Available online at www.sciencedirect.com
SCIENCE DIRECT®
Food Chemistry 99 (2006) 663–669
Food Chemistry
www.elsevier.com/locate/foodchem

Pasting characteristics of fresh yams (*Dioscorea* spp.) as indicators of textural quality in a major food product – 'pounded yam'

Bolanle Otegbayo [a], Johnson Aina [b], Robert Asiedu [c,*], Mpoko Bokanga [d]

[a] *Bowen University, Iwo, Osun State, Nigeria*
[b] *Department of Food Technology, University of Ibadan, Ibadan, Nigeria*
[c] *International Institute of Tropical Agriculture, c/o LW Lambourn and Co., Carolyn House, 26 Dingwall Road, Croydon CR9 3EE, UK*
[d] *African Agricultural Technology Foundation, Nairobi, Kenya*

Received 10 January 2005; received in revised form 22 August 2005; accepted 22 August 2005

Abstract

Low efficiency of available screening procedures constrains breeding and selection of yams (*Dioscorea* spp.) towards high textural quality of food products made from their tubers. This study was undertaken to determine the potential usefulness of pasting characteristics of fresh yams as rapid indicators of food textural quality in 'pounded yam', a staple food for millions of yam consumers, especially in West and Central Africa. Significant associations ($P < 0.05$) were found, through canonical correlation analysis, between pasting characteristics of fresh yams from six varieties, each, of *Dioscorea rotundata* and *Dioscorea alata* and the textural quality of pounded yam samples prepared from them. Good textural quality of pounded yam was associated with high peak viscosity, breakdown, final viscosity, holding strength and setback viscosity but with low pasting temperature in the fresh yam.

Keywords: *Dioscorea*; Pasting properties; Textural quality; Pounded yam

1. Introduction

Yams (*Dioscorea* spp.) are important in household food security and income generation, especially in West and Central Africa where most of the world's production occurs. The dominant species cultivated in this sub-region are the indigenous *Dioscorea rotundata* Poir., and *Dioscorea alata* L. introduced from Asia (Orkwor, 1998). Pounded yam is a very popular food product from the crop in West and Central Africa. It is a glutinous dough made by peeling the yam, cutting to pieces, boiling, pounding and kneading. For consumption, the dough is usually cut with the fingers, moulded in the palm, dipped into stew and swallowed without mastication.

Quality of the tuber for the production of yam-based dishes is a major criterion for acceptance of new yam varieties by farmers, processors and consumers. Yams show variation in suitability to the making of specific food products across species and varieties and yam breeders rely on sensory evaluation for screening of new breeding lines for this attribute. Such assessment is necessary to ensure high acceptability of new varieties. However, carrying out such assessment is very cumbersome and extremely time-consuming. Only a few lines can be objectively evaluated within a day and the screening can only be done close to the end of the selection cycle when the numbers of genotypes have been reduced on the basis of other selection criteria. There is therefore a need to identify physicochemical factors in fresh yams that control the textural quality of yam foods. Such factors could then form the basis for development of screening tools that will enable plant breeders to select yam varieties, with good food quality attributes, more efficiently.

* Corresponding author. Tel.: +44 234 2241 2626; fax: +44 234 2241 2221.
E-mail address: r.asiedu@cgiar.org (R. Asiedu).

0308-8146/$ - see front matter © 2005 Elsevier Ltd. All rights reserved.
doi:10.1016/j.foodchem.2005.08.041

Texture is one of the three main acceptability factors used by consumers to evaluate food, the other two being appearance and flavour (Bourne, 1990). Food processors therefore place a lot of weight on development of products that have the textural attributes desired by consumers since foods can be rejected or accepted on the basis of their textural quality. Ayernor (1976) confirmed that a defect in perceived texture leads to negative impact on consumers' hedonic responses to the product. According to Bourne (1982) textural quality is a group of physical characteristics that arise from the structural elements of the food, sensed by the feelings of touch, related to deformation, disintegration and flow under a force, and measured objectively by force, distance and time. Texture is an important index of quality of pounded yam and the textural qualities relevant to the product are springiness, cohesiveness (mouldability), hardness, smoothness and adhesiveness (stickiness).

Pasting characteristics of starches have been associated with cooking quality and texture of various food products (Kim, Wiesenborn, Orr, & Grant, 1995; Moorthy, 1994, 2002; Wiesenborn, Orr, Casper, & Tacke, 1994). Pasting is the result of a combination of processes that follows gelatinisation from granule rupture to subsequent polymer alignment, due to mechanical shear during the heating and cooling of starches. This study was undertaken to determine the potential usefulness of pasting characteristics of yams as indicators of food textural quality in pounded yam. This would be useful in the breeding and selection of yams for this attribute as well as in commercial processing.

2. Materials and methods

2.1. Sample selection and handling

Fresh yams from six varieties of each of *D. rotundata* and *D. alata*, the two most widely cultivated and consumed yam species, were obtained from the International Institute of Tropical Agriculture (IITA), Ibadan. The yams were harvested from field plots set up in randomised complete block design with three replications. The varieties were selected to represent variation in cooking and eating characteristics, from very good to very poor. Four healthy-looking yams of each variety, from each of the three replications, were cleaned and peeled. Each yam was then split into four longitudinal sections. Four sub-samples, containing a quarter from each of the four yams, were assembled for each variety, from each replication. One from each of these four sub-samples was used for determination of dry matter, a second for pasting properties and a third for preparation and sensory evaluation of pounded yam. The use of portions from the same tuber was to ensure a valid assessment of association between the pasting characteristics of the fresh yams and textural quality of the product made from them. The determinations of dry matter and pasting properties were carried out in duplicate, giving six values per variety for each attribute (considering the three replications in the field).

2.2. Determination of pasting characteristics

The pasting profiles of the fresh yams were studied using a Rapid Visco Analyser (RVA) (Series 4, Newport Scientific PTY LTD. NSW, Australia) (Anonymous, 2003). Many authors (Blakeney, Welsh, & Martin, 1992; Deffenbaugh & Walker, 1989, 1996; Farhat, Oguntona, & Neale, 1999; Perez, Breene, & Bahnassey, 1998) have compared the pasting curves of various starches and flours using the RVA, a rapid method (12–20 min) requiring small amounts of sample, to the conventional Brabender Viscoamylograph, which uses about 10–100 g sample for analysis and is typically carried out over a 45–120 min period. It has been widely reported that the pasting curves obtained with the two types of instruments are very similar and viscosity results are reproducible.

One sub-sample of fresh yam sections (as described in Section 2.1) for each variety was washed and diced into small cubes. This analysis was conducted on fresh yams and not on yam flour (pounded yam is usually locally processed from boiled fresh yams) and, since RVA is normally used on dry weight basis, the weight of fresh yam used for RVA analysis was calculated by correcting it to dry weight basis. The weight of material taken per sample was calculated using this formula:

$$\text{Corrected sample weight for RVA}(S) = \frac{A \times 100}{100 - M},$$

where A is the sample weight (depending on the type of sample, this is taken from the general guide on weight of sample from RVA manual), and M the actual moisture content of the sample. Distilled water was added to the weighed yam sample in a blender (Waring blender 21/8110ES, Model 38BL40, Christison Particle Technologies, Gateshead, UK). The volume (W) of distilled water was determined as

$$W = 25(S - A),$$

where S is the corrected sample weight for RVA and A the sample weight (as in previous formula).

The material was blended for 5 min to get a fine slurry; 25 ml of this slurry were dispensed into a canister, and three drops of antifoam A were added to it, to prevent foaming. The canister was inserted into the RVA machine. The 12-min profile was used, with the following time-temperature regime: idle temperature 50 °C for 1 min, heated from 50 to 95 °C in 3 min 45 s, then held at 95 °C for 2 min 30 s. The sample was subsequently cooled to 50 °C over a 3 min 45 s period, followed by a period of 2 min where the temperature was controlled at 50 °C.

2.3. Preparation of pounded yam

A sub-sample of yam sections (as explained in Section 2.1) was washed and sliced to about 5 mm thickness. From this, 900 g of sliced yam were cooked with 500 ml of water for 20 min in the cooking regime of the National yam pounder (Model sd-900Y, National Electronic Co. Ltd.,