

Determination of Heavy Metals (Cadmium, Arsenic and Lead) in Iranian, Pakistani and Indian Rice Consumed in Khorasan-Razavi Province, Iran by Inductively Coupled Plasma (ICP)

Amir Noori Deldar¹, Mohammadreza Abedi²

¹Applied Chemistry Department, Quchan Branch, Islamic Azad University, Quchan, Iran, ²Young Researchers Club, Quchan Branch, Islamic Azad University, Quchan, Iran

Abstract

In the last years, we observed the news based on the pollution of some foods to the heavy metals. With the advancement of various industries and factories, the heavy metals in the environment is increasing, the factories are another major cause of environmental pollution to these metals. Generally these elements are entered into the human body in different ways such as inhalation, skin contact and above all, through contaminated food and cause the side effects. The aim of this study was to review and determination of Heavy metals (Cadmium, Arsenic and Lead) in Iranian, Pakistani and Indian rice Consumed in khorasan-razavi province, Iran by inductively coupled plasma (ICP).

Key words: Heavy metals, Inductively coupled plasma (ICP), Pakistani and Indian rice

INTRODUCTION

Human health can be at risk caused by consumption of contaminated food. Much of the contaminated food are produced from the products that their plants are grown in contaminated soil. Some Heavy metals such as lead, cadmium and arsenic are among the hazardous toxins around us. Some heavy metals, such as iron, copper and zinc are essential in small amounts for normal body function, but their excessive entry to the body will cause poisoning. The toxins are available in the soil, breathing air, drinking water, building materials, etc. These metals are not metabolized in the body and are not excreted from the body after entering the body and are accumulate in body tissues and this causes various disorders in the body. The metal are also alternative for the other salts and minerals needed by the body. They also increase the viral

infections, bacterial and fungal spread. For example, they sediment in vascular tissues, muscles, bones and joints and cause the side effects such as neurological disorders (Parkinson, Alzheimer, depression, schizophrenia) Types of cancers, poverty of nutrients, hormone imbalance, obesity - abortion - respiratory and cardio - vascular diseases, damage to the liver, kidneys and brain etc.

Including the most accurate method for determining the concentration of heavy metals in the food is using the Inductively Coupled Plasma (ICP) which could measure the concentration of these elements in ppm and ppb measure; but what is important is how to prepare the samples, digestion and extraction of these metals from the food. The first and the most common method of sample digestion and extraction of metals is ash method using an electric furnace. In this method, the sample is turned to ash at 550° C in an electric furnace; it is given to ICP device after dissolution in dilute nitric acid in order to determine the concentration of heavy metals. Since the elements such as lead, cadmium and arsenic are unstable at high temperatures, some of the elements may be lost in the sample in this method because of the high heat. As a result, the reported concentrations of these elements in the sample is lower than the actual value. Another

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Corresponding Author: Amir Noori, Deldar, Applied Chemistry Department, Quchan Branch, Islamic Azad University, Quchan, Iran.
E-mail: amir.noorideldar95@yahoo.com

method used for digestion of extracted sample of the elements is wet acid digestion method; in this case the sample is digested in the presence of concentrated nitric and hydrochloric acids under the heat. Here, there is the possibility of wasting the metal evaporation because the lack of the control over pressure of the temperature and the system is generally open. Another method proposed for digestion and extraction of metals is the acid digestion of the sample under temperature and pressure closed and controlled conditions using the microwave system. Since the sample is digested under controlled temperature and pressure, as a result, the heat does not cause the loss and reduce the amount of metals contained in food.

Given that rice is one of the components of a healthy diet and nutrition and as the substance most used by a large portion of society, On the other hand, in the last years with the increase in rice imports from Asian countries such as India and Pakistan... there is the potential contamination of these products with heavy metals due to weather and cultivation conditions, It is important to check the quality of this valuable food in terms of heavy metal pollution. So the research project is proposed to start exploring this relationship and provide a reliable and accurate method.

Statement of the Problem

Contained explain the aspects, limit of the problem, its detailed introduction explaining the unknown and obscure aspects, the variables related to the research question, purpose of the research.

Statement of the Problem: In the last years, we observed the news based on the pollution of some foods to the heavy metals. With the advancement of various industries and factories, the heavy metals in the environment is increasing, the factories are another major cause of environmental pollution to these metals. Generally these elements are entered into the human body in different ways such as inhalation, skin contact and above all, through contaminated food and cause the side effects. Given that the rice is one of the healthy diet components and as the food ingredient the most used by a large portion of society; therefore, evaluating its quality in terms of heavy metal pollution is more important than anything else. Over the years, different studies in the field of microbial and chemical contamination of food in the country, indicate the serious challenges in the health food; of course heavy metals should also be added to these factors.

After preparation and digestion of the sample, a total of 20 different samples of rice are analyzed with the commercial register and the production place using the above-mentioned methods and the amount of lead, cadmium and arsenic are evaluated.

In order to ensure the accuracy of the above methods in any of the three methods, also three infected (Spike) in three levels of different pollutants are digested; this action is repeated in three consecutive days and the optimal method for sample digestion and extraction of metals is determined with calculating the percentage of recovery (70-100).

Three times repeated sample was conducted for each procedure in order to obtain the repeatability of each method, then 10 infected samples are digested at determined level by the same method and the reliability of each method is gained through calculating the relative standard deviation (% RSD) and the uncertainty of each method is calculated.

The infected samples were contaminated ten times at the lowest detectable concentration by the device with any method used to digest and is injected into the device in order to determine (LOD) and (LOQ) for each element in each method.

Relevant Backgrounds

Brief Statement of the conducted studies on the subject and obtained outcomes within and outside and scientific theories related with the statement.

Literature Review

Rice contaminated with heavy metals such as copper, cobalt, cadmium, arsenic, chromium, mercury, nickel, lead and manganese in soil, irrigation water and pesticides on rice quality and its nutritional properties is effective (1&2). Entering all heavy metals into the body has the harmful effects. Some of the these elements, such as lead, cadmium, nickel and mercury are toxic to human even in small amounts and cause the various health problems, such as kidney damage, lung problems, cancer and bone injuries (3). That is why this contamination is considered as an important health Food. On the other hand, farmers use the rice to fertilize their crops using chemical fertilizers causing the accumulation of these metals in rice (4).

Rice pollution with heavy metals depends the other reasons such as Industry Status area, traffic and distance the growth of the road. Therefore, the plants grown in industrial areas have higher concentrations of lead (5).

Arsenic contamination of the groundwater has resulted in a gradual increase of the element in grain rice. The carcinogenic properties of arsenic have been proven; therefore, some strategies should be made to reduce effectively the arsenic in rice consumption (6).

There is some evidence that if the rice has been washed and cooked with plenty of water, the level of arsenic in that will be

reduced (7). Children under one year who their staple food is rice products or children who have celiac disease and cannot digest the gluten found in wheat Oudh; they need to remove the arsenic from their rice (8). According to the guidelines of National Standards Institute, the maximum permitted levels of rice heavy metals for lead is 0/15 mg, Cadmium 0/06 mg and arsenic 0/15 mg for per kilogram of rice (9).

A study was carried out in 2010 in different areas of Lorestan Province for the determination of heavy and toxic metals used in widely cultivated rice; in this study, 99 samples of Iranian (Tarom and Domsiyah) rice was cultivated and was collected in three regions of Lorestan Province. The amounts of lead and cadmium were determined using Atomic Absorption Spectrophotometer. Lead and cadmium concentrations in samples of rice cultivated in Lorestan Province is less than allowed amount and there is no problem for human health (10).

Another study in 2010 was done entitled “The amount of nickel and chromium cadmium lead in imported Hindi rice in Iran” that 20 types of consumed Hindi rice was collected from Iran market and was tested. More than 50% of samples with the amount lead set by the WHO, the rest of the samples are at lower level than specified value determined by WHO in terms of chrome, nickel and cadmium (11).

Variables

1. How much heavy metals including cadmium, arsenic and lead are there in rice?
2. Is there different in the amount of heavy metals in rice cultivated in various regions?

Hypotheses or Research Questions

The amount of heavy metals including cadmium, arsenic and lead in Pakistani and Hindi rice is higher than the standard.

Research Purposes

Including scientific, applied purposes, specific requirements, doing research.

Importance and Necessity of the Research

Given that the rice is one component of a healthy diet and nutrition as the most used substance by a large

portion of society, On the other hand, in the last years with the increase in rice imports from Asian countries such as India and Pakistan and contamination possibility of these products with heavy metals due to weather and cultivation conditions, it is important to check the quality of this valuable food in terms of heavy metal pollution. So the research project is proposed to provide a reliable and accurate method in this regard.

What is the Innovation and New Aspects of the Study? (This Section must be Completed by Supervisor)

It can be measured some metals in addition to mentioned ones with more concentration through studying the different methods of digestion and preparation of rice sample and also considering that the measure is done by ICP device.

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