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Analytical Studies of the Trace Elements in the Certain Three Varieties of Mango Fruits *(Mangifera indica L.)*

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The trace elements contamination in the fruits and vegetables is a common practice in the present time. Therefore, WHO protocols have the certain permissible limits for the trace elements in the organic food and vegetables. The studied three varieties of ripe mango cultivar. viz. Amarpali , Langra and Chanusa . Sample were collected from the local area (Delhi NCR in Ghaziabad U.P. region) and then it is prepared for analysis of trace elements - Arsenic (As) , Cadmium (Cd) , Chromium (Cr) , Iron (Fe) , Calcium (Ca) , Lead (Pb) , Tin (Sn) , Sodium (Na) , Potassium (K) , Nickel (Ni), Zinc (Zn) , and Mercury (Hg). Using by Inductively Coupled Plasma - Optical Emission Spectroscopy made by - perkin Elmer ICP-OES. As and Hg were not detected in Amarpali variety while in Langra As , Cd , Sn, Ni has not been found and in Chausa As, Cd, Sn ,Hg not detected The quantity of Pb was found to be very less in all the three varieties. Under the prescribed limit. Chromium was found at 22.27 mg/Kg to 23.04 mg / Kg, while iron 103.5 to 135.1 mg / kg was found which is a bit high, but profitable ,Calcium is found at 96.88 mg / kg to 136.1 mg/ Kg. sodium is found at 92.14 mg / Kg to 146.55 mg/ Kg. Potassium is found at 106.3 mg / Kg to 114.3 mg/ Kg., Zinc is found at 4.47 mg / kg to 5.33 mg/ Kg. The trace element contamination plays an important role in the quality of any fruit and vegetable.

Keywords: Mango Fruits, Trace Elements, Contamination, Amarpali, Langra And Chausa, Inductively Coupled Plasma , ICP-OES

Introduction

Mango; king of the fruits is the popular orchard crop of India. It's a favorite fruit among the Indian Community. India stands first in the world's Mango production. It accounts for 50 % of total fruit area and 27 % of total fruit production in India. Uttar Pradesh is a large producer in our country. Scientifically Mango is known as Mangifera indica L. It has an excellent flavour, attractive colour and taste with high nutrients value. It is a good source of vitamins, antioxidants, proteins, carbohydrates and amino acids. (Farid, S.M. and Enani, M.A. 2010 , Slavin, J.L. & Lloyd, B. 2012). The ripening process is concerned mainly with alterations in biochemical components already existing in the organ (Maldonado-Ceils, M.E.; 2019). Fruit ripening is a genetically programmed, highly coordinated, and irreversible phenomenon involving a series of physiological, biochemical, and organoleptic changes that lead to the development of a soft, edible, ripe fruit with desirable qualities. A Fruit are divided in three part Peel-Epicarp, (Gerg, 2021) Pulp (mesocarp) and Seed-endocarp (Fig-2) peel and seed use as bio-waste and has antioxidant properties but pulp is edible part and also good source of antioxidants and main portion of most commonly used. (Maldonado-Celis, 2019). About 50-60 % of the total mango weight is used to make a wide variety of food products. (APEDA-Agricultural and Processed Food Products Export Development Authority-2020 (Hussain and Iqbal, 2003). Mango related products in the market are steadily increasing with an annual increase of 5%. (National Mango Database, Indian Status of Mango: Area, Production and Productivity-Growth-2020 (Hussain and Iqbal, 2003).

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Objectives of the Study

The main objectives of the present study are to scrutinise the studied Mango Amarpali, Langra and Chausansa whether they have trace elements permissible amount or hazardous level.

(a)-Amrapali (b)- Langra (c) Chausa

Figure 1- Mango cultivar

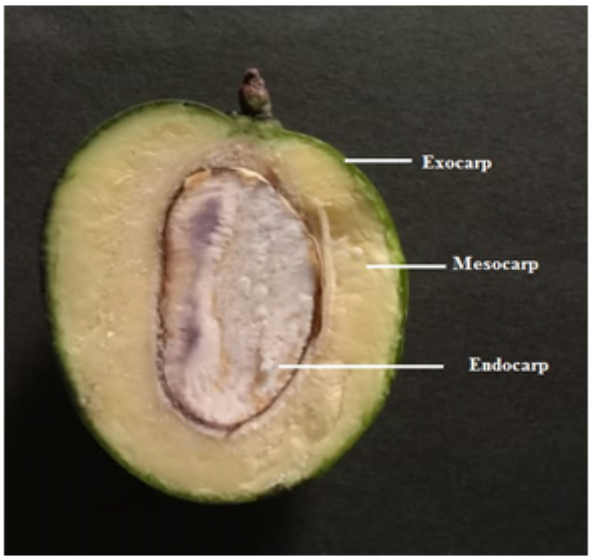

Figure 2- Major Parts of Mango

Review of Literature

The Mango fruit may be a part of the diet. People usually take 400 grams of fruit and vegetables in their daily diet. One can prevent chronic diseases such as heart disease, cancer, diabetes and viral activities etc by using fruits or vegetables (Zaidi et al, 2005 and Daud, et al 2010). Mango is the perfect resource which can be used as food as well as vegetables. Therefore, the Mangoes demand is increasing day by day as a noble food resource. The world health organisation (WHO) also recommended the fruit for good health.

The excess use of fertilizers deteriorates the quality of the fruit. (Valarino, 2019). Trace element contamination of the food or in fruits is one of the most significant aspects of food quality. (Bakkali, 2009 , Sharma & Agarwal, 2009) in fruits and vegetable trace elements or heavy metals receive minerals from soil or soils environments (Doherty, et al 2012). These trace elements exceed the requirement and the causes of health related diseases. (Shang, 2021) Sometimes an excess of these elements uncontrolled uses of the fertilizers also increases during the farming. Uncontrolled uses of fertilizers is commonly used to increases crop yields, these increases the crop yield , but quantity of trace elements increases in soil , trace metal contamination in edible plants may be related to soil nature, along with climate change ,irrigation with contamination water addition of fertilizers etc. even the soil also gets contaminated. (Sanayei et al 2009 , Voutsa et al 1996 and Yusuf et al 2003). All these elements absorb by the plant and directly affect the fruits and other agricultural products, (Brandt and Rickard 1996) due to which human health is also affected. . (Chaney , 1983) Many literature have reported the presence of trace elements in fruits. (Tegegne, 2015 and Zaidi et al 2005). Present studies observed the level of trace elements in the mango varieties i.e. As , Cd , Cr, Fe, Ca ,Pb , Sn, Na, K, Ni, Zn, and Hg in three varieties (Amrapali, Langra and Chausa) of mango (Table -1)

and concern about the safe limits of trace elements for human life.

Material and Methods

Three varieties of fully ripe mango viz. Amrapali, Langra and Chausa were collected and washed with double distilled water. Then squashed the pulp and let it dry perfectly. The dried pulp was separated. These are obtained from endocarp and exocarp by stainless steel knives. Just after squashing the pulp is stored in the refrigerator below 4oC .

Samples Preparation

Weighing the pulp accurately 0.5 gm of sample and put in a clean Teflon vessel. After wearing the gloves on hands, bring it in the fume hood. Add 8 ml conc. HNO3 for pre-treatment for 30 minutes. Then, again add 2 ml or conc. HNO3 and 1 ml of H2O2. Cover these Teflon vessels, fix these vessels in microwave digester assembly by tightening up with screws. Fix this assembly inside the microwave digester to digest the sample. After digestion let the vessels cool at room temperature. Open and vent each vessel in the fume hood. Transfer the digested sample solution into a 50 ml volumetric flask and dilute to the mark (level up) with Milli Q-water. Fix stopper on volumetric flask and shake well. Then, filter sample solution with what man filter paper in a 15 ml centrifuge tube. Ultimately these filtered sample solutions are run in the ICP-OES.

Preparation of Stock Solution

It was performed under three steps.

1. Available Metal stock standards concentration is 100 ppm (mg / L) with approx.100 purity
2. Working standard (10 ppm) - take 100 µ of 1000 ppm stock standard of each standard metal solution [100 µl) from 1000 ppm multi element standard solution and 100 µl from each other 6 metal solution of 1000 ppm] in 15 ml centrifuge tube and level up till 10 ml with Millipore water, Mix well in vortex.
3. Calibration standards are prepared at concentration levels of 0.05, 0.1, 0.2, 0.5, 1.0, 2.0, 5.0 ppm (mg /L). Perfection of the calibration curve is verified by the recovery of a check standard having connection in the middle of the calibration curve 1.0 mg/L (ppm).

The result is observed by comparing with working standard solution run the sample in ICP-OES

Quality Control

Check Standard -Recovery should fall within 80-120%
Duplicate samples- RSD should be < 20 %
Spike samples- Recovery should fall within 80-120 %
Reagents used for the analysis were of analytical grade and Milli– Q water is used for all dilutions. Supra pure grade reagent (Merck, Germany) of nitric acid is utilized for the digestion of samples. All the glassware was cleaned by sticking it in dilute nitric acid and then rinsed with distilled water before use.

Observations

The tests are shown in Table 1. and Table 2. The average trace element concentration in three varieties of mango are tabulated. This study shows that the level of trace element is higher known from tests of selected varieties of mango sample than the Compare to earlier reported results and from fixed safe limits by World Health Organization (WHO) which is depending on using excess pesticides and on the basis of biodiversity.

Table-1 Results of Trace Elements in Mango Varieties

Metal	Amrapali	Langra	Chausa
	Present Concentration (mg / kg)	Present concentration (mg / kg)	Present Concentration (mg / kg)
As	ND	ND	ND
Cd	0.2	ND	ND
Cr	20.27	22.95	23.04
Fe	135.1	122.24	103.5
Ca	136.1	156.73	96.88
Pb	1.58	2.07	2.17
Sn	0.59	ND	ND
Na	146.55	123.55	92.14
Ni	0.11	ND	ND
Zn	4.47	4.47	5.33
Hg	ND	ND	ND
K	114.3	114.3	106.3

Table-2-Operation conditions for the analysis of trace elements by ICP-OES

Parameter	Value
RF power (KW)	1.30
Nebulizer pressure	0.80 L/min
Analysis pump rate	1.5ml/min
Flush pump rate	2.5 ml/min

Plasma flow	15 L/ml
Auxiliary flow	0.20 L/min
Plasma veiw mode	Axial
Data acquisition	Peak hoping
Replicates	3

According to [SOP (standard operating procedure) of multi-element determination of metal and trace elements in aqueous samples and filters by ICP-OES] Fernanda et al (2013)

Result and Discussion

Trace element Arsenic is responsible to skin cancer, long-term exposure to arsenic may also cause cancers of the bladder and lungs. (Burton-Freeman, 2017) The concentration of as not found in the sample. (Jaffar and Masud, 2003, Fowler, et al, 2015). Cadmium can lead to kidney disease and cause bones to become weaker. Large amounts of cadmium can damage the kidney, liver and heart and in severe cases may cause death. The concentration of Cd not found in the mango sample (Nordberg, et al 2005 , Uluozlu, et al 2009 , Fowler, et al 2015) Sn in human body causes the skin disease, harmful for bad breath, dental cavities, sensitive teeth, gingivitis, plaque, and hair loss. The concentration of Sn not found in studied the sample. Nickel is also the micronutrient essential for proper functioning of the human body, as it increases hormonal activity and is involved in lipid metabolism. The concentration of Ni not found in the sample of Langra and chaunsa but present in very small extent in Amarpali variety of mango.

Mercury and mercury vapour can produce harmful effects on the nervous, digestive and immune systems, lungs and kidneys, skin eye and may be fatal. The concentration of Hg not found in the sample (Jaffar, M., Masud, K., 2003).

Chromium is important in the breakdown of fats and carbohydrates. It stimulates fatty acid and cholesterol synthesis. They are important for brain function and other body processes. Chromium also aids in insulin action and glucose breakdown (Ang and Ng, 2000 and Tripathi, et al 1998). Iron is an essential component of human blood. It is responsible for the deficiency of anaemia diseases. The concentration of Fe found in the mango fruit is . 135.1 mg/ Kg. (Jaffar and Masud, 2003 & Ang, 2000) .

The work of calcium in humans is to provide strength of bones and teeth, where it supports their structure and hardness. The concentration of Ca found in the mango fruit is 136.1 mg/ Kg (Nirmal et al 2007). Lead may enter the body by air, water and food materials.

Lead can be removed from fruit and vegetables by washing with water. The concentration of lead in the mango fruit was below the detectable level of the instrument which shows that either lead is absent in the sample or present in trace amounts. (Fowler, et al 2015). Zinc is found in cells throughout the body. It is needed for the body's defensive (immune) system to properly work. It plays an important role in cell division and cell growth.

Zinc is also needed for the senses of smell and taste. The earlier study reported daily intake of zinc is 15 mg for men and 12 mg for adult females. (Uluozlu, et al 2009 & Nordberg et al 2005).

Sodium plays an important role in blood pressure in humans and how nerves and muscles work. Most of the sodium in the body (about 85%) is found in blood and lymph fluid. It helps your nerves to function and muscles to contract. A diet rich in potassium helps to offset some of sodium's harmful effects on blood pressure.

Conclusion

In the present study. We investigated the trace elements in three varieties of ripe mango cultivar. Viz. Amarpali , Langra and Chausa. The concentration of trace element in mango fruits are found eg. Cr- 20.27 mg /kg in Amrapali 22.95 mg /kg in Langra and 23.04 mg /kg in Chausa Fe- 135.1 mg /kg in Amrapali 122.24 mg /kg in Langra and 103.5 mg /kg in Chausa . Ca - 136.1 mg /kg in Amrapali 156.73 mg /kg in Langra and 96.88 mg /kg in Chausa. Pb- 1.58 mg /kg in Amrapali 2.07 mg /kg in Langra and 2.17 mg /kg in Chausa . Zn , 4.47 mg /kg in Amrapali 4.47 mg /kg in Langra and 5.33 mg /kg in Chausa. Na- 146.55 mg /kg in Amrapali 123.55 mg /kg in Langra and 92.14 mg /kg in Chausa . K, 114.3 mg /kg in Amrapali 114.3 mg /kg in Langra and 106.3 mg /kg in Chausa . Cd was found 0.2 mg /kg in Amrapali and not detected in Langra and Chausa . Sn - 0.59 mg /kg in Amrapali and not detected in Langra and Chausa. Ni - 0.11 mg /kg in Amrapali and not detected in Langra and Chausa . As and Hg not observed in any varieties of mango fruits. Thus the findings indicate that all varieties of mango contained acceptable value of trace elements and similar to earlier study of heavy metals contamination in fruits and vegetables. But a comparatively large amount of Fe from other previous study results.

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