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Proximate composition of indigenous fruits and vegetables grown in tribal region of Western India

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Abstract: The nutritive value of indigenous fruits (11), green leafy vegetables (12), other vegetables (11) and roots and tubers (8) of western India were analysed in terms of protein, fat, fiber, ash, carbohydrates and energy. *The study concluded that the different indigenous fruits and vegetables consumed in tribal areas are rich source of protein and fat and may be used in daily diet. Hence these indigenous fruits and vegetable may be recommended to achieve sustainable food and nutritional security.*

Key words: Tribal, Indigenous plants, Fruits and Vegetable, Food and Nutritional security

Introduction

The variability in climate, edaphic, and topographic conditions causes diversity of vegetation. "Indigenous" means, a species is defined as native of indigenous to a given region or ecosystem, if it is present in that region is the result of only natural process with no human intervention. Knowledge of such available indigenous plant resources used by man has enabled him to survive in adverse climates. Tribals lives as part of nature and they exploited nature to meet their food/nutritional demands. Tribal instantly collect vegetables from the surrounding at the time of weeding at agriculture farm or grazing their cattle in forest and consume it in either or in cooked form. Analysis of such indigenous fruits and vegetables consumed by the tribal provide an important tool for assessing actual nutrient contribution of these indigenous fruits and vegetables. The present study was therefore undertaken to find out the nutrient composition of forty two indigenous fruits and vegetables consumed by the tribal population of Udaipur District (Rajasthan), located in Western India.

Material and Methods

The field survey was conducted during September 2011 to March 2012, in the five tribal *blocks* i.e. Jhdol, Kotra, Kherwada, Sarada and Salumber of Udaipur district of Rajasthan (India). The main tribes of the area are *Bheel, Meena, Garasia and Kathodi.* In order to collect relevant information an open end proforma with group discussion were used. In each *block* a total 50 groups (ten groups from each *block*) were studied at a time till the receipt of desired information. Total of 450 tribal people were contacted to gather required information. For an effective communication, the help of forest guards and *Van Mitra* were utilized. Plants were collected, photographed, identified and voucher specimens prepared for the herbarium. Ethnobotanical information about fruits and vegetables was gathered through personal observations and discussions with the villagers. On the basis of consumption by the local population residing in the study area, a total of 42 fruits and vegetables were selected for the study as per the feasibility and availability of samples. All the selected samples were sub divided into four groups i.e. fruits, green leafy vegetables, other vegetables and roots and tubers.

Samples were washed thoroughly in running tap water to remove dust, dirt etc. and tender and edible part were collected. Each sample was dried at 45 ± 5 °C in hot air oven. They were ground to fine powder in a sieve through 1.0 mm mesh and stored in airtight container for analysis.

All samples were analysed for the proximate principle-moisture, protein (N x 6.25), crude fat (ether extraction), ash and crude fiber (NIN, 2003). The carbohydrate, content was calculated by difference, i.e. 100, the sum of the per cent of ash, protein, fat and fiber. Energy value was calculated by multiplying the values obtained for carbohydrate, protein and fat, with 4, 4 and 9 respectively and adding up the values.

Statistical analysis: The data analyses were analysed in triplicate (n = 3), and presented as means standard error of deviation.

Result and Discussion

The nutritional composition of indigenous fruits, green leafy vegetables, other vegetables and roots and tubers are presented in Table 1 to Table 4, respectively.

Fruits: *Holoptelea integrifolia* observed to be the fruit with lowest moisture content and *Citrus medica* with the highest (89.13 g/100g). For other fruit species, this value varied

Table 1. Proximate composition of indigenous fruits (g/100g on dry weight basis).

S. No.	Botanical Name	Local name	Moisture	Protein	Fat	Ash	Fiber	CHO	Energy (Kcal)
1	*Citrus medica*	*Bijura*	89.13±0.40	9.15±0.73	1.83±0.35	5.17±0.01	12.37±0.37	71.49±0.93	339.03±1.38
2	*Cordia gharaf*	*Gundi*	56.29±0.27	8.17±1.01	13.13±0.15	4.62±0.08	5.98±0.25	68.09±0.85	423.25±1.13
3	*Diospyros melanoxylon*	*Timru*	62.57±1.55	2.04±0.29	1.90±0.53	3.75±0.06	11.28±0.24	81.02±0.88	349.36±2.71
4	*Feronia limonia*	*Kotambadi*	70.34±0.87	8.76±0.77	11.70±0.10	5.20±0.07	7.48±0.11	66.87±0.89	407.80±0.46
5	*Ficus benghalensis*	*Bad*	73.00±1.39	4.86±0.17	8.37±0.25	6.06±0.04	32.74±0.38	47.97±0.44	286.62±2.06
6	*Ficus recemosa*	*Gullar*	81.32±1.58	4.57±0.34	3.43±0.49	7.38±0.04	14.18±0.06	70.44±0.49	330.94±2.54
7	*Holoptelea integrifolia*	*Bandar Batti*	2.18±0.05	21.79±1.61	43.33±0.35	3.76±0.04	4.06±0.07	27.05±1.54	585.38±1.94
8	*Manilkara hexandra*	*Rayna*	47.88±1.8	4.28±1.18	8.37±0.12	3.47±0.06	2.20±0.09	81.69±1.23	419.17±0.45
9	*Nelumbo nucifera*	*Kamal Kakari*	82.93±1.84	21.11±0.17	3.10±0.2	6.47±0.13	3.94±0.15	65.38±0.24	373.87±0.5
10	*Pithecellobium dulce*	*Jangal Jalebi*	84.7±0.35	18.68±0.51	1.40±0.17	5.07±0.11	3.93±0.12	70.92±0.39	371.00±1.01
11	*Tribulus terrestris*	*Gokhru fruit*	8.52±0.36	14.98±1.11	7.23±0.32	6.38±0.02	27.10±0.23	44.30±1.12	302.23±2.62

Table 2. Proximate composition of indigenous green leafy vegetables (g/100g on dry weight basis)

S. No.	Botanical Name	Local name	Moisture	Protein	Fat	Ash	Fiber	CHO	Energy (Kcal)
1	*Asphodelus tenuifolius*	Piyagi	89.21±0.17	20.24±0.34	3.67±0.12	10.1±0.1	12.3±0.16	53.7±0.37	328.74±0.85
2	*Cassia tora*	*Puariya*	84.92±0.05	29.38±1.18	5.67±0.06	11.69±0.81	9.52±0.16	43.71±0.78	343.66±3.05
3	*Centella asiatica*	*Brahami Buti*	85.71±0.31	19.17±0.17	2.43±0.21	18.27±0.21	10.63±0.12	49.5±0.34	296.56±1.37
4	*Cicer arietinum*	*Liliya*	77.08±0.12	29.77±0.77	3.97±0.06	12.12±0.03	10.85±0.08	43.29±0.73	327.96±0.4
5	*Cordia dichotoma*	*Gunda ka More*	78.48±1.35	22.47±0.0	2.5±0.0	13.39±0.09	10.86±0.2	50.78±0.26	315.51±1.04
6	*Euphorbia royleana*	*Thour*	93.53±0.64	11.68±0.29	9.47±0.12	14.15±0.05	9.04±0.14	55.67±0.1	354.58±0.36
7	*Marsilea minuta*	*Jhalod Ri Bhaji*	70.14±1.82	24.52±0.77	3.17±0.25	8.32±0.13	10.64±0.14	53.29±0.89	340.32±2.39
8	*Medicago sativa*	*Rajka*	72.66±0.97	24.23±0.58	2.5±0.0	11.59±0.05	14.58±0.13	47.11±0.63	307.84±0.35
9	*Melilotus indica*	*Pili Sangi*	79.57±0.69	30.45±0.61	5.27±0.06	10.58±0.06	7.47±0.41	46.23±0.29	354.13±1.76
10	*Polygonum glabrum*	*Pani vala*	84.86±0.83	28.9±0.29	2.37±0.06	12.44±0.54	7.62±0.18	48.68±0.79	331.6±2.39
11	*Portulaca oleracea*	*Lunakiya*	90.94±0.26	19.26±0.51	3.37±0.15	26.37±0.51	7.47±0.26	43.52±0.49	281.45±2.07
12	*Tribulus terrestris*	*Gokhru Leaves*	82.16±0.36	20.92±0.45	1.63±0.21	16.55±0.33	16.6±0.25	44.24±0.63	275.92±1.65

Table 3. Proximate composition of indigenous other vegetables (g/100g on dry weight basis)

S. No	Botanical Name	Local name	Moisture	Protein	Fat	Ash	Fiber	CHO	Energy (Kcal)
1	*Acacia nilotica*	*Babul Fali*	62.43±0.12	12.36±0.45	2.67±0.12	3.77±0.04	11.57±0.06	69.64±0.35	352.00±0.3
2	*Aloe barbadensis*	*Sinduri*	89.52±0.63	11.97±0.51	13.33±0.42	6.2±0.09	9.42±0.35	59.08±0.76	404.2±1.66
3	*Averrhoea carambola*	*Kamrakh*	91.96±0.64	6.62±0.17	2.7±0.1	4.35±0.02	7.9±0.11	78.44±0.13	364.52±0.86
4	*Bombax ceiba*	*Samble Dodi*	76.9±0.37	10.63±0.29	2.43±0.31	6.76±0.07	12.18±0.13	67.99±0.46	336.41±0.97
5	*Carissa congesta*	*Jangli Karonda*	81.58±0.33	6.32±0.17	20.53±0.12	4.75±0.08	6.37±0.25	62.02±0.25	458.17±1.82
6	*Cissus quandrangula*	*Hadjood*	91.87±0.03	9.15±0.45	3.63±0.12	15.13±0.28	11.8±0.28	60.28±0.44	310.41±0.6
7	*Crotalaria juncea*	*San*	75.2±0.75	24.13±0.45	2.61±0.1	7.08±0.07	19.77±0.3	46.41±0.64	305.69±0.86
8	*Dendrocalamus strictus*	*Bans/ Karel*	91.54±0.29	27.24±0.17	5.1±0.1	12.08±0.15	11.47±0.17	44.11±0.57	331.3±0.99
9	*Dioscorea* Sp.	*Alitha Fruit*	72.08±0.9	8.08±0.34	2.07±0.21	3.01±0.01	3.23±0.22	83.61±0.47	385.35±0.24
10	*Leptedenia reticulata*	*Shani Dhodi*	88.44±0.4	11.97±0.0	6.6±0.26	5.53±0.08	22.7±0.23	53.2±0.08	320.08±2.15
11	*Phoenix sylvestris*	*Khazoor Root*	82.79±0.07	17.61±0.67	9.57±0.21	8.01±0.01	4.84±0.04	59.97±0.58	396.43±0.96

between 8.52 to 84.70 g/100g. Wide variation was recorded for protein content. The lowest protein was recorded in *Diospyros melanoxylon* and the highest in *Holoptelea integrifolia* followed by *Nelumbo nucifera, Pithecellobium dulce* and *Tribulus terrestris* (Table 1). Maximum crude fat content was observed for *Holoptelea integrifolia* (43.33 g/100g) followed by *Cordia gharaf* (13.13 g/100g) and *Feronia limonia* (11.70g/100g) while lowest in *Pithecellobium dulce* (1.40g/100g). Highest carbohydrate percentage was recorded in *Manilkara hexandra* and lowest in *Holoptelea integrifolia* (27.05 g/100g).

The protein content of *Holoptelea integrifolia,*

Tribulus terrestris, Nelumbo nucifera, Cordia gharaf, Pithecellobium dulce, Feronia limonia and *Manilkara hexandra* was higher than the common conventional fruits. Thus, these fruits may have great potential to combat malnutrition. The fat content of *Holoptelea integrifolia,* was found exceptionally higher (43.33 g/100g) which is more than major oil seeds i.e. groundnut and mustard seeds (Gopalan et al., 2007). Hence, it may be the future alternative source for edible oil/ cooking oil.

The fruits of *Holoptelea integrifolia* and *Tribulus terrestris, were consumed in dried form by the local people of the studied area and this was the reason that the moisture content was low in comparison to the reaming analysed fruits.* Fiber, carbohydrates and energy content in all the anlysed indigenous fruits were comparable to the conventional *fruits.*

Green leafy vegetables

Moisture content varies among all the analysed green leafy vegetables ranged from 70.14 per cent in *Marsilea minuta* to 93.53 per cent in *Euphorbia royleana respectively. Marsilea minuta* recorded lower moisture in the present study than Gopalan et al., 2007. This might be due to effect of variation in climatic conditions. Highest protein was observed in *Melilotus indica* leaves (30.45 g/100g) followed by *Cicer arietinum, Cassia tora and Polygonum glabrum* on dry weight basis. Crude fat content ranged from 1.63 to 9.47 g/100g for *Tribulus terrestris* and *Euphorbia royleana,* respectively. *The* maximum total mineral ash was in *Portulaca oleracea* leaves (26.37g/100g). Crude fiber was maximum in *Tribulus terrestris* (16.6g /100g) followed by *Medicago sativa, Cordia dichotoma* and *Cicer arietinum. Energy was found to be more in Euphorbia royleana and Melilotus indica* contained comparatively low fat content but higher protein content. Proximate composition of all the analysed green leafy vegetables was comparable to the conventional green leafy vegetables (Gopalan et al., 2007). Other workers also reported that wild leafy vegetables contained nutrient comparable to the conventional foods (Gupta et al. 2005, Nazarudeen, 2010 and Bhati and Jain, 2015).

Among all the green leafy vegetables, *Marsilea minuta was found to be highest protein content followed by Cicer arietinum, Medicago sativa and Melilotus indica in fresh form.* Maximum ash and fiber content was recorded in Tribulus terrestris (16.6g/100g) leaves.

Other vegetables

The proximate composition of the other vegetables are presented in Table 3. Wide variation was observed in moisture content among all the analysed other vegetables (62.43 to 91.96 per cent). The crude protein maximum (27.24 g/100g) was found in *Dendrocalamus strictus* followed by *Phoenix sylvestris, Acacia nilotica, Leptedenia reticulate* and *Aloe barbadensis*. This range of protein, however, is relatively higher than the common conventional other vegetables. The mineral ash ranged from 3.01 to 15.13 g/100g being minimum in *Dioscorea sp.* And maximum in *Cissus quandrangula.* The crude fat content in all the other vegetables varied between 2.07 g/100g in *Dioscorea sp.*and 20.53 g/100g in *Carissa congesta.* The results showed the analysed indigenous other vegetables have comparable levels of nutrients to the conventional other vegetables.

Roots and tubers:

The proximate composition of indigenous root and tuber crops are given in Table 4. The maximum moisture content (84.68 per cent) was found in *Dioscorea sp* (*Alitha Kand,*) followed by *Dioscorea petaphylla* (82.55 per cent), *Dioscorea hispida* (82.28 per cent) and *Dioscorea esculanta* (81.09 per cent). Protein content ranged from 5.93 g/100g (*Dioscorea esculanta*) to 9.63 g/100g (*Dioscorea petaphylla*).

Protein contents of all the analysed roots and tubers were found to be comparable with the conventional roots and tubers. Crude fat content was ranged from 1.07 to 20.3 g/100g. The maximum ash content was found in *Pueraria tuberosa* (8.55 g/100g) and minimum in *Dioscorea hispida* (3.35 g/100g) among the analysed roots and tubers. Total carbohydrate content ranged from 76.03 g/100g in *Dioscorea petaphylla* to 86.60 g/100g in *Dioscorea esculanta.* Crude

Table 4. Proximate composition of indigenous roots and tubers (g/100g on dry weight basis)

S. No.	Botanical Name	Local name	Moisture	Protein	Fat	Ash	Fiber	CHO	Energy (Kcal)
1	*Amorphophallus paeonilfollus*	*Suran*	75.78±0.87	6.03 ±0.17	1.53 ±0.29	6.75 ±0.04	3.74±0.18	81.94 ±0.23	345.43 ±1.78
2	*Dioscorea esculanta*	*Aamchal*	81.09±0.31	5.93 ±0.34	1.5 ±0.1	3.73 ±0.06	2.23±0.15	86.6 ±0.29	383.64 ±1.36
3	*Dioscorea hispida*	*Kandu*	82.28 ±1.4	7.39 ±0.17	1.53 ±0.15	3.35 ±0.06	3.66±0.15	84.07±0.16	379.64 ±0.66
4	*Dioscorea petaphylla*	*Suwari*	82.55±0.76	9.63 ±0.29	2.03 ±0.06	4.74 ±0.12	7.56±0.29	76.03±0.49	360.96 ±0.51
5	*Dioscorea tomentosa*	*Jangli Kanda*	75.99±0.25	9.05 ±0.51	1.97 ±0.06	3.64 ±0.01	2.17±0.11	83.17±0.41	386.57 ±0.45
6	*Dioscorea* Sp.	*Alitha Kand*	84.68±0.27	6.52 ±0.17	1.97 ±0.06	4.25 ±0.1	3.51±0.12	83.76±0.13	378.82 ±1.17
7	*Dioscorea* Sp.	*Amallya Kand*	65.03±0.71	8.27 ±0.34	1.13 ±0.06	3.88 ±0.02	1.93±0.09	84.79±0.31	354.65 ±0.9
8	*Pueraria tuberosa*	*Modi*	80.46±0.03	8.66 ±0.17	1.07 ±0.06	8.55 ±0.2	2.46 ±0.1	79.27±0.5	332.21 ±1.43

fiber ranged from 1.93 g/100g to 7.56 g/100g in *Dioscorea* sp. (*Amaliya Kand*) and *Dioscorea petaphylla*, respectively. Energy content was minimum in *Pueraria tuberose* (332.21 Kcal/ 100g) and maximum in *Dioscorea esculanta* (383.64 Kcal/ 100g). The results showed that analysed roots and tubers contained almost similar amount of protein, crude fat and crude fiber to the conventional roots and tubers which are in common use. However the carbohydrate and energy was found to be lower than common roots and tubers.

Conclusion

These results suggested that indigenous fruits and vegetables should not be ignored. They can be used as alternative source of food and nutrition. This study will help to propagate knowledge on these lesser known indigenous fruits and vegetables to promote their production and utilization as valuable component of a well balanced diet. Inspite of using/ consuming the invasive species, it is better to use such indigenous fruits and vegetables as a source of nutrients. Furthermore, forest at *Aravalli* hills possess a rich diversity of tuberous plants and mineral rich containing soil. But due to de-forestation, habitat destruction, introduction of exotic species and changes in climatic conditions., many plants which were common in the *Aravalli* hills have become rare and endangered. Thus, there is an urgent need to take a step in the conservation of these fruits and vegetables for nutritional security.

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