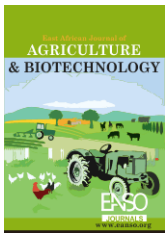

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Original Article

Effects of Tuber Size and Section on the acceptability of foods from Integrated Nutrient Grown D. *cayenensis*

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Yellow Yam, Sensory Evaluation, Tuber Sizes, D. cayenensis.

ABSTRACT

Yam (*Dioscorea spp*) is an important staple in Nigeria, valued for its high carbohydrate composition. Among the edible yam species, white yam is mostly used in traditional meals. The study investigated the effect of tuber size and section on the acceptability of foods produced from integrated nutrient grown yellow yam (D. *cayenensis*) species. Three different sizes (small, medium, and big) of *D. cayenensis* yams species grown by integrated nutrient were processed into different food forms (fried, boiled & pounded) using different sections (Apex, Middle and Distal). Forty (40) trained and semi trained taste panel members evaluated twenty seven (27) food samples produced from improved yellow yam species. Sensory evaluation results were, as follows, the boiled yam sample showed values ranging from 6.20 (Small size Apex) to 7.20 (big size middle); fried sample ranged from 6.20 (medium middle) to 7.70 for big Distal. The pounded yam form had a range of 4.0 (an unacceptable value) for medium base to 7.09 (big medium). Generally, boiled and fried yam samples produced from the different sizes and sections of the yellow yams were accepted by the taste panel members. Fried and the boiled yams from the middle sections were more preferred than yam samples produced from other regions. The middle section in all the sizes particularly the big size of the yellow yam was preferred for pounding. The yellow yam species is therefore, recommended for use especially, in the production of traditional foods for human consumption.

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INTRODUCTION

Yam (*Dioscorea spp*) is a tuber crop that belongs to the family of *Dioscoreaceae*. The genus *Dioscorea* contains a wide range of species both edible and non-edible. The edible yams include *Dioscorea rotunduata* (white guinea yam), *Dioscorea cayenensis* (yellow guinea yam), *Dioscorea alata* (water yam), *Dioscorea dumentorum* (three-leafed yam) and *Dioscorea bulbifera* (aerial yam) (Orkwor, 2000). Yam is a premium and cash crop in Nigerian food system and her economy. Yams, according to the International Institute for Tropical Agriculture [IITA] 2010 are produced on 5 million hectares in about 47 countries in tropical and sub-tropical regions of the world. Available research reports, shows that Nigeria is the world largest producer of yams, producing 68 percent of yams on about 3 million hectares of land (Orkwor,2000),35.017 million metric tonnes with value equivalent of 5.654 billion USD (IITA, **2011),** accounting for 48.1 to 61.7 percent of the global yam production (Oladipo *et al*., 2020; IITA, 2012; LopezMontes *et al*., 2015).

Yellow yam (*D.caynenensis*) is named after its yellow flesh, due to presence of carotenoids (Martin and Sadik, 1997). In Nigeria, yams are processed into various food forms, which include pounded yam (from *D. rotundata* and sometimes *D. cayenensis*), boiled yam, roasted or grilled yam, fried yam slices and yam balls, mashed yam, yam chips and flakes (Coursey, 1983; Ekine and Okeke, 2013), equally consumed in baked or roasted form in combination with tomato stew, sauces or with traditional palm oil (Obidiegwu *et al*., 2020). Fresh yam tubers are also peeled, chipped, fermented dried and milled into flour, this flour is cooked in boiling water and turned into a thick paste similar to *fufu* and eaten with soup. Among the Yoruba in Western Nigeria, this is called *amala* and East of the River Niger, it is called *akwunaji* (Orkwor *et al*., 1998). Besides serving as traditional foods, yam has huge socio-cultural importance in West Africa, used in several ceremonies such as marriages, thanksgiving, and other festivals (Irtwange (2018).

Among these yam varieties, white yam is the most economically important and highest widely cultivated and utilized. Adequate utilization of other numerous yam species in the traditional food preparation would promote food availability. The underutilization of some edible yam species, including the yellow yam could be attributed to the nature of available local varieties. The improved yellow yam (*D. cayenensis*) specie grown by integrated nutrient at the National Root Crops Research Institute (NRCRI), Umudike is well targeted to add to existing good-agronomic-practices (GAP) of yam varieties and to boost household food security. Therefore, the present study assessed consumer acceptability of recipes developed from different sizes and sections of the experimental D. *cayenensis* yam variety.

MATERIALS AND METHODS

The major experimental material(*D.cayenensis*) was grown at National Root Crops Research Institute (NRCRI) Umudike, yam programme field under integrated nutrient managements, involving organic (brewers spent grain) and inorganic (N: P: K- 15:15:15) fertilizers. The

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yellow yam tubers were harvested at 9 months after planting.

Harvested yam tubers with no bruises were sorted into three sizes, namely: small size (seed yam), medium size and big size using weights ≤ 0.5 kg; 0.6-0.9 kg and ≥1.0 kg respectively according to method of Etudaiye *et al.* (2016) with modifications (≤0.4 kg; 0.5 kg ≤0.8 kg and ≤ 1.5 kg) based on the available yam samples. Weight of yam samples was obtained using a sensitive battery/electrically operated scale, 2 kg maximum digital 0.1 decimal point of Electronic Compact Balance S. Mettler. Yam samples was arranged in NRCRI traditional yam barn and used within short time (5days) from harvest.

Preparation Yam Recipes

Sectioning: Adequate quantity wholesome yellow yam tubers from each size (small, medium, and big) were processed into different recipes (forms) (fried, boiled and pounded). The samples were measured and sectioned into apex, middle and distal according to the size of the tubers. The sectioned sample sizes were labelled SA= Small Sized Apex, SM= Small size Middle, SD= Small size Distal, MA= Medium size Apex, MM= Medium size Middle, MD= Medium size Distal, BA= Big size Apex, BM= Big size Middle and BD= Big size Distal. Each section was hand peeled under running water, and the section of the tubers were measured and sliced in accordance to the intended products. Three (fried, boiled and pounded) food forms were processed according to food preparation method described by Omodamiro *et al.* (2013) and Adegunwa, *et al.* (2011). Method of deep frying was used to prepare fried food form. This involved pre-heating of the vegetable oil (Kings Brand) to a temperature ranging between 120 – 160^{o}C. The yam slices were turned in the cooking oil occasionally and intensity of the temperature adjusted, when necessary, until bright brown colour was attained.

Traditional method of boiling yam was adopted. Different yam samples (SA, SM, SD, MA, MM, MD, BA, BM, & BD) were sliced into small sizes (5.5 cm) boiled in clean water for 20-25 minutes until soft. The hot soft-boiled yam was then pounded in a mortar with the aid of pestle. Figure 1 shows the procedure used for the preparation of the yam into three food forms.

Sensory Acceptances of Food Forms

The fried samples were evaluated for Colour, Taste, Crispness, Mouth feel and General acceptability. Boiled samples were evaluated for Colour, Taste, Texture, Mouth feel and General acceptability. While pounded yam were evaluated for Colour, Texture, Elasticity, Mouldability and General acceptability. All were done using a 9 Point Hedonic scale, where 9 = Extremely liked and 1 = dislike Extremely by 40 trained and semi-trained sensory panellists. Portable water was provided for mouth rinsing between tasting samples (Iwe, 2002).

Statistical Analysis

Raw data obtained from sensory evaluation were subjected to statistical analysis using Microsoft excel and latest version of Statistical Analytical System (SAS) software.

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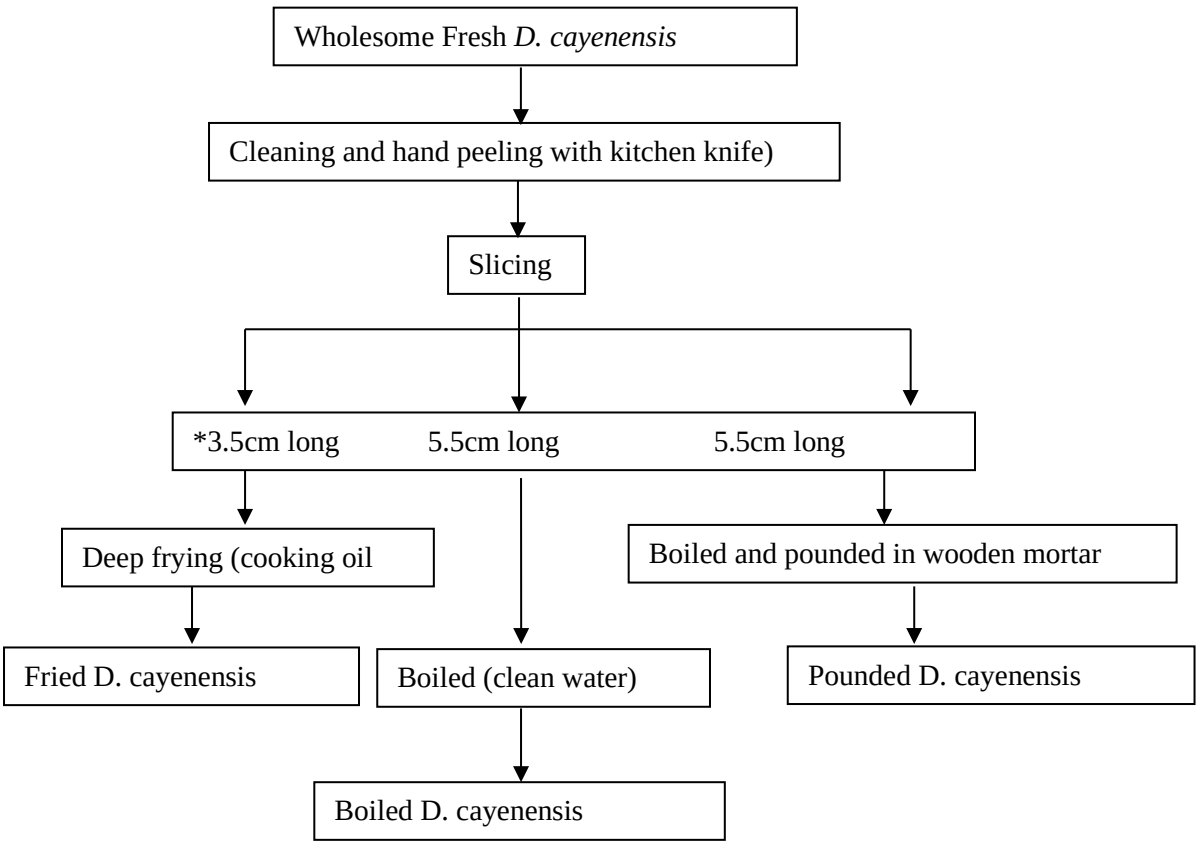
Figure 1: Processing of three food forms from wholesome fresh *Dioscorea cayenensis*



Note * Middle section of medium size

RESULTS AND DISCUSSION

The results of sensory evaluation of fried and boiled experimental yams are shown in *Tables 1* and *2*. In *Table 1*, it was found that the medium distal (MD) size of yam ranked highest in appearance in fried form, though not significant ($p \leq 0.05$) from other yam samples (MA, SM, SD, BA, BM & BD) but significant from the appearance of the small apex (SA) and medium middle yam samples. The taste of the middle distal size of yellow yam samples was more preferred to the taste panel, though not significant ($p \leq 0.05$) from the taste obtained from the other samples, except for SA and MM. Big distal (BD) yellow yam sample was found to be more crispy compare to the other yam samples though not significant ($p \leq 0.05$) from samples MA, SM, MD, BA, BM & BD. Generally, sample MD ranked highest in almost all the parameters evaluated (appearance, taste, and general acceptability) and was more preferred by the taste panel members in fried form. Higher acceptability of fried yam samples could be attributed to consumer's desire for fried foods. This finding conforms to the report of Kplorlanyuie and Cowther (2022) in acceptability of packaged yam strips as convenient food.

The boiled and fried food forms were acceptable by the taste panels. There was no significant difference ($p \leq 0.05$) in the panellists' acceptance for the boiled and fried samples in all the sizes. However, there was a significant difference ($p \leq 0.05$) in the section. The head sections of the small sizes scored the lowest in colour, taste, texture, and general acceptance 5.70; 6.10; 6.60 and 6.0 respectively but still acceptable in the 9-point Hedonic scale used. For the pounded samples, the small and the medium sizes were not significantly different ($p \leq 0.05$) in their scores. However, the big sizes differed significantly ($p \leq 0.05$) and had the highest scored in the sensory acceptability. Perhaps the big size has an advantage in the pound ability of the yellow yam. The scoring of the small sized (seed) yam was

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generally low especially in the pounded food form.

In contrast to the acceptability of yellow yam samples in fried form, MD yam samples ranked almost lowest in all the parameters tasted in boiled form as shown in *Table 2*. Sample MA of yellow yam samples was more acceptable in boiled form though not significant ($p \leq 0.05$). Appearance, taste, and mouth feel of medium apex size yam sample was more preferred by the taste panel in boiled form compared to other yellow yam samples. Generally, big middle size yellow yam sample ranked highest though not significant ($p \leq 0.05$) from the other samples except sample SA.

Small apex size yam varieties were more acceptable in fried form compared to boiled form (*Figure 2*). This finding was like what was observed with SD, MD, and BD yellow yam samples. On the other hand, small medium size yam varieties were liked equally by taste panels in fried and boiled forms. It could be concluded that distal size of yellow yam recipes is more acceptable by taste panellist in fried form.

It was found that medium distal size of yellow yam samples was highly acceptable ranking above 7 in almost all the parameters tasted in fried yam recipe, it is not acceptable in pounded yam form. Small middle size yellow yam was equally not liked in pounded form, based on the parameters tasted. Again, medium middle (BM), big apex (BA), big middle (BM) and big distal yellow yam samples were significantly ($p \leq 0.05$) liked by the taste panel members in pounded form, especially, texture, elasticity, and mould ability, which are the major interest of pounded yam consumers Bolanle et al., (2018).

Table 1: Results of Sensory Evaluation of Fried yellow yam sample

Yam Sections	Appearance	Taste	Crispness	Mouth feel	Gen. Acceptability
SA	5.70b	6.10c	6.60bc	6.60ab	6.70bc
SM	6.90a	7.00abc	6.90abc	6.70ab	7.10abc
SD	6.80a	6.40bc	6.60bc	7.20ab	7.20ab
MA	7.00a	7.20ab	6.80abc	6.90ab	7.10abc
MM	5.70b	6.20bc	6.00c	6.30b	6.20c
MD	7.50a	7.60a	7.20ab	7.20ab	7.40ab
BA	7.00a	6.60abc	7.20ab	6.80ab	6.80abc
BM	7.10a	6.90abc	7.40ab	7.50a	7.20ab
BD	7.30a	7.50a	7.60a	7.40a	7.70a
LSD (0.05)	0.959	1.030	0.944	1.051	0.982

Symbols used for yam samples: SA= Small Apex, SM= Small Middle, SD= Small Distal, MA= Medium Apex, MM= Medium Middle, MD= Medium Distal, BA= Big Apex, BM= Big Middle and BD= Big Distal

Table 2. Result of Sensory Evaluation of boiled yellow yam samples

Yam Sections	Appearance	Taste	Texture	Mouth feel	Gen Acceptability
SA	5.25^{c}	5.50^{c}	5.70^{c}	5.80^{c}	6.20^{b}
SM	7.25^{a}	7.10^{a}	7.33^{a}	7.00^{ab}	7.10^{ab}
SD	6.67^{ab}	6.75^{ab}	6.42^{abc}	6.80^{abc}	7.00^{ab}
MA	7.50^{a}	7.25^{a}	6.83^{abc}	7.10^{a}	7.10^{ab}
MM	6.00^{ab}	6.10^{bc}	6.83^{abc}	6.80^{abc}	6.20^{b}
MD	5.92^{bc}	6.10^{bc}	6.20^{bc}	5.83^{bc}	6.30^{ab}
BA	6.10^{bc}	6.42^{ab}	6.60^{abc}	6.80^{abc}	6.60^{ab}
BM	7.33^{b}	6.60^{ab}	7.00^{ab}	7.20^{a}	7.20^{a}
BD	6.83^{a}	7.00^{ab}	6.50^{abc}	6.42^{abc}	6.83^{ab}
LSD (0.05)	0.991	0.990	1.157	1.191	0.975

Symbols used for yam samples: SA= Small Apex, SM= Small Middle, SD= Small Distal, MA= Medium Apex, MM= Medium Middle, MD= Medium Distal, BA= Big Apex, BM= Big Middle and BD= Big Distal

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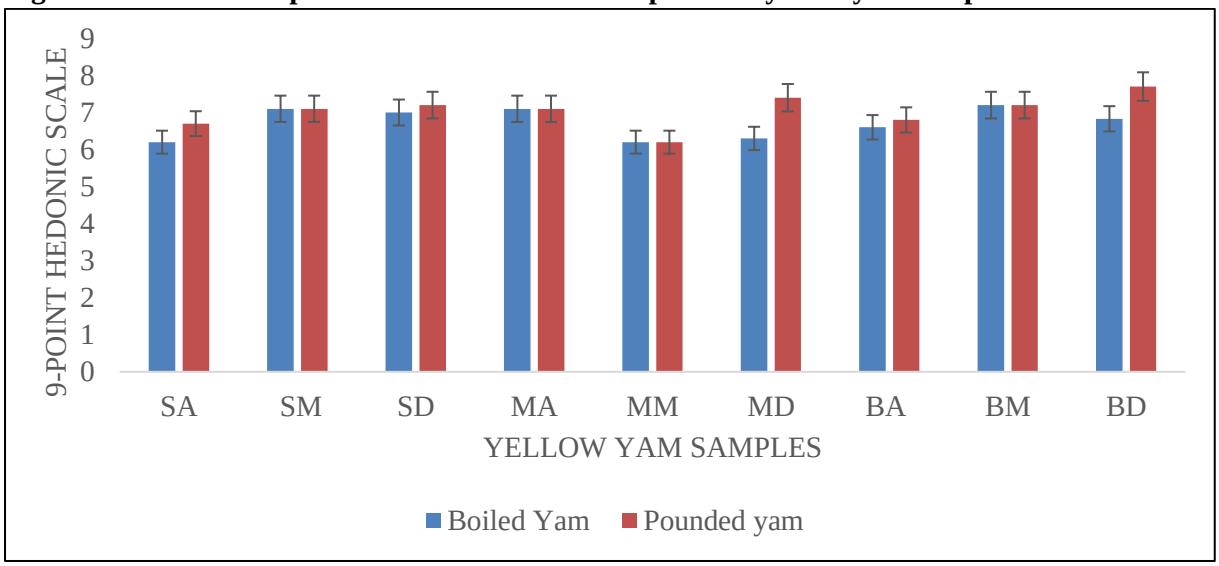
Figure 2: General acceptance values for boiled and pounded yellow yam samples



Symbols used for yam samples: SA= Small Apex, SM= Small Middle, SD= Small Distal, MA= Medium Apex, MM= Medium Middle, MD= Medium Distal, BA= Big Apex, BM= Big Middle and BD= Big Distal.

Table 3: Results of sensory evaluation of pounded yellow yam samples

Sample	Appearance	Texture	Elasticity	Mould ability	General Acceptability
SA	3.72^{b}	5.09^{bc}	4.09^{b}	5.45^{bc}	5.27^{bc}
SM	3.45^{b}	4.27^{c}	4.54^{b}	4.09^{c}	4.36^{c}
SD	NA	NA	NA	NA	NA
MA	6.54^{a}	6.27^{ab}	6.63^{a}	6.45^{ab}	6.45^{ab}
MM	6.45^{a}	6.63^{a}	7.00^{a}	6.81^{ab}	6.81^{a}
MD	4.45^{b}	4.36^{c}	4.36^{b}	4.18^{ab}	4.00^{c}
BA	6.90^{a}	6.54^{a}	7.00^{a}	6.81^{ab}	7.00^{a}
BM	7.36^{a}	7.00^{a}	7.00^{a}	7.00^{a}	7.09^{a}
BD	7.18^{a}	6.63^{a}	7.18^{a}	7.09^{a}	6.81^{a}
SA	1.154	1.332	1.375	1.420	1.396

Symbols used for yam samples: SA= Small Apex, SM= Small Middle, SD= Small Distal, MA= Medium Apex, MM= Medium Middle, MD= Medium Distal, BA= Big Apex, BM= Big Middle and BD= Big Distal

CONCLUSION

Foods (fried and boiled yam) produced from the medium and big yellow yam sizes were more acceptable and could serve as traditional household food varieties. On the other hand, the middle section of yellow yam is better in production of pounded yam

Recommendation

The researchers therefore recommend, boiling and frying as a processing method for yellow yam (*D. cayenensis*) consumption for palatability. Consumption of big size yellow yam varieties in pounded yam form at the household and commercial level as the case maybe. And Small yam size varieties for planting.

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