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Mineral Content of Minor Fruits of South Gujarat, India

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A B S T R A C T

In the present study fruits are considered to provide a wide range of mineral elements. Minor fruits of south Gujarat specially *Artocarpus heterophyllus* L., *Tamarindus indica* L., *Zizyphus mauritiana* L. and *Emblica officinalis* L. are mainly conserved and consumed by tribals in very restricted area though have every potentiality of production in this environmental conditional survey experiment was undertaken to determine mineral in above mentioned minor fruits. The micro and macronutrient like N, P, K, Ca, Mg, S, Fe, Zn, Mn and Cu were highest in jackfruits *Artocarpus heterophyllus* L. taken from Karadi, Bardoliand Songadh regions of South Gujarat and Amla fruit had the higher content of Fe, Mn and Cu found grown in Pardi side fruits and maximum value Zn was reported in Gandevi fruits. It can be conferred from the result exploring the source of mineral composition of minor fruits, may increase the consumption of these fruits as food supplements and encourage their cultivation, conservation by the native tribal user and farmer community of the south Gujarat region.

Introduction

In a general sense, those fruits which though are consumable to the human being but relatively less palatable than other fruits, which have lesser demand in the market, which are grown to a limited extent only and are not usually cropped in organized plantations with application of inputs are considered in grouping as minor fruit crops. Other terms that are used for minor fruits are less-known fruits, less appealing fruits, less exploited fruits, stray fruits, wild fruits (Mazumdar, 2004). More than 30% of rural families in India are living in poverty due to small holding size and low soil productivity (Hegde, 2009). As many underutilized tree species are tolerant to harsh agro-climatic conditions, Bharatiya Agro Industries Foundation has promoted agri-horti-forestry using these tree species on degraded hilly terrains in the Western Ghats region of

Gujarat and Maharashtra. The tribal inhabitants of this region, traditionally dependent on non-timber forest products, preferred local fruit species instead of arable food crops, and selected Jackfruit (*Artocarpus heterophyllus* L.), Tamarind (*Tamarindus indica* L.), Ber (*Zizyphus mauritiana* L.) and Amla (*Emblica officinalis* L.) (Hegde, 2009). Many of these underutilized species, survived under harsh agroclimatic conditions, can be established on degraded lands, which are presently being underutilized either due to poor soil fertility or moisture scarcity. However, most of these species are in a state of neglect, while a small number of them are under cultivation in their native tracts by local communities for specific household uses only.

The jackfruit (*Artocarpus heterophyllus* L.) belongs to family Moraceae and genus *Artocarpus*. It is the largest tree born fruit in the world. The genus *Artocarpus* contains about 50 species; most are native to Asia. Jackfruit is rich in several nutrients. It can act as source of complete nutrition to the consumers.

It is rich in vitamin B and C, potassium, calcium, iron, proteins and high level of carbohydrates, jackfruit affordable and readily available supplement to our staple food Priya *et al.,* (2014). The nutritional aspects of various edible fruit parts of jackfruit (*Artocarpus heterophyllus*). Jackfruit contains higher content of calcium, magnesium, copper, iron, as per the finding of Tiwari and Vidyarthi (2015).

Tamarind (*Tamarindus indica* L.) belongs to the family Fabaceae subfamily Caesalpiniodeae, tribe Amherstieae and Genus *Tamarindus* (Leonard, 1957). Tamarind is a well-known for its nutrition and various uses. The properties of this species have been extensively studied. Tamarind has many valuable properties and virtually every part of the tree has been utilized by both rural and urban dwellers. The most valuable and commonly used part of the tamarind tree is the fruit. Tamarind pulp is also rich in minerals like potassium, phosphorous, iron, sodium, zinc and calcium according to Parvez *et al.*, (2003).

Indian jujube (*Ziziphus jujube* L.) is also known as ber, jujube, desert apple or Indian plum. It belongs to the genus *Ziziphus* and family Rhamnaceae. It is called the king of arid zone fruits. Ber is the Urdu name for the fruit of the tree *Zizyphus vulgaris*, or *mauritania*or *sativa* and is called the jujube berry in English. It is also known as the Indian jujube or Chinese date.

The ber fruit has high sugar content and a high level of vitamins A & C, carotene, phosphorus, pospherous, magannis, iron and calcium. Ber can provide food security, due to sustained production of the fruits, irrespective of drought and salinity; it grows well on poor and degraded land.

Indian gooseberry (amla) is one of the most important plants of Ayurveda. It is small to medium deciduous tree belonging to a family Euphorbiaceae growing in India, Sri Lanka, Pakistan, Uzbekistan, South East Asia, and China. In Sanskrit, *Emblica*has many synonyms: Amalaki (pure, clean), Dhatriphala (nurse fruit), Amritaphala (fruit of immortality), Amla, Anola, Emblica, Gooseberry and others. All of these synonyms show how important this plant is in traditional Indian medicine. The fruits of *Emblica*are widely consumed as raw, cooked or pickled. They are also principal constituents of many Ayurvedic preparations (Scartezzini and Speroni 2000; Khatoon *et al.*, 2006). Amla is well known for its nutritional qualities. It is one of the most extensively studied plants due to its richness in polyphenols, minerals and is regarded as one of the richest source of

vitamin C (Jain *et al.,* 2000; Bharthakur *et al.,* 1991). The amla fruit are rich in mineral contents such as Calcuium, phospherous, iron,copper, magnnis, magnessium, cobolt reported by Poonam and Mahanta (2014).

Materials and Methods

The present study was conducted at the Department of Soil Science and Agricultural Chemistry, N. M. College of Agricultural, Navsari Agricultural University, Navsari. The fresh fruit samples of Jackfruit, Tamarind, Indian jujube and Amla for experiment collected from local cultivar of South Gujarat includes the districts of Navsari, Surat, Bharuch, Valsad, Tapi, Narmada and Dang (Table 1).

Sampling material

Fresh and dry powdered fruit.

Time of harvesting

Edible maturity stage.

Sample preparation

Fresh fruits at edible maturity stage were harvested from different plants and were subjected to different types of chemical analysis.

Total nitrogen

The total nitrogen content was determined by the method of Kjeldhal method (Jackson, 1979).

Determination of total P, K, S, Ca and Mg elements from fruits samples by wet digestion method

This procedure was preferred to dry ignition, because of possibility of loss of mineral constituents at high temperature during dry ignition. 0.5 gm dried fruits powder was taken in 150ml conical flask. 10-15 ml of di-acid (HNO_3: $HClO_4$ =10:4) mixture was added and a funnel was placed on the flask and allowed to stand for overnight. The mixture was heated gently at first on hot plate, and then heated more vigorously until a clear solution was obtained. The mixture was not heated to dryness as phosphorus and arsenic might be lost if the solution was dried. Heating was continued till the volume reduced to approximately 3 to 5 ml. After that the clear solution was cooled and transferred to a 100ml volumetric flask through filter paper Whatman No.01 and the volume was made up to the mark This solution was stored and used for further analysis of P, K, S, Ca and Mg elements.

Determination of phosphorus

Determination of phosphorus from fruits sample was done by using spectrophotometer by Jackson, (1967) method.

Determination of potassium

Determination of Potash from fruits sample was done using flame photometer by the method of Jackson (1967).

Determination of sulphur

Determination of sulphur from fruits sample was done using turbid metric spectrophotometer by Tandon (1993) method.

Determination of Ca and Mg

The fruits sample using Versanate (EDTA) titration by Cheng and Bray (1951) method.

Determination of micronutrient using atomic absorption

Spectrophotometric method

Micronutrients (Fe, Mn, Cu, and Zn) were estimated by the method of Elwell and Gridley, (1967).

Results and Discussion

Mineral elements of jackfruit

The mineral content of jackfruit in different locations of South Gujarat was differed significantly (Table 2). The highest value of nitrogen content (184.53 mg/100gm) was obtained in Navsari grown fruits compared to the rest of the other places respectively. The nitrogen content in above finding is agreed with results of Goswami *et al.,* (2011). They reported nitrogen content in jackfruits varied from 137mg/100gm to 191 mg/100gm.

The maximum content of phosphorous reported in Valsad fruits (411.50 mg/100gm) which is at par with Bardoli fruits (409.30 mg/100gm) respectively. Thus the present finding was more or less similar with the finding of Narasimham (1990). He reported amount of P content in jackfruits ranged from 380mg/100gm to 400mg/100gm.

The higher potassium content was reported in Valsad fruits (338.67 mg/100gm) which is at par with Songadh fruits (337.00mg/100gm). The potassium content of present table found similar ranged (191 to 407mg/ 100gm) with this study reported by Narasimham (1990).

Significantly higher content was found in Bardoli fruits (36.09 mg/100gm). The value of calcium is comparable with results of Gunasena *et al.,* (1996).They reported Calcium content in jackfruit ranged from 20 mg/100gm to 37mg/100gm respectively. There was no significant difference observed in it. The maximum value of Magnesium content was reported in Bardoli side fruits (32.88mg /100gm) followed by Songadh fruits (32.35 mg/100gm). The present finding was more or less similar with those reported by Narasimham (1990). Maximum sulfur content recorded in Songadh 64.33mg/100gm while minimum sulfur content in Navsari 61mg/100gm respectively. The maximum iron content was recorded in the Hasapur grown fruits (2.04mg/100gm) followed by Karadi fruits (1.88mg/100gm). The result of above finding was similar with that reported of that by Gunasena *et al.,* (1996). They found Fe content in jackfruit was about 0.5 to 1.1 mg/100gm respectively.

Zinc content in jackfruit pulp ranged from 0.09 to 0.11 mg/ 100gm. The highest zinc content observed in Navsari fruits (0.11mg/100gm). The range of zinc content in jackfruit varied from (0.07-0.13mg/100gm) reported by Ragone and Cavaletto (2006).

There was no significant difference observed in it. The maximum value of manganese was reported in Bardoli side fruits (0.57mg /100gm). Tiwari and Vidyarthi (2015) reported range of manganese content varied from 54 to 60 mg/100gm in different age of fruits maturity which is more or less similar with above results respectively. Higher copper content was observed in Bardoli fruits (0.84 gm /100gm) followed by Songadh grown fruits (0.81 gm /100gm). Parvez *et al.,* (2003) reported similar copper content in jackfruit was approximately 0.8mg/100gm respectively.

Mineral elements of tamarind

The perusal of data presented in table 3 reported significant variation in mineral element content in tamarind fruits collected from various location of South Gujarat. Highest N content was found in Navsari location fruits (82.24 mg/100gm). The present results were found to be closer to the findings of Wenkam and Miller (1965). They reported the nitrogen content in tamarind was about 59mg/100gm.

The results showed the highest phosphorous content in Pardi grown fruits (6.18 mg/100gm) which was at par with Valsad fruits (6.16 mg/100gm), Navsari fruits (6.09

mg/100gm. The higher value of phosphorous content than above finding was reported by Parvez *et al.,* (2003). They obtained phosphorous content in tamarind pulp varied from 62-570 mg/100gm.

Higher content of potassium was found in Dang fruits and (34 mg/100gm) while the lower value was in recorded in Chikhli fruits (30 mg/100gm).

Anon (1976) and Duke (1981) reported the potassium content are similar to present work. They reported K content ranged from 30 to 40 mg/100gm.

The maximum calcium content was observed in Chikhli fruits (90.67mg /100gm). The range of calcium content in varied from 81.67mg /100gm to 90.67mg /100gm.The calcium content in tamarind fruits ranged from 34 to 94mg/100gm reported by Coronel (1991). Higher 72mg/100gm content was observed in Dang region fruits (87.67mg/100gm) which is at par with fruits of Pardi (87.33mg/100gm) and Chikhli (85.67mg/100gm). The Mg content in tamarind pulp ranged between (80.67 to87.67mg/100gm) respectively.

The higher sulfur content was observed in Dharampur fruits (149.66 mg /100gm). The range of sulfur content in tamarind from 141.66 to149.66 mg/100gm. Parvez *et al.,* in 2003 reported the sulfur content in tamarind fruits varied from 102 to 150mg/100gm respectively. However, numerically higher value of iron content was observed in Navsari grown fruits 0.96 mg/100gm. Coronel (1991) found similar result of above finding. They reported iron content in tamarind ranged from 0.2 to 0.9 mg/100gm respectively. However, numerically higher value of zinc content was observed in Navsari grown fruits 0.12 mg/100gm respectively. Parvez *et al.,* (2003) reported Zinc content in tamarind varied from 0.8-0.9 mg/100g respectively.

Highest manganese content was observed in the tamarind fruits of Navsari (2.80mg/100gm). Parvez *et al.,* (2003) found similar results as like above findings. They recorded Mn content in tamarind ranged from 2.56- 3.02 mg/100gm.

The highest value of copper content (0.103 mg/gm) was obtained in Navsari grown fruits compared to the rest of the other places of south Gujarat. The results of above finding agree with result of Parvez *et al.,* (2003). They observed copper content in tamarind ranged from 0.8-1.2 mg/100gm.

Mineral elements of Indian jujube

The perusal of data presented in table 4. Revealed that the jujube collected from different places of South Gujarat significantly differed in respect of mineral content. The nitrogen content in jujube collected ranged from 144.33 mg/ 100gm to 163.33mg/ 100gm. The maximum content of nitrogen was found in the fruits of Vyara and Dungri (163.33 mg/ 100gm) which is at par with the fruits obtained from Aat (159.67mg/ 100gm).

Table.1 Fruits sample collected from different following places

Fruits	**Different places of South Gujarat**					
Jackfruit	Navsari	Karadi	Hasapur	Bardoli	Songadh	Valsad
Tamarind	Navsari	Dharampur	Valsad	Pardi	Chikhli	Dang
Indian jujube	Navsari	Vyara	Dang	Dungri	Bardoli	Aat
Amla	Navsari	Pardi	Karadi	Tapi	Hasapur	Gandevi

Table.2 Amount of micro and macro nutrient of Jackfruits collected from different places of South Gujarat

Location	Macronutrient						Micronutrient			
	N mg/100gm	P mg/100gm	K mg/100gm	Ca mg/100gm	Mg mg/100gm	S mg/100gm	Fe mg/100gm	Zn mg/100gm	Mn mg/100gm	Cu mg/100gm
Navsari	184.53	383.70	309.33	35.10	31.90	61.00	1.70	0.11	0.50	0.78
Karadi	183.26	380.50	261.00	34.96	32.01	61.33	1.88	0.09	0.50	0.79
Hasapur	182.43	386.97	285.33	33.81	31.92	62.00	2.04	0.10	0.55	0.8
Bardoli	184.37	409.30	314.67	36.09	32.88	63.66	1.02	0.10	0.57	0.84
Songadh	181.40	398.87	337.00	35.07	32.35	64.33	1.42	0.10	0.52	0.81
Valsad	181.57	411.50	338.67	35.37	31.93	63.66	1.37	0.09	0.50	0.76
Mean	182.93	395.14	307.67	35.07	32.17	63.66	1.57	0.10	0.52	0.76
CD @ 5%	**NS**	**4.741**	**10.683**	**0.278**	**NS**	**NS**	**0.142**	**NS**	**NS**	**NS**

NS: Non Significant

Table.3 Amount of micro and macro nutrient of Tamarind collected from different places of South Gujarat

Location	Macronutrient						Micronutrient			
	N mg/100gm	P mg/100gm	K mg/100gm	Ca mg/100gm	Mg mg/100gm	S mg/100gm	Fe mg/100gm	Zn mg/100gm	Mn mg/100gm	Cu mg/100gm
Navsari	82.24	6.09	34	85.00	80.67	144.66	0.96	0.12	2.80	0.103
Dharampur	72.21	6.03	32	81.67	83.00	149.66	0.89	0.10	2.17	0.1
Valsad	72.69	6.16	33	84.67	82.00	143.33	0.94	0.10	2.08	0.096
Pardi	73.84	6.18	31	86.00	87.33	141.66	0.88	0.11	2.22	0.09
Chikhli	73.90	6.03	30	90.67	85.67	143.66	0.87	0.11	2.12	0.097
Dang	67.81	5.95	34	78.00	87.67	145.66	0.94	0.09	2.08	0.1
Mean	73.78	6.07	32	84.33	84.39	145.66	0.91	0.11	2.25	0.1
CD @ 5%	**NS**	**0.144**	**NS**	**NS**	**3.275**	**NS**	**NS**	**NS**	**0.103**	**NS**

NS: Non Significant

Table.4 Amount of micro and macro nutrient of Ber collected from different places of South Gujarat

Location	Macronutrient						Micronutrient			
	N mg/100gm	P mg/100gm	K mg/100gm	Ca mg/100gm	Mg mg/100gm	S mg/100gm	Fe mg/100gm	Zn mg/100gm	Mn mg/100gm	Cu mg/100gm
Navsari	144.33	477.00	75.06	90.90	68.89	86.00	0.43	0.23	40	0.64
Vyara	163.33	496.00	74.54	90.92	68.67	88.23	0.45	0.26	38	0.66
Dang	153.00	486.00	75.14	91.00	69.14	82.00	0.44	0.25	41	0.65
Dungri	163.33	500.00	74.85	90.96	68.87	82.10	0.43	0.25	39	0.63
Bardoli	148.00	485.00	75.01	90.94	68. 85	87.00	0.46	0.27	38	0.65
Aat	159.67	480.67	74.85	90.98	69.14	84.33	0.42	0.24	37	0.65
Mean	155.28	487.44	74.91	90.95	68.93	84.33	0.44	0.25	39	0.65
CD @ 5%	**8.786**	**15.259**	**NS**	**0.156**	**NS**	**2.905**	**0.015**	**0.023**	**NS**	**NS**

NS: Non Significant

Table.5 Amount of micro and macro nutrient of Amla collected from different places of South Gujarat, India

Location	Macronutrient						Micronutrient			
	N mg/100gm	P mg/100gm	K mg/100gm	Ca mg/100gm	Mg mg/100gm	S mg/100gm	Fe mg/100gm	Zn mg/100gm	Mn mg/100gm	Cu mg/100gm
Navsari	131.20	48.33	18.96	128.26	10.80	46.33	1.24	0.34	42	0.12
Pardi	143.33	47.33	19.60	127.60	10.82	45.00	1.27	0.35	43	0.14
Karadi	127.07	45.33	19.20	127.62	10.88	45.33	1.24	0.34	40	0.12
Tapi	132.17	44.33	18.54	126.91	10.96	47.33	1.23	0.32	42	0.11
Hasapur	139.07	46.00	19.91	127.54	10.77	47.00	1.23	0.34	42	0.12
Gandevi	134.40	45.67	20.02	129.20	10.70	43.00	1.24	0.36	41	0.10
Mean	134.54	45.33	19.86	127.86	10.82	43	1.25	0.34	42	0.12
CD @ 5%	**5.997**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

NS: Non Significant

The higher content of phosphorous found in ber fruit grown in Dungri side (500mg/ 100gm) followed by Vyara (496mg/ 100gm) Bardoli (485mg/ 100gm). The results were comparable with data reported by Li *et al.*, (2007).

Higher potassium content was observed in Navsari region fruits (75.06 mg/100gm) and lower potassium content was recorded in Vyara fruits (74.54mg/100gm). Li *et al.*, (2007) accounted 79.2mg/100gm potassium content in ber fruit form different ber varieties which is agree with above results

Significantly higher content of calcium was found in Dang fruits (91.00mg/100gm). The calcium content of present work similar with Yazao cultivar of ber91.00 mg/100gm reported by Li *et al.*, (2007).

Higher magnesium content was observed in Navsari region fruits (68.89 mg/100gm). Bakshi and Singh (1974) reported the magnesium content of ber fruits was about 65mg/100gm.

The maximum content of sulfur reported in Vyara fruits (88.23mg/100gm) which is at par with Bardoli fruits (87 mg/100gm). The sulfur content of ber differ location wise and higher content of sulfur found in Vyara may be due to soil availability.

The higher iron content was reported in Bardoli fruits (0.46mg/100gm) which is at par with Vyara fruits (0.45mg/100gm). Morton, (1987); Pareek and Dhaka, (2008) and Pareek *et al.*, (2009) revealed that ber fruit iron content ranged from 0.76 mg/100gm to 1.8 mg/100gm which are comparable with present work. The iron content in Ber slightly differ may be due to technical error in analysis.

The ber fruit for present study were collected from six different location of South Gujarat. The results showed the highest zinc content in fruits collected from Bardoli (0.27mg /100gm). Li *et al.*, (2007) revealed that Ber fruit zinc content contains ranges from 0.35mg /100gm to 0.63mg/100gm.

Numerically higher value of manganese content was found in place Dang 41mg/100gm and that of lower in Aat 37mg/100gm. These results are similar to the finding of Li *et al.*, (2007) and Wafaa *et al.*, (2011). They reported that Ber fruit manganese content ranged from 24.6 to 51.2 mg/100gm.

The maximum value was found under place Dang 0.41mg/100gm. These results are similar to the finding of Li *et al.*, (2007) and Wafaa *et al.*, (2011). They found that Cu content in ber fruit ranged from 24.6 to 51.2mg/100gm.

Mineral elements of amla

The data concerned mineral elements of the Amla fruit taken from different sites of South Gujarat had been presented in table 5. Amla fruit juice had the higher content of nitrogen content found grown in Pardi side (143.33mg/ 100gm) followed by Hasapur fruits (139.07mg/ 100gm). This result is similar to finding of Gopalan *et al.,* (1991).

They obtained nitrogen content of amla varied from 124 to 185mg/100gm. it might be due to the variation in environmental conditions and soil type.

The maximum value of phosphorous content was reported in Navsari fruits (48.33mg/100gm). The results of above finding agree with following study. According to Parveen and Khatkar in 2015 phosphorous content in different cultivars of Amla varied from 45 to 65 mg/100gm.

The maximum value of potassium content was reported in Gandevi side fruits (20.02mg/100gm). The result of present study was agreed with Barthakur and Arnold (1991). They reported that potassium content ranged from 20 to 25 mg/100gm.

Highest calcium content was recorded in Gandevi location fruits (129.20 mg/100gm). Similar results of calcium have been reported by Gopalan *et al.,* (1991). They observed ranged of calcium content varied from 120 to 200 mg/100gm respectively.

Highest magnesium content was recorded in Tapi location fruits (10.96mg/100gm). The results were comparable with data reported by Gopalan *et al.,* (1991). They reported that magnesium content varied from 7.55 to 12.50 mg/100gm respectively.

Sulfur content in amla fruits ranged from 43 to 47.33mg/ 100gm. The highest sulfur content was observed in Tapi fruits (47.33mg/100gm) followed by Hasapur fruits 47.00mg/100gm. The range of sulfur content in Amla varied from (0.07 to 0.13mg/100gm) reported by Ragone, and Cavaletto (2006) respectively. The maximum value of iron content was obtained in Pardi fruits (1.27mg/100gm). The value of iron is comparable with results of Gopalan *et al.,* (1991). They found iron content in amla fruits was about 1.2 mg/100gm.

The maximum value of Zn content recorded in Gandevi location fruits (0.36 mg/100gm). The zinc content in amla varieties varied from 45 to 53mg/100gm which is higher than present results due to different genotypes and environmental conditions reported by Parveen and Khatkar in 2015.

Higher content was observed in Pardi grown fruits (43 mg /100gm). The range of manganese content in varied from 40mg /100gm to 43mg /100gm.

The present finding was in very close with the findings of Poonam and Mahanta (2014). They reported that manganese content in amla fruit was about 50 mg/100gm.

Higher copper content was observed in Pardi grown fruits (0.14mg /100gm) while, the lowest values of copper content in 0.10 mg/100gm Gandevi fruits respectively.

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