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Determination of metals (Cd and Pb) in potatoes and its commercially available product in Quetta

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Abstract

Potatoes are the tubers and belong to the Solanaceae family. After maize, wheat and rice, potato is the fourth most important food crop in consumption. Potato provides dietary fiber, carbohydrates, high quality proteins minerals and vitamins. The samples such as potatoes, potato chips, slanty, lays and lays wavy were collected from local market of Quetta. Cobalt and cadmium were analyzed by using atomic absorption spectrometer. The accumulation of both Cabolt and cadmium were found in all the samples analyzed. The cobalt concentration was detected in the range from 0.03 mg/L to 0.16 mg/L. While cadmium accumulation was found in the range from 0.01 mg/L to 0.1 mg/L. it is concluded that further research studies are required to study the effect of metals on health.

Keywords: Potatoes, products, cobalt, cadmium, atomic absorption spectrometer.

INTRODUCTION

Potatoes are the tubers and belong to the Solanaceae family [1, 2]. Several research studies have been conducted on the potatoes and it has been indicated that all over the world there are 5000 varieties of potatoes and among all these varieties solanum tubersum is the most cultivated species [3]. After maize wheat and rice potato is the fourth most important food crop in reduction [4]. Potato provides dietary fiber, carbohydrates, high quality proteins minerals and vitamins [5].Metal contaminants include in potato and its products are the (Pb, Cd, Zn, Hg ,Mg, Mn ,Cu, and Co). Among these Zn ,Fe, Cu, Cr, Mn and cobalt are classified as essential elements but when present in body above certain concentration can become harmful and causing varieties of health effects. Metals such as lead, and cobalt may exhibit toxicological problems even at low levels [6]. Potato products (Lays, potato chips, slanty, wavy) are small, packaged foods. These products are ready to eat. These products are readily available in the market and can be consumed to avoid hunger. On the other hand, this food may contain essential and harmful metals in varying amounts. The presence of heavy metals in food must be known either for their nutritional worth or for their hazardous character [7]. Potato products are now popular all over Quetta city, particularly among adults and children. They are readily available in markets and children can easily eat

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or swallow. Studies have been conducted to assess heavy metal contents of several types of potato products. Substances including toxic heavy metals may be present in food, can also enter the food chain due to human activities including agricultural and industrial processes [8].

These of cadmium are frequent in many industrial activities. Its major application is the production of alloys batteries and pigments [9]. Cadmium is added into human bodies through several sources like eating contaminated food, smoking cigarettes, working in primary metal industries etc [10]. Emission from industrial activities including smelting and mining, pigments alloys and manufacture of batteries also sources of cadmium. cadmium is present in potatoes grains leafy vegetables kidneys crustaceans mollusks [11].some foodstuffs like liver shellfish cocoa powder mushrooms dry seaweeds that are rich in cadmium increases the concentration of cadmium in human bodies.in human bodies blood vessels are the major organs that becomes highly toxic due to cadmium accumulation [12]. This study aimed to determine the concentration of cobalt and cadmium in potatoes and its commercially available products being used by children on large scale.

Experimental

Reagents

The study utilized reagents of analytical grade. Ultra-pure distilled water served as the solvent for all dilutions. The concentrated nitric acid (HNO_3), perchloric acid ($HClO_4$), and sulfuric acid (H_2SO_4) used were sourced from Merck and were of high purity. Prior to use, plastic and glassware were meticulously cleaned by immersion in 20% HCl followed by rinsing with distilled water. Standard solutions of the metals being analyzed were prepared for calibration purposes by diluting their respective stock solutions, each with a concentration of 1000 mg/L, also sourced from Merck.

Sample Collection and Preparation

Potatoes and potato products, such as chips (potato chips) and various varieties of Lays (including Lays and wavy Lays), were randomly obtained from Quetta city. The samples were collected in plastic bags and transported to the laboratory. Upon arrival, they were cleaned using ultra-pure deionized water to eliminate any impurities. Subsequently, the potato samples were dried in an oven at 80°C until a constant weight was achieved. All samples were finely powdered using a pestle and mortar and then set aside for further processing.

Acid digestion

1 gram of the dried and finely powdered samples from each was accurately weighed and transferred into a beaker. Subsequently, they were treated with a mixture of concentrated acids (HNO_3, $HClO_4$, and H_2SO_4) in the ratio of 5:1:1 for digestion, following a previously reported protocol with slight modifications [13]. The mixture was then heated at 75°C for approximately 20 minutes, after which it was allowed to cool. Following cooling, the mixture was filtered using Whatman filter paper No. 42. The resulting filtrate was diluted with extremely ultra-pure deionized water until it reached a volume of 50 ml and was then set aside for further analysis.

Analysis of the Samples

The various elements were analyzed by using Atomic Absorption Spectrometer ((AAS, Thermo -Electron Corporation, S4 AA System, S. No, GE711544, China) double beam and deuterium background hollow cathode lamps of Co and Cd were used at specific wavelengths.

RESULT AND DISCUSSION

The mean concentration values of the elements (Co and Cd) obtained by using atomic absorption spectrometer are displayed in table 1. The cobalt (Co) concentration values ranged from 0.03 mg/L to 0.16 mg/L. while cadmium (Cd) concentration values ranged from 0.01 to 0.1 mg/L in different snack foods like potatoes, potato chips, slanty, lays and lays wavy.

Table 1. The concentration of Co and Cd in potatoes, potato chips, slanty, lays and lays wavy (mg/L).

Samples	Metals	
	Co	Cd
potatoes	0.12	0.03
Potato chips	0.03	0.1
slanty	0.11	0.1
lays	0.16	0.01
Lays wavy	0.10	0.02

Cobalt (Co):

Lays exhibited the highest concentration of cobalt among the tested samples, with a value of 0.16 mg/L. This indicates a relatively higher presence of cobalt in Lays compared to other snacks. Possible reasons for this could include variations in manufacturing processes, ingredient sourcing, or packaging materials. Potatoes showed the second-highest concentration of cobalt at 0.12 mg/L. While lower than Lays, this concentration is still notable and suggests the presence of cobalt in the potato samples, potentially due to soil contamination or agricultural practices. Slanty had a cobalt concentration of 0.11 mg/L, slightly lower than that of potatoes. This indicates a moderate level of cobalt presence in Slanty, which may be attributed to similar factors as observed in potatoes. Lays wavy exhibited a cobalt concentration of 0.10 mg/L, placing it in the mid-range among the tested samples. The slight variation in cobalt concentration compared to other Lays products may be due to differences in flavoring, processing, or other factors specific to the manufacturing process. Potato Chips had the lowest cobalt concentration among the tested samples, with a value of 0.03 mg/L. This suggests a relatively lower presence of cobalt in chips compared to other snacks, indicating potential differences in ingredients or processing methods.

Cadmium (Cd):

Potato chips exhibited the highest concentration of cadmium among the tested samples, with a value of 0.1 mg/L. This suggests a relatively higher cadmium content in chips compared to other snacks. Possible sources of cadmium in chips may include frying oils, seasoning ingredients, or contamination during processing. Slanty showed the second-highest concentration of cadmium at 0.1 mg/L, similar to chips. This indicates a notable presence of cadmium in Slanty, which may be attributed to similar factors as observed in chips. Potatoes had a cadmium concentration of 0.03 mg/L, placing it in the mid-range among the tested samples. While lower than chips and Slanty, this concentration is still notable and suggests the presence of cadmium in the potato samples, possibly due to environmental factors or agricultural practices. Lays wavy exhibited a cadmium concentration of 0.02 mg/L, slightly lower than that of potatoes. This indicates a relatively lower presence of cadmium in Lays wavy compared to other snacks, although still present at detectable levels. Lays showed the lowest concentration of cadmium among the tested samples, with a value of 0.01 mg/L. This suggests a relatively lower cadmium content in Lays compared to other snacks, indicating potential differences in manufacturing processes, ingredient sourcing, or other factors specific to the Lays product line.

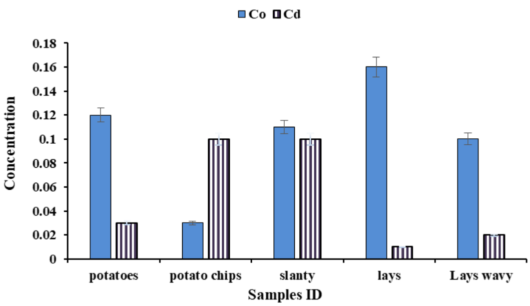

Figure 1. Concentration of cobalt and cadmium in potatoes, potato chips, slanty, lays and lays wavy (mg/L).

CONCLUSION

Potatoes are the fourth most important food crop with respect to consumption after the maize, wheat and rice. Potato provides dietary fiber, carbohydrates, high quality proteins minerals and vitamins. Overall, the detailed comparison provides insights into the variations in cobalt and cadmium concentrations across different snack products, highlighting the importance of monitoring metal content for food safety and regulatory compliance. Further research may be warranted to investigate the specific sources and potential health implications of these metal contaminants in snack foods.

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