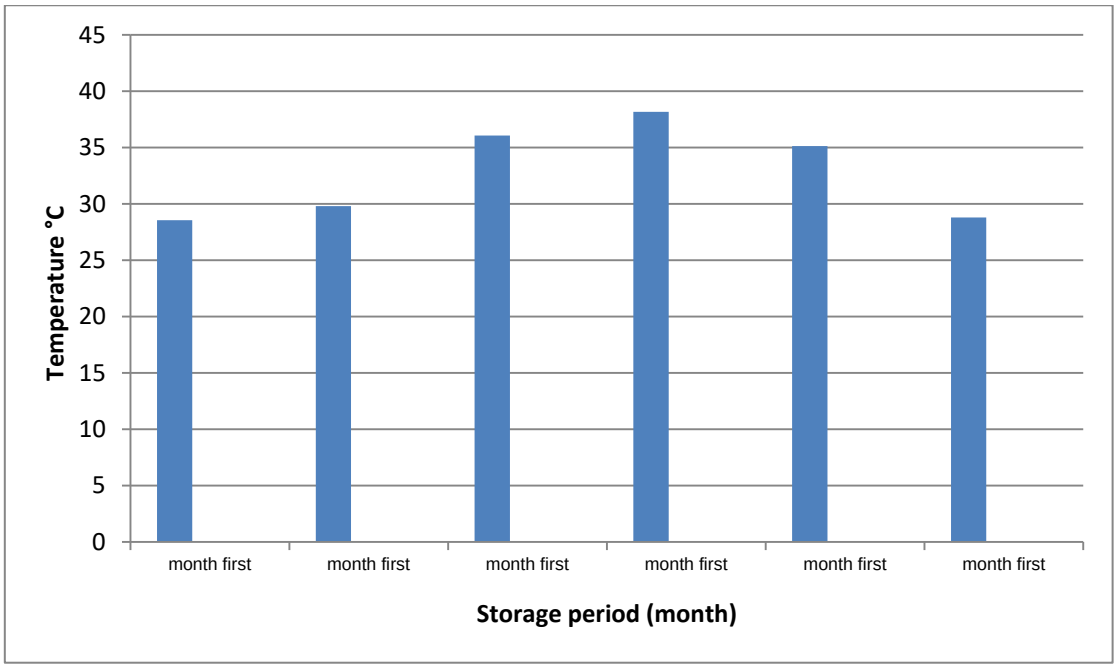

Figure (2): Average temperatures for the months of coffee storage in the open atmosphere

Storage begins 4/10/2018 and ends 10/10/2018. The columns represent the average temperature for each month.

Relative humidity rate during coffee storage:- From Figure (3) it is clear that there is a variation in the relative humidity rates for the months of storage.

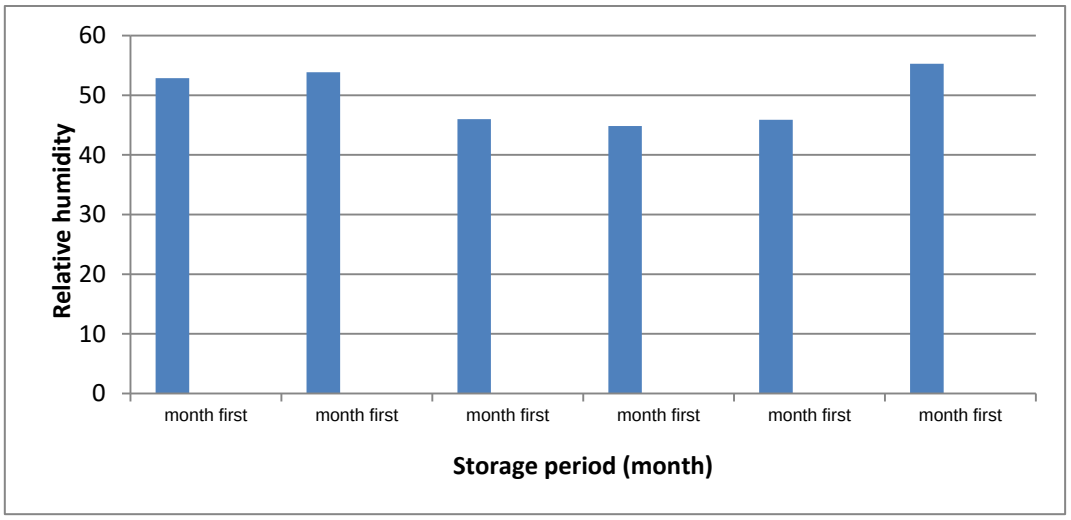

Figure (3): Average relative humidity for months of coffee storage

Storage begins 4/10/2018 and ends 10/10/2018. The bars represent the average relative humidity for each month.

Coffee while the rate was 52.86% during the first month of storage, as storage continued, there was a decrease in the relative humidity rate during the following months of storage, especially in the fourth month, when the rate reached 44.85%. This comes from the fact that these months fall within the summer months. Low in relative humidity, however, in the last month of storage, which falls between September and October, there was an increase in the rate of relative humidity. As is the case when discussing temperatures, the change in relative humidity greatly affected the microbial and chemical properties of Brazilian coffee stored in the open atmosphere [8].

Concentration of total phenolic substances in Brazilian green coffee stored in the open atmosphere

From the table it is clear that there are significant differences at the level of (P≥0.05) in the total phenolic substances, as it is noted that the level of phenolics in Brazilian coffee ranged between 12.09-13.52 mg/g of coffee at the beginning of storage. There was a change in the level of phenolics by prolonging storage periods and other variables. After two months of storage, the concentrations of phenols decreased to between 11.03-18.93 mg/g, which is significantly higher than they were at the beginning of storage, and the phenols levels increased to between 25.90-47.85 mg/g coffee after 6 months of storage, and this is due to the significant decrease in moisture in the coffee. Brazilian stored coffee, as pointed out by [9], who pointed out the effect of storage temperatures and moisture content on changing the proportions of phenolics in coffee.

From the table, it is noted that the interaction

between storage times and humidity levels changed significantly during coffee storage, and

that the lowest values were 12.09 mg/g coffee in coffee containing 15% moisture and at the beginning of storage, and the highest values reached 43.14 mg/g coffee in coffee containing 10% moisture. Humidity after 6 months of storage. This occurred due to the decrease in relative humidity and the increase in storage temperatures, as shown in Table (1).

Table (1): Concentration of total phenolic substances, estimated as gallic acid (mg/g) in green Brazilian coffee in the open atmosphere

Humidity rate	Average storage periods	interaction between storage periods and humidity	Cardamom concentration%				Humidity %	Storage periods (month)
			1.5	1	0.5	0		
		13.52 H	13.52 0.19± P S	13.52 0.19± P S	13.52 0.019± P S	13.52** 0.19± P S*	5	0
		12.66 T	12.66 0.05± Q R	12.66 0.05± Q R	12.66 0.05± Q R	12.66 0.05± Q R	10	
		12.09 Y	12.09 0.09± R	12.09 0.09± R	12.09 0.09± R	12.09 0.09± R	15	
		17.58 W	18.93 0.07± G	14.36 0.09± S	18.57 0.29± G	18.45 0.48± G	5	2
		15.54 S	11.03 0.07± S”	17.23 0.78± F	16.94 0.09± F	16.95 0.12± F	10	
		12.71 T	12.14 0.16± R	12.15 0.10± R	13.60 0.14± Q S	12.96 0.41± Q R	15	
		31.93 J	26.33 0.12± M	36.87 0.09± W	35.83 0.10± S	28.71 1.90± I	5	4
		29.47 D	23.60 0.16± S	33.06 0.12± T	29.80 1.09± K	31.42 1.90± I	10	
		28.82 H	28.63 0.05± I	28.66 0.09± I	32.69 1.97± T	25.30 0.07± N	15	
		40.29 B	47.69 0.09± A	40.25 0.12± H	41.57 0.08± D	31.66 0.09± I	5	6
		43.14 A	43.33 0.09± J	47.42 0.25± A	33.98 0.05± H	47.85 0.09± A	10	
		39.85 B	44.49 0.05± B	47.47 0.09± A	41.57 0.10± D	25.90 0.10± N M	15	
	12.75 D		12.75 I	12.75 I	12.75 I	12.75 I	0	Interference between

	15.28 J		14.03 T	14.58 H	16.37 S	16.12 S	2	storage periods and cardamom
	30.08 B		26.19 W	32.86 D	32.77 D	28.47 H	4	
	41.10 A		45.17 A	45.05 A	39.04 B	35.14 J	6	
25.83 A			26.61 B	26.25 B	27.37 A	23.08 W H	5	Interaction between moisture and cardamom
25.20 B			22.65 W	27.59 A	23.34 H	27.22 A	10	
23.3 J			24.34 D	25.09 J	24.98 J	19.06 S	15	
			24.53 W	26.31 A	25.23 B	23.12 D	the average	

***Similar letters are not significantly different at the 0.05 probability level. **Values represent averages of three replicates.**

This explains the role of these two factors in influencing the percentages of total phenols in the coffee samples, as with prolonged storage periods, a decrease in the moisture content occurred, and this led to To a high concentration of phenols. As for the interaction rates between storage periods and cardamom percentages, the lowest rate was 12.75 mg/g of coffee at the beginning of storage, and the highest rate was 45.17% mg/g of coffee after 6 months of storing the coffee to which 1.5% cardamom was added, while it appeared from the table that the interaction between The percentages of moisture and cardamom changed significantly during coffee storage, as the lowest rates were 19.06 mg/g coffee in the treatment that started with 15% moisture and free of cardamom powder, and the highest rate reached 27.59 mg/g coffee in the treatment that started with 10% moisture and 1%. Cardamom powder.

Conclusions

The conditions surrounding coffee storage have a major impact on its chemical composition.

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