Short Communication

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PHYSICO-CHEMICAL PROPERTIES OF STARCHES FROM SOME NIGERIAN CULTIVARS OF THREE-LEAVED YAM, *DIOSCOREA DUMETORUM* (KUNTH) PAX

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Several species of the genus *Dioscorea* (the yam) are important food crops in many tropical countries and in some subtropical regions. The most important and popular species is *D. rotundata* which has been found to be the most suitable for the preparation of "fufu" or "pounded yam" commonly preferred in Southern Nigeria. This suitability has been attributed to the high viscosity of the starch (Osisiogu and Uzo 1973). Rasper and Coursey (1967) described the starches of five cultivars of *D. rotundata* along with those of some other tubers grown in Ghana. Faboya and Asagbra (1990) also described the properties of starches of five Nigerian cultivars of *D. rotundata.*

D. dumetorum is one of the less popular species of *Dioscorea* because of its poor taste and non-suitability for the prepartion of "fufu", although its yields match those of *D. rotundata.* Inspite of the importance of *D. dumetorum* as a food crop and availability, comparatively little is known of the properties of its starches. This paper describes the physico-chemical properties of starches of two cultivars of *D. dumetorum,* the white and yellow bulky types and examines the potential uses of the starches.

For investigation the samples were purchased from a local market near Uyo, the Akwa Ibom State capital. The starch was extracted and the percent extract was determined using the method of Faboya and Asagbra (1990). Moisture, ash and crude protein contents were determined by the official methods of AOAC (1980); swelling property was determined using the method of Shantha and Sidappa (1970), pH was determined by the method of Rasper and Coursey (1967) while amylose was determined using the method of McCready and Hassid (1943). The determinations were carried out in duplicate and average results are presented in Table 1. The reagents were of Analytical Reagent grade and doubly distilled water was used in all extractions and preparations.

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The granules of *D. dumetorum* starch are very fine (about 2-5 microns). Table 1 shows the percentage of starch extracted from the white and yellow cultivars. It is evident that the starch content of *D. dumetorum* is far lower than those of most substances commonly used as starch food materials.

The colour of the starches obtained from the two species of *D. dumetorum* tubers varied from white to slightly brown. Since the granules of *D. dumetorum* starch are very small in appearance, it was difficult to separate the very small granules from the slurry, resulting in incomplete removal of the soluble impurities.

The pH measurements (Table 1) indicate that the two cultivars of *D. dumetorum* had acidic pH values, the white cultivar had a pH of 5.0 and the yellow cultivar a pH of 5.4. This is in consonance with the acidic pH values previously reported for tuber starch by Rasper and Coursey (1967) and Glicksman (1969). Raw starches are usually processed at a pH range of 5-7; within this range, gelatinisation temperature is not affected by pH. Tubers are known to contain alkaloids and the difference in the pH values of these species may be due to the levels of these nitrogeneous bases in the different cultivars of *D. dumetorum.*

Moisture content of the white and yellow cultivar was found to be 10.2% and 12.0% respectively. Most starches when equilibrated under normal atmospheric conditions contain 10-17% moisture (Glicksman 1969). By drying starch to a level below its equilibrium moisture content, it will preferentially withdraw moisture from other systems having a lower affinity for moisture. *D. dumetorum* starch, if dried down to a much lower moisture content (as low as 1.5%), could be used in applications where it is desired to extract moisture from other materials, or to protect active powders from the deleterious effects of moisture. One of such applications is in the confectionary industry as a mold agent for gum drops.

The ash content was 0.29% for the yellow cultivar and 0.30% for the white cultivar. Ash content is directly proportional to the mineral elements composition and this may be influenced by the mineral level of the soils in which the yams are grown. *D. dumetorum* starch is richer in mineral elements than *D. rotundata* starch (Faboya and Asagbra 1990).

Table 1 shows that the two cultivars of *D. dumetorum* are rich in protein compared with other yams. These values are within the range of values (1.40-5.37%) reported by Ingram (1962) for some other varieties of *Dioscorea* tubers' starches. The values are higher than those reported by Rasper and Coursey (1967) for some species of *D. dumetorum* cultivated in Ghana. *D. dumetorum* could thus act as a good source of protein, required in the diet as a source of essential amino acids.

Table 1

Chemical properties of *D. dumetorum* starches as compared with those of other *Dioscorea* tubers.

Sample	Starch %	Moisture %	Amylose * %	Ash* %	Protein* %	pH
D. dumetorum (white cultivar)	15.57	12.00	16.50	0.30	3.50	5.0
D. dumetorum (yellow cultivar)	15.44	10.20	16.00	0.29	3.40	5.4
D. rotundata+ (Abuja cultivar)	28.6	12.50	27.80	0.28	0.47	10.5
D. rotundata+ (Efuru cultivar)	27.7	11.69	27.70	0.15	0.79	10.2
D. rotundata+ (Elayintu cultivar)	13.2	11.66	28.20	0.09	0.91	8.2
D. rotundata+ (Lafia cultivar)	25.0	12.30	25.50	0.13	0.55	8.5
D. cayenensis+ (Igangan cultivar)	26.5	12.92	30.00	0.13	0.32	8.5

*, On dry weight basis. +, Faboya and Asagbra (1990).

Table 1 also indicates that the amylose content is of 16.0% for the yellow species and 16.5% for the white species of *D. dumetorum*. Common starches are known to contain 15-30% amylose, the remainder being amylopectin. The values obtained for amylose in this work fit into this range. Amylose is considered primarily responsible for gel formation while amylopectin tends to be soluble forming solutions that will not gel under normal conditions. Since the amylopectin contents are far higher than the amylose contents, the starch of *D. dumetorum* should not be expected to form gel with measurable strength. This has been conformed to the work of Rasper (1969). Starches with lower amylose content require less cooking and give substantially clearer pastes.

D. dumetorum starch also has high swelling characteristics as shown in Fig 1. It is evident that the size of the granules increased with temperature. Faboya and Asagbra (1990) observed that for *D. rotundata* cultivars, starches with highest pasting temperature and high swelling characteristics had lowest viscosities. Although pasting temperatures and viscosities were not determined for the cultivars of *D. dumetorum* reported in this work, it can be inferred that since *D. dumetorum* starch has high swelling characteristics, the viscosities on pasting would be low. This would be comparable with those previously obtained by Rasper and Coursey (1967) for the Ghanaian cultivars which yielded pastes of extremely low viscosities, thus being unsuitable for the manufacture of "fufu". An industrial process in which low paste viscosity is required is in the printing of textiles. The lower the viscosity of the paste, the better the penetrating power. *D. dumetorum* starch produces gel with a very weak strength which shrinks if held for a prolonged period of time and some of the liquid phase separates from the gel. This phenomenon is termed syneresis and is undesirable in food products.

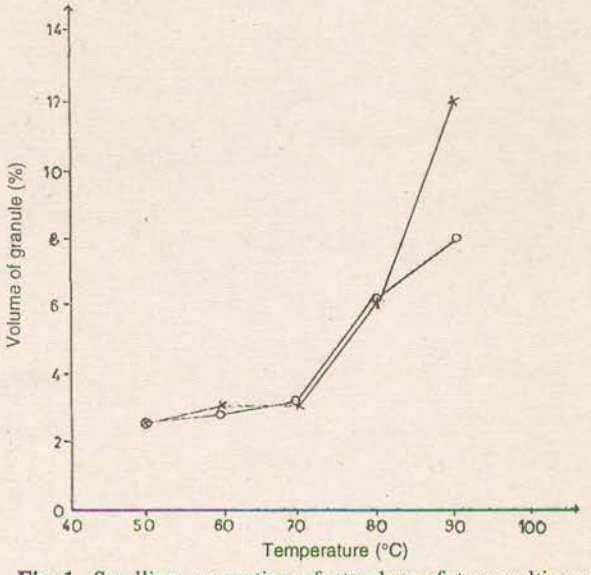

Fig 1. Swelling properties of starches of two cultivars of *D. dumetorum*. white O—O, yellow x—x.

Key words: *Dioscorea dumetorum*, Starch, Physico-chemical properties.

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