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Nutritional potential of indigenous fruits and vegetables

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Foods which are generally grown in tribal locality, hilly and wasteland can provide a solution to the problem of food security and nutritional security especially to the people who are living near to such places. World over, tribal population still stores a vast local food cultures are inseparable from traditional knowledge on utilization of local plants as food therapeutic systems. Due to maximum utilization of such indigenous plants by tribal community these plant food are also sometime called as "tribal foods". These tribal fruits and vegetable are not a part of commercial orcharding like mango, banana, spinach, potato etc. but appear in market in small quantities and these are often referred also know as uncommon foods/ underutilized foods /under exploited foods/ neglected foods or indigenous foods. In the present review paper pertinent text and research related to the area has been presented.

Key Words : Tribal foods, Indigenous fruits, Indigenous vegetables

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INTRODUCTION

The consumption of wild plants is, adopted by the local people for sustenance, is intrinsically linked to their strong traditional and cultural system and is inseparable. The indigenous communities continuously include wild edibles to their daily food intake and sales from the surplus add to their income. Simultaneously, an emphasis on the sustainable harvesting of wild edible plants will help enhance and maintain the region's biodiversity. As the local people are endowed with a vast knowledge concerning the utilization of wild plants, the paper focuses on their knowledge and illustrates the need to select local priority plant species with potential to become valuable staple foods and important alternatives to the usual cultivated agricultural crops (Angami *et al.*, 2007). In remote rural settlements where vegetable cultivation is not practiced and market supplies are not organized, local inhabitants depend on indigenous vegetables, both cultivated in kitchen gardens and wild, for enriching the diversity of food. Knowledge of such foods is part of traditional knowledge which is largely transmitted through participation of individuals of households. These indigenous fruits and vegetables plays important role in meeting the nutritional requirement of tribal population in remote parts of the country (Sundriyal and Sundriyal, 2004). It is estimated that in India about 800 species are consumed as wild edible plants (Singh and Arora, 1978).

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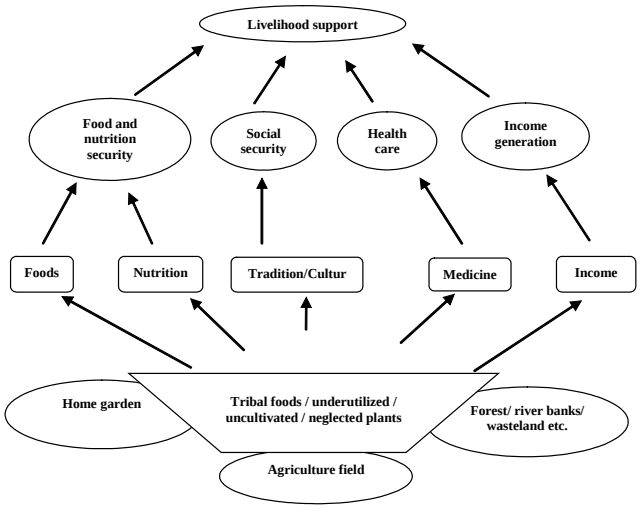
Helpful in livelihood support:

Studies on Ethno-food and ethno-medicinal plants have been carried out all over the world in tribal areas. Various researches have emphasized on the diversity and value of traditional vegetables (Dhyani *et al.*, 2007 and Kala, 2007). Most of these traditional leafy vegetables have a potential for income generation but fail to compete with exotic vegetables at present due to lack of awareness

(Maikhuri *et al.,* 2004; Banerjee *et al.,* 2015 and Jansenvan *et al.,* 2004). Tribals diet comprises verity of unconventional foods, *viz.,* edibal forms of flowers, fruits, tubers, leaves, stems, seeds and wild mushrooms. Tribals eat vegetables of leafy varieties, which grow as wild weeds and depend on such natural products for their food. Indigenous fruits and vegetables play an important role in the nutrition of people and children in rural and tribal communities. These have the ability to grow under stressed and adverse conditions and also known for their nutritive values. Tribal populations particularly children and women of these localities are fulfilling their nutritional requirements by consuming these fruits available freely in their vicinity (Malik *et al.,* 2010). These fruits and vegetables play a vital role in the livelihood support for the tribal communities (Fig. 1).



Source : Modified from Ogle, 2001

Fig. 1 : Role of underutilized fruits and vegetables in livelihood support

Macro nutrient contents:

Bhati and Jani (2016) analysed eleven un-common and uncultivated fruits consumed in tribal region of Udaipur district of Rajasthan selected and analysed for proximate composition, minerals, vitamins and free radical scavenging activity. The major findings of study are as follows: Protein, fat, ash, fibre, carbohydrate and energy were ranged from 2.04 to 21.79 g/100g, 1.40 to 43.33 g/100, 3.47 to 7.38 g/100g, 2.20 to 32.74 g/100g, 27.05 to 81.69 g/100g and 286.62 to 585.38Kcal/100g on dry weight basis, respectively.

Upadhayaya and Saikia (2012) analysed nutrient content leaves of *Centella asiatica* collected from three districts of Assam. The ash and crude fat content ranged from 8.06 to 11.6 per cent and 1.98 to 2.74 per cent, respectively. Whereas protein and carbohydrate was noted and varyied from 30.97 to 32.55 per cent and 42.39 to 50.26, respectively. The results also represent that increase in the content of phenolics and antioxidant leads to decrease in the content of nutrient. The results showed correlation between antioxidant activity and phenolics content.

Swarnkar and Katewa (2009) studied, 26 wild root and tubers were analyzed and the range of moisture, ash, crude protein, total carbohydrate, crude fibre, crude fat and energy. The moisture and ash content of these root and tubers ranged from 8.20 per cent to 91.18 per cent and from 1.01 per cent to 12.3 per cent, respectively. The maximum ash content was found in *Ampelocissus latifolia* (12.3 %) and minimum in *Nelumbo nucifera* (1.01 %) among the studied plants. The maximum moisture content was found in *Urgenia indica* (91.18 %) and minimum in *Cyperus rotundus* (8.20 %). Protein content ranged from Tacca 2.33 per cent in *Leontopetaloides* to 16.43 per cent in *Trapa natans*. Total carbohydrate content ranged from 9.38 per cent in *Cayratia trifolia* to 92.27 per cent in *Dioscorea bulbifera*. Crude fat content was maximum in *Curcuma amada* (2.74 %) and minimum in *Asparagus racemosus* (0.10 %). Crude fibre ranged from 0.40 per cent in *Dioscorea bulbifera* to 28.64 per cent in *Nelumbo nucifera*. Energy content was minimum in *Cayratia trifolia* (77.04 Kcal 100g fresh tuberous root) and maximum in *Dioscorea bulbifera* (391.54 Kcal. 100g fresh tuber). The study emphasized that these less familiar wild tuber and root crops should not be ignored. Rather, they can be used as good alternative source of food to alleviate hunger and malnutrition.

In the Sikkim Himalaya a total of 190 species, among these species, 27 (22 fruit species and five for leaves/shoots) plant species were analyzed for their nutritive values. Among different plant parts, generally higher nutrient concentration was recorded for leaves, followed by shoots and fruits. For different species the crude fibre content ranged between 2.15 to 39.90 per cent, and the total soluble salts between 4.66 to 21.00 per cent, and the vitamin C content from 6 to 286 mg/100 g. The fat content was determined high in the fruits of *Castanopsis hystrix, Machilus edulis* and *Cinnamomum* species, while the protein content was highest in *Hippophae rhamnoides, Cucumis melo,* and *Eleagnus latifolia*.

(Sundriyal and Sundriyal, 2004).

Thomas and Oyediran (2008) investigated the nutritional importance and micronutrient potentials of two non-conventional indigenous green leafy vegetables *viz.*, *Colocasia esculenta* and *Ocimum gratissimum*. Fresh leaves of *Colocassia esculenta* and *Ocimum gratissimum* contained 82.8 and 93.9 g of moisture, 3.4 and 3.0 g protein, 5.8 and 4.0 g crude fibre and 31.2 and 23 kcal of energy which indicated that former had higher contents than latter.

The nutrient content of thirteen underutilized green leafy vegetables was analyzed by Gupta *et al.* (2005). Moisture content of the analysed samples ranged between 73.0 and 95.3 g/100 g, with the highest being in *Coleus aromaticus* (95.3 g/ 100 g). Delonix *elata* had the lowest moisture content of 73 g/100 g while the rest of the greens had moisture content of about 85 g/100 g. *Delonix elata* and *Digera arvensis* had a high protein content of 7.1 and 4.3 g/100 g, respectively. *Trianthema portulacastrum*, *Polygala erioptera*, *Commelina benghalensis*, *Boerhaavia diffusa* and *Centella asiatica* had a protein content in the range of 2 to 3 g/ 100 g while *Celosia argentea*, *Cocculus hirsutus*, *Amaranthus tricolor*, *Gynandropsis pentaphylla* and *Cucurbita maxima* were in the range of 3 to 4 g/100 g. All the leafy vegetables were found to be poor sources of fat, which ranged between 0.2 and 0.9 g/100 g. The maximum amount of ether-extracted fat was observed in *Delonix elata* while the rest of the green leafy vegetable contained less than 0.75 g/100 g fat. The ash content of all green leafy vegetable was high except for *Polygala erioptera* (0.77 g/100 g).

Bhati and Jain (2015) analysed nine weeds commonly used by the tribal community The present paper deals with nutritional potential of nine weeds grow naturally and consumed as green leafy vegetable by the tribals of Udaipur district of Rajasthan. Protein content was found to be high in *Melilotus indica* followed by *Cassia tora* and *Polygonum glabrum* on dry weight basis. Crud fat, ash and crude fibre content are comparable to the conventional green leafy vegetables used commonly.

Micro nutrient contents:

Micronutrients, such as iron, zinc, magnesium, and copper contents were analyzed in different plant parts of various wild edible species. The iron content was higher in leaves and new shoots. The nutritive values of certain wild edible species are comparable with various commercial fruits (Sundriyal and Sundriyal, 2004). The association between food variety and nutrient intake/ health status among rural women was tested in two agro-ecological setting. It was observe that wild vegetables plays a significant contribution to the overall micronutrient

Table 1 : Major nutrients in edible portion of certain fruits (50g of edible portion of fruit)

Botanical name	Moisture (%)	Energy (Cal)	CHO (g)	Fibre (g)	Fat (g)	Protein (g)
Tamarindus indica	20.9	142	34	2.8	0.05	1.6
Manilikara elangii	54.7	80	18	2.2	0.5	0.9
Bambusa arundinacea	56.3	76	17.1	2	0.05	2
Phoenix dactylifera	59.2	72	16.9	1.9	0.2	0.6
Aegle marmalos Bael	61.5	68	15.9	1.5	0.15	0.9
Manilikara hexandra	68.6	67	13.9	-	1.2	0.3
M. indica	73.6	56	11.4	-	0.8	0.7
Feronia limonia	64.2	67	9.1	2.5	1.85	3.6
F. indica	67.8	57	11.4	2.4	0.9	0.9
F. cunia	79.4	26	5.4	3.2	0.3	0.6
Diospyros melanoxylon	70.6	56	13.4	0.4	0.1	0.4
D. embryopteris	69.6	56	13.3	0.8	0.05	0.7
Annona squamosal	70.5	52	11.8	1.6	0.2	0.8
Ficus bengalensis	74.1	36	5.9	4.3	1	0.9
Emblica officinalis	81.8	29	6.8	1.7	0.05	0.3
Physallis peruviana	82.9	27	5.6	1.6	0.1	0.9
Moringa oleifera	86.9	13	1.8	2.4	0.05	1.3

Source: Simlot (2001)

intake mostly carotene, vitamin C and calcium intake (Ogle, 2001).

Indrayan *et al.* (2005) studied mineral content of seeds of *Nelumbium nucifera* and observed that calcium 22.1 mg/100g, magnesium 9.20 mg/100g, cupper 0.0463 mg/100g, zinc 0.0840 mg/100g and iron 0.1990 mg/100g.

Twenty three fruits *viz., Alangium Salvifolia, Anacardium occidentale, Annona reticulate, Artocarpus integrifolia, Canthium parviflorum,Carica papaya, Cordia Myxa,Cordia oblique, Diosphros Melanoxylon, Eugenia Jambolana, Feroxia elephantum, Ficus Glomerata, Gardenia Turgide, Mangifera indica, Manilkara hexandra, Murraya Paniculata, Phoenix humilis, Phoenix sylvestris, Phyllanthus emblica, Polyalthia cerasoides, Semecarpus anacardium,* and *Zizyphus jujube,* were analyzed for total carotenoids (TC) and Beta carotene (BC) contents using High Performance Liquid Chromatography (HPLC). Among them, *Canthium parviflorum* contained very high TC (9.51 mg %) and BC (6.10 mg %) contents, and the edible orange colour fresh rind portion analyzed had the highest (6.8 mg %) BC content. Other fruits contained negligible content of TC (0.0015 to 1.32 mg %) and BC (0.004 to 0.49 mg %). The edible pulp portion of the fruit *Diosphros melanoxylon* contained no BC but the rind portion analyzed fresh and dried had BC 0.79 and 2.17 mg per cent, respectively (Rajyalakshmi *et al.,* 2003).

Study was conducted by Norhayati *et al.* (2011) to determine the amount of ascorbic acid, α-tocopherol and carotenoid content in twelve accessions of *Centella asiatica* in leaf tissues. The ascorbic acid content in the leaf tissues varied from 27.35 ± 2.33 to 95.86 ± 12.60 mg/g.fwt. Whereas the α-tocopherol concentration in *Centella asiatica* varied from 0.065 ± 0.001 to 0.233 ± 0.029 µg/g.fwt. The amount of carotenoid concentration detected in *Centella asiatica* was higher *i.e.* 36.55 ± 0.06 mg/g.fwt. There was no significant variation observed among all the twelve accessions of *Centella asiatica* in leaf tissues.

Thomas and Oyediran (2008) investigated the nutritional importance and micronutrient potentials of two non-conventional indigenous green leafy vegetables *viz., Colocasia esculenta* and *Ocimum gratissimum*. All minerals estimated were higher in colocasia leaves (6 mg sodium, 850 mg potassium, 240 mg calcium, 51.0 mg phosphorus and 3 mg iron) than *Ocimum gratissimum* leaves. β-carotene content was 691 and 571.6 µg/100 g, while ascorbic acid was 89.2 and 36.5 mg/100 g, respectively.

The micro nutrient content of thirteen underutilized green leafy vegetables was analyzed by Gupta *et al.* (2005). *Digera arvensis, Boerhaavia diffusa, Cucurbita maxima,* and *Amaranthus tricolor* had a high calcium content of 506, 330, 302 and 239 mg/100 g, respectively. *Trianthema portulacastrum* and *Polygala erioptera* were observed to have 52 and 41 mg/100 g, respectively, while the rest of the greens had calcium content in the range of 112–188 mg/100 g. The phosphorus content was found to be in the range of 16–63 mg/100 g for all the green leafy vegetables. *Digera arvensis* contained the greatest amount of potassium (604 mg/100 g) and *Polygala erioptera* the least amount (125 mg/100 g). *Coleus aromaticus* also contained low amounts of potassium (138 mg/100 g). The rest had potassium contents in the range of 317–476 mg/100 g on fresh weight basis. *Coleus aromaticus* had a low iron content of 2.62 mg/100 g. Four greens, *Celosia argentea, Centella asiatica, Amaranthus tricolor* and *Digera arvensis*, were found to have exceptionally high iron content of 13.15, 14.86, 15.01 and 17.72 mg/100 g fresh weight bases, respectively. At 0.97 mg/100 g, *Centella asiatica* had the highest zinc content, followed by *Delonix elata* at 0.76 mg/100 g. The remaining green leafy vegetables contained zinc levels in the 0.33–0.68 mg/100 g range. *Coleus aromaticus* and *Digera arvensis* were found to have a total carotene content of 10.38 and 17.93 mg/100 g, respectively. *Delonix elata* and *Cocculus hirsutus* had a higher total carotene content of 59.92 and 66.67 mg/100 g, respectively.

Rajyalakshmi *et al.* (2003) carried out study on vegetables, 5 roots and tubers, 23 fruits and 3 stored products collected and consumed by tribals of Andhra Pradesh, India were analyzed for total carotenoids (TC) and Beta carotene (BC) contents using High Performance Liquid Chromatography (HPLC). The results of the study indicated that the vegetables, roots and tubers analyzed showed negligible vitamin A activity with TC and BC content ranging from 0.01 to 0.61 and 0.14 to 0.23 mg per cent, respectively. Among the fruits, *Canthium parviflorum* contained very high TC (9.51 mg %) and BC (6.10 mg %) contents, and the edible orange color fresh rind portion analyzed had the highest (6.8 mg %) BC content. Other fruits contained negligible

content of TC (0.0015 to 1.32 mg %) and BC (0.004 to 0.49 mg %). The edible pulp portion of the fruit (*Diosphros melanoxylon* contained no BC but the rind portion analyzed fresh and dried had BC) 0.79 and 2.17 mg per cent, respectively. Tribals were found to have distinct attitudes and beliefs towards food they use or avoid in certain physiological conditions.

Swarnkar and Katewa (2009) studied, 26 wild root and tubers. The content of minerals *i.e.* calcium, iron, sodium, potasium, zinc, magnesium ranged from 0.9 mg/100g *(Dioscorea hispida)* to 963 mg/100g (*Colocassia esculenta*), 0.6 mg/100g (*Cayratia trifolia*) to 74.9 mg/100g (*Colocassia esculetna*), 3 mg/100g (*Curcuma amada*) to 240 mg/100g (*Asparagus abscendens*), 2.8 mg/100g (*Cyperus rotandus*) to 3741 mg/100g (*Colocassia esculetna*), 0.14 mg/100g (*Dioscorea pentaphylla*) to 3.8 mg/100g (*Curcuma amada*), and 0.1 mg/100g (*Asparagus abscendens*) to 375 mg/100g (*Colocassia esculetna*) on dry weight basis, respectively.

Anti-oxidant activity:

In traditional societies nutrition and health care are strongly interconnected and many plants have been consumed both as food and medicine (Pieroni, 2000). DPPH radical-scavenging activity has been widely used to assess the in vitro antioxidant activity of crude plant extracts. DPPH is a stable free radical at room temperature which acts as an acceptor of electrons or hydrogen radicals to become a stable diamagnetic molecule (Soares *et al.,* 1997 and Yadav *et al.,* 2016). In the test, DPPH radical was used as substrate to evaluate the free radical scavenging activity of the extracts. It involves the reaction of specific antioxidant with a stable free radical and results in decrease in absorbance which can be detected at 490 nm. The decrease in absorbance at 490 nm is characterised by reduction in DPPH radical, induced by antioxidants. The decrease in absorbance by antioxidant molecules is due to its reaction with free radical and results in the scavenging of the radical by hydrogen donation which is measured by the change in colour from purple to yellow.

Menichini *et al.* (2011) study antioxidant potential of *Citrus medica* L. cv. DIAMANTE FLOWERS, leaves and fruits (endocarp and mesocarp) at two maturity stages. Flowers and leaves were characterized by the highest total phenols and flavonoids content. A declining trend was observed during maturity of fruits for both phenols and flavonoids. The antioxidant activity evaluated by the β-carotene bleaching test showed a strong activity for flowers and endocarp of mature fruits with IC50 values of 2.8 µg/ml and 3.5 µg/ml, respectively, after 30 min of incubation. The mature fruits endocarp (IC50 value of 426.0 µg/ml) could inhibit a-amylase with an IC_{50} value 2-fold higher than immature fruits.

Ponmozhi *et al.* (2011) investigated the anthocyanin extracted from Pithecellobium dulce fruit percarp and its evaluation for antioxidant activity. The per cent of inhibited value of *Pithecellobium dulce* fruit pericarp extracting from 40 per cent to 66 per cent in different methods of extraction. Whereas in another study Aqueous (AEPD) and hydroalcoholic (HAEPD) extracts for free radical-scavenging activity by DPPH was analysed in *Pithecellobium dulce*. At the concentration of 160µg/ml the scavenging effect of AEPD and HAEPD on the DPPH radical was 41.8 per cent, 44.5 per cent, respectively, when compared to the scavenging effect of ascorbic acid at the same concentration (70.35 %) with the IC_{50} values of 14.89, 11.48, and 6.02 µg /ml, respectively. In the present investigation both the extracts at different doses demonstrated significant DPPH radical-scavenging activity in comparison with the standard, indicating their abilities to act as radical scavengers (Megala and Geetha, 2010).

The methanolic extracts of *Holoptelea integrifolia* (Roxb.) leaves (MLE) and stem bark (MSBE) were studied for the wound-healing potential. Since wound healing is severely hampered by microbial infection and reactive oxygen species (ROS), this study was undertaken to evaluate antimicrobial and antioxidant activity apart from wound-healing activity. The antimicrobial property of the *Holoptelea* was studied against the six bacterial and five fungal strains using the agar well diffusion method and minimum microbicidal concentration and minimum inhibitory concentration were determined for each strain, in which methanolic extract of stem bark (MSBE) has shown bigger zone of inhibition (11.3–20.4 mm) than methanolic extract of leaves (MLE) (9.6–14.9 mm). The anti-oxidant activity was evaluated by DPPH free radical scavenging activity using HPLC method. The IC_{50} values obtained for MSBE (TPC: 78.53 ± 1.26 mg/g) and MLE (TPC: 57.71 ± 1.45 mg/g) were 37.66 ± 0.48 and 50.36 ± 0.59µg/well, respectively. In excision wound model, more than 90 per cent wound healing was recorded in treated groups by 14 days of post surgery, whereas

only 62.99 per cent was observed in the control group. In incision model, higher breaking strengths and higher hydroxyproline content in treated groups suggested higher collagen re-deposition than the control group. Finally, histopathology studies conformed wound-healing activity of *Holoptelea integrifolia* (Reddy *et al.,* 2008).

Maridass *et al.* (2008) studied 29 *Diospyros* species for extractive values and qualitative identification of phytochemicals constituents. Species-wise percentages of methanol extract yields in decreasing order were as follows: *Diospyros malabarica* (5.61 %), *Diospyros racemosa* (5.21 %), *Diospyros Montana* (4.87 %), *Diospyros ovalifolia* (4.39 %), and *Diospyros melanoxylon* (4.36 %) and minimum percentage was noted of *Diospyros foliosa* (1.25 %). Fruits of *Diospyros* species were showed the presence of bioactive constituents of alkaloids (82 %), flavonoids (68.97 %), tannin (55.17 %), terpenoids (100 %), and essential oils (100 %) were detected in 29 *Diospyros* species.

Rai *et al*. (2006) studied the antioxidant activity of hydro-alcoholic extract of lotus seeds using *in vitro* and *in vivo* models. Total phenolics in extract was 7.61 per cent and exhibited strong free radical scavenging activity as evidenced by the low IC50 values (16.12 µg/ml) in 1,1-diphenyl-2-picryl hydrazyl, which was comparable to rutin (IC50, 18.95 µg/ml). In nitric oxide method, the extract showed more activity (IC50, 84.86 µg/ml) than standard rutin (IC50, 152.17 µg/ml). Lotus seed extract possess hepatoprotective, free radical scavenging properties and anti-fertility properties (Sohn *et al.,* 2003).

Marsilea minuta cooked and consumed as leafy vegetable as well as juice of the fresh shoots and decoction of leaves are used to treat cough and other respiratory troubles by the tribal community (Sen *et al.*, 20011; Sarker and Hossain, 2009 and Upreti *et al.,* 2009). Study done Praneetha *et al.* (2011), on *Marsilea minuta* was evaluated for hepato-protective, anti-hepato-toxic activities. In antihepatotoxic study it was observed that administration of standard, (Silibinin 50mg/kg), MMME (Methenol extracted *Marsilea minuta*) 100, 200 and 400 mg/kg b.w., significantly ($P<0.05$) reversed the levels of these parameters in their respective groups as compared to toxic group. The symptoms of toxicity upto a dose level of 2000 mg/kg b.w.p.o. for 72 hrs. The results indicate that MMME at 200 mg/kg. b.w. afforded better protection as compared to MMME at 100 and 400 mg/kg. It is also evident that antihepatotoxic effect of the extract at 200mg/kg is almost close to that of the reference drug Silibinin (50 mg/kg).

Upadhayaya and Saikia (2012) leaves of *Centella asiatica* collected from three districts of Assam were analysed for antioxidant activity content. The results also represent that increase in the content of phenolics and antioxidant leads to decrease in the content of nutrient. In case of antioxidant activity, ethanoic extract of the samples showed effective scavengers of DPPH and this activity was comparable to that of ascorbic acid. The percentage inhibition in case of DPPH was 73.7 per cent, 86.2 per cent, 83 per cent and 88.2 per cent for sample 1, 2, 3 and ascorbic acid, respectively.

The antioxidant was screened in *Centella Asiatica* leaves, the IC50 value of BHT and ascorbic acid was obtained 26.0 µg/ml and 5.0 µg/ml respectively. In this investigation, the chloroform extract (CF) of the plant showed the highest antioxidant activity with IC50 value of 4.00 µg/ml. Aqueous soluble fraction (AQ) of the methanol extract also revealed potent antioxidant activity (IC50=7 µg/ml). On the other hand, the carbon tetrachloride (CT), n-hexane soluble fraction (HX) showed moderate antioxidant activity with the IC50 value of 40 and 298 µg/ml, respectively. These results denote the presence of antioxidant principles in the extractives (Ullah *et al.,* 2009).

Guil *et al.* (1997) studied sixteen wild edible plants species for ascorbic acid, dehydroascorbic acid and carotenes in southeast Spain. Ascorbic + dehydroascorbic acids contents were very high in several species, especially in *Chenopodium album* L. (155 mg/100 g). Carotenoid content ranged from 4.2 mg/100 g (*Stellaria media Villars*) to 15.4 mg/100 g (*Amaranthus viridis* L.).

Prakash *et al.* (2011) carried out a research on the potential sources extracts of some fruits and their different parts were studied for total phenolic contents (TPC), antioxidant (AOA) and free radical scavenging activities (FRSA). Phenols have profound importance due to their biological and free radical scavenging activities. The amount of TPC varied from 10.5 to 343.2 mg/g and AOA from 20.3 to 96.7 per cent. Fruits of *Caesalpinia mexicana*, *Acacia auriculiformis*, fruit pericarp fibres of *Cocus nucifera*, and fruits of *Emblica officinalis* were found to have high TPC (73.1 to 343.2 mg/g) and high AOA (68.5 to 96.7 %).Promising fruits were studied for their FRSA and reducing power (RP) measured by

DPPH assay where the fruits of *Caesalpinia mexicana*, fruit pericarp fibres of *Cocus nucifera*, fruits of *Emblica officinalis* showed very low IC50 ranging from 0.009 to 0.016 mg/ml, EC50 from 0.39 to 0.70 mg/mg DPPH and reasonably high values (142.1 to 256.3) of anti radical power (ARP), indicating their strong FRSA and reducing power (RP) as evident by their low ASE/ml values (0.42 to 1.08). They also showed better inhibition of lipid peroxidation measured by using ferric thiocyanate assay and by using egg yolk compared to reference standard, quercetin. The ferrous and ferric ion chelating capacity of the promising fruits and their underutilized parts in terms of IC50 varied from 0.12 (*Emblica officinalis*, fruits) to 2.44 mg/ml (*Mangifera indica*, Seed kernel) and 0.22 (*Caesalpinia mexicana*, fruits) to 2.59 mg/ml (*Litchi chinensis*, fruit peel), respectively. Fruit of *Acacia auriculiformis*, *Caesalpinia mexicana*, *Emblica officinalis*, fruit pericarp fibres of *Cocus nucifera*, were also assayed for their specific phenolic composition through HPLC where the amount of caffeic acid varied from 48.5 to 2231 μg/g, chlorogenic acid 63.8 to 912.1 μg/g, ellagic acid 46.4 to 1429.1 μg/g, ferulic acid 36.7 to 762.9 μg/g, gallic acid 181.6 to 2831.6 μg/g, protocatechuic acid 41.7 to 322.8 μg/g and quercetin 44.6 to 367.6 μg/g.

LITERATURE CITED

Angami, A., Gajurel, P.R., Rethy, P., Singh, B. and Kalita, S.K. (2007). Status potential of wild edible plants of Arunachal Pradesh. *Indian J. Tradit. Knowl.,* **5**(4) : 541-550.

Banerjee, S., Joglekar, A. and Mishra, M. (2015). A critical review on importance of green leafy vegetables. *Internat. J. Appl. Home Sci.,* **2** (3&4) : 124-132.

Bhati, D. and Jain, S. (2015). Weeds: An uncommon source of nutrients used by tribal community. *Indian J. Ecol.,* **42**(1): 86-89.

Bhati, D. and Jain, S. (2016). Nutrition potential of uncultivated fruits grown in tribal region of Udaipur district of Rajasthan. *Bioscan,* **11** (1) : 15-18

Dhyani, D., Maikhuri, R.K., Rao, K.S., Kumar, L., Purohit, V.K., Sundriyal, M. and Saxena, K.G. (2007). Basic nutritional attributes of *Hippophae rhamnoides* (seabuckthorn) populations from Uttarakhand Himalaya, India. *Curr. Sci.*, **92** : 1148-1152.

Guil, J.L., Rodríguez-García, I. and Torija, E. (1997). Nutritional toxic factors in selected wild edible plants. *Plant Foods Human Nutr.*, **51** (2) : 99-107.

Gupta, S., Lakshmi, A.J., Manjunath, M.N. and Prakash, J. (2005). Analysis of nutrient anti-nutrient content of underutilized green leafy vegetables. *J. Food. Sci. Tech.*, **38** (4) : 339-345.

Indrayan, A.K., Sharma, S., Durgapal, D., Kumar, N. and Kumar, M. (2005). Determination of nutritive value analysis of mineral elements for some medicinally valued plants from Uttaranchal. *Curr. Sci.*, **89** (7) : 10.

Jansenvan, R.W.S., Venter, S.L., Netschluvhi, T.R., Heever, E. van den, Vorster, H.J. and de Ronde, J.A. (2004). Role of indigenous leafy vegetables in combating hunger malnutrition. *South African J. Bot.*, **70** : 52-59.

Kala, C.P. (2007). Prioritization of cultivated wild edibles by local people in the Uttaranchal hills of Indian Himalaya. *Indian J. Tradit. Knowl.*, **6** : 239-243.

Maikhuri, R.K., Rao, K.S. and Saxena, K.G. (2004). Bioprospecting of wild edibles for rural development in central Himalaya. *Mountain Res. Develop.*, **24** : 110-113.

Malik, S.K., Chaudhury, R., Dhariwal, O.P. and Bhari, D.C. (2010). Genetic resources of tropical underutilized fruits in India. NBPGR, NEW DELHI (INDIA).

Maridass, M., Ghanthikumar, S. and Raju, G. (2008). Preliminary phytochemical analysis of *Diospyros species. Ethnobotanical Leaflets*, **12**: 868-872.

Megala, J. and Geetha, A. (2010). Free radical-scavenging H+, K+-ATPase inhibition activities of *Pithecellobium Dulce. Food Chem.*, **121** : 1120–1128

Menichini, F., Loizzo, M.R., Bonesi, M., Conforti, F., De Luca, D., Statti G.A., De Cindio B., Menichini, F. and Tundisand R. (2011). Phytochemical profile, antioxidant, anti-inflammatory hypoglycaemic potential of hydroalcoholic extracts from *Citrus medica* L. cv. DIAMANTE FLOWERS, leaves fruits at two maturity stages. *Food Chem. Toxicol.*, **49** : 1549–1555.

Norhayati, Y. Nor 'Aini, M. F., Misri, K., Marziah, M. and Azman, J. (2011). α-Tocopherol, ascorbic acid carotenoid content in *Centella asiatica* leaf tissues callus cultures. *Pertanika J. Trop. Agric. Sci.*, **34** (2): 331 - 339.

Ogle, B.M. (2001). Wild vegetables and micronutrient nutrition. Studies on the significance of wild vegetables in women's diet in Vietnam.*Acta Universitatis Upsaliensis. Comprehensive summaries of Uppsala Dissertations from the faculty of Medicine* 1056. 59pp. Uppsala. ISBN 91-554-5068-7.

Pieroni, A. (2000). Medicinal plants food medicines in the folk traditions of the upper Lucca province. *Italy J.*

Ethnopharmacol., **70** : 235–273.

Ponmozhi, P., Geetha, M., Saravana, M.K. and Suganya, D. (2011). Extraction of anthocyanin analysing its antioxidant properties from *Pithecellobium dulce* fruit pericarp. *Asian J. Pharm. Clin. Res.*, **4** (1) : 41-45.

Prakash, D., Upadhyay G. and Pushpangadan, P. (2011). Antioxidant potential of some under-utilized fruits. *Indo-Global J. Pharmaceu. Sci.*, **1** (1) : 25-32.

Praneetha, P., Swaroopa Rani, V. and Kumar, B.R. (2011). Hepatoprotective activity of methanolic extract of leaves of *Marsilea minuta* Linn against CCl Induced Hepatic Damage in Rats. *Global J. Pharmacol.*, **5** (3): 164-171.

Rai, S., Wahile, A., Mukherjee, K., Saha, B.P. and Mukherjee, P.K. (2006). Antioxidant activity of *Nelumbo nucifera* (sacred lotus) seeds. *J. Ethonopharmacol.*, **104**: 322-327.

Rajyalakshmi, P., Padmavathi, T.V. N. and Venkatalaximi, K. (2003). Total carotenoid beta carotene contents of other vegetables, roots tubers, fruits stored products collected from forest areas of Andhra Pradesh, South India. *Plant Foods Human Nutr.*, **58**: 1–11.

Reddy, B.S., Reddy R.K.K., Naidu, V.G.M., Madhusudhana, K., Agwane, S.B., Ramakrishna, S. and Diwan, P.V. (2008). Evaluation of antimicrobial, antioxidant wound-healing potentials of *Holoptelea integrifolia*. *J. Ethnopharmacol.*, **115** (2) : 249–256.

Sarker, S.K. and Hossain, E.A. (2009). Pteridophytes of greater Mymensingh district of Bangladesh used as vegetables medicines. *Bangladesh J. Plant Taxon*,**16** : 47-56.

Sen, S., Chakraborty, R., De, B. and Devanna, N. (2011). An ethnobotanical survey of medicinal plants used by ethnic people in West South district of Tripura, *Indian J. Forest. Res*., **22** : 417-426.

Simlot, M.M. (2001). Nutritive value of important underutilized fruits. Proceeding of winter school on the exploitation of underutilized fruits (3 -23rd October), Maharana Pratap University of Agricultural Technology, Udaipur, RAJASTHAN (INDIA).

Singh, H.B. and Arora, R.K. (1978). Raishan (Digitaria sp.)- a minor millet of Khasi Hills, India, *Econ. Bot.*, **26** : 376-380.

Soares, J.R., Dins, T.C.P., Cunha, A.P. and Ameida, L.M. (1997). Antioxidant activity of some extracts of *Thymus zygis*. *Free Radical Res.*, **26** : 469–478.

Sohn, D.H., Kim, Y.C., Oh, S.H., Park, E.J., Li, X. and Lee, B.H. (2003). Hepatoprotective free radical scavenging effects of *Nelumbo nucifera*. *Phytomedicine*, **10**: 165-169.

Sundriyal, M. and Sundriyal, R.C. (2004). Wild edible plants of the Sikkim Himalaya: Nutritive values of selected species, *Econ. Bot.*, **58** (2) : 286-299.

Swarnkar, S.S. and Katewa, S.S. (2009). Nutritional evaluation of some wild roots tubers from tribal area of Rajasthan, India. *J. Root Crops*, **35** (1) : 86-91.

Thomas, A.O. and Oyediran, E.O. (2008). Nutritional importance micronutrient potentials of two non-conventional indigenous green leafy vegetables from Nigeria. *Agric. J.*, **3** (5): 362-365.

Ullah, M.O., Sultana, S., Haque, A. and Tasmin, S. (2009). Antimicrobial, Cytotoxic Antioxidant Activity of *Centella Asiatica*. *European J. Scientific Res*., **30** (2) : 260-264.

Upadhayaya, S. and Saikia, L.R. (2012). Evaluation of phytochemicals, antioxidant activity nutrient content of *Centella asiatica* (L.) urban leaves from different localities of Assam. *Internat. J. Pharm Bio Sci.*, **3**(4): 656 – 663.

Upreti, K., Jalal, J.S., Tewari, L.M., Joshi, G.C., Pangtey, Y.P. and Tewari, G. (2009). Ethnomedicinal uses of pteridophytes of Kumaun Himalaya, Uttarakhand, *India. J. Am. Sci*., **5** : 167-170.

Yadav, Adya, Paul, Virginia and Yadav, Neelam (2016). Antioxidant properties of Moringa (*Moringa oleifera),* Adusa (*Justicia adhatoda),* Beetroot (*Beta vulgaris* L.) and cauliflower (*Brassica olerace*) leaves. *Internat. J. Appl. Home Sci.*, **3** (3 & 4) : 94-99.

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