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Original Article

“Functional and Chemical Properties of Starch isolated from Tubers”

A. Surendra Babu1* and R. Parimalavalli2

1,2Department of Food Science, Periyar University, Salem-II, Tamil Nadu, India

Corresponding Author *Email: surendrababu934@gmail.com.

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Abstract

The present study was aimed to test uniformity of isolated starches from tubers with respect to functional and chemical properties. Three different methods were used to isolate starch from Amorphophallus paeonifolius (Elephant Foot Yam) and Dioscorea trifida L. (Cush-Cush Yam). Functional properties such as Water Absorption Capacity, Oil Absorption Capacity, Swelling Capacity and chemical properties such as Moisture Content and Dry Matter were analysed. Starch yield from the Elephant Foot Yam and the Cush-Cush Yam by different methods was ranged from 1.90 – 6.80 g% and 2.19-2.70 g% respectively. A significant difference in Swelling Capacity (0.62-1.25 g/g) and Water Absorption Capacity (0.22-0.64 ml/g) was seen among the Elephant Foot Yam starches. In the same way, significant difference in Swelling Capacity (0.45-0.83 g/g) and Oil Absorption Capacity (1.06-1.40 ml/g) was noticed among the Cush-Cush Yam starches. Elephant Foot Yam starches exhibited no significant difference in Moisture content (9.99-12.13%) and Dry matter (88.46-89.99%). A similar trend was observed among the Cush-Cush Yam starches in Moisture content (14.66-17.50%) and Dry matter (82.33-86.12%). Hence the starches isolated from tubers by different methods had varied functional and same chemical properties.

Key words: Elephant Foot Yam; Cush-Cush Yam; Water Absorption Capacity; Oil Absorption Capacity; Swelling Capacity.

1. INTRODUCTION

Tropical tuber crops Elephant Foot Yam and Cush-Cush Yam contain starch as the major component and thus act as an important source of starch. [5]. Yams are classified generally under the genus Dioscorea, family Dioscoreaceae and under Discorcales [13]. Amorphophallus paeonifolius (also elephant foot yam) is an herbaceous, perennial C3 crop. It is basically a crop of south eastern Asian origin. It serves as a source of starch as well as protein [11]. Cush-Cush yam (Dioscorea trifida L.) is the most important edible yam from the Amerindian family of the Dioscorea genus [8]. They form an important food source in tropical countries including East Africa, the Caribbean, and South Africa etc. [13]. Except Cassava and to smaller extent Sweet Potato, starch from Yam and other tuber crops have not been exploited for industrial applications because of difficulty in the extraction of pure starches and its properties [5]. One of the limiting factors for industrial application of non-official starches such as yam and elephant foot yam is the lack of adequate information on the physiochemical, fundamental and derived properties of the starches[8]. The Dioscorea genus has a large biological diversity including more than 600 species worldwide. This genus appears nowadays as a source of native starches whose functional characteristics, if sufficiently exploited, could find some applications in food ingredient industry [2]. Therefore, understanding the functional and chemical properties of starch could help in utilization of different applications [12]. Thus, the study was aimed to isolate starch from tubers by different methods and to test uniformity of isolated starches with respect to functional and chemical properties.

2. MATERIALS AND METHODS

2.1 Sample preparation

Tubers namely Amorphophallus paeonifolius (Elephant Foot Yam) and Dioscorea trifida L. (Cush-Cush Yam) were purchased from local market in Salem (Tamil Nadu) in November, 2011. The tubers were placed in a polyethylene bag to prevent loss of moisture during transportation to the laboratory of Department of Food Science, Periyar University where analysis was conducted. Non edible portion (peel) was eliminated. Edible portion was washed with running cold water to remove impurities and cut into small pieces. Starch was isolated from each tuber separately by three different methods and the isolated starches were analysed for functional and chemical properties.
2.2. Methods of extraction of starch

2.2.1. Method 1

Starch was extracted from the tubers in triplicates as described by Vasantan (2001). Blending of tubers with water was done at a ratio of 1:10 until smooth slurry forms. Sodium metabisulphite of 0.01% (w/v) was added during slurring. After slurring, the first filtration was done with double-layered cheesecloth. The resulting filtrate was then subjected to further filtration through a series of polypropylene screens (250, 175, 125, and/or 75 μm). The filtrate was centrifuged for 20 min at 5000 × g, 20°C. Starch settled (a white layer) at the bottom of centrifuge tube was washed with toluene, oven dried at 30°C - 40°C. The dried starch was made into powder.

2.2.2. Method 2

According to the method of Riley et al. (2006), edible portion of tubers was homogenized with 1 M NaCl (900.0 ml) solution using a blender. The mixture was filtered through triple layered cheesecloth; starch was washed with distilled water. The granules were allowed to settle for a minimum of 3 h at room temperature. The precipitated starch was washed three times with distilled water, dried at room temperature for two days and then in oven at 50°C overnight. Starch was removed and allowed to air dry at room temperature.

2.2.3. Method 3

As described by Abo-Eltetoh et al. (2010) with slight modification, edible portion of tubers was crushed with distilled water for 1-2 min. The slurry of each was then passed through double-layered cheesecloth and the filtrate was allowed to settle for a minimum of 3 h at room temperature. The precipitated starch was washed three times with distilled water, dried at room temperature for two days and then in oven at 50°C for three hours.

2.3. Functional properties

2.3.1. Water Absorption Capacity (WAC) and Oil Absorption Capacity (OAC)

The water/oil absorption capacity was determined by the method of Abbey and Ibeh (1988). Ten millilitre of water/oil was added to one gram of starch sample in a centrifuge tube of known weight. The mixture was allowed to stand for 30 min, centrifuged (3500 g, 15 min) and the supernatant was discarded. The tube with residue was weighed and the gained weight was regarded as water/oil absorption capacity and expressed in ml/g.

2.3.2. Swelling Capacity (SC)

The Swelling capacity method was determined by the method of Leach et al. (1959). Starch suspension of 1% (w/w) was heated for 30 min over the temperature range of 55-95°C by immersion in a water bath with gentle stirring. After cooling for 15 min at room temperature it was centrifuged at 5000rpm for 30 min then swelling capacity was determined and expressed in g/g.

2.4. Chemical properties

2.4.1. Moisture Content (MC) and Dry Matter (DM)

The method of Ashaye et al. (2010) was used for determining Moisture Content (MC) and Dry Matter (DM). Two millilitres (2ml) of each sample was measured into a previously weighed crucible, dry over water for some time. The crucible together with sample was then transferred into the oven set at 100°C to dry to a constant weight for 24 hours over night. At the end of 24 hours, the crucible plus sample was removed from the oven and transfer to dessicator cooled for ten minutes and weighed. The MC and the DM were determined and expressed in percentage.

3. STATISTICAL ANALYSIS

Three replications of each sample were used for statistical analysis. Data were subjected to Analysis of Variance using MS Excel 2007, and the means were compared by Critical Difference (CD). Differences at p<0.05 were considered to be significant.

<table>
<thead>
<tr>
<th>Properties</th>
<th>Method-1</th>
<th>Method-2</th>
<th>Method-3</th>
<th>F-Value</th>
<th>Critical difference</th>
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</thead>
<tbody>
<tr>
<td>Functional Properties</td>
<td>WAC (ml/g)</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td></td>
<td>0.22±0.10</td>
<td>0.40±0.19</td>
<td>0.64±0.16</td>
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<td>0.25±0.03</td>
<td>0.23±0.16</td>
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<td>2.04±0.16a</td>
<td>1.89±0.06</td>
<td>3.60±0.08a</td>
<td>21.08*</td>
<td>0.71</td>
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<tr>
<td>Chemical Properties</td>
<td>MC (%)</td>
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<td></td>
<td>9.99±0.90</td>
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<td>89.99±0.90</td>
<td>87.93±3.34</td>
<td>88.46±2.04</td>
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<td>1.62</td>
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</table>

Table 1. Functional and chemical properties of Elephant Foot Yam Starches.

<table>
<thead>
<tr>
<th>Properties</th>
<th>Method-1</th>
<th>Method-2</th>
<th>Method-3</th>
<th>F-Value</th>
<th>Critical difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional Properties</td>
<td>WAC (ml/g)</td>
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<td></td>
<td>0.39±0.04</td>
<td>0.39±0.04</td>
<td>0.41±0.01</td>
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<td>1.06±0.05</td>
<td>1.36±0.05b</td>
<td>1.40±0.10b</td>
<td>18.20*</td>
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<td>0.45±0.01</td>
<td>0.51±0.15b</td>
<td>0.83±0.05c</td>
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<td>0.18</td>
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<tr>
<td>Chemical Properties</td>
<td>MC (%)</td>
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<td></td>
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<td></td>
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<tr>
<td></td>
<td>15.95±1.40</td>
<td>17.50±3.12</td>
<td>14.66±2.02</td>
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<td>86.12±2.77</td>
<td>82.33±3.32</td>
<td>85.33±2.02</td>
<td>1.57NS</td>
<td>5.50</td>
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</table>

Table 2. Functional and Chemical Properties of Cush-Cush Yam Starches.

4. RESULTS AND DISCUSSION

Different methods involving homogenising, blending followed by addition of chemicals, sieving and recovery of starch by centrifugation were used for isolation of starch from tubers. The obtained starch yield of Elephant Foot Yam (EFY) was 1.90g%, 6.80g% and 3.32g% for Method-
starch had been broken during heating and the water molecules bonded to the free hydroxyl groups of amyllose and amylpectin by hydrogen bonds cause an increment in the absorption capacity and solubility [6]. Swelling power of starch depends on the capacity of starch molecules to hold water through hydrogen bonding. The Moisture content of the EFY starch and CCY starch was similar to moisture content of the commercial yam starch i.e., 11.75±0.05 [10]. On the other hand the dry matter of EFY and CCY starches was analogous with the cassava starch which is 86.71-87.18% [7].

5. CONCLUSION
The study concluded that, the yield of starch was in the range of 1.90-6.80% and 2.20-2.70% in elephant foot yam and cush-cush yam respectively. WAC showed significant difference among the elephant foot yam starches, whereas OAC indicated significant difference among the cush-cush yam starches. SC was also significantly varied among the starches of both tubers. Therefore the starches isolated by different methods were varied with respect to functional properties but uniform in chemical properties.

REFERENCES
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