

Nutritional value of some traditional edible plants used by tribal communities during emergency with reference to Central India

Ashok K Jain & Preeti Tiwari

School of Studies in Botany, Jiwaji University, Gwalior-474011, MP, India

Email: asokjain2003@yahoo.co.in

Received 05.01.1; revised

Paper deals with the study of a large number of plant species used by tribes in emergency, i.e. during scarcity of food. Information on uses of plants by tribes from abroad and various regions of India has been provided. Special emphasis has been made on estimation of nutritional value of plants consumed by *Gond* and *Sahariya* tribes of Central India.

Keywords: Nutritional value, Traditional, Emergency, Plant species, Tribes, Central India

IPC Int. Cl.⁸: A61K 36/00, A01G 1/00, A01G 7/00, A47G 19/00, A23L 1/00, A23L 1/06

Traditional knowledge includes pre-existing, underlying traditional culture or folklore and literary and artistic works created by current generations of society which are based on or derived from pre-existing traditional culture or folklore. Traditional culture and folklore tends to be trans-generational, old and collectively "owned" by groups or communities. Living close to nature the tribal communities have acquired immense information about the use of wild flora and fauna, which is not known to outer world. The folk selection was based on local needs, customs, preferences and habits¹. This rich knowledge or system if subjected to scientific scrutiny could benefit the mankind in many ways.

Traditional knowledge is gained from nature, in the laboratories of life and crystallized over millennia. This knowledge survives usually among the indigenous local communities. These are not always confined to rural or remote areas; many highly educated families living in urban areas and even in foreign lands also continue to follow many traditions. The strong basis of this knowledge has been the necessity, instinct, curiosity, strong observation, constant trail, long experience and close association with nature².

Although not tested and verified in the modern laboratory, these knowledge have stood the test of time and used by indigenous people for generations. This enormous body of ancient wisdom percolated

down in oral fashion due to lack of any other suitable media which persists till date, although threatened³. Several tribal communities have their history which goes back to many centuries and still persists with their traditions. In fact the life, culture and traditions of these tribal communities have remained almost static for hundreds of years, in spite of number of floods, droughts and famines and other natural calamities. Still they manage to persist and flourish their culture despite of all adverse.

Emergency food

Emergency food is often termed as wild food, as apparently it implies the absence of human interference and management, but in fact such food plants, result from the co-evolutionary relationship between human and environment. Emergency food plants can be divided into two broad groups on the basis of consumption, the one which are not consumed regularly on account of their limited seasonal availability while others are frequently consumed due to easy availability⁴.

It has been noticed that the tribes who still live in their undisturbed forest areas and having the traditional food habit like consumption of large variety of seasonal foods, are found to be healthy and free from most of the diseases⁵. According to one report from Govt. of India, food deficiency usually prevails in under developed tribal areas⁶. Still such tribal groups sustain successfully under adverse conditions as they stick on the alternative source of

*Corresponding author

food, in the absence of wheat and rice and other kinds of conventional staple food plants. A large number of plant species as supplementary food, used by tribes of India are reported in "Dictionary of Indian Folk Medicine and Ethnobotany"⁷. Broad nutrient categories include carbohydrates, fats, proteins, vitamins and minerals such as sodium, calcium, potassium etc. which are required in comparatively larger amount by the body and therefore called as macro-elements, whereas elements required in smaller amount are called trace or minor elements e.g. iron, zinc, copper, etc.

Some reports from abroad

Various field work conducted by number of workers all over the world and survey among aboriginal societies, tribal markets and scrutiny of ethnobotanical literature had brought about the record of several hundred wild edible plants, which not only satisfy hunger but are nutritious too. A few important examples from abroad are mentioned here.

Uses of several plants during emergency in the Mixtec Highlands (Mexico) by Mestizos and Mixtecs and other small Indian groups have been observed⁸. In these areas lack of maize is the main problem in times of scarcity. Several starchy plants are used as emergency foods to replace this staple maize: bananas (*Musa* sp.) and banana roots, mango seeds (*Mangifera indica*), sweet potato (*Ipomoea batatas*), inga (*Inga sapindiooides*) acorn (*Quercus candidans*), cocoyam (*Xanthosoma sagittifolium*), manioc (*Manihot esculenta*), etc. It indicates that each emergency food has a different status. The tasty plants (mushrooms etc.) are commonly used by everybody, snack food plants are commonly eaten by children, bitter greens are eaten by old people. Information on some wild cereals used by nomadic Tuargs in Gourma, Northern Mali with reference to the cereal *Cenchrus biflorus* has been collected from arid and semi-arid zones of West Africa⁹. Reports on importance of grasshoppers as traditional food in villages in Northern Transvaal, South Africa indicate the use of common insects during emergency¹⁰.

Indian scenario

The concept of emergency food plants is not new in Indian scenario. In fact literary wealth of ancient and medieval India, contain huge information on this aspect¹¹. Kautilya's Arthashastra (ca 4th century BC) is one of the oldest treatises in Sanskrit and deals with exceptional interest and values. It comprises vast

information regarding emergency food and supposed to be first authentic approach regarding the concept¹². Kautilya states that during emergency, one can survive by consuming any of the food as mentioned below:

1. Ingestion of a dose of powder of *siris* (*Albizzia lebbbeck*) *udumbara* (*Ficus glomerata*) and *shami* (*Prosopis cineraria*) mixed with ghee, prevents hunger at least for a period of fortnight.
2. Consumption of a specified quantity of the scum, prepared from the mixture of *kaseruka* (*Scripu grossus*) rhizome of *utpala* (*Nelumbo nucifera*), roots of *ikshu* (*Saccharum officinarum*) mixed with *visa* (*Aconitum ferox*), *durva* (*Cynodon dactylon*) milk and *maad* (starch of rice) enables one to fast for a month.
3. One can go without food for a month after consuming a specified quantity of the powder of *masa* (*Phaseolus radiatus*), *yava* (*Hordeum vulgare*), *kulattha* (*Dolichos biflorus*) and the roots of *dabha* (*Desmostachya bipinnata*) along with milk and ghee.
4. If one drinks the glutinous paste of the roots of *prasnarni* (*Uraria lagopoides*) and *salparni* (*Desmodium gangeticum*) along with cow's milk, one can fast for a month.

Indian subcontinent is inhabited by over 53 million tribes belonging to over 550 different communities under 227 ethnic groups, who reside in about 5000 villages in different forest vegetation types¹³. Each tribal community has a distinct social and cultural identity of its own and speaks a common dialect. About 106 different languages and 227 subsidiary dialects are spoken by tribes of India. The population of individual tribes are as large as about 5 million for the *Gonds* of Madhya Pradesh and as small as 23 among the Great Andamanese. Two third of the tribal population is concentrated in Madhya Pradesh, Orissa, Bihar, Gujarat and Rajasthan states of India. In the North eastern region and in islands, the tribal population is about 50% with high ethnic density¹⁴.

Indian tribes utilize over 9500 wild plants for various purposes including medicinal, fodder, fiber, fuel, edible, essence, cultural and other purposes⁵. Out of this number nearly 3900 wild plants are used as edibles. Reports from several tribal dominating regions indicate that a large number of wild plant species are used by them during emergency.

Over 155 edible plants were reported to be used by tribes of Assam as supplementary and

emergency food¹⁵. A large number of plant species including algae, fungi and angiosperms have been reported to be used by tribes of Manipur. In addition to general uses, various indigenous techniques associated with the preparation and preservation of fermented plant products like bamboo shoots (*soibum* and *Soidom*), seeds of *Glycine max*, petiole of *Alocasia indica* along with small fishes (*Hentak*) and seeds of *Anisomeles indica* with other plant ingredients are used¹⁶.

Uses of over 64 wild plant species, consumed by folk people from Mandi district in Northwest Himalayas have been reported¹⁷. The produce of six species, viz. *Cordia dichotoma*, *Diplagium polypoides*, *Emblica officinalis*, *Morchella esculenta*, *Myrica esculenta* and *Punica granatum* are used widely and marketed. A good number of life supporting promising food plant species belonging to angiosperms, ferns and fungi are used by *Abujh-Maria* tribe of Bastar region of Chhatisgarh state¹⁸. Ethnobotanical survey among the tribals inhabiting Western Ghats forests of Kerala indicates that a large number of wild plant species are used as edibles¹⁹⁻²⁰. Crude protein and lipid contents besides several other agro-botanical aspects of eight accessions of *Canavalia gladiata* (Sword bean) have been studied from eight different agro-climatic regions of Tamil Nadu²¹. Leaves and flowers of many wild plants are used as supplementary vegetable in Darbhanga district of Bihar²². A large varieties of wild tubers are consumed by tribes of Andhra Pradesh²³.

Paharia tribes of West Bengal consume a large number plants during emergency²⁴. Ripen fruits of *Grewia optiva* are eaten by local tribes of Indo-Nepal Himalaya²⁵. A survey indicates that over 37 wild edible plants are used by *Tripuri* tribe of Tripura state²⁶. An account indicates the use of over 195 wild edible species by tribal communities of Himalayan region²⁷. Nutritional value of some indigenous

varieties of paddy grown by tribes of Assam, Bihar, Chhatisgarh and Jharkhand has been studied²⁸.

Central India

Central India mainly includes the state of Madhya Pradesh, is considered as the land of tribes. Nearly 60 tribal communities constitute about 24% of total population of the state of Madhya Pradesh. The main tribes are The main tribes are *Gonds*, *Bhils*, *Bhilala*, *Abujhmaria*, *Marias*, *Murias*, *Korku*, *Kols*, *Baigas*, *Mariagonds*, *Khond*, *Birhors*, *Dhanwars*, *Halbas*, *Kamars*, *Bhumia*, *Bharia*, *Urave*, *Oraon*, *Kareba*, *Pradhans*, *Dhurgonds*, *Dorlas*, *Bhaina*, *Hijwars*, *Majhwars/Majhi*, *Sawar* and *Sahariya*. Main tribal districts of the state are Sheopur, Morena, Shivpuri, Guna, Gwalior, Hoshangabad, Betul, Shahdol, Jhabua and Ashoknagar.

In this state a large number of plants are used by tribes during emergency as supplementary food. A survey indicates that a large number of wild edible plants are used by tribal communities of Madhya Pradesh during emergency²⁹. During the ethnobotanical survey in Central India several edible plant species consumed by Gond tribe have been reported³⁰. Nearly 28 wild plant species are consumed as food or vegetables by aboriginals of Vindhyan Plateau, an important region of Central India³¹. Over 45 plant species including *Bauhinia vahlii*, *Amaranthus viridis*, *Rhus parviflora*, *Ficus benghalensis*, *Phoenix dactylophera*, etc. consumed during emergency by tribes inhabiting Pachmarhi Biosphere Reserve³².

Methodology

Present work was carried out on 10 wild species, used by tribes of different regions of Central India for estimating the nutritional value. The selected species are used as edibles during emergency by *Gond* and *Sahariya* tribes of the state. Following ten species were selected for this purpose (Table 1). Nutritional

Table 1—Species selected for nutritional analysis

S. No	Name of the plant species	Common name	Family	Parts consumed
1.	<i>Oxalis corniculata</i> Linn.	<i>Khatti buti</i>	Oxalidaceae	Leaves
2.	<i>Rhus parviflora</i> Roxb.	<i>Raitung</i>	Anacardiaceae	Fruits
3.	<i>Moringa oleifera</i> Lam.	<i>Sehjana</i>	Moringaceae	Leaves, Flowers
4.	<i>Bauhinia vahlii</i> Wt. & Arn.	<i>Mahul, Seldey</i>	Caesalpiniaceae	Seeds
5.	<i>Cassia fistula</i> Linn.	<i>Amaltas</i>	Caesalpiniaceae	Flowers
6.	<i>Cassia obtusifolia</i> Linn.	<i>Panwar</i>	Caesalpiniaceae	Leaves
7.	<i>Prosopis cineraria</i> Linn.	<i>Shami, Kshenkur</i>	Mimosaceae	Pods, Bark
8.	<i>Boerhavia diffusa</i> Linn.	<i>Punarnava</i>	Nyctaginaceae	Pods, Bark
9.	<i>Achyranthes aspera</i> Linn.	<i>Latjeera, Chirchita</i>	Amaranthaceae	Seeds
10.	<i>Amaranthus viridis</i> Linn.	<i>Chaulai</i>	Amaranthaceae	Leaves

Table 2—Total sugar (%) in different parts of selected plants species

S. No.	Part of plants	Plant species	Total sugar content (%)	SE
1	Leaves			
a.		<i>O. corniculata</i>	12.056	±0.2
b.		<i>M. oleifera</i>	4.232	±0.8
c.		<i>C. obtusifolia</i>	4.44	±0.5
d.		<i>B. diffusa</i>	0.6	±0.2
e.		<i>A. viridis</i>	1.268	±0.7
2	Fruits			
a.		<i>R. parviflora</i>	1.256	±0.7
b.		<i>P. cineraria</i>	10.944	±0.5
3	Flowers			
a.		<i>M. oleifera</i>	13.232	±0.2
b.		<i>C. fistula</i>	8.00	±0.5
4	Seeds			
a.		<i>B. vahlii</i>	4.79	±0.8
b.		<i>A. aspera</i>	1.488	±0.8
5	Bark			
a.		<i>P. cineraria</i>	0.78	±0.5

Table 3—Crude protein (%) in different parts of selected plants species

S.No.	Part of plants	Plant species	Crude protein content (%)	SE
1	Leaves			
a.		<i>O. corniculata</i>	22.28	±0.6
b.		<i>M. oleifera</i>	22.8	±0.5
c.		<i>C. obtusifolia</i>	20.25	±0.7
d.		<i>B. diffusa</i>	16.7	±0.5
e.		<i>A. viridis</i>	6.33	±0.09
2	Fruits			
a.		<i>R. parviflora</i>	5.11	±0.7
b.		<i>P. cineraria</i>	12.79	±0.5
3	Flowers			
a.		<i>M. oleifera</i>	18.9	±0.7
b.		<i>C. fistula</i>	13-13	±0.9
4	Seeds			
a.		<i>B. vahlii</i>	24.21	±0.5
b.		<i>A. aspera</i>	21.37	±0.7
5	Bark			
a.		<i>P. cineraria</i>	7.26	±0.7

value of leaves, fruits, flowers, seeds and bark (of tree species) of selected species were analyzed. Some important nutritional parameters like total sugars³³, protein³⁴, lipids³⁵ and amino acids³⁶ have been estimated by standard methods.

Results and discussion

Estimated values of various nutritional compounds observed in different parts of selected plant species are presented in Tables 2-5 and Fig. 1-3.

Discussion

With the advancement of the modern civilization the traditional knowledge about the uses of plants for

Table 4—Crude lipid (%) in different parts of selected plants species

S. No.	Part of plants	Plant species	Crude lipid content (%)	SE
1	Leaves			
a.		<i>O. corniculata</i>	23.75	±0.5
b.		<i>M. oleifera</i>	19.5	±
c.		<i>C. obtusifolia</i>	23.025	±0.8
d.		<i>B. diffusa</i>	20.5	±0.6
e.		<i>A. viridis</i>	20.25	±0.5
2	Fruits			
a.		<i>R. parviflora</i>	24.5	±0.6
b.		<i>P. cineraria</i>	19.75	±0.7
3	Flowers			
a.		<i>M. oleifera</i>	21.5	±0.6
b.		<i>C. fistula</i>	23.75	±0.7
4	Seeds			
a.		<i>B. vahlii</i>	28.5	±0.7
b.		<i>A. aspera</i>	18.42	±0.7
5	Bark			
a.		<i>P. cineraria</i>	10	±0.9

various purposes, among the aboriginal cultures is rapidly disappearing. There is urgent need for ethnobotanical observations to find out the secrets of nature of such rapidly disappearing primitive culture. Present work is a scientific approach regarding the nutritive value of wild food plants consumed by two different tribes of Central India, i.e. *Gond* and *Sahariya*. Out of a large number of plant species, only 10 were selected and investigated on nutritional grounds. The plants consumed by two tribes as supplementary diet during scarcity of regular or conventional food yielding plants. On account of their nutritional status these plants can be recommended as food for outer world besides their main consumers to fight against malnutrition and food scarcity.

Protein is one of the important parts of Human nutrition; it not only supports growth but is also important for maintenance and repair of body tissues. The total daily protein intake is based on the growth needs and desirable weight of an individual. The protein diet recommended for a healthy adult is set at 0.8 gm protein per kilogram of body weight³⁷. The major component of deposited or stored lipid in plants and animal cells are Triacylglycerols. Lipids besides plant sources are also synthesized within the body on account of availability of fatty acids.

Among all the ten species investigated for their nutritive *Oxalis corniculata* L., consumed by *Sahariya* tribe, emerged as the most nutritive one. Its leaves contain 12.05% of total sugar, 22.28% crude proteins and 23.75% crude lipids. The values are sufficient to match the Recommended Dietary

Table 5—Qualitative estimation of amino acids in different parts of selected plant species

S. No.	Edible parts	Plant name	Essential amino acids	Non-essential amino acid
1.	Leaves			
a.		<i>O. corniculata</i>	Phenylalanine, Isoleucine, Valine.	Asparagine, Alanine, Serine, Ornithine, Cystine.
b.		<i>M. oleifera</i>	Phenylalanine, Isoleucine, Leucine, Valine, Methionine, Threonine, Glutamine.	Asparagine, Ornithine, Aspartate, Cystein, Alanine.
c.		<i>C. obtusifolia</i>	Isoleucine, valine.	Asparagine, Serine, Ornithine, Alanine.
d.		<i>B. diffusa</i>	Phenylalanine, Isoleucine, Valine, Methionine, Leucine.	Asparagine, Aspartate, Serine, Ornithine.
e.		<i>A. viridis</i>	Phenylalanine, Isoleucine, Methionine, Valine.	Aspartate, Ornithine.
2.	Fruits			
a.		<i>R. parviflora</i>	Phenylalanine, Isoleucine, Valine.	Asparagine, Serine, Ornithine.
b.		<i>P. cineraria</i>	Phenylalanine, Isoleucine, Leucine, Valine.	Serine, Ornithine, Proline.
3.	Flowers			
a.		<i>M. oleifera</i>	Phenylalanine, Isoleucine, Methionine, Valine, Leucine, Threonine.	Alanine, Asparagine, Serine, Aspartate, Cystine, Ornithine.
b.		<i>C. fistula</i>	Phenylalanine, Isoleucine, Valine.	Semi Essential Tyrosine. Alanine, Asparagine, Serine, Ornithine, Proline.
4.	Seeds			
a.		<i>B. vahlii</i>	Phenylalanine, Isoleucine, Valine, Histidine, Leucine.	Serine, Ornithine.
b.		<i>A. aspera</i>	Phenylalanine, Isoleucine, Valine, Glycine.	Asparagine, Serine, Ornithine.
5.	Bark			
a.		<i>P. cineraria</i>	Phenylalanine, Isoleucine.	Alanine, Proline.

Allowances³⁸. All the nine essential amino acids are found to be present in the leaves of *Moringa oleifera*. Besides these components leaves of *M. oleifera* are the good source of β carotene, a precursor of vitamin - A. It contains 6.8-14.3 mg/100gm fresh wt. of β carotene. Flowers of *M. oleifera* are another good source of nutrition on the grounds of RDA as it contains 13.23% of total sugar, the value was highest among the investigated plants.

Seeds of *Bauhinia vahlii* often consumed by the Gond tribe of Madhya Pradesh are the richest source of proteins (24.21%). The lipid value for the seeds (28.5%) is also quite high. Further, its seeds seem to be the good source of nitrogen and richest source of magnesium.

Cassia obtusifolia L. also seems to be rich in protein (20.25%), lipid (23.25%), total sugars (4.44%), is sufficient to meet the daily requirement of nutrition and equivalent to that of many conventional food plants and products.

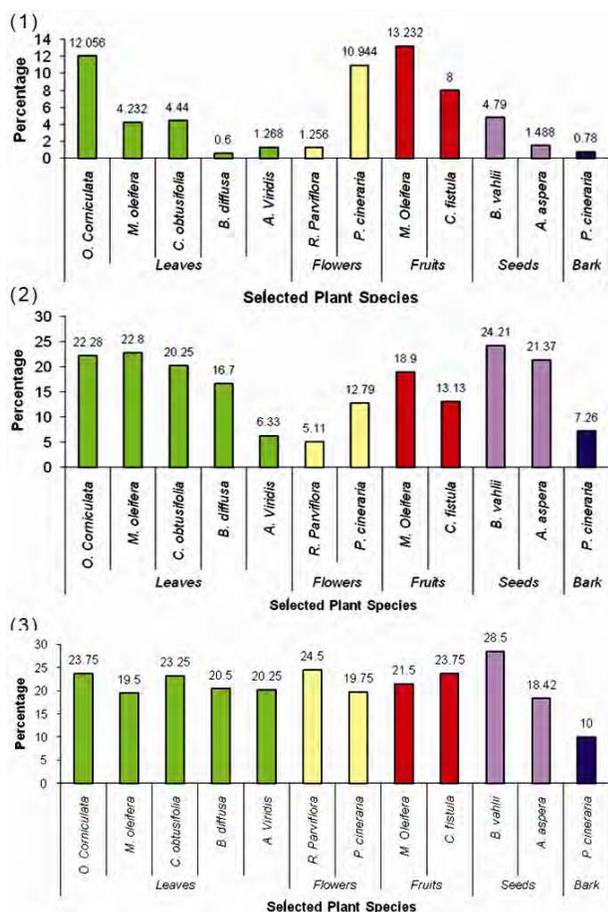
Boerhaavia diffusa is another under exploited wild species, known for its medicinal value since long back, but left untouched on nutritional grounds. It is frequently consumed by *sahariya* tribe. It is also a good source of electrolyte potassium.

Amaranthus viridis is nutritionally rich wild edible species, consumed by *sahariya* tribe during rainy months. Proteins value associated with the leaves of

A. Viridis is 6.33%, which is not satisfactory on nutritional grounds. It comes as a best source for mineral and electrolyte diet.

Prosopis cineraria is a life saving plant species earlier reported to be consumed during severe droughts of Rajasthan. Nutritive values of leaves of this species have been established as life saving plant of western Rajasthan³⁹. The leaves are used as cattle feed and pods are consumed by local people and tribes since ancient time. The value obtained during investigation of bark was, is not satisfactory to fulfill RDA values, which is 50-100 gm/day. Crude protein content (7.26%) and crude lipid content (10%) were observed to be lowest among all the ten species studied. Pods of *P. cineraria* were found more nutritive as compared to the bark. Prolong consumption of bark may cause malnutrition but can ensure survival during extreme condition. Bark flour cannot be considered as supplement to the conventional food plants, but do have characteristic features of emergency food plants.

Achyranthus aspera is reported to be good during severe famine and drought since ancient time. It is mentioned that seeds were consumed during wars and other emergencies in combination with other plants. The species has potential to meet the nutritional requirement of body to survive especially with limited source of food during wars, etc. Potential of seeds of



Figs 1—3: (1) Percent total sugar in different parts of selected plant species, (2) Percent crude protein in different parts of selected plant species & (3) Percent lipid in different parts of selected plant species

A. aspera regarding their life saving properties can be established on the basis of amount of free sugar, i.e. 2.37% and 1.48% of total sugars which is enough to ensure survival capacity, being immediate source of energy. The percent crude protein in the species, is bit lower than that of almond. Phenylalanine, isoleucine and valine are found essential amino acids in the seeds of *A. aspera*.

Fruits of *Rhus parviflora* are consumed raw by *Gond* tribe of Central India, possess lowest nutritive value among 10 species studied. Besides the low mineral values the fruits have potential to meet other nutritional requirements as supplement or in combination with other seasonal fruits. Only three essential amino acids viz. phenylalanine, Isoleucine and valine were found in the species.

On the basis of detailed chemical analysis and observations, it can be concluded that all the leafy edibles, though seasonal or perennial exhibited higher

nutritive value. Young leaves of *O. corniculata* and *M. oleifera* seem to have potential to replace other conventionally used vegetables. This may help to release stress from the costly conventional food plants or vegetables. Protein and other nutritive contents are found in higher concentration in wild form as compared to the cultivated ones⁴⁰. All the selected species grow wild in nature and are not being cultivated. This may be the reason for high nutritive value. But on account of their limited production these plants cannot replace conventional staple food plants however can only be used as supplement in their particular native places. There are a good number of other species which possess high nutrient value but are not sold/available in the local markets. Efforts should be made to bring and popularize these plants, as it has been done for mushroom, which are being introduced to the farmers and local markets after being evaluated on nutritional grounds.

References

- Arora RK, Ethnobotanical studies on plant genetic resources-National efforts and concern, *Ethnobotany*, 7 (1994) 125-136.
- Jain SK, Objective Ethnobotany knowledge traditional, approaches modern, *Ethnobotany*, 16 (2004) 1-9.
- Mohanty RB, A folkloric account of selection of cattle: An ethnobiological study, *Indian J Tradit Knowle*, 2(1) (2003) 69-73.
- Jain SK, Human Aspects of plant diversity, *Econ Bot*, 54(4) (1999) 459-470.
- Anonymous, Ethnobiology in India: A Status Report, All India Coordinated Research Project on Ethnobiology, (Ministry of Environment and Forests, Government of India, New Delhi), 1995.
- Arora RK & Pandey A, Ethnobotany in Primitive tribe in Rajasthan. Wild edible plants of India, Diversity conservation and use, (Ethnobotany in Primitive tribe in Rajasthan, ICAR and NBPGR), 1996.
- Jain SK, *Dictionary of Indian Folkloremedicine and Ethnobotany*, (Deep publications, New Delhi), 1991.
- Katz E, Emergency food of the Mixtec Highland (Mexico), In: *Ethnobotany in Human Welfare*, edited by SK Jain, (Deep Publications, New Delhi), 1996, 54-61.
- Hveem B, Berg G & Diallo D, Utilization of wild cereals by nomadic tuaregs in Gourma, Western Sahel, In: *Ethnobiology in Human welfare*, edited by S K Jain, (Deep publications, New Delhi), 1996, 62-69.
- Van der Wall BCW, Importance of Grasshopper as traditional food in villages in Northern Transvaal, South Africa, In: *Ethnobiology in Human welfare*, edited by S K Jain, (Deep publications, New Delhi), 1996, 35-41.
- Rai AK & Shukla HO, A critical study on plants of "Ramcharitmanas" a religious book of Hindus, (S.E. B.S. News letter), 8 (1989) 3-4.
- Sensarma P, Emergency food in Kautilya's Arthashastra – An ancient Sanskrit work, In: *Ethnobiology in Human Welfare*,

- edited by SK Jain, (Deep Publications, New Delhi), 1996, 20-21.
- 13 Anonymous, Ethnobotany in India: A Status Report. All India Coordinated Research Project in Ethnobiology, (Min. of Environment and Forests, Govt. of India, New Delhi), 1994.
 - 14 Arora RK, Native food plants of the northeastern tribals, In: *Glimpses of Indian Ethnobotany*, edited by SK Jain, (Oxford and IBH Co. New Delhi), 1981, 91-106.
 - 15 Borthakur SK, Wild edible plants in market of Assam, India-An ethnobotanical investigation, In: *Ethnobiology in Human Welfare*, edited by SK Jain, (Deep Publications, New Delhi), 1996, 31-34.
 - 16 Sinha SC, Wild edible plants of Manipur, India, In: *Ethnobiology in Human Welfare*, edited by SK Jain, (Deep Publications, New Delhi), 1996, 42-47.
 - 17 Singh PB, Wild edible plants of Mandi district in north west Himalaya, In: *Ethnobiology in Human Welfare*, edited by SK Jain, (Deep Publications, New Delhi), 1996, 22-25
 - 18 Sahu TR, Life support promising food plants among aboriginals of Bastar (M.P.) India, In: *Ethnobiology in Human Welfare*, edited by SK Jain, (Deep Publications, New Delhi), 1996, 26-30.
 - 19 Radhakrishnan K, Pandurangas AG & Pushpangadan P, Ethnobotany of wild edible plants of Kerala India, In: *Ethnobiology in Human Welfare*, edited by SK Jain, (Deep Publications New Delhi), 1996, 48-51.
 - 20 Raveendran JC, Some Lesser known edible plants among the Tribal of Kerala India, In: *Ethnobiology in Human Welfare*, edited by SK Jain (Deep Publications, New Delhi), 1996, 52-53.
 - 21 Vedivel V, Janardhanan K & Vijaya Kumari K, Diversity in sword bean (*Caravalia gladiata* (Jacq.) DC.) collected from Tamil Nadu, India, *Genetic Resource and Crop Evolution*, 45 (1998) 63-68.
 - 22 Jha V, Mishra S, Gupta AN & Jha A, Leaves and flowers utilized as supplementary vegetable in Darbhanga (North Bihar) and their ethnobotanical significance, *J Econ Taxon Bot Addl Ser*, 12 (1996) 395-402.
 - 23 Ressay RNM, Reddy H & Venkata Raju RR, Ethnobotany of less known tuber yielding plants from Andhra Pradesh, *J Non Timber Forest Prod*, 3(13) (1996) 60-63.
 - 24 Basu R & Mukherjee, Food plants of the tribe "Paharias" of Purulia, *Advances in Plant Sci*, 9(2) (1996) 209-210.
 - 25 Sneha Lata, Indigenous Knowledge about *Grewia optiva* in Indo Nepal Himalaya, *Ethnobotany*, 9 (1997) 112-116.
 - 26 Singh HB, Hynniewta TM & Bera PJ, An ethnobotanical note on wild edible plants of Tripura India, *Ethnobotany*, 11 (1999) 26-28.
 - 27 Sundriyal M & Sundriyal RC, Under utilized edible plants of Sikkim Himalaya: Need for domestication, *Curr Sci*, 85 (6) (2003) 731-736.
 - 28 Rehman S, Sharma MP & Sahai S, Nutritional and medicinal values of some indigenous rich varieties, *Indian J Tradit Knowle*, 5(4) (2006) 454-458.
 - 29 Oommachan M & Masih SK, Multifarious uses of plants by the forest tribals of M.P. Wild edible plants, *J Trop Forestry*, 11 (1988) 163-169.
 - 30 Rai MK, Observation on the ethnobotany of Gond tribe of Seoni district, plants used as food, *J Econ Tax Bot Addl Series*, 10 (1992)
 - 31 Dwivedi SN & Pandey A, Ethnobotanical studies on wild and indigenous species of Vindhyan Plateau 1, *Mexpaceous Flora*, 1992, 144-148.
 - 32 Patole SN & Jain AK, Some edible plants of Pachmarhi Biosphere Reserve (MP), *Ethnobotany*, 14 (2002) 48-51.
 - 33 Jain VK & Guruprasad KN, Effect of Chlorocholine chloride and gibberelic acid on the anthocyanin synthesis in radish seedlings, *Physiol Plant*, 15 (1989) 485-500.
 - 34 Lowry OH, Rosebrough HJ, Farr AL & Randall RJ, Protein measurement with folin phenol reagent, *J Biol Chem*, 193 (1951) 265-275.
 - 35 Bligh EG & Dyer WJ, A rapid method of total lipid extraction and purification, *Can J Biochem Physiol*, 37 (1959) 911-917.
 - 36 Rajendra W, High Performance Liquid Chromatographic determination of Amino acids in biological samples by column derivatization with O-phthalaldehyde, *J Liquid Chromatogr*, 10 (5) (1987) 941-945.
 - 37 Suitor CW & Crowley MF, *Nutrition Principles Application in Health Care*, 2nd edn, (J.B. Lippincoll company, Philadelphia, New York), 1984.
 - 38 Anonymous, Recommended Dietary Allowances for healthy Americans, 1980.
 - 39 Bohra HC, Nutrient Utilization of *Prosopis cineraria* (Khejri) leaves by desert sheep and goats, *Ann Arid zone*, 19 (1980) 73-81.
 - 40 Murugesan GS, Vadivel V & Janardhanan K, A comparative study of the chemical composition. Effect of Post Harvested Treatment on Wild & cultivated Pigeon peas, *J S Bot Cl*, 16 (1999) 25-29.