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EVALUATION OF LEVELS TRACE ELEMENTS OF SIX AREAS OF PRODUCTION OF GREEN COFFEE (*COFFEA CANEPHORA*) IN CÔTE D'IVOIRE.

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Abstract: Objective: evaluate of levels trace elements of six areas of production of green coffee (*Coffea canephora*) in Côte d'Ivoire. **Methods**: The study focused on green coffee collected in six production areas selected according to major national production regions. The samples were collected in cloth bags cretonne for the promote good aeration. This study allowed the determination of levels of trace elements by atomic absorption spectrometry (AAS). **Results:** The results obtained showed that the Iron was represented in large quantities (73, 26 mg / 100 g of green coffee). Copper, Zinc and Lead were represented in small quantities respectively 2, 25; 1, 06 and 0, 12 mg / 100 g of green coffee. As for Selenium and Fluorine, they were into trace respectively, less than 0,001 and 0,005 mg / 100 g of green coffee. **Conclusion:** The green coffee of Côte d'Ivoire contains trace elements which involve systems that allow the body to fight against the harmful effect of oxidative stress and cardiovascular diseases.

Keywords: Green coffee (*Coffea canephora)*, Trace elements, Oxidative stress, Cardiovascular diseases and Côte d'Ivoire.

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INTRODUCTION

The green Coffee (*Coffea canephora*) was introduced in Côte d'Ivoire in 1930. Today, with a production of about 150,000 tons, Côte d'Ivoire stands as one of the main producing countries [1]. Market demands require coffee production of high quality [2]. The quality improvement is essential for coffee consumption [1]. Numerous studies have identified different constituents of coffee [3-4-5]. The presence of these compounds is depending on the species and especially the production area [6-7]. These components have an impact on consumer health, unlike caffeine and at chlorogenic acid which have been the subject of numerous studies, Very little data are available, in Côte d'Ivoire, on the levels trace elements contained in coffee that are between 3 and 5 % of the dry weight of the grains [5]. Trace elements are essential for the proper functioning of the body [8-9]. Studies have shown that green coffee is rich in trace elements, such as, potassium, sodium, copper, iron, zinc which are also indicators of the quality of the product [7-10-11]. The objective of this work was to evaluate of levels trace elements of six areas of production of green coffee (*Coffea canephora*) in Côte d'Ivoire in order to have a competitive green coffee and very good for the health of the consumer.

MATERIAL AND METHODS

Study samples

We used coffee beans (*Coffea canephora*). The sampling took place in the period of May and June matching the intermediate season. The samples were collected in cloth bags cretonne for the promote good aeration.

Study areas

The study areas were production cities grouped into six areas

Area 1: Aboisso, Adiaké, Ayamé

Area 2: Adzopé, Agboville, Alépé

Area 3: Abengourou, Bongouanou, Dimbokro

Area 4: Divo, Gagnoa, Lakota

Area 5: San Pedro, Sassandra, Soubré

Area 6: Daloa, Duekoué, Issia

Technical equipment

The samples were analyzed at the Company's mineral analysis laboratory for the Mining Development of Côte d'Ivoire (SODEMI) in Abidjan. The study required a muffle furnace, an incubator, a dessicator, a precision balance and an atomic absorption spectrophotometer, concentrated nitric acid (HNO_3, 69 %), demineralized water and standard solutions of different trace elements (Iron, Copper, Zinc, Lead, Selenium and Fluorine).

Mineralisation

100 g of green coffee were taken in dry crucibles and heated to 105 °C in an incubator for 08 hours. The dry matter obtained was brought to 550°C in a muffle furnace for 08 hours. The crucible containing the ashes was removed and placed in a desiccator to cool to room temperature.

Assays minerals

The assays were performed by atomic absorption spectrophotometry. 1g of the ash was taken up with 2 ml of HNO_3 (69%). The mixture was transferred to plastic tubes of 50 ml and supplemented up to the gauge with demineralised water. The solution obtained is homogenized. Same time one blank for each mineral has been prepared, it consisted of demineralised water at 1%, nitric acid and the mineral from stallion to be assayed. A calibration curve resulting absorbance versus of the concentration was deduced for each sample the concentration of the element in percentage of dry matter.

Statistical analysis

The results are expressed as mean ═ SEM (Standard Error of Mean). We used the statistical programs: Stat View ® 4.01 (Mind Vision Logiciels, Concepts, Inc., Berkeley, CA, USA) and GraphPad Prism ® (version 4.00; GraphPad Software Inc., San Diego, CA, USA).

RESULTS

Iron content

Figure 1 gives iron content of green coffee produced in the six areas of our study. This content is very high in zones 6 and 3 with values of 73,26 and 59,81 mg / 100 g of green coffee. This value is low in zones 1 and 2 with the respective values of 8, 22 and 6,76 mg / 100 g of green coffee.

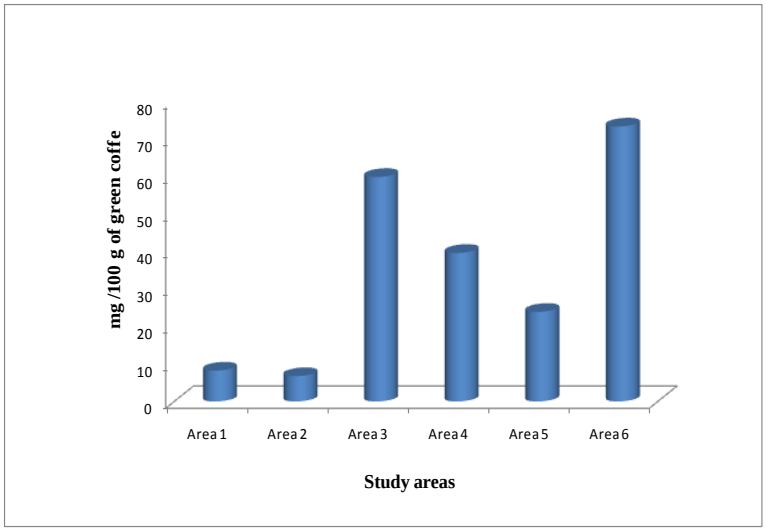

Figure1: Iron content

Copper content

Copper content of green coffee in the six areas has a maximum value of 2,25 mg / 100 g in Zone 6 and the lowest value was 1,75 mg / 100 g of green coffee in Zone 2 (**Fig. 2**).

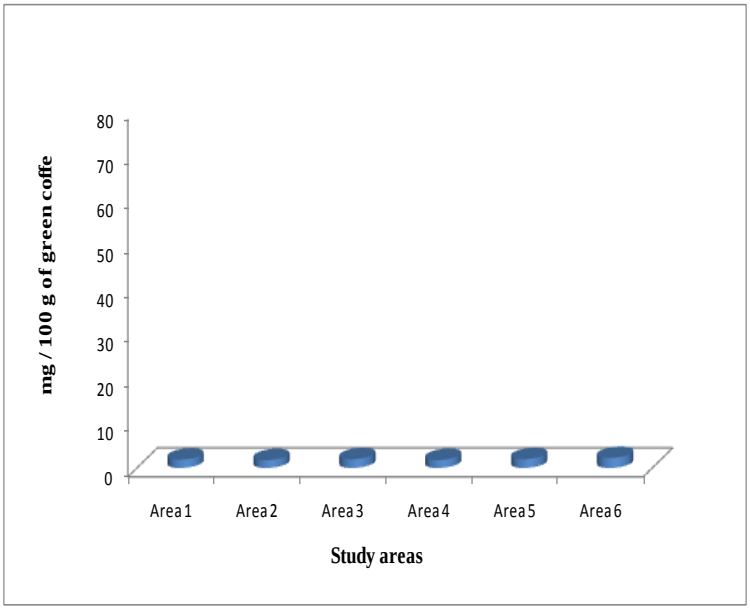

Figure 2: Copper content

Zinc content

Zinc content of the six regions is shown in figure 3. High values are found in zones 4, 6 and 5 respectively of 1, 06; 1, 04 and 1,03 mg / 100 g of green coffee. The weakest value is in zone 2, with a value of 0, 75 mg / 100 g of green coffee.

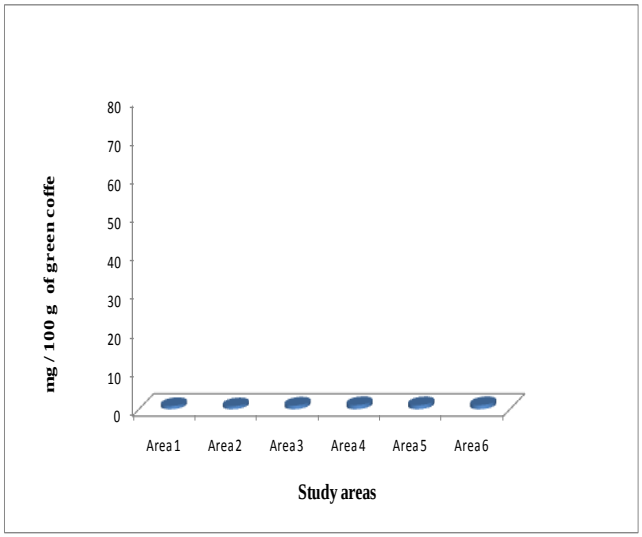

Figure 3: Zinc content

Lead content

Figure 4 shows that the lead content determined within six growing areas is low. The largest value is in the areas 4 and 5 with a value of 0.12 mg / 100 g green coffee. The lower value is 0, 07 mg / 100 g of green coffee in Zone 2.

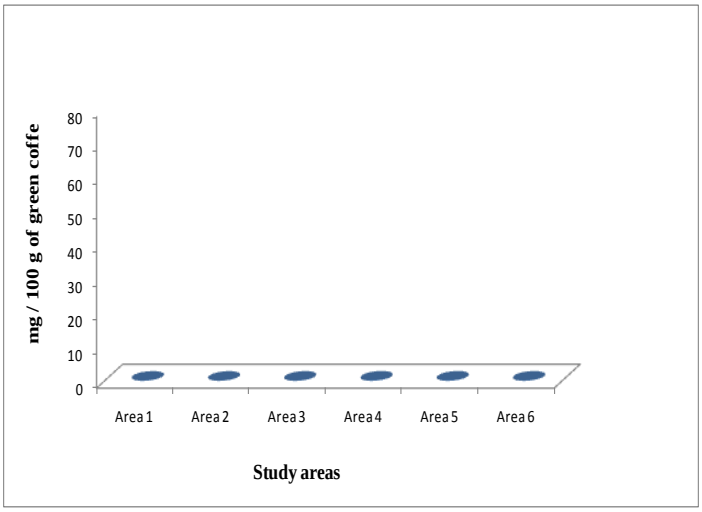

Figure 4: Lead content

Levels of Selenium and Fluorine

These two trace elements are found in very small quantities (Trace) in the green coffee produced in the six areas. Selenium is estimated at less of 0,001 mg / 100 g of green coffee. Content of fluorine is less than 0,005 mg / 100 g of green coffee **(Table I).**

Table I. Levels of Selenium and Fluorine in 100 g of green coffee

	Trace elements (mg / 100 g of green coffee)	
Areas	**Selenium**	**Fluorine**
1	< 0,00 1	< 0,005
2	< 0,00 1	< 0,005
3	< 0,00 1	< 0,005
4	< 0,00 1	< 0,005
5	< 0,00 1	< 0,005
6	< 0,00 1	< 0,005

DISCUSSION

Our study aimed to evaluate the trace elements of green coffee producing areas in Côte d'Ivoire. The results showed that the iron was strongly represented in the coffee with a value of 73, 26 mg/ 100 g of green coffee **(Fig.1).** Trace elements such as copper, zinc and lead are shown in small quantities with respective maximum values of 2, 25 ; 1,06 et 0,12 mg/ 100 g of green coffee (**Figs. 2; 3; 4**). Selenium and fluorine are very poorly represented (Traces) with values of less than 0,001 and 0,005 mg/ 100 g of green coffee respectively **(Table I).**

Our results are consistent with the results conducted by several research teams on proportions of trace elements such as iron, copper, zinc and lead contained in Robusta coffee. Proportions of trace elements range between 4 and 4, 5 % [7-3]. Trace elements are not produced by the body, but in food [6]. Coffee is a beverage consumed much in our regions, it contains trace elements that are beneficial to our body [11-2]. In our study, we showed that the iron had a

high value in zone 6 with a value of 73, 26 mg/ 100 g of green coffee. Iron is essential for the production of hemoglobin of red blood cells and at proper functioning of muscles. Iron deficiency causes anemia, source of great tiredness [12]. The low content of Iron of 6,76 mg/ 100 g of green coffee in zone 2 is due to the variability of soil [11].

Copper is found in small quantities in the coffee with a maximum value of 2, 25 mg/ 100 g of green coffee. Green coffee is a provider of trace elements. Copper is essential for numerous reactions in the body, particularly in the digestion [10]. A deficiency in the body Copper causes a risk of cardiovascular disease [4]. Our results show that green coffee produced in the study areas gives a value of 1, 06 mg/ 100 g of green coffee of Zinc, who is a trace element necessary for the proper functioning of the epidermal cells. Zinc acts on the breath and is a vital element which acts as an antioxidant and prevents the harmful effects of free radicals [12].

Our results gave a small amount of Selenium and Fluorine respectively 0,001 and 0,005 mg/ 100 g of green coffee. Fluorine is a trace element essential to the health of our teeth. As against the Selenium is a powerful antioxidant that plays a protective role in the cardiovascular system. These trace elements are used in low doses [13-14]. Our experimentation has shown that lead is contained in small amounts in green coffee at the rate of 0, 12 mg / 100 g of green coffee. Lead is classified as toxic trace elements in high doses for the body [1]. To protect itself from this toxic effect of oxygen, the organism has developed defense systems that eliminate Free Radicals (FR). These systems consist of antioxidants, trace elements and proteins that prevent the iron to trigger production of Free Radicals [15-16]. Antioxidants and trace elements are the only molecules that can trap and neutralize Free Radicals [17]**.** Living organisms do not produce trace elements, they come from foods or beverages such as green coffee. These trace elements have systems that allow the body to fight against the harmful effects of oxidative stress and cardiovascular disease [12-18-19].

CONCLUSION

Our study to determine the trace element content contained in green coffee (*Coffea canephora*) produced in six areas of Côte d'Ivoire. The results showed that our green coffee contains Iron in large quantities. Copper, Zinc and Lead are represented in small quantities. The Selenium and Fluorine, they exist in very small quantities (traces). The green coffee of Côte d'Ivoire contains trace elements that have systems that allow the body to fight against the harmful effects of oxidative stress and cardiovascular disease.

DECLARATION OF CONFLICT OF INTEREST

The authors wish to declare that there is no conflict of interest.

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