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Isolation of starches from non-conventional sources of north-eastern region of India

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Abstract
North eastern India is blessed with potential source of starch i.e., sweet potato, discoscorea, jackfruit seed and tapioca etc. Starch has numerous applications in various industries like food, textiles and pharmaceutical industries. So various non-conventional sources (sweet potato, discoscorea, jackfruit seed, buckwheat, taro and tapioca) were used to extract starch and their proximate analysis, yield and amylose content were analyzed in the present study. Yield of starch was highest in discoscorea i.e., 84% and amylase was highest for 26.1% for taro starch. Non-conventional sources of starch such as sweet potato, jackfruit seeds, dioscorea are good and have been less utilized as compared to conventional sources. So, it is necessary to utilize these underutilized crops for their use in many food and non-food applications. Non-conventional starches and their value addition have increasingly been gaining importance in recent years because of their potential application as functional ingredients in the development of new products.

Keywords: Non-conventional starch, sweet potato, jackfruit seed, buckwheat, taro, tapioca

Introduction
North eastern India is blessed with potential source of starch that can be obtained from sweet potato, colocacia, yam and tapioca etc. Starches have many diverse applications like as in food, textiles and pharmaceutical industries. Native starches have low shear stress resistance, thermal decomposition, high retro gradation and native starches have many disadvantages for industrial applications such as insolubility in cold water, narrow peak viscosity and loss of thickening power after cooking *viz*. they become thick for a short time and then begin to break down. In addition, retro gradation occurs after loss of ordered structure on starch gelatinization which results in syneresis or water separation in starchy food systems (Kittipongpatana and Kittipongpatana, 2014) [8]. They do not stand up well to processing, and produce a low quality final product. Due to these limitations, native starches have restricted applications at the industrial level. However, these shortcomings of native starch could be overcome, for example, by introducing small amounts of ionic or hydrophobic groups onto the molecules. These facts motivated the employment of modified starches as important functional ingredients in processed foods in recent years. Non-conventional sources such as sweet potato, jackfruit seeds, dioscorea are good source of starch and has been less utilized as compared to conventional sources. So, it is necessary to utilize these underutilized crops for their use in many food and non-food applications. Non-conventional starches and their value addition have increasingly been gaining importance in recent years because of their potential application as functional ingredients in the development of new products (Sarkar and Jindal, 2015; Sarkar, 2016) [9, 10]. So the present study was undertaken to explore the underutilized non-conventional source of starch in NE region of India.
The non-conventional sources of starch identified from availability of the resources in the local market were *Dioscorea* sp., jackfruit, mango, sweet potato, tapioca, taro and buckwheat. However availability of these resources are purely seasonal based in the local market of Garo hills (Tura, Meghalaya), Guwahati (Assam), Agartala (West Tripura), Subroom (South Tripura).

Materials and Methods
Isolation of starches was extensively studied and optimized procedure for each sources are given in details.

Discoscorea starch isolation (Jamaica Riley *et al*., 2006) [7]
The discoscorea was washed, cut into small pieces and ground with a plant micro- Muller, which was sieved with 160 mesh shifter. After having been sieved, the yam four was steeped in ethanol to remove non-polar small constitutes. After depositing, the supernatant was removed by suction sand the settled starch layer was resuspended in distilled water. After 7 or 8 cycles of resuspending repeatedly, the slurry was centrifuged at 3000 rpm for 20 minutes. The white layer was resuspended in distilled water and re-centrifuged 3–5 times. The starch suspension obtained was dried in a convection oven at 50 °C.

Jackfruit seed starch isolation (Kittipongpatana and Kittipongpatana, 2014) [8]
The brown spermoderm covering cotyledon of jackfruit seed was removed by soaking the jackfruit seeds in solution of sodium hydroxide (NaOH) (5 g/100 ml) and citric acid (5 g/100 ml), each for 2 minutes and washed with water. The cotyledon was used to prepare flour and starch. The seeds were sliced (2 mm thickness) and tray dried at 45 °C until the moisture content was less than 13 g/100 g. The dried jackfruit seeds were grounded in a grinder and passed through a sieve (0.18 mm mess size). Isolation of jackfruit seed starch from jackfruit seed flour used a modified method of Bobbio *et al*. (1978) [3]. Slurry of jackfruit seed flour was prepared in 0.05 mol equi/L NaOH solution and constantly stirred for 6 hr. The slurry was centrifuged at 3000 x g for 20 mins at 4°C. The supernatant was drained and upper brown sediment was scraped and followed by a 2nd extraction with a 0.05 mol equi/ L NaOH solution. The remaining sediment was mixed with distilled water and filtered by a sieve (0.075 mm mess size) to eliminate fibers. The filtrate was neutralized with 0.1 mol/L HCl to pH 7 and the slurry were centrifuged at 300 x g for 20 mins at 4 °C. The starch cake was dried at 50 °C for 12 h. The starch was ground with a mortar and passed through a sieve (0.15 mm mess size). The starch were packed in a plastic bag and kept at room temperature until further use.

Mango seed starch isolation
Mangoes were washed, peeled and stones were separated from pulp using a pulper. Stones were washed to remove any traces of adhering pulp and then dried at 40 °C in a hot air cabinet drier for 10 hr. Kernels of mango were removed from the stones after breaking them open. Kernels were cut into small pieces (2cm) and steeped in water containing 0.16% sodium hydrogen sulphite for 12 hr at 50 °C. The steep water was drained off, and the kernels were ground. The ground slurry was screened through nylon cloth mess. The material left on the nylon cloth was washed thoroughly with distilled water. The filtrate slurry was allowed to stand for 1 hr. The supernatant was removed by suction and the settled starch layer was resuspended in distilled water and centrifuged at wide-mouthed cups at 2800 rpm for 5 mins. The upper non-white layer is scrapped off. The white layer was resuspended in distilled water and recentrifuged 3–4 times. The starch was then collected and dried in an oven at 50 °C for 6–7 hr.

Tapioca starch isolation (Carvalho *et al*., 2007) [4]
Fresh tuberous roots were washed, peeled, and washed again, chopped to about 1cm³ cubes and transferred into a heavy duty blender. 1 litre of water was added to 500 g of the chopped tubers, and the chopped tubers were pulverized at a high speed for 5 min. The suspension was then filtered using a double cheese (muslin) cloth. The filtrate was allowed to stand for 4 hrs to facilitate starch sedimentation and the top liquid was decanted and discarded. The sediment was resuspended in 1 L of water and the whole process was repeated 3 times. The sediment was then washed and dried in the sun (open) air for 2 days or in a drier at 50 °C.

Taro starch isolation (Agama-Acevedo *et al*., 2010) [1]
The sample washed, peeled and fibrous roots removed. Immediately after peeling, the tubers were sliced into 2–3 cubes, soaked in Sodium metabisulphite (50 mg/L) for 1 hr and then shredded in a warring blender. The starch in the slurry was separated from all debris by vacuum filtration through a muslin cloth. The filtrate containing the starch was allowed to stand (~ 2 hr or ~12 hr) at room temperature until a dense firm starch layer was obtained. The supernatant was siphoned and discarded and the precipitate was suspended in excess 0.02 % NaOH. After standing for ~ 4 hours, the supernatant was removed. The washing sedimentation process with alkali was repeated until the supernatant layer was free of color and suspended haze. The final sediment was suspended in deionized water, passed through a 70 µm polypropylene screen, neutralized to pH 7. The starch was air dried at room temperature.

Sweet potato starch isolation (Iheagwara, 2013) [6]
Sweet potato were washed, peeled and shredded. Shreds were put into plain water (pH 6.8). After that the shredded sweet potato were put in water solution containing various chemicals, such as potassium metabisulphite (KMS) (0.25%), citric acid (0.12%) and sodium chloride (1%) to improve the color of starch. Starch solution was allowed to stand for 6 hours and then the solution was centrifuged for 20 min. the supernatant was discarded and pellet was collected. The starch pellet was dried in an oven at 40 °C. Then it was powdered and passed through an 80-mesh sieve and packed in polyethylene bags until use.

Buckwheat starch Isolation (Christa *et al*., 2009) [5]
Buckwheat flour was steeped in 0.2% NaOH (1:6 w/v) and placed in 45±2 ºC water bath for 90 min. The slurry was centrifuged at 1500 x g for 15 min at 25±2 ºC. The brown coloured supernatant was discarded and the starch was carefully scrapped and was resuspended in distilled water, centrifuged, decanted. Starch was resuspended in distilled water and pH was adjusted to 6.5–7.0 with 1 M HCl. Starch was washed three times with distilled water and dried at 45±2 ºC. Starches were analyses as per AOAC, 2005 [2].

Results and Discussions
Proximate analysis of the dioscorea, jackfruit seed, mango seed, sweet potato, buckwheat and tapioca starches were analysed for the proximate composition and yield. The results are tabulated in Table 1. Yield of starch after isolation ranged between 11.5–84% (Agama-Acevedo *et al*., 2010) [1]. Highest yield of starch was observed in *Dioscorea sp* followed by tapioca and sweet potato After isolation of starch the protein contain of the starch was very low (0.04–0.18%) which indicates good quality of starch as it is low in protein content. The starch had low moisture content ranging from 12.6–10.17% (Iheagwara, 2013) [6]. Low moisture content indicates good keeping quality of the starches. Fat content of the starches were 0.03–0.17%, which shows that starches were relatively low in fat content. Carbohydrate content was varies

from 89.95–85.23% and highest carbohydrate content was observed in jackfruit seeds and lowest in buckwheat starches. Amylose content was observed from 26.4–18.07%. Amylose plays significant role in quality of isolated starches. Highest amylase was observed in jack fruit seed starch and lowest in *Dioscorea sp* starches. Ash content ranged from 0.04–0 .75%.

Table 1: Proximate analysis of the starch after isolation from their sources

Starch Source	Yield (%)	Moisture (%)	Protein (%)	Lipid (%)	Ash (%)	Carbohydrate (%)	Amylose (%)
Dioscorea sp.	84	12.6	0.08	0.04	0.75	86.5	18.07
Jack fruit seed	17	9.89	0.09	0.03	0.04	89.95	26.4
Mango Seed (*Mangifera indica)*	11.8	10.3	0.18	0.09	0.20	88.63	14
Sweet potato(*Ipomoea batatas)*	48	11.76	0.19	0.17	0.24	87.64	21.46
Tapioca (*Manihot esculenta)*	60	12.5	0.04	0.06	0.11	87.29	19.8
Buckwheat	23	10.19	0.07	0.13	0.16	85.23	22.8
Taro (*Colocasia esculenta*)	15	11.2	0.04	0.08	0.14	88.54	26.1

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Conclusion
Isolation of starch from non-conventional sources will be helpful for improving the economic value of the underutilized crops. Starch has extended shelf life so post-harvest loss will be reduced and these starches can be utilized for development of various innovative products.

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