Abstract—The heavy metals were determined in different sample of fruits available in Pakistan by using Atomic Absorption Spectrometry. Iron was found dominant elemental ion followed by manganese and zinc. The obtained results revealed that Fe was found as 73-183.5; Zn, 5-56.5; Mn, 1.5-68.5; Cu, 4.5-55; Co, 0.5-2; Cr, 0.5-18.5; Ni, 2-18.5 mg/kg for Fe, Zn, Mn, Cu, Co, Cr, Ni; Pb, 1.5-12.5 and Cd was 0.05-0.1 mg/kg of sample dry weight. The obtained results were compareable with literature reported values.

Index Terms—Heavy metals, Atomic Absorption Spectrometry, wet Acid digestion, seasonal fruits.

I. INTRODUCTION

Heavy metals are naturally occurring in earth crust. They cannot be destroyed nor be decomposed [1]. Total heavy metals are 38. Of which 13 elements are discharged from industries such as Cd, Cu, Cr, Fe, Hg, Mn, Mo, Ni, Pb, As, Zn and Sn. Some heavy metals such as Fe, Mn Zn, Cu, Mo, Co, Cr, Ni & Sn are vital for living organisms. Metals like Cd, As, Hg and Pb are toxic for all living organisms.

Heavy metals came into environment from different sources such as natural, manmade and air borne sources. Fertilizer, Pesticides and manures came into airborne sources. Heavy metals are not harmful for environment at low level. If the rate of accumulation of heavy metals is more than their discharge in living organisms then can be dangerous. Lengthened buildup of heavy metals through food stuff may lead to chronic effect in the kidney and liver of humans and causes disruption of numerous biochemical processes leading to cardiovascular, nervous, kidney and bone diseases [2].

Fruits and vegetables are potential sources of vitamins and minerals to benefit human health. Fresh fruits contain two times as much ascorbic acid as oranges and are rich in sugar, minerals, and tannins [5].

The basic purpose of this research work is to find out heavy metals concentration (mg/kg) present in different fruits available in Pakistan, this data will help to provide condition of pollution in fruits and also to assure food safety.

II. MATERIALS AND METHODS

A. Materials

The selection of fruits based on criteria regarding their consumption and availability.

A total of five fruits sample were taken for the study. The fruits (Pineapple, Sweet lime, Pear, Cherry, Grape fruit) were collected from local market of Faisalabad for the analysis of heavy metals. Samples were taken in polythene bags and then placed in refrigerator.

Fruits were firstly washed with tap water to remove dust and sticky particles. The samples were washed thrice with distilled water.

Grapefruit, Sweet lime and Pineapple were peeled. The edible portion of all fruits were cut into small pieces. Then dried in oven between temperature ranges (45-80°C) until constant weight was achieved while preventing overheating. The dried samples were cooled at room temperature and then ground by using porcelain pestle and mortar into powder form. Each sample in powder form was passes through sieve (mesh no 45, width=0.355mm) to get homogenous particles and then stored in zipper bags (Polythene bags) until digestion.

B. Reagents:

The chemicals and Reagents used in all the experiments of this research work were of analytical grade. De-ionized water...
was used for the preparation of working standards. The Conc. nitric acid (HNO₃), and hydrogen peroxide (H₂O₂) used were of supra pure quality (Merck, Darmstadt, Germany). Calibrated standards were prepared from the commercially available stock solution (Applichem (1000ppm)). working standards were prepared from deionized water.

C. Wet acid digestion

Wet acid digestion was done by using standard method given by AOAC 1990 [6]. 1.0 gram of sample (dried) was weight carefully by using electric balance taken in 50 ml beaker and treated with 10 ml of conc. HNO₃ placed on hot plate to get semi dried sample. Again 10 ml of HNO₃ and 4 ml of H₂O₂ were added and again kept on hot plate and heated. Addition of HNO₃ and H₂O₂ continued until clear solution was obtained. Solution was cooled at room temperature and then filtered by using 42 Whatman filter paper. The volume was made up to 50 ml by adding distilled water into the volumetric flask and transferred into cleaned dried plastic bottles and then taken to AA spectrophotometer. A blank sample applying all reagents under similar conditions in empty flask was prepared.

D. Analysis

Elements in the prepared samples were determined by using Atomic Absorption Spectrophotometer (Hitachi Polarized Zeeman AAS, Z-8200, Japan) following the conditions described in AOAC (1990). The elected metals are Cd, Co, Cu, Cr, Fe, Mn, Ni, Pb, Zn.

III. RESULTS AND DISCUSSION

A. Iron level in different fruit sample

Iron concentration is higher as compared to the other metals in fruits samples. Iron is important component of hemoglobin; it plays an important role in human body metabolism. The level of iron was ranged from 73 to 183.5 mg/kg of sample dry weight. The highest level was observed in Grapefruit and lower in Pear. National research council recommended dietary allowance for females is 15 mg and (10-12) mg for males [7]. WHO has established maximum iron ion level permitted for human consumption is up to 60 mg/day [8]. Pak. J. Nutr, 2014[9], have reported 132.6mg/kg for Pineapple. Furthermore, 18.7, 236, 20mg/kg have been reported for the concentration of Fe in Sweet lime and cherry by A. M. Basha et al[10]. T. Muhammad et al[11], Fallahi et al[12]. By comparing our data with literature reported values it is found that Fe contents in Pear, pineapple and cherry in the present study is much lower while sweet lime and grapefruit contains higher.

B. Cadmium level in different fruit sample

Cadmium is non essential toxic metal spreads in environment due to human activities. It is easily taken up by plants and accumulated via roots of plants [13]. Cd content ranges between 0.05-0.1 mg/kg. Saracoglu et al [14], M.A. Radwan, A.K. Salama 2006[15] have reported 0.004, 0.002mg/kg for pineapple and grapefruit. Furthermore, 0.007mg/kg have been reported for the concentration of Cd in cherry by Krejpcio Z. et al [16]. S. E Mahdavian K.R market India[17] has reported Cd concentration in Pear 3.85mg/kg.

Permissible limit for Cd recommended by WHO is 0.2 mg/kg[18]. Cd contents were in safe limit therefore poses no health risks for local consumers.

C. Zinc level in different Fruits Sample

Zn is necessary for proper function of immune system and also takes part in the synthesis of DNA, Protein and Insulin. The concentration of zinc is found maximum in cherry 56.5 mg/kg and minimum in pear 5mg/kg. Pak. J. Nutr, 2014[9], M.A. Radwan, A.K. Salama,2006 [15] have reported 1.840, 3.01mg/kg for Pineapple and Grapefruit respectively. 576, 23.08mg/kg have been reported for Zn concentration in cherry and sweet lime by T. Muhammad et al[11] and S. E Mahdavian K.R market India[17].Recommended daily dietary intake of zinc is about 15mg for adult male and 12mg for
female [19] and maximum intake is recommended up to 30mg during pregnancy [20].

The level of Zn found in analyzed samples was found to be within legal limits and not poses health hazards for body.

D. Lead level in different fruits sample

Lead is like to be Cd that has no beneficial role in human metabolism, producing progressive toxicity.

The level of Lead was ranged from 1.5 to 12.5 mg/kg. Lead is observed maximum in Grapefruit and minimum in Pineapple. Lead enters into body via food, air and water and cannot be removed by washing vegetables and fruits (Divrikli et al 2003). Lead is accumulating in bones and it can take in place of calcium. Lead creates health disorders such as sleeplessness, tiredness, hear and weight loss. As lead is not being translocated readily in plants, Lead found in plants is mainly due to the atmospheric deposition. Atmospheric deposition is mainly caused from various sources such as vehicle lead emission closely to the agricultural land. Pak. J. Nutr,2014[9], M.A. Radwan, A.K. Salama, 2006[15] and A.M. Basha et al [10] have reported Pb concentrations 1.120, 0.16 ,0.9mg/kg for Pineapple, Grapefruit and sweet lime respectively. Furthermore Krejpcio Z. et al[16], S. E Mahdavian K.R Market,India [17] have reported Pb concentrations 0.059, 9.52mg/kg in Cherry and Pear.

Permissible limit recommended by WHO for Pb is 0.5 mg/kg of body weight [22]. Pb found in our analyzed samples of fruits was above the legal limits. Higher level of lead may be due to cultivation of plants near the heavy traffic areas. This may lead to potential health hazards for local consumers.

E. Cobalt level in different fruit sample

Co contents were ranged from 0.5 to 2 mg/kg. A very little work has been done to found co concentration in food materials. In previous researches Co is present in Pineapple 0.022mg/kg[14] and of pear is 7.39mg/kg[17]. Our results of Co in analyzed samples of fruits were within permissible range of safe limits.

F. Chromium level in different fruit sample

Cr is a trace essential mineral that take part in metabolic functions of Lipids and carbohydrates. The Food and Nutrition Board of the NAS/NRC states that a safe, adequate intake of chromium for an adult is 50–200µg/day or 0.05-0.2 mg/day[23].Permissible value recommended by WHO/FAO is 1.2mg/kg[24].Cr was found maximum in grapefruit 18.5 mg/kg and minimum in pear 0.5 mg/kg. 0.20, 1.5mg/kg for chromium concentration have been reported by Ogunkunle et al, Nigeria [25], A.M. Basha et al[10] in Pineapple and sweet lime respectively.
G. Copper level in different fruit sample

Cu is essential to make immune system strong, prevent from anemia, bone diseases and interconnected with the working of Zn and Fe in the body [26]. Cu toxicity causes iron deficiency in the body.

The Cu concentration was found to be maximum in pineapple 55mg/kg and minimum in Grapefruit 4.5mg/kg. Saracoglu et al [14], M.A. Radwan, A.K. Salama [15] and T. Muhammad et al [11] have reported Cu concentrations 0.015, 7.75, 14.5mg/kg for Pineapple, Grapefruit and cherry respectively. 0.61mg/kg have been reported for copper concentration in pear by Chem. Bull. "POLITEHNICA" Univ. (Timișoara) Romania[27]. The permissible limits for Cu in all foods is 0.01mg/kg [28]. Daily requirement of Cu for an adult is 2-3mg/day[29]. High level of copper may be due to the use of agricultural chemicals and artificial fertilizers.

H. Manganese level in Different fruit sample

Mn is also essential for strong bones and to stimulate enzymes. It is necessary for the proper use of thiamine, helps to stimulate enzymes that are essential for utilization of biotin, B1 and vitamin C.

The Mn contents ranged from 1.5 to 68.5 mg/kg. The obtained results show that the amount of Mn is highest in Pineapple as compared to others. Our result is in accord with that obtained by Tsoumbaris and Tsoukali-Papadopoulou (1994) [30] who determined high concentration (25.83–70.76 mg/kg) of Mn in cereals and fruits respectively in Greece. Large amount of heavy metals gathering is mainly due to industries and factories near to the land where crop is cultivated.

I. Nickel level in different fruit sample

Ni is essential for proper body function. It activates some enzyme in trace amount its higher amount leads to toxicity. High level of Ni may also result in Zn or Fe deficiency also annihilates enzymatic working.

The values of Ni were compared with the normal reported range that is 0.10-5.00 mg/kg (Kabata-Pendias, A. and H. Pendias, 1984)[31]. WHO recommends 100–300µgg−1 for daily intake [32]. Ni contents in some fruits like Grapefruit and cherry are higher than the Permissible limit for body.
elevated level of Ni may lead to Nickel toxicity and poses health hazards.

IV. CONCLUSION

The results obtained in this work of some selected fruits on concentration of heavy metal compared with similar samples from other published work. In all fruit samples concentrations of Fe is higher, The necessity of Zn and Fe make it indispensable that their concentration should be high. Level of heavy metals such as (Cr, Cu, Mn, Ni) in different fruit samples was above the permissible limit. Level of toxic metals i.e. Pb is above the Permissible limit of WHO, while the level of Cd was found below the Permissible limit of WHO. Biomonitoring of heavy metals in all fruits should be done in order to avert consumer from severe diseases.

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