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Original Research Article

Extraction of pure taro starch from local cultivars of Bengal, India and effect of seasonal variation

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Abstract: With the increased use of starch, both for food and non-food purposes, it has become imperative to look for non-conventional sources and Eddoe type of taro (Scientific name: *Colocasia esculenta var. antiquorum*; Common name: Gathikochu) is such a non-conventional tuber source in West-Bengal, India for extraction of pure starch. Bengal taro flour was found to contain 49.72-76.23 g starch for 100g of flour on analysis. Isolation process of taro starch powder was established from sliced taro corm. Starch yield was reported from sliced taro corm as 31.49%, 53.76% and 73.71% for spring, monsoon and winter seasons respectively. Purity and quantity of extracted starch powder content reflected significant variation in starch yield for three seasonal varieties. Scanning Electron Microscopy and studies of swelling power and apparent viscosity revealed difference between taro and standard corn starch. This has wider implication in implementation of industrial-level starch extraction from Bengal cultivar of taro and modification process thereafter.

Keywords: Taro; Corm; Carbohydrate; Mucilage; Matrix; Gathikochu; Yield

Introduction

Starch is one of the most abundant substances in nature and is a semi-crystalline carbohydrate synthesized as granules in many plant tissues. The major botanical sources of starch are wheat, maize, potato, cassava and taro[1]. Starch is a basic component of our food and may serve as a base for industrial economy. Modified starches, achieved by physical, chemical, enzymatic or genetic modifications of native starches have successful food applications as fat replacers/fat mimetics, as texture improvers, as encapsulating agent and also in formation of stable gel at high temperature and shear[2]. Native starches are produced from the seeds of plants such as corn, wheat, sorghum or rice, tubers or roots of plants like cassava, potato or arrowroot and the pith of the sago palm.

Tropical root and tuber crops are important food crops serving either as subsidiary or subsistence food in different parts of the tropical belt[3]. Taro (*Colocasia esculenta*), a root crop of edible aroid family, is grown widely in tropical and subtropical regions of the world for its underground starch[4]. Taro starch, in view of its small granule size, has been considered to be easily digestible; hence it finds use in baby foods and the diets of people allergic to cereals and children sensitive to milk[5]. It is also proposed to be used as fat replacer in food emulsions[6].

Among the non-food uses of taro starch, its use as filler in biodegradable plastics, in toilet formulations or aerosol are abundant[6]. This starch has potential due to its high yield and functionality[7]. Extraction and utilization of this starch in large scale is not practiced, probably due to difficulty in extraction of starch from fresh tubers, which contain a lot of mucilaginous material[8]. Both water-extraction and alkaline-extraction methods were investigated for isolation of purified taro flour (final starch powder) from taro powder in Thailand[9]. Laboratory extraction of taro starch has been carried out from water-suspension of pulp from fresh-root of local cultivars of taro in Fiji[10]. Fresh tubers of *Colocasia* were extracted using ammonia solution for isolation of starch in Central Tuber Crops Research Institute, Trivandrum, India[11]. Difference in starch properties has already been reported for different cultivars of taro. There are differences in composition of storage organs of edible aroid according to the habitat and the genotype, but the environmental influence was found to be stronger than genetic factors. Some of the varieties of cassava, susceptible to environmental influences had already been reported[12]. In India, taro from North-East origin had already been evaluated for starch extraction[13]. However, local cultivar of taro from West-Bengal, India has not been studied for isolation and characterization of starch. Proper characterization and further

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modification of starch also require pure and representative sample of native starch.

Unlike cassava, this starch has also not been exploited in industries. Lack of information on the properties of starch from taro produced in West-Bengal, India has hindered the prospect of utilization of this starch in industry. Starch yield, purity of isolated starch and molecular information with seasonal variation can be important to suggest novel industrial applications [14]. Knowledge on properties of pure and representative sample of the same would unfurl the new agricultural resources in starch production in India.

The objective of this study is to find suitability of extraction process for isolation of pure starch from three seasonal variety of Bengal cultivar of *Colocasia esculenta var. antiquorum* (common name gathikochu) to produce representative sample of starch. It also aims at investigating proximate composition of extracted starch and functional and morphological properties of the purest variety.

Materials and Methods

Materials:

Fresh Eddoe type of taro corms (*Colocasia esculenta var. antiquorum*, locally known as gathikochu), were purchased from local market of West-Bengal. Corms were purchased in three occasions for each particular season of monsoon, winter and summer for subsequent analysis. This sort of purchase system simulated that of small entrepreneurs for food-processing industries. Distilled water was used for extraction. Corn starch, obtained from SD Fine Chemicals Ltd. was used in the experiments to compare starch properties.

Determination of Dry matter content:

The dry matter contents of fresh taro corms were determined using the method described by Bensei[5]. Approximately 10 g. (1kg =1000g.) of freshly peeled and shredded roots were placed in each of two weighed petri dishes (*w1*). The samples were dried at 65°C for 72 h, cooled in a desiccator and weighed immediately. The drying and weighing steps were repeated until consecutive constant weights (*w2*) were achieved. Dry matter (DM) contents of the roots were calculated using the Equation (1).

$$\textbf{DM (\%) = w2/w1 x100 (1)}$$

Determination of Chemical composition of Taro:

Fresh taro corms were washed, peeled and sliced. Taro slices were dried in a hot air oven at 40^{o}C for 20 hours. The chips were then ground and sieved through 60 mesh to get taro flour.

Average chemical composition like moisture, ash, protein, fat and crude fibre for taro flour from three seasonal varieties of taro were determined following the official method of analysis[15].

Starch was determined on taro flour by an acid hydrolysis method. Sample preparation was done by the method, as described by Ranganna[16] and determination was done as described by Borchers[17]. Little modification was done with respect to taro flour. To the weighed sample (approx. 1 g.), 25-30 ml. Water was added and heated to 80- 82 ^{0}C. It was allowed to stand for some time to obtain a solution of starch. About 20-25 ml. (1ml = 10^{-6} m^{3}.) of 95% ethanol was added and the mass was centrifuged at 5000 rpm for 10 min. using a table-top centrifuge (Remi make) till the precipitate settled at the bottom. It was filtered and the residue was washed with about 50% alcohol until the filtrate was sugar-free, as indicated by formation of red-ring with alpha-napthol test[16]. Residue was again treated with cold water and centrifuged until supernatant was mucilage-free, as indicated by flocculent precipitate with ethanol[18]. Residue was refluxed directly with hydrochloric acid (10% v/v), neutralized, diluted to volume and filtered (if necessary). Another sample was refluxed with water only[17]. Reducing sugar was determined on a suitably diluted aliquot of the filtrate by the Folin-Wu method [19](Folin 1929). Starch value was calculated as described by Borchers[17], as follows,

$$\textbf{Starch value = 0.9 x (glucose value}_{\textbf{acid-hydrolyzed sample}} \textbf{ – glucose value}_{\textbf{water-refluxed sample}}\textbf{) (2),}$$

Water-extraction of starch from sliced Taro corm:

Fresh taro corms were washed, peeled and sliced. Extraction of starch from taro slices was carried out according to Nand *et al.,* [10] with little modification. Taro slices were macerated in a mixer-blender for 2 minutes using a definite ratio of sliced taro and water. High sample to water ratio was used during the extraction process to increase the efficiency and to reduce the lipid and protein in the extracted starch[20]. Corm: water ratio was maintained as 1:5**.** Macerated mass was filtered using muslin cloth. Residual cake was deposited on the filter cloth and it was analyzed for its total solids. Slurry was allowed to stand for two hour. Suspension was centrifuged at 5000 rpm at ambient temperature for 15 minutes. Separation was observed in two layers in the centrifuge tube. Turbid and dark pink colour supernatant was analysed for total solids. Residue was re-centrifuged using three parts of distilled water. A large volume of distilled water was used after extraction to wash the starch in order to avoid damaging the starch or changing its rheological properties[21]. The washing step using distilled water was repeated, until the supernatant became clear and colourless. Supernatants were also analysed for its total solids. Total solids in residual cake and in the supernatants were determined using gravimetric method as described by Rangana[22]. Little modification was done by making a suspension of cake solids in water. Residue was finally dried at 50^0 C in tray drier for overnight to obtain the starch powder.

Determination of extracted starch powder content:

Extracted starch powder content (SC) was determined by equation 3, as described by Nand *et al.,*[10]

$$SC\ (\%) = W_3/W_4\ X100\ (3)$$

W_3 is the weight of starch extracted from a known weight (W_4) of the root matter.

Different taro corm and water ratios were maintained for extraction. The best batch with respect to extracted starch powder content was evaluated for single-stage and multiple-stage water extraction to increase extraction efficiency. Multiple-stage extraction was followed for three different seasonal varieties, as it was found to be more efficient.

Determination of proximate composition of extracted starch powder:

Extracted starch powders for three seasonal varieties were analyzed for their chemical composition like moisture, ash, protein, fat and crude fibre.

Determination of starch yield of extracted starch powder:

Starch content was determined on extracted starch powder by an acid hydrolysis method as previously described for taro flour. The percentage starch yield for three seasonal varieties were determined from the ratio of recovered starch to the total starch, as described by equation 4, used by Lee *et al.,*[21]

Starch yield = (recovered starch/ total starch) (4)

Scanning Electron Microscopy (SEM):

Images of extracted taro starch granules and standard corn starch granules were mounted on a stub by using both-side adhesive tape and gold-coated using sputter coating technique. Coated samples were placed inside the SEM chamber for study. Images were recorded using a Scanning Electron Microscope (Make – JEOL Ltd., Japan; model no. JSM 5200) operating at 20 kV and 3500x magnification.

Determination of Swelling power and Solubility:

Starch solubility and swelling power were determined by heating starch-water suspension in a thermostatically controlled water-bath, set at temperature 85C, according to Schoch[23], as described by Walter *et al.,*[24] Briefly, weighed starch sample was suspended in distilled water in a 250ml. beaker, suspension was heated with constant agitation for 30minutes. Mass was then centrifuged for 15minutes at 5000rpm. Supernatant was separated and soluble material was recovered by evaporation of the liquid. The amount of this material was used to calculate the starch solubility. The swelling power was obtained by measuring amount of residue from the centrifugation and calculating amount of water absorbed by the starch (percent weight increase) after correction for the amount of solubilized starch. The result was calculated by equation 5[25]

Swelling power = Weight of sediment paste x 100/Weight of sample on dry basis x (100 - %solubility) (5)

Determination of Apparent viscosity:

Apparent viscosity of starch was determined using a Brookfield viscometer (model LVDV-E) described by Uriyapongson and Rayas-Duarte[26]. Starch slurry (5%, db) was cooked in a boiling water-bath for 15min. and was cooled to 50^0C. Cold paste viscosity was determined using spindle No. 3 at five different speeds (1,2,5,10 and 20 rpm) at 5^0C, with the help of a thermo-regulating water bath.

Results

Dry matter content:

The average corm dry matter content of spring, winter and monsoon seasons are 30.18±0.55%, 22.57±0.49% and 25.35±0.91% respectively (values are mean ± std. deviation of three determinations).

Chemical properties of Taro:

Average chemical compositions of Bengal taro flour for three seasonal varieties are reported in Table 1.

Solid-profile in cake and in supernatant in successive washings:

Solid-profile in cake and in supernatant in successive washing stages during extraction of starch is shown in Table 2.

Extracted starch powder content from Taro:

Extracted starch powder content (% w/w) from sliced taro corm were found to be 7.15g., 10.12g. and 10.51g. for spring, winter and monsoon season respectively.

Effect of taro corm and water ratio and single-stage-multiple-stage extraction:

Effect of corm and water ratio and different extraction processes involving single and multiple stages on weight of residual cake and extracted starch powder are reported in Table 3.

Average chemical composition and percentage yield of Taro starch powder:

Seasonal effect of extraction on chemical composition and percentage yield of taro starch powder are studied and shown in Table 4 and 5 respectively.

Table.1: Average chemical composition of Bengal Taro flour of three seasonal varieties

Seasonal variety	Percentage (dry basis)[a]				
	Protein content	Crude fibre	Fat content	Ash content	Carbohydrate content[b]
Winter (Nov-Feb)	9.11±0.33	11.63±0.51	0.39±0.06	5.32±0.33	73.76±0.64
Spring (Mar-May)	8.81±0.84	8.09±0.33	0.38±0.06	5.74±0.09	76.99±0.38
Monsoon (Jun-Oct)	8.74 ± 0.56	2.52±0.26	0.61±0.07	4.89 ±0.37	83.24±1.26

Seasonal variety	Carbohydrate content	Starch content	Soluble carbohydrate[c]
Winter(Nov-Feb)	73.76±0.64	49.72±2.36	24.04±1.73
Spring(Mar-May)	76.99±0.38	68.25±0.68	8.74±1.06
Monsoon(Jun-Oct)	83.24±1.26	76.23±0.54	6.97±1.85

[a]Values are mean of triplicate determinations ± standard deviation
[b]Carbohydrates= 100- (protein+fat+ash+fibre)
[c]Soluble carbohydrate = Carbohydrate-starch

Table.2: Total solid profile in cake and supernatants in successive washing stages during water-extraction from taro corm

Seasonal variety	Weight of solids in cake(g)[a]	Weight of total solids in first supernatant(g)[a]	Weight of total solids in second supernatant (g)[a]	Weight of total solids in third supernatant (g)[a]
Winter season (100 g. in 500 ml. of water)	5.22±0.21	4.47±0.57	0.78±0.07	0.32±0.05
Spring season(100 g. in 500 ml. of water)	5.82±0.63	1.57±0.14	0.36±0.04	0.01±0.00
Monsoon season(100 g. in 500 ml. of water)	5.64±0.44	5.30±0.51	0.98±0.10	0.54±0.09

[a]Values are mean of triplicate determinations ± standard deviation

Table.3: Effect of taro corm and water ratio and single-stage-multiple-stage extraction on final quantity of starch powder

Sliced Taro Corm (g)	Water (ml.)	Weight of residual cake (g)[a]	Final starch powder (g)[a]	Water (ml.)[b]	Weight of residual cake (g)[a,b]	Final starch powder (g)[a,b]
100	200	34.67±2.52	5.23±0.87	-	-	-
100	450	27.27±0.61	7.57±0.70	-	-	-
100	500	25.97±1.45	10.67±0.57	200+200+100	18.43±0.80	12.13±1.31
100	700	70.5±1.32	5.43±0.61	-	-	-

[a]Values are mean of triplicate determinations ± standard deviation
[b] For multiple-stage extraction

Table.4: Effect of seasonal variety on average chemical composition of water-extracted taro starch powder from taro corm

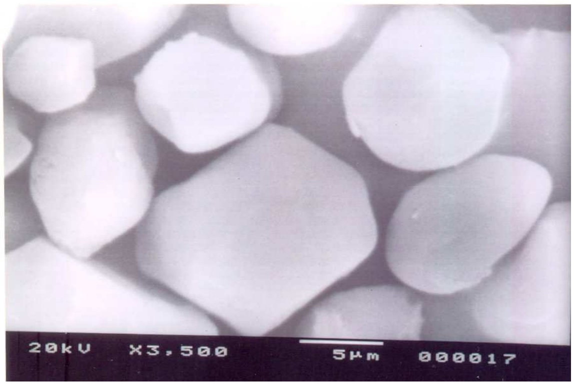
Seasonal variety	Percentage (dry basis)[a]				
	Protein content	Crude fibre	Fat content	Ash content	Carbohydrate content[b]
Winter(Nov-Feb)	2.38±0.45	3.72±0.44	0.17±0.03	1.07±0.08	92.66±0.05
Spring(Mar-May)	0.83±0.15	0.57±0.11	0.25±0.11	1.52±0.12	96.83±0.05
Monsoon(Jun-Oct)	1.51±0.42	1.95±0.46	0.12±0.04	1.43±0.11	94.99±0.9.0

[a]Values are mean of triplicate determinations ± standard deviation
[b] Carbohydrate content includes both starch and soluble carbohydrate

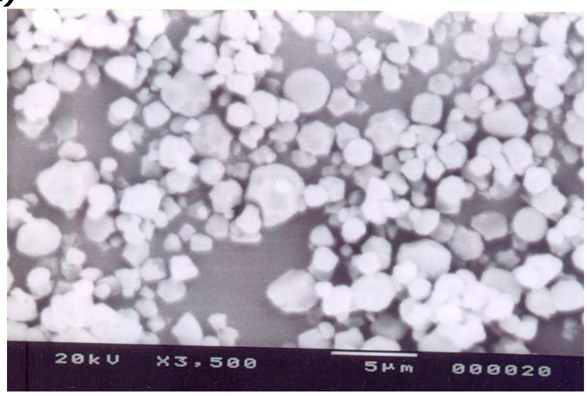
Table.5: Effect of seasonal variety on (%) starch yield for water-extracted starch powder from taro corm

	Percentage starch content of taro corm[a]	Extracted starch powder content (%)[a]	Purity of extracted starch powder (wet basis)[a]	Starch content of extracted starch powder[a]	Percentage starchYield (%)[a]
Winter (Nov-Feb)	11.29±0.24	11.47±0.65	72.62±0.75	8.32±0.39	73.71±4.64
Spring (Mar-May)	20.56±0.38	7.77±0.45	83.33±0.72	6.47±0.43	31.49±1.81
Monsoon (Jun-Oct)	19.36±0.70	12.80±1.56	83.78±0.34	10.39±0.76	53.76±5.15

[a]Values are mean of triplicate determinations ± standard deviation



A)



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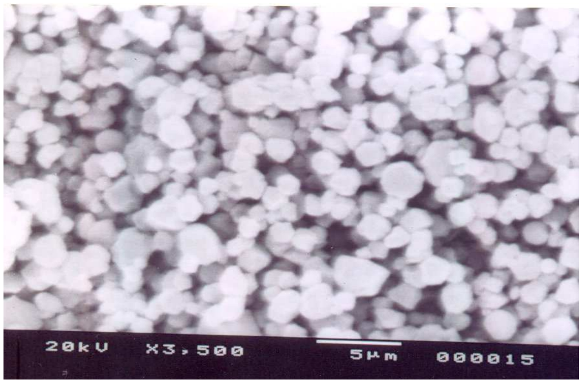
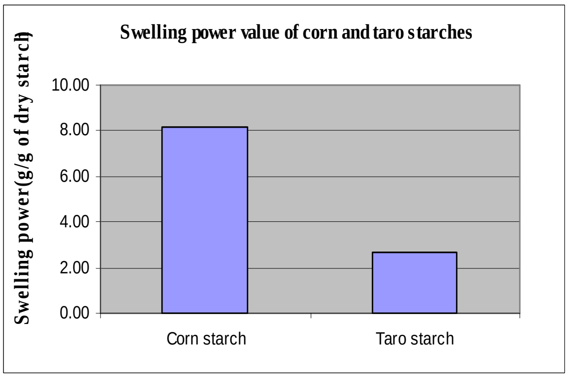
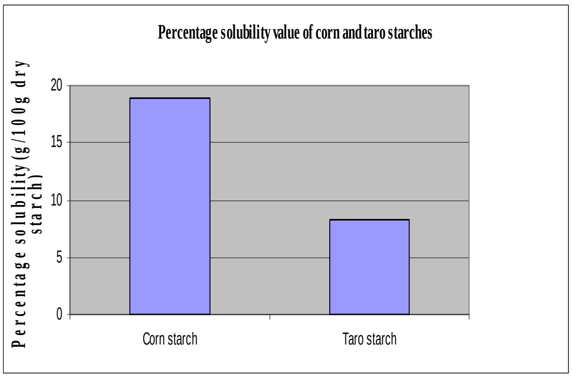


C)

Fig.1: Starch granules (3500x) observed from Scanning Electron Microscope: (A) Corn starch (B) Taro starch from monsoon variety (C) Taro starch from winter variety



(A)



(B)

Fig.2: Physicochemical properties of starches: (A) Swelling power of corn and taro starches (B) Percentage solubility of corn and taro starches

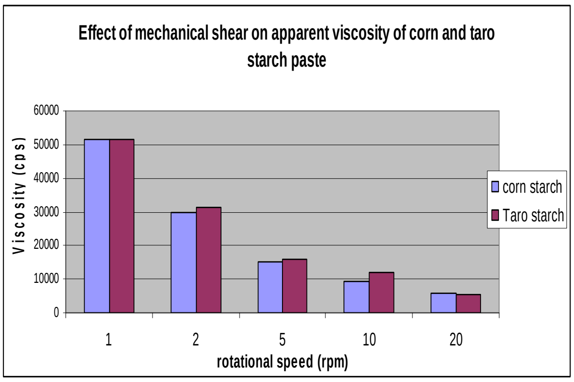


Fig.3: Effect of mechanical shear on apparent viscosity of corn and taro starch pasteb (1 centipoise = 0.001 kilogram per meter-second)

Discussions and Conclusions

Dry matter content:

Difference in dry matter content, observed between seasonal varieties of taro corm, ultimately reflected in corm-matrix moisture content and hence, in its plasticizing effect during starch isolation process through water-extraction from taro corm.

Chemical properties of Taro:

Total carbohydrate content varied for different seasonal varieties of taro flour. It was observed that monsoon variety contained highest amount of carbohydrate with an average value of 83.24 g./100 g. of taro flour (dry basis), while winter variety had the lowest one of 73.76 g./100 g. taro flour (dry basis). The findings are found to be similar with the observations of Tattiyakul *et al.,*[9] for different taro corms cultivated in different locations of Thailand. Starch content of taro flour also varied significantly with different seasonal variety and the monsoon variety containing highest amount of starch (76.23g./100g. taro flour). This data reflected variation in starch content of fresh taro corm in different climatic conditions. This observation is found to be similar to the findings by Rahman *et al.,*[27] for variation in starch content of breadfruit.

Solid-profile in cake and in supernatant in successive washings:

Solids in residual cake did not vary much during water extraction (wet-grinding) of three seasonal varieties. Several washing steps were needed to be carried out in order to remove slimy mucilage. Similar finding was observed by Tattiyakul *et al.,*[9] Total solids content gradually decreased in successive supernatants, as washing continued through repeated centrifugation. Higher solids in supernatants for winter season taro might be due to high amount (24.04%) of soluble carbohydrate or mucilages in taro corm, as mucilages are washed out in successive washings. Highest quantity of starch content in taro flour and in taro starch suspension for monsoon variety might result in loss of some starch granules in washings, as indicated by violet coloration in third supernatant and so, solid content for monsoon season supernatant also increased. Total solids content in third washings for spring season is significantly less i.e. 0.01g., compared to 0.54g. and 0.32 g. for monsoon and winter seasons. It indicated that centrifugal washing was most effective for spring season taro with least content of other impurities in final starch powder in spring season.

Extracted starch powder content from Taro:

Extracted starch powder content was the least from spring season taro corm and was not much different in winter and monsoon season. It might be due to less amount of free moisture (70%) in fresh corm in spring season compared to monsoon and winter season, as indicated by 30.18% dry matter content of fresh corm of spring season. Distribution of starch granules is uneven in the cell walls of tubers. Granules can be liberated from tuber by proper disruption of the cell walls[28]. Decrease of available water in taro corm matrix might hinder the disruption of cell walls and thus liberation of starch granules. In monsoon, starch content of fresh tuber corm increased, as indicated by the starch content of monsoon season taro flour in Table 1, and available water might be sufficient for effective liberation of starch granules from the matrix. In winter season, 78% available water in taro corm matrix, as indicated by 22.57% dry matter content of taro corm, might be responsible for effective extraction of starch and resulted in comparable quantity of final starch powder as in monsoon season.

Effect of taro corm and water ratio and single-stage-multiple-stage extraction:

It was observed that, ratio of sliced taro corm: water had a significant effect on weight of residual cake and final quantity of starch powder, as shown in Table 3. Both 1:2 and 1:7 ratio resulted in higher loss in starch content from cake due to higher weight of cake and lower quantity of final powder. Maximum amount of powder was obtained from 1:5 ratio of taro: water. It might be due to efficient milling or maceration of taro slices, when optimum ratio was maintained.

Milling in three successive stages, maintaining 1:5 ratio, produced 1.46% (w/w) more starch powder, when compared to single stage of milling. Weight of residual cake was also 7.54% (w/w) less in multiple stage milling.

1:5 corm-water ratio and multiple-stage extraction resulted in 7.77g, 11.47 g. and 12.80 g. extracted starch powder for spring, winter and monsoon varieties respectively. Extracted starch powder content followed the similar trend for multiple-stage milling as it was found for single-stage milling for three different seasonal varieties.In all the cases, quantity of powder content increased from single-stage to multiple-stage and the increase was in the range of 0.62%-2.29% (w/w).

Effect of seasonal variety on chemical composition of Taro starch powder:

Purified taro starch powder from winter contained highest amount of other impurities e.g. crude fibre and protein compared to those of other seasons. Presence of high amount of soluble carbohydrate, specifically gummy materials in the taro corm, as indicated by 24% of soluble carbohydrates in taro flour of winter season might interfere in centrifugal separation of starch residue from starch slurry. Gums show higher water-binding capacity, which substantially increase viscosity of slurry and also hinder sedimentation of plant components during centrifugation[29]. Hence, centrifugal separation of starch is ineffective.

Protein content of purified starch powder varied from 0.8-1.51% in spring and monsoon season. It might be due to high protein content in original taro flour (8.7-8.8%), and so in fresh taro corm. Taro starch molecule might be embedded in the endosperm protein matrix, making granule isolation more demanding, as in case of cereals[30]. High protein content of purified taro flour or final starch powder in water-extraction process was also reported by Tattiyakul *et al.,*[9]. Crude fibre content of purified starch powder was the least in spring season as indicated by 0.57%.It might be due to effective purification during centrifugal washings, as soluble carbohydrate content in taro flour (spring) is only 8.74%.The purification process resulted in 1.95% crude fibre in final starch powder in monsoon season. Some fibre-bound pigments in fresh root might affect the seperation of crude fibre, as indicated by strong dark colour of the screened starch slurry, obtained during starch isolation from taro corm.

Effect of seasonal variety on (%) starch yield for Taro starch powder:

Purity of extracted starch powder was found to be highest i.e.83.78% in monsoon season and gradually decreased to 83.33% and 72.62% in spring and winter seasons respectively. On dry basis, the purity was 93.60%, 91.66 and 79.15% in monsoon, spring and winter seasons respectively. Hence, a representative sample of starch powder containing more than 96% starch (w/w) would not be obtained from any of these varieties of taro by water-extraction method. A good representative sample should contain >96% (w/w) starch and should be free of other plant components, such as fiber (soluble and insoluble), protein and lipids[31].

Both extracted starch powder content and purity of starch powder varied to a significant extent depending on seasonal variation in fresh taro corm composition. It resulted in varying % of starch yield in different seasons through water-extraction process. Highest starch yield was 73.71% in winter season. It might be due to the fact that water extraction process from taro corm could not result in both quantitative extraction and effective purification of starch powder.

Scanning electron microscopy (SEM):

A SEM was used to observe extracted starch granules to determine the cleanliness of the granules after water extraction. Fig. 1A shows scanning electron micrograph of standard corn starch granules. Two samples of water-extracted taro starch granules of maximum and minimum purity i.e. of monsoon and winter variety are shown in Fig.1B and 1C respectively. Starch granules achieved from water extraction process for monsoon variety appeared to be relatively clean compared to that of winter season. Residual materials, possibly protein were found in starch granules for winter variety in significant amount, compared to the monsoon variety. This finding is similar with the observations by Lee *et al.,*[21] for two variety of lentil starches, extracted using distilled water at 22C. Figures showed that taro starch granules were small, irregular shapes, and polygonal. The surface-average diameter of taro was found to be significantly small (1-4 micron) than that of corn starch (5-10 micron). Range of corn starch granules from 5-25 microns in diameter were already reported by Wurzberg[32]. The findings of taro starch granules are in agreement with the observations by Tattiyakul *et al.,* 2006[9].

Swelling Power and Solubility:

Swelling power and % solubility value for the most clean variety i.e. monsoon variety of taro starch sample with highest purity are shown in Fig. 2 against standard corn starch. Taro starch, when heated at 85C, showed significantly less swelling power and percentage solubility, when compared to that of standard corn starch. Result of swelling power for taro starch is close to the swelling index value obtained for native cocoyam starches from two different cultivars[33]. Percentage solubility value for taro starch with respect to standard corn starch followed the similar trend as observed by Salwa *et al.,*[34]. The high swelling power and solubility value of corn starch with respect to taro starch could be explained by granule size and amylose content. Starch with large granules swells rapidly when heated in water and crystalline, molecular structure of starch is broken. It allows water molecules to bond with the free hydroxyl groups of amylose and amylopectin by hydrogen bond, which then increases absorption and solubility[34].

Apparent viscosity:

Apparent viscosity was determined for taro starch sample with maximum cleanliness as characterized by SEM and highest purity. Fig.3 shows apparent viscosity for monsoon variety taro starch and standard corn starch samples against rotational speed. It was observed that viscosity of taro starch and that of standard corn starch decreased, when shear rate increased from 1 to 2,6,10 and 20 rpm at 50^0C. This typical decrease in viscosity with an increase in rotational speed indicates shear thinning behavior. This finding is in accordance with the decrease in apparent viscosities of amaranth and waxy corn starch pastes with increase in rotational speed[26]. Final viscosity formed at the end of cooling at 50°C is called cold paste viscosity (CPV). Cold paste viscosity of both isolated taro starch and standard corn starch samples were found to be comparable at all rotational speeds. CPV of the starch pastes could be attributed to aggregation of the amylose molecules on cooling[35] and this value could be associated with the amylose content of native starch [36]**.**

Conclusion

Isolation of starch from fresh taro corm through water-extraction process was established with the analysis of chemical composition of final starch powder. Being a tuber source, starch isolation from taro corm would be relatively simple compared to more demanding starch isolation process from cereals. Significant abundance of taro corm at reasonable price throughout the year and ease of extraction with water resulting in a definite percentage yield would probably lead to an alternate process for production of commercial starch from eddoe type of taro from West Bengal, India. Characterization of water-extracted starch was also carried out with respect to standard corn starch. However, limitation of this process for quantitative recovery of starch was also found out. This has a significant implication in implementation of industrial-level starch extraction and modification process thereafter. In further study by the author, use of alkali extraction process was found to be better, as regards for isolation and characterization of pure taro starch powder with significant yield.

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