Wild edible plants: a potential source of nutraceuticals

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Abstract: Wild edible fruits of *Randia dumatorum* (Manhar), fruiting bodies of fungi, *Asterus hygromatricus* (Putpura), *Costus speciosus* (Kevkand) and *Pureria tuberosa* (Patal Kumdha) were collected from different localities of central region which are being consumed raw or as vegetable . These species evaluated for their nutritional and anti nutritional parameters.

Fruiting bodies of *A.hygromatricus* contain high carbohydrate content i.e. 29.48% and 35.41% in outer and inner part respectively and fruits of *R. dumetorum* contain high carbohydrate (18.93%). *A.hygromatricus* is the good source of protein. Water soluble vitamins- ascorbic acid and thiamine were also found to be present in both *R.dumetorum and A.hygromatricus* Minerals viz., calcium, phosphorus and magnesium were also in appreciable amount. Polysaccharide-Starch contents in tubers varied from 25.82-38.30%.*C.speciosus* possess high protein value (19.20%). Lipid/oil content was also estimated in species, which contribute high energy value of tubers. Diosgenin, contents was estimated in *Costus speciosus* collected from different localities of central region, varied 1.37-2.11%.

The all plant species contain high food value. Food energy provided by the edible parts of the species varied from 126 g calories to 336 g calories which is comparable with other commonly used edible species.

The above mentioned plant species are being utilized in different areas of central region according to their availability and scarcity during the season and contained high amount of nutritional compositions and used as vegetables as well as medicinal purposes.

Key words: wild ,edible plants, neutraceuticals, polysaccharides , diosgenin, food energy

Introduction:

Forest resources, mainly various plants and their products, have an important place in the daily life of tribal and other forest dwellers. The tribal communities are largely dependent on the forest produces for their sustenance. Forest provide them wood, food ,fuel, fodder, fibre, medicine and wide range of other non wood forest products, essential not only for meeting their own requirements, but these are also a potential source of their income and livelihood. The wild plants from forest provides many essential nutrients which helps to improve both the physical and mental well-being of rural/tribal. It is estimated that 80% of the forest dwellers depend on forests for 25-50% of their annual food requirements.

The nutritional value of many forest foods is not known but appears to be enough information to indicate that forest foods are nutritionally valuable. The studies on the nutritional value of forest food is extremely important as it will encourages people to consume greater quantity of food and provides them with a better balance of nutrients (FAO, 1989).

There are several species occurring wildly and being consumed by the rural communities. The species were collected from different localities of Madhya Pradesh and Chhattisgarh and evaluated their nutritional and anti nutritional parameters.

Randia dumetorum Poir. belongs to family – Rubiaceae. A deciduous, thorny shrub or a small tree, upto 9 m. height, wildly distributed as an undergrowth in sal forests. It is commonly known as manhar in Madhya Pradesh and Chhattisgarh tribal communities. Its bark is dark brown or grey, rough scaly, leaves obovate, flowers first white, later turning to yellow, fragrent, berry yellow when ripe, 3.0-3.7 cm. long, globose or

broadly ovoid, smooth or obscurely longitudinally ribbed, seeds many, flat, about 4 mm. long, angular. The fruits are used as vegetable and also credited with a number of medicinal properties. The pulp of the fruit, dried and powdered, valuable emetic and used as a substitute for ipecacuanha (*Cephaelis ipecacunha*) , useful in nervine calmative and antispasmodic.

A.hygrometricus commonly known as putpura, pottu, is considered a mycorrhiza forming fungus of sal (*Shorea robusta*) forest areas during the rainy season. Its mycorrhiza is smooth and simple. Tribals collects fruit bodies of *A. hygrometricus* from sal forest and use for the preparation of vegetables. Its sporophore is subglobose to tuberiform, hard, 1.5-2.5 (-3.5) cm in diameter, peridium dingy white to dingy brown, 1.5 mm thick on sides, 2.5 mm at base, three layered, internally pure white when fresh, greyish to dark brown in the middle layer. Spores yellowish brown to brown, globose to subglobose, inamyloid, slightly thick-walled, prominently echinulate and 9-11 µ in diameter. It is an important non-wood forest product of sal forest and provides income to tribal population and Non Timber Forest Produce traders.

The plant *Costus speciosus* (koen) Sm. belongs to family Zingiberaceae, commonly known as Keokand. Its rhizome is used for edible as well as medicinal purposes. It grows well in moist and partial shady localities. It is mucilaginous, feebly astringent and has no aroma, rhizome is edible and used after cooking. The whole plant has medicinal properties due to the presence of diosgenin, a steroid which is used as a precursor for the preparation of steroidal drugs. The rhizomes are bitter, astringent, acrid, cooling, aphrodisiac, purgative, anthelmintic, depurative, febrifuge, expectorant and useful in burning sensation, constipation, leprosy, worm infection, skin diseases, fever, asthma, bronchitis, inflammations and anaemia. Rhizomes of *C.speciosus* are used for making syrup and young shoots are used as vegetable by the tribal.

P. tuberosa DC. Family-Papilionaceae, is commonly known as Kudzu, Sural, bilaikand, bharda, tirra, bankumra. A large perennial climber with very large tuberous roots. Stem woody, up to 12 cm in dia., leaves trifoliolate, flowers blue or purplish blue, in racemes 15-30 cm long, pods flat, 5-7 cm long, densely clothed with long, silky and bristly brown hairs. The tubers are large 30-60 cm long and 25-30 cm broad weighing up to 35 kg. They are often found in strings connected with the main roots by thin roots. The tubers eaten raw or boiled by the tribal communities. Tubers are demulcent and possess cooling effect and used on swollen joints and as a lactagogue.

Material and Methods

The wild edible plants of all the species were collected from various sources according to their availability in the forest.

A. hygromatricus fruit bodies and fruits of *R. dumetorum* were collected from Sal forest areas of Mangli, Bichiya (Mandla) in the month of June. Rhizomes/tubers of *C. specious and P. tuberose* were collected from Dondi (Durg), Sankra(Dhamtari), Kanker of Chhattisgarh and Bichiya (Mandla) and Dindori of Madhya pradesh.

Moisture content was determined by oven dehydration at 98^0C for 5h.

Total carbohydrate content was estimated by Anthrone method (Hedge and Hofreiter, 1962). The ash content of the sample was determined by weighing the incinerated residue obtained at 600^0C according to Association of Official Analytical Chemists Method, 1970.

Calcium and magnesium were estimated by titrimetric method, potassium by flame photometry and phosphorus spectrophotometrically. The total nitrogen content was estimated by Micro-Kjeldahl method (Association of Official Analytical Chemists, 1970) .The crude protein content of the sample was calculated by multiplying the total nitrogen content by the factor 6.25 (Sadasivam and Manickam, 1992). Ascorbic acid content was estimated by the titrimetric method of Aberg (1958). Thiamine was estimated by the method of Sadasivam and Manickam (1992). Crude fat or oil was extracted by Soxhlet extraction with petroleum ether for 6h. The extract was allowed to cool. Ether was evaporated on a water bath and flask was cooled at room temperature and weighed.

The phenolic acids were extracted from the plant parts by the procedure of Charpentier and Cowles (1981) with the help of HPLC. Five grams of dried plant material was transferred to a conical flask containing 100 ml of 2N HCl. The contents were heated for 30 minutes over a boiling water bath, cooled to room temperature and filtered. The filtrate was transferred to a separating funnel and extracted with 150 ml (50 x 3) of ether. The combined ether layer was washed with distilled water and dried over anhydrous sodium sulphate. It was than filtered and evaporated under stream of nitrogen. The residue thus obtained was dissolved in 10 ml of HPLC grade methanol and filtered through 0.5 µm filter before injecting it into HPLC column. Water's HPLC system equipped with two 515 pumps and controlled by a interface PC2, manual injector valve (Rheodyne), Water's 2996 PDA detector with column C-18 reverse phase was used. 4.0 percent acetic acid in 75:25 water and methanol at flow rate 1 ml/minute and at 254 nm wavalength, The following known phenolics

were used as standards: Anthralinic acid, salicylic acid, protocatechuic acid, chlorogenic acid, p-hydroxybenzoic acid, vanillic acid, caffeic acid, syringic acid, p-coumaric acid and ferullic acid. The detector response was calibrated against known amount of individual phenolic acid.

Tannin content in the sample was estimated according to the method of Schanderi (1970). Total phenol content in the sample was estimated by Folin-Ciocalteau reagent (Malick and Singh, 1980). The hydrogen cyanide content of the sample was estimated according to the method of Indira and Sinha (1969).

Saponin content was determined by the modified method of Fenwick and Oakenfull(1981). The gross food energy was estimated according to the method of Osborne and Voogt (1978) using equation :

FE= (%CPX4)+ (% lipids X 9) +(% COH X4)

FE= food energy (in gm calories)

CP=Crude Protein

CHO= carbohydrate

Results and Discussion

Surveyed forest areas of Mandla (Kalpi, Narayanganj, Bichiya, , Anjanai, Mangli), Amarkantak, Dindori of Madhya Pradesh, Dhamtari, Bilaspur, Kanker and Durg of Chhattisgarh and collected wild edible fruits of Manhar (*Randia dumetorum*), fruit bodies of edible fungi, Putpura (*Astraeus hygromatricus*) during the month of June, rhizomes/tubersof *Costus specious, and Pureria tuberosa.*

Reports on analysis of nutrients contents in fruit bodies of *A. hygromatricus* and *R. dumetorum* are rather limited. But they are being consumed by the tribal as vegetable in all Sal forest areas of central region of India. Therefore, these species were taken to probe further the potential of these species in supplementing the nutrient deficient diets of tribals and other populace during sustenance from forest.

Polysaccharides content- starch/carbohydrate and other nutrient composition of fruit bodies of *A. hygromatricus* and *R. dumetorum* are shown in Table-1& 2.

Table-1 shows that *A. hygromatricus* is the good source of protein. 11.71% protein content was recorded in outer part and 4.66% in inner part of the fruit bodies. Fruit bodies contain high carbohydrate content i.e. 29.48% and 35.41% in outer and inner part respectively.

Fresh fruit bodies contain 83.87% moisture. 2.5% ash, 1.04 and 0.24% oil content were estimated in outer and inner part of *A. hygromatricus*.

Water soluble vitamins- ascorbic acid and thiamine were also found to be present in both inner and outer part (3.26 & 0.26 mg/100g) .

The data indicates that the fruit of *R. dumetorum* contain high carbohydrate (18.93%) and crude protein content (9.14%). The total nitrogen content was found to be 1.46%. Minerals viz. calcium (42.5 mg/100g), phosphorus (1045mg/100g) and magnesium (50mg/100g) were also found in appreciable amount. The ascorbic acid content in *R. dumetorum* was 7.44mg/100g while thiamine content was 2.21 µg/100g.

Table -1 Nutritional composition of *A. hygromatricus* and *R. dumatorum*

Parameters analysed	***A. hygromatricus* .** **Outer part**	**Inner part**	***R. dumatorum***
Moisture (%)	83.87		82.80
Ash(%)	2.5		1.6
Carbohydrate(%)	29.48	35.41	18.55
Starch(%)	0.11	-	7.61
Oil(%)	1.05	0.24	1.7
Protein(%)	11.71	4.66	9.24
Fibre)%	0.02	0.13	5.40
Ascorbic acid (mg/100g)	3.26	0.26	7.4 4
Thiamine (µg/100g)	5.23	3.54	2.21

Values are the mean of three replications.

A. hygromatricus and *R. dumatorum* are a rich dietary source of various minerals (Table–2) and its outer and inner part contain appreciable amount of iron, magnesium, phosphorus, potassium and zinc. The levels of trace mineral elements i.e. iron and zinc among others were fairly significant in the plants analyzed. It was reported that trace elements comprise less than 0.0001% of the total body function. It is necessary component of haemoglobin, myoglobin and in the transport of oxygen. Similarly, zinc functions as co-factor of several enzymes in energy metabolism and immune factor (William and Devlin,1991).

Table- 2 Minerals in *A. hygromatricus* and *R. dumatorum*

Parameters analysed	***A.hygromatricus* .**		***R. dumatorum***
	Outer part	**Inner part**	
Phosphorus (mg/100g)	935	405	1045
Potassium (mg/100g)	2132	1241	1059
Ca(mg/100gm)	29.5	25.8	42.5
Magnesium (mg/100g)	242	11	181
Iron (ppm)	2.787	2.35	2.487
Zinc (ppm)	0.897	0.448	0.408
Mangnese (ppm)	0.74	0.17	7.61

Values are the mean of three replications.

The phenolic fraction of plants has been linked to their antioxidant capacity and antimicrobial activity. RP-HPLC with PA detection was employed to distinguish and quantify phenolic acids. The number of phenolic acids varied from 3 & 4 in *A. hygromatricus* and *R. dumetorum* respectively (Table–3). Anthralinic acid was present in both plants varying 5.24 – 7.21 µg/g. It was present as a major component 7.21 µg/g in *A. hygromatricus*. Caffic acid (6.34 µg/g) was identified as major component in *R. dumatorum*. Vanillic acid was present only in *R. dumatorum* (Manher). There were number of major and minor peaks in HPLC chromatograms which could not be identified.

Table –3: Phenolic acid composition of *A. hygromatricus* and *R. dumetorum*

S. No	Phenolics	***A. hygromatricus***		***R. dumetorum***	
		Retention time (min).	Amount (µg/g)	Retention time (min).	Amount (µg/g)
1.	Protocatechuic acid	4.68	3.62	4.68	--
2.	Vannilic acid	--	--	2.53	2.70
3.	Ferulic acid	8.48	4.54	8.48	2.67
4.	Salicylic acid	21.61	--	21.61	--
5.	Caffic acid	--	--	8.64	6.24
6.	p-hyodroxy benzoic acid	--	--	--	--
7.	Anthralinic acid	12.54	7.21	12.54	5.24
8.	Syringic acid	9.95	4.37	9.95	--

Total phenolic content and tannins were determined spectrometrically. It ranged from 1.4 to 8.1%. Toxic contents, cyanogens was not detected in both the species while saponin was present only in *R.dumatorum* fruits(2.1%). Tannin contents ranged from 1.1-4.1%. The essence of estimating the concentrations of these secondary plant metabolites is to establish and advice on the quantity one can consume at a time.

Table 4: Anti-nutrient contents in *A. hygromatricus* and *R. dumetorum*

Bio -chemicals	***A. hygromatricus***		***R. dumatorum***
	Outer part	**Inner part**	
Tannins(%)	1.10	1.14	4.1
Phenols(%)	1.4	4.25	8.1
Cyanogens(%)	Nil	Nil	Nil
Saponins(%)	Nil	Nil	2.1

Values are the mean of three replications

The rhizomes/tubers of *C.speciosus* and *P. tuberosa* are eaten raw or as vegetable in different parts of Madhya Pradesh and Chhattisgarh. Results and analysis of polysaccharide-starch and its amylose content of species are given in Table-5.

Major source of reserve food in plants is polysaccharide. The most abundant and important is starch and constitutes an energy source essential for growth. It is produced in the process of photosynthesis. Starch immobilized as a reserve substance and typically present in storage organs. In plants storage organ for starch may be seed, root, tuber or stem. The polysaccharide-starch and amylose percentage were determined by spectro photometrically . Starch contents in tubers of *C.speciosus* and *P. tuberosa* w*as* estimated and present31.65 and 38.30%, respectively. The most important potential sources of starch are cereal grains 40-90% (dry weight basis), pulses 30-70% (dry weight basis) and tubers 60-85% (dry weight basis) (Guilbot and Mercier, 1985). Some tropical forest tuber crops are very rich in starch besides many minerals and other nutrients viz., *Amorphophyllus paeoniifolius, Canna edulis, Colocasia esculenta, Dioscorea esculenta, D.rotundata* , *Ipomoea batatas, Manihot esculenta, Maranta arundinacea, Pachyrrizus erisus*, *Coleus* sp.and *Curcuma* sp. (Moorthy, 2001).

The linear component of starch i.e., amylose imparts definite characteristics to starch. The large variation was observed in amylose content of starch in both species i.e.14.44% and 28.53%. Moorthy and Nair (1989) also reported amylose content in six varities of *Dioscorea rotundata*. After cellulose, starch is the principal carbohydrate/polysaccharide photosynthesized by the means of solar energy.

The physico-chemical properties of starch of different species were recorded (Table-6).

The moisture content of dry starch of tubers was found 9.37 and 12.87% in *P.tuberosa* and *C .speciosus*, respectively.The moisture content of the starch depends on climatic factor and the process used for drying the starch. Several workers reported wide variation in moisture content in tuber starches (Moorthy,2002), depends on a number of factors such as method of extraction, age of plant, environmental conditions. Extracted starch is invariably accompanied by various other components viz., fibre, lipids, proteins and minerals etc. Some of these impart desirable qualities to the starch, while others affect the quality.

Table -5 Polysaccharides- Starch and Amylose contents

S.No.	Species	Starch (%)	Amylose (%)
1	*Costus speciosus*	31.65 ± 0.6	14.44±0.3
2	*P. tuberosa*	38.30 ±0.4	28.53±0.3

Values are the mean ±SD of three determinations.

Table-6 The Physico-chemical properties of starches.

S. No.	**Biochemicals estimated in starch (%)**	***C .speciosus***	***P.tuberosa***
1	Moisture	12.87	9.37
2	Protein	0.0.01	0.0046
3	Fat	0.14	1.68
4.	Fibre	0.011	Negligible
5	Phosphorus	0.14	0.110
6	Cyanogens	ND	ND

Values are the mean of three replications
ND-not detected

The fat/ lipid content in starch of two species was found 0.14 and 1.68% fat content estimated in *C .speciosus* and *P. tuberosa* which is less amount in comparison with *Stephania glabra* (2.23%), *Pureria thomsonii* (2.45), *Cassimiroa edulis* (1.48%) and greater amount in comparison with *Careya arborea* (1.02%), *Aesculus assamica* (0.51%) and *Canna edulis* (0.30%) (Soni,1995). Lipid/fat is another important component of starch that has a strong effect on the starch properties. The formation of the starch –lipid or starch- surfactant complexes improves the textural properties of various foods.

Phosphorus contents of both starches was estimated. Phosphorus is an important component of starch, which is associated in the synthesis of starch in chloroplast. The high phosphorus content can impart high viscosity to starch and have tremendous application in food industries. The cyanogens content was not detected in both the starches.

The nutritive and mineral composition determined in the tubers of *C. speciosus* and *P. tuberosa* are summerized in Table-7& 8. Lipid /oil content were also estimated in species, which contribute high energy value of rhizomes. 6.16% oil contents were estimated in *P .tuberosa.* High fibre contents 18.90% and 12.77% were recorded in *P. tuberose* and *C. speciosus*, respectively.

Table 7 : Nutrient Contents in Rhizomes/tubers.

Species	**Moisture (%)**	**Total carbohydrates (%)**	**Crude protein (%)**	**Oil (%)**	**Fibre (%)**	**Ascorbic Acid (mg/100g)**
C.speciosus	89.91	44.51	19.2	3.52	12.77	22.5
P.tuberosa	82.35	52.26	9.99	6.16	18.9	15.7

Values are the mean of three replications

Results of analysis also showed that species are rich in mineral content Table-5. There is considerable importance of minerals because of usefulness of such elements as intermediates for biosynthesis of corticosteroids and related hormones. The contents compare favourably with those of common vegetables such as carrot, radish, turnip, cabbage and turnip.

The relatively high carbohydrate as well as moisture and protein contents are the main qualities of these plants. The observations made on the *fibre* contents of the different plants are also encouraging. The high *fibre* content in them facilitate digestion, which is a major function of vegetables in human diet, besides, it also increases faecal bulk and lower gastric cholesterol.

Table-8. Minerals in Rhizomes/ Tubers.

Species	**Nitrogen (%)**	**Phos-phorus (%)**	**Potassium (%)**	**Sodium (%)**	**Magnesium(%)**	**Calcium (%)**
C.speciosus	3.14	0.06	1.42	0.28	0.19	1.72
P.tuberosa	2.38	0.21	2.11	0.20	0.25	1.14

Values are the mean of three replications

Recently there is a growing interest in phenolic compounds as therapeutic agents many diseases, also imparts resistance in plants against pests. The HPLC analysis of phenolics isolated from tubers revealed the presence of many phenolic acids , out of which some were identified. The phenolic acids were detected and estimated in *C.speciosus* and *P.tuberosa* (Table-9) .Salicylic acid was present in *C.speciosus* (1.79 µg/g) and and absent in *P.tuberosa.* Protocatechuic acid was found absent in *C.speciosus* while detected in *P.tuberosa* (8.93 µg/g). Chlorogenic acid and syringic acid were not detected in all the three species.

Table -9. Phenolic acid composition in *C.speciosus* and *P.tuberosa*

S. No	**Phenolics**	***C .speciosus***		***P.tuberosa***	
		Retention time (min).	**Amount (µg/g)**	**Retention time (min).**	**Amount (µg/g)**
1	Salicylic acid	21.61	1.79	ND	--
2	Protocatechic acid	ND	--	4.7	8.93
3	Anthralinic acid	ND	--	ND	--
4	Vanillic acid	2.53	4.79	2.56	188.27
5	Syringic acid	ND	--	ND	--
6	Ferulic acid	8.55	2.34	8.56	3.99
7	Caffeic acid	ND	--	ND	--
8	Chloro-genic acid	ND	--	ND	--

Rhizomes/tubers of *C.speciosus* and *P.tuberosa* were collected from different localities viz., Madhya Pradesh and Chhattisgarh of central region. The significant differences in their nutrient content were recorded (Table-10). *C.speciosus* samples collected from Dondi (Durg) also give significantly higher contents of carbohydrates, protein, fibre, ascorbic acid and moisture percentage in comparison to samples collected from Sankra and Dindori (Table-10).

Carbohydrates , fibre, ascorbic acid and oil percentage were found to be in *P. tuberosa* samples (Dondi,Durg) while Protein and starch content was maximum in Kanker samples which was significantly higher than Dindori and Sankra localities.

Analysis of rhizomes collected from different localities of central region showed wide variation in diosgenin content Table- 11. Maximum diosgenin content was found in the rhizomes collected from Kanker (CG) followed by Mandla samples (M.P.)and Durg (CG) contained 2.11% diosgenin, while Dhamtari samples possessed 1.37 %.

Diosgenin widely used as starting material in commercial production of steroidal hormones, is chiefly obtained from certain species of *Diospyros* which *D. deltoidea* constitute the main Indian raw material. This source, however has limitations in ensuring large supply on a sustained basis due to its restricted distribution in few localities of north-west Himalayas and a poor response to domestication. *Costus specious* is alternative source of diosgenin widely distributed in central part of India. Rhizomes of *C. speciosus* are used for making syrup and young shoots are used as vegetable by the tribals. Nutritional analysis showed that it contain appreciable amount of nutrients. *C. speciosus* possesses both medicinal and nutritive value.

Table -10 Variation in nutritional contents in rhizomes collected from different localities.

Localities/species	Moisture(%)	Carbohydrate(%)	Starch(%)	Protein (%)	Fibre(%)	Ascorbic acid (mg/100g)	Oil (%)
C.speciosus							
Dondi (Durg)	**89.91**	**44.51**	31.65	**19.2**	**12.77**	**22.5**	**3.52**
Sankra (Dhamtari)	83.89	40.70	33.15	15.28	10.38	20.6	2.49
Dindori	85.57	40.67	29.68	16.36	11.55	19.1	2.54
Kanker	82.21	43.79	**33.68**	14.63	10.64	18.5	2.76
C.D.(0.05)	1.375	2.322	1.225	3.732	1.893	2.563	NS
P.tuberosa							
Dondi (Durg)	82.35	**52.26**	38.30	9.99	**18.90**	**15.7**	**6.16**
Sankra (Dhamtari)	**84.66**	48.73	38.66	7.46	15.66	14.3	4.59
Dindori	82.62	46.19	36.40	9.88	18.74	12.1	5.51
Kanker	80.19	46.64	**39.59**	**10.58**	16.22	15.3	4.87
C.D.(0.05)	0.672	1.984	2.674	1.463	1.893	2.705	3.224

Values are the mean of three replications

The usefulness of forest food products depends on quantity of antinutritional contents i.e. phenol, tannin, cyanogens, saponins and oxalates.

The phenol content was estimated in *P.tuberosa as* compared to other rhizomes/tubers.

Tannin and phenols complexes proteins, divalent metals, cellulose, hemicellulose, pectin and other carbohydrates (Mahanto ,*et.al*., 1982). High consumption of tannin is dangerous to health, being a phenolic secondary plant metabolite with one or more hydroxyl substitutes bonded to aromatic ring, it produces anthocyanides, another toxic product on acid degradation (Gatachew,*et.al*.2000; Waterman and Cole, 1994).

Table-11. Diosgenin contents in *Costus speciosus* of different localities.

S.No.	Locality	Diogenin (%)
1	Sankra (Dhamtari)	1.37 ± 0.02
2	Dondi (Durg)	2.11 ± 0.09
3	Dindori	1.58 ±0.04
4	Bichiya (Mandla)	2.17 ±0.05
5	Kanker	2.73 ±0.13
	C.D.(0.05)	0.138745

Values are the mean ±SD of three determinations.

The tannin content of tubers/rhizomes were analyzed and found low in all the species, ranged from 0.03 and 0.34%, thus can be assumed to be non-toxic. Mole and Water (1987) also showed that addition of 1mg/ml of tannic acid to a standard trypsin solution led to the formation of an insoluble complex.

Significant variations in antinutritional contents in different localities were observed (Table13). Minimum (0.43 %) phenol content was recorded in *C. augustifolia* sample (Sankra) while significantly higher in Dindori samples (0.01%). Tannins and oxalate were found minimum in Dindori samples. *C.speciosus* and *P.tuberosa* samples (Kanker) contain minimum phenols(0.52 %, 0.99%) while non significant variation in tannin and oxalate were recorded in *C. speciosus*. Rhizomes of *E. nuda* (Sankra) possessed 0.72 % phenols significantly lower than other localities.

Table- 12. Anti nutrients in rhizomes/tubers.

S. No.	Biochemicals (%)	*C .speciosus*	*P.tuberosa*
1.	Phenols	0.65	1.09
2.	Tannins	0.03	0.23
3.	Cyanogens	ND	ND
4.	Saponins	ND	ND
5.	Oxalate	0.03	0.06

Values are the mean of three replications
ND- not detected

Table -13. Variation in anti nutritional contents in rhizomes/tubers collected from different localities.

Localities/species	Phenols(%)	Tannins(%)	Oxalate(%)
C.speciosus			
Dondi (Durg)	0.65	0.03	0.03
Sankra (Dhamtari)	0.62	0.05	0.02
Dindori	0.57	0.02	0.03
Kanker	0.52	0.03	0.02
C.D.(0.05)	0.0421	NS	NS
P.tuberosa			
Dondi (Durg)	1.09	0.23	0.06
Sankra (Dhamtari)	1.22	0.26	0.06
Dindori	1.31	0.31	0.05
Kanker	0.99	0.25	0.05
C.D.(0.05)	0.102	0.0316	0.0137

Values are the mean of three replications

*NS- Non significant

Level of oxalate in tubers 0.02-0.06% which was considerably lower than those found in most other starchy staples (less than 100 mg/100g) (Hollow way et al., 1989). Oxalate is the most an important acid from a dietary point of view, being an anti nutritional factor. Dietary oxalate binds to Ca, preventing it from being used for essential functions in human metabolism. Oxalate form insoluble salts with calcium, which can lead to the development of kidney stones (Holmes et al., 1995).

The all plant species contain high food value as indicated in Table-14. Food energy provided by the edible parts of the species varied from 126 g calories to 336 g calories which are comparable with other commonly used edible species.

Table-14. Food energy of different edible plants .

Species	Food Energy (g calories)
Costus specious	286.52
Astraeus hygrometricus	336.74
Randia dumatorum	126.46
P.tuberosa	304.44

Conclusion It was observed that the study sites were dominated by the tribal communities. They were mostly poor, under developed, neglected and fully dependent on plants for food and collects wild plants parts like leaves, fruits, seeds, tubers, mushrooms *etc*. for their self sustenance. A few of species were studied for their nutritional and anti nutritional contents. The above mentioned plant species were being utilized in different areas of central region according to their availability during the season. These contained high amount of nutritional contents. The results of the study showed that relatively high polysaccharide/carbohydrates protein and minerals were available which provides numerous health benefits.

The edible fruit bodies of mushroom, *A. hygrometricus* and fruits of *R. dumetorum* contained appreciable amount of nutrients. The rhizomes/tubers of *P. tuberose and C. speciosus* possessed high quantity of polysaccharides and other nutrients.

At present, only a fraction of total potential is being tapped by the tribal communities. These species are need to be domesticated for further utilization in neutraceutical preparations.

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