EVALUATION AND EXTRACTION TECHNIQUES OF HEAVY METAL AND MINERALS IN FRUITS AND VEGETABLES USING SUGAR SOLUTION

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ABSTRACT: Fruits and vegetables are widely usedas well as for nutritional purposes .The texture and firmness in them is due to their composition which is mainly cellulose, hemicelluloses and pectin.As compared to fruits, vegetables are a richer mineral source but both of them are 'nutrient-dense foods' that provide extensive amount of micronutrient, minerals, vitamins but only little calories. Thespurposesofsthesstudyswasstosvaluatesthesamountsofmetalssandsmineralssinsfruitssandsvegetablesstosbessafesforshumansconsumption. Five treatments were applied to all the fruits and vegetables. (T1)- Control, (T2)-Sample slices were dipped into tap water for 15 mins, (T3)-Samples slices were dipped into tap water for 30 mins, (T4)-Sample slices were dipped into 2% sugar solution for 15 mins, (T5)- Sample slices were dipped into 2% sugar solution for 30 mins. Samples were digested in fume hood by using the diacid mixture (HClO4:HNO3; 1:3). Sugar solution, tap waterand samples were analyzed for Sodium (Na), Calcium (Ca) and Potassium (K) by using Multi-channel Flame photometer (AFP 100). Heavy metals including Pb, Zn, Mn, Ni, Mg, Se, Cr, Cu and Fe in the digested samples were measured using Atomic Absorption Spectrophotometer (Polarized Zeeman Z-8230 Atomic Absorption Spectrophotometer). The results showed that all the fruits and vegetables shows the value under the permissible limit by WHO for the potassium (K), sodium (Na), zinc(Zn), iron (Fe), nickel (Ni) and magnesium (Mg). Only high concentration of potassium (K) was observed in tomato (1762 ppm) and coriander (2809 ppm). While lead (Pb), chromium (Cr), calcium (Ca) and manganese (Mn) have the values which are very high than the limits. Banana showed the highest value for lead (Pb) and chromium (Cr) which are 20.17 ppm and 3.83 ppm the value are ten times higher than the permissible limit. Copper (Cu) is not detected in any fruit and vegetable. Spanish showed the maximum value for Ca (5885 ppm). The highest value for Mn is observed in Coriander which is 23.5 ppm.

Keywords: Heavy metals, Minerals, Vegetables, Fruits.

Introduction: Fruits and leafy vegetables are widely used for cooking purposes. They are used to enhance the quality of soups (leafy vegetables) and also for their nutritional purposes. They are made up of chiefly cellulose, hemicellulose and pectin substances that give them their texture and firmness. Fresh fruits and vegetables are of great importance in the diet because of the presence of vitamins and mineral salts. In addition, they contain water, calcium, iron, sulfur and

potash. They are very important protective food and useful for the maintenance of health and the prevention and treatment of various diseases (Sobukola and Dairo, 2007).

Fruits and vegetables are the main sources of carotenoids in the diet (Rao and Rao, 2007). The presence of conjugated double bonds in carotenoids has the main role in determining their antioxidant properties (Sandmann, 2001).The vitamins present in fruits and vegetables make an important contribution to human nutrition, as they have specific functions in normal body performance. The vitamin content of fruits and vegetables shows a wide variation among species (Salunkhe *et al.*, 1991). Vegetables are a richer source of minerals than fruits, but both vegetables and fruits are considered "nutrient-dense foods" in that they provide substantial amounts of micronutrients, such as minerals and vitamins, but relatively few calories. Vegetables depictvital diet constituents by contributing vitamins, metallic element,iron, macromolecule and various nutrients. Furthermore, as well, act as buffering agents for acidic materials. Nonetheless, they have extremely vital and destructive components over a substantial range of concentrations. Metal accretion in vegetables would probably cause risk to human wellbeing(Turkdogan *et al.*, 2003; Damek and Sawicka, 2003).Food is the main source of uptake of toxic trace metals for human beings. Vegetables are taken as anecessary portion of food either in cooked or raw form. The individuals of Pakistan, especially those of mediocre and low-income groups utilize a considerable quantity of vegetables and fruits. They are also vital to neutralize the acid formed in thestomach during digestion, besides being useful fiber according to food experts (Hashmi *et al.*, 2007).

Heavy metals have been reported to have positive and negative roles in human life (Dundar and Saglam, 2004). Long-term exposure even in a minute quantity to these heavy metals has lethal effects on human beings and other living organisms (Qadir *et al.*, 1997).Heavy

metals are often very harmful to the human body even in low concentrations as there is no effective excretion mechanism (Ghosh *et al.,* 2012). Some metals like cadmium, lead and mercury are major contaminants of food supply and may be considered the most important problem to our environment. Such as excessive content of Pb and Cd metals in food is associated with a number of diseases especially with cardiovascular, kidney, nervous as well as bone diseases (Steenland and Boffetta, 2000). They have also been implicated in causing carcinogenesis, mutagenesis, and teratogenesis (Pitot and Dragan, 1996). Copper toxicity induces iron deficiency, lipid peroxidation, and destruction of membranes. High level of Nickel may also result in Zn or Fe deficiency as well as enzymic malfunctioning (Jarup, 2003).

While others like iron, zinc, and copper are essential for biochemical reactions in the body (Zaidi *et al.,* 2005). Iron (Fe) plays important role in highly complex reactions that take place at molecular level and very essential for human life e.g., oxygen transport to the body (Dreosti, 1980), Manganese (Mn) is very essential for proper functioning of various body parts like nerves and brain (Steenland and Boffetta, 2000), Nickel (Ni) is highly important for many metabolic reactions in living organisms (Nadeem *et al.*, 2010) and about 200 enzymes require Zinc (Zn) as a coenzyme.

Additional sources of heavy metals for plants are rainfall in atmospherically polluted areas, traffic density, use of oil or fossil fuels, for heating, atmospheric dust, plant protection agents and fertilizers which could be absorbed through leaf blades. These plant materials could also be contaminated from various sources including trace metals as farmers wash them with waste water before bringing them into the market (Divrikli *et al.,* 2006). Environmental contamination is arising from the part deposition, industrial activities, and agriculture activities. In Pakistan, the main supply of significant metals is untreated disposition into theirrigation

system, tanneries and smoke particularly from automobile and plastic material (Farooq *et al.*, 2008).

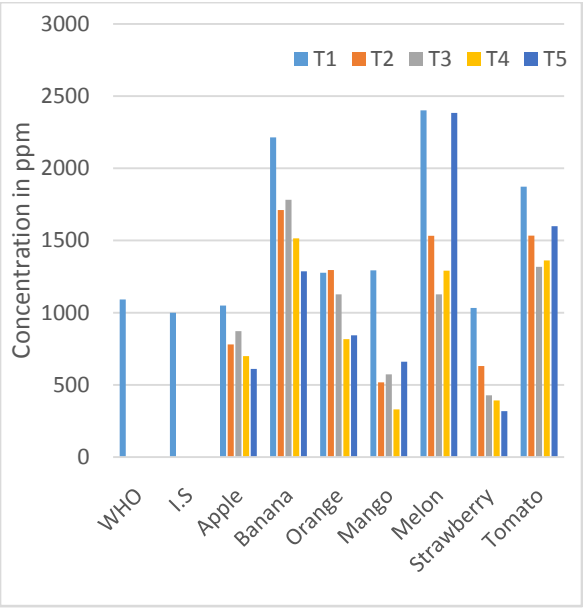
Based on persistent nature and cumulative behavior as well as the probability of potential toxicity effects of heavy metals as a result of consumption of leafy vegetables and fruits, there is need to test and analyze these food items to ensure that the levels of these trace elements meet the agreed international requirements.

Material and Methods: The purpose of the study was to evaluate the amount of metals and minerals in fruits and vegetables to be safe for human consumption. Fruit and vegetable samples were collected randomly from local markets of Lahore. Selected fruits were mango, orange, strawberry, banana, melon, tomato and apple and selected vegetables were onion, cabbage, lady finger, cucumber, coriander, brinjal and spanich. The collected samples were washed and rinsed thoroughly with tap water and then with distilled water and the peeled off. The samples were then sliced into small pieces and the seeds were removed. Five treatments were applied to all the fruits and vegetables. (T1)- Control, (T2)-Sample slices were dipped into tap water for 15 mins, (T3)-Samples slices were dipped into tap water for 30 mins, (T4)-Sample slices were dipped into 2% sugar solution for 15 mins, (T5)- Sample slices were dipped into 2% sugar solution for 30 mins. Samples were digested in fume hood by using the diacid mixture ($HClO_4$:HNO_3; 1:3). 1g of air dried sample was taken in Kjeldha's digestion tube followed by 10ml of diacid mixture and heated at 150 °C for 30 minutes on digestion block and then at 250 °C until wine green or water clear color reached (John 1984 Method). Sugar solution, tap waterand samples were analyzed for Sodium (Na), Calcium (Ca) and Potassium (K) by using Multi-channel Flame photometer (AFP 100). Heavy metals including lead (Pb), zinc (Zn), manganese (Mn), nickel (Ni), magnesium (Mg), chromium (Cr), copper (Cu) and iron (Fe) in the digested samples were measured using

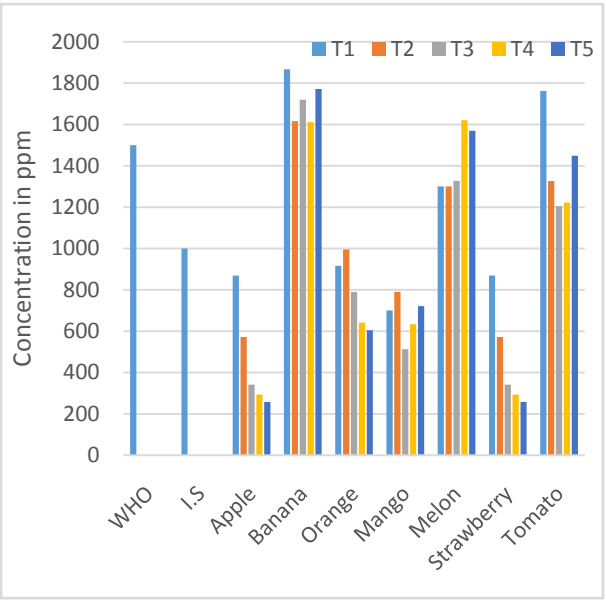
Atomic Absorption Spectrophotometer (Polarized Zeeman Z-8230 Atomic Absorption Spectrophotometer).

Results and Discussions:

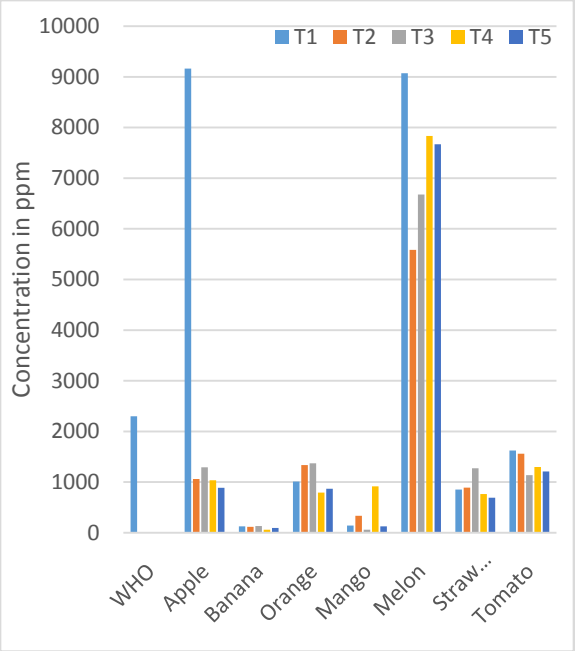
Outcome of this study provide the concentration of sodium (Na), potassium (k), calcium (Ca), zinc (Zn), iron (Fe), magnesium (Mg), lead (Pb), chromium (Cr), copper (Cu), nickel (Ni) and manganese (Mn) in fruits (mango, orange, strawberry, banana, melon, tomato and apple) and vegetables (onion, cabbage, lady finger, cucumber, coriander, brinjal and spanich).Fruits and vegetables are the main sources of carotenoids in the diet. The presence of conjugated double bonds in carotenoids has the main role in determining their antioxidant properties.



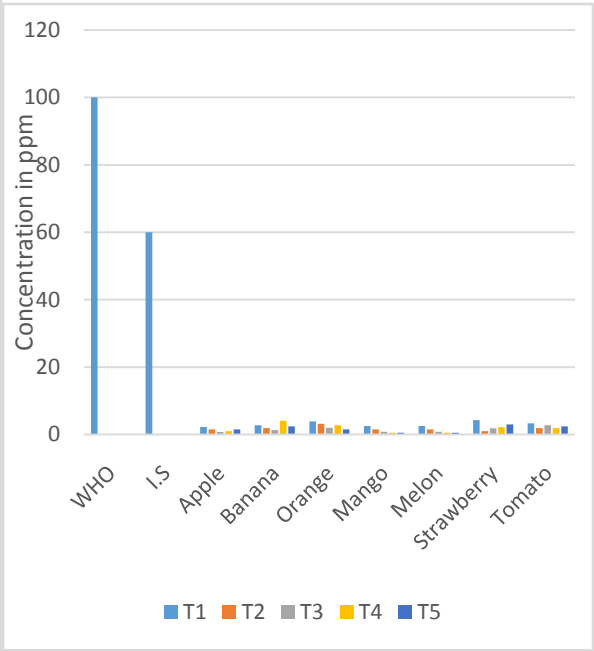
Concentration of Ca in fruits in ppm



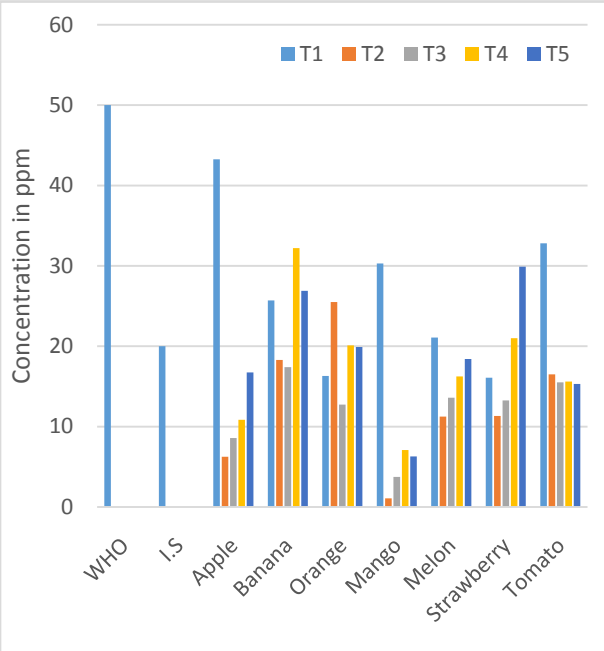
Concentration of K in fruits in ppm

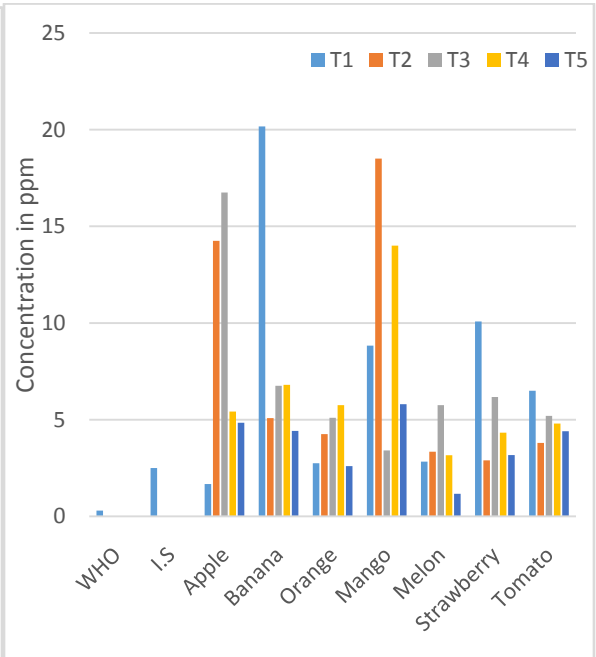


Concentration of Na in fruits in ppm

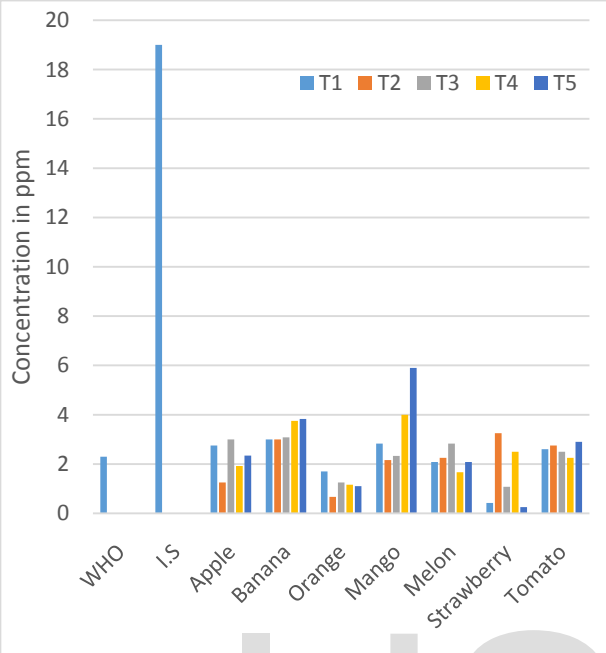


Concentration of Zn in fruits in ppm

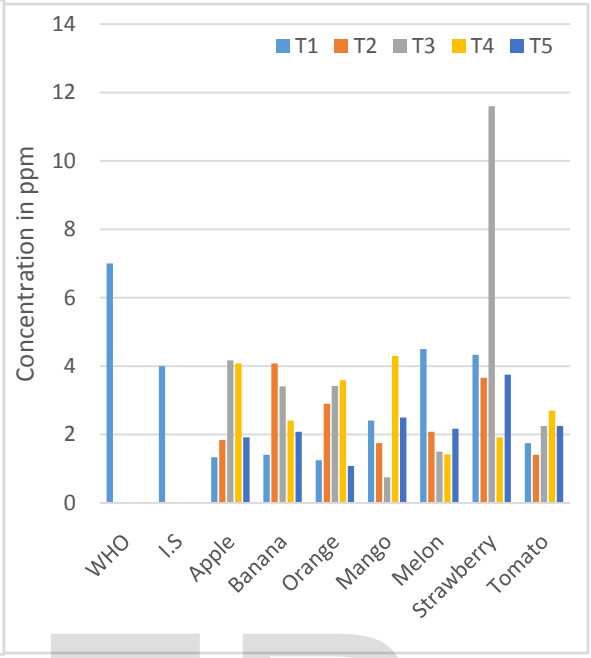




Concentration of Fe in fruits in ppm

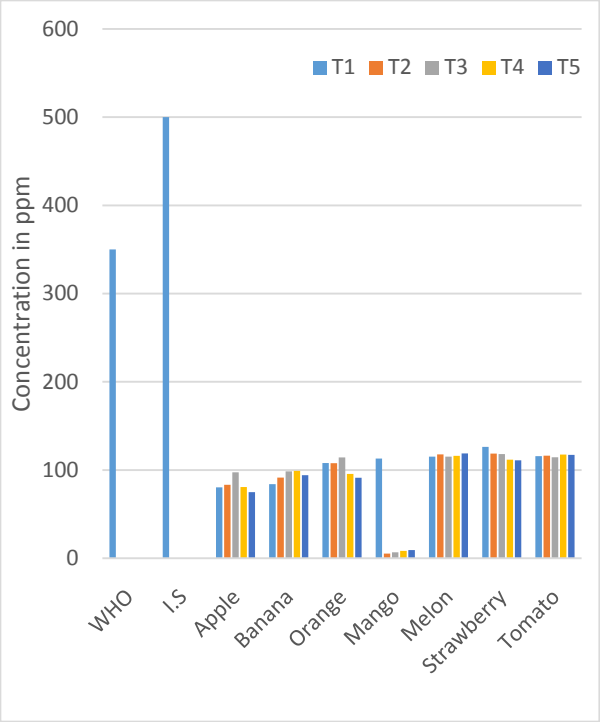


Concentration of Pb in fruits in ppm

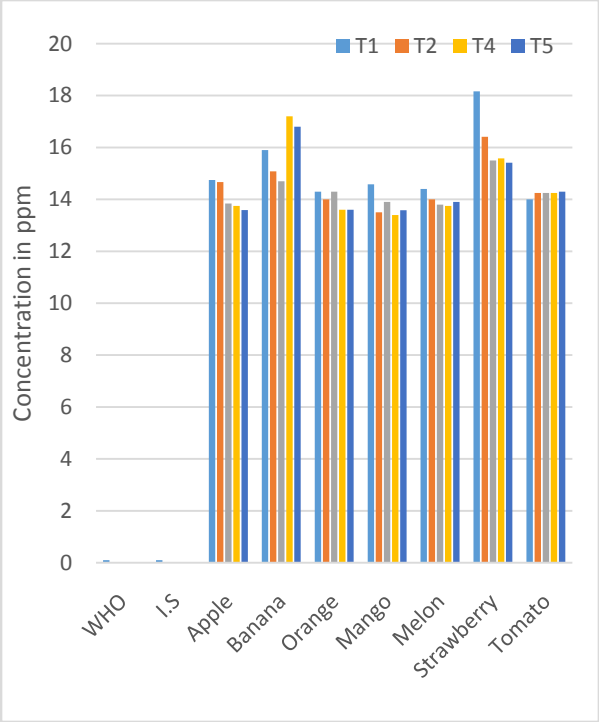


Concentration of Cr in fruits in ppm

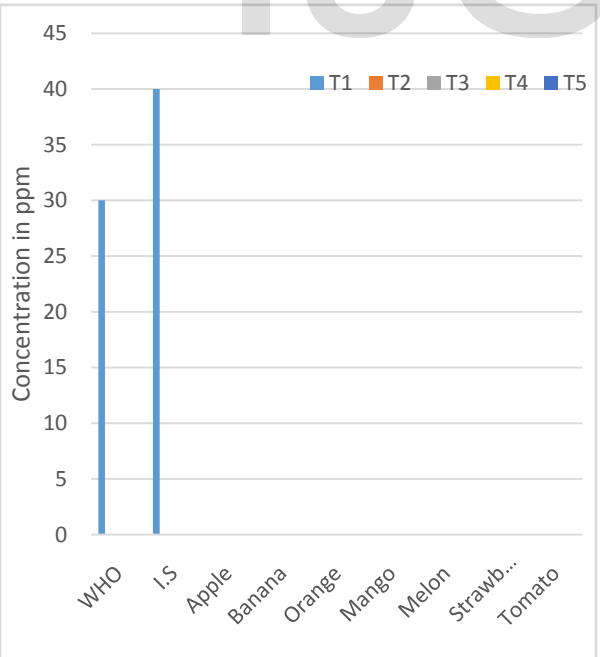
Concentration of Ni in fruits in ppm



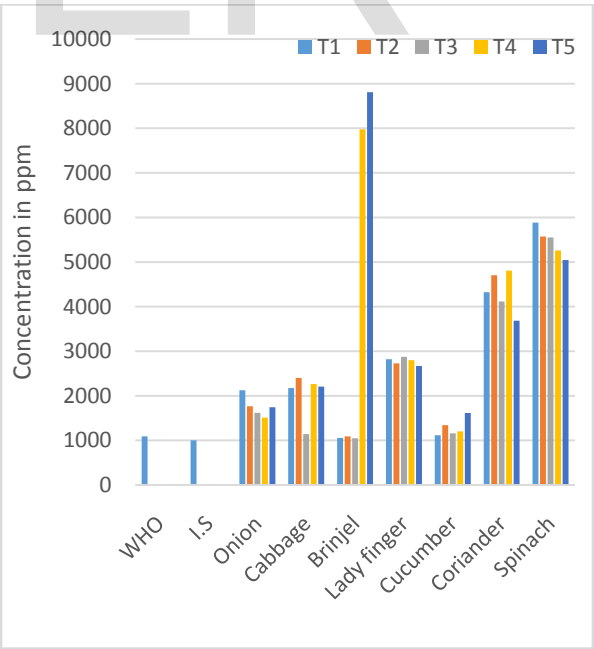
Concentration of Mg in fruits in ppm



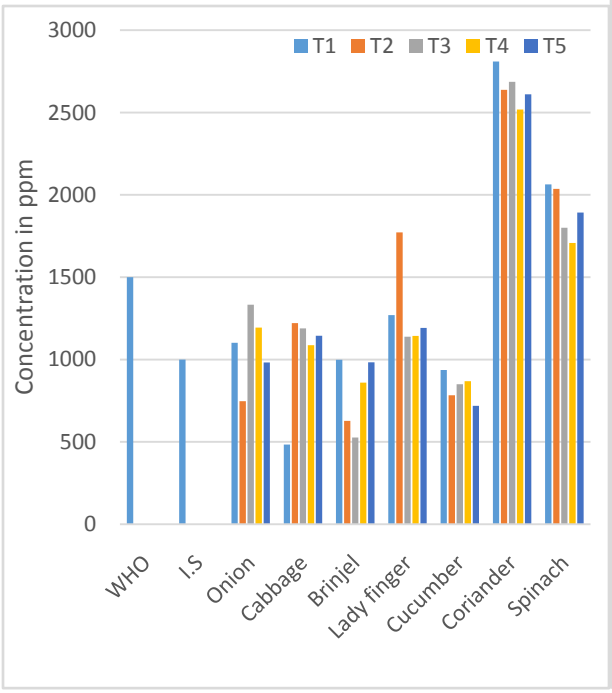
Concentration of Mn in fruits in ppm



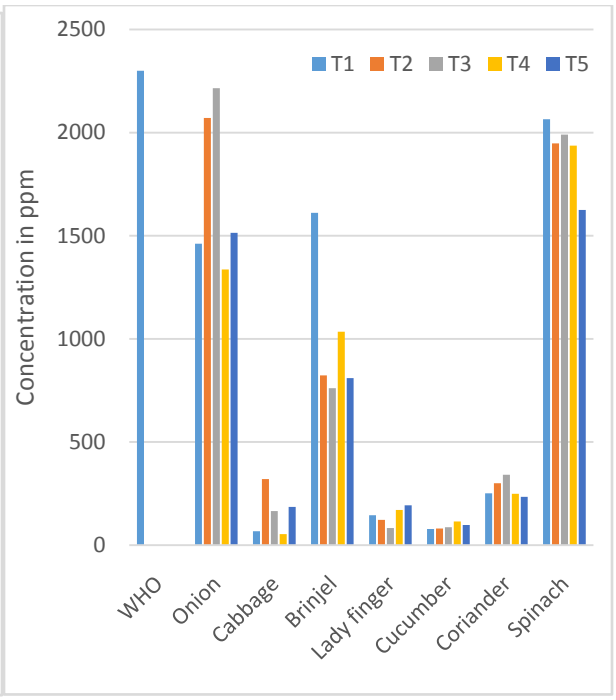
Concentration of Cu in fruits in ppm



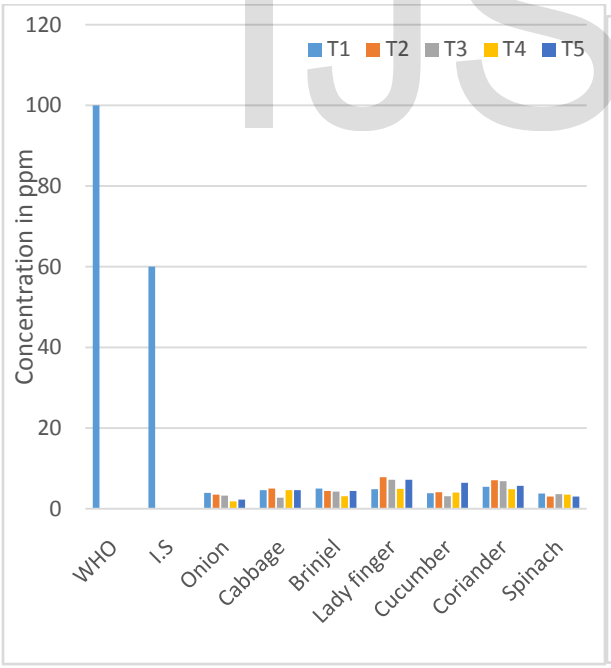
Concentration of Ca in vegetables in ppm



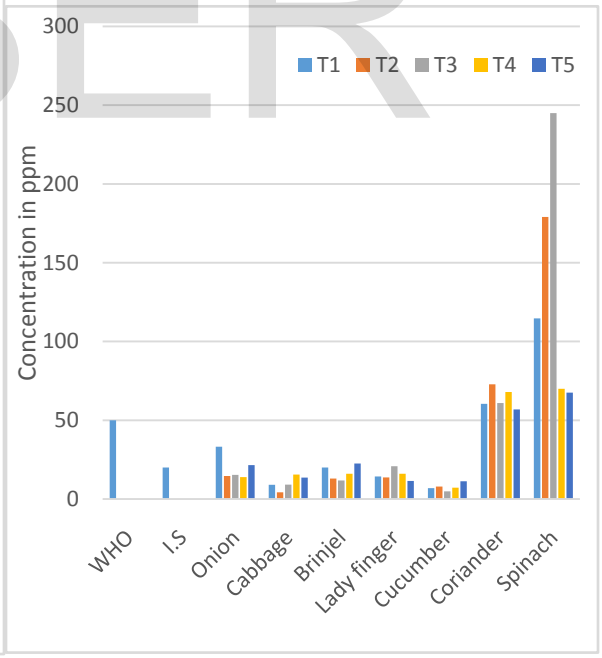
Concentration of K in vegetables in ppm



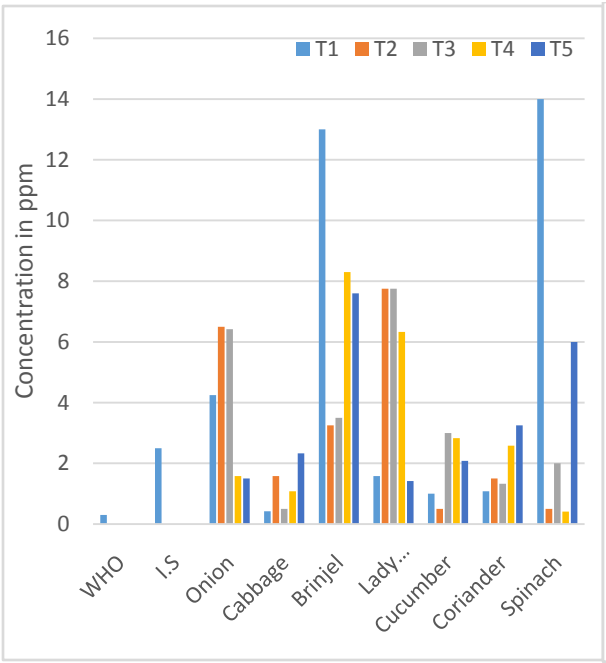
Concentration of Na in vegetables in ppm



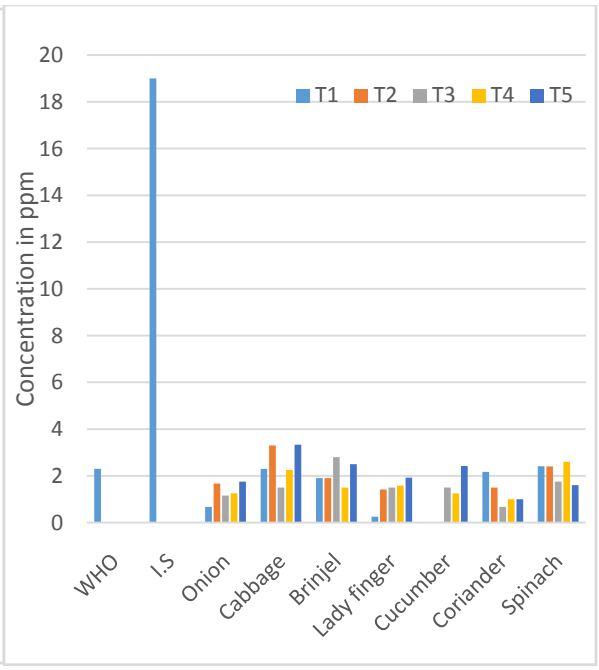
Concentration of Zn in vegetables in ppm



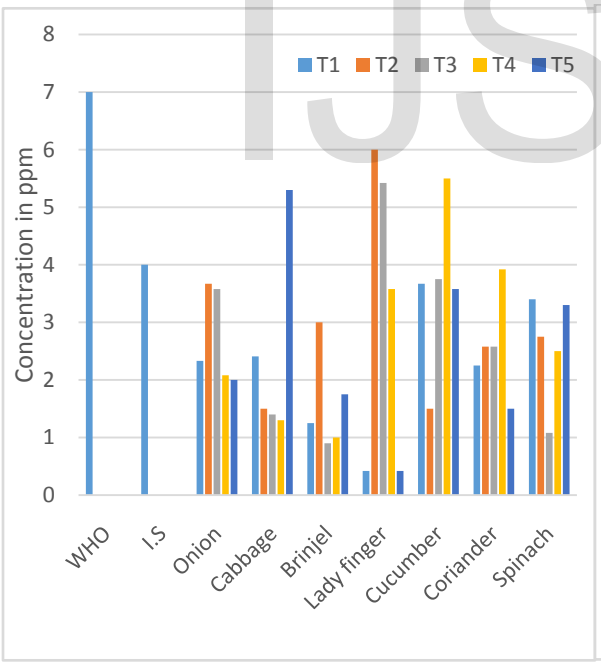
Concentration of Fe in vegetables in ppm



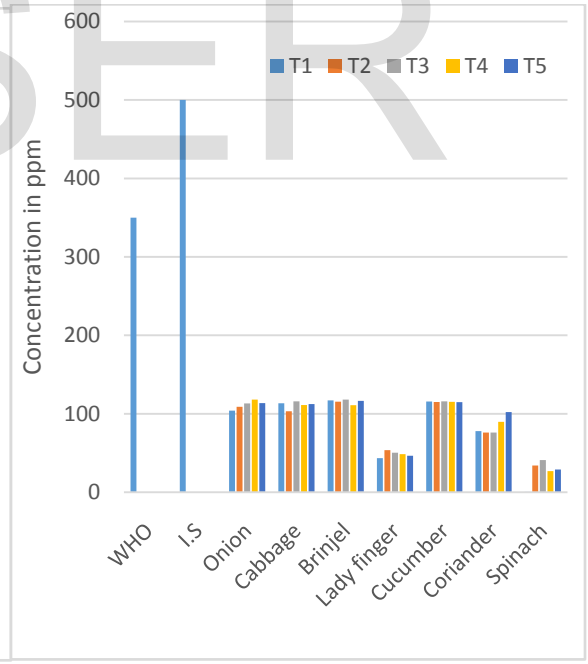
Concentration of Pb in vegetables in ppm



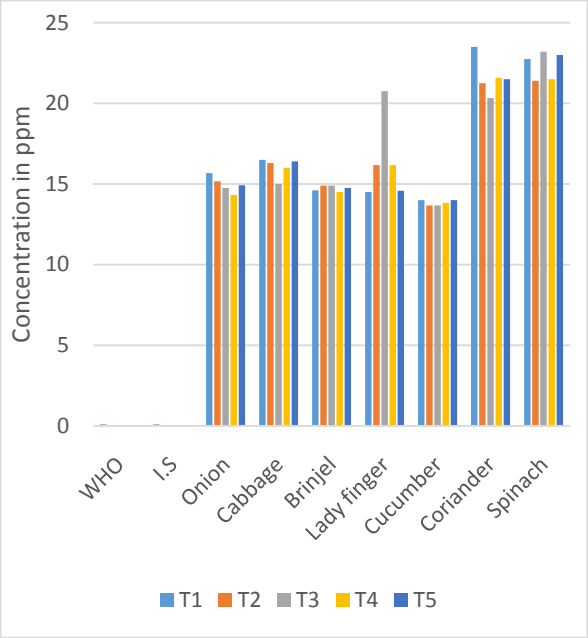
Concentration of Cr in vegetables in ppm



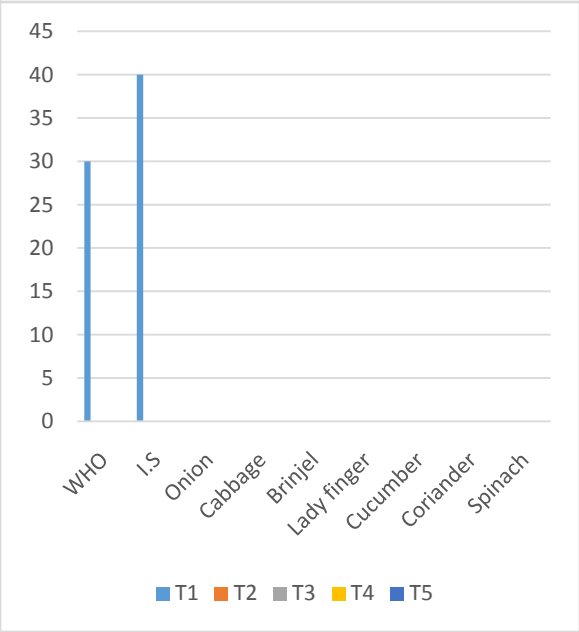
Concentration of Ni in vegetables in ppm



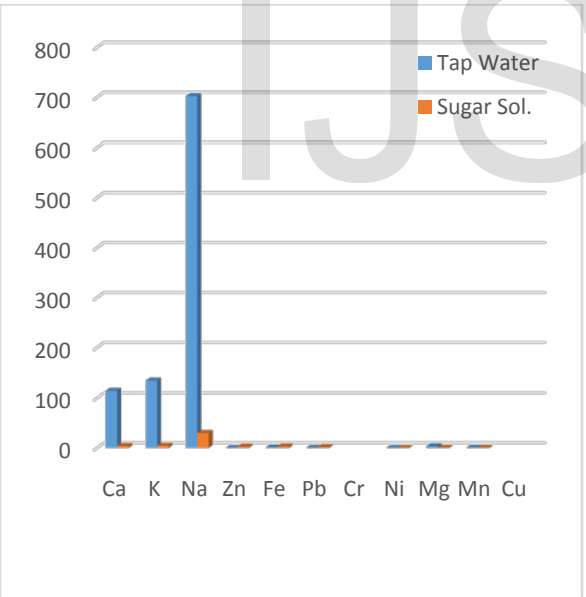
Concentration of Mg in vegetables in ppm



Concentration of Mn in vegetables in ppm



Concentration of Cu in vegetables in ppm



Concentration of minerals and heavy metals in tap water and sugar solution

Discussions:

Fruits and vegetables are widely usedas well as for nutritional purposes .The texture and firmness in them is due to their composition which is mainly cellulose, hemicelluloses and pectin.As compared to fruits, vegetables are a richer mineral source but both of them are 'nutrient-dense foods' that provide extensive amount of micronutrient, minerals, vitamins but only little calories.The purpose of the study was to valuate the amount ofmetals and minerals in fruits and vegetables to be safe for human consumption.All the fruits and vegetables showed the high conc. of Ca. The concentration of Ca is only reduced for mango and strawberry by the use of sugar solution.

- The concentration of K is reduced in all the samples of fruits except melon by the use of sugar solution.
- Sugar solution has reduced the concentration of Na in apple and brinjal.
- Spinach showed the highest conc. of Fe. The concentration of Fe for orange banana and strawberry is increased by the use of sugar solution.
- All the samples showed the high conc. of Pb. Use of sugar solution decreased the concentration of Pb in banana, tomato, strawberry brinjal and spinach and onion increased the concentration of Pb in cabbage and cucumber and lady finger.
- All the fruits and vegetables showed very low concentrations of Zn, Cr, Mg.
- All the samples of fruits and vegetables showed the value of Ni under the recommendation of international standards

- All the samples of fruits and vegetables showed very high concentration of Mn but sugar solution has no effect on the concentration of Mn.

- Cu is not detected in any of the sample.

The results showed that all the fruits and vegetables shows the value under the permissible limit by WHO for the potassium (K), sodium (Na), zinc(Zn), iron (Fe), nickel (Ni) and magnesium (Mg).

Conclusion: Presence of heavy metals in fruits and vegetablesis a very critical issue and it badly effects the human health. Main reason behind accumulation of these metals in the fruits and vegetables is because of irrigation with the waste water or because of the unfit water which is used for the irrigation. Drain water is also used for the irrigation which is also the major cause of the accumulation of the metals. Industrial effluent is also mixed in the water which is used for the irrigation purpose because of which heavy metals such as lead (Pb) and chromium (Cr) are accumulated in the fruits and vegetables and impose serious threat to human being. Proper irrigation is required to reduce the accumulation of metals in fruits and vegetables

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