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Genetic Resources of Tuber Crops in Tripura and Tuber Crop Based Ethnic Foods

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Abstract

The climatic and topographical conditions of Tripura are very much suitable for the existence of wide range of variability in tuber crops. Elephant foot yam var. Tripura Batema and Gajendra performed well in terms of tuber diameter, tuber length and yield with respective values of 30.4 cm and 30.1 cm, 13.7 cm and 13.5 cm and 6.7 kg/plant and 6.4 kg/plant. Tubers of some wild species of elephant foot yams such as *Amorphophallus bulbifer* (Roxb.) Blume are extremely acrid. Tuber length of greater yam var. Tripura Tha is 54.0 cm with 14.6 cm diameter. *Dioscorea bulifera* L., *D. hamiltonii* Hook. F and *D. pentaphylla* L. are other wild types of yams. Variability in both eddoe and bunda type taro has also been recorded, where, corm weight and yield in the eddoe type selections ranged from 24.0-54.2g and 4.3-11.6 t/ha, respectively. Plant height, rhizome length and rhizome weight in different local types of swamp taro were in the range of 70.2-153.2 cm, 20.6-62.0 cm and 300 g - 5.9 kg/plant, respectively. Stolons of both common taro and swamp taro are very much popular as ethnic food. Giant taro (*Steudnera colocasioide*s Hook. f.) is locally known as *Bish Kochu* and big rooted taro or elephant ear (*Alocasia macrorrhizos* (L.) G. Don, Schott.), locally known as *Man Kochu* or *Fen Kochu*. Respective plant height is 195.5 and 231 cm and rhizome length is 85.6 and 110.6 cm with girth 41.3 and 55.5 cm. Tannia (*Xanthosoma sagittifolium* L.(Schott), *X. violaceum* (L.) Schott) and Bengal Arum (*Typhonium trilobatum* (L.) Schott) are the other commonly found minor tuber crops. Various ethnic food preparations in combination with meat, fish or dry fish are very much popular among the tribal communities.

Key words: Minor tuber crops, tuber crop variability, ethnic foods,

Introduction

Tuber crops are very much popular in Tripura among the tribal as well as non-tribal communities. In Tripura, taro and elephant foot yam together occupies around 1.32 thousand ha area with a production of 22.74 thousand MT. Productivity of taro is 16.5 MT ha^{-1} and elephant foot yam is 22 MT ha^{-1}. Climate of Tripura is tropical with hot and humid summer, low temperature in winter season, and main precipitation is monsoon rainfall with pre-and post-monsoon rainfall as well. Average rainfall of the state is 24500 mm, temperature range in summer, rainy season and fall is 20-36° C and winter temperature range is 5-18° C. Apart from the climatic suitability, topography is also very much suitable for different types of tuber crops. Another most important aspect is 31.75%

of the total population of the state is schedule tribe (ST) comprising 19 sub tribes. The main source of livelihood of majority of the tribal population is agriculture and different models of integrated farming systems comprising various compatible components of agricultural and horticultural crops as well as animals are integrated. The most common farming system adopted by the tribal farming communities is rice and tuber crop based agri.–horti.–piggery–gottary–fishery system. Moreover, under climate change scenario, considering the biotic and abiotic stress on the main agricultural and horticultural crops, the potential of tuber crops can be

exploited in the north eastern states like Tripura by prioritizing germplasm conservation and improved variety introduction and production technology intervention in a farming system mode or mono cropping system. The present study was carried out with the objectives to collect and evaluate the tuber crops found in Tripura and also to explore the tuber crop based ethnic foods.

Materials and Methods

The present study was carried out during 2013-2015 in the ICAR Research Complex for NEH Region, Tripura Centre, Lembucherra, Tripura, situated between latitudes 22°56' and 24°32' North, and longitudes 90°09' and 92°20' East. Different types of tuber crops were collected from different areas of the state after extensive survey in the cultivated, wild and semi wild habitats of the major and minor tuber crops in the state. Planting materials were multiplied in the experimental blocks in the Tripura Centre. Some of the major tuber crops were also introduced from Central Tuber crops Research Institute, Thiruvananthapuram (Kerala), and Bhubaneswar (Odisha) which were already being maintained in the germplasm blocks in the Tripura Centre. All the tuber crops were evaluated for vegetative and reproductive growth parameters such as plant growth, petiole growth, leaf size, tuber weight, length and breadth/girth and total yield potential. Stolon length and diameter were also recorded on taro and swamp taro collections. Informations on tuber crop based traditional foods and ethno medicinal uses were also gathered from various tribal households. Different ingredients were cataloged and recipes were recorded.

Results and Discussion

Tuber crop genetic resources

In Tripura, there are two vernacular names for each tuber crop, one in *Kokborok* language (tribal language) and another in Bengali language (Table 1). Apart from different major tuber crops, many minor tuber crops are also cultivated as well as found in wild or semi wild habitats in the state. Among the major tuber crops, elephant foot yam (*Amorphophallus paeoniifolius* (Dennst.) Nicolson) is grown in upland areas. Locally it is known as '*Ol Kochu*' in Bengali and '*Batema*' in *Kokborok*. In '*Jhum*' land (Shifting cultivation practices) some local types of

Table 1. Different types of tuber crops found in natural habitats and cultivation in Tripura

Sl. No.	Name of the crop	Scientific name	Vernacular name in Bengali (B) and *Kokborok* (K)	Habitat in Tripura	Nature of acridity (Soluble oxalate)	Plant parts used for edible purpose
1	Elephant foot yam	*Amorphophallus paeoniifolius* (Dennst.) Nicolson	Ol Kochu (B)/ Bathema (K)	Cultivated in Upland	Low	Tuber and petiole
2	Wild elephant foot yam	*A. bulbifer* (Roxb.) Blume., *A. sylvaticus* (Roxb.) Kunrth. and *Amorphophallus muelleri Blume*	Dakaduma or Gangli Ol kochu (B)/ Mui morong or Bolong batema (K)	Wild-semi wild lands under forest trees.	Petiole low to Medium, but tubers are extremely acrid	Immature bud sprouts, petiole and tuber
3	Greater Yam	*Dioscorea alata* L.	Chupri alu or Ban alu (B)/ Thaduk (K)	Cultivated at bunds and trails on trees.	Low to medium	Tuber
4	Lesser yam	*Dioscorea esculenta* (Lour.) Burkill	Suthni alu or Susnialu (B)/Thaktwi waksa (K)	Semi wild and cultivated at bunds and trails on trees.	Low to medium	Tuber
5	Areal Yam	*Dioscorea bulbifera* L.	Pesta Alu or Gachh Alu or Mou alu (B)/Tha Borok (K)	Semi wild and cultivated at bunds and trails on trees.	Low	Tuber and areal Bulbils

6	Mountain yam	*Dioscorea hamiltonii* Hook. F.	Ganga (B)/ Thakun or Tha Lang Ta (K)	Semi wild type	Low	Tuber
7	Five leaf yam	*Dioscorea pentaphylla* L.	Saura alu(B)/Tha Bolong (K)	Wild type	Low	Tuber
8	Chinese yams	*D. oppositifolia* L.	Kanta alu (B)/Tha Bolong (K)	Wild	Low	Tuber
9	Cassava	*Manihot esculenta* L.	Shimul Alu (B)/ Tha Borchuk (K)	Semi wild and cultivated	Low	Tuber
10	Taro: Eddoe type (Taro)	*Colocasia esculenta var. antiquorum* Schott.	Arbi or Chara Kochu or Mukhi kochu (B)/ Tha Badia (K)	Cultivated	Low to medium	Rhizomes, petiole and leaves
11	Taro: Dasheen type (Bunda)	*Colocasia esculenta var. esculenta* (L.) Schott	Panchamukhi (B)/ Mayung kafer (K)	Cultivated	Low to medium	Rhizomes, petiole and leaves
12	Taro (Semi wild green petiole)	*Colocasia esculenta* (L.) Schott	Lati Kochu (B)/ Maittu (K)	Grown in waste land near water bodies or marshy land along the bunds.	Medium to High	Petiole, leaves, stolon and rhizome.
13	Taro (semi wild red petiole)	*Colocasia esculenta* (L.) Schott	Lal lati kochu (B)/ Maittu(K)	Grown in waste land near water bodies or marshy land along the bunds.	Medium to High	Petiole, leaves and stolon
14	Sweet potato	*Ipomoea batatas* (L.) Lam.	Misti alo (B)/ Jenga Thaktoi (K)	Cultivated	Nil	Tubers
15	Swamp taro: Green petiole	*Colocasia esculenta var. stolonifera* L Schott	Jal kochu or Panu kochu(B)/	Cultivated in marshy low land	Low	Rhizome, petiole and stolon
16	Swamp taro: Red petiole	*Colocasia esculenta var. stolonifera L Schott*	Jal Kachu or Maan kochu (B)/ Tuini khama (K)	Cultivated in marshy low land	Low	Rhizome, petiole and stolon
17	Swamp taro: Purple petiole	*Colocasia esculenta var. stolonifera* (L.) Schott	Jal kachu (B)/ Gorashi or khama (K)	Cultivated in marshy low land	Low	Rhizome, petiole and stolon
18	Swamp taro: Semi wild type	*Colocasia esculenta var. stolonifera* (L.) Schott	Jagnli jal kochu (B)/ Bolong khama (K)	Grown in waste land near water bodies or marshy land along the bunds.	Medium to high	Small rhizomes, petiole, leaves and stolon
19	Elephant ear taro/ Giant rooted taro	*Alocasia macrorrhiza* (L.) G. Don	Fen kochu or Man kochu(B)/Borkachu (K)	Naturally grows or planted at back yard waste areas	medium	Giant rhizome

20	Giant taro/Giant arum	*Steudnera colocasoides* Hook. f.	Bish Kochu or Sala kochu (B/K)	Semi wild conditions or planted at back yard waste areas. Grows under shades.	Extreme	Giant rhizome
21	Bengal arum	*Typhonium trilobatum* (L.) Schott	Ghat Kanchu or Kharkon kochu/ Kharkon (K)	Wild shady conditions	Petioles low to medium, tuber is acrid.	Tender leaves and stems
22	Tannia: Blue/ purple petiole	*Xanthosoma violaceum* (L.) Schott	Jari kocu or Radha kochu (B)/ Sammua Tha (K)	Naturally grows in semi wild conditions Grows under shades I semi wild conditions	Low to medium	Petioles
23	Tannia: Green petiole	*Xanthosoma violaceum* (L.) Schott	Jari kochu or Krisha kochu (B)/) Manai (K)	Naturally grows in semi wild conditions Grows under shades and semi wild conditions.	Low to medium	petioles
24	Tannia: Errow leaf elephant's ear	*Xanthosoma sagittifolium* (L.) Schott	Dud Kachu (B)/ Manai (K)	Cultivated	Low to high	Rhizome and petiole
25	Tania: Ornamental	*Xanthosoma spp.*	Foliage plant	Cultivated as or namental plant	Medium	Not edible

elephant foot yams are grown and tuber size of these types is comparatively smaller. Tubers and tender petioles of elephant foot yam are consumed and used also for traditional medicinal purpose. Tubers of wild elephant foot yam (*A. bulbifer* (Roxb.) Blume and *A. sylvaticus* (Roxb.(Kunth.) are smaller and extremely acrid due to high content of soluble oxalates. These are locally known as '*Mui morong*' or '*Bolong Batema*' in *Kokborok* (Table 1). Plant height, tuber diameter and tuber weight of varieties Tripura Batema and Gajendra were 117.4 cm and 115.6 cm, 30.4 cm and 30.1 cm and 6.7 kg plant^{-1} and 6.4 kg plant^{-1}, respectively (Table 2). Total yield was 30.4 t ha^{-1} in Tripura Batema and 20.5 t ha^{-1} in Gajendra. Tuber weight of other varieties namely Appa Kudal, Sree Padma and Sree Athira was 4.6 kg plant $^{-1}$, 5.8 kg plant^{-1} and 5.4 kg plant^{-1}, respectively. Greater yam (*Dioscorea alata* L.), called '*Thaduk*' in *Kokborok*, is cultivated along the bunds and slopes by trailing on the trees or bamboo poles. Average tuber length of var. Tripura Tha is 54.0 cm with 14.6 cm diameter (Table 3). Average yield recorded was 5.4 kg plant^{-1}. It was closely followed by Odisha Elite. Lesser yam (*D. esculenta* (Lour.) Burkill), called '*Thaktwi Waksa*' in *Kokborok*, has its natural habitat under cultivated as well as semi wild conditions. Tuber length of commonly grown lesser yam is 18.4 cm and diameter is 12.5 cm. Other minor yams are aerial yam (*D. bulbifera* L.), mountain yam (*D. hamiltonii* Hook. F.), Chinese yam (*D. oppositifolia* L.) and five leaf yam (*D. pentaphylla* L.) called '*Thwngui*', '*Thakun*' or '*Tha Lang Ta*', '*Tha Bolong*' and '*Tha Kwiccha*', respectively in *Kokborok* (Table 1). Tapioca (*Manihot esculenta* L.), called '*Tha Burchuk*' in *Kokborok*, is grown at the back yard of tribal household. Some semi wild types are also found in hilly areas in Northern parts of the state. Tuber length and diameter ranged from 33.4 to 39.5 cm and 7.5 to 9.4 cm, respectively among the var. Sree Vijaya, Sree Prakash and Sree Jaya. Tuber weight ranged from 2.5 to 3.6 kg plant^{-1} in the respective varieties (Table 4).

Table 2. Physical parameters and yield of different elephant foot yam varieties and local collection in Tripura

Variety	Plant height (cm)	Petiole dia. (cm)	Rachis spread (m^2)	Shoot weight (g)	Tuber dia. (cm)	Tuber length (cm)	Tuber weight (kg $plant^{-1}$)	Yield (t ha^{-1})
Gajendra	115.6	16.7	1.23	0.8	30.1	13.5	6.4	29.5
Tripura Batema	117.4	16.8	1.3	0.75	30.4	13.7	6.7	30.4
Jhum Batema	80.4	5.3	0.64	0.31	15.8	9.4	0.5	12
Local wild Bathema	50.6	3.5	0.5	0.23	8.2	6.5	0.21	5
Appa Kudal	112	13.2	1.13	0.65	25.3	10.4	4.6	24
Shree Padma	108.1	13.4	1.17	0.74	26.5	12.1	5.8	26.5
Shree Athira	100.4	10.5	1.15	0.6	23.7	10.2	5.4	23.3
CD (0.05)	4.1	1.2	0.7	0.15	1.5	1.5	0.11	3.5
CV(%)	24.9	46.2	30.8	38.6	35.4	23.3	64.6	44.1

Table 3. Physical parameters and yield of different yam varieties and local collection in Tripura

Crop	Branch No./plant	Thickness of main stem (cm)	No. of tubers (cm)	Tuber length (cm)	Tuber dia. (cm)	Cumulative weight tuber (kg/plant)	Yield (T/Ha)
Tripura Tha (Greater Yam) *D. alata*	6.4	1.3	2.5	54	14.6	5.4	22.4
Odisha Elite	6.3	1.2	2.3	49.6	13.5	5.8	20
Areal yam underground tuber (*D. bulfifera*)	7.4	1.6	1.2	20.3	18.2	5.5	14.3
Local Tha (Lesser Yam) *D. esculenta*	7.3	1	2.2	18.4	12.5	3.4	12.3
Local Greater Yam (*D. alata*)	7	1.5	2.3	47.4	14.2	4.8	18.4
Mountain yam (*D. hamiltonii*)	5.4	1.5	2.5	55.2	11.3	2.5	12.5
Chinese yam (*D. oppositifoilia*)	5.6	1.4	2.4	90/5	10.5	3.5	18.6
CD(0.05)	0.5	0.1	0.12	4.3	0.5	0.14	1.3
CV(%)	7.4	18.1	24.5	48.3	14.8	19.2	23.6

Table 4. Physical parameters and yield of different tapioca varieties and local collection in Tripura

Variety	Plant height (m)	No. of inter-nodes	Stem diameter (cm)	Internodal distance (cm)	No. of tubers (cm)	Tuber length (cm)	Tuber diameter (cm)	Tuber weight (kg/plant)	Maturity	Yield (T/Ha)
Shree Vijaya	2.45	66.5	7.2	6.3	9.5	35.4	7.5	3.6	7	30.5
Shree Prakash	2.46	67.2	7.5	7	6.6	33.4	8.3	2.5	7.5	27.6
Shree Jaya	2.5	69.5	7.8	6.4	8.4	39.5	9.4	3.2	6.5	33.5
Tripura Local	3	88.2	6.4	3.5	7.3	26.5	6.5	2.5		26.4
CD(0.05)	0.6	2.5	0.11	1.3	0.52	3.2	1.6	0.2	0.15	2.1
CV(%)	10.2	14.2	8.3	27	16	16.1	15.5	18.5	7.1	10.8

Eddoe type taro (*Colocasia esculenta* var. *antiquorum* Schott.), called '*Tha Badia*' in *Kokborok*, is widely grown in plains and hills of the state. Vegetative and yield parameters (Table 5) of variety Muktakeshi were recorded to be 105.6 cm plant height, 917.7 cm^2 leaf spread index, 7.4 numbers of corm/plant, 4.3 cm corm diameter, 6.8 cm corm length and 56.0 g weight of corms and 11.6 t/ha yield. Number of corms/plant, corm weight and yield in other local selections ranged from 3.2-6.5, 24.0-54.2 g and 4.3-11.6 t/ha, respectively. Stolon length and diameter in different local selections varied from 60.4-66.5 cm and 11.2-12.2 mm, respectively. There are two

Table 5. Physical parameters and yield of different taro varieties and local collection in Tripura

Crop	Plant height (cm)	Leaf spread index (cm^2)	Petiole base dia. (cm)	Petiole dia. (cm)	Corm/ plant	Corm length (cm)	Corm dia. (cm)	Corm weight (g)	Yield (T/Ha)	Stolon length (cm)	Stolon dia. (mm)	Petiole colour	Stolon colour	Mother corm weight (g)
Local (South) 1	110.3	724.8	4.5	2.1	5.4	4.6	3.4	24	7.3	63.4	11.3	Pale green	Pale green	65.3
Local (South) 2	108.5	719.8	5.1	2.4	6.3	6.8	4.1	38.3	10.5	64.3	11.7	Pale green	Pale green	72.5
Local (South) 3	100.3	881.1	5	2.6	6.5	7.1	4.6	54.2	11.6	66.5	11.5	Pale green	Pale green	70
Muktakeshi	105.6	917.7	6.1	2.6	7.4	6.8	4.3	56	11.6	30	12.5	Pale green	Pale green	76
Local (West)-1	85.4	559	4.2	2.2	5.6	5.2	4.4	35.8	6.5	63	12.5	Pale green	Pale green	62.4
Local (Semi wild) Green	82.1	712	4.4	2	3.2	4.6	3.8	24.2	4.3	60.4	11.2	Pale green	Pale green	54.2
Local (Semi wild) Black-Reddish	86.3	638.8	4.2	2.1	3.6	4.9	3	26.9	4.7	60.4	12.4	Reddish	Reddish	52.4
CD(0.05)	1.3	5.3	0.2	0.11	0.1	0.12	0.1	2.1	1.2	0.5	0.1			2.6
CV(%)	12.4	17.2	14.2	10.8	28.3	19.8	14.6	32.5	39	28.8	25.7			13.9

types of semi wild taro on the basis of petiole colour, one is green and another is maroon blackish red type. Both are called '*Maittu*' in *Kokborok* and these are mostly preferred for stolons or even acrid corms are also consumed by the tribal people. Two types of swamp taro or Chinese taro (*Colocasia esculenta var. stolonifera* (L). Schott) are widely cultivated, locally known as '*Jal Kochu*' in Bengali and '*Tuini Khema*' in *Kokborok*. These are green petiole swamp taro (leaves and petiole green and rhizome skin brown with slight greenish tinge) and red petiole swamp taro (petiole dark reddish maroon/burgundy/crimson and rhizomes skin dark brown and maroon). Petiole colour of another distinct swamp taro type is greenish light purple and rhizomes skin brownish with light purple blush. Semi wild type swamp taro is called '*Bolong Khema*' in *Kokborok*. Plant height, girth of rhizome, rhizome length and rhizome weight in different local types were in the range of 70.2-153.2 cm, 30.3-44.5 cm, 20.6-62.0 cm and 300g-5.9 kg/plant, respectively. Yield ranged from 6.5-118.3 t/ha (Table 6). Stolon length varies from 45.8-55.3 cm in length and 15.7-23.4 mm in diameter. Sweet potato (*Ipomoea batatas* (L.) Lam.), called '*Jenga Thaktoi*' in *Kokborok*, found in the state is specifically white/creamy fleshed. Variability was observed in leaf shape, tuber skin colour and tuber shape and size (Table 7). Different types of leaf shape recorded were broad cordate, elongated cordate, palmately lobbed, palmately compound and cordate. Tuber weight ranged from 195.5-270.4 g, tuber length and diameter ranged from 18.5-22.5 cm and 3.4-7.8 cm, with yield in the range of 15.5-25.5 t/ha. Variation in skin colour in was also recorded.

Among minor tuber crops (Table 8), Big rooted taro or Elephant ear taro (*Alocasia macrorrhizos* (L.) G. Don), locally known as '*Man Kochu*' or '*Fen Kochu*' or '*Bor Kochu*', which also is perennial type and plants are bigger. Another type of giant taro (*Steudnera colocasioides* Hook. f.), locally known as '*Bish Kochu*' or '*Sala Kochu*', is perennial type and loves shady places. Leaves

Table 6. Physical parameters and yield of different swamp taro varieties and local collection in Tripura

Crop	Plant height (cm)	Leaves No./plant	Thickness of joint petiole base (cm)	Girth of rhizome (cm)	Rhizome length (cm)	Petiole length (cm)	Rhizome weight (Kg)	Yield (t ha^{-1})	Petiole colour	Stolon length (cm)	Stolon Dia.(mm)	Stolon colour
Swamp Taro 1	153.2	4.1	45.8	41.2	62.0	91.2	5.9	118.3	Green	51.4	23.4	Pale green
Swamp Taro 2	127.5	4.5	51.9	44.5	52.1	75.4	4.4	88.4	Green	50.7	20.6	Pale green
Swamp Taro 3	122.7	4.5	44.3	39.6	46.7	76.0	4.7	94.6	Green	48.5	23.1	Pale green
Swamp Taro 4	140.5	5.2	44.5	39.4	56.1	84.3	5.8	116.3	Blackish Red	52.4	20.3	Reddish
Swamp Taro 5	117.4	4.3	42.5	39.0	51.8	66.3	0.8	84.2	Green	53.6	19.5	Pale green
Swamp Taro 6	115.6	5.5	46.2	41.7	47.2	67.6	4.6	92.7	Purple tinge	55.3	22.4	Purple
Swamp Taro 7	107.4	4.6	44.4	39.2	46.5	61.2	5.2	104.3	Blackish Red	45.8	17.5	Reddish
Swamp Taro 8	70.2	5.3	32.0	30.3	20.6	50.3	0.3	6.5	Green	40.3	15.7	Pale green
CD(0.05)	2.5	0.4	1.5	2.2	1.8	2.6	0.24	0.6	-	2.6	1.3	—
CV(%)	11.6	10.8	6.1	5.7	12.5	13.3	28.8	23.6		5.8	9.4	

Table 7. Physical parameters and yield of sweet potato collections in Tripura

Crop	Vine length (m)	Leaf shape	Leaf length (cm)	Leaf breath (cm)	No. of tubers/ plant	Tuber weight (g)	Skin colour	Flesh colour	Tuber length (cm)	Tuber dia.(cm)	Yield/ plant (kg)	Yield (t ha^{-1})
Kamala Sundari	1.3	Broad Cordate	12.2	13.5	3.2	270.4	Light creamy purple	Creamy white	20.4	5.4	0.75	20.4
Sweet Potato Selection 1	2.1	Elongated Cordate	16.4	10.5	3.5	230.0	Dark Purple	Creamy white	22.5	3.6	0.80	19.4
Sweet Potato Selection 3	2.3	Palmately Lobbed	13.4	12.6	3.3	204.6	Pale whitish brown	Yellowish white	19.5	3.4	0.67	15.5
Sweet potato Selection 4	2.6	Palmately compound	17.3	13.5	3.2	195.5	purple	Yellowish white	21.4	4.3	0.65	16.5
Sweet Potato Selection-5	2.4	Cordate	14.4	12.6	3.5	285.3	Creamy whitish brown	Creamy white	18.5	7.8	0.9	25.5
CD(0.05)	0.25	—	1.4	0.3	0.10	6.2	—	—	1.3	0.5	0.15	2.4
CV(%)	23.5		14.3	9.8	4.5	16.7			7.7	36.7	13.5	20.2

Table 8. Physical parameters and yield of different minor tuber crop collections in Tripura

Crop	Plant height (cm)	Petiole Nos./plant	Leaf length(cm)	Leaf breath(cm)	Thickness of petiole Base (cm)	Petiole length(cm)	Rhizome length (cm)	Rhizome girth (cm)	Weight of rhizome (Kg)
Giant taro or Bish Kachu (*Alocasia fornicata* (Roxb.) Schott)	195.5	4.5	96.5	70.5	37.5	45.6	85.6	41.3	4.6
Elephant ear taro or Giant rooted taro (*Alocasia macrorrhizos* (L.) G. Don)	231	4.6	118.6	95.4	45.3	65.8	110.6	55.5	8.5
Tannia: Errow leaf elephant's ear (*Xanthosoma sagittifolium* L. (Schott.)	61.0	3.4	35.3	26.2	15.6	45.4	26.5	16.4	0.25
Semi wild green petiole tannia (*Xanthosoma violaceum* (L.) Schott)	107.2	4.1	60.2	50.4	18.5	87.9	20.4	21.3	0.2
Semi wild blue petiole tannia (*Xanthosoma violaceum* (L.) Schott)	108.4	4.4	59.8	50.2	19.1	88.4	20.6	20.7	0.18
Panchmukhi (*Colocasia esculenta var. esculenta (L.)*	94.6	4.3	55.4	41.2	22.5	49.1	21.3	31.4	0.8
Bengal Arum (*Typhonium trilobatum (L.) Schott*	25	3.5	20.3	14.5	2.5	23.0	4.0	3.1	0.1
CD(0.05)	5.6	0.10	2.5	2.7	2.4	6.1	2.5	2.8	2.3
CV(%)	68.8	11.7	51.7	47.6	62.0	46.0	96.9	60.1	152.9

are broad and rhizomes are extremely acrid. Hence, after proper curing only these rhizomes

are cooked. Respective plant height is 231 and 195.5 cm, leaf length 118.6 and 96.5 cm and breadth 95.4 and 70.4 cm, whereas, rhizome length is 110.6 and 85.6 cm with girth 55.5 and 41.3 cm. Both green petiole and blue/purple petiole tannia (*Xanthosoma sagittifolium* L. (Schott.) types are cultivated. Moreover, two semi wild types of tannia (*X. violaceum* (L.) Schott) are found in the state namely green petiole taro (locally called '*Jari Kochu*' or '*Radha Kochu*' or '*Sammua Tha*') and purple blue petiole taro (locally called '*Jari Kochu*' or '*Krishna Kochu*' or '*Manai*'). Respective plant height ranges from 61.0 to 108.4 cm. Panchmukhi (*Colocasia esculenta* var. *esculenta* (L.), which is *Bunda* type and called '*Mayung Kafer*' in *Kokborok*, is also cultivated and rhizome length is 21.3 cm. Bengal Arum (*Typhonium trilobatum* (L.) Schott) is found in wild and semi wild habitat. Plant height, leaf length and breadth are 25 cm, 20.3 cm and 14.5 cm, respectively. Other commonly found wild *Allocasia* spp. are *Alocasia fornicata* (Roxb.) Schott, *A. odora* (Roxb.) Koch and *A. decipiens* Schott.

Variability in tuber crops, inter and intra genera as well as spices, is very common in India (Edison *et al*., 2006 and Palaniswami *et al*., 2008). North Eastern India is one of the important centers of distribution for root and tuber crops among the five areas demarcated in India. Shadeque (1989), Sharma and Hore (1995) and Mehdi and Borthakur (2011) reported a wide range of variability in tuber crops in this part of the country. Various species of greater and lesser yams have been reported to exist in the North Eastern India and Bangladesh (Sharma and Hore, 1995 and Islam *et al*., 2011). Sivadasan and Jaleel (2000) reported existence of 16 spices in India and Anil *et al*. (2011) recorded a wide range of

variability in *Amorphophallus paeoniifolius* collected from different parts of India. Greater variability among various swamp taro on plant morphological and stolon characters were also reported by Mitra (2013). In case of eddoe as well as bunda type taro, a vast range of traditional non-descript, but superior in traits have been reported to exist in the north eastern states (Buragohain *et al*., 2013).

Ethnic foods and ethno medicinal uses

Elephant foot yam, greater and lesser yams and cassava are commonly cooked with fresh or dry fish or meat along with spices (Fig 1b). Elephant foot yam is also meshed into paste after boiling to prepare '*Bata'* or *'Bharta*'(Fig 1a). Other than these, there are some wild types of elephant foot yams. Unfolded tender leaf sprouts clasped with spathe of these wild elephant foot yams (locally called *Dakadoma*) are deep fried after removing the spathe coated with gram (*Besan*) or rice flour paste. Chopped pieces of tender petioles at mature stage are also cooked with dry fish. Extremely acrid tubers of these plants are peeled after putting hand gloves. Slices are boiled with common soda for 10-15 min and dried under shade. These slices are cut into small pieces and cooked with dry fish and spices (Fig 2c). Pieces of swamp taro or common taro stolons are cooked with dry fishes or some times without dry fishes (Fig 1d). Swamp taro rhizomes are cut into slices (approx. 1 cm thick), dipped into *besan* (gram flour) or rice flour paste and deep fried and called '*Kochu Bhaja*' (Fig 1c). Grated rhizomes are also cooked with various spices and fish. Boiled swamp taro petioles are chopped, meshed and cooked with *Dolichos* roasted seeds, peanuts and other spices (or even roasted small prawns are also added) to prepare '*Kochu Saag*' (Fig 2a). Arbi corms are mainly cooked with fish and sometimes with dry fish locally called '*Charar Dal*'. Taro leaves are also chopped or grinded and cooked with dry fish as '*Saag*' and also cooked by adding tamarind with boiled and meshed leaves locally called '*Kochu Patar Tak*' or '*Ambal*'. Cultivated or semi wild taro flower spathes are cut into pieces after removing the spadix and cooked with dry fish (Fig 2d). *Bish Kochu* (giant taro) rhizome, which is extremely acrid, is kept under shade for almost one week

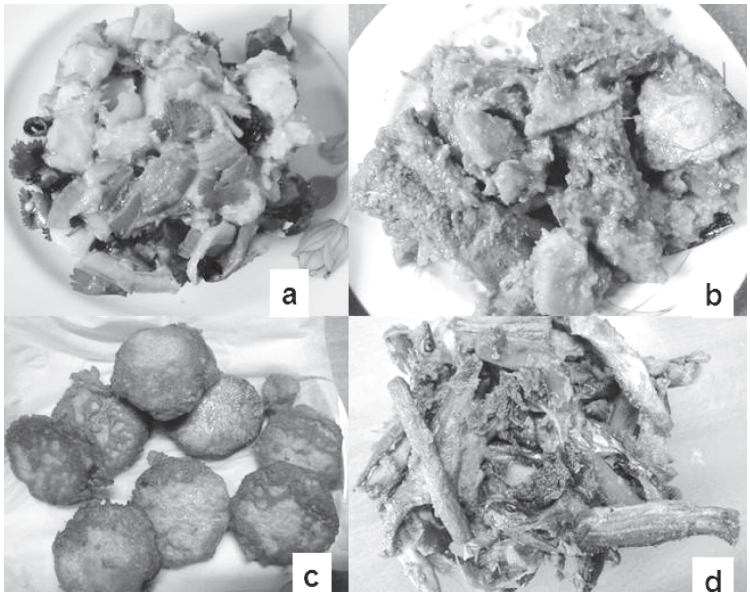

Fig. 1. Traditional tuber crop based foods: a. Elephant foot yam tuber Bhartha, b. Dioscorea tuber with fish, c. Swamp taro rhizome with fry and d. Stolon with dry fish.

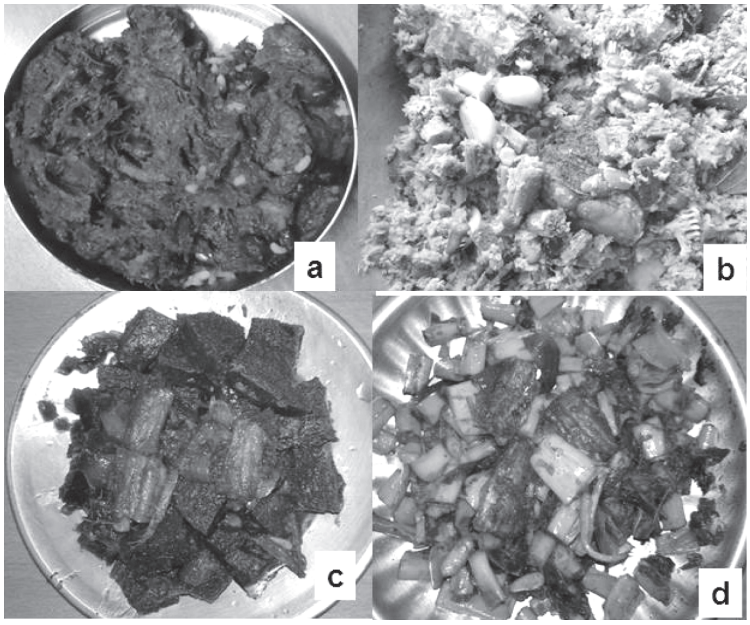

Fig. 2. Traditional tuber crop based foods: a. Swamp taro petiole *sag*, b. *Bish kochu* rhizome with fish, c. Wild elephant foot yam tubers with dry fish and d. Taro flower spathe with dry fish.

after uprooting the rhizome for curing to reduce acidity. Rhizome is grated and cooked with fish, *Dolichos* roasted seeds (Fig 2b). Cooking on mid flame for long duration (40-50 min.) neutralize the acridity. If acidity persists then tamarind is added. Sometimes, small pieces of peeled rhizomes are blanched and cooked with fish/meat and spices in gravy. Elephant ear taro or giant rooted taro locally called *Fen Kochu* is also prepared by grating similarly as *'Bish Kochu'* or grinded into paste to prepare '*Kochu Bata'* with mixture of spices. Moreover, peeled rhizome is cut into small slices of 1 cm thick, blanched and deep fried by coating with gram flour paste as '*Kochu Bhaja*. Green or purple blue taro (*Xanthosoma* spp.) petioles are chopped and cooked with lentil or pigeon pea or any other pulses. Chopped leaves of these taros are cooked with dry fish as '*Sag'*. Apart from dietary supplements, tuber crops are rich in protein, crude fibre, starch, vitamins and minerals. Nutritive value of some traditional tuber crops found in north eastern India namely *Alocasia* spp., *Colocasia* spp. and *Xanthosoma* spp. has been well reported by Sharma *et al*. (2016). All these crops are also rich in minerals like Zn, Ca and Fe. Significance of all these tuber crops as ethnic food has also been well reported by Vidyarthi (1987), Medhi and Borthakur (2011) and Deb *et al*. (2013). Taro leaves are rich in protein, vitamins, minerals and dietary fibre (Opara, 2003).

Petiole and tubers of elephant foot yam, cultivated as well as wild types, are used to cure cough, piles, asthma and as blood purifier. Yams are used to cure fever, cough, head ace, gonorrhia, leprosy, abdominal pain and constipation. Boiled tubers of aerial yam are taken orally to arrest dysentery and leaf paste applied on burns and boils. Taro petiole sap is applied on wounds for blood coagulation and to cure fever and cough. Taro is also used to cure piles and tonsillitis. Boiled leaves are consumed to meet the mineral deficiencies. Swamp taro is used to treat liver problems, ulcers and rheumatism. Meshed giant taro rhizome paste is applied on painful parts in gout and rheumatism. It also relieves oedema and constipation. Bengal arum leaves and tubers used against bleeding piles, rheumatism and also in curing skin eruption, tuberculosis and tetanus. Medicinal uses of all these tuber crops have well been reported by Das *et al*. (2006), Sharma *et al*. (2008), Saikia *et al*. (2010) and Mehdi and Borthakur (2011). The reason for use of tuber crops in ethno medicinal purpose by the tribal traditional healers in the state might be due to the fact that tuber crops are rich in anti-oxidants and other phytochemicals, and show significant antibacterial activities (Mulla *et al*., 2009, Hurkadale *et al*., 2012 and Sheikk *et al*., 2013).

Conclusion

There is rich diversity in major and minor tuber crops in Tripura being a part of areas identified as areas of distribution and variability. All these tuber crops are integrated in the farming system mode of agriculture practiced by the tribal farmers and meet out their family nutritional requirement, used as feed for pigs and also earn good income. There is an urgent need to conserve the traditional tuber crops and popularization of tuber crop based farming system at larger scale in the state.

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