

Nutritive value of edible bamboo species and traditional uses in northeastern India

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Abstract: Edible bamboo species growing in northeastern India, their nutritional contents, and traditional food products prepared from bamboo shoots are highlighted. Over 50 native bamboo species are being used for edible purpose in large or small quantity in northeastern India. A number of traditional dishes prepared from edible shoots demonstrate the indigenous technical ingenuity required for preservation and fermentation of products. Traditional ways of reducing acidity due to glucocyanides in fresh bamboo shoots were also noticed. Wide variation was observed in the physical characteristics like length, girth, weight of whole shoots and edible portion in 14-day-old harvested shoots of 22 species. Nutrient contents in the dry matter of edible portion showed that crude protein content ranged from 15.1 to 36.1 per cent fat 0.64 to 3.62 per cent, carbohydrate 31.6 to 50.6 per cent, crude fibre 13.4 to 29.8 per cent and calorific value 2.21 to 3.70 cal/g. Mineral contents showed a range of 0.21 to 1.97 per cent for Ca, 0.42 to 1.34 per cent for P and 0.42 to 0.61 per cent for Mg. Micronutrient contents varied from 4.0 to 17.6 ppm for Mn, 5.0 to 24.5 ppm for Fe, 0.6 to 3.5 ppm for Zn, non-detectable to 0.2 ppm for Cu, non-detectable to 0.5 ppm for Co contents.

Key words: Edible bamboo, micronutrients, nutritive value, rural market.

INTRODUCTION

Of the 125 bamboo species belonging to 23 genera occurring in India (Hore, 1998), northeastern states account for 77 species and one variety belonging to 19 genera (Karthikeyan *et al.*, 1989; Tewari, 1992). Richness of diversity of bamboo in this region has immense potential in the development of bamboo industry, especially bamboo shoot industry.

Young succulent bamboo shoots had been held in high esteem for centuries as an edible delicacy in the northeastern India. Now, it is gaining popularity in Indian restaurants. Globally, bamboo shoot industry is becoming a money-spinner. Market of canned bamboo shoot is increasing annually by 12 per cent but the world production

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has increased by only 8 per cent. The increasing gap between demand and supply also provides an opportunity to export edible bamboo shoot. Moreover, phytosterols for steroid drugs, ester group of compounds, antioxidants, flavanoids, lowering blood lipids and other vitality enhancing drugs can also be manufactured from young edible bamboo shoots (Kato *et al.*, 1982; Ishit and Hiroi, 1990; Ishit *et al.*, 1990; Srivastava, 1990; Zhung, 1997). These have widened the commercial potential of edible bamboo shoots. Recently, policy makers in India have also taken note of this and the National Bamboo Mission gives emphasis on production and processing of bamboo shoots. Considering the growing importance of edible bamboo shoots in India, a study was conducted to survey the bamboo species used for edible shoot production, to evaluate their nutritional value and to list the traditional food products prepared from shoots.

MATERIALS AND METHODS

The study was conducted at ICAR Research Complex for North Eastern Hill Region, Basar, Arunachal Pradesh, India during 1997 to 2002. In the northeastern India, bamboo covers a range of valleys and low hills, which experience humid tropical to subtropical climate receiving 2000 to 4000 mm rainfall. The states of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura in the northeastern India were covered during the study. A benchmark survey was conducted to identify priority bamboo species used as edible shoot, different freshly cooked and fermented food products relished by the inhabitants, especially the tribal population. The survey was conducted in a way that each tribe was represented. The sample number of households was determined depending upon the population of a particular tribe. In Arunachal Pradesh, number of households surveyed was 60, 40, 30 and 20 in *Adi*, *Khamti*, *Mishmi* and *Tangsa* tribes, respectively. In Assam, 100 households covering Guwahati, Naogaon, Dibrugarh, Tezpur and Tinsukia areas were sampled. In Meghalaya, 60 households of *Khasi* tribe in Shillong and Nongpoh areas were surveyed. In Manipur, Mizoram, Nagaland, Sikkim and Tripura 30, 50, 40, 30 and 30 households were surveyed, respectively. Since different tribes were distinct in their food habits and in the preparation of edible bamboo shoot based dishes, information was documented tribe-wise under each state.

Availability of edible shoot and its products in the daily rural market of Along and Basar in Arunachal Pradesh and Nongpoh in Meghalaya was surveyed and data from five rural markets were collected. For nutritional evaluation, 14-day-old bamboo shoots were collected from the bamboosetum established at research farm of ICAR, Arunachal Pradesh Centre. The young shoots were harvested from clumps of 22 bamboo species. Measurements of length, girth (base, middle and top), and fresh weight were taken to determine the physical characteristics of harvested shoots. Edible portion in the whole harvested shoot and dry matter in edible portion were also determined.

Table 1. Important bamboo species harvested for edible shoots in northeastern India

Species	Arunachal Pradesh	Assam	Manipur	Meghalaya	Mizoram	Nagaland	Sikkim	Tripura
<i>Arundinaria aristata</i>	—	—	—	—	—	—	✓	—
<i>A. callosa</i>	—	—	✓	—	—	—	—	—
<i>A. debilis</i>	—	—	✓	—	—	—	—	—
<i>A. falconeri</i>	—	—	✓	—	—	—	—	—
<i>A. hookeriana</i>	—	—	—	—	—	—	✓	—
<i>A. maling</i>	—	—	—	—	—	—	✓	—
<i>A. prainii</i>	—	—	✓	—	—	—	—	—
<i>A. racemosa</i>	—	—	✓	—	—	—	—	—
<i>A. rolloana</i>	—	—	✓	—	—	—	—	—
<i>Bambusa auriculata</i>	—	—	✓	—	—	—	—	—
<i>B. balcooa</i>	—	✓	✓	—	—	—	—	✓
<i>B. bambos</i>	—	✓	—	—	—	—	✓	—
<i>B. binghamii</i>	—	—	✓	—	—	—	—	—
<i>B. burmanica</i>	—	—	✓	—	—	—	—	—
<i>B. khasiana</i>	—	—	✓	✓	—	—	—	—
<i>B. kingiana</i>	—	—	✓	—	—	—	—	—
<i>B. multiplex</i>	—	—	✓	—	—	—	—	—
<i>B. nutans</i>	—	✓	—	✓	—	—	✓	—
<i>B. oliveriana</i>	—	—	✓	—	—	—	—	—
<i>B. pallida</i>	✓	✓	✓	✓	—	—	—	—
<i>B. polymorpha</i>	—	—	✓	—	—	—	—	✓
<i>B. schizostachyoides</i>	—	—	✓	—	—	—	—	—
<i>B. teres</i>	—	—	—	—	—	—	—	✓
<i>B. tulda</i>	✓	✓	✓	✓	✓	✓	✓	✓
<i>B. vulgaris</i>	—	—	✓	—	—	—	—	—
<i>Cephalostachyum capitatum</i>	—	—	✓	—	—	—	—	—
<i>C. latifolium</i>	—	—	✓	—	—	—	—	—
<i>C. pallidum</i>	—	—	✓	—	—	—	—	—
<i>C. pergracile</i>	—	—	✓	—	—	✓	—	—
<i>Chimonobambusa callosa</i>	—	—	—	—	—	✓	—	—
<i>Dendrocalamus brandisii</i>	—	—	✓	—	—	—	—	—
<i>D. calostachyus</i>	—	—	✓	—	—	✓	—	—
<i>D. flagellifer</i>	—	—	✓	—	—	—	—	—
<i>D. giganteus</i>	✓	—	✓	—	✓	✓	—	—
<i>D. hamiltonii</i>	—	—	✓	✓	✓	✓	✓	✓
<i>D. hookeri</i>	✓	—	✓	✓	—	✓	✓	—
<i>D. longifimbriatus</i>	—	—	✓	—	—	—	—	—
<i>D. longispathus</i>	—	—	✓	—	✓	✓	—	—
<i>D. membranaceus</i>	—	—	✓	—	—	—	—	—
<i>D. sericeus</i>	—	—	✓	—	—	—	—	—
<i>D. sikkimensis</i>	—	—	—	—	—	✓	—	—
<i>Gigantochloa albociliata</i>	✓	—	—	—	—	—	—	—
<i>Melocalamus indicus</i>	—	—	✓	—	—	—	—	—
<i>Melocanna baccifera</i>	—	✓	✓	—	✓	—	—	✓
<i>Melocanna</i> sp.	—	—	—	—	—	✓	—	—
<i>Neohouzeaua dullooa</i>	—	—	—	—	—	—	—	✓
<i>Phyllostachys mannii</i>	✓	—	—	—	—	—	—	—

Species	Arunachal Pradesh	Assam	Manipur	Meghalaya	Mizoram	Nagaland	Sikkim	Tripura
<i>Pseudostachyum polymorphum</i>	✓	—	✓	—	—	—	✓	—
<i>Pseudostachyum</i> sp.	—	—	—	—	—	—	—	—
<i>Teinostachyum dullooa</i>	—	—	✓	—	—	—	—	—
<i>T. helferi</i>	—	—	—	—	—	✓	—	—
<i>T. wightii</i>	—	—	✓	—	—	—	—	—
<i>Thyrsostachys oliveri</i>	—	—	✓	—	—	—	—	—

Proximate analyses of nutrients were done as per the procedures laid down in AOAC (1980). Atomic absorption spectrophotometer (Perkin Elmer Model 3110) was used to determine micronutrients. One gram of sample was digested in concentrated HNO₃ on hot plate at 50°C. After complete digestion, the solution was made up to 100 ml with distilled water. The aliquot was analysed for Cu, Zn, Fe, Mn and Co. The dried samples were also analysed for HCN contents by the procedure suggested by Hayes *et al.* (1955).

RESULTS AND DISCUSSION

Priority edible bamboo species

Over 50 native bamboo species are used for edible purpose in small to large quantity in northeastern India (Table 1). This accounted for 16 species of *Bambusa*, 12 species of *Dendrocalamus*, nine species of *Arundinaria*, four species of *Cephalostachyum*, two species each of *Melocanna* and *Teinostachyum*, one species each of *Chimonobambusa*, *Phyllostachys*, *Pseudostachyum*, *Melocalamus*, *Neohouzeaua*, and one introduced species of *Gigantochloa*. This region, bestowed with a range of agro-niches resembling those of China and Taiwan, has a scope for introduction of many more commercial edible species. The use of a species was largely governed by its availability, acidity (bitterness) and size of young shoot. Sharma (1980) listed 26 bamboo species traditionally used for edible purpose in the Asia Pacific region. Of these, 15 bamboo species were widely used for edible shoot. Among these, *Bambusa balcooa*, *B. pallida*, *B. tulda*, *Dendrocalamus giganteus*, *D. hamiltonii*, *D. hookeri* and *D. longispathus* dominated. From delicacy and taste point of view, *B. bambos*, *B. tulda*, *D. giganteus*, *D. hamiltonii* and *D. membranaceus* were preferred. Overall, *D. hamiltonii* ranked first as the area and availability of *D. giganteus* was very much restricted. Some of the traditionally preferred bamboo species for canning are *B. bambos*, *B. burmanica*, *B. polymorpha*, *B. tulda*, *B. vulgaris*, *Cephalostachyum pergracile*, *D. brandisii*, *D. giganteus*, *D. hamiltonii*, *D. membranaceus*, *G. albociliata*, *Melocanna* sp. and *Thyrsostachys oliveri*.

Traditional bamboo shoot dishes

Traditional dishes prepared from fresh and fermented edible bamboo shoots are listed (Appendix 1). Storage life of 6 months to 2 years without use of preservatives and the traditional way of reducing acidity due to glucocyanides (HCN) in fresh shoots demonstrate indigenous technical ingenuity. Techniques of reducing acidity due to glucocyanides from fresh shoot by chopping into small pieces, partial drying, boiling in water with/without salt and draining out water or putting in hot water for 10-15 minutes or in water for a week at ambient temperature were followed. Bamboo shoots were found to be an important source of food during the rainy season. Besides young shoot, succulent rhizomes of *B. balcooa* and *C. pallidum* in Manipur and *B. tulda* in Assam are also used for edible purposes.

Nutritional and biochemical aspects of edible bamboo shoot

Besides being delicious, edible bamboo shoots were found to be rich in nutrients. The edible portion weighed over 2 kg in three bamboo species, *D. giganteus*, *D. hookerii* and *B. balcooa* (Table 2). Over one kg weight of edible portion was found in *D. sikkimensis*, *T. helferi*, *B. tulda*, *B. bambos* and “Hard jati” (Table 2).

Table 2. Physical characteristics of 14-day-old shoots of different bamboo species

Bamboo species	Length (cm)	Girth (cm)			Fresh weight/shoot (g)	Edible portion/shoot (g)	Edible portion (%)	Dry matter in edible portion (%)
		Base	Middle	Top				
<i>Bambusa balcooa</i>	52	44	33	15	2850	2113	74	6.50
<i>B. bambos</i>	60	41	36	16	2383	1250	53	8.00
<i>B. cacharensis</i>	56	34	25	20	1313	917	70	7.70
<i>B. nana</i>	56	9	8	6	208	127	61	10.25
<i>B. nutans</i>	46	31	25	20	1442	993	69	6.63
<i>B. pallida</i> Type-1	63	27	21	14	1500	808	54	6.50
<i>B. pallida</i> Type-2	52	16	15	12	1525	700	46	6.71
<i>B. polymorpha</i>	43	16	14	25	417	250	60	7.57
<i>B. tulda</i>	65	39	25	20	1983	1313	66	7.90
<i>B. variegata</i>	57	11	11	7	358	228	64	10.93
<i>Dendrocalamus asper</i>	69	17	15	11	900	462	51	6.50
<i>D. giganteus</i>	72	71	54	16	3900	2613	67	6.75
<i>D. hamiltonii</i>	50	19	18	10	958	592	62	9.01
<i>D. hookeri</i>	57	50	35	17	3733	2315	62	7.50
<i>D. sahnii</i>	42	23	14	10	817	550	67	8.10
<i>D. sikkimensis</i>	77	34	31	20	2433	1660	68	7.00
<i>Schizostachyum mannii</i>	67	7	7	5	505	225	45	9.55
<i>S. pergracile</i>	46	14	14	11	567	293	52	10.89
<i>S. polymorphum</i>	43	10	10	8	607	333	55	9.13
<i>Teinostachyum helferi</i>	48	31	24	16	2300	1575	68	6.86
“Hard jati”	42	26	23	15	1733	1100	63	8.53
“Khupri”	49	17	13	10	925	520	56	8.50
“Zoram local”	70	23	14	09	1045	700	67	8.10

Table 3. Proximate analyses of 14-day-old bamboo shoot in different bamboo species on dry matter basis

Bamboo species	Energy (cal/g)	Crude protein (%)	Fat (%)	Fibre (%)	Carbo- hydrates(%)	Minerals (%)	Ca (%)	Mg (%)	P (%)
<i>Bambusa balcooa</i>	3.06	24.9	1.72	13.4	47.7	12.3	1.35	0.424	0.96
<i>B. bambos</i>	2.90	25.5	1.42	16.5	44.1	12.5	1.52	0.420	0.78
<i>B. cacharensis</i>	2.21	21.2	0.64	16.8	48.4	13.0	1.00	0.531	0.83
<i>B. nana</i>	2.67	17.9	0.80	22.1	47.0	12.2	1.81	0.463	0.69
<i>B. nutans</i>	2.77	22.4	0.86	19.6	44.9	12.2	1.53	0.545	0.94
<i>B. pallida</i> Type-1	2.64	19.1	0.78	22.1	45.0	13.0	1.29	0.545	0.64
<i>B. pallida</i> Type-2	2.49	16.0	0.68	16.0	44.8	12.2	1.44	0.476	0.66
<i>B. polymorpha</i>	2.66	27.3	1.41	18.0	36.1	17.2	1.97	0.613	0.76
<i>B. tulda</i>	2.66	20.0	0.90	20.7	44.5	13.9	1.08	0.610	0.75
<i>B. variegata</i>	2.51	15.4	0.85	26.9	45.6	11.4	1.71	0.544	0.60
<i>Dendrocalamus asper</i>	3.28	25.3	3.62	13.6	50.6	8.86	0.21	0.505	0.42
<i>D. giganteus</i>	2.53	15.1	0.73	26.5	46.6	11.2	1.17	0.505	0.51
<i>D. hamiltonii</i>	2.74	20.1	1.26	19.9	45.7	13.1	1.40	0.468	0.59
<i>D. hookeri</i>	2.95	36.1	2.65	15.1	31.6	14.5	1.79	0.491	1.05
<i>D. sahnii</i>	2.58	20.1	1.66	25.1	40.5	12.6	1.09	0.465	0.68
<i>D. sikkimensis</i>	2.67	21.0	0.62	20.7	44.3	13.3	1.91	0.514	0.71
<i>Schizostachyum</i> <i>pergracile</i>	2.59	19.3	0.89	24.0	43.4	12.5	1.85	0.501	0.63
<i>S. polymorphum</i>	3.70	19.2	2.65	29.8	36.8	11.6	0.78	0.570	0.49
“Hard jati”	2.76	26.3	0.84	18.0	40.8	14.0	1.88	0.573	0.97
“Khupri”	2.72	17.3	1.04	22.2	48.2	11.3	1.04	0.46.7	0.62
“Zoram local”	2.90	27.8	2.44	14.9	39.3	15.7	1.69	0.509	1.34
Mean	2.69	21.9	1.17	19.9	43.6	13.1	1.53	0.524	0.77
Coefficient of variation (%)	7.15	23.6	50.1	20.0	9.86	11.6	19.7	13.26	25.9

The edible portion obtained from the fresh shoot ranged from 45 per cent in *S. mannii* to 74 per cent in *B. balcooa*. Dry matter in the edible portion of 14-day-old shoots of different bamboo species varied from 6.5 per cent in *B. balcooa*, *B. pallida* Type-1 and *D. asper* to 10.9 per cent in *B. variegata*.

Proximate analyses showed that the edible portion based on dry matter had 15.1 to 36.1 per cent crude protein, 0.64 to 3.62 per cent fat, 31.6 to 50.6 per cent carbohydrates and 8.86 to 17.2 per cent minerals (Table 3). Maximum variability was recorded for fat content and minimum variability for energy content. *D. hookeri* had the highest content of crude protein (36.1%) and *D. asper* had the highest content of fat (3.62%). Among minerals, calcium and magnesium contents were highest in *B. polymorpha* and phosphorus content highest in “Zoram local”. Lowest crude fibre content was recorded in *B. balcooa*. Micronutrient contents in edible portion of the bamboo shoots on dry matter basis showed high variability in different species (Table 4). The range for Mn was 4.0 ppm in *D. hamiltonii* to 17.6 ppm in *S. pergracile*, for Fe 5.0 ppm in *D. asper* to 24.5 ppm in “Hard jati”, for Zn 0.6 ppm in *B. variegata* to 3.5 ppm in *S.*

Table 4. Micronutrients in the edible portion of 14-day-old bamboo shoot in different bamboo species on dry matter basis

Bamboo species	Micronutrients (ppm)				
	Mn	Zn	Fe	Cu	Co
<i>Bambusa balcooa</i>	8.1	1.3	9.8	0.1	ND
<i>B. bambos</i>	7.1	0.9	14.1	0.1	ND
<i>B. cacharensis</i>	14.2	1.2	8.1	0.1	0.1
<i>B. nana</i>	9.0	0.9	12.7	0.1	0.3
<i>B. nutans</i>	10.7	1.2	10.4	0.1	0.4
<i>B. pallida</i> Type-1	12.5	1.2	14.6	0.1	0.2
<i>B. pallida</i> Type-2	15.6	1.3	11.9	0.2	ND
<i>B. polymorpha</i>	8.9	1.4	5.6	0.1	0.1
<i>B. tulda</i>	6.1	1.4	13.6	0.1	0.1
<i>B. variegata</i>	6.9	0.6	22.7	ND	0.5
<i>Dendrocalamus asper</i>	3.0	2.5	5.0	1.7	0.5
<i>D. giganteus</i>	4.1	0.9	2.61	0.1	0.3
<i>D. hamiltonii</i>	4.0	1.3	19.4	0.2	0.4
<i>D. hookeri</i>	7.2	1.3	8.4	0.1	ND
<i>D. sahnii</i>	8.7	0.9	8.0	0.1	0.2
<i>D. sikkimensis</i>	11.6	1.7	12.0	0.1	0.2
<i>Schizostachyum mannii</i>	9.0	2.1	6.2	ND	ND
<i>S. pergracile</i>	17.6	3.5	23.1	0.2	0.5
<i>S. polymorphum</i>	12.5	1.6	10.3	0.1	ND
<i>Teinostachyum helferi</i>	6.2	1.2	8.7	0.1	0.2
“Hard jati”	10.3	1.4	24.5	0.1	ND
“Khupri”	7.3	1.0	17.5	0.1	ND
Coefficient of variation (%)	38.1	43.80	42.29	47.39	104.50

ND: Not detectable

pergracile. Cu content was found highest in the shoot of *D. asper* and Co content was highest in *B. variegata*, *D. asper* and *S. pergracile*. Cu and Co were not detectable in a number of species by atomic absorption spectrophotometer. No HCN content was observed in the oven-dried samples of the edible portion of different species.

Table 5. Availability of edible bamboo shoot (fresh and fermented) in selected local markets of northeastern region

State/Market	Nature of products	Quantity
Arunachal Pradesh	Along	Fresh shoot (<i>Ek</i>)
		Wet fermented and flattened whole shoot (<i>Ipe</i>)
		Finely pieced dry product
	Basar	Fresh shoot
		Fermented wet product
Meghalaya	Nongpoh	Bamboo pickle
		Fermented wet product

Appendix 1. Traditional food dishes prepared from bamboo shoots in northeastern India

Arunachal Pradesh

Adi tribe

FRESH

Pupe: Small pieces of shoot portion are boiled or fried with fish or leafy vegetables.

Iku : Shoot is ground and dried. It is used as chutney or flavouring agent in curry and dal (pulses).

FERMENTED

Eup: Whole bamboo shoot or small pieces are kept in basket lined with layers of leaves inside. The basket is covered with leaves and made airtight by placing stones. The basket is kept inside the forest for 1-3 months for fermentation. The fermented shoots or small pieces are dried or preserved wet by storing in the internodal portion of bamboo. Shelf life: 6 months for wet product and 2 years for dried ones.

Eku: Juice drained from fermented bamboo shoot is stored for about 45 days and used as flavouring agent in vegetable, fish and meat preparations.

Khamti tribe

FRESH

Nosom: Tip of young bamboo shoot is used as vegetable. It is boiled or fried with vegetable or fish.

Nupham: Fresh shoots are chopped and boiled with salt.

FERMENTED

Nogom: Fresh shoots are chopped into small pieces and put in airtight container with water for fermentation, for about 1-3 weeks. After fermentation, liquid is boiled to reduce the volume five times. It is called *Nammu* and used as vinegar. The solid part is dried and used as flavouring agent in fish, meat or vegetable preparations.

Mishmi tribe

FRESH

Apoka: Fresh shoots of *D. hamiltonii* and *P. mannii* are boiled in water. Alternatively, they are washed with warm water or after removing the outer sheaths kept in water for 6 to 7 days. They are cut into small pieces and fried with fish or vegetables or made into chutney.

Aporhu Bahi: Bamboo shoot is the main ingredient.

Anuna: In this, rice, fish and dried bamboo shoot, are cooked in equal parts.

FERMENTED

Apohru/ Fermentation is as done by *Adi* tribe. After fermentation it is sun-dried and used as flavouring agent/ingredient in curries of vegetable, meat or fish. Shelf life is from 6 months to 2 years.

Aponshi: In this, only the tip of bamboo shoot is fermented.

Asumbrii: This dish is prepared by adding broken rice and fish or meat with wet fermented bamboo shoot.

Appendix 1 (Contd.)

Assam

FRESH

Gaza: Small pieces of bamboo shoot are fried with fish or vegetables.

FERMENTED

Kharisa: In an earthen pot of 5 litre capacity, small pieces of shoot and water (1:2 ratio) is put and covered with banana leaves and allowed to ferment; shelf life is 6 months to one year.

Bah gazar : In this, succulent rhizome of *B. balcooa* is cut into small pieces, sun-dried and ground. It is stored in bottles as bamboo powder for use as ingredients in various dish preparations or as chutney. It gets fermented during storage.

Manipur

FRESH

Ushoi/Laiwaul: In this, soft shoots of *D. giganteus* and *B. tulda* are used as vegetable; first boiled water is drained out to remove acidity.

FERMENTED:

Soi Bum: It is considered a medicinal diet; for fermentation, shoots are cut into small pieces and packed in airtight containers of different capacities. The fermented product is cooked with fish or prepared into rough slurry after boiling with other vegetables.

Meghalaya

Khasi tribe

FRESH

Ungsie: Small pieces of edible portion are fried with dry fish, black pepper and other spices.

Mizoram

FRESH

Kar/Kan: Small pieces of shoot are fried with spices and onion.

Chum: Small pieces are boiled with salt.

Vaipadem: In this, shoot is cooked with dry fish, onion, garlic, ginger and other spices.

Nagaland

Angami tribe

FRESH

Zukolak Ari: In this, bamboo shoot is cooked with vegetables.

Zukolak An: In this, shoot is mixed with dry fish and cooked. The cooked material is made into chutney.

FERMENTED

tzuk : Ground pulp of bamboo shoot is packed airtight in bamboo containers with palm leaves and kept below ground and allowed to ferment for six months.

Itzuk : It is a dried solid fermented product used in preparation of various curries.

Etzu : It is an extract *i.e.*, juice taken out after fermentation. It is stored and used for flavouring vegetable, meat and fish curries.

Zuku : In this, outer sheath of shoot is peeled off and put inside *itzuk*; it is used after chopping in preparation of different curries.

Appendix 1 (Contd.)

Sikkim

FRESH

Sabaji : Small pieces of bamboo shoots are put in hot water for 10-15 minutes and taken out. They are cooked dry, fried or used in preparation of curry with any vegetables.

FERMENTED

Mesu : This is made by pressing tightly chopped edible portion into a bamboo container, corked by leaves of bamboo. It is left for fermentation at ambient temperature (20-25°C) for 7 to 15 days. *Mesu*, a wet fermented product, is used as ingredient and flavouring agent in various preparations by Nepalese.

Tripura:

FRESH

Muiagudak : It is a vegetable obtained from fresh shoots of *Melocanna* spp. It is cooked with potato, beans or dry fish or made into curry with onion, garlic, ginger and other spices.

Muiachakhal : In this, bamboo shoot is cooked with potato, leafy vegetables, papaya with little soda for softening. Sometimes, it is cooked with pork or put as a paste into dal.

Aundru : In this, boiled bamboo shoot is mixed with:
 a. chillies and salt; during boiling, fish, particularly dry fish, is put into it and taken out after boiling and eaten separately.
 b. wet rice and boiled water are mixed with paste of bamboo shoot, onion, garlic, particularly shoot of *B. tulda*.

Muiabhaja : Fine pieces of tender shoots are fried with potato, dry fish, green chillies and onion. Sometimes, *B. tulda* (young shoot) along with water soaked rice, ginger, chillies, salt, *etc.*, are cooked in bamboo internodes.

Rural market

Survey of market showed that edible bamboo shoots, largely collected from the forests, were meant for household consumption, and for sale daily in the rural market (Table 5). The arrival of edible shoots in the daily rural markets was indicative of the internal consumption and the growing demand for bamboo shoot. Another study conducted in Changlang district of Arunachal Pradesh showed that annual household consumption of edible shoots was on an average 10-12 kg fresh shoots as vegetables, 20 kg fermented and dried fermented shoots and 20 kg wet fermented product by *Tangsa* tribe (Anonymous, 2000). The total consumption of edible shoots ranged from 7 to 20 kg for each household in different villages. In a locality, 168 families consumed annually 2688 kg of edible bamboo shoots. The availability of edible bamboo shoots in selected local market had been studied (Jha *et al.*, 2000).

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