



Trace element levels in plant foods available from local market of Chennai

KEYWORDS

Mrs. B.Meenakshi, M.Sc, M.Phil

Research scholar, Manonmaniam Sundaranar University, Tirunelveli

Dr.R.Venkataraman, Ph.D

Associate Professor,
Department of Chemistry, PG & Research centre,
Sri Paramakalyani College, Alwarkurichi, Tirunelveli

Introduction:

Plant foods (Fruits and vegetables) tend to be the rich source of trace elements and are used as staple food both in raw and cooked forms. Fruits and vegetables are considered as "protective supplementary food" as they contain large amount of minerals and dietary fibers in addition to carbohydrates and proteins. Concentration of trace elements in fruits and vegetables are directly related to their interaction with environmental, geological and biological systems. Estimation of trace elements levels in fruits and vegetables is a growing trend in nutritional studies throughout the world. Knowing the trace element content in commonly consumed fruits and vegetables is vital as one can rightly consume them. There is paucity of data with regards to the trace element levels in plant foods from Chennai and hence this study is carried out with an aim to estimate the trace elements (Zinc, Copper, Selenium, Iron, Chromium and Manganese) in different nutraceuticals (Vegetables, Fruits, Cereals and Pulses) that are available in local markets and consumed as a part of food from Chennai, the metropolitan city and capital of Tamil Nadu, India.

Materials and Methods:

Samples of 22 varieties of nutraceuticals {Vegetables: amla, brinjal, bitter gourd, coriander leaves, carrot, cabbage, cauliflower, cucumber, fenugreek leaves, garlic[dry], ginger[fresh], lady's finger, snake gourd, small onion, tomato[ripe]}, Fruits (apple, mountain banana[ripe]), Dry fruits (cashew, almond, dry dates), Cereals (refined wheat flour) and Pulses (Bengal gram(dhal)) were collected from Koyambedu market, Chennai city. These nutraceuticals arrive from different farming locations in the vicinity of Chennai. The nutraceuticals were washed under running tap water to remove the dirt and adherent particles, later rinsed thoroughly with distilled water and air dried. The dried samples were cut using Teflon knife, weighed and 1g of each sample were placed in separate polythene bags and transported to the laboratory. The nutraceuticals were digested in a microwave digestion system [1 g of the sample is digested with 10 ml of HNO₃ and 2 ml of HCl in microwave digestion system, the temperature maintained at 180 °C for 20 minutes]. The resulting solutions were cooled and diluted to 25 ml with distilled water. The resulting solutions were analyzed by Inductively coupled Plasma Optical Emission Spectroscopy (ICP-OES) (model: Perkin Elmer Optima 5300 DV), the most appropriate technique for trace element determination as it has the advantages of accuracy, able to analyze a wide range of sample types, need for small sample and especially lower detection limit for the trace elements having very low concentration in biological samples.

Results

The average concentration of Zinc, Copper, Selenium, Iron, Chromium and Manganese analyzed in 22 varieties nutraceuticals is shown in table 1. The order of maximum concentration was Fe > Zn > Cu > Mn > Cr > Se.

Zinc

The results show that the nutraceuticals of the present study contained Zinc concentration ranging from 0.38 to 43.88 µg/g. The lowest concentration of zinc (0.38 µg/g) was observed in apple and the highest concentration was observed in cashew (43.88 µg/g). Zinc levels were not detectable in amla, bitter gourd, ginger, garlic and tomato.

Copper

The results show that the nutraceuticals contained Copper concentration ranging from 0.01 to 20.39 µg/g. The lowest concentration of Copper (0.01 µg/g) was observed in apple and cucumber and the highest concentration was observed in cashew (20.39 µg/g).

Selenium

In the present study Selenium was not detectable in the nutraceuticals. The reason for this might be due to the low Selenium content in the soil.

Iron

The results show that the nutraceuticals contained Iron concentration ranging from 1.09 to 96.49 µg/g. The lowest concentration of iron (1.09 µg/g) was observed in amla and the highest concentration was observed in Bengal gram (96.49 µg/g).

Chromium

The results show that the nutraceuticals contained Chromium concentration ranging from 0.02 to 13.17 µg/g. The lowest concentration of Chromium (0.02 µg/g) was observed in garlic & snake gourd and the highest concentration was observed in onion (13.17 µg/g).

Manganese

The results show that the nutraceuticals contained Manganese concentration ranging from 0.09 to 28.14 µg/g. The lowest concentration of Manganese (0.09 µg/g) was observed in amla and the highest concentration was observed in wheat flour (28.14 µg/g).

The results of trace elements in various nutraceuticals studied are shown in table 1.

Discussion

In the present study, the lowest concentration of Zinc (0.38

$\mu\text{g/g}$) was observed in apple and the highest concentration was observed in cashew (43.88 $\mu\text{g/g}$). Ismail F *et al* from Hyderabad had reported lowest concentration of Zinc (mg/100g) in banana and the highest concentration in lady's finger.¹ Hashmi DR *et al* from Karachi had reported low Zinc level in potato and high level in lady's finger.² Marbaniang *et al* from shillong had reported lowest concentration of zinc ($\mu\text{g/g}$) in ginger and the highest concentration in coriander.³ Zahir E *et al* from Karachi had reported the lowest concentration of Zinc ($\mu\text{g/g}$) in lemon and the highest concentration in dates.⁴

In the present study, the lowest concentration of Copper (0.01 $\mu\text{g/g}$) was observed in apple and cucumber and the highest concentration was observed in cashew (20.39 $\mu\text{g/g}$). Ismail F *et al* from Hyderabad *et al* had reported lowest concentration of Copper (mg/100g) in lady's finger, cucumber similar to our study and the highest concentration in mint and brinjal.¹ Hashmi DR *et al* from Karachi had reported low Copper level in onion and high level in brinjal & mustard.² Marbaniang *et al* from shillong had reported lowest concentration of Copper ($\mu\text{g/g}$) in lettuce and the highest concentration in ginger.³ Zahir E *et al* from Karachi had reported the lowest concentration of Copper ($\mu\text{g/g}$) in apple similar to our series⁴ and the highest concentration in mango.

In the present study, the lowest concentration of Iron (2.11 $\mu\text{g/g}$) was observed in amla and the highest concentration was observed in Bengal gram (96.49 $\mu\text{g/g}$). Ismail F *et al* from Hyderabad had reported lowest concentration of Iron (mg/100g) in potato and the highest concentration in mint.¹ Hashmi DR *et al* from Karachi had reported low Iron level in turnip and high level in spinach & tomato.² Marbaniang *et al* from shillong had reported lowest concentration of Iron ($\mu\text{g/g}$) in spinach and the highest concentration in turmeric.³ Zahir E *et al* from Karachi had reported the reported lowest concentration of Iron ($\mu\text{g/g}$) in tomato and the highest concentration in apple which is in contrast to our series.⁴

In the present study, the lowest concentration of Chromium (0.02 $\mu\text{g/g}$) was observed in garlic & snake guard and the highest concentration was observed in onion (13.17 $\mu\text{g/g}$). Hashmi DR *et al* from Karachi had reported low Chromium level in mustard and high level in coriander.² Marbaniang *et al* from shilling had reported lowest concentration of Chromium ($\mu\text{g/g}$) in fern and the highest concentration in turmeric.³ Zahir E *et al* from Kara-

chi had reported the reported lowest concentration of Chromium ($\mu\text{g/g}$) in tomato and the highest concentration in banana.⁴

In the present study, the lowest concentration of Manganese (0.21 $\mu\text{g/g}$) was observed in apple and the highest concentration was observed in wheat flour (28.14 $\mu\text{g/g}$). Ismail F *et al* from Hyderabad *et al* had reported lowest concentration of Mn (mg/100g) in mango and the highest concentration in lady's finger.¹ Hashmi DR *et al* from Karachi had reported low Manganese level in tomato and high level in mint.² Marbaniang *et al* from shillong had reported lowest concentration of Mn ($\mu\text{g/g}$) in lettuce and the highest concentration in beet leaves.³ Zahir E *et al* from Karachi had reported lowest concentration of Mn in neem and the highest concentration in lemon.⁴

The nutritive value of Indian foods published by the National Institute of Nutrition [NIN] Hyderabad is shown in table 2.

In the present study, high concentration of Zinc and Copper were noted in cashew which is similar to NIN reference ranges. Selenium was not detectable in any of the nutraceuticals of our interest whereas high Selenium levels was noted in cauliflower as per NIN reference standards. Iron was rich in dates followed by cashew & Bengal gram as per NIN standards. In our series Iron was rich in cashew and bengal gram. In our series high levels of Chromium and Manganese were found in onion and wheat flour respectively which is in contrast to the NIN data of cashew and almond respectively.⁵ The probable reasons for these variation in trace element levels might be due to the soil in which these plants are grown, the water used for irrigation, the influence of fertilizers used and the genetic characteristics of these plants, thus stressing the need to analyze trace elements in a given geographical area before suggesting recommendations.

Conclusion:

To conclude, high levels of Zinc and Copper were found to be present in cashew, high levels of Iron, Chromium and Manganese were found to be present in bengal gram, onion and wheat flour respectively and Selenium levels were not detectable in any of the nutraceuticals of interest in the present study.

Acknowledgement: We thank Ms.Vineeta, SAIF, IIT,Bombay, Mumbai for performing the trace element analysis in fruits and vegetables.

Table 1: Trace element concentrations in various nutraceuticals

S No	Nutraceuticals	Botanical name	Zn ($\mu\text{g/g}$)	Cu ($\mu\text{g/g}$)	Se ($\mu\text{g/g}$)	Fe ($\mu\text{g/g}$)	Cr ($\mu\text{g/g}$)	Mn ($\mu\text{g/g}$)
1	Amla	Phyllanthus emblica	ND	0.12	ND	1.09	0.09	0.09
2	Brinjal	Solanum melongena	0.79	0.19	ND	2	0.31	0.11
3	Bitter gourd	Memordica charantia	ND	0.14	ND	2	0.26	0.14
4	Coriander leaves	Coriandrum sativum	0.97	0.33	ND	6.6	0.9	1.2
5	Cucumber	Cucumis sativus	0.87	0.01	ND	2.11	ND	0.51
6	Carrot	Daucus carota	1.28	0.42	ND	3.67	0.29	0.79
7	Cabbage	Brassica oleracea	1.98	0.62	ND	2.71	0.33	2.03
8	Cauliflower	Brassica oleracea	3.24	0.36	ND	5.68	0.20	3.06
9	Fenugreek leaves	Trigonella foenum-graecum	3.5	1.8	ND	58	1	5.7

10	Ginger(fresh)	Zingiber officinale	ND	0.26	ND	2	0.08	1.2
11	Garlic	Allium sativum	ND	0.28	ND	1.49	0.02	0.2
12	Snake guard	Trichosanthes cucumerina	1.80	0.93	ND	5.61	0.02	0.39
13	Small onion	Allium cepa	3.78	1.14	ND	46.33	13.17	2.26
14	Lady's finger	Abelmoschus esculentus	3.98	0.13	ND	7.73	0.10	3.57
15	Tomato(ripe)	Cyphomandra betacea	ND	0.2	ND	4.5	0.22	0.11
16	Almond	Prunus dulcis	31.45	8.84	ND	38.30	0.55	16.80
17	Cashew	Anacardium occidentale	43.88	20.39	ND	57.63	0.21	11.81
18	Dry dates	Phoenix dactylifera	3.32	2.14	ND	27.76	0.17	4.67
19	Apple	Malus pumila	0.38	0.01	ND	4.57	0.30	0.21
20	Mountain banana	Musa hybrids	2.66	1.89	ND	7.56	0.15	5.63
21	Bengal gram(Dhal)	Cicer arietinum	19.55	8.19	ND	96.49	0.40	10.98
22	Refined Wheat flour	Triticum aestivum	22.65	3.47	ND	46.25	0.55	28.14
	Minimum		ND	0.01	ND	1.09	0.02	0.09
	Maximum		43.88	20.39	ND	96.49	13.17	28.14

ND: Not detected

Table 2: Trace element concentrations in various nutraceuticals as per NIN standards

S No	Nutraceuticals	Zn (mg/100g)	Cu (mg/100g)	Se (mg/100g)	Fe (mg/100g)	Cr (mg/100g)	Mn (mg/100g)
1	Amla	ND	ND	ND	1.2	ND	ND
2	Brinjal	0.22	0.12	44	0.38	0.007	0.13
3	Bitter gourd (green)	0.39	0.09	21	0.61	0.005	0.08
4	Coriander leaves	0.32	0.14	49	1.42	0.014	0.5
5	Cucumber	0.23	0.09	17	0.60	0.002	0.14
6	Carrot	0.36	0.10	27	1.03	0.017	0.16
7	Cabbage	0.30	0.02	ND	0.8	0.005	0.18
8	Cauliflower	0.40	0.13	231	1.23	0.003	0.10
9	Fenugreek leaves	0.36	0.1	167	1.93	0.006	0.23
10	Ginger(fresh)	1.93	0.74	ND	3.5	0.057	5.56
11	Garlic dry	1.93	0.63	ND	1.2	0.020	0.86
12	Snake guard	0.31	0.27	35	1.51	0.004	0.14
13	Small onion	0.41	0.18	ND	1.2	0.009	0.18
14	Lady's finger	0.42	0.11	30	0.35	0.005	0.15
15	Tomato(ripe)	0.41	0.19	11	0.64	0.015	0.26
16	Almond	3.57	0.97	ND	5.09	0.161	1.88
17	Cashew	5.99	1.66	ND	5.81	0.163	1.42
18	Dry dates	0.03	0.05	ND	7.3	0.004	0.20
19	Apple	0.06	0.10	7	0.660	0.008	0.14
20	Mountain banana	0.15	0.16	7	0.36	0.004	0.20
21	Bengal gram(Dhal)	1.7	1.34	160	5.3	0.001	1.05
22	Refined Wheat flour	0.6	0.21	115	2.7	0.001	0.62
	Minimum	ND	ND	ND	0.35	ND	ND
	Maximum	5.99	1.66	231	7.3	0.163	1.88

ND: Not detected

REFERENCE

1. F. Ismail, M.R. Anjum, A.N. Mamon, T.G. Kazi. Trace Metal Contents of Vegetables and Fruits of Hyderabad Retail Market. Pak J Nutr. 2011; 10 (4): 365-372. | 2. Hashmi DR, Ismail S, Shaikh GH. Assessment of the level of trace metals in | commonly edible vegetables locally available in the markets of Karachi city. Pak J Bot.2007; 39(3): 747-751. | 3. D.G.Marbaniang, P.Baruah, R.Decruse, E.R.Dkhar, D.F.Diengdoh , C.L.Nongpiur. Study of the Trace Metal Concentration in Some Local Vegetables Available in Shillong City, Meghalaya, India. International Journal of Environmental Protection. 2012; 2 : 24-28 | 4.Zahir E, Naqvi II, Uddin SM. Market basket survey of selected metals in fruits from Karachi city (Pakistan). J basic appl sci.2009;5:47-52. | 5.Gopalan C, Ramasastri BV,Balasubramanian SC.Nutritive value of Indian foods. National Institute of Nutrition, ICMR, Hyderabad press.2012. |