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Heavy Metals Content in Several Imported Rice Crops (*Oryza sativa*) from the Local Markets

Abstract- *Rice crop may be subjected to several heavy metals contamination due to various causes such as contaminated irrigating water, fertilizers containing certain heavy metals and other agricultural applications. This work was designed to examine several heavy metals (Lead, Chromium, Arsenic and Copper) in rice crop imported from India, USA, Brazil, Thailand, Paraguay and Uruguay in addition to locally cultivated rice. Rice samples were collected from local markets and subjected to the examination of above heavy metal content using acidic digestive method and heavy metal ions were determined by Atomic Absorption Spectrophotometer. It has been found that these examined rice crops have shown significant variations in terms of heavy metal content and importing countries where in case of Lead ion, Iraqi rice had the highest mean (19.27 ± 0.25 mg/kg) content while India 1 showed the lowest (9.51 ± 0.08 mg/kg) mean value. For rice Chromium content, it was found that USA rice gave the highest (4.02 ± 0.51 mg/kg) mean value and the lowest mean content (0.15 ± 0.02 mg/kg) was detected in the Iraqi rice. Regarding rice Arsenic content, all examined rice crops had As content varying from minimum mean value of 0.2 ± 0.012 mg/kg in India2 to a maximum value of 0.37 ± 0.021 mg/kg in India1. For Copper rice content, this study has found the Iraqi crop had the highest (4.50 ± 0.07 mg/kg) mean value while Thailand gave the lowest mean value of 2.66 ± 0.25 mg/kg.*

Keywords: *Lead, Chromium, Arsenic, Copper, Imported rice, Contaminated Soil*

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1. Introduction

Rice crop (*Oryza sativa* L.) represents one of the most staple food worldwide where about more than a thousand million people consume it being a major source of energy in diets. Approximately 90% of world rice grains are produced at Asia followed by South America countries. It is well known that growing rice crop needs a significant quantity of water. However, such water may be subjected to various environmental pollutants mainly heavy metal ions due to natural and man-made sources. Apparently, it is extremely hard to find any site of the earth is not affected by environmental contamination by one way or the other due to natural and/or anthropogenic activities such as volcanic eruptions [1], erosion of soil, dissolving and leaching rock and soil containing heavy metals [2] to end up in surface water bodies. Also, artificial activities such as various industrial works, municipal wastewater [3] and agricultural applications as fertilizers [4,5]. In addition, different biocides [6] may end up in surface and ground waters. Environmentally contaminants that are more concerned are heavy metals due to widely man applications. It is well known that all heavy metals are accumulated on soil and water and built up elevated levels sufficient to cause health and environmental threats. However, much scientific attention was focused on the inevitable negative consequences of various heavy metals particularly on food cultivation and production and reported significant findings [6-10].
Chemical fertilizers are considered an important source of heavy metals contamination. Studies have shown a positive relationship between Cd concentration in soil and cadmium in the plant Rice is the best indicator of Cd soil contamination [11]. Rice plant is one of nature's great scavengers of heavy metals. It is well known that studied heavy metals toxicity forms probable threats having been causing several health risks [11-12]. The toxic effects of these metals despite being do not have any biological role; but they remain present in certain harmful forms mainly

for the human body and its proper functioning where most commonly found heavy metals in rice are arsenic, cadmium, chromium, copper, lead, nickel, and zinc where these heavy metals may cause risks for human health and the environment [14-16].

Some metals are quit essential to maintain various biochemical and physiological functions in rice but at very low concentrations. However, they become extremely toxic when they exceed certain threshold concentrations. The most commonly found heavy in rice grain are arsenic, cadmium, chromium, copper, lead, nickel, and zinc, all of which cause risks for human health and the environment [17-19].

The current study was designed to determine lead, chromium, arsenic and copper ions in several long grain rice imported from different origin countries in addition to local rice.

2. Materials and Methods

Each rice sample from various origin country, which is India as Iand II, Thailand, Uruguay, Paraguay, Brazil, USA and local crop, were collected from different local markets where each sample was represented by three sub-sample. Fifty grams were taken from each sub-sample of all examined rice grains and washed thoroughly with de-ionized water and left to dry at lab conditions for one week. Each sub-sample was powdered and sieved using 2mm stainless sieve. Five gm from the sieved powder of each were placed in 50 ml digestive flask and received 4 ml perchloric acid and 8 ml nitric acid and left for overnight for complete acidic digestion. All examined rice samples were subjected to gradual heating with shaking up to 120 ºC until all acidic residual was eliminated indicating to the full digestion process. However, each digested sample were filtered using 42mm wattman filter paper into 50 ml conical flask and the sample volume was completed to 50 ml using de-ionized distill water and tested for lead, chromium, arsenic and copper content following the method of [20] using 6300 atomic absorption spectrophotometer with proper cathode lamp. All obtained results were subjected to statistical analysis of variance (F test) using SPSS test.

3. Result and Discussion

Mean lead, chromium, arsenic and copper content ± standard deviation in rice grain from eight different origins is given in Table1 while analysis of variance of these data is displayed in Table 2.

Table 1: Mean Pb, Cr, As and Cu content ± standard deviation in rice grain from eight different origins.

Rice Type	Mean Metal content ± Standard deviation (mg/kg)			
	Lead	Chromium	Arsenic	Copper
India 1	9.51 ± 0.08	2.85 ± 0.12	0.37 ± 0.02	2.94 ± 0.1
India 2	11.1 ± 0.09	1.23 ± 0.01	0.2 ± 0.012	2.91 ± 0.15
Thailand	11.83 ± 0.17	0.6 ± 0.08	0.23 ± 0.03	2.66 ± 0.25
Brazil	11.3 ± 0.08	3.45 ± 0.04	0.32 ± 0.02	2.39 ± 0.08
Paraguay	12.82 ± 0.09	3.3 ± 0.08	0.27 ± 0.02	3.06 ± 0.04
Uruguay	14.02 ± 0.02	2.55 ± 0.04	0.27 ± 0.01	3.42± 0.08
USA	14.22 ± 0.08	4.02 ± 0.51	0.22 ± 0.02	4.20 ± 0.08
Iraq	19.27 ± 0.25	0.15 ± 0.02	0.26 ± 0.01	4.50 ± 0.07

In case of rice lead content, the highest mean value (19.27 ± 0.25 mg/kg) was recorded in local rice sample while the sample of India1 had the lowest mean value of 9.51 ± 0.08 mg/kg (Figure 1). However, the remaining samples had mean Pb value ranging from 11.1 ± 0.09 mg/kg in India2 to 14.22 ± 0.08 mg/kg in American rice.

Analysis of variance shows highly significant differences ($P \geq 0.001$) between these values and LSD values (0.656 mg/kg) gives clear significant differences ($P \geq 0.05$) between these examined rice samples. Regarding rice chromium content, it has been found that American origin had the highest mean value (4.02 ± 0.51 mg/kg) followed by that of Brazilian rice which gave a mean value of 3.45 ± 0.04 mg/kg and Paraguay product which had a mean value of 3.3 ± 0.08 mg/kg while the lowest mean value (0.6 ± 0.08 mg/kg) was recorded for Thailand rice crop followed by that of local sample which contained a mean value of 0.15 ± 0.02 mg/kg (Figure 2).

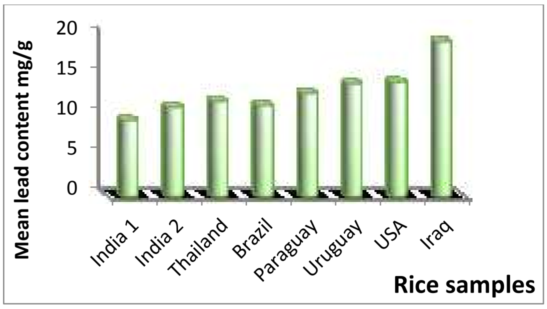

Figure 1: Mean value of lead content in eight different rice grains

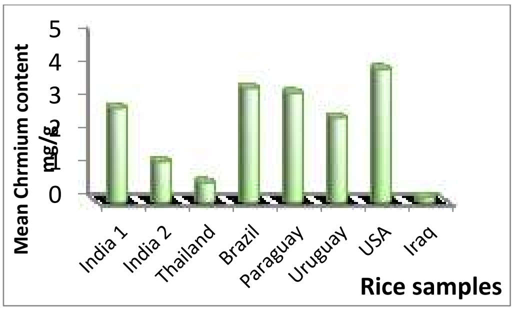

Figure 2: Mean value of chromium content in eight different rice grains.

Analysis of variance of chromium rice contents reveals high significant differences (P≥0.001) between all examined rice samples where F value was found to be 8.98 (Table 2) and these significant differences were insured by LSD test due to its value of 0.2053 mg/kg.

For As, rice content, the current study has found that India 1 sample gave the highest mean value recording 0.37 ± 0.021 mg/kg followed by that of Brazilian crop which had a mean value of 0.32 ± 0.02 mg/kg while India 2 had the lowest mean value of 0.2 ± 0.012 mg/kg. However, the mean arsenic content of the remaining examined samples was found to range from 0.22 ± 0.02 mg/kg to 0.27 ± 0.02 mg/kg (Figure 3).

Analysis of variance of these data shows very significant differences (P≥0.001) between all examined rice crops due to F value of 9.0 (Table 2). In addition, LSD value of 0.043 was backed such significant differences between examined rice samples. In addition, the current work has found that highest mean value of rice copper content (4.50 ± 0.07 mg/kg) was found in local rice sample while the lowest (2.39 ± 0.08 mg/kg) was detected in Brazilian crop. Meanwhile, other examined rice samples had a mean copper value ranging from 2.66 ± 0.25 mg/kg to 3.42± 0.08 mg/kg (Figure 4).

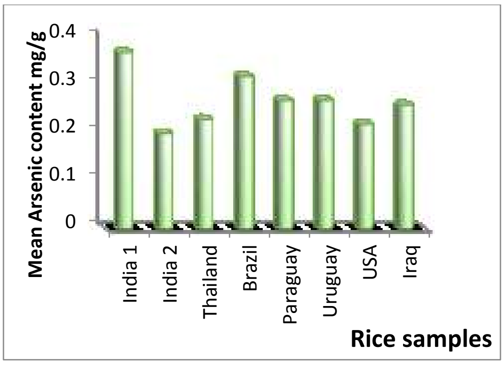

Figure 3: Mean value of arsenic content in eight different rice grains

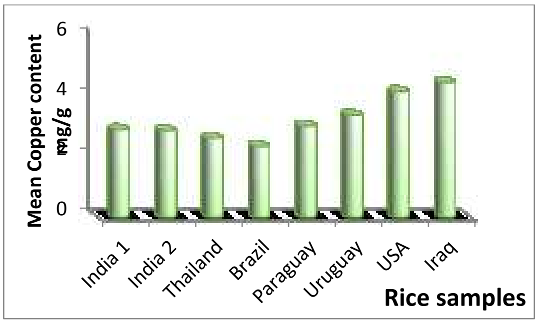

Figure 4: Mean value of copper content in eight different rice grains.

Analysis of variance of rice copper content shows highly significant differences (P≥0.001) between these values (Table 2) and LSD values (P≥0.05) of 0.280 mg/kg confirms such clear significant differences between all examined rice samples.

Apparently, this study has found that high rice metal content was recorded for lead which varied from11.1 ± 0.09 mg/kg in sample of India 2 to 19.27 ± 0.25 mg/kg in local rice sample followed by chromium where mean value was ranged between 0.6 ± 0.08 mg/kg in Thailand sample and 4.02 ± 0.51 mg/kg in USA sample. The lowest rice metal content was found in case of copper which situated between 2.39 ± 0.08 mg/kg of Brazilian sample to 4.50 ± 0.07 mg/kg in local and finally rice arsenic content was found to be the least metal content in all examined rice samples varying from 0.2 ± 0.012 mg/kg in India 2 sample to 0.37 ± 0.021 mg/kg in India 1 sample (Figure 5).

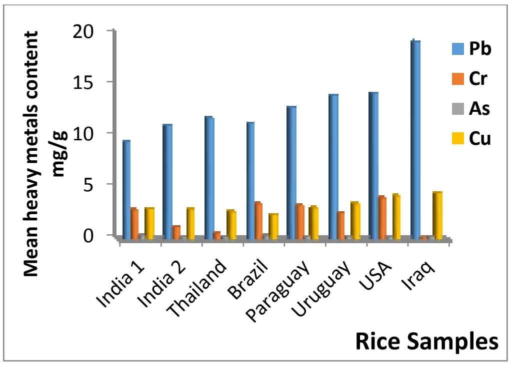

Figure 5: Mean value of lead, chromium, arsenic and copper content in eight different rice grains.

In general, it seems very obvious to conclude that India 1 sample had highest arsenic mean value (0.37 ± 0.021 mg/kg) among examined rice samples while USA rice sample had the highest mean of rice chromium content which was 4.02 ± 0.51 mg/kg, but the local rice sample showed highest mean value in case of lead and copper giving a value of 19.27 ± 0.25 mg/kg and 4.50 ± 0.07 mg/kg respectively.

Recent work [16] has examined certain heavy metals rice content such as As, Cd, Pb, Hg, and Se in Srilanka in both locally cultivated and imported rice samples and reported similar finding but at lower concentrations. Another study [21] has examined heavy metal contamination in soils utilized for growing rice in China. They have focused on Cd, Cr, As, Ni, Mn, Pb, and Hg in three brown rice cultivated sites and found that brown rice contained measurable concentrations of these tested heavy metals and suggested that may be due to the soil being contaminated by these metals by various human activities. Such elevated concentrations of heavy metals in rice crop may cause severe health problems being easily transmitted into the human body via digesting route as warned by various studies [22-24].

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