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Physico-chemical properties of six varieties of taro (*Colocasia esculenta* L. Schott) flour

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Abstract - Taro also known as banda is an important tuber crop and is grown throughout tropical and subtropical regions of world. It is used as vegetable and is also consumed directly after boiling. The present study was conducted in the Department of Food Science and Technology N.D. University of Agriculture and Technology, Kumarganj. Corms/cormels of six taro varieties [NDB-2, NDB-3, NDB-9, NDB-9, EC-20 and NDB-21] were converted into flour and analysed for some physico-chemical properties. In general a wide variation was observed in the chemical compositions of the flour samples analysed. On a dry weight basis, crude protein ranges between 9.30-10.90%, available carbohydrate 71.92-73.05%; crude fibre 1.00-1.69%; ash 5.78-6.65% and crude fat 0.72-0.86%.Apart from this, variety NDB-2 recorded highest amount of total sugars(6.33%). The results also revealed that the corms of variety NDB-2 contained lowest level of oxalic acid and was found suitable for preparation of chips.

Key words - Taro, Flour, Varieties, Chemical composition

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Taro is a common name for the corms and tubers of several plants in the Araceae family. Of these, *Colocasia esculenta* is the most widely cultivated. Taro (*Colocasia esculenta* L. Schott) also known as banda is an important tuber crop and is grown throughout tropical and subtropical regions of the world. The corm of taro is relatively low in protein (1.5%) and fat (0.2%) and this is similar to many other tuber crops. It is a good source of starch (70-80 g/100 g dry taro), fiber (0.8%) and ash (1.2%) (Quach *et al*., 2000). Taro corm has reasonably high contents of potassium and magnesium, whose ranges are 2251-4143 and 118-219 mg/100 g dry matter, respectively.

Acridity of the corms and cormels, the high rate of post harvest losses and lack of proper scientific attention prompted a project aimed at developing taro flour that could be used for the processing purpose. The use of flour in food processing depends largely on its physico-chemical properties (Mcwatters,1983). Therefore, the present work is carried out to assess the physical and biochemical characteristics of flour obtained from six varieties of taro corm and to select suitable variety for making chips.

EXPERIMENTAL METHODOLOGY

Taro samples and treatments :

Six cultivars of taro corm were used for the experiments and procured from MES Vegetable Farm, N.D.University of Agriculture and Technology, Kumarganj, Faizabad. Three corms after removing the cormels of each cultivar were peeled manually by a stainless steel knife and skin free corms were cut into thin slices. These pieces following shade drying were ground to fine powder by using a mixi grinder and the samples were packaged in polyethylene bags. The packaged product was stored at ambient conditions and the samples

were subjected to chemical analysis within 15 days.

Tuber colour and size:

Five corms of each cultivars were taken randomly for assessing physical characters. Colour of corm was observed visually. Cormels (if present) were separated from main corm manually by employing a stainless steel knife and its weight was recorded.

Corm weight, length and diameter:

Five corms of each cultivar were weighed and their average weight was computed. Corm length and diameter was measured by an ordinary ruler and their average value was calculated.

Specific gravity:

Specific gravity was determined by the water displacement method.

Peel and Flesh content:

The content of peel was separated from flesh with the help of steel knife. The scrapped peel was weighed and its content was expressed in percentage on the basis of corm weight. The flesh content was expressed on the basis of corms weight.

Proximate analysis:

Moisture content of fresh corm was determined by the method of Ranganna (1986). Percent dry matter was calculated by subtracting the per cent moisture content from 100. Ash content was measured by the method of Rangana (1986). Crude fat, crude fibre and carbohydrate was estimated by the method as described by Raghuramula *et al.* (1983). Sugar were determined by titrating the samples against fehlings solution using phenolphthalein as indicator (Lane and Eynon, 1923). Starch content in corm flour was determined by acid hydrolysis method as described by Ranganna (1986). Oxalic acid content in dried corm powder was done by titration method as described by Krishna and Ranjhan (1980). Crude protein in corm flour was determined by method of Ranganna (1986).

EXPERIMENTAL FINDINGS AND ANALYSIS

The results obtained from the present investigation are below :

Physical characteristics-

Taro size, flesh content and specific gravity:

The physical characters of taro corms and cormels of different varieties are presented in (Table 1A) and (Table 1B). Corm weight, corm length diameter, cormel number and cormel weight were ranged from 198.04-398.48g, 11.66-21.98 cm, 4.14-6.46 cm, 0.0-4.8 per corm and 0.0-82.44g. The variety NDB-2 recorded maximum corm weight (398.48g) corm diameter (6.46cm) and cormel weight (82.44g) while corms of EC-20 were found to possess minimum corm weight (198.04g) and corm length (11.66). NDB-21 recorded minimum corm diameter (4.14cm), cormel number (2.2 per corm) and cormel weight (7.24g).

Table 1A : Physical characters of taro corms and cormels of different varieties

Variety	Corm weight (g)	Corm length (cm)	Corm diameter (cm)	Cormel No. (per corm)	Cormel weight (g)	Skin colour
NDB-2	398.48	14.34	6.46	4.6	82.44	Brown
NDB-3	391.48	16.22	6.32	0.0	0.0	Dark brown
NDB-9	388.48	21.98	4.88	4.8	25.56	Light brown
NDB-14	314.96	12.86	6.28	3.6	14.52	Brown
EC-20	198.04	11.66	5.00	4.4	36.94	Light brown
NDB-21	244.80	17.46	4.14	2.2	7.24	Brown
C.D. (P=0.01)	160.80	4.26	1.09	3.18	62.88	-

Table 1B : Physical characters of taro corms of different varieties

Variety	Specific gravity (g/cc)	Peel (%)	Flesh (%)
NDB-2	1.4152	3.67	96.33
NDB-3	1.0857	3.41	96.60
NDB-9	1.3002	4.69	95.15
NDB-14	1.9238	3.73	96.27
EC-20	1.5487	5.21	94.79
NDB-21	1.3784	6.16	93.84
C.D. (P=0.01)	0.3844	1.87	2.03

Corm length (21.98 cm) and cormel number (4.8 per corm) was maximum with NDB-9. Similarly, Medhi and Parasarathy (1999) observed wide variations in corm length and corm diameter with 19 varieties of taro corms considerably. Large variations in corm height and cormel number were also found by Nair and Pillai (1999).

The flesh and peel content of taro corms of six varieties studies in present investigation varied from 93.84-96.60 and 3.41-6.16 per cent, respectively whereas variations in specific gravity of corms were ranged from 1.0857-1.9238 g/cc. The highest flesh content (96.60%), and minimum peel content (3.41%) and specific gravity (1.0857g/cc) were recorded with corms of NDB-3 (Table 1B). Flesh content of corm of variety NDB-2 and NDB-14 occupied the second and third position, respectively. Minimum flesh content (93.84%) and maximum peel content (6.16 %) were observed with corms of variety NDB-21.

Maximum specific gravity (1.9238g/cc) was exhibited by the corms of variety NDB-14. Prajapati (2001), however, observed smaller variation of 0.800-0.901g/cc in the specific gravity of Banda. The differences in physical characters of taro corm and cormel may probably be due to differences in the varieties. Statistically there were significant differences in the physical characters of taro corm and cormel. However, no informations is available in the literature pertaining to content of flesh and peel, and skin and colour of two corms.

Table 2A : Moisture and dry mater contents in taro corms of different varieties

Variety	Moisture (%)	Dry matter (%)
NDB-2	79.83	20.1
NDB-3	78.01	21.99
NDB-9	77.41	22.59
NDB-14	78.49	21.51
EC-20	79.86	20.14
NDB-21	78.79	21.21
C.D. (P=0.01)	NS*	NS

*NS stands for non significant

Chemical characteristics:

Proximate composition:

Data on moisture and dry matter contents in taro corms of different varieties are given in Table 2A.

Variation in the moisture and dry matter content were ranged from 77.41-79.86 and 20.14-22.59 per cent, respectively and were statistically non-significant. Seralathan and Thirumaran (1999) reported 70.3 per cent moisture in colocasia tubers. Wills *et al.* (1983) however, noticed wide variations (55.8-74.4g/100g flesh) in moisture content of 22 cultivars of taro grown in Papua New Guinea highlands. Similarly, Prajapati (2001) and Joseph *et al.*(1999) observed slight higher dry matter content in Banda and colocasia tubers, whereas Asghar and Cable (1984) reported wide variations in dry matter content (20-48 per cent) of two corms.

Proximate composition of dried taro corms powder of different varieties is presented in Table 2B. In the present findings slight variations in the contents of moisture (8.15-9.20%), crude protein (9.30-10.90%), crude fat (0.76-0.86%) ash (5.78-6.65%), crude fibre (1.00-1.69%) and carbohydrates(71.92-73.05) were found statistically in significant. However, contents of crude fibre and carbohydrates in corms when expressed on the basis of fresh weight were observed to differ significantly.

Reducing, non-reducing and total sugars:

The respective data on reducing, non-reducing and total sugars content of taro corm flours of different varieties ware given in Table 2C. There were significant variations in the sugar content of dried corm powder.

NDB-2 recorded highest content of total sugars (6.33%) and non-reducing sugars (3.00%) while content of reducing sugars (4.06%) was maximum with NDB-21. Minimum content of total sugars (3.74%), non-reducing sugars (0.36%) and reducing sugars (2.91%) were recorded with varieties NDB-9 and NDB-14, NDB-21 and NDB-14, respectively. The varieties also differed significantly when expressed on fresh weight basis. Tamate and Bradbury (1985) and Ghosh and Hasan (1992) also obtained wide variations in the sugar content of taro corms on fresh and dry basis, respectively.

Crude protein:

Crude protein on fresh weight basis varied 2.31-2.60

Table 2B : Proximate composition of dried taro corm powder of different varieties

Variety	Moisture	Crude protein (%) (%N × 6.25)	Crude fat (%)	Ash (%)	Crude fibre (%)	Carbohydrates (%)
NDB-2	8.15	10.90	0.81	6.00	1.26	72.88
NDB-3	8.37	40.85	0.73	5.78	1.69	72.58
NDB-9	9.20	9.30	0.72	6.23	1.50	73.05
NDB-14	8.52	10.44	0.81	6.30	1.00	72.93
EC-20	8.76	10.80	0.76	6.65	1.11	71.92
NDB-21	8.46	10.78	0.86	6.37	1.10	72.44
C.D. (P=0.05)	NS*	NS	NS	NS	NS	NS

NS=Non-significant

Table 2C : Sugar content in dried taro corm powder of different varieties

Variety	Reducing sugar (%)	Non-reducing sugar (%)	Total sugar (%)
NDB-2	3.16	3.00	6.33
NDB-3	3.07	2.9	6.22
NDB-9	3.26	0.46	3.74
NDB-14	2.91	0.79	3.74
EC-20	3.73	1.29	4.73
NDB-21	4.06	0.36	4.44
C.D. (P=0.01)	1.14	1.61	1.16

Table 2D : Starch and oxalic acid contents in dried taro corm powder of different varieties

Variety	Sugar (%)	Oxalic acid (%)
NDB-2	67.78	0.06
NDB-3	67.58	0.17
NDB-9	70.55	0.20
NDB-14	70.43	0.17
EC-20	68.52	0.23
NDB-21	69.19	0.11
C.D. (P=0.01)	NS*	0.09

NS=Non-significant

per cent in present investigation. Seralathan and Thirumaran (1999) found that colocasia corm contained 3.2 per cent protein. However, Wills *et al.* (1983) observed wide variation (0.5-2.1g/100g) of flesh in protein content of 36 samples of taro corms.

Starch and oxalic acid contents:

Data on starch and oxalic acid contents of dried corm powder of different varieties are presented in Table 2D.

Minimum oxalic acid content (0.06%) was found in NDB-2 and it was followed by variety NDB-21 that contained 0.11 per cent oxalic acid while maximum content (0.23 %) was registered by EC-20. There were significant variation among the oxalic content of flours.

Slight variations (67.58-70.55%) in the starch content of corm flours were found insignificant. Similar findings were also observed earlier pertaining to starch content of taro flour on dry weight basis (Chian-Chuang *et al.,* 1996). However on fresh weight basis higher values of starch content in taro corms are reported by earlier workers (Hakama *et al.,* 1979; Wills *et al.,* 1983; Prajapati, 2001; Seralathan and Thirumaran, 1999).

The differences in the chemical characteristics of taro corms of different cultivars in present study and with those of earlier findings might be due to differences in maturity and method of expression (wet or dry basis) variety, agro-climatic conditions, locality, and stage of maturity [Taro corm is very poor source of fat. The present work also confirms the observations of earlier workers (Godoy *et al.,* 1992; Tagodoe and Wai-kit, 1994); Habashy and Radwan, 1997; Seralathan and Thirumaran, 1999. In contrast to present findings pertaining to crude fibre content. Wills *et al.* (1983), however reported wide variations (1.4-5.4g/100g flesh)] after crude protein.

Taro corms are rich in starch and mineral contents and larger part of corms in edible. However acridity is the major factor governing the edibility of taro corms. Joseph *et al.* (1999) reported that acrid free taro has not so for obtained from the natural population. It is also suggested that the acridity of taro is not caused solely by calcium oxalate crystal but us also associated with a boiling water and ethanol labile factors (Moy *et al.,* 1979).

Conclusion:

The findings of present study reveals that NDB-2 variety of taro contained lowest content of oxalic acid either on fresh or dry basis, besides having highest corm weight and diameter. Therefore, NDB-2 variety may be utilized to have best potentiality for processing purpose.

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