

Estimation of carbohydrate, protein and minerals of some non-conventional leafy vegetables of semi-arid regions of Gujarat, India

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ABSTRACT

Based on their availability in rural and tribal areas as well as their nutritional composition, eleven non-conventional leafy vegetables were selected and analyzed. Carbohydrate contents ranged from 1.9 to 56.8 mg g⁻¹ in *Portulaca quadrifida* and *Moringa oleifera*. Total protein ranged from 3.64 to 39.39 mg g⁻¹ in *Celosia argentea* and *Moringa oleifera*. Mineral contents like Ca, Mg, Na, K, and Fe were recorded high in *Cassia tora* (29.19 mg g⁻¹), *Portulaca oleracea* (54.78 mg g⁻¹), *Basella rubra* (1.37 mg g⁻¹), *Chenopodium album* and *Basella rubra* (3.48 mg g⁻¹), and *Portulaca quadrifida* (5.66 mg 100 g⁻¹) respectively. Results revealed that these green leafy vegetables are nutritious and should be included in the diet to overcome various nutritional problems.

Figure : 01

References : 28

Tables : 03

KEY WORDS : Minerals, Non-conventional leafy vegetables, Nonstructural carbohydrates, Protein

Introduction

For fundamental nutrition and healthy body development most of the countries have diversity of foodstuffs. There are still an estimated 78 million malnourished people in developing countries, particularly in rural and tribal areas²⁸. A more abundant use of foods rich in energy, proteins, iron and vitamins, particularly those from rural areas, can greatly reduce malnutrition. In India, negligible attention is given to non-conventional plants in food security. The use of traditional vegetables as a source of essential nutrients is therefore not officially promoted. In droughts and famines, wild plants play a crucial role as a food supplement and as a form of survival. Indigenous knowledge on medicinal uses of wild plants has been relatively well studied and documented, However, research on wild food plants has not been adequately examined, particularly when it comes to the socioeconomic, cultural, traditional, and nutritional aspects of the plant. At least 3000 plants are known to mankind, with 30 crops providing more than 90% of the world's calories and only 120 crops being economically significant^{7,22}. Lack of nutritional information and the insufficient development of nutritionally improved foods have a direct impact on nutrition. A great deal of effort has been dedicated to seeds while leafy vegetables have largely been ignored. Leaves are reportedly inexpensive and easy to cook. They are known as potential sources

of minerals and vitamins^{8,9,11,21}. The most commonly used green leafy vegetables in the Indian diet are Spinach, fenugreek, cabbage, coriander etc. These are known as conventional plants. But tribal people live in unexploited areas, are devoid of their significant supply. "Tribal people use maximum plants that are found in their local areas where exotic species are scarce. These plants are generally used at the time of famines or during natural disasters. Hence these plants are known as non-conventional, underutilized or indigenous plants¹³. These under-utilized vegetables are good sources of nutrients in rural areas where exotic species are limited and provide a considerable amount of protein, minerals and vitamin intakes¹⁷. Nutritional importances of these plant species is less known to common man³. Some recent studies reveal that wild edible plants are rich in minerals, vitamins, carbohydrates, proteins, fats and fiber and in addition they are used as a remedy for various diseases²³.

Many tribal people consume leafy vegetables in their diets to meet their nutritional requirements. They contribute protein, vitamins, iron, fiber, ascorbic acid, and other essential minerals to the diet, which are usually in short supply in urban diets¹⁸. The preservation of indigenous vegetables, especially those preserved by drying, is critical to household food security during shortages. Generally, non-conventional leafy vegetables are semi-cultivated, weedy plants that require little input.

TABLE-1 : List of non-conventional plants used for analysis

No.	Plant Species (Scientific names)	Local Names	English name	Family
1.	<i>Amaranthus peniculatum</i>	<i>Rajagaro</i>	Ammarant	Amaranthaceae
2.	<i>Amaranthus viridis</i>	<i>Moto tandaljo</i>	Wild amaranth	Amaranthaceae
3.	<i>Anethum graveolens</i>	<i>Suva ni bhaji</i>	Dill	Apiaceae
4.	<i>Basella rubra</i>	<i>Poi</i>	Indian spinach	Basellaceae
5.	<i>Cassia tora</i>	<i>Kunvadio</i>	Cassia	Caesalpiniaceae
6.	<i>Celosia argentia</i>	<i>Lemdi ni bhaji</i>	Quail grass	Amaranthaceae
7.	<i>Chenopodium alba</i>	<i>Cheel ni bhaji</i>	Lamb's quarters	Chinopodiaceae
8.	<i>Cicer arietinum</i>	<i>Chanaa</i>	Gram	Leguminoceae
9.	<i>Moringa oleifera</i>	<i>Saragavo</i>	Drumstick	Moringaceae
10.	<i>Portulaca oleracea</i>	<i>Moti luni</i>	Common purslane	Portulacaceae
11.	<i>Portulaca quadrifida</i>	<i>Nani luni</i>	-	Portulacaceae

Though they are very important, they are neglected by the scientific and developmental system. Most of these plants are used by tribal people without a scientific understanding of their nutritional value, which can lead to some health problems and malnutrition. Hence, scientific studies were needed to investigate the nutrient content of non-conventional leafy vegetables in order to overcome malnutrition, and a study was carried out to analyze and quantify the nutrient content of eleven non-conventional leafy vegetables found in semi-arid regions of Gujarat in order to determine their nutritional value.

Material and Methods

Study area: Three different districts namely Panchmahal, Ahmedabad and Bhavnagar were selected for study on the basis of tribal population residing and availability of indigenous plant species within the region.

Tribes: There are 17 scheduled tribes commonly found within the study areas namely *Bhil* group of the tribe including *Bhil Garasia*, *Dholi Bhil*, *Dungari Bhil* etc. and *Naikda* or *Nayaka* including *Cholivala Nayaka*, *Kapadia Nayakas*, etc. the *Patelia*, the *Rathava* and the *Koli Dhor*, *Tokre Koli* or *Kolgha*, *siddi* etc.

Source of plant material: The leafy part of a total of eleven plant species was taken to carry out this study on the basis of their utilization by tribal communities in preparation of different dishes (Table 1) were collected from the field. The plant species considered in the present study are primarily used as vegetables, as an ingredient in soups and various other dishes. Identification of collected plants was done by local flora ²⁵. Uses of the plants were recognized by folklore and by books ² and from Freedman's "Famine Food" database (2003).

All collected plants were taken to the laboratory and washed thoroughly first by tap water and then by distilled water. Then the leaves were separated manually and further washed three times with distilled water. After washing they were covered by blotting paper and sun dried completely. Dried plant material was ground, sieved through 60 mm meshes and stored in air-tight polythene bags under room temperature condition for further biochemical analysis.

Analysis of total carbohydrate was done¹⁵ and was calculated by addition of total sugar and total starch.

Analysis of total sugar was done²⁰. Procedure for

TABLE-2 : Carbohydrate contents (mg g⁻¹ of dry weight) of selected non-conventional leafy vegetables

Plant species	Total sugar (mg g ⁻¹)	Reducing sugar (mg g ⁻¹)	Non-reducing sugar (mg g ⁻¹)	Total starch (mg g ⁻¹)	Total Carbohydrate (mg g ⁻¹)
<i>Amaranthus peniculatum</i>	1.88±0.09	1.76±0.09	0.118±0.08	1.69±0.07	3.57±0.17
<i>Amaranthus viridis</i>	4.875±0.09	3.564±0.09	1.31±0.19	4.38±0.17	9.2±0.38
<i>Anethum graveolens</i>	2.316±0.16	1.73±0.09	0.60±0.19	2.085±0.14	4.4±0.30
<i>Basella rubra</i>	6.49±0.68	3.24±0.02	3.24±0.66	5.84±0.62	12.34±0.57
<i>Cassia tora</i>	13.18±0.14	4.98±0.19	8.19±0.32	11.86±0.12	25.01±0.23
<i>Celosia argentea</i>	9.76±0.66	5.88±0.27	3.87±0.6	8.78±0.66	18.54±1.2
<i>Chenopodium album</i>	4.13±0.23	1.99±0.09	2.13±0.15	3.79±0.20	7.85±0.44
<i>Cicer arietinum</i>	17.44±0.66	8.96±0.03	8.488±0.68	15.70±0.5	31.82±0.6
<i>Moringa oleifera</i>	29.57±0.02	11.09±0.02	18.89±0.006	26.92±0.02	56.84±0.01
<i>Portulaca oleracea</i>	1.12±0.03	0.86±0.02	0.25±0.04	1.013±0.02	2.13±0.06
<i>Portulaca quadrifida</i>	1.016±0.06	0.507±0.06	0.512±0.02	0.917±0.05	1.918±0.09

Each data is a mean of five replicates and ± signifies standard deviation.

analyzing reducing sugar was the same as total sugar without hydrolysis and neutralization²⁰. Non-reducing sugar was analyzed by subtraction of reducing sugar from total sugar¹⁵. Total starch was calculated following a conversion factor of 0.9 to total sugar¹⁵. Total protein analysis was done¹².

Mineral analysis

Analysis of minerals like Ca and Mg was done by EDTA titration²⁷; Na and K were done following Flame photometer method and Fe by colorimeter⁴.

Sample preparation for minerals was done by tri-acid digestion method²⁷.

Statistical analysis

All tests were performed in five replicates and

statistical analysis was carried out using statistical software MSTAT 4.0 C package for computers (Michigan State University, USA)⁹

Results and Discussion

As shown in Table-2, carbohydrates were found to range from 1.91 to 56.84 mg g⁻¹ for *Portulaca quadrifida* and *Moringa oleifera*, compared to cabbage (46 mg g⁻¹), *coriander* (63 mg g⁻¹), and fenugreek (66 mg g⁻¹)^{5,19}. The carbohydrate content of *Moringa oleifera* was closer to that reported earlier¹ i.e. 58 mg g⁻¹.

Highest protein was found in the leaves of *Chenopodium album* followed by *Basella rubra*, *Cicer arietinum* and *Moringa oleifera* (Fig. 1). The reported values of protein are higher than cabbage (18mg g⁻¹), spinach (20 mg g⁻¹) and *coriander* (30 mg g⁻¹)²⁰. Protein content

TABLE-3 : Mineral contents (mg g⁻¹ of dry weight) of selected non-conventional leafy vegetables

Plant species	Ca(mg g ⁻¹)	Mg (mg g ⁻¹)	Na (mg g ⁻¹)	K(mg g ⁻¹)	Fe (mg 100g ⁻¹)
<i>Amaranthus peniculatum</i>	21.3 ±0.31	44.83 ±0.45	0.02 ±0.004	1.32±0.03	1.51±0.008
<i>Amaranthus viridis</i>	20.39±0.57	46.79±0.69	0.009±0.001	1.46±0.02	0.219±0.006
<i>Anethum graveolens</i>	16.08±0.12	25.82±0.21	0.241±0.005	0.011±0.001	0.176±0.002
<i>Basella rubra</i>	25.6±0.2	3.8±0.91	1.37±0.02	3.06±0.02	0.918±0.002
<i>Cassia tora</i>	29.19±0.75	31.18±0.10	0.004±0.02	0.41±0.003	0.52±0.001
<i>Chenopodium album</i>	20.42±0.57	40.32±0.75	0.073±0.025	3.48±0.02	0.899±0.009
<i>Cicer arietinum</i>	22.46±0.21	6.75±0.19	0.227±0.004	2.48±0.02	1.36±0.001
<i>Portulaca oleracea</i>	24.3±0.29	54.78±0.58	0.161±0.011	3.48±0.22	0.304±0.001
<i>Portulaca quadrifida</i>	17.35±1.0	30.43±0.55	0.028±0.008	2.16±0.06	5.66±0.001

Each data is a mean of five replicates and ± signifies standard deviation

was higher in *Chenopodium album* (Fig. 1) than reported earlier¹² i.e. 34.80 mg g⁻¹. The protein content of plants like *Cassia tora*, *Celocia argentia*, *Amaranthus viridis* is (Fig. 1) closer to that reported previously¹² i.e. 33.4, 16.14 and 26.48 mg g⁻¹, respectively. It was reported²⁴ that protein content of *Moringa oleifera* was 22.9 mg g⁻¹ which is closer to what we are reporting (20.5mg g⁻¹), while others²⁶ had reported for protein contents in Spinach (26 mg g⁻¹) and Cauliflower (29.9 mg g⁻¹) are higher than remaining non-conventional leafy vegetables reported in our study.

Among the plant species reported, most provided good sources of essential minerals, like Ca, Mg, Na, and K, but the amount of Fe was moderate (Table-3). Seven out of the eleven reported plant species i.e. *Cassia tora*, *Basella rubra*, *Portulaca oleracea* *Cicer arietinum*, *Amaranthus peniculatum*, *Chenopodium album* and *Amaranthus viridis* contained relatively large amount of Ca and the amounts ranged from 16.1 to 29.2 mg g⁻¹ of specimen's dry weight (Table-3).

The calcium content of all reported species was relatively higher than other conventional leafy vegetables like spinach (0.73 mg g⁻¹), fenugreek (5.2mg g⁻¹), Cabbage (0.39 mg g⁻¹)²⁰. The calcium content of *Cassia*

tora was higher than reported earlier¹² i.e. 34.4 mg g⁻¹, but it was higher in *Amaranthus viridis*, *Chenopodium album* and *Portulaca oleracea* (Table-3) than reported¹² i.e. 18, 14.4 and 11.5 mg g⁻¹, respectively. Ca content of *Amaranthus peniculatum* and *A. viridis* was also found higher than its another non-conventional species i.e. *Amaranthus hybridus* (5.30 mg g⁻¹) as reported¹⁸. Mg content ranged from 6.7 to 56.8 mg g⁻¹, which is within the recommended dietary intake for adults and children. Maximum Mg was found in the leaves of *Portulaca oleracea*. Mg in all the species was found very higher than other conventional leafy vegetables like cabbage (0.31 mg g⁻¹), Spinach (0.84mg g⁻¹), fenugreek (0.33mg g⁻¹) and coriander (0.64 mg g⁻¹) as reported in past¹⁹.

Results revealed that all leafy plants possessed a good amount of Na and K. The Na ranged from 0.009 to 1.37 mg g⁻¹ (Table-3). Highest amount was recorded in the leaves of *Basella rubra*, which was higher than other conventional leafy vegetables like spinach (0.56 mg g⁻¹), fenugreek (0.70 mg g⁻¹), and cabbage (0.14 mg g⁻¹), as reported⁵. Remaining species possessed lower Na than other conventional leafy vegetables. K content ranged from 0.011-3.48 mg g⁻¹ (Table 3) and was in good proportion in *Chenopodium album*, *Portulaca oleracea*, *Cicer arietinum*, *Basella rubra* and *Portulaca quadrifida*. Fe in reported

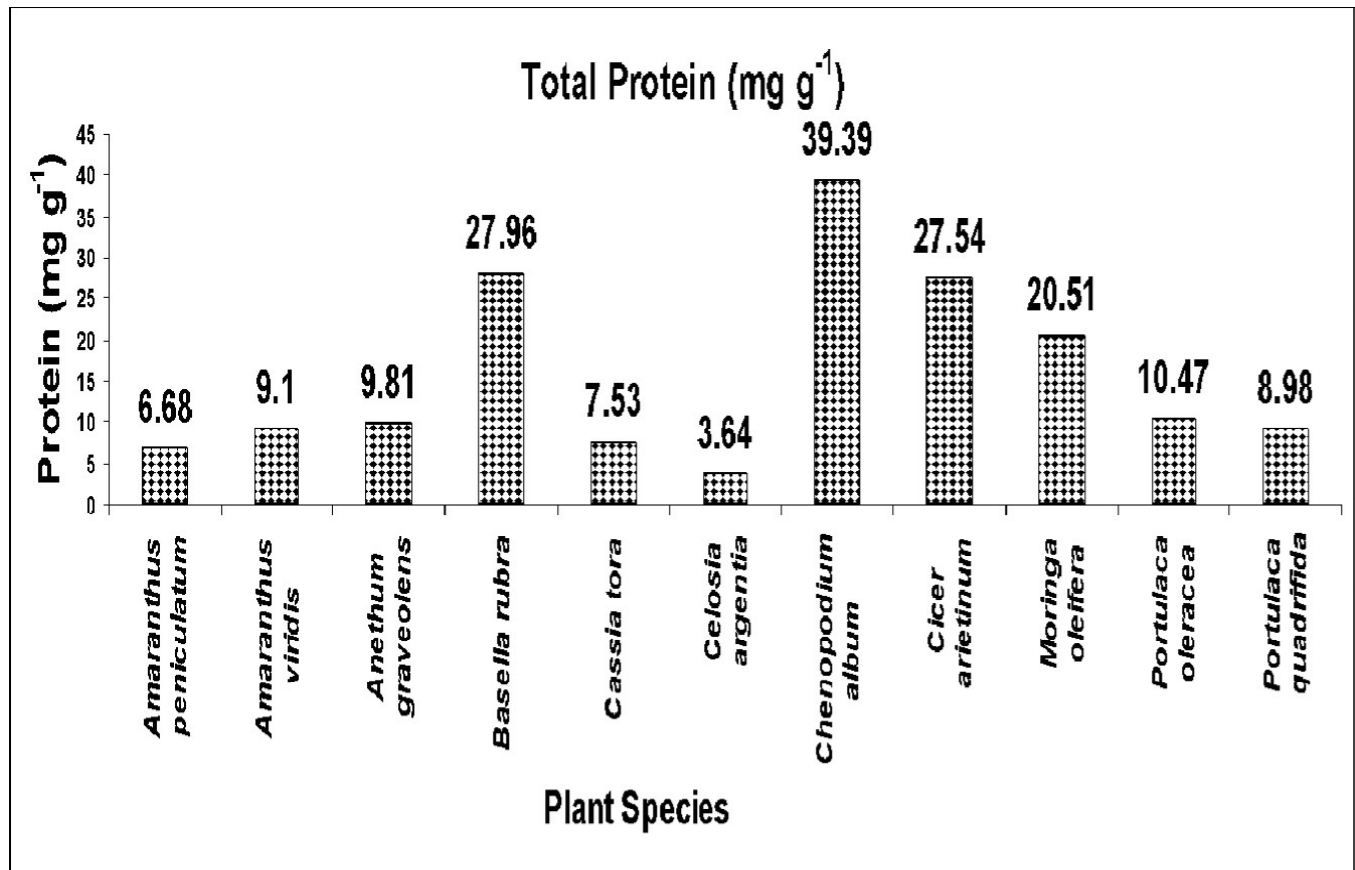


Fig. 1 : Total Protein content (mg g⁻¹ of dry wt) of selected non-conventional leafy vegetables. (Each data is a mean of five replicates and \pm signifies standard deviation)

plant species was lower than the conventional leafy vegetables and also not fulfills recommended dietary intakes.

Non-conventional plants of semi-arid region possessed high nutritional status. Though they are nutritionally rich they are avoided for consumption because

of its disagreeable taste or lack of awareness. Therefore there is need to preserve them for critical periods to fight against hunger. Most of the reported plant species provide good source of protein and minerals. Hence, these green leafy vegetables should be included in the diet to overcome various nutritional problems like, iron and protein deficiency.

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