Effect of drying methods on nutritional composition of *D. alata* and *D. rotundata* yam varieties.

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Abstract

A study was conducted to investigate the effect of sun-drying and oven-drying methods on the nutritional composition of water yam and white yam varieties. Oven-drying was done at 60°C for 72 hrs while sun drying was done at 33°C for 120 hrs to obtain a constant weight. The functional properties proximate composition, mineral contents and pH were determined to investigate the effect of dry methods on the nutritional value of the yam flour. It was observed that all parameter examined were affected by the dry methods as they varied in composition with two different processed samples (sun and oven dried). The results of the experiment shows that sun dried yam flour retaining the highest value in protein, ash, fiber and CHO and also in minerals Ca, Mg and P. than oven dried method except moisture content which have low value than the sample. Sun dried yam flour had the highest value, thereby retaining the best nutritional composition of the samples.

Keywords: Sun dry, Oven dry, *Alata, Rotundata.*

Introduction

Yams are widely grown and consumed amongst various communities in the tropics, among them is D. *rotundata* and *D. alata* are very important tubers in West Africa.

These tropical food crops are abundant at a particular period, when they are in season and are scarce, during the off season (when they are out of season). Since these food crops are highly perishable after harvest; drying is a common practice for preserving them, in order to make them available throughout the year [1,2].

Sun and oven drying are the popular drying methods used in drying these food crops; sun drying being the most common practice [3]. These food crops, when dried are processed to produce flour which can be reconstituted to form paste or dough [4,5]. In Nigeria, West Africa, yam flour is used to produce a paste known as amla that is eaten with soup by the consumers [6-9].

These two drying methods (sun and oven) utilize heat to remove water from food by evaporation. The removal of water by heat has been reported to affect the nutrient contents of food in various ways. It can either increase the concentration of some nutrients by making them more available or decrease the concentration of some nutrients [9-11]. This study was therefore carried out to establish the effects of these various drying methods on the nutrients of these important food crops, in order to determine the most suitable method that will not only increase their shelf life but also retain their nutrients adequately. Since, good nutritional value of food is important to the well-being of the consumers.

Materials and Methods

White yam (*Dioscorea rotundata*) and water yam (*Dioscorea alata*) yam two varieties each were collected from NRCRI Umudike yam barn.

Sample preparation

They were washed with clean water, peeled using stainless kitchen knife and sliced into smaller pieces of about 3 mm thickness. The slices were divided into two sets, one set was sun-dried for two weeks and the other set was oven dried to constant weight was obtained. The dried slices were milled with a hammer mill and then sieved under laboratory sieve of 600 mm aperture size and stored in air tight container for further laboratory analysis.

Determination of proximate compositions

Moisture, protein, crude fat, crude fibre and ash contents of the four yam flour samples were determined according to standard methods described by AOAC 1995, carbohydrate was determined by difference.

Determination of functional properties

The water absorption capacity and oil absorption capacity was determined by the method of Onwuka et al. with some modifications [12]. 1 gm of each sample was weighed into a beaker, 10 ml of water was added and the suspension was stirred with magnetic stirrer for 1 min. The suspension was then allowed to stand for 30 min. at room temperature after which it was centrifuged (New Life Centrifuge NL-90-2) at 5,000 rpm for 30 min. after centrifugation the volume of the supernatant was measured and the result was expressed as

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volume (ml) of water absorbed per 100 g of the sample. The same procedure was used for oil absorption capacity except that water was replaced with vegetable oil of specific gravity of 0.98 g/ml. The swelling power of the samples was determined according to the method described by Leach et al. with some modifications. The weight of centrifuge tube containing 1.25 gm of the sample was taken; the sample was turned to slurry by adding 10 ml distilled water. The slurry was heated at a temperature of 70°C for 30 min. in a water bath, cooled to room temperature and centrifuged at 2300 rpm for 30 min. The supernatant was decanted and the centrifuged tube was placed in a hot air oven to dry for 30 min. at 45°C, the residue was then weighed. The swelling power was expressed as the ratio of the weight of flour paste to the weight of dry flour. The bulk density was determined by the method describe by [12].

Determination of the gelation temperature

The least gelation concentration was determined by the method of James et al. [13]. Test tubes containing suspensions of 2, 4, 6, 8 up to 20% (w/v) flour in 5 ml distilled were heated for 1 h in boiling water, followed by cooling in ice and further cooling for 2 h at 4°C. The least gelation concentration was the one at which the sample did not fall down or slip when the test tube was inverted.

pH determination

10 gm of the sample was dispersed in 100 ml distilled water, it was mixed thoroughly and filtered; the pH of the filtrate was measured using pH meter (Starter 2100 Bench pH Meter) which had been previously standardized with buffer solution of pH 4 and 9. The energy value was calculated using Atwater factor.

Determination of minerals calcium, magnesium and potassium

The mineral content of each sample was determined by James, *et al* (1995). The dry ash extraction method follows specific mineral element. Exactly 2 gm of the sample was burnt to ashes in a muffle furnace at 500ºC. After complete ashing, the ash was diluted with 1% Hydrochloric (Hcl) acid, then filtered into a 100 ml standard flask, and made up to the mark with deionized water. The solution was read with AAS machine (model No: Analysis 400, Serial No 201510114102) for the determination of potassium, iron, magnesium, and sodium. All values were expressed in mg/100 gm.

Statistical analysis

One way analysis of variance (ANOVA) was used to compare means of variables and results were expressed as means of variables.

Results

The functional properties of yam tuber are shown in Table 1. Water absorption capacity range from 2.52% to 3.54 was high

Table 1. *Functional properties of yam flour.*

Dry Methods	Samples	WAC%	OAC%	SP%	GT%
Sun	TDr160	3.54[a]	2.21[f]	3.30[h]	6.75[g]
Oven	TDr160	2.52[f]	2.43[d]	4.48[a]	6.42[d]
Sun	TDa194	3.32[b]	2.34[e]	4.22[b]	6.75[g]
Oven	TDa194	2.67[e]	2.54[c]	3.37[g]	6.71[d]
Sun	TDr206	2.70[d]	2.58[c]	3.62[e]	7.08[c]
Oven	TDr206	2.84[c]	2.68[a]	3.56[f]	6.51[f]
Sun	TDa247	2.76[d]	2.73[b]	3.75[d]	7.58[b]
Oven	TDa247	2.65[e]	2.42[d]	3.87[c]	7.33[a]
Note: Means with the same letters in a column are not significantly (p_0.05) different.					

Table 2. *Proximate composition of yam flour.*

Methods	Samples	Moisture%	Protein%	Ash%	Fiber%	Fat%	CHO%
Sun	TDr160	5.01[h]	3.45[c]	3.23[a]	1.93[a]	0.65[a]	85.63[d]
Oven	TDr160	6.49[f]	1.23[g]	2.76[c]	1.60[c]	0.77[c]	87.35[b]
Sun	TDa194	6.54[e]	2.87[e]	2.67[c]	1.75[b]	0.68[b]	85.49[e]
Oven	TDa194	6.73[d]	0.79[h]	1.89[f]	1.42[d]	0.43[d]	80.74[a]
Sun	TDr206	7.55[a]	5.56[a]	3.06[b]	1.66[c]	0.71[a]	88.46[g]
Oven	TDr206	7.67[c]	3.37[d]	2.65[d]	1.23[e]	0.23[e]	84.85[f]
Sun	TDa247	6.05[g]	4.55[b]	2.34[e]	1.04[f]	0.49[d]	85.53[e]
Oven	TDa247	7.82[b]	2.49[f]	1.86[f]	1.11[f]	0.18[f]	86.54[c]
Note: Means with the same letters in a column are not significantly (p_0.05) different.							

Table 3. *Mineral composition of yam flour.*

Methods	Samples	Ca%	Mg%	P%	Tan%	pH%
Sun	TDr160	3.82[a]	2.62[b]	3.12[e]	1.14[a]	6.10[a]
Oven	TDr160	2.67[c]	1.42[f]	2.59[f]	0.23[f]	5.70[b]
Sun	TDa194	2.69[c]	2.74[a]	3.26[d]	0.67[c]	5.04[e]
Oven	TDa194	2.19[e]	1.23[g]	2.44[g]	0.14[g]	5.37[c]
Sun	TDr206	3.76[b]	2.52[c]	4.63[a]	1.02[b]	6.09[a]
Oven	TDr206	1.93[f]	1.87[e]	3.76[c]	1.34[e]	5.34[c]
Sun	TDa247	2.45[d]	2.44[d]	3.98[b]	0.88[d]	5.68[b]
Oven	TDa247	1.12[g]	1.26[g]	2.48[g]	0.21[f]	5.21[d]
Note: Means with the same letters in a column are not significantly (p_0.05) different.						

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in sun dried white yam flour and lower in oven dried water yam flour. The oil absorption capacity range from 2.21% to 2.73% was high in sun dried water flour and lower in oven dried white yam flour. Swelling power range from 3.30% to 4.8% and oven dry white yam flour. The gelatinization temperature range from 6.45% sun dry white yam flour to 7.58% and oven dry water yam, respectively.

The proximate composition is shown in Table 2 and Table 3. The moisture content of processed sample range from 5.01% sun dried white yam to 8.25% sun dried white yam. Protein range from 0.79% oven dried water yam to 5.56% sun dried white yam. The ash range from 1.89 oven dried water yam to 3.25% sun dried white yam. Fiber ranges from 1.11% oven dry water yam to 1.93% sun dry white yam. Fat range from 0.18% oven dry water yam to 0.75% sun dry white yam. CHO range from 80.74% oven dry water yam to 88.74% sun dry white yam.

The minerals in the processed yam tuber, calcium range from 1.12% oven dry water yam to 3.82% sundry of white yam. Magnesium ranges from 1.23% oven dry water yam to 2.74% sundry white yam. Potassium range from 2.44% oven dry water yam to 4.63% sundry white yam. Tannins range from 0.21% oven dry water yam to 1.14% sundry white yam. pH range from 5.21% oven dry water yam to 6.10% sundry white yam.

Discussion

The moisture content of the yam tuber is usually high hence the water yam and white yam have low value of moisture content. Our results support the report of Riley et al. It is believed that materials such as flour range of crude protein content from 0.79% - 5.56%. There is significant difference among the samples Dugler, et al. Intake of staple foods with low protein content may lead to several impaired biological processes in the body. This shows that *D. alata* is rich in protein and can provide this nutrient to the consumers [14].

The high gelatinization temperature of sample might be attributed to the high starch content. High protein solubility is always necessary for gelation as observed by Farquer, et al. [15].

Minerals are biological components of diets which perform biochemical and physiological functions in living cells through synergistic interactions or independent modulation of biological reactions, Dugler, H et al. [14,16,17].

Conclusion

Acceptable yam flour can be produced through different drying methods depending on intend usage. The results of the experiment carried out on the yam flour indicated that some dry methods affect the nutritional component of the dried yam flour by not only altering the biochemical composition. The results of this study revealed that the processing (Sun drying, and oven-drying) yam tubers has significant effect on the nutrient content as well as gelation temperature, protein, ash, and minerals elements. Sun drying method has been found to be a good method to produce yam flour with better retention of nutritional contents.

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