A Review on The Effects of Heavy Metals on Human Health

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Abstract-*The heavy metals or trace elements play an important role in the metabolic pathways during growth and development of plants, when available in required concentration. The heavy metal concentration of Cadmium (Cd), Cobalt (Co), Copper (Cu), Iron (Fe), Nickel (Ni), Lead (Pb) and Zinc (Zn) are the major parameters which observed to be performed with Inductive Coupled Plasma Analyzer (ICPA) (Perkin-Elmer ICP Optima 3300 RL, USA). The high concentration of Cd, Co and Cu content plays important role and hence to be properly investigated. On the other hand, high content of Fe, Ni, Pb and Zn also plays a vital role hence to be properly studied. The behaviour of heavy metal concentration on vegetables and fruits studied in this paper. The paper based on the study of heavy metals on fruits and vegetables and its impact on human health is discussed in this paper. The standard rates were observed in different fruits and vegetables in this paper.*

Keywords-Heavy Metals, Human Health, Environment.

I. INTRODUCTION

Fresh fruits and vegetables are of great importance in the diet because of the presence of vitamins and mineral salts. They are used to increase the quality of soups (leafy vegetables) and also for their dietary purposes (Sobukola et al., 2007). Fruits and leafy vegetables are widely used for culinary purposes. They are made up of chiefly cellulose, hemi-cellulose and pectin substances that give them their texture and firmness (Sobukola and Dairo, 2007). In addition, they contain water, calcium, iron, sulphur and potash (Sobukola et al., 2007). They are very important protective food and useful for the maintening health and the prevention and treatment of various diseases (D'Mello, 2003). However, these plants contain both essential and toxic metals over a wide range of concentrations (Radwan and Salama, 2006).

In human life heavy metals plays positive as well as negative roles (Adriano, 1984; Slaveska et al., 1998; Divrikli et al., 2003; Dundar and Saglam, 2004; Colak et al., 2005). Some like copper, iron and zinc are essential for biochemical reactions in the body (Zaidi et al., 2005) while others like lead, cadmium and mercury are major contaminants of food supply and may be considered the most important problem to our environment. Additional sources of heavy metals for plants are: rainfall in atmospheric polluted areas, traffic density, use of oil or fossil fuels, for heating, atmospheric dusts, plant protection agents and fertilizers which could be adsorbed through leaf blades (Kovacheva et al., 2000; Lozak et al., 2002; Atrouse et al., 2004; Sobukola et al., 2008). Generally, most of the heavy metals are not biodegradable; they have long biological half-lives and have the potential for accumulation in the different body organs leading to unwanted side effects (Jarup, 2003; Sathawara et al., 2004). There is a strong link between micronutrient nutrition of plants, animals and humans and the uptake and impact of contaminants in these organisms (De Leonardis et al., 2000; Yuzbasi et al., 2003; Baslar et al., 2005; Yaman et al., 2005). The content of essential elements in plants is conditional, the content being affected by the characteristics of the soil and the ability of plants to selectively accumulate some metals (Divrikli et al., 2006).

Absorption and accumulation of heavy metals in fruits and vegetables are influenced by many factors, including: composition and intensity of atmospheric deposition, including precipitations, concentration of heavy metals in soil, phase of plant vegetation (Vontsa et al., 1996). All of these can be added to other sources generated by agricultural technologies such as: administration of organic and mineral fertilizers with the load of heavy metals, irrigation with wastewater, or application of pesticides, which contain in their structure such chemical elements (Singh et al., 2004; Sharma et al., 2006).

Urban, industrial and household activities, traffic, contribute significantly to increasing the load degree with heavy metals containing particles of inferior atmosphere (Lacatusu et al., 2008), from where these particles will settle down on the plants foliage system and soil. The heavy metals are overtaking in the edible parts of vegetables and fruits by physiological path, either from soil, from leaves surface or with these kinds of chemicals loaded irrigation water. Many times, the plants foliage system is represent the edible part of vegetables (parsley, lettuce, dill, lovage etc.).

Consumption of fruits or vegetables contaminated with heavy metals by humans, could lead to changes in health

of the inhabitants of polluted areas, and can contribute to the emergence of various chronic diseases. The phenomenon has become alarming for people who systematically eating such vegetables and fruits produced in their own gardens located in polluted areas.

II. MATERIALS AND METHODS

Fruits and vegetables were reviewed for heavy metals. The general steps observed was, sample first dried in a hot air oven for 24hrs and then was ground and passed through sieve. Sieved sample then digested with nitric and hydrochloric acid on a hot plate at 950C as prescribed by US EPA method 2007. The analysis performs by Inductively Coupled Plasma Optical Emission Spectroscopy (ThermoscientificiCAP 6000 Series). All the analysis generally performed in triplicate and expressed in mg/Kg. The samples collected majorly analysed for heavy metal properties as Cadmium, Chromium, Copper, Iron, Manganese, Nickel, Lead and Zink

Analytical data were statistically processed, computing the values of the grouping centre (arithmetic mean, geometric mean, median) and the spreading parameters (minimum, maximum, standard deviation and variation coefficient). Characterization of heavy metals and selected fruits and vegetables using inductively coupled plasma analyser.

III. DISCUSSION

The review indicated that the concentrations of heavy metals investigated in fruits and leafy vegetables which are commonly consumed. The values are given as mean ± SD and the results noted are means of three replicates. Heavy metals affect the nutritive values of agricultural materials and also have deleterious effect on human beings. National and international regulations on food quality set the maximum permissible levels of toxic metals in human food; hence an increasingly important aspect of food quality should be to control the concentrations of heavy metals in food (Radwan and Salama, 2006; Sobukola et al., 2008).

Heavy metals are found naturally in the earth. They become concentrated as a result of human caused activities and can enter plant, animal, and human tissues via inhalation, diet, and manual handling. Then, they can bind to and interfere with the functioning of vital cellular components. The toxic effects of lead are well known to the ancient times. Divrikli et al. (2006) have recently reported 0.002 mg/kg as cadmium level in Indian basil.

Copper is an essential micronutrient which functions as a biocatalysts, required for body pigmentation in addition to iron, maintain a healthy central nervous system, prevents anaemia and interrelated with the function of Zn and Fe in the body (Akinyele and Osibanjo, 1982). However, most plants contain the amount of copper which is inadequate for normal growth which is usually ensured through artificial or organic fertilizers (Itanna, 2002). Radwan and Salama (2006), Onianwa et al. (2001) and Parveen et al. (2003) have reported 1.47, 0.25 and 0.25 mg/kg for apple, respectively. Furthermore, 1.22 and 2.13 mg/kg; 1.27 and 2.13 mg/kg and 2.51 and 0.95 mg/kg have been reported for the concentration of Cu in watermelon, orange and banana by Radwan and Salama (2006) and Onianwa et al. (2001), respectively. Also, Divrikli et al. (2006) and Ozcan (2004) have earlier reported Cu contents of 0.02 and 0.0081 mg/kg, respectively for Indian Basil.

One of the most important metals for normal growth and development in human beings is Zinc (Divrikli et al., 2006). Its deficiency may be due to inadequate dietary intake, impaired absorption, excessive excretion or inherited defects in zinc metabolism (Colak et al., 2005; Narin et al., 2005). Zinc deficiency due to consumption of plant foods that have inhibitory components for Zn absorption is of growing concern in developing countries. The deficiencies in these countries have been attributed to high consumption of bread made without yeast (Divrikli et al., 2006). Available literature have shown that the level of Zn in apple are 1.36, 0.16 and 2.05 mg/kg (Radwan and Salama, 2006; Onianwa et al., 2001 and Parveen et al., 2001). Radwan and Salama (2006) and Onianwe et al. (2001) have also reported Zn levels of 5.35 and 7.40 mg/kg; 2.38 and 2.20 mg/kg; as well as 5.59 and 1.50 mg/kg for watermelon, orange and banana, respectively. However, 0.011 and 0.014 mg/kg were reported for Indian basil by Divrikli et al. (2006) and Ozcan (2004) respectively.

Nickel also plays specific role in body functions including enzyme functions. It occurs naturally more in plants than in animal flesh. It activates some enzyme systems in trace amount but its toxicity at higher levels is more prominent (Divrikli et al., 2006). Ni level of 0.067 mg/kg for Indian Basil has been reported by Divrikli et al. (2006).

Acute doses (10-30 mg/kg/day) of Cadmium can cause severe gastrointestinal irritation, vomiting, diarrhoea, and excessive salivation, and doses of 25 mg of Cd/kg body weight can cause death. Low-level chronic exposure to Cd can cause adverse health effects including gastrointestinal, hematological, musculoskeletal, renal, neurological, and reproductive effects. The main target organ for Cd following chronic oral exposure is the kidney (ATSDR 1999a). Intake of

Cd can double if one smokes cigarettes because each cigarette contains about 2 mg Cd.

Deficiency of Cobalt in diet results into pernicious anaemia, severe fatigue, shortness of breath and hypothyroidism, while overdose may lead to angina, asthma, cardiomyopathy, polycythemia and dermatitis. The safety limit for human consumption of Co is 0.05 to 1 mg/day in humans (ATSDR 1994a). Thus recorded range of Cobalt concentration in vegetables needs to be fall within the safety limit.

Iron is an essential element in production of Red Blood Cells (RBCs). Low intake of Fe may cause anaemia, tiredness and pallid physique, while high intake may results into hepatic megaly, cardiac infraction and nephric malfunction. The acceptable limit for human consumption of Iron is 8 to 11 mg/day for infants as well as adults (ATSDR 1994b). During investigation if the value of Fe was found much higher, this is significant due to iron-rich soil of the area.

Manganese is a very common compound that can be found everywhere on earth. Manganese is one out of three toxic essential trace elements, which means that it is not only necessary for humans to survive, but it is also toxic when too high concentrations are present in a human body. When people do not live up to the recommended daily allowances their health will decrease. But when the uptake is too high health problems will also occur.

The uptake of manganese by humans mainly takes place through food, such as spinach, tea and herbs. The foodstuffs that contain the highest concentrations are grains and rice, soya beans, eggs, nuts, olive oil, green beans and oysters. After absorption in the human body manganese will be transported through the blood to the liver, the kidneys, the pancreas and the endocrine glands.

IV. CONCLUSION

The results noted in this work on concentration of heavy metals of some selected common fruits and leafy vegetables compared well with similar samples from other published works. Generally, the levels of heavy metals were observed to be lower than those of previous published works and those given by various authorities except the certain level of some heavy metals. The values of heavy metals presented in this reviewed work from fruits and leafy vegetables can be valuable for further analysis to be conducted on same domain.

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