Analysis of Qualitative Characteristics of Indigenous Taro Species of Manipur

Kh. Swarnalata Devi[1], Joydip Mandal[2], A. K. Bijaya Devi[3]

Department of CIHAB, Visva-Bharati, Shantiniketan 731235, CAU Iroisemba Imphal Manipur 795004, India
Email ID: *swarna.lata.khwairakpam[at]gmail.com*

Abstract: ***The study were to analyse the qualitative characteristics of 6Taro (colocasiaesculenta) varieties representing a core sample of the germplasms collection to assess the possibility of selecting varieties according to their quality content and to relate those characteristics with local consumption based on superior eating quality, Altogether, 32 accessions were collected and studied the morphology, phenotype and genotype described during 3 years. The superiors varieties are sorted out and analysed their corms were made for percentage of dry matter, starch, sugars, Nitrogen range. Significant variation exists for each of these characteristics. Varieties with good eating quality are characterised with high dry matter, starch and sugar contents.***

Keywords: Qualitatives, Taro, Germplasm, Food quality, Starch

1. Introduction

Taro (*Colocasiaesculenta (*L). schott) is the most widely distributed stem tuber species in the tropical and sub-tropical regions of the world (Okonkwo, 1993). The family Araceae comprises about 117 genera and 4095 species distributed mostly in tropical areas (Stevens, 2012). The genus *Colocasia* includes 8-16 species native to tropical Asia. The species *C. esculenta*, also known as Taro or Cocoyam, is cultivated and naturalized throughout the tropics (Acevedo-Rodríguez and Strong, 2005; Randall, 2012). Stem tuber crops are very important agricultural crop of Manipur for its adaptation to the agroclimatic conditions of the state. They are widely adapted and vegetative propagation are very fast and high. They start to grow from the premonsoon period and harvested on the month of October The whole plant are also edible and can substitute the cereal crops as food. Taro is a crop with potential for increased commercial advantage Harvesting alone can account of the total production costs andis also largely dependent on tuber shape (Onwueme and Charles 1994) Selection could overcome the difficultyof producing new varieties in a crop. Few studies have been conducted on the physico-chemical of *Colocasia esculenta*. Martin (1974) observed in Puerto Rico that high dry weights are associated with fine structure, dense feel, high quality, and concluded that high density is a varietal character that is not changed much by environmental influences. The lack of information on variation within Colocasia esculenta hinders its prospective utilisation as a high quality exportable vegetable. Rajesh Kumar and Jain (1999) evaluated 30 accessions of less diversified group of Dasheen type Colocasia (*Colocasia esculenta* var. esculenta) for growth, corm yield with its attributes and qualitative parameters during kharif seasons. In most places of Manipur, these plants are used mainly in the preparation of three important cuisines i.e. *Paan-thongba*, *Paan-eronba* and *Paan-ootti* made from corms and leaves. The present study aims at providing information on the qualitative variation of Colocasia. (*C.esculenta)* tuber corms from selected varieties collected in Manipur area where significant genetic diversity has been detected with Morphological characterization (swarnalata 2013). The objectives of the study were: (1) to analyse the qualitative characteristics of 6 Colocasia esculenta varieties representing of the germplasm collection; (2) to assess the possibility of selecting varieties according to their qualitiy content. (3) to relate those characteristics with local quality consumption based on superior quality.

2. Materials and methods

Selection of a good quality

Overall, between 2009 and 2011, 32 accessions of *Colocasa esculenta*. were collected from the different places of the Manipur (Table 1), These accessions were planted during the first week of May every year during three growing seasons, from 2009 to 2011, at CAU (Central Agricultural University) Iroisemba (Figure 1), which receives: The total rainfall received during the crop season (May to October, 2009 and 2010) was 142.52 mm and 214.85 mm, respectively of rainfall per year, Each accession was represented by 4 plants, established8 m2square, with four individual. Each year, the harvest began in September for early maturing types and lasted until October for late maturing types, each year these accessions were described using 32 internationally standardised morpho-agronomical 1200 descriptors (IPGRI 1997). The results were compiled in a database in ExcelTM format, corrected orupdated every year, and duplicates were identified. The Manipur germplasm collection was finally found to present at least 32 distinct morphotypes (Swarnalata 2013). It was then decided to assemble a core sample including 20% of these morphotypes and representing the extent of variation observed for the tuber corms based on morphological data, combined with knowledge about the structure of the germplasm was used to stratify the collection. Overall, 32 varieties were finally selected based on their: (a) dry matter contain; (b) starch quality; (c)sugar content ; (d) nitrogen content (e)corm shape; (f) corm yield. Particular attention was also given to some particular morphotypes so that the maximum variation could be included. Good varieties appeared to have characteristics are well accepted, Physico-chemical characteristics of dried tuber corm. During the growing season May 2009-October 2010), the 32 varieties belonging to the good varieties were each. These four plants were planted and harvested the same day, when that variety was mature. No visual variation was ever observed between the four replicate. Fresh corms were cut for each of the six plants and bulked into one sample per variety. Central transverse sections (approx. 10 cm thick) of the corms were cut for each of the four plants and bulked into one sample per variety. The cormel of selected plants was dried in oven at 60 $\pm 2^0$C to a constant weight. The weight of fresh and dry cormels was recorded by digital balance in gram. Dry matter samples (flours) produced at the Laboratory of the Biochemistry Department of Central Agriculture University in Manipur and all analyses were conducted Dry matter (D.M., % fresh weight), starch (% dry weight), total sugars contents were determined. Crude protein contents were calculated from nitrogen contents (N · 6.25) obtained using the Kjeldahl method. All analyses were performed in duplicate. The onset and the end temperatures of the gelatinisation transition of starch were calculated with a linear base line between 55 and 90 _C. Data analysis. The computations were expedited by the computer programme NTSYS (Exeter Publishing Ltd., Setauket, N.Y.).

3. Results

3.1 Selection of the good quality

Variation and frequencies of the most significant All 32 accessions present in the germplasm collection were scored for their eating quality and 6 accessions were found to present corm with good eating quality (12.7%), while 26 were rated as average. The list of the 6 varieties included in the good quality is presented in Table 3. Accessions originating from different districts, out of the two places of Imphal west district surveyed, were included. Varieties with different eating qualities (6 good accessions, 10average and 16 poor ones) were selected in order to be able to compare their physico-chemical characteristics. Finally, morphotypes which were well differentiated were also selected. It is assumed that this sample, assembling 20% of the total number morphotypes existing in the germplasm collection, gives a fair representation of the diversity found in Manipur within the cultivated species Colocasia (*C.esculenta*). Varieties with good quality appear all types of corm shapes (round, dumbell, cylindrical, conical, elliptical), they originate from different places. All varieties that present cylindrical tuber corms (i.e., Mukhi1, Mukhi2, Mamingkhangdaba (singdapan), conical (Pangong, Panangangba), Round (Yerum-pan), have whitetuber corm flesh and are of good eating quality (10.9%of total number of accessions). Oxidation occur mostly in varieties with poor eating quality but two varieties (Mukhi-1, Mukhi-2) with good eating quality were also found to oxidise (Table 3).A detailed study conducted using 32 descriptors (IPGRI 1997) scored on the 32 accessions revealed tremendous variation in corm shape and forms of vegetative and underground organs characteristics (SPYN 2003) These groups are not related to the geographical origin of the varieties or with some peculiar morphological traits. Although qualitative are controlled genetically, they do not appear to correspond to some particular morphotypes .However, most of the 6 varieties presenting good eating quality. Good varieties appear to be characterised with a high starch value (A/S ratio>0.17 in Table 4). All varieties presenting tubers with poor eating quality are characterised by low A/S ratio<0.16, and high nitrogen contents except 6 varieties which has a high A/S ratio (0.21) but very low total sugars content. This characteristic appears somewhat important and a variety such as Mukhi-2 (Mukhipaan angouba) is famous and appreciated throughout Manipur because of its very 'sweet' taste, which is confirmed by the highest sugars content (21.49%). However, several varieties rated as 'good' also have low total sugars content, and therefore sugars content alone cannot determine quality. Simple linear correlations between four physio-chemical characteristics were computed and the results are presented in Table 3. Starch, and total sugars contents are positively correlated with dry matter. Proteins contents are positively correlated between them, but negatively correlated with dry matter, starch and nitrogen. Total sugars content are negatively correlated with proteins contents. Some of these correlation coefficients confirm previous results obtained by Lebot et al. (1998) with cultivars grown in New Caledonia.

4. Discussion

The physico-chemical characteristics variation of Taro tuber corms focused mostly on differences existing between species measured on samples collected in different growing environment .Lebot et al. (1998) analysed 131cultivars of D. Alata from New Caledonia for dry matter, starch, proteins and minerals but amylase and total sugars were not measured and oxidation and eating quality ratings were not available. Overall, less variation (expressed in CV%) was found in Imphal west (i.e.12.19% for dry matter, 28.40% for starch, 11.4 and 0.42 for nitrogen) which is consistent with the greater genetic diversity found in Manipur (Swarnalata.2013). Our study attempted to compare different varieties, planted the same day in the same plot with the same experimental conditions, so that comparison of their physico-chemical characteristics would be possible. As far as the quality is concerned, A/S ratio (>0.17) which appears to be necessary to produce a good taste, with the required firmness. These varieties are also characterised with high dry matter and total sugars contents and low proteins. High dry matter has already been shown to be associated with fine structure, dense feel in the mouth and quality (Martin 1974; Bourrieau 2000). This is often, but not always, combined with a white flesh which is not susceptible to oxidation when exposed to air. Corm shape is not related to good taste and good cooking quality, selection on external characteristics alone cannot guarantee the quality. When accessions with suitable chemotypes are combined with an attractive corm shape, the final number of varieties presenting these desired traits is quite low and, in Manipur for example, they represent less than 10%of the total number of accessions (SPYN 2003). Chemotypes appear to be genetically controlled. Breeding of Colocasia (*C.esculenta)* for improved chemical composition of the corm is dependent on the knowledge that one cultivar presents a chemotype better than another when they are grown in the same environment. However, important qualitative characteristics are significantly correlated with dry matter content (starch, sugars). This indicates, although it does not prove, that screening numerous accessions for this trait alone (i.e., specific gravity) could contribute to the selection of suitable qualitative analysis. The range of values found for a particular trait reveals that there is scope for improvement in the long term by breeding and by clonal selection in the short term. Nothing is known of the genetic basis of such traits

Table 1: Geographical origin of colocasia esculenta accessions collected from Manipur (see Figure 1).

Sl. No.	Genotypes	Sources
1	Pangong	Imphal-West (Kangchup)
2	Pan Angangba	Imphal-West (Kangchup)
3	Mukhi-i	Imphal East (Top-Awang)
4	Yerum Pan	Imphal-West (Kangchup)
5	MamingKhangdaba	imphal-West (Iroisemba)
6	Mukhi –ii	Imphal-West (Oinam)
7	Telia	CAU
8	Birabhumi	CAU
9	Kovvur	CAU
10	Panchmukhi	CAU
11	Jhankhari	CAU
12	NDUAT – 1	CAU
13	Nadia Local	CAU
14	Topi	CAU
15	White Gaurea	CAU
16	Sahatramukhi	CAU
17	C – 5	CAU
18	C – 7	CAU
19	C – 10	CAU
20	Acc. No.2	CAU
21	Acc. No.3	CAU
22	Acc. No.4	CAU
23	Acc. No.6dssss	CAU
24	Acc. No.7	CAU
25	Acc. No.8	CAU
26	Acc. No.9	CAU
27	Acc. No.11	CAU
28	Acc. No.12	CAU
29	Acc. No.14	CAU
30	Acc. No.16	CAU
31	Acc. No.17	CAU
32	Acc. No.18	CAU

Table 2: Variation and frequencies of the most significant tubertraits measured on 32 accessions (representing approx. 19distinctmorphotypes). Descriptors Traits %

Sl. No.	Characters	Heritability (%)	Gen. Adv. as % of Mean	General Mean
1	Plant height (cm)	88.86	23.89	34.64
2	Number of leaves per plant	59.84	13.98	6.16
3	Leaf length (cm)	94.43	54.76	28.25
4	Leaf width (cm)	97.07	51.53	22.72
5	Plant canopy (cm^2)	96.13	63.92	954.48
6	Fresh weight of leaves/plant (g)	94.33	21.87	159.33
7	Dry weight of leaves/plant (g)	94.28	36.43	17.63
8	Weight of corm (g)	78.81	35.91	167.73
9	Length of corm (cm)	78.51	44.58	6.12
10	Diameter of corm (cm)	64.57	18.94	7.33
11	Number of cormel/plant	85.25	58.82	6.21
12	Weight of cormel (g)	96.24	49.05	27.48
13	Length of cormel (cm)	40.58	21.59	3.94
14	Diameter of cormel (cm)	65.14	41.84	3.57
15	Dry matter (%)	80.68	39.11	13.09
16	Nitrogen content (%)	84.75	75.18	1.09
17	Starch content (%)	77.99	39.1	23.64
18	Sugar content (%)	81.69	35.21	8.26
19	Yield (t ha^{-1})	92.15	47.32	9.48

Table 3: Physio- chemical characteristics of 32 *Colocasiaesculenta* accessions from Manipur

Genotypes	D.M%	N%	Starch%	Sugar%
Pangong	12.19	0.42	28.4	10.59
Pan Angangba	12.54	1.09	29.84	10.87
Mukhi-1	10.46	0.72	26.89	8.59
Mukhi-2	21.83	2.53	45.19	10.49
Yerum Pan	15.76	1.25	20	6.85
MamingKhangdaba	17.17	1.73	32.88	10.04
Telia	13.04	1.86	26.93	9.88
Birabhumi	11.46	1.17	23.1	8.18
Kovvur	9.86	0.66	18.84	4.92
Panchmukhi	13.82	0.77	25.22	7.24
Jhankhari	11.27	0.66	25.1	7.87
NDUAT-1	9.02	1.04	23.58	8.89
Nadia Local	10.47	1.18	23.4	9.43
Topi	11.34	1.23	23.28	9.59
White Gaurea	11.25	1.04	25.43	7.14
Sahartramukhi	17.75	1.05	24.69	9.07
C5	13.36	0.71	21.34	9.27
C7	13.34	0.72	21.17	8.44
C10	15.62	1.39	23.92	8.23
Acc. No.2	14.96	1.09	19.1	5.18
Acc. No.3	13.24	0.53	22.37	9.62
Acc. No.4	13.18	0.46	20.85	8.94
Acc. No.6	17.26	0.93	20.88	8.96
Acc. No.7	15	1.34	22.77	8.17
Acc. No.8	13.04	1.45	21.64	8.17
Acc. No.9	13.04	1.49	17.93	4.84
Acc. No.11	7.7	0.85	22.71	9.06
Acc. No.12	14.8	1.17	18.17	5.38
Acc. No.14	11.5	1.16	16.79	8.94
Acc. No.16	12.36	0.9	18.3	7.56
Acc. No.17	11.2	1.65	21.54	6.84
Acc. No.18	9.97	0.79	24.24	7.09
General Mean	13.09	1.09	23.64	8.26
SEM (±)	0.87	0.11	1.13	0.37
CD at 5%	2.41	0.3	3.12	1.02
CV (%)	16.26	24.18	11.68	10.89

References

[1] Bourrieau M. 2000. Valorisation des racines et tuberculestropicaux pour l'alimentationhumaine en Oce´anie: le cas du laplap au Vanuatu. The`se de Maste`re en ge´nie agro-alimentaireme´diterrane´enet tropical (MSc thesis), ENSAI/SIARC, Montpellier, France, 122 pp.

[2] Bradbury J.H. and Holloway W.D. 1988. Chemistry of Tropical Root Crops: Significance for Nutrition and Agriculture in the Pacific. ACIAR Monograph No. 6, 201 pp.

[3] Brown M.W. 1995. Quality Standards and Marketing of Selected South Pacific Root Crops. Institute of Research, 1207

[4] Extension and Training for Agriculture (IRETA), University of the South Pacific, Western Samoa, 145 pp.

[5] Coursey D.G. 1976.Yams. In: Simmonds N.W. (ed.), Evolution of Crops Plants. Longman Publisher, London. Egesi C.N., Asiedu R., Egunjobi J.K. and Bokanga M. 2003.Genetic diversity of organoleptic properties in water yam (DioscoreaalataL.). J. Sci. Food Agric. 83: 858–865. IPGRI 1997.International Standard Descriptors for Yams. IPGRI, Rome, Italy.

[6] Jackson G.V.H. 1994.Taro and Yam genetic resources in the Pacific and Asia. Report prepared for ACIAR and IPGRI.ANUTECH Pty Ltd., Canberra, Austral Lebot V., Trilles B., Noyer J.L. and Modesto J.1998.Genetic relationships between Dioscoreaalata L. cultivars. Genet. Resour. Crop Evol. 45 (6): 499–509.Malapa R. 2000. Evaluation de la diversite´ ge´ne´tique de la grandeigname (Dioscoreaalata) par AFLP. Me´moire deDEA (MSc thesis). University de Rennes, France, 53 pp.

[7] Lebot V, Trilles B, Noyer JL, Modesto J (1998) Genetic relationships between Dioscorea alata L. cultivars. Genet Resource Crop Evol 45: 499–509.

[8] Malapa R., Arnau G., Noyer J. L. and Lebot V. 2005. Genetic diversity of the greater yam (Dioscoreaalata L.) and relatedness toD. nummulariaLam. and D. transversaBr. as revealed wit.

[9] Martin FW, Rhodes AM (1977) Intra-specific classification of Dioscorea alata. Trop Agric (Trinidad) 54: 1–13

[10] Martin FW (1974) Tropical Yams and Their Potential. Part 3. Dioscorea alata . In: Agriculture handbook No. 495. USDA, Washington, DC

[11] Okonkwo, C. (1993). Taro, Colocasia spp. In: Bergh, G. (Ed.) Genetic improvement of vegetable crops. Oxford: Pergamon, pp. 709-715.

[12] Onwueme, I.C., W.B. Charles. 1994. Tropical root and tuber crops. Production, perspectives and future prospects. FAO Plant Production and Protection Paper 126. FAO, Rome.

[13] Kumar Rajesh, Jain 1999. Evaluation of some dasheen type colocasia (*Colocasia esculenta* var. *esculenta*) under Bihar Piateau Region. Indian Journal of Plant Genetic Resources Year : 1999, Volume : 12, Issue : 3

Author Profile

Dr. Khwairakpam Swarnalata Devi

Dr. Joydip Mandal (Senior lecturer), Department of CIHAB, Visva-Bharati, Shantiniketan, 731235

Dr. AK Bijaya Devi (Associate Professor), Department of Horticulture, CAU Iroisemba, 795004