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Food and Nutritional Security through wild edible vegetables or weeds in two district of Jharkhand, India

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Abstract
In present study, 26 species of local underutilized leafy vegetables commonly consumed by tribals of Jharkhand were identified through market survey and local villages of three district of state. Leafy vegetables sold in markets, *Amaranthus viridis* (Gandhari) was found highest in quantity followed by *Centella asiatica* (Beng), *Hygrophila polysperma* (Muchari), *Polygonum plebeium* (Chemti), *Marsilea minuta* (Chatta saag), *Crotalaria juncea* (Sanai phool) etc. Besides these, there are also few other leafy vegetables which are not found in local markets but rural people collect them for their surroundings and consume them, few of these are *Oxalis corniculata* (Netho), *Ficus geniculata* (Putkal), *Colocasia esculenta* (Kachu patta), *Hibiscus sabdariffa* (Kudrum phool, patta), *Portulaca oleracea* (Golgola). The leafy vegetables were found to be rich in many nutrients. The antioxidant found maximum in *Colocasia esculenta*. The ascorbic acid content found maximum in *Amaranthus viridis*. The maximum calcium and magnesium content found in *Vangueria spinosa*. The maximum phosphorous content found in *Oxalis corniculata*. The maximum potassium content found in *Polygonum plebeium*. The maximum sulphur content found in *Ficus geniculata*. The maximum iron content found in *Centella asiatica.* The maximum zinc content found in *Vangueria spinosa.* The maximum found in *Moringa oleifera*.

Keywords: Underutilized, Leafy vegetables, Jharkhand, Antioxidant, Nutritional.

Introduction
Jharkhand is very rich with respect to the diversity of green leafy vegetables that are cultivated and is collected from wild. These leafy vegetables most often come from short lived herbaceous plants, whereas, leaves or flower of some woody plants are also eaten by local people. During rainy consumed by the natives. A sizable proportion of the consumed leafy vegetables is not and summer season, rural people collect various species of edible weeds from their agricultural and non- agricultural fields as well as from forestland to supplement their staple food. These species consumed by tribal people in the form of leafy vegetables vary from locality to locality and season to season depending on the availability of resources. Such vegetables constitute an integral part of the diet of these tribals as they get these plants in their immediate surroundings without any investment. These leafy vegetables are cooked as saag, eaten raw or dried and stored for uses round year. The diversity of leafy vegetables species offer variety in family diet and contributes to household food and nutritional security as well as increase dietary diversity.

Further, it provides rural household with supplementary income opportunities through their sale in the markets. Many varieties of these underutilized leafy vegetables, both cultivated and wild are sold in these local markets in both fresh and dried form. During the rainy season, a large quantity of these leafy vegetables are harvested and dried in sun, to be consumed with cooked rice water in the form of soup during the lean period when the supply of vegetables is limited and prices are high.

These local leafy vegetables are among the most nutritious vegetables as they are rich sources of minerals such as calcium, magnesium, iron and potassium as well as a good source of vitamins which show wide and essential medicinal use as tradition of these local people or tribals. They are also high in fibre, extremely low fat and carbohydrates, and also provides a fair source of protein. Thus, these leafy vegetables play a significant role in reducing micronutrient deficiency and provides food security to the tribal population of rural Jharkhand, however no systematic information is yet available regarding the consumption pattern and nutritional composition of these lesser known vegetables. A part from being a rich source of micronutrients and vitamins the leafy vegetables are also said to be a good source of antioxidants. Leafy vegetables contains number of phytochemicals which help to protect the cells from oxidative damage induced by free radicals and thereby help to reduce the oxidative stress (Wada and Ou 2002) [15] and thereby play a role in health management, especially

lowering risk of chronic human aliments such as cancer, cardiovascular disease and other age related disorders. (Vanpoppel *et al.*, 1994) [14]. Some researchers have also enumerated the traditional uses of these leafy vegetables plants along with some of their nutritional properties (Kumari and Kumar 2001; Thakur, Kumar and Kumar 2012; Sharma and Rawal 2013) [9, 13].

Keeping these facts in view, attempts have been made to survey the selected districts of Jharkhand to assess the availability and extent of consumption of these lesser known leafy vegetables among the tribal people of Jharkhand. Besides, biochemical analysis of these underutilized leafy vegetables including antioxidant potential and nutritive value has also been done to establish the nutritional and therapeutic authenticity of lesser known vegetables.

Material and Methods

The study was conducted between December to March and June 2017, in two districts (Ranchi and Khunti) of Jharkhand state in Eastern India and 29 villages also 3 blocks (Namkum, Bundu, Piska nagdhi). The area lies between 85.0-55.6° latitude and 22.9-23.5° longitude. The choice of study sites was based on the prevalence of all tribes in area, and also the forest cover, to allow for collection of the maximum number of locally consumed species. The selected communities had cultivated and consumed leafy vegetables for a long time, but had not fully exploited the plants economic potential.

The tribal hamlets and forest pockets were first visited to collect a broad range of information on the habit, habitat and growth season of traditional vegetables and their medicinal values. Personnel who spoke the local language and had worked for nongovernmental organizations in the area assisted the author. The local people were informed about the study and cooperated in the documentation of their vegetables and their medicinal uses.

Past literature on the local use of traditional vegetables was reviewed and questions to ask prepared. Interviews were conducted in 10 villages and local markets with 70 people: elderwomen, elder men, and people working in agriculture, and those having extensive knowledge of local vegetables and also about particular species and their medicinal uses in different disease.

Plant specimens were collected with the informants from home gardens, cultivated land, forests, and local markets. The plants were photographed, pressed and dried for identification. The vegetables were identified using the classical reference on indigenous crops by Haines (1921-25). The plants were listed alphabetically, and entries included the botanical names, family, local names, parts consumed or used. Vegetables sold by tribal people in rural (Khunti), peri- urban (Nam kum) and urban markets (Ranchi) also were recorded during different season of the year. A list of reported vegetables was prepared and checked with informants to ensure that no locally used leafy vegetables were missing.

Samples of 26 potential species of these underutilized leafy vegetables were also collected from the markets and were subjected to biochemical analysis. Antioxidant activity and nutritive properties including vitamin C (ascorbic acid) and minerals (macromineral i.e. Ca, P, Mg, K, S and micro mineralsi. e. Fe, Zn and Mn of these underutilized leafy vegetables were analyzed.

- **Antioxidant Activity:** - Antioxidant activity of fresh leafy vegetables samples were measured in the form of 2, 2 -diphenly -1- picrylhydrazyl (DPPH) radical scavenging ability (Kang and Saltiest 2002). The assay is based on the reduction of absorbance at 517nm. The decreases in absorbance with sample addition was used for calculation of antioxidant activity. A standard curve using different concentrations of ascorbic acid (20-100 µg/ml) was also developed and the result were expressed as ms ascorbic acid equivalent antioxidant capacity (AEA)/100g.

- **Ascorbic Acid (Vitamin C):-** Ascorbic acid was determined from fresh sample by volumetric method using 2, 6-dichlorophenol indophenols dye, which turns pink in acid solution (A.O.A.C.1990) [1]. Results were expressed in mg of ascorbic acid per 100g of fresh weight.

- **Minerals Estimation :-**For determining mineral content, the leaves or tender shoots or flower were washed initially by tap water followed by dilute hydrochloric acid (0.005) and finally with double distilled water. The leafy sample were them dried in air oven at a temperature of 65±5ºC for 24 hours, ground and passed through an 80-mesh sieve (180 µm). Dried sample (1g) were digested with diacid mixture (HNO_3:$HClO_4$:9:4). After digestion and extraction of samples,

- Total P (Phosphorous) was determined with the vanodomolybdophosphoric acid yellow -colour method (Jackson 1973) [8].
- Total K (Potassium) was determined with the flame photometric method (Jackson 1973) [8].
- Total S (Sulphur) was determined with the Gum acacia and barium chloride spectrophotometric method (Hesse1971).
- Water soluble Ca and Mg were determined by the versanate method (Hesse 1971).
- Water soluble Fe, Mn, Zn were measured with an atomic absorption spectrophotometer (AAnalyst 100, Perkin Elmer, Norwalk, CT, USA).

Statistical analysis

Standard Deviation (S.D) was calculated for antioxidant activity, ascorbic acid content and tannin. Whereas, the data obtained on minerals content were subjected to statistical analysis of variance (ANOVA) technique using completely randomized design (CRD).

Result and discussion

In the present study, twenty six species of local underutilized leafy vegetables consumed by tribals of Jharkhand were identified through market surveys and villages. During market survey it was found that these leafy vegetables are sold in two forms in the village markets viz. fresh and dried form. Most of these local leafy vegetables are available during winter season, when these were collected and sold in fresh form in the local markets, while the surplus of them were dried and powdered at home and were sold throughout the year in dried form, especially during the lean season i.e in summer. Some of the underutilized leafy vegetables are cultivated while others grow wild either in agricultural fields, wasteland or forests area. These underutilized leafy vegetables can be obtained from different plant types, herbs, shrub, trees or creepers. The parts most commonly consumed are leaves, but tender shoots, buds, flowers, flower buds are also eaten. The information on, botanical names, local name, habitat, habit,

parts consumed are given in Table 1. The availability of leafy vegetables in market *Amaranthus viridis*(Gandhari) was found highest in quantity in the market followed by *Centella asiatica* (Beng), *Hygrophila polysperma* (Muchari), *Polygonum plebeium* (Chemti), *Marsilea minuta* (Chatta saag), *Crotalaria juncea* (Sanai phool) etc. Besides these, there are also few other leafy vegetables which are not found in local markets but rural people collect them for their surroundings and consume them on daily basis, few of these are *Oxalis corniculata* (Netho), *Ficus geniculata* (Putkal), *Colocasia esculenta* (Kachu patta), *Hibiscus sabdariffa* (Kudrum phool, patta), *Portulaca oleracea* (Golgola).

Table 1: List of indigenous leafy vegetables and their uses

S.No.	Botanical Name	Family	Local Name	Habit
1.	*Amaranthus viridis*	Amarathaceae	Gandhari saag	Shrub
2.	*Alternanthera sessilis*	Amaranthaceae	Garundi saag	Shrub
3.	*Antidesma diandrum*	Euphorbiaceae	Matha saag	Tree
4.	*Bauhinia purpuria(Flower)*	Caesalpiniaceae	Koinar phool	Tree
5.	*Bauhinia purpuria(Leaf)*	Caesalpiniaceae	Koinar saag	Tree
6.	*Centella aisatica*	Apiaceae	Beng saag	Shrub
7.	*Crotalaria juncea*	Fabaceae	Sanai phool	Herb
8.	*Cassia tora*	Fabaceae	Chakodh saag	Shrub
9.	*Colocasia esculenta*	Araceae	Kachu saag	Herb
10.	*Euphorbia hirta*	Euphorbiaceae	Dudhi saag	Shrub
11.	*Ficus geneculata*	Moraceae	Putkal saag	Tree
12.	*Hygrophila polysperma*	Acanthaceae	Muchari saag	Waterweed
13.	*Hibiscus sabdariffa(leaf)*	Malvaceae	Kudrum saag	Herb
14.	*Hibiscus sabdariffa(flower)*	Malvaceae	Kudrum phool	Herb
15.	*Indigophera tinctoria*	Fabaceae	Jhirhul phool	Tree
16.	*Ipomea batatas*	Convolvulaceae	Kanda saag	Shrub
17.	*Moringa oleifera(leaf)*	Moringaceae	Sutti saag	Tree
18.	*Moringa oleifera(flower)*	Moringaceae	Sutti phool	Tree
19.	*Marsilea minuta*	Marsileaceae	Chatta saag	Shrub
20.	*Oxalis corniculata*	Oxalidaceae	Netho saag	Shrub
21.	*Oxalis articulata*	Oxalidaceae	Netho (khatta)saag	Shrub
22.	*Oxybasis rubra*	Amaranthaceae	Jungli bathua	Herb
23.	*Polygonum plebeium*	Polygoraceae	Chemti saag	Shrub
24.	*Portulaca oleracea*	Portulacaceae	Golgola saag	Shrub
25.	*Trianthema portulacastrum*	Aizoaceae	Khapra saag	Shrub
26.	*Vangueria spinosus*	Rubiaceae	Katai saag	Tree

Fig 1: *Cassia tora*

Fig 2: *Centella asiatica*

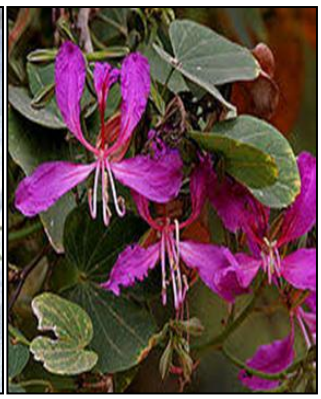

Fig 4: *Bauhinia purpurea*

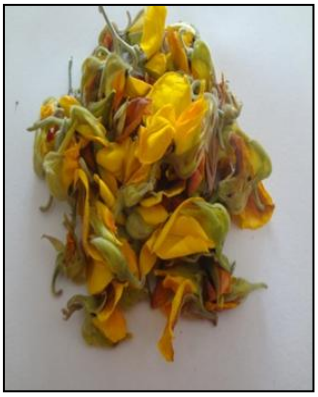

Fig 3: *Crotalaria juncea*

Fig 5: *Hygrophilia polysperma* **Fig 6:** *Colocassia esculenta*


Fig 7: *Ficus geniculate* **Fig 8:** *Polygonum plebeiun*


Fig 13: *Portulaca oleracea* **Fig 14:** *Euphorbia hirta*


Fig 9: *Oxalis articulate* **Fig 10:** *Ipomea batatas*


Fig 15: *Amaranthu sviridis* **Fig 16:** *Alternanthera sessils*

Fig 11: *Oxalis corniculata*


Fig 17: Indigophera tinctoria **Fig 18:** *Oxybasis rubra*

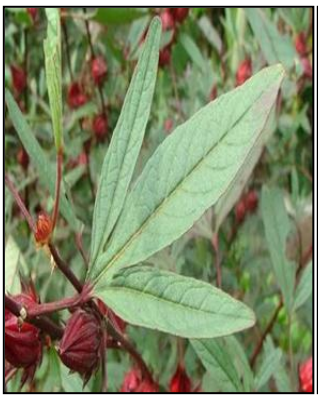


Fig 12: *Hibiscus sbdariffa*

Fig 19: *Vangueria spinosa*

Fig 20: *Moringa oleifera*

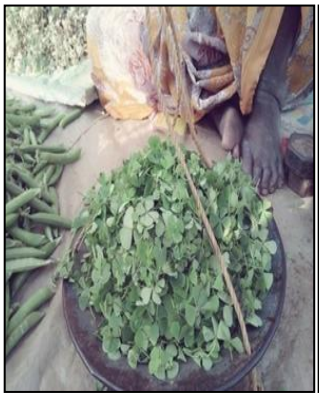

Fig 21: *Marsilea minuta*

Fig 22: *Cucurbita moschata*

Antioxidant activity

The antioxidant activities (mgAEAC/100g) of twenty six underutilized leafy vegetables were analysed and have been shown in Table 2. Antioxidant activities of these leafy vegetables in the range of variation (1783.33 to 5200 mgAEAC/100g). The total antioxidant found maximum in *Colocasia esculenta* (5200.00 mg AEAC/100g) followed by *Crotalaria juncea* (4708.33 mg AEAC/100g), *Bauhinia purpuria* (flower) (4100.00 mg AEAC/100g), while minimum was in *Oxalis corniculata* (1783.33 mg AEAC/100g) amongst the leafy vegetables analyzed. The high antioxidant activity of these wild leafy vegetables may be responsible for their wide use in the diet of the tribals and may provide a source of dietary antioxidants (Sahu, Kar and Routray 2013) [11].

Table 2: Total antioxidant of greeny leafy vegetables used by the tribes of Jharkhand, India.

Vegetable	Total antioxidant mg AEAC/100g
Amaranthus viridis	3525.00
Alternanthera sessilis	1100.00
Antidesma diandrum	3400.00
Bauhinia purpuria(Flower)	4100.00
Bauhinia purpuria(Leaf)	1816.67
Centella aisatica	958.33
Crotalaria juncea	4708.33
Cassia tora	3733.33
Colocasia esculenta	5200.00
Euphorbia hirta	2716.67
Ficus geneculata	4000.00
Hygrophila polysperma	3758.33
Hibiscus sabdariffa(leaf)	341.67
Hibiscus sabdariffa(flower)	2941.67
Indigophera tinctoria	3558.33
Ipomea batatas	4083.33
Moringa oleifera(leaf)	1425.00
Moringa oleifera(flower)	4058.33
Marsilea minuta	991.67
Oxalis corniculata	1783.33
Oxalis articulate	2575.00
Oxybasis rubra	2576.00
Polygonum plebeium	2578.00
Portulaca oleracea	2580.00
Trianthema portulacastrum	2582.00
Vangueria spinosus	2584.00
Mean	2833.65
F- test	S
S. Ed. (±)	446.442
C. D. (0.05%)	946.458

Ascorbic acid (Vitamin C)

The ascorbic acid content (mg/100g) of twenty six potential underutilized leafy vegetables of Jharkhand has been shown in Table 3. The ascorbic acid content of these leafy vegetables range of variation (23.33 to 723.67 mg/100g). The ascorbic acid content found maximum in *Amaranthus viridis* (723.67 mg/100g) followed by *Alternanthera sessilis*(548.67 mg/100g), *Marsilea minuta* (531.33 mg/100g), while

minimum was found in *Euphorbia hirta* (23.33 mg/100g). As in another study the range of vitamin C content (10.19 to 211.20 mg/100g) has been reported by other researchers also in 38 species of tropical leafy vegetables (Ogunlesi *et al.* 2010) [10].

Table 3: Ascorbic acid mg/100g of greeny leafy vegetables used by the tribes of Jharkhand, India.

Vegetable	Ascorbic acid mg/100g
Amaranthus viridis	723.67
Alternanthera sessilis	548.67
Antidesma diandrum	437.67
Bauhinia purpuria(Flower)	146.00
Bauhinia purpuria(Leaf)	52.67
Centella aisatica	41.00
Crotalaria juncea	35.00
Cassia tora	210.00
Colocasia esculenta	64.33
Euphorbia hirta	23.33
Ficus geneculata	146.00
Hygrophila polysperma	70.33
Hibiscus sabdariffa(leaf)	58.33
Hibiscus sabdariffa(flower)	169.33
Indigophera tinctoria	47.00
Ipomea batatas	146.00
Moringa oleifera(leaf)	41.00
Moringa oleifera(flower)	40.67
Marsilea minuta	531.33
Oxalis corniculata	181.33
Oxalis articulata	58.33
Oxybasis rubra	79.65
Polygonum plebeium	71.79
Portulaca oleracea	77.71
Trianthema portulacastrum	83.12
Vangueria spinosus	93.81
Mean	160.70
F- test	S
S. Ed. (±)	60.118
C. D. (0.05%)	127.451

Minerals content (Micronutrients and macronutrients)

Minearls content (mg/100g) of potential underutilized leafy vegetables of Jharkhand including both macrominerals viz, Calcium (Ca), Phosphorous (P), Magnesium (Mg), Potassium (K) and Sulphur (S) and microminerals viz, Iron (Fe), Zinc (Zn) and Manganese (Mn) has been shown in Table 4. Calcium and Phosphorous are important for growth and healthy maintenance of bones, teeth, muscles, and blood (Akubugwo *et al.* 2007) [4].

Calcium content in all leafy vegetables analyzed range of variation (4.46 to 90.53 mg/100g) has been shown in Table 4. The maximum calcium content was found in *Vangueria spinosa* (90.53 mg/100g) followed by *Marsilea minuta* (80.35 mg/100g), *Ipomea batatas* (71.48 mg/100g), while minimum calcium content was found in *Antidesma diandrum* (4.46 mg/100g). These values are higher than the values reported for eight green leafy vegetables grown in South-eastern, Nigeria such as *Ficus capensis, Solanum melongena, Moringa oleifera* etc. (Achikanu *et al*. 2013) [2]. Thus, results have been reported in six non-conventional leafy vegetables of Nigeria, where *Moringa oleifera, Amaranthus spinosus, and Adansonia digitata* contained comparatively higher amount of calcium (2040.6 mg/100g, 968.7 mg/100g, and 1824.6 mg/100g, respectively) (Barminas, Charles and Emmanuel 1998) [6].

Phosphorous content range varied from (3.76 to 19.79 mg/100g) has been shown in Table 4. The maximum phosphorous content was found in *Oxalis corniculata* (19.79 mg/100g) followed by *Euphorbia hirta* (19.29 mg/100g), *Hibiscus sabdariffa* (19.09 mg/100g), while minimum phosphorous content was found in *Bauhinia purpuria* (3.76 mg/100g).

Magnesium content was ranged from (2.98 to 90.74 mg/100g) has been shown in Table 4. The maximum magnesium content was found in *Vangueria spinosa* (90.74 mg/100g) followed by *Ficus geniculata* (41.11 mg/100g), *Hygrophila polysperma* (40.46 mg/100g), while the minimum magnesium content was found in *Alternanthera sessilis* (2.98 mg/100g). As in another study, *A. spinosus* have been reported to contain the highest amount of magnesium (912.4 mg/100g) amongst six non-conventional leafy vegetables of Nigeria (Barminas *et al*. 1998) [6]. Dietary deficiency of magnesium which is linked with ischemic heart diseases could be prevented by the regular consumption of these vegetables as all these vegetables are good source of magnesium.

The potassium content of the leafy vegetables range varied from (0.68 to 8.19 mg/100g) has been shown in Table 4. The maximum potassium content was found in *Polygonum plebeium* (8.19 mg/100g) followed by *Hygrophila polysperma* (6.80 mg/100g), *Ficus geniculata* (6.33 mg/100g), while the minimum potassium content was found in *Ipomea batatas* (0.68 mg/100g). In another investigation, *Centella asiatica* has been found to contain the highest potassium concentration amongst four wild leafy vegetables of South Africa (Afolayan and Jimoh 2009) [3]. These indigenous vegetables could therefore meet the daily requirements of potassium for an adult and be useful in the management of hypertension and other cardiovascular diseases (Arlington *et al.* 1992) [5].

The sulphur content of leafy vegetables analyzed varied from(2.01 to 13.36 mg/100)has been shown in Table 4.The maximum sulphur content was found in *Ficus geniculate* (13.36 mg/100g) followed by *Oxalis articulate* (12.9 mg/100g), *Polygonum plebeium* (11.37 mg/100g), while the minimum was found in *Antidesma diandrum* (2.01 mg/100g).

Iron content in the local underutilized leafy vegetables in the present study varied from (0.11 to 1.73 mg/100g) has been shown in Table 5. The maximum iron content was found in *Centela asiatica* (1.73 mg/100g) followed by *Ficus geniculata* (1.33 mg/100g), *Vangueria spinosa* (1.27 mg/100g), while the minimum content was found in *Antidesma diandrum* (0.11 mg/100g) and thus, may help to overcome some of the nutritional problems associated with iron deficiency. However, a comparatively higher range of iron (2.2 to 19.9 mg/g) has been reported in fifteen species of less known wild leafy vegetables of Dumka district of Jharkhand (Thakur *et al.* 2012) [13].

Zinc content in the present investigation varied amongst leafy vegetables analysed from (0.02 to 0.24 mg/100g) has been shown in Table 5. The maximum zinc content was found in *Vangueria spinosa* (0.24 mg/100g) followed by *Moreinga oleifera* (leaf) (0.23 mg/100g), *Bauhinia purpuria* (leaf) (0.14 mg/100g), while the minimum was found in *Alternanthera sessilis* (0.02 mg/100g). These values are higher as compared to the comparatively higher levels of zinc content (0.3 to 1.2 mg/100g) reported in twenty one wild vegetables traditionally consumed in North-East India (Saikia and Deka 2013).

The Manganese content of these underutilized leafy vegetable varied from (0.03 to 1.89 mg/100g) has been shown in Table 5. The maximum was found in *Moringa oleifera* (leaf) (1.89 mg/100g) followed by *Ficus geniculata* (0.99 mg/100g), *Indigophera tinctoria* (0.68 mg/100g), while minimum was found in *Antidesma diandrum* (0.33 mg/100g). These values

are lower as compared to those reported in fifteen species of less known wild leafy vegetables of Dumka district of Jharkhand (0.29 to 17.9 mg/100g) (Thakur *et al*. 2012) [13].

Table 4: Macronutrient of greeny leafy vegetables used by the tribes of Jharkhand, India.

Vegetable	Macronutrients				
	Calcium mg/100g	**Magnesium mg/100g**	**Phosphorus mg/100g**	**Potassium mg/100g**	**Sulphur mg/100g**
Amaranthus viridis	19.63	10.85	6.72	3.02	4.77
Alternanthera sessilis	8.98	2.98	3.89	1.56	2.54
Antidesma diandrum	4.46	4.51	3.76	1.09	2.01
Bauhinia purpuria(Flower)	4.84	10.09	6.08	1.47	3.11
Bauhinia purpuria(Leaf)	17.91	16.04	8.97	3.85	5.13
Centella aisatica	30.18	12.97	11.96	2.98	6.11
Crotalaria juncea	27.81	14.17	12.16	3.79	7.90
Cassia tora	64.44	5.29	11.15	2.49	7.47
Colocasia esculenta	28.77	16.59	17.38	5.65	10.00
Euphorbia hirta	44.88	9.77	19.29	3.00	7.96
Ficus geneculata	27.82	41.11	13.32	6.33	13.36
Hygrophila polysperma	40.66	40.46	11.51	6.80	7.01
Hibiscus sabdariffa(leaf)	28.47	14.04	8.97	4.02	6.11
Hibiscus sabdariffa(flower)	22.91	12.36	19.09	3.73	5.25
Indigophera tinctoria	12.86	22.10	11.00	7.91	9.96
Ipomea batatas	71.48	36.38	9.75	0.68	7.73
Moringa oleifera(leaf)	24.47	20.42	5.59	5.42	7.93
Moringa oleifera(flower)	5.92	7.29	9.38	1.99	3.34
Marsilea minuta	80.35	38.33	10.13	6.14	5.67
Oxalis corniculata	36.97	6.36	19.79	2.34	6.28
Oxalis articulata	24.53	23.40	12.92	5.14	12.90
Oxybasis rubra	18.97	15.09	13.80	3.83	9.58
Polygonum plebeium	27.44	17.73	10.13	8.19	11.37
Portulaca oleracea	14.20	12.95	6.50	4.33	8.58
Trianthema portulacastrum	6.20	11.25	12.83	2.91	3.76
Vangueria spinosus	90.53	90.74	11.72	4.95	7.60
Mean	30.99	20.47	11.07	3.98	7.06
F- test	S	S	S	S	S
S. Ed. (±)	9.990	3.235	0.754	0.708	0.195
C. D. (0.05%)	21.179	6.858	1.598	1.500	0.414

Table 5: Micronutrient of greeny leafy vegetables used by the tribes of Jharkhand, India.

Vegetable	Micronutrients		
	Fe content mg/100g	**Mn content mg/100g**	**Zn content mg/100g**
Amaranthus viridis	0.67	0.18	0.05
Alternanthera sessilis	0.14	0.22	0.02
Antidesma diandrum	0.11	0.03	0.03
Bauhinia purpuria(Flower)	0.11	0.03	0.05
Bauhinia purpuria(Leaf)	0.53	0.57	0.14
Centella aisatica	1.73	0.30	0.13
Crotalaria juncea	0.81	0.44	0.06
Cassia tora	0.28	0.14	0.08
Colocasia esculenta	0.32	0.09	0.14
Euphorbia hirta	0.97	0.29	0.07
Ficus geneculata	1.33	0.99	0.11
Hygrophila polysperma	1.03	0.25	0.12
Hibiscus sabdariffa(leaf)	0.73	0.13	0.07
Hibiscus sabdariffa(flower)	0.58	0.15	0.07
Indigophera tinctoria	0.77	0.68	0.10
Ipomea batatas	0.90	0.13	0.04
Moringa oleifera(leaf)	1.21	1.89	0.23
Moringa oleifera(flower)	0.45	0.06	0.03
Marsilea minuta	0.46	0.17	0.13
Oxalis corniculata	0.30	0.09	0.10
Oxalis articulata	0.77	0.33	0.11
Oxybasis rubra	0.77	0.22	0.06
Polygonum plebeium	1.18	0.12	0.10
Portulaca oleracea	0.15	0.14	0.07
Trianthema portulacastrum	0.36	0.13	0.07
Vangueria spinosus	1.27	0.26	0.24
Mean	0.69	0.31	0.09
F- test	S	S	S
S. Ed. (±)	0.183	0.073	0.008
C. D. (0.05%)	0.388	0.154	0.017

Tannin Content

The tannin content (%) of twenty six underutilized leafy vegetables were analysed and have been shown in Table 4.1.6. The tannin content of these leafy vegetables in the range of variation (0.07 to 0.46%). The tannin content was found maximum in *Ficus geniculata* (0.46%) followed by *Moringa oleifera (leaf)* (0.45%), *Vangueria spinosa* (0.42%), while minimum was found in *Antidesma diandrum* (0.07%) amongst the leafy vegetables analyzed. As in another study the range of ash content was found higher that has been reported by the other researcher also in eight species of underutilized vegetables. (Saha *et al*; 2015) [12].

Table 6: Tannin content present in underutilized leafy vegetables consumed by the local tribes of Jharkhand, India.

Vegetable	Tannin (%)
Amaranthusviridis	0.19
Alternantherasessilis	0.09
Antidesmadiandrum	0.07
Bauhinia vaiegata(Flower)	0.12
Bauhinia variegata(Leaf)	0.17
Centellaaisatica	0.21
Crotalaria juncea	0.36
Cassia tora	0.23
Colocassia esculenta	0.30
Euphorbia hirta	0.24
Ficus geniculata	0.46
Hygrophilapolysperma	0.20
Hibiscus sabdariffa(leaf)	0.20
Hibiscus sabdariffa(flower)	0.15
Indigopheratinctoria	0.29
Ipomeabatatas	0.14
Moringaoleifera(leaf)	0.45
Moringaoleifera(flower)	0.24
Marselia quadrifolia	0.31
Oxalis corniculata	0.25
Oxalis articulata	0.20
Oxybasisrubra	0.10
Polygonumplebeium	0.18
Portulacaoleracea	0.29
Trianthemaportulacastrum	0.37
Vangueriaspinosa	0.42
Mean	0.24
F- test	S
S. Ed. (±)	0.055
C. D. (0.05%)	0.116

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References

1. AOAC. Official Methods of Analysis. Washington D.C.: Association of Official Analytical Chemists, 1990.
2. Achikanu CEPE, Eze- Steven, CM Ude, OC Ugwuokolie. Determination of the vitamin and mineral composition of common leafy vegetables in South- eastern Nigeria. International Journal of Current Microbiology and Applied Science. 2013; 2:347-353.
3. Afolayan AJ, FO Jimoh. Nutritional quality of some wild leafy vegetables in South Africa. Internaltional Journal of Food Science and Nutrition. 2009; 60:424-31.
4. Akubugwo IE, NA Obasi, GC Chinyere, AE Ugbogu. Nutritional and chemical values of Amaranthus hybridusn L. leaves from Afikpo, Nigeria. Africa Journal of Biotechnology. 2007; 6:2833-2839.
5. Arlington VA, ML Arbeit, TA Nicklas, GS Berenson. Considerations of dietary sodium potassium energy ratios of selected foods. Journal of the American College of Nutrition. 1992; 11:210-222.
6. Barminas JT, M Charles, D Emmanuel. Mineral composition of non-conventional leafy vegetables. Plant Foods for Human Nutrition. 1998; 53:29-36.
7. Hesse HH. The Botany of Bihar and Orissa I-IV. Calcutta: Botanical Survey of India, 1921-1925.
8. Jackson ML. Soil chemical analysis. New Delhi: Prentice Hall of India, 1973.
9. Kumari B, S Kumar. A Checklist of Some Leafy Vegetables Used by Tribes in and Around Ranchi, Jharkhand. Zoos' Print Journal. 2001; 16:442-444.
10. Ogunlesi M, W Okiei, L Azeez, V Obakachi, M Osunsanmi, G Nkenchor. Vitamin C contents of Tropical Vegetables and Foods Determined by Voltammetric and Titrimetric Methods and Their Relevance to the Medicinal Uses of the Plants. International Journal of Electrochemical Science. 2010; 5:105-115.
11. Sahu RK, M Kar, R Routary. DPPH Free Radical Scavenging activity of some Leafy Vegetables used by TribalsofOdisha, India. Journal of Medicinal Plants Research. 2013; 1:21-27.
12. Saha J, Biswal AK, Deka SC. Chemical Composition Of Some Underutilized Green Leafy Vegetables Of Sonitpur District Of Assam, India. International Food Research Journal. 2015; 22(4):1466-1473.
13. Thakur S, S Kumar, A Kumar. Potential of Some Wild Leafy Vegetables as Natural Sources for Supplementation of Micronutrients in Vegetarian Diets of Santhal Pargana Area of Jharkhand. Indian Journal of Fundamental and Applied Life Sciences. 2012; 2:65-67.
14. Vanpoppel G, AFM Kardinaal, HMG Princen FJ Kok. Antioxidant and coronary heart disease. Annals of Medicine. 1994; 26:429-434.
15. Wada L, B Ou. Antioxidant activity and phenolic content of Oregon cranberries. Journal of Agricultural and Food Chemistry. 2002; 50:3495-3500.