

## Short Communication

# Studies on the functional properties and the nutritive values of amura plant starch (*Tacca involuocrata*) a wild tropical plant

S. G. Zaku<sup>1\*</sup>, O. C. Aguzue<sup>1</sup>, S. A. Thomas<sup>1</sup> and J. T. Barminas<sup>2</sup>

<sup>1</sup>Chemistry Advance Laboratory, Sheda Science and Technology Complex, P. M. B. 186, Garki, Abuja-FCT, Nigeria.

<sup>2</sup>Department of Chemistry, Federal University of Technology, P. M. B. 2076, Yola, Adamawa State, Nigeria.

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Starch, is a natural biodegradable biopolymer which is in high demand recently for use in many industrial products. However, this has greatly increased the search for more new sources of starch from plants. The plant *Tacca involuocrata* is a wild plant that contains starch which is eaten when the flour is been cooked, usually by the villager or rural dweller in the Northern Nigeria as their food. A new starch was able to be isolated from these Amura tubers which yield 30.23% of starch on dry weight basis. The chemical composition; swelling power, solubility power, water-binding capacity, granular density, ash, moisture, crude protein, total lipid, crude fibre, amylose contents, phosphorus contents were determined. The chemical composition data were 9.15% moisture content, 0.20% ash content, 2.10% crude fibre, 0.39% crude protein, 0.09% total lipid and 98.80 ppm phosphorus. The starch exhibited high water binding capacity, solubility and limited swelling power behavior which were dependent on temperature. Based on the ability of the starch to be easily cooked and form gels, the starch may be a potential hydrocolloid for application in sauces and variety of new food products.

**Key words:** *Tacca involuocrata*, swelling power, solubility power, bulk density, water binding capacity.

## INTRODUCTION

Amura plant is a crop found in the family of Taccaceae of the genus *Tacca*. The plant is found in the wild in Northern Nigeria and is not being cultivated. It is an important source of food for the rural people of Northern Nigeria. No scientific information appears currently available on the plant starch.

More interest is currently being focused on the possibilities of exploiting the vast numbers of less familiar plant resources existing in the wild (National Academy of Sciences, 1975). Many such plants have been identified, but the lack of data on their chemical composition has limited the prospects for their utilization (Vijayakumari et al., 1994). Most reports on some lesser-known and unconventional crops indicate that they could be good sources of nutrients, starch and many have the potential of broadening the present narrow food base of the human species (Viano et al., 1995).

In most developing tropical countries the food situation

is worsening owing to increasing population, shortage of fertile land, high prices of available staple foods (Sadik, 1991). This has resulted in a high incidence of hunger and malnutrition, a situation in which children and women, especially pregnant and lactating women, are most vulnerable (Weaver, 1994).

Predictions of future food needs based on the current rates of population increase and food production emphasize the seriousness of this problem [6]. There can be no immediate single solution to the problem of food sufficiency; an interdisciplinary approach is necessary (Avery, 1991). Starch is widely used as thickener, water binder, emulsion stabilizer and gelling agent in food industries, therefore all information on new sources of starch for industries will be of value in dealing with the food problem (Masek, 1966; Hutchinson and Dalziel, 1973).

This study provides data on the nutrient and chemical composition of Amura starch found in Nigeria. The specific goal of this study is to produce or discover new starch from a different source other than cassava, yam, corn, potatoes and other complex carbohydrates. The

\*Corresponding author. E-mail: zakusamaila@yahoo.com.

**Table 1.** Proximate compositions of the starch (on dry weight basis).

Parameter	Composition
Starch yield (%)	30.23 ± 0.01
Moisture (%)	9.15 ± 0.02
Ash (%)	0.20 ± 0.04
Crude protein (%)	0.39 ± 0.02
Crude fiber (%)	2.10 ± 0.06
Total lipids (%)	0.09 ± 0.01
Carbohydrate (%)	88.07 ± 0.03
Phosphorus (ppm)	98.80 ± 0.23
Aqueous pH	5.80 ± 0.03

The results are means of triplicate determinations ± standard deviation.

**Table 2.** Selected physicochemical properties of the starch.

Parameter	Composition
Bulk density (g/cm <sup>3</sup> )	0.81 ± 0.03
Amylose content (%)	28.07 ± 0.04
Swelling power (g/10ml)	3.4 ± 0.01
Solubility power (%)	66.6 ± 0.02
Water-binding capacity (%)	56 ± 0.01

The results are means of triplicate determinations ± standard deviation.

present uses of this plant vary with location and there is little information on its uses.

## MATERIALS AND METHODS

### Amura tuber samples

The amura tubers were collected from a bush at Dampar village in Ibi local government of Taraba State, Nigeria.

### Starch extraction

Starch was extracted by the method of Moorthy and Nair (1989) with modifications (sodium-metabisulfite was used instead of sodium chloride). The freshly harvested Amura tubers (100 g) were peeled and homogenized with 1% sodium-metabisulfite (900 ml) solution using a waring commercial blender.

The mixture was filtered through a triple-layered cheesecloth and starch washed thoroughly using distilled water. The granules were allowed to settle for 3 h and the water decanted off. The wet cakes of the starch were sun dried, ground into powder, packaged into transparent polyethylene bags and labeled prior to analysis.

### Chemical composition

The quantitative evaluations of crude fiber, moisture and ash contents of the starch samples were determined using the method of AOAC (1990). The method described by Pearson et al. (1981) was used for fat content analysis. Carbohydrate was obtained by

difference 100% - (moisture + protein + fat + ash + fiber)%. The nitrogen content was determined by the micro-Kjeldahl equipped with Kjeltac digester and distilling system. The protein of the starch was estimated by multiplying the nitrogen content by 6.25 as described by AOAC (1990).

The method described by Wang and Kinsella (1976) was used for bulk density determination. The water binding capacity was determined as reported by Akintayo (1999). The method reported by Song and Jane (2000) was used for amylose contents analysis. The solubility and swelling power determinations were carried out using the methods described by Leach et al. (1959). For determination of phosphorus, the sample treatment method outlined by Chaisawang and Suphantharika (2006) was followed and the phosphorus content was then determined by the molybdenum blue method using a spectrophotometer (Smith and Caruso, 1964). All determinations were in triplicates.

## RESULTS AND DISCUSSION

### Chemical composition

Tacca starch was isolated from fresh harvested tubers of *Tacca involucrata*. The proximate compositions of this starch and its yield (30.23%) are presented in Table 1. This yield might be an indication of appreciable accumulation of starch in the fresh tubers. The inorganic materials in the starch appears low as shown by the low ash content. The crude protein of the starch is 0.39% which is low compared to potato (0.63%) and corn (0.88%) starch (Ahmad et al., 1999). Hence Tacca starch could be a possible raw material in the food industry for production of glucose or fructose, where interference with Maillard reaction may be absent (Shahidi et al., 1999).

The total lipid content obtained at 0.09% is equally low compared to potato (0.12%), corn (0.20%) and sago (0.25%) starches (Ahmad et al., 1999). The low protein and lipid contents of this starch obtained might suggest good purity of the starch isolated. The phosphorus value is low compared to cassava (113 ppm), corn (171 ppm), sago (110 ppm) and potato (715 ppm) starches (Srichuwong et al., 2005). The amylose content (28.07%) in Table 2, falls within the apparent amylose range of 24 - 31% for sago starch (Ahmad et al., 1999), but higher than 21.8% for maize (Spence and Jane, 1999). The amylose content found for Tacca starch may place it as an enzyme-resistant starch and may also indicate the present of fewer amylopectin branch linkages located in the crystalline region of the starch (Spence and Jane, 1999). The pH measurement showed that Tacca starch is acidic and comparable with the previous pH values reported for tuber starches (Coursey and Rasper, 1967).

### Solubility, swelling power, water-binding capacity, bulk density of granules and amylose content

Solubility has been shown to positively correlate with swelling, suggesting that solubilization occurred along with granular swelling (Srichuwong et al., 2005). The

amylose acts both as diluents and inhibitor of swelling, especially in the presence of lipids which can form insoluble complexes with some of the amylose during swelling and gelatinization. The starch molecules are held together by hydrogen bonding in the form of crystalline bundles, called micelles (Rincon et al., 1999). Thus, swelling power and solubility patterns of starches have been used to provide evidence for associative binding force within the granules (Srichuwong et al., 2005).

The ability of starch to absorb water is an indication of its moisture stability more specially in the food industry (Adebowale et al., 2006). Water binding capacity of starches also provides evidence of the degree of intermolecular association between starch polymers due to associative forces such as hydrogen and covalent bonding (Rincon et al., 1999). Bulk density is a function of particle size; particle size is inversely proportional to bulk density. The relatively high value of bulk density of *Tacca* suggests its suitability as drugs binder and disintegrant in pharmaceuticals.

## Conclusion

The starch isolated from *Tacca involucrata* can be used as alternative binders and disintegrants in table formulation owing to its appreciable values of swelling power, bulk density and solubility.

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