Determination of Lead, Cadmium and Arsenic Metals in Imported Rice into the West Azerbaijan Province, Northwest of Iran

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ABSTRACT: Industrialization of human activities causes environmental pollution with chemicals resulting in contamination of agricultural productions. Therefore, strict control of agricultural products is required to protect rice contamination with heavy metals as it is one of the world's food crops consumed especially in Asian countries. The aim of this study was determination of the amount of heavy elements in imported rice of West Azarbaijan province. Thus, the amount of lead, cadmium and arsenic, in 8 of 16 kinds of imported rice samples (16 different brands) were evaluated. The results indicated that all samples contain trace amounts of lead and cadmium 0.916±, 0.035 and 0.022 ± 0.027, respectively and only 42% of samples (7 types of brands) contain trace amounts of arsenic 0.057±0.014. Standard of extent permitted for lead, cadmium and arsenic in rice of standard of Iran, in the order of 0.1, 0.2 and 0.2 ppm (mg/kg) is designated. All samples contained lead and arsenic within the limit and 6.2% of samples (only one brand commercial) contained cadmium levels higher than 0.103 ppm (mg/kg), respectively. According to the standard rates and normal range listed metals, it is recommended to use the cleaning products with a high degree of confidence.

Keywords: Rice, Lead, Cadmium, Arsenic, Flame Atomic Absorption Spectrometry (FAAS).

INTRODUCTION

Lead, cadmium and arsenic are from the prevalent toxic elements in food and environment that have a long half-life after the absorption in humans and animals can make unsought and unpleasant effects such as damage to internal organs, the nervous system, kidneys, liver and lungs (Oliver, 1997; Wen, 2009; Oymak, 2009).

Major disadvantages of these heavy metals are such as neurological disorders (Parkinson's, Alzheimer's, depression, schizophrenia), cancers, nutrient deficiency, imbalance of hormones, obesity, abortion, cardiopulmonary disorders, cardiovascular disease, damage to liver, kidneys and brain, allergy and asthma, endocrine disorders, viral infections, reduces the body's tolerance, dysfunction of enzymes, changes in metabolism, infertility, anemia, fatigue, nausea and vomiting, headache and dizziness, irritability, weakened immune systems, gene damage, premature aging, skin disorders, memory loss, loss of appetite, arthritis, hair loss, osteoporosis, insomnia and even death (Fu, 2008; Baars, 2008). Due to the industrial activity contamination of the ground water will be increases (Kanchana, 2012). Heavy metal ions are essential micronutrients for plant metabolism but when present in excess, can become extremely toxic (Begum, 2009). Heavy metals are dangerous because they tend to bioaccumulate. Bioaccumulation means an increase in the concentration of a chemical in a biological organism over time, compared to the chemical's concentration in the environment (Mohanand Syed Shafi, 2013). Excess concentration of Lead causes damages the nervous system and causes brain disorder. Excessive lead also causes blood disorders in mammals (Hanuman Reddy, 2012).

In most cases food contamination accrued by environmental pollution that main source has been expansion of cities rapidly (cars exhaust, etc.), and water pollution caused by industrial and agricultural land irrigated with sewage, electronic waste, use of fertilizers, pesticides and etc. has been reported (Rai, 2002).

According to research conducted the main cause of most agricultural pollution in Heavy elements such as pollutants that are added to the soil in various ways, especially waste-water discharges, soil absorbing complex surfaces cause chemical pollution of soil. Then entry those to food chain of human and animal health is risks for health of human (Sharma, 2007 and Singh, 2004).

Radioactive elements and heavy rain to the earth's atmosphere include fossil fuel combustion, automobile exhaust, metal smelting, chemical industry, waste incineration and waste of paint, rubber burning vehicles, radio-isotopes from reactor accidents and major fires that infest soil (Dinis, 2010; Wuana, 2011).

Chemicals used in agricultural drainage, sewers, abandoned industrial facilities such as factories, gas, electrical industry, tanning industry tanners or even recreational activities and sports such as shooting are very effective in soil contamination. Among all of chemical pollutants, trace elements and heavy metals it seems, ecological impacts, biological and environmental health of organisms living on earth is special.

Today, the main sources of pollutants are active mines, fossil fuels, fertilizers and pesticides that are considered the elements in the biosphere. Pollutants are divided into two types such as biodegradable and non-biodegradable pollutants; non-biodegradable pollutants include salts of heavy metals, phenolic compounds with long-chain, and pesticides such as DDT, which build up in the food chain and affect biological organisms in the water (Wuana, 2011). The main elements that cause pollution to the environment are lead or plumb, arsenic and cadmium.

Arsenic is present in seafood, gypsum color, pesticides, household cleaning, insecticides - glass and mirrors, edible salt, color, wine, water or plumbing, smoke from fuel and burning wood (Smedley, 2002). There is lead in a car battery , ceramics, juices in cans, cigarette ashes, car exhaust, leaded gasoline, hair color, insecticides, mascara eyelash, snow, alloy solder, to paint, city water or well, wine and pipes (Wuana, 2011). There is cadmium in dental alloys, batteries, engine oil, seafood, ceramics, smoke, tea and coffee, fertilizers, Soldering Alloy, Galvanized pipe, water pipes or wells, Welding electrodes, smoke from burning tires plastics and no grains and bran (Campbell, 2006).

This study was designed to determine levels of heavy metals such as lead, cadmium and arsenic in imported rice from neighboring countries sold in the market to run the country and especially in the West Azerbaijan province.

MATERIALS AND METHODS

Sampling

This study was done in the reference laboratory of the Food and Drug of assistance of Medical Sciences of Uremia University, West Azerbaijan of Iran, on rice varieties imported (16 different brands) from the field requesting the opening of cargo following the considerations of moral face of various brands of rice that has not been imported. From each of the 16 types of rice imported, 8 samples in sufficient quantities in suitable containers and away from moisture were collected and transferred to the laboratory of Food and Beverages safety Research Center of Uremia University of Medical Sciences.

Preparation of samples Ten g of each milled rice sample was put in a ashes container of sufficient volume with closed door and placed on a hot plate at about 150 °C. At first, samples were dried and then transferred into the manhole till non-carbon white ash was produced (at 550°C for one night) , then samples were removed from manhole (Rahman, 1990).

Acid digestion:

One gram of gotten ash was weighted and transferred to a container with lid containing 100 ml of it and 10 ml /g mixture of pure nitric acid in a 1:1 ratio with 30% hydrogen peroxide were added slowly, and after 10-15 min the container was placed on a cooker for 10 minutes until the mixture became a clear solution up to half the volume of the solution, heating will continue After, the samples were cooled and transferred to a container, 20 ml of distilled water was added and the volume was completed to it (Rahman, 1990). Total Pb, As, Hg and Cd contents of samples were measured using Varian Flame Atomic Absorption Spectrometer (AA240Z Zeeman, with Graphite Furnace vaporization) at wavelength range: 185 to 900 nm.

RESULTS AND DISCUSSION

Average amounts of lead and cadmium in rice samples tested were 0.037 ± 0.916 and 0.027 ± 0.22, respectively (0.0916±0.035 and 0.022±0.027 ppm as in table 1), respectively, and only 42 percent of rice samples contained trace amounts of arsenic, and the average was 0.014 ± 0.057, respectively. All samples contained trace amounts of lead and cadmium 0.043 and 0.001 to 0.147 and 0.103 ppm, respectively, only one type of rice (6.25% of the sample) contained amount of cadmium higher than standard (0.1 ppm for Cd) and the rest of the samples contained levels below the standard threshold (0.2 ppm for Pb), respectively. The results were shown in table 1.

In the survey conducted in 2010 by Malakootian and colleagues who found that the lead content of rice is 364mg/kg (Malakootian, 2011).

Table 1. Average amounts of heavy metals including lead, cadmium and arsenic in examined rice samples

Rice code (Rice Brand)	Lead (Pb)	Cadmium (Cd)	Arsenic (As)	Be authorized or unauthorized of samples
1	0.043	0.004	0	Authorized
2	0.05	0.045	0	Authorized
3	0.057	0.017	0	Authorized
4	0.096	0.004	0.025	Authorized
5	0.049	0.01	0	Authorized
6	0.049	0.103	0.012	Authorized
7	0.1	0.057	0	Authorized
8	0.059	0.042	0	Authorized
9	0.147	0.006	0	Authorized
10	0.123	0.01	0.023	Authorized
11	0.146	0.012	0.007	Authorized
12	0.117	0.017	0	Authorized
13	0.077	0.002	0.013	Authorized
14	0.118	0.003	0.023	Authorized
15	0.123	0.001	0.05	Authorized

High levels of heavy metals in rice (Oryza sativa L.) resulting from a typical E-waste recycling area in southeast China and its potential risk to human health were reported (Masironi, 1977). One of the main reasons for exposure of human to heavy metals is the soil-crop-food. Almost all the heavy metals in the human body have deleterious effects on leave. Rice is one of the world's most widely consumed grains in the diet of the people. According to report of FAO, almost 30 percent of the world's energy and 20% of the protein source is provided through consumption of the rice (WHO, 1989).

The recommended maximum lead content in rice according to WHO / FAO is 0.3 mg/ kg. In our study, lead levels in the analysed rice samples were less from recommendation by the WHO/FAO (WHO, 2004).

Average amounts of Cd and Pb obtained in this study were lower compared to the allowed amount by Food and Drug Administration for department of health which announces that cadmium is 0.1 ppm and lead 0.1 ppm, Bakhtiarian, (Bakhtiarian, 2001) determined heavy metals in rice in north Iran and found that the maximum levels of lead and cadmium in rice with Hassani brand were 0.0793 and 0.965 ppm, respectively.

Al-Saleh and Shinwari (Al-Saleh and Shinwari, 2001) reported average levels of cadmium and lead for rice 0.02 mg/kg to 0.135 mg/kg, respectively. Also, Zeng and his colleagues (Zeng, 2008) reported that the amounts of lead and cadmium in rice in South Korea were 0.01 to 0.032 and 0.032 to 0.374 mg /kg, respectively.

Watanabe et al. (Watanabe, 2006) performed a study on the cadmium (in rice) of 17 regions in the world, especially in Asia. The results showed that the highest reported of amount of rice contamination to cadmium is within Asia (55.70 ng/g) and outside of Asia was 133.20 ng/g more. Cadmium levels in our study are lower than average of Asian rice cadmium.

Shimbo, (Shimbo, 2001) determined lead and cadmium levels in rice offered in Japan and found that average cadmium level in not polished rice is 50 ng /g and for rice flour is 19 ng/g and lead level in rice flour is 2-3 ng /g.

Cheng and colleagues (Cheng, 2006) in a study reported levels of cadmium and lead in rice planted in China as 0.081 and 0.113 mg/kg, respectively. Also in the study of Kobayashi et al. (Cheng, 2006) content of cadmium in water of Jinzo area is determined as 1.06 -0.02 micrograms/gram and in the Kakehashi river as 1.06 to 0.11 micrograms/gram.

International Agency for Research on Cancer (IARC) introduced cadmium as carcinogenic and this metal has been considered as a major factor in causing kidney failure (Kobayashi, 2004).

Zouli and colleagues (Zazooli, 2008) studied the Persian rice and the cadmium content was reported (0.4 mg/kg). Another study by Lin, (Zazooli, 2010) investigated market rice in Taiwan and cadmium 0.02 mg/kg was determined.

FAO recommended cadmium content in rice of 0.2 mg/kg (FAO, 2004).

Imported rice to Iran are acceptable in terms of heavy metals and their use is not problem, but recommended that the products be used to that these metals are clean.

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