Evaluation of Related Potential Health Risks for Dry Black Tea from Baghdad's Markets

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Abstract

Background: Tea is the most widely consumed beverage on the planet. Tea consumption is helpful to human health since it includes various key elements. The presence of heavy metals in tea at trace levels has gotten a lot of attention since they are linked to health.

Methodology: To gather data on the prevalence of heavy metals in black tea, a basket survey was done in the tea markets in Baghdad.

Results: A total of 36 black tea samples were examined for heavy metals. The averages of heavy metals levels were Pb (1.92±0.67mgkg$^{-1)}$, Cu (9.4±1.51mgkg$^{-1)}$, Zn (13.625±1.82mgkg^{-1}), and Fe (81.15±18.52 mgkg^{-1},). According to the results, all heavy metals levels were acceptable range and no risk possible following tea consumption.

Conclusion: The information in this database could be used to set tolerance limits for other heavy metals in tea.

Aim: The aim of this work is to evaluate the levels of heavy metals in back tea.

Keywords: heavy metals, black tea, Baghdad markets.

1. Introduction

Tea is one of the world's most popular beverages, and its health advantages are well known including medicinal properties (1). Tea may be a good source of manganese, and the high potassium content may be advantageous for hypertensive people (2). Heavy metal contamination in food and beverages is damaging to human health, and numerous nations have enacted food rules to limit heavy metal concentrations in food and beverages. The potential health effects of trace metals in tea have been examined in many papers, as the tea bush is known to acquire those (3).

The contents of numerous elements in several portions of the tea plant, such as the shoot, mature leaf, small stem, tick wood, and root, in black tea prepared by the crush–tear–curl and orthodox procedures, and in the tea brew, were examined by(4). There are a few papers on the presence of heavy metals in tea and the analytical challenges connected with separating them from tea leaves (5).

Heavy metals are mostly found in plants' growth media, nutrition, agro inputs, and soil. Pesticides and fertilizers are possible additional sources. Plants are harmed by high heavy metal levels, which result in delayed flowering, decreased chlorophyll content, and a reduction in the number and quality of shoots (6).

We don't have a lot of information on the heavy metal content of black tea from south India, which produces roughly 230 million kg of tea per year and exports nearly half of it. About a hundred tea samples were collected and evaluated for heavy metals such as nickel, chromium, lead, cadmium, and copper in different factories in southern India. Many components have an important role in human metabolic processes and overall health. Copper in trace amounts is necessary for human health. Zinc, manganese, iron, copper, magnesium, titanium, aluminum, strontium, bromine, sodium, potassium, phosphorus, iodine, and fluorine are all found in tea leaves. The tea infusion is low in protein, vitamins, and carbs; however, it may include important dietary metals and metal binding polyphenols (7).

2. Materials and methods

2.1. Sample collection

A total of 36 black tea samples were collected from different markets in Baghdad city. Collection was used numeric plastic bags full size 500 gram for 1 month of work. Samples were brought to the laboratory and kept to analyst.

2.2. Sample preparation

The glassware containers used in the study were washed with tap water before being immersed overnight in 6 N HNO3 solutions and rinsed with ultra-pure water multiple times to remove detergent absorption (8). The standard approach outlined in Official methods of analysis (AOAC) (9) was used to prepare samples for heavy metal analysis. Before 5 ml of 6 M HCl was poured into the crucible, a prepared tea sample was carefully weighed (0.5 g) and placed in a silicon crucible that was heated in a muffle furnace for 3 hours at temperature 450 C for aching.

It was ensured that every ash particle came into contact with the acid. To achieve a clean solution, the crucible containing the acid solution was heated and digested. Dissolving the final residue in 0.1 M HNO3 solution yielded up to 50 mL. To create standard solutions, Perkin–Elmer Pure Atomic Spectroscopy Standards (NIST traceable CRM, Perkin–Elmer Corporation, USA and Merck – Germany) were utilized. Working standard solutions were prepared by diluting the stock solution with 0.1 M nitric acid to confirm the linearity (10, 11).

2.3. Analytical procedure

Cu, Pb, Zn, and Fe in tea samples were evaluated using an atomic absorption spectrophotometer (AA Analyst 800, Perkin–Elmer Corporation, USA) with flame and graphite furnace. An air-acetylene flame was used to determine the metal content. For Cu, Pb, and Zn, the instrument was operated in flame mode with acetylene 2 ml/min and air 17 ml/min, and in graphite furnace mode (Pb and Fe), the manufacturers' inert argon gas flow and temperature parameters were followed (12).

Data from triplicate measurements were rounded off to the nearest tenth of a standard deviation. Metal content in black tea samples was determined using the described approach. 1 g of tea was put to a mixture of 9 mL concentrated HNO3 and 3 mL concentrated HCl in a beaker to digest these samples. With distilled water, the sample volume was increased to 25 mL after digestion. Blanks were made in the same way as the sample and went through the same pre-concentration technique as the sample.

3. Results

The results of analysis of the tea sample are summarized in (Table 1). In tea, Pb was (1.9200 ± 0.70158) ppm, Cu was (9.400 ±1.5736) ppm, Zn was (13.625 ± 1.9046) ppm, and Fe was (81.150 ± 19.3415) ppm.

Table (1): Descriptive statistics of heavy metals levels recorded in tea samples by atomic absorption spectrophotometer.

Descriptive Statistics						
Metal	**N**	**Range**	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Pb ppm	**12**	**1.69**	**1.31**	**3.00**	**1.9200**	**0.70158**
Cu ppm	**12**	**6.6**	**5.7**	**12.3**	**9.400**	**1.5736**
Zn ppm	**12**	**6.9**	**10.3**	**17.2**	**13.625**	**1.9046**
Fe ppm	**12**	**53.3**	**54.7**	**108.0**	**81.150**	**19.3415**
Valid N (listwise)	**12**					

The results of this study showed that all tested metals in all samples of the study were under the warring level, which mean that consuming the tea is safety for the human health (Table 2).

Table (2): Normal and warning levels of heavy metals recorded in tea samples by atomic absorption spectrophotometer.

No.	Pb ppm	Cu ppm	Zn ppm	Fe ppm
1	**3.0**	**8.7**	**11.4**	**108.0**
2	**1.87**	**9.6**	**13.2**	**93.0**
3	**1.52**	**10.2**	**12.4**	**61.4**
4	**1.31**	**9.3**	**13.2**	**54.7**
5	**1.35**	**10.5**	**16.2**	**62.0**
6	**1.45**	**9.9**	**13.9**	**66.7**
7	**1.52**	**10.2**	**17.2**	**88.0**
8	**1.35**	**5.7**	**10.3**	**66.7**
9	**1.32**	**9.3**	**13.4**	**70.7**
10	**2.85**	**12.3**	**13.6**	**100.0**
11	**2.55**	**9.0**	**15.2**	**96.0**
12	**2.95**	**8.1**	**13.5**	**106.6**
Mean ± SD	**1.92±0.67**	**9.4±1.51**	**13.625±1.82**	**81.15±18.52**
Range	**1.31-3**	**5.7-12.3**	**10.3-17.2**	**54.7-108**
Normal level (A) (mg/kg/day)	**20**	**20**	**-**	**-**
Warning threshold (mg/kg)	**50**	**100**	**20**	
Normal level (B) (mg/kg/day)	**0.3**	**73.3**	**-**	**-**
RfD (Mgkg-1 Element Bwday-1)	**3.5×10-3**	**4×10-2**	**3×10-1**	**0.7**

Pb level recorded in tea samples by this study found to be less than recorded in Turkey, but it was more than recorded in KSA and Japan. Cu, Zn, and Fe levels receded in tea samples in this work found to be less than those recorded in Turkey, KSA, and Japan (Table 3).

Table (3): Heavy metal levels in tea recorded in different countries comparing with our study.

Metal	This study	Iraq (Hadi and Karkaz 2016)	KSA	Turkey	Japan
Pb	**1.92 ± 0.67**	**0.37±0.03**	**1.7± 0.8**	**8.3±0.1**	**0.71±0.02**
Cu	**9.4±1.51**	**1.53±0.06**	**18.1±6.9**	**24.8±1.4**	**27.7±0.7**
Zn	**13.6±1.8**	**4.02±0.67**	**65.7±31.3**	**140.9±9.1**	**36.6±0.7**
Fe	**81.1±18.5**	**NA**	**250.5±199**	**NA**	**134±48**

In general, the levels of Fe were recorded in more levels than the other elements. The Pb content of all of the made tea samples in our study was less than 10 mg kg 1, which was the limit set by the PFA Act. (Figure1).

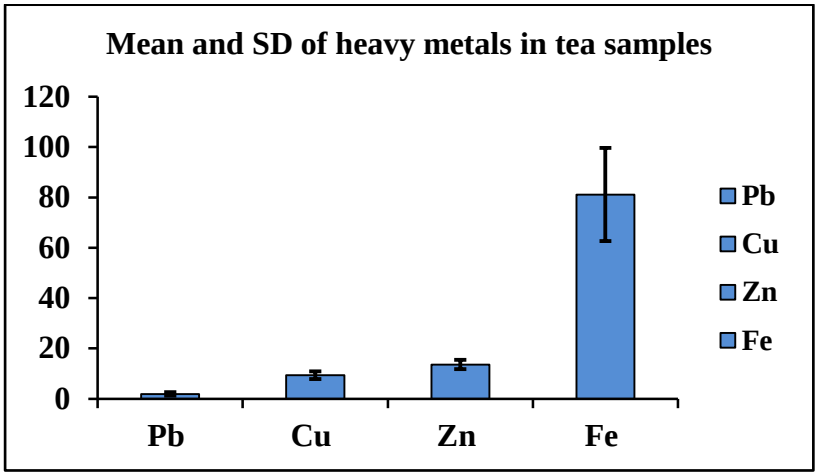

Figure (1): Mean and SD of heavy metals recorded in tea samples collected from Iraqi markets

4. Discussion

The amount of heavy metal in black teas collected from various locations of Baghdad city varied significantly. The amounts of Pb, Cu, Zn, and Fe in tea varied depending on the agroclimatic zone, according to the findings. Tea is consumed in around 3 billion cups each day around the world (13).
The daily average intake of tea in Iraq is roughly 0.5 litters of black tea (14). Tea consumption per capita in the United States was estimated to be 7.3 gallons in 1988 (15).

Although the use of copper in small amounts poses no health or environmental risk, excessive use will result in undesirable copper levels in black tea. According to the investigation, copper concentrations in prepared tea samples ranged from 15.9 to 32.2 mg kg1. Copper is a naturally occurring metal found in tea that is required for the polyphenol oxidase enzyme to function. Along with Al and Zn, it is one of the most significant components in tea. Nilgiris tea samples had the lowest copper levels, whereas Gudalur tea samples had the highest (16). Researchers were reported on the content of copper in produced tea (17). All of the produced tea samples had a Cu level of less than 30 mg kg1, well below the 150 mg kg1 allowed by India's Prevention of Food Adulteration Act (18). Potassium fertilizers, phosphate fertilizers, N–P–K mixes, manganese, zinc, boron, and magnesium sources all contain lead (19).

Zinc is used as a foliar spray to feed zinc, which is the only micronutrient that is frequently deficient in tea. Pb may penetrate the tea plant when foliar applied zinc sulphate tainted with lead. Copper fungicides sprayed with heavy metal impurities may promote the accumulation of Pb and Cd in tea. One of the most common sources of Pb contamination is copper oxychloride (20). Because tea soils are acidic, heavy metals dissolve more easily. Tea bushes in high traffic areas are exposed to Pb and Cd from automotive exhaust and dust (21). The average Pb level in Chinese black tea samples was 1.42 mg kg 1. (16).

5. Conclusion

Cu and Pb levels in black tea from south India were below the PFA limit of 150 and 10 mg kg1, respectively, according to a database created for heavy metals in black tea. The data produced could be used to set tolerance limits in tea for other heavy elements as chromium, nickel, and cadmium.

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تقييم المخاطر الصحية المحتملة ذات الصلة للشاي الأسود الجاف من أسواق بغداد

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الملخص

المقدمة: الشاي هو المشروب الأكثر استهلاكا على نطاق واسع على هذا الكوكب. استهلاك الشاي مفيد لصحة الإنسان لأنه يتضمن عناصر رئيسية مختلفة. وقد حضي موضوع وجود المعادن الثقيلة في الشاي بمستويات ضئيلة على الكثير من الاهتمام لأنها مرتبطة بالصحة.

طرق العمل: ولجمع البيانات عن انتشار المعادن الثقيلة في الشاي الأسود، أجريت دراسة استقصائية في أسواق الشاي في بغداد.

النتائج: تم فحص ما مجموعه 36 عينة من الشاي الأسود بحثا عن المعادن الثقيلة. وكانت متوسطات مستويات المعادن الثقيلة للرصاص (1.92±0.67 ملغ/كغم)، وللنحاس (9.4±1.51 ملغ/كغم)، وللزنك (13.625±1.82 ملغ/كغم)، وللحديد (81.15±18.52 ملغ/كغم).

التوصيات: وفقا للنتائج، كانت جميع مستويات المعادن الثقيلة مقبولة ولا يوجد خطر ممكن بعد استهلاك الشاي.

الهدف: هدف العمل الحالي الى تقدير مستويات المعادن الثقيلة في عينات الشاي الأسود.

الكلمات المفتاحية: معادن ثقيلة ، شاي أسود ،أسواق بغداد.