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# Determination of Cadmium, Lead, Nickel and Zinc in Some Green Tea Samples Collected from Libyan Markets

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**Abstract:** Green tea is one of the most common drinks in all cities of Libyan. Heavy metal contents such as cadmium (Cd), lead (Pb), nickel (Ni) and zinc (Zn) were determined in four green tea samples collected from Libyan market and their tea infusions by using atomic Absorption spectrophotometry after acid digestion. The results obtained indicate that, the concentrations of Cd, Pb, Ni and Zn in tea infusions samples ranged from 0.07-0.12, 0.19-0.28, 0.09-0.15, 0.18-0.43 mg/l after boiling for 5 min.; 0.06-0.08, 0.18-0.23, 0.08-0.14, 0.17-0.27 mg/l after boiling for 10 min.; 0.07-0.11, 0.18-0.24, 0.08-0.14, 0.21-0.34 mg/l after boiling for 15 min. respectively. On the other hand, the concentrations of the same element mentioned above obtained in tea leaves ranged from 6.0-18.0, 36.0-42.0, 16.0-20.0, and 44.0-132.0 mg/kg respectively. The concentrations of Cd, Pb, Ni and Zn in tea leaves samples were higher than prevention of food adulteration (PFA) limit and world health organization (WHO) permissible limit.

***Keywords*:** Boiling, Infusion, Heavy Metals , Green Tea.

## INTRODUCTION:

In Libya, the consumption of green tea is very high
compared with black teas. The chemical components of tea leaves and their infusions have received great interest because of their

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relation to health and disease (Cooper, 2012; Stagg and Millin, 1975; Coriat and Gillard, 1986). Some of the possible beneficial effects of drinking tea are: antioxidative activity (Luczaj and Skrzydlewska, 2005), immune system boosting (Mark, 2007), protective effect against a range of cancers including lung, prostate, and breast cancer (Siddiqui et al., 2005; Way et al., 2004; Record and Dreosti, 1998) and reduction of blood cholesterol levels (Fujita and Yamagami, 2008).

The chemical composition of tea leaves and manufactured tea is very complex. Itnd consists of tanning substances, flavonols, alkaloids, proteins and amino acids, enzymes, aroma-forming substances, vitamins, minerals and trace elements (Jha et al., 1996). Several elements, such as Ca, Na, K, Mg and Mn, are present at mg/g level, whereas elements such as Cr, Fe, Co, Ni, Cu, Zn and Cd are present at a few µg/g. The elemental contents in tea leaves may depend on several factors such as geographical location where the plant is cultivated, fertilizer, industrialization process and storage condition.

**Table 1:** Green tea samples

| Sample | Tea Name | Manufactured by |
|---|---|---|
| 1 | Masoud | Hangzhou Everlong Imp. & Exp. Co., Ltd, Hangzhou, China |
| 2 | Gunpowder | China Tea (Hunan) Co., Ltd, Changsha, Hunan, China |
| 3 | Flecha | Zhejiang Highthen Imp. & Exp. Co., Ltd., Hangzhou,China |
| 4 | Lipton | Unilever Gulf FZE, Jebel Ali, United Arab Emirates |

## MATERIALS AND METHODS:

Four of the most widely consumed brands of green tea were purchased from local Libya markets and listed in **Table 1.**

For the determination of cadmium (Cd), lead (Pb), nickel (Ni) and zinc (Zn) contents:

a) In green tea leaves, accurately weighed (0.5 g) of each sample was transferred into a quartz-glass beakers and kept at 450 °C for 16 hours on a hot plate and in a muffle furnace for ashing and digested using 10 ml of a mixture (2:1v/v) concentrated $HNO_3$ and HCL. The mixture was heated on hot plate ,then the digest was transferred into 100 ml volumetric flask after filtered (Whatman 42) and adjusted to the mark using distilled water .

b) Tea infusions were prepared to test the solubility of the metals after (a) 5 min, (b)10 min, (c)15 min as follows: 100 ml of hot distilled water was added to 2 g of sample .After the given time, tea infusion were lift to cool at room temperature for 2 min and then filtered through filter paper (Whatman No 42), then digested by added 3 ml of concentrated $HNO_3$ 65% and 5ml conc. HCL 37% ,the sample covered and heated on hot plate, the solution filtered and the infusion diluted to 100ml with deionized water and immediately measured. The pH of the tea infusions were determined potentiometrically.

Atomic Absorption spectrometry (AAS) with a GBC 932 Avanta Ver. 1. 33 (Austria) was used for the cadmium (Cd), lead (Pb), nickel (Ni) and zinc (Zn) determination in in green tea leaves and green tea infusion.

## RESULTS AND DISCUSSIONS:

The pHs of the tea infusions were in the range of 5.03-6.15 (average value 5.38) as shown in **Table 2**&**Fig 1**.

**Table 2:**pHs of green tea infusions.

| Sample | pH | | |
|---|---|---|---|
| | 5 min | 10 min | 15 min |
| 1 | 5.67 | 5.47 | 5.42 |
| 2 | 5.21 | 5.35 | 6.15 |
| 3 | 5.41 | 5.39 | 5.40 |
| 4 | 5.03 | 5.05 | 5.06 |

The concentrations of Cadmium (Cd), Lead (Pb), Nickel (Ni) and Zinc (Zn) elements of the four brands of green tea product that are determined in this study are summarized in **Tables 3-6**.

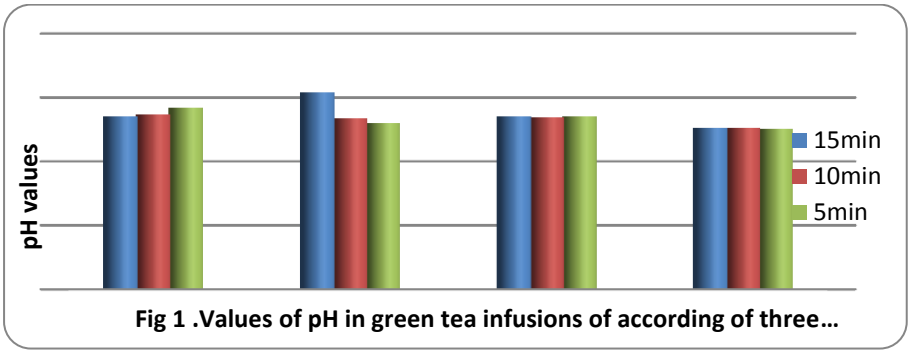


**Fig 1 .Values of pH in green tea infusions of according of three…**

**Zinc (Zn):** The result shows that these four brands of green tea product contained Zn concentrations ranging from 44.0 to 132.0 mg/kg in leaves and 0.17 to 0.43 mg/l in infusion as shown in **Table 3**&**Fig2.**The lowest concentration (44.0 mg/kg) was observed in Lipton tea leaves brand and the highest concentration (132.0 mg/kg) was observed in FLECHA tea leaves brand.

**Table 3:** Contents of **Zinc** in tea leaves (mg/kg), concentrations of zinc in tea infusions in relation to extraction times (mg/l), and relative part of soluble zinc in tea infusions (%).

| Sample | Leaves content mg/kg | Infusion content | | | | | |
|---|---|---|---|---|---|---|---|
| | | 5 min | | 10 min | | 15 min | |
| | | mg/l | % | mg/l | % | mg/l | % |
| 1 | 48.0 | 0.26 | 27.1 | 0.17 | 17.7 | 0.22 | 22.9 |
| 2 | 86.0 | 0.43 | 25.0 | 0.26 | 15.1 | 0.26 | 15.1 |
| 3 | 132.0 | 0.26 | 9.8 | 0.27 | 10.2 | 0.34 | 12.9 |
| 4 | 44.0 | 0.18 | 20.5 | 0.20 | 22.7 | 0.21 | 23.9 |

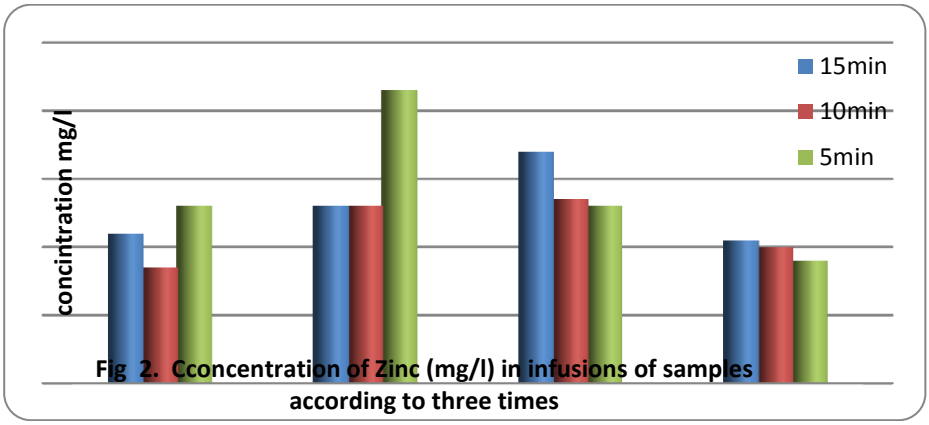


Fig 2. Cconcentration of Zinc (mg/l) in infusions of samples according to three times

**Nickel (Ni):** Ni concentration was observed to range from 16.0 to 20.0 mg/kg in tea leaves and 0.08 to 0.15 mg/l in tea infusion as shown in **Table 4**&**Fig 3**.

**Table 4:** Contents of **Nickel** in tea leaves (mg/kg), concentrations of nickel in tea infusions in relation to extraction times (mg/l), and relative part of soluble nickel in tea infusions (%).

| Sample | Leaves content mg/kg | Infusion content | | | | | |
|---|---|---|---|---|---|---|---|
| | | 5 min | | 10 min | | 15 min | |
| | | mg/l | % | mg/l | % | mg/l | % |
| 1 | 16.0 | 0.09 | 28.1 | 0.08 | 25.0 | 0.08 | 25.0 |
| 2 | 20.0 | 0.15 | 37.5 | 0.09 | 22.5 | 0.09 | 22.5 |
| 3 | 20.0 | 0.14 | 35.0 | 0.14 | 35.0 | 0.14 | 35.0 |
| 4 | 16.0 | 0.10 | 31.3 | 0.11 | 34.4 | 0.11 | 34.4 |

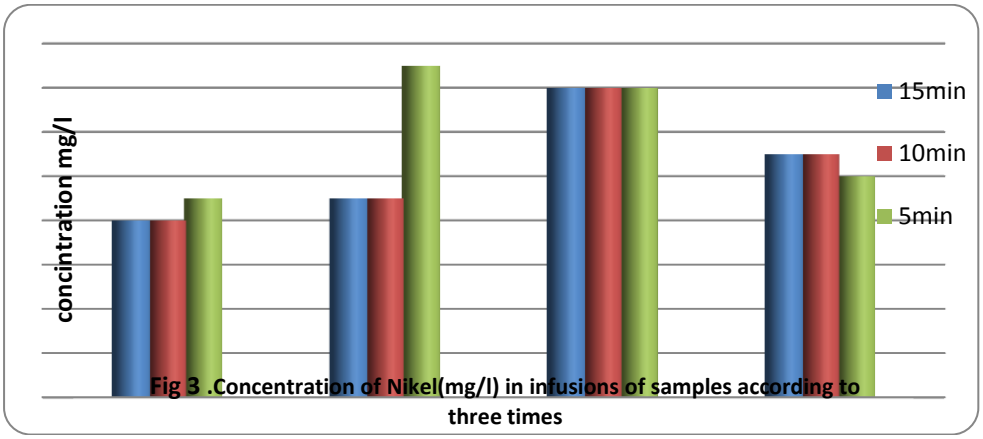


Fig 3 .Concentration of Nikel(mg/l) in infusions of samples according to three times

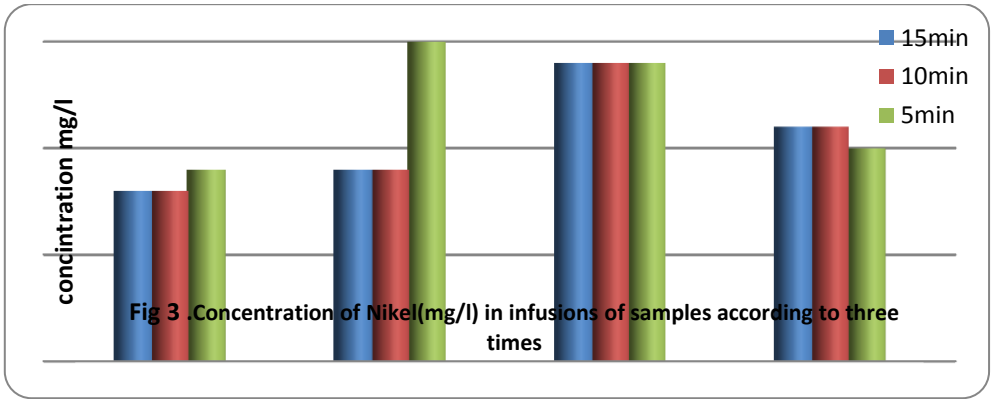


Fig 3 .Concentration of Nikel(mg/l) in infusions of samples according to three times

**Lead (Pb):** The levels of Pb were in the range of 36.0 to 42.0 mg/kg in tea leaves and 0.18 to 0.28 mg/l in tea infusion as shown in **Table 5&Fig 4**.

**Table 5:** Contents of **Lead** in tea leaves (mg/kg), concentrations of lead in tea infusions in relation to extraction times (mg/l), and relative part of soluble lead in tea infusions (%)

| Sample | Leaves content mg/kg | Infusion content | | | | | |
|---|---|---|---|---|---|---|---|
| | | 5 min | | 10 min | | 15 min | |
| | | mg/l | % | mg/l | % | mg/l | % |
| 1 | 38.0 | 0.19 | 25.0 | 0.18 | 23.7 | 0.18 | 23.7 |
| 2 | 42.0 | 0.28 | 33.3 | 0.20 | 23.8 | 0.19 | 22.6 |
| 3 | 36.0 | 0.21 | 29.2 | 0.22 | 30.6 | 0.24 | 33.3 |
| 4 | 38.0 | 0.22 | 28.9 | 0.23 | 30.3 | 0.22 | 28.9 |

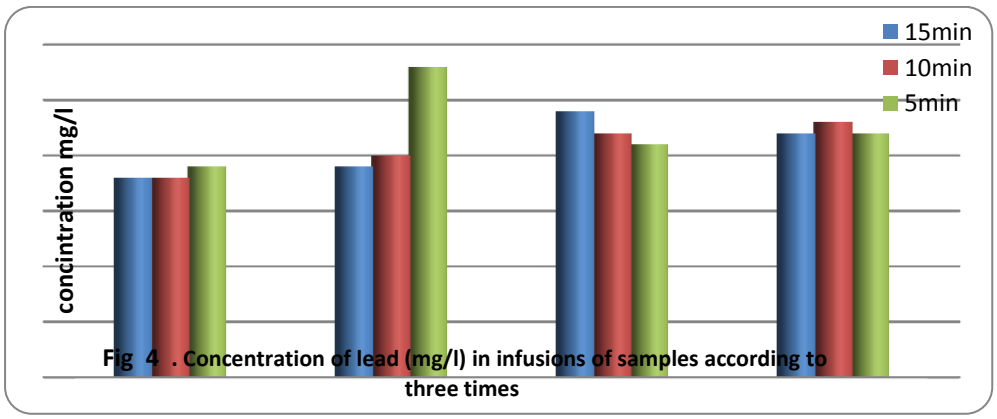


Fig 4 . Concentration of lead (mg/l) in infusions of samples according to three times

**Cadmium (Cd):** Cd levels in green tea samples included in the present study were in the ranged of 6.0 to 18.0 mg/kg in tea leaves (lowest in FLECHA; highest in GUNPOWDER tea brand) and 0.06 to 0.12 mg/l in tea infusion as shown in **Table 6&Fig 5.**

**Table 6:** Contents of **Cadmium** in tea leaves (mg/kg), concentrations of cadmium in tea infusions in relation to extraction times (mg/l), and relative part of soluble cadmium in tea infusions (%)

| Sample | Leaves content mg/kg | Infusion content | | | | | |
|---|---|---|---|---|---|---|---|
| | | 5 min | | 10 min | | 15 min | |
| | | mg/l | % | mg/l | % | mg/l | % |
| 1 | 12.0 | 0.08 | 33.3 | 0.06 | 25.0 | 0.07 | 29.2 |
| 2 | 18.0 | 0.12 | 33.3 | 0.08 | 22.2 | 0.07 | 19.4 |
| 3 | 6.0 | 0.12 | 100 | 0.08 | 66.7 | 0.09 | 75.0 |
| 4 | 14.0 | 0.07 | 25.0 | 0.08 | 28.6 | 0.11 | 39.3 |

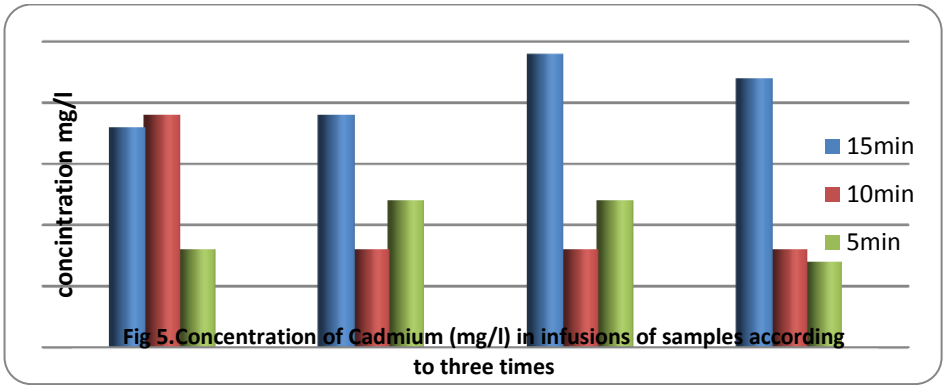


Fig 5.Concentration of Cadmium (mg/l) in infusions of samples according to three times

## CONCLUSION:

In this study concentrations of the cadmium, lead, nickel and zinc were measured in four green tea samples from different locations in leaves and different infusion times using AAS method. Concentrations of Cd, Pb, Ni and Zn in tea leaves were ranged from 6.0 to 18.0, 36.0 to 42.0, 16.0 to 20.0 and 44.0 to 132.0 mg/kg respectively and in tea infusions were ranged from 0.06 to 0.12, 0.18 to 0.28, 0.08 to 0.15 and 0.17 to 0.43 mg/l respectively.

## REFERENCES:

**1**.Cooper R. 2012. Green tea and theanine: health benefits. Int. J. Food Sci. Nutr. 63: 90-97.

**2**.Stagg G.V. and Millin D.J. 1975. The nutritional and therapeutic value of tea – review. J. Sci. Food Agric. 26:1439-1459.

**3**.Coriat A.M. and Gillard R.D. 1986. Beware the cup that cheers. Nature. 321, 570.

**4**.Luczaj W. and Skrzydlewska E. 2005. Anti-oxidative properties of black tea. Prev. Med. 40:910-918.

**5**.Mark H. 2007. The beneficial effects of tea on immune function and inflammation: a review of evidence from in vitro, animal, and human research. Nutr. Res. 27:373-379.

**6**.Siddiqu I.A., Raisuddin, S. and Shukla Y. 2005. Protective effects of black tea extract on testosterone induced oxidative damage in prostate. Cancer Lett. 227:125-132.

**7**.Way T., Lee H., Kao M. and Lin J. 2004. Black tea polyphenol the aflavins inhibit aromatase activity and attenuate tamoxifen resistance in HER2/neu-transfected human breast
cancer cells through tyrosine kinase suppression. Eur. J. Cancer. 40:2165-2174.

**8**.Record I.R. and Dreost I.E. 1998. Protection by black tea and green tea against UVB and UVA + B induced skin cancer in hairless mice. Mutat. Res. 422:191-199.

**9**.Fujita H. and Yamagami T. 2008. Antihypercholesterolemic effect of Chinese black tea extract in human subjects with borderline hypercholesterolemia. Nutr. Res. 28:450-456

**10**.Jha A., Mann R. S. and Balachandran R. 1996. Tea: A refreshing beverage. Indian Food Industry. 15:22-29.