Available online www.jsaer.com

Journal of Scientific and Engineering Research, 2019, 6(12):18-22

Research Article

ISSN: 2394-2630
CODEN(USA): JSERBR

Effect of Drying Methods on the Pasting Properties of Three Species of Trifoliate Yam (*Dioscorea dumetorum*) Flours

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Abstract This study was carried out to determine the effect of different drying method on the pasting properties of three species of trifoliate yam flour. The samples were peeled, washed, sliced and divided into two batches, first batch was dried in hot air Oven at 70°C while second batch was dried for 4 days at 29-30°C and 60-70% relative humidity. The samples were milled into flour packaged and sealed with appropriate labels. Pasting properties were determined using Rapid Visco Analyzer and statistical analysis was carried out to test for significant difference ($p \leq 0.05$) using analysis of variance (ANOVA) among the WTY, YTY and DYTY for both oven and sun dry method. The Sun dried sample had the highest peak viscosity (51.33 – 221.42 Bu), holding strength and final viscosity of 131.17 – 237.08 Bu. Breakdown value of sun dried samples were significantly different ($p \leq 0.05$) from Oven dried samples. Setback value for Oven dried sample was significantly different ($p \leq 0.05$) from Sun dried samples. Pasting temperature ranged from 92.60 – 93.65°C and 93.18 – 93.65°C while pasting time ranged from 6.45 – 6.48 min and 6.48 -6.95 min for oven and sun dried samples respectively. Across the threes trifoliate yam species, sun dried had the highest pasting temperature and pasting time. The flour samples processed from the three different species of trifoliate yam with oven and sun dry method are suitable for food industries, for baking for pharmaceutical company and as thickeners.

Keywords Trifoliate yam, drying method, flour and pasting properties

Introduction

Yam (*Dioscorea*sp.) is one of the most important food crops in West Africa especially Nigeria and is well accepted as a staple food in most homes [1]. Yams are both annual and perennial tuber-bearing and climbing plants with more than 600 species in which only few are cultivated for food and medicine [2]. The most cultivated species in Nigeria are the white yam (*D. rotundata*), yellow yam (*D. cayenensis*), water yam (*D. alata*) and trifoliate yam (*D. dumetorum*) [3]. Trifoliate yam (*Dioscorea dumetorum*) is however a lesser-known yam among the species and underutilized. The tubers are eaten during the time of famine or scarcity and are usually boiled with the peel and eaten as boiled yam. Trifoliate yam hardens few days after harvest and this leads to reduction in moisture and starch content and increase in sugars and structural polysaccharides [4]. Triofoliate yam has been reported to be nutritionally superior to the commonly consumed yams with high protein and mineral content [5]. In an attempt to explore these benefits and to add more value to *D. dumetorum* as an important source of food and energy, Medoua *et al* [6-7] developed schemes for processing of its hardened tubers into flours and suggested that these flours can be used in bakery. Therefore, there is need to increase utilization of yam through industrial processing to minimize post-harvest losses which in turn may lead to increased earnings from this crop. The starch content of the tuber presents prospects for the processing of yams into starches. Currently, yams are not listed among the most common sources of industrial starch which is principally provided by corn, potato, wheat, tapioca and rice [8]. Starch is an important raw material for a number of industries including textiles, paper, adhesives, pharmaceuticals and food. As a country becomes more industrialized, demand for both native and modified starches increases but these demand are rather met through imports instead of locally made starch. *D. dumentorum* spp is not a widely studied variety. The post-harvest hardening phenomenon problem has an adverse effect on the productivity of the yam. Starch production and evaluation is therefore carried out in order to improve the utilization of trifoliate yam locally and industrially. This will reduce dependence on starch importation and thus increase the industrial utilization from locally available raw material. The result from this research will benefit the breeders, processors and other researchers. The objective of this work therefore is to evaluate the effect of drying methods pasting properties of the starch from three varieties of trifoliate yam flour.

Materials and Methods

The three cultivars of trifoliate yam (yellow, white and deep-yellow) were obtained from a local farm in Obolla-Afor, in Udenu Local Government Area of Enugu State, Nigeria.

Figure 1: Trifoliate Yam sample used for the experiment

Preparation of Trifoliate yam flour

The tubers were washed with distilled water, peeled and sliced at uniform thickness of 10mm using stainless kitchen knife .The slices were drained using plastic sieve and then divided into two equal batches of the same quantity. First batch of the slices of the three varieties of Trifoliate Yam were dried in hot air oven (Multi-Purpose Oven (Model OKH-HX-1A) China) at 70°C with the weight being measured at interval of 20 minutes until a constant weight was obtained. Second batch was sun-dried for 4 days at 29-30°C and 60 - 70% relative humidity. The six dried Trifoliate Yam samples were milled into flour using hammer mill, packaged in polythene bags, sealed and then stored in air tight containers with appropriate labeling and then carried to the laboratory were, pasting properties was investigated.

Determination of pasting properties of trifoliate yam flour

Pasting characteristics were determined using a Rapid Visco Analyzer (Model RVA 4500 Newport Scientific Australia). 3.0g of the sample was weighed into a previously dried canister and 25 ml of distilled water was dispensed into the canister containing the sample. The suspension was thoroughly mixed and the canister was fitted into the Rapid ViscoAnalyzer as recommended. Each suspension was kept at 50°C for 1min and then heated up to 95°C with a holding time of 2min followed by cooling to 50°C with 2min holding time. The rate of heating and cooling were at a constant rate of 11.85°C per min. Peak viscosity, trough, breakdown, final viscosity, set back, are read from the pasting profile with the aid of thermocline for windows software connected to a computer. The pasting properties were repeated and the result obtained were analyzed statistically using one-way analysis of variance (ANOVA) to test for the significant differences that existed among the samples.

Results and Discussion

The results of the pasting properties of starches processed from trifoliate yam varieties are presented in Table 1.

Table 1: Pasting Properties of Three Different varieties of Trifoliate Yam flour

Drying Method	Sample Name	Peak viscosity (Bu)	Trough viscosity (Bu)	Breakdown viscosity (Bu)	Final viscosity (Bu)	Setback viscosity (Bu)	Peak time mins	Pasting temperature °C
Oven	WTY	44.25	41.92	2.33	107.33	65.42	6.45	93.05
Dried	YTY	95.76	87.40	8.36	128.50	35.40	6.45	92.60
	DYTY	62.75	60.58	2.17	230.83	170.25	6.48	93.65
Sun	WTY	221.42	157.00	64.42	237.08	80.08	6.95	93.18
Dried	YTY	98.50	91.83	6.67	131.17	39.33	6.68	93.65
	DYTY	51.33	48.67	3.03	137.25	85.55	6.48	93.44

WTY White Trifoliate Yam, YTY Yellow Trifoliate Yam, DYTY Deep-Yellow Trifoliate Yam

Discussion

From Table 1, the peak viscosity which measures the strength of the paste formed during cooking and determines the ease of swelling of starch molecules during heating before it breakdown [9], the result obtained from Oven dried sample were found to be 44.25(Bu), 95.76(Bu), 62.75(Bu) and Sun Dried sample were 221.42(Bu), 98.50(Bu), 51.33(Bu) for WTY, YTY, DYTY respectively. This is in line with what was reported by Ikegwu *et al.*, [10] where he found peak viscosity of *Brachystegia eurycoma* flour and starch to be 77.58 and 267.08 RVU respectively and low to compare with what Amoo *et al* [11], reported peak viscosity of yam starch to be 639.726(Bu). It implies that the water binding capacity of the starch was higher at Sun dried samples than Oven dried sample and this indicates that Sun dried sample is suitable for products that its gelling strength, thick paste and elasticity is needed.

From Table 1, the breakdown which measures the ability of starch to withstand collapse during cooling or the degree of disintegration of granules or paste stability [8]. The results obtained from Oven dried samples of Trifoliate yam flour were 2.33(Bu), 8.36(Bu), 2.17(Bu) and Sun dried sample were 64.42(Bu), 6.67(Bu), 3.03(Bu) for WTY, YTY, DYTY respectively. The higher the breakdown viscosity, the lower the ability of the sample to withstand heating and shear stress during cooking [12]. It is therefore noticed that the Sun dried sample have the highest breakdown, it is implies that its paste stability is low on cooling due to weak cross-linking among the starch granules. This is in line with what Amoo *et al* [11] (15-385 BU) reported for breakdown viscosity of yam starches and very low to compare Aviara *et al* [13] (145-216 BU) on sorghum flour.

From Table 1, the trough viscosity which measures the ability of the paste or gel formed to withstand breakdown during cooling. The results obtained from Oven dried sample of Trifoliate yam flour were 41.92(Bu), 87.40(Bu), 60.58(Bu) and Sun dried samples were 157.00(Bu), 91.83(Bu), 48.67(Bu) for WTY, YTY, DYTY respectively. It found that the trifoliate yam flour sample processed using Sun drying method recorded highest value for Trough viscosity than the sample dried with Oven method. This implies that the Sun dried sample have good geletization characteristics and have the tendency to withstand deformation during cooling than Oven dried samples. At this point, any other treatment will distort the gel or the paste formed in both Oven and Sun dried samples.

From Table 1, the setback viscosity gives an insight about declining tendency of starch in flour sample [14-15]. The results obtained from Oven dried sample of trifoliate yam flour were 65.42(Bu), 35.40(Bu), 170.25(Bu) and Sun dried were 80.08(Bu), 39.33(Bu), 85.55(Bu) for WTY, YTY, DYTY respectively. From the result obtained the setback viscosity of the samples range from 35.40(Bu) – 170.25(Bu) and 39.33(Bu) - 85.55(Bu) for Oven and Sun dried respectively. It was observed that Oven had the highest setback viscosity. Low setback values are useful for products like weaning foods which require low viscosity and paste stability [16]. Hence, Sun dried samples of trifoliate yam flour may be useful for such products while Oven dried trifoliate yam sample starch may be useful for products such as pounded yam that require high cohesive pastes.

The pasting temperature provides an indication of the minimum temperature required for sample cooking, energy cost involved and other component stability [8]. The results obtained from the sample dried with Oven ranged from 93.05 °C – 93.65 °C and 93.18 °C – 93.65 °C for Sun dried trifoliate yam starch for WTY, YTY, DYTY respectively. Slight different was observed in Sun dried sample and this indicates that gelatinization time, energy cost and starch stability during processing of trifoliate yam starch was a bit high in the Sun dries sample. This is in line with the pasting temperature (85.700Bu – 87.75Bu) of the trifoliate yam starches results obtained by Ezeoha and Okafor [8]. It can also be observed from the results (Table 1) that the higher the pasting temperature, the longer the pasting time.

The pasting time of the trifoliate yam starches irrespective of the drying method used was found to be low compared with the pasting time recorded by Amoo *et al* [11], who observed pasting time of 17.40-17.55 mins for yam varieties but similar with the pasting time (4.600 min – 4.800min) of trifoliate yam starch recorded by [8]. The difference in the pasting time may be attributed to difference in cultivar. The starches with shorter pasting time such as that of Oven dried samples of trifoliate yam starch varieties maybe appropriate for the production of foods that require shorter processing time [8].

Conclusion

This study has shown that when trifoliate yam tubers are processed to flour under different drying method, the pasting properties of the flour samples are profusely affected. It was found that, Oven dried trifoliate yam flour sample can be used industrially for products that require high unit yield as well as products such as weaning foods that require low viscosity and paste stability at low temperatures. Oven dried samples may have the highest ability to withstand heating and shear stress during cooking due to its high viscosity. Sun dried sample can be exploited for starch production because of their high starch yield. The processed starch may be used in the industries or for food products that require thick paste, high gel strength and elasticity. Oven dried sample may be used in the preparation of pounded yam and fufu. Starches from Oven dried sample can also be employed in food preparations that require shorter processing time. Oven and Sun dried starch processed from trifoliate yam varieties can also serve as alternate sources of starch based on their unique characteristics and thus, can be used for diverse products. With the high starch yield obtained from WTY, YTY, DYTY samples irrespective of the drying method as compared with cassava and corn, the industrial potential of the yams flour could be fully exploited for starch production. The available data on the industrial potentials of the yams and starch is adequate to encourage the commercial production of trifoliate yam flour for commercial starch production.

References

[1]. Olufunmilola Adunni Abiodun, Jacob Adeyosoye Adegbite and Tajudeen Solagbade Oladipo, (2009). Effect of Soaking Time on the Pasting Properties of Two Cultivars of Trifoliate Yam (*Dioscorea dumetorum*) Flours. *Pakistan Journal of Nutrition, 8: 1537-1539.* DOI: 10.3923/pjn.2009.1537.1539 URL: https://scialert.net/abstract/?doi=pjn.2009.1537.1539

[2]. IITA., (2006). Yam: Research Review. International Institute of Tropical Agriculture, Ibadan, Nigeria, pp: 1-4.

[3]. Amusa, N.A., A.A. Adegbite, S. Mohammed and R.A. Baiyewu, (2003). Yam disease and its management in Nigeria. Afr. J. Biotechnol., 2: 497-502.

[4]. Afoakwa, E.O. and S.K.S. Dedeh, (2001). Biochemical and textural changes in trifoliate yam (*Dioscorea dumetorum*) tubers after harvest. http://works.bepress.com/emmanueloheneafoakwa/47/.

[5]. Martin, G.S., L. Treche, T. Noubi, E. Agbor and A. Gwangwa, (1983). Introduction of Flour from *Dioscorea dumetorum* in a Rural Area. In: Tropical Root Crops: Production and uses in Africa, Terry, E.R., E.V. Doku, O.B. Arene and N.M. Mahungu (Eds.). International Development Research Centre, Doaula, Cameroon, pp: 161-163.

[6]. G. N. Medoua, I. L. Mbome, T. A. Egbe, and C. M. F. Mbofung, (2007). Salts soaking treatment for improving the textural and functional properties of trifoliate yam (*Dioscorea dumetorum*) hardened tubers," Journal of Food Science, vol. 72, no. 8, pp. E464–E469.

[7]. G. N. Medoua, I. L. Mbome, T. Agbor-Egbe, and C. M. F. Mbofung, (2008). Influence of fermentation on some quality characteristics of trifoliate yam (*Dioscorea dumetorum*) hardened tubers," Food Chemistry, vol. 107, no. 3, pp. 1180–1186.

[8]. Ezeocha and NIGERIA Jennifer C. Okafor (2016) Evaluation of the Chemical, Functional and Pasting Properties of Starch from Trifoliate Yam (*Dioscorea dumetorum*) Landraces.

[9]. Sanni, L. O., Kosoko, S.B., Adebowale, A.A. and Adeoye. R.J. (2001).The influence of palm oil and chemical modification on the pasting and sensory properties of fufu flour. International Journal of Food Properties, 7: 229-237.

[10]. Ikegwu, O. J. V., Nwobasi, N., Odoh, M.O. and Oledinma, N.U. (2009). Evaluation of the pasting and some functional properties of starch isolated from some improved cassava varieties in Nigeria. African Journal of Biotechnology, 8 (10): 2310-2315.

[11]. Amoo, A.R.N., Wireko-Manu, F.D. and Oduro, I. (2014) Physicochemical and pasting properties of starch extracted from four yam varieties. Journal of Food and Nutrition Sciences; 2(6): 262-269.

[12]. Adebowale, A.A. Sanni, L.O. and Awonorin, S.O.(2005). Effect of texture modifiers on the physicochemical and sensory properties of dried fufu. Food Science Technology International, 1 (5): 373-382.

[13]. Aviara, N.A., Igbeka, J. C. and Nwokocha, L. M. (2010). Physicochemical Properties of Sorghum (Sorghum Bicolor L. Moench) Starch as Affected by Drying Temperature. Agricultural Engineering International: the CIGR Ejournal. Vol. XII

[14]. Jimoh, K.O., Olurin, T.O. and Aina. J.O. (2009). Effect of drying methods on the rheological characteristics and colour of yam flours. African Journal of Biotechnology, 8 (10): 2325-2328.

[15]. Kim, T.U., Gu, B.G., Jeong, J.Y., Byun,S.M. and Shin,Y.C. (1995). Purification and characterization of a maltotetrase-forming alkaline –amylases from an alkaliphilic Bacillus strain, GM8901. Appl Environ Microbiol. 61:3105-3112.

[16]. Oduro, I., Ellis, W.O., Nyarko, L., Koomson, G. and Otoo, J. A. (2001). Physicochemical and pasting properties of flour from four sweet potato varieties in Ghana. Proceedings of the Eight Triennial Symposium of the International Society for Tropical Root Crops (ISTRC-AB), Ibadan, Nigeria. 2001, 12-16 November.