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Determination of Toxic Heavy Metals in Tremendously Consumed Indigenous Fruit Species ViaBangladeshi People

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Abstract
Background:*Fruits are nature's marvellous gift to the humankind; indeed, they are life-enhancing medicines packed with vitamins, minerals, antioxidants and many phytonutrients (Plant-derived micronutrients).In recent years, world consumption of the fruit has significantly increased due to their potential nutritional and therapeutic benefits. Fruits are sources of many essential nutrients that are under-consumed, including potassium, dietary fibre, vitamin C, and folic acid. Consuming a diet rich in fruit may reduce the risk for stroke, other cardiovascular diseases and type-2 diabetes. Consequently, it is emergent to determine the toxic elements in highly consumed indigenous fruit with a good number of varieties.*
Objective: *The study aims to assess the concentrationof four heavy metal (Pb, Cd, Cr and Hg) in ten indigenous fruit speciescollected from local markets of Dhaka city, Bangladesh.*
Method: *Fruit elements were measured by using atomic absorption spectrometry (AAS) to evaluate their potential health risks from the toxic metals by the consumption of fruit.*
Result:*The concentration of toxic elements in fruit samples found 0.062-0.34 mg/kg for Pb, 0.053-0.34 mg/kg for Cr, The Mercury (Hg) and Cadmium(Cd) concentrations in the investigated fruit samples found below detection limit (<0.02 mg/kg for Hg and <0.01 mg/kg for Cd) except in Pear (Pyruscommunis) fruit. The estimated daily intake (EDI) of all the substantial studied basis of mean fruit consumption of 44.7 g/person/day by Bangladeshi households indicates that no risk to people's health concerning the EDI of studied heavy metals through the use of the selected fruit samples.*
Conclusion:*From the human metals calculated on health point of view, the estimation of non-carcinogenic risk indicates that intake of individual heavy metals, as well as combined heavy metals through the consumption of fruit, is safe for human health.*
Keywords:*Indigenous Fruit; Toxic Metals; Health Hazard Assessment; Atomic Absorption Spectrometry.*

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I. Introduction

Proper nutrition is an integral part of leading a healthy lifestyle. Nutrition also focuses on to reduce diseases, conditions, and problems can be prevented or reduced with a healthy diet. Similarly, nutrition involves identifying how certain diseases and conditions maybecaused by dietary factors, such as poor diet (malnutrition), food allergies, and food intolerances.

The term 'fruit' is conveniently used to refer to the part of the seed suitable for human consumption, eaten fresh, either ripe or young. Fruits are low in calories and fat and are a source of simple sugars, fibre, and vitamins, which are essential for optimising our health. Each person should consume at least 85 grams of fruits per day for a healthy life. In that case, we consume only about 35 grams per day.

Bangladesh abounds with a large variety of tropical and sub-tropical fruits. The most widely cultivated fruits are mango, jackfruit, blackberry, pineapple, banana, litchi, lemon, guava, custard apple, Indian berry, papaya, tamarind, melon, watermelon.

Heavy metals are generally defined as metals with relatively high densities, atomic weights, or atomic numbers. In metallurgy, for example, a heavy metal may be determined based on density, whereas in physics the distinguishing criterion might be atomic number, while a chemist would likely be more concerned with chemical behaviour. Heavy metals, in general, are not biodegradable, have long biological half-lives and have the potential for accumulation in the different body organs leading to undesirable side effects [1-2]. Heavy metal contamination may occur due to factors including irrigation with contaminated water, fertilisers and metal-based pesticides, industrial emissions, transportation, harvesting process, storage and sale [2-4]. Lead and cadmium are among the most abundant heavy metals and are particularly toxic. The excessive amount of these metals in food is associated with cardiovascular, kidney, nervous, as well as bone diseases [5-6]. Lead is well known for its toxicity and adverse effects on human health. Some chronic effects of lead poisoning are colic, constipation and anaemia [7].

Mercury plays a crucial role in damaging the tertiary and quaternary protein structure and alters the cellular function;it can impair any organ and lead to malfunctioning of nerves, kidneys and muscles. Chromium toxicity significantly affects the biological processes in various plants such as maise, wheat, barley, cauliflower, Citrullus and in vegetables. Chromium toxicity causes chlorosis and necrosis in plants [8].

Objective

This study aims to determine the level of some heavy metal in fruits of Bangladesh and assess the carcinogenic and non-carcinogenic human health risk associated with the consumption of the selected fruits.

The rationale of the study:

Nowadays some growers, as well as traders in Bangladesh, are commercially using some chemicals namely Ripen, Gold-Plus, Profit etc. for the ripening of tomato, papaya, mango and banana, directly to the fields and processing areas. These chemicals change the nutritional properties of fruits and vegetables as well as lead serious health hazards to human beings like cancer, skin irritation, diarrhoea, liver disease, kidney disease, gastrointestinal irritation [9]. Children are at particular risk to the harmful side effects of food contamination, which may lead to severe liver and kidney diseases, including various forms of cancer and epitasis[10]. Keeping in mind the potential toxicity and persistent nature of heavy metals, and the frequent consumption of vegetables and fruits, it is necessary to analyse these food items to ensure the levels of these contaminants meet agreed international requirements [2]. This study aims to determine the concentrations of toxic elements in selected fruits which are the cheapest and widely consumed tropical fruits in Bangladesh as well as to warn the people and government about the focus and severe side effects of food contamination.

II. Materials and Methods

Study area and sampling location:

We collected ten indigenous fresh fruit species which are highly consumed by the Bangladeshi population from two different local markets Dhaka city, namely: Mirpur-10 andMohammadpur Krisi Market.

Selection of Elements:

The concentrations of four toxic elements Lead (Pb), Cadmium (Cd), Chromium (Cr), and Mercury (Hg) determined in 20 samples of commonly fresh fruit.

Collection and preservation of samples

After collection fruit species have been wrapped in polythene bags to transport to the Analytical Chemistry Laboratory, Chemistry Division, Atomic Energy centre Dhaka, Bangladesh Atomic Energy Commission, immediately after transportation to the laboratory samples have been washed with distilled water, further washed with deionised water to remove the dirty or other fouling substances. The edible parts of each sample have been removed and chopped into pieces with the aid of a steam cleaned stainless steel knife, then took the weight of samples.After that, the samples are dried in 100°C oven until the samples are dehydrated, which achieved by reaching constant pressure and temperature for 2 days.

Then we took the weight of the dry sample to measure the moisture content of fruits. Further, the dried samples have been grounded into a fine powder form and stored in a fresh plastic polythene bag ready for digestion.

Instrument:

Instrumentation sue detail description of the instruments used through the experiment shown below-

1. Graphite Furnace Atomic Absorption Spectrophotometer (GF-ASS)

Model No- AA280Z
Manufacture - Varian
Country of origin-Australia
Installation year-2008

2. Cold Vapor Atomic Absorption Spectrophotometer (CV – ASS)

Model No - AA240FS
Manufacture - Varian
Country of origin-Australia
Installation year - 2008

3. Electronic Balance

Model No - EK 300H
Capacity-300g

Readability-0.01g
Country of origin – Japan
Installation year
4. Fume hood (ACL/E/F-01)
5. Oven
6. Hotplate
Other regular items used from laboratory

- Sample vials (25 ml, 50 ml)
- Beaker (100, 250, and 500ml)
- Conical flask (50,100, and 250ml)
- Round bottle flask
- Funnel (50, and 100 ml)
- Burette (100 ml)
- Micro syringe (10-100mml)
- Pipette filler
- Petri dish
- Distilled water
- De-ionized water
- Gloves
- Glass rod
- Stand and holder
- Tissue paper
- Magnetic hot plate

Sample digestion:

To determine the trace elements from edible portions of the fruit acid digestion method has been performed. Acid digestion is a method of dissolving sample into solution by adding acids and heating until the complete decomposition of the matrix. In this study,theacid digestion method executed by using a hot plate.In hot plate digestion system from each fruit sample, 1g dry sample placed in a 100 ml beaker. Afterwards, about 8 ml of concentrated nitric acid (analytical grade, 65%) poured into the beaker. A crystal glass placed at the mouth of the beaker, and the beaker placed on a magnetic hot plate. The mixture has been heated for 2 hours to remove all oxidisable matter. Then 1 ml of hydrogen peroxide (30%) added in the mixture and the temperature maintained another 30 minutes. Once the digestion has completed while all samples completely dissolved in the acid and the volume content is 1 ml. The digested acid solution filtered by filter paper and adding reduced to deionised water and stored in 25 ml vial.

Blank Preparation:

During the digestion process of fruit samples, reagent blanks (laboratory blank) prepared to ensure that the samples and the chemicals used are not contaminated.They arearrangedsimilarly as samples,except that no samples added to the digestion vessels. After digestion, reagent blanks are rated as samples and diluted with the samefactor. They are analysed before the main samples.Each set of digested samples have its reagent blanks and corrected by using their blank samples.

Spike Sample Preparations:

Spike sample analysis used to test the method at varying concentrations of the analyte.Knownamounts of analyte added to the unknown sample and the calculatedtherecoverypercent.Ifinterferences are present in the samples,results obtained which are significantlyhigher or lower than the actual concentration.Each set of digested samples has at least onespike sample.

Instrumental Analysis:

A Varian AA28OZ Atomic Absorption Spectrometer (AAS) with Zeeman background correction system equipped with a graphite furnace (GTA 120)and an autosampler (PSD120)used for the determination of Pb,Cd and Cr.Moreover, Hg determined using Cold Vapour AAS (CV-AAS).Atomic signals measured for Pd,Cd,Cr in peak area mood and Hg in integration mood.The working standard solutionsprepared by appropriate dilution of the respective 1000 milligram per litre(mg/L)stock standard solutions using 1%(w/w) supra pure grade Nitric Acid (MerckDarmsta,Germany). All containers and glassware have been cleaned by soaking into 20% Nitric acidfor at least 24 hours and rinsed three times with deionised water before use.

Statistical analysis

Statistical analyses carried out by using Statistical Package for Social Science (SPSS) for Windows version 16.0. The results obtained in the present study are reported as mean values ± standard deviation (SD).

Precautions:

One of the main problems in the sample preparation is the contamination of the sampleduring sample pretreatment (weighting, cutting and digestion). Therefore, several precautionsare taken to prevent contamination, such as-

a. Using acidic solution 20%(v/v) and deionised water to clean all bottles and glasswarebefore use.
b. Fruit samples have been washes with deionised water before cutting to remove adsorbedelements onto skin.
c. Contamination may also occur from acid mixture used for digestion or from atmosphericair of lab. Therefore to check any error from any of the mentioned possible sources, reagentblanks prepared in each set.

Calculation of human health risk assessments for fruit consumption:

Estimated Daily Intakes(EDI)

The estimated daily intakes (EDI) for the analyzed metals were calculated by using theformula:

$EDI= (EFr\times ED\times FIR\times MC/ BW\times TA) \times 10^{-3}$

Where,

EFr= Exposure frequency (365 days/year),

ED= Exposure duration (70 Years),

FIR = Food ingestion rate (g/person/day) which is 61 g defined for the European people.

MC= Mean concentrations of metals in fruit samples (mg/kg, wet-weight basis);

BW =Average body weight (adult 70 kg);

TA =Averaging time for non-carcinogens (365 days x number of exposure years, assuming70 years).

Non-carcinogenic risk:

Target Hazard Quotient(THQ):

Target hazard quotient (THQ) is typically used to estimate the potential non-carcinogenic risk of pollutants. It is the ratio of EDI and reference dose (RfD, mg/kg-BW/day) that is expressed by:

$$\mathbf{THQ = EDI/ RD} \qquad (1)$$

The RfDs are based on 0.004, 0.001, 1.5, 0.003 and 0.0005mg/kg- BW/day for Pb,Cd,Cr, and Hgrespectively.If the THQ value is lower thanl,the exposed population should notexperience any adverse health hazard. Conversely, if the THQ value is 1, there is a potentialhealth risk and the probability of health risk will be increased with increasing THQ value.Ithas been reported that exposure to more than one pollutant may result in additive andinteractive effects on human health.Thus, in the present study, a cumulative health risk for theinvestigated heavy metals was assessed by summing the THQ value measured for individualheavy metal and expressed as total THQ (TTHQ) as follows.

$$\mathbf{TTHQ= THQ(toxicant\ 1)+ THQ\ (toxicant\ 2)+ THQ(toxicant\ n)} \qquad (2)$$

The greater the value ofTTHQ, the greater the level of concern.

Carcinogenic risk:

The incremental probability of developing cancer in an individual over a lifetime exposure toa potential carcinogen is generally expressed as carcinogenic risk (CR). Cancer risks due to the lifetime exposure to Pb, Cd, Cr and Hg through the consumption of the selected fruitspecies were measured using the equation:

$$\mathbf{CR=CSF\times EDI} \qquad (3)$$

Where CSF is the carcinogenic slope factor of 0.0085, 0.38, 0.5 and 0.0005 mg/ kg/ day forPb, Cd, Cr and Hg respectively set by USEPA, USDOE, FAO/WHO.EDI is theestimated daily intake of heavy metals. Acceptable risk levels for carcinogens range from 10^{-4} (risk of cancer over a humanlifetime is 1 in 10.000) to 10^{-6} (risk of developing cancerdeveloping over a human lifetime is 1 in 1,000,000).

III. Result

Concentrations of heavy metals (Pb, Hg, Cd and Cr) in selected fruit species collected from two markets which are highly consumed by Bangladeshi people are listed in Table-1. All samples were analyzed using Atomic Absorption Spectrophotometer.

The overall range of four heavy metals in ten kinds of fruit samples collected different markets is found to be Cr (<0.05-0.34 mg/kg), Pb (<0.06-0.34 mg/kg), Cadmium and mercury contents are found below the detection limit for all the investigated samples except Pear (Pyruscommunis) fruit sample.From the overall investigation in selected fruit samples of two markets, it is found that Pb and Cr concentrations of some fruits samples are beyond permissible limit but most of the fruits like Mango (Mangiferaindica), Guava (Psidiumguajava), Orange (Citrus chrysocarpa), Papaya(Carica papaya), Grape (Vitisvinifera) are safe from hazardous effects of four investigated heavy metals shown in Table-1.

The average concentration of four heavy metals Pb, Cr, Hg and Cd in ten kinds of fruits samples which is highly consumed by Bangladeshi people are listed in Table 2.Average for each type of fruit has been calculated taking into account of two markets results. According to the ranking order of average concentration of the heavy metals in fruit sample is Cr (0.67 mg/kg)>Pb (0.32 mg/kg) > Cd (0.04 mg/kg) > Hg (0.03 mg/kg).

The mercury content of the maximum fruit samples has been found <0.02 mg/kg but only Pear (Pyruscommunis) have 0.03 mg/kg Hg concentration. The cadmium content of the maximum fruit samples have been found <0.01 mg/kg, only 0.045 mg/kg found for Pear (Pyruscommunis). Minimum and maximum lead level observed in this study is 0.07 mg/kg for Guava (Psidiumguajava) and 0.32 mg/kg for Banana (Musa sapientum), Lead is not detected in Orange (Citrus chrysocarpa) and Grape (Vitisvinifera) and detection limit of Lead for these samples is 0.06 mg/kg. Apple(Malus pumila), Banana(Musa sapientum), Pear (Pyruscommunis), Pomegranate (Punicagranatum), Malta(Citrus sinensis) exceeded the permissible limit of 0.1 mg/kg and 60% has exceeded the allowable limit in investigated fruit samples. The minimum and maximum chromium level observed in this study is 0.057 mg/kg for Grape (Vitisvinifera) and 0.2 mg/kg for Malta (Citrus sinensis). Chromium was not detected in Pear (Pyruscommunis) and Pomegranate (Punicagranatum) and detection limit of Chromium for these samples is 0.05 mg/kg.

Table 1: Concentrations (Mean ± SD) of toxic elements in ten types of fruit species collected from selected markets of Dhaka city.

Sample location	Fruits species	Concentrations (Mean ± SD) of toxic elements (mg/kg)			
		Hg	**Cd**	**Pb**	Cr
Mohammadpur Krishi market	Apple *(Malus pumila)*	<0.02	<0.01	0.31±0.01	0.27±0.004
	Banana *(Musa sapientum)*	<0.02	<0.01	0.29±0.01	0.15±0.006
	Mango *(Mangiferaindica)*	<0.02	<0.01	1.15±0.03	0.052±0.02
	Pear *(Pyruscommunis)*	<0.02	<0.01	0.19±0.01	<0.05
	Pomegranate *(Punicagranatum)*	<0.02	<0.01	0.17±0.03	<0.05
	Guava *(Psidiumguajava)*	<0.02	<0.01	0.08±0.01	0.054±0.001
	Orange *(Citrus chryosocarpa)*	<0.02	<0.01	<0.06	0.071±0.004
	Grape *(Vitisvinfera)*	<0.02	<0.01	<0.06	<0.05
	Papaya *(Carica papaya)*	<0.02	<0.01	0.12±0.01	0.053±0.002
	Malta *(Citrus sinesis)*	<0.02	<0.01	0.21±0.01	0.16±0.002
Mirpur-10	Apple *(Malus pumila)*	<0.02	<0.01	0.23±0.01	<0.05
	Banana *(Musa sapientum)*	<0.02	<0.01	0.34±0.02	0.131±0.003
	Mango *(Mangiferaindica)*	<0.02	<0.01	0.16±0.01	0.061±0.003
	Pear *(Pyruscommunis)*	0.061±0.01	0.09±0.01	0.13±0.001	<0.05
	Pomegranate *(Punicagranatum)*	<0.02	<0.01	0.29±0.03	<0.05
	Guava *(Psidiumguajava)*	<0.02	<0.01	0.061±0.02	0.09±0.003
	Orange *(Citrus chryosocarpa)*	<0.02	<0.01	<0.06	0.071±0.004
	Grape *(Vitisvinfera)*	<0.02	<0.01	<0.06	0.113±0.004
	Papaya *(Carica papaya)*	<0.02	<0.01	0.062±0.03	0.073±0.007
	Malta *(Citrus sinesis)*	<0.02	<0.01	0.17±0.03	0.34±0.009
Overall Range		**(<0.02-0.61)**	**(<0.01-0.09)**	**(<0.06-0.31)**	**(<0.05-0.34)**

Table 2: TheAverageconcentrations (Mean ± SD) of toxic elements in selected fruit species.

Fruits species	Concentrations (mean ± SD) of toxic elements (mg/kg)			
	Hg	**Cd**	**Pb**	**Cr**
Apple *(Malus pumila)*	<0.02	<0.01	0.26±0.06	0.133±0.002
Banana *(Musa sapientum)*	<0.02	<0.01	0.32±0.03	0.14±0.015
Mango *(Mangiferaindica)*	<0.02	<0.01	0.16±0.007	0.06±0.0024
Pear *(Pyruscommunis)*	0.03±0.001	0.045±0.0005	0.16±0.04	<0.05
Pomegranate *(Punicagranatum)*	<0.02	<0.01	0.23±0.08	<0.05
Guava *(Psidiumguajava)*	<0.02	<0.01	0.07±0.014	0.67±0.001
Orange *(Citrus chryosocarpa)*	<0.02	<0.01	<0.06	0.07±.0014
Grape *(Vitisvinfera)*	<0.02	<0.01	<0.06	0.057±0.002
Papaya *(Carica papaya)*	<0.02	<0.01	0.09±0.042	0.062±0.003
Malta *(Citrus sinesis)*	<0.02	<0.01	0.19±0.03	0.2±0.019
Permissible limit	**0.01****	**0.05***	**0.1***	**0.2****

*Bangladesh **WHO

Estimated Daily Intake (EDI):

The EDI of heavy metals through the consumption of selected ten fruit species by people shown in Table-3. The result indicates that Hg contributes to the lowest daily intake and Pbcontributes to the highest daily intake. The EDI has been calculated by considering that a 61kg person consumes 44.7 g fruit per day. The result of EDI reveals that the EDI values fortheexamined fruit samples are below the recommended values which indicates no risk topeople's health associated with the intake studied heavy metals through the consumption ofthe selected fruit samples.

Table 3: Comparison of the estimated daily intake of heavy metals from fruit species studied with the recommended daily dietary allowances.

Metal	Mean concentration (mg/kg)	EDI (mg/kg/person)	Recommended daily dietary allowance (mg/kg/person)	THQ	TTHQ	Carcinogenic risk (CR)
Pb	0.1345	1.17×10^{-5}	0.21(JECFA,2009)	0.02938	0.2462	
Cd	0.0045	3.92 ± 10^{-5}	0.06(JECFA,2009)	0.00392		1.49×10^{-6}
Cr	0.078135	6.80 ± 10^{-5}	0.20(JECFA,2009)	4.54×10^{-5}		3.40×10^{-5}
Hg	0.003035	2.64×10^{-6}	0.03(JECFA,2009)	0.005281		

THQS of individual heavy metal through fruit consumption by average Bangladeshi adults presented in Table-3. Average heavy metal concentration in fruit species used to calculate THQ for the people of Dhaka city, Bangladesh. The THQ values for the targetedheavy metal followed the descending order of Pb> Hg > Cd > Cr. Table-3 indicates thatthe THQ value of each metal was less than 1 which suggests that people would notexperience significant health risks if they only intake individual heavy metal through theconsumption of fruit. However, the TTHQ in this study is less than 1, indicates there ispotential health risk through the use of fruits involved exposure to a mixture of fourexamined metals.

IV. Discussion

The concentration of toxic elements in selected indigenous small fruit species concentrations of heavy metals (Pb, Hg, Cd and Cr) in selected fruit species which is highlyconsumed by Bangladeshi people have assessed in this study and discussed in thefollowing sections.

Lead:

Lead contents in the literature have been reported in the range of 0.005 (kiwi) to 0.013(mango) in the determination of essential and toxic elements in fruit by [11-12], performed to compare the macro and micronutrient elements andheavy metal contents of ten different types of fruit;wedidn't found in Pb in selectedfruit.The maximum legislative value of lead as described by the Commission Regulation(EC)No.18881/2006 [13] and Bangladesh Gazette s.r.o.No.233- Act 2014 is 0.1 mg/kg. In this study,the range of Lead concentration in selected fruit species is 0.07-0.32 mg/kg. The highestamount of lead is in Banana fruit, the lowest amount found in guava. It has been shown thatthe concentration of Lead is higher than in literature studies.

Chromium:

Chromium was found in almost all selected fruit varieties except Guava and Mango, the highestamount of chromium found in Sapodilla, 0.062 ± 0.02 mg/100g and the lowest amount were in the Strawberry, 0.030 + 0.01 mg by [14] investigated the minerals and heavymetal concentration in selected tropical fruits in Bangladesh. In this study, the range of Chromium concentration in selected fruit species is 0.06-0.14mg/kg. The highest amount of chromium is in Banana fruit, the lowest amount foundin mango. It has been shown that the concentration of Chromium is almost the same as literature.

Cadmium:

ln this study, Cadmium has been found in one species Pear (Pyruscommunis) as 0.045mg/kg. In rest of the sample fruit species, the concentration of Cdis found to be below the amount of cadmium has been found in only oneselected fruit species which is below the standard of 0.05 mg/kg set by Bangladesh Gazette.The concentration of cadmium the literature has not been found available in selected fruit species.

Mercury:

Mercury was found in Sapodilla, Stone-apple, Elephant-apple and Tamarind fruit rangingfrom 0.214 ± 0.02 mg to 0.634 ± 0.04 mg. The highest amount of mercury found in Elephant-apple, 0.634 ± 0.04 mg in [14] investigated the minerals and heavy metalconcentration in selected tropical fruits in Bangladesh.

In this study, Mercury has been found in one species Pear (Pyruscommunis) as 0.03 mg/kg.The amount of mercury found in only one selectedfruit species which is higher the standard of 0.01 mg/kg set by the national standard of China onmaximum levels of contaminants in foods[15].

Carcinogenic Risk:

The CR values of Cd and Cr due to exposure from the consumption of selected ten indigenous fruit species is 1.49×10^{-6} and 3.40×10^{-5}.Generally, the values of CR lower than 10^{-6} considered as negligible, above 10^{-4} are deemed to be unacceptable and lying in between 10^{-6} to 10^{-4}isregarded as the acceptable range [16-17].In the present study, CR for toxic elements is beyond the unacceptable range. Therefore, the risk of cancer due to exposure to the above four aspects through the consumption of selected ten indigenous fruit species is less than that of other available fruit species.

Limitation:

- The study was restricted only to evaluate limited toxic elements.
- Results may vary due to unwanted contamination.
- We cannot include the number of indigenous fruits for better result.

Recommendations:

The following scopes are recommended for future work-

- ✓ The study should be carried out considering more number of toxic elements.
- ✓ The indigenous fruits with therightamount of varieties should be considered for future research.
- ✓ People are used to taking different classes of fruits; therefore, along with fruit species, cultured and imported fruit species should also be considered for future study.
- ✓ Continuous monitoring is required for trend analysis of toxic elements in the indigenous fruit species.

V. Conclusion

Everybody loves to consume fruits because they are delicious. People consumed fruits since ancient times and fruit is a word that was spoken even in the mythology. Fruits are not only consumed as food but also used for the preparation of medicine. Indigenous fruits considered to be one of the essential sources containing an enormous amount of nutritional contents and lesser amounts of toxic chemical contaminants. Therefore, constant monitoring of heavy metals is needed on all food commodities to evaluate if any potential health risks from heavy metal exposure do exist, to assure food safety, and to protect the end user from food that might injure their health.

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