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Quality evaluation of pounded yam made using various yam cultivars and processing methods

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Abstract

The quality of pounded yam made from three different *Dioscorea rotundata* cultivars was assessed using three different processing methods: mortar and pestle, pounding machine, and attrition mill. The functional and pasting properties of yam starch, as well as the textural characteristics of pounded yam, were evaluated. The functional qualities of yam starch yielded values ranging from 10.36 to 12.81 g/g, 3.50 to 4.76%, 25.52 to 40.83%, and 81.00 to 83.00% for swelling power, solubility index, water absorption capacity, and dispersibility, respectively. The peak, breakdown, final, and setback viscosities of yam starch ranged from 571.09 to 682.67 (RVU), 302.96 to 355.29, 378.29 to 591.13, and 119.75 to 324.96 RVU, respectively. The scientific and subjective approaches for evaluating the samples revealed similar characteristics. The judges' acceptance of the pounded yam samples was significantly influenced by both the processing procedures and the yam cultivars.

Keywords: Pounded yam; White yam; Processing methods; Texture; Quality

Introduction

One of Africa's many delicious foods are 'pounded yam', a sticky smooth dough. It is prepared by peeling, boiling, crushing, and kneading yam tubers. Nigeria is the largest producer of yam in Africa (FAOSTAT, 2021) and pounded yam is considered the primary yam food product. The quality of pounded yam influences farmers' selection of species and varieties they cultivate. *Dioscorea rotundata* is the most often used edible yam tuber for pounded yam production (Otegbayo *et al*. 2010). Due of its significance, it is the chosen cuisine served to high-profile guests at festivals, marriages, and other traditional celebrations (Otegbayo *et al*. 2021). Pounded yam is a cherished meal that is consumed throughout Nigeria and all of Africa. It gets its name from the realization that it's usually made by using a mortar and pestle to crush cooked yam until they constitute a dough-like product. Pounded yam is considered to be the 'ultimate food' in status among Nigerians who consume yams (Adeola *et al*. 2012).

Textural quality is the most crucial food quality characteristic that consumers of pounded yam consider, according to previous studies (Akissoe *et al*. 2009; Baah *et al*. 2009; Nindjin *et al*. 2007; Otegbayo, *et al*. 2018). The term "textural quality" refers to a series of physical qualities that derive from the structural components of food, which are perceived by touch, connected to stretching, dissolution and movement under a force, and are objectively assessed by force, distance and duration (Otegbayo *et al.* 2018).

According to Ufondu *et al*. (2022), the textural attributes essential for pounded yam by consumers are: elasticity, adhesiveness (stickiness), smoothness, cohesiveness (mouldability).

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Otegbayo *et al*. (2021) described Pounded yam of good textural quality as cohesive, smooth, stretchable, moderately soft, and moderately adhesive while bad textural quality to be lumpy, non-stretchable, very adhesive and non-cohesive.

In many African nations, pounded yam is a highly esteemed everyday food. However, the conventional method of processing it using pestle and mortar is discouraging its consumption. Due to the stress involved in preparing pounded yam and some side effects associated with it such as body exhaustion, time consumption, bruising on the palm, unclean preparation e.t.c. some consumers prefer to use machines. Some pounded yam consumers dispute using machines because they believe that pounded yam made with machines has reduced textural attributes. To them, pounded yam made with mortar and pestle has better textural qualities. Hence this study was carried out to evaluate the quality of pounded yam using different processing methods and cultivars of white yam.

Materials and methods

Material Collection

Three varieties of *Dioscorea rotundata Poir* (Abuja, Pampers and Lagos) were collected at Bodija market in Ibadan, Oyo state, and taken to the yam breeding unit at the International Institute of Tropical Agriculture (IITA) for identification.

Starch extraction

The yam starch was extracted from yam tubers (Abuja, Lagos and Pampas) using a wet method, as described by Afolabi *et al.* (2024). The tubers were peeled, cleaned, and cut into cubes. This was followed by grinding it into a slurry with water using a laboratory blender. The slurry was sieved, and the filtrate was allowed to settle before being drained and thoroughly washed with water. Before evaluation, the settled starch was dried, ground into a smooth powder, packed, and stored in zip-lock bags.

Functional properties

Swelling power and solubility index

The procedure described by Ufondu *et al*. (2022), was used in determining the swelling power and solubility index of yam starch. The yam starch was poured into the centrifuge tube filled with water that has been distilled was homogenized using vortex mixer for approximately three minutes. The tube was submerged in a water bath at 60°C, agitated for 30 minutes, allowed to cool, and then centrifuged at 3000 rpm for 15 minutes. After being put into an aluminium dish, the centrifuge supernatant was dried at 105°C in the oven. Then the weight of the residue was taken. The swelling power and solubility index was calculated using the formula shown below:

$$Swelling\ capacity\ (g/g) = \frac{weight\ of\ hydrated\ granules}{dry\ weight\ of\ starch}$$

$$Solubility\ (g/g) = \frac{weight\ of\ solubilized\ starch}{dry\ weight\ of\ starch}$$

Water absorption capacity

The WAC was determined at room temperature following the method of Chandra *et al*. (2015). Samples of 1 g (W1) was weighed into a centrifuge tube. The tube and the sample was weighed (W2). Ten millilitres (10 mL) of distilled water was added to the sample in the tube. The content of the tubes was mixed for 30 s every 5min using a glass stirring rod for 10 minutes. The tubes were centrifuged at 3500 × g for 20 min using a centrifuge (BOSCH, TLD-500, England). The supernatant was carefully decanted and the contents of the tube was allowed to drain at a 45° angle for 10 min and then weighed (W3). The water absorption capacity was expressed as a percentage of the volume of water absorbed by the sample.

$$Water\ absorption\ capacity\ (\%) = \frac{W3 - W2}{W1} X\ 100$$

$W3$=$weight\ of\ test\ tube$ +$sample\ after\ centrifuging\ and\ decanting$

$W2$=$weight\ of\ test\ tube$+$sample\ before\ water\ addition\ and\ centrifuging$

$W1$=$weight\ of\ sample$

Dispersibility

The Dispersibility of the starches was determined following the methods described by Oke *et al*. (2020). Ten grams of flour were carefully placed in a measuring cylinder with a capacity of 100 milliliters. Distilled water was then added to the cylinder until the total volume reached 100 millilitres. The setup was agitated and then left to settle for three hours. The volume of sediment particles was measured and subtracted from the total of 100. The discrepancy was measured in terms of percentage dispersibility.

Pasting properties of the yam starch

The pasting properties of the extracted starch was obtained using Rapid Visco Analyzer (RVA). Yam starch samples (3 g) and distilled water (25 ml) was thoroughly mixed together and later placed in the RVA. The starch samples were tested using a 12-minute standard profile in which the starch and distilled water mixture was heated to 50-90°C for two minutes before cooling for another two minutes to 50°C. Heating and cooling were carried out at a constant rate of 11.25°C/min and 900 rpm, respectively. The following parameters were evaluated from the RVA that was connected to the computer; pasting time, pasting temperature, peak viscosity, trough viscosity, breakdown, set back, final viscosity as well as temperature of pasting. The viscosity measured using Rapid Visco Analyzer is expressed as Rapid Visco Analyzer unit (RVU).

Preparation of pounded yam

The pounded yam was prepared using the methods described by Afolabi *et al.* (2023b). The proximal and distal ends of the tubers were removed, and only the middle section was used in this investigation. Yam tubers were washed, peeled, and chopped into small cubes. Individual yam cultivars were prepared and boiled for 20 minutes before being divided into three pieces for pounding with mortar and pestle, a yam pounder, and an attrition mill. The boiled yam of each cultivar was mashed separately for five minutes at high speed without adding water using a yam pounder, followed by a mortar and pestle and an attrition mill. To prevent surface drying, approximately 25 g of each pounded yam sample was covered in aluminium foil immediately after preparation and stored in a zip lock bag before evaluation.

Texture analysis of pounded yam

Instrumental textural analysis was carried out according to the method described by Otegbayo *et al*. (2007). The sample of pounded yam from each variety prepared with different preparation methods was analyzed using a Texture analyzer (Serial No: 2-P6-Z10447-01-V0038D577) connected to a personal computer. The textural properties include hardness, resilience, springiness, adhesiveness, and cohesion. The pounded yam samples were placed on a flat surface and compressed to around 50% of their original height using a cylinder-shaped plunger probe with a diameter of 100 mm and a pre-load test speed of 5.0 mm/s.

Sensory evaluation of pounded yam

The textural quality of pounded yam samples was evaluated by semi-trained panelists. The sensory assessment of pounded yam samples was carried out using the method reported by Ufondu *et al.* (2022). The sensory evaluation included thirty semi-trained panelists who are natural pounded yam eaters, including male and female undergraduate students from First Technical University in Ibadan. The panellist was asked to rate the attributes (elasticity, stickiness, smoothness, mouldability, hardness, and appearance) of the pounded yam samples on a 9-point hedonic scale, ranging from dislike extremely to dislike extremely (1 = dislike extremely, 2 = dislike very much, 3 = dislike moderately, 4 = dislike slightly, 5 = neither like nor dislike, 6 = like slightly, 7 = like moderately, 8 = like very much, 9 = like extremely).

Statistical analysis

Samples were prepared in duplicate, and analysis were performed in triplicate. The data were examined using a one-way ANOVA. Duncan ($P < 0.05$) used XLSTAT to report the results as mean ± SD.

Results and discussion

Functional properties of yam starches

The functional characteristics of yam starch obtained from the three varieties of *D. rotundata* (Abuja, Lagos and Pampas) are shown in Table I. The starches' swelling power ranged from 10.36 to 12.81 g/g for Lagos and Abuja yams. The swelling power of Abuja yam starch

Table I. Functional properties of yam starch

Sample	Swelling power (g/g)	SI (%)	WAC (%)	Dispersibility (%)
AYS	12.81±0.10^{a}	3.50±0.16^{c}	28.33±2.01^{b}	83.00±0.00^{a}
LYS	10.36±0.03^{b}	4.76±0.06^{a}	25.52±0.97^{b}	81.00±2.00^{a}
PYS	10.71±0.14^{b}	4.20±0.08^{b}	40.83±0.64^{a}	82.00±2.83^{a}

Results are expressed as mean ± SD (n = 3). Means with different letters within the same column were significantly different at $p < 0.05$. AYS, Abuja yam starch; LYS, Lagos yam starch; PYS, Pampas yam starch. SI; solubility index.

increased significantly as compared to other types. The swelling power of the examined starches is within the range of *D. rotundata* starches reported by Tanimola *et al.* (2022). Swelling power is the ability of starch or flour to absorb and retain water within the swelled flour granule, which is required in a variety of food applications (Aiido *et al.* 2022).

The variations in swelling power of yam starch could be attributed to their different starch content and the presence of lipids that hinder swelling (Tortoe *et al.* 2017). LSY has the highest percent solubility index (4.761%), whereas sample AYS has the lowest (3.50%). Solubility is the percentage of starch released into the supernatant during the process of estimating swelling power. It was found that the solubility index of starches was inversely proportional to swelling power. Specifically, the starch with the highest swelling power had the lowest solubility index. This corresponds to the findings of Efah-Manu *et al.* (2022) on yam flour and starches. According to Otegbayo *et al.* (2014), yam cultivars, starch granule shape, and the connection of yam starch chains with the crystalline and amorphous arenas can all have a substantial impact on yam starch swelling power and solubility indexes. The water absorption capacity (WAC) was found to be varied between 25.52 and 40.83% for LYS and PYS. According to Oke *et al.* (2020), starch polymers' high water absorption capacity is due to their loose structure, whereas a low number indicates a more compact molecular structure. The water absorption capacity is a metric that measures the amount of water retained by yam starch during the processing step. This property has a considerable impact on yam starch's ability to generate a paste, boost its usage as bulking, and maintain the consistency and stiffness of food products, particularly in baking applications. (Ezeocha *et al*. 2015).

The dispersibility of the yam starch samples ranged between 81.00% and 83.00% for Lagos and Abuja yam. Dispersibility is a quantitative measurement of the ability of individual molecules within a food sample, often flour or starch, to separate when exposed to water, revealing hydrophobic interactions (Awoyale *et al.* 2020). Oke *et al.* (2020) reported that yam-jack bean flour mixes with dispersibility ranging from 75.5 to 80.4% have a reasonable reconstitution capacity. This shows that when these yam starches are blended, they can easily make dough of a fine consistency.

Pasting properties of yam starch

Table II shows the pasting properties of starch obtained from three different *D. rotundata* types (Abuja, Lagos, and Pampas). Pasting behaviours of yam starches varied significantly ($p<0.05$). AYS has the highest peak viscosity (682.67 RVU), whereas LYS has the lowest (569.13 RVU). No significant variation in peak viscosity was seen between the starches. The phrase "peak viscosity" refers to the highest level of viscosity achieved quickly after the starch slurry becomes viscous. Linli *et al.* (2019) attributed variations in peak viscosity of starches to yam starch microstructures, amylose, and amylopectin content. According to Otegbayo *et al.* (2021), high peak viscosity is suggested to help improve the texture of pounded yams. AYS has the highest trough viscosity (345.25 RVU), while PYS, a yam starch sample, has the lowest (215.79 RVU). Significant differences ($P<0.05$)

Table II. Pasting properties of yam starch

Sample	PV (RVU)	TV (RVU)	BD (RVU)	FV (RVU)	SV (RVU)	Peak Time (min)	Pasting Temp (°C)
AYS	682.67±11.08^{a}	345.25±12.78^{a}	337.42±31.70^{a}	465.00±25.34^{b}	119.75±17.44^{b}	4.64±0.05^{a}	84.10±0.07^{a}
LYS	569.13±6.07^{a}	266.17±2.00^{b}	302.96±8.08^{a}	591.13±13.58^{a}	324.96±10.58^{a}	4.57±0.05^{a}	82.85±0.71^{a}
PYS	571.09±7.21^{a}	215.79±4.13c	355.29±7.34^{a}	378.29±15.15^{b}	162.50±9.27^{b}	4.67±0.19^{a}	83.65±0.57^{a}

Results are expressed as mean ± SD (n = 3). Means with different letters within the same column were significantly different at $p < 0.05$. AYS, Abuja yam starch; LYS, Lagos yam starch; PYS, Pampas yam starch; PV, Peak viscosity; TV, Trough viscosity; FV, Final viscosity; BD, Breakdown; Setback Viscosity were observed between the samples. Trough viscosity is the viscosity at which starch remains stable when subjected to continual high temperatures and mechanical shear stress (Olatunde *et al.* 2017). The elevated trough viscosity suggests that it could be valuable in an industry that requires a stable gel. The highest breakdown value was obtained for PYS (302.96 RVU). According to Sanfu and Engmann (2016), the achieved value exceeds that of aerial yam starch (113 RVU). The high breakdown values observed in the yam starch sample indicate fewer granule ruptures. This property contributes to the paste's higher resistance to viscosity breakdown, which leads to greater stability (Otegbayo *et al.* 2014).

The high viscosity seen in certain varieties of *D. rotundata* may be attributed to their elevated water absorption capacity (WAC) which allows the unrestricted swelling of starch prior to its physical breakdown (Adebowale *et al*. 2008; Ufondu *et al*. 2022). The parameter most frequently employed to assess the quality of flour samples is the final viscosity. From Table II, LYS has the highest viscosity (591.13 RVU) while PYS has the lowest value for final viscosity (378.29 RVU). The final viscosity obtained in this study is higher than the final viscosity of some selected white yam flour (259.16RVU to 437RVU) reported by Afolabi *et al*. (2023a). Final viscosity provides insight into a starch's capacity to develop a viscous paste or gel following the process of cooking and subsequent cooling (Nwakaudu *et al*. 2017). The setback viscosity ranged between 162.90 to 324.96 RVU. The setback viscosity refers to the capacity of gelatinized starch to experience retrogradation following its cooling to a temperature of 50°C. The parameter quantifies the stability of the cooked paste. The setback values LYS was significantly higher than other starches which indicates its higher tendency to retrograde. The observed peak time (4.57 to 4.67 min) and pasting temperatures (82.85 to 84.10°C) of the yam starches did not exhibit substantial variation, as indicated by the lack of significant difference ($p>0.05$) across the samples. The pasting temperature refers to the temperature at which the initial noticeable change in viscosity occurs, and it is an index that is defined by the initial increase in

Table III. Texture analysis of pounded yam

Sample	Hardness (N)	resilience (mm)	Springiness (mm)	Adhesiveness (g.sec-1)	cohesiveness
AYM	5.25±58.00^{a}	0.08±0.71^{c}	0.33±4.50^{d}	-86.18±9.13^{b}	0.70±0.01^{a}
AYP	2.25±15.34^{c}	0.27±4.29^{b}	0.56±1.58^{ab}	-33.17±3.05^{a}	0.62±0.03^{b}
AYA	2.09±17.96^{d}	0.37±0.52^{a}	0.63±2.83^{a}	-226.67±6.17^{d}	0.34±0.00^{d}
PYM	5.02±49.01^{b}	0.05±0.60^{c}	0.29±3.40^{d}	-78.29±18.02^{c}	0.69±0.00^{a}
PYP	2.15±4.23^{c}	0.21±3.18^{b}	0.48±0.47^{c}	-29.28±2.04^{a}	0.58±0.02^{c}
PYA	1.64±6.85^{e}	0.32±0.41^{a}	0.54±1.72^{b}	-209.78±5.06^{e}	0.29±0.00^{d}
LYM	5.25±69.11^{a}	0.07±1.82^{c}	0.31±5.61	-80.11±3.24^{bc}	0.69±0.01^{a}
LYP	2.31±26.45^{c}	0.23±5.30^{b}	0.52±2.69^{b}	-29.89±4.16^{a}	0.56±0.04^{c}
LYA	1.95±28.70^{de}	0.35±1.63^{a}	0.59±3.94^{a}	-215.56±7.28^{d}	0.31±0.01^{d}

Results are expressed as mean ± SD (n = 3). Means with different letter within the same column were significantly different at $p < 0.05$
AYM: pounded yam from Abuja yam using mortar and pestle, Sample AYP; pounded yam from Abuja yam using pounding machine. Sample AYA; pounded yam from Abuja yam using attrition mill. Sample PYM; pounded yam from Pampas yam using mortar and pestle. Sample PYP; pounded yam from Pampas yam using pounding machine. Sample PYP; pounded yam from Pampas yam using attrition mill. Sample LYM; pounded yam from Lagos yam using mortar and pestle. Sample LYP; pounded yam from Lagos yam using pounding machine. Sample LYA; pounded yam from Lagos yam using attrition mill.

viscosity resulting from the swelling of starch. The pasting properties of yam starches are significantly influenced by the type of yam, the size of the starch granules, and the intermolecular contact between them (Otegbayo *et al*. 2007).

Textural Evaluation of Pounded yam

The result of textural analysis of pounded yam samples is shown in Table III. From the results, the hardness of the pounded yam sample from mortar and pestle was the highest 5.25N for Abuja and Lagos yam while the corresponding values for pounded yam samples from attrition mill and pounding machine are 2.09N, I.64N,1.95N and 2.25N, 2.15N and 2.31, respectively. The hardness of the product is the peak force observed at the initial compression of the product, as indicated by the TPA curve. The pounded yam samples produced with an attrition mill have a much softer (lowest hardness) than those pounded using other processing methods. This is also correlated with the sensory evaluation results and can be attributed to the impact of various types of stresses applied to the pounded yam during processing. The pounded yam sample processed with an attrition mill has higher elasticity (springiness), as evidenced by the textural analysis results (Table III). There is a statistically significant difference ($p<0.05$) in springiness between pounded yam samples made using different procedures. High adhesiveness is found in pounded yam samples processed using an attrition mill with AYA having the highest value (226.67 g.sec-1) whereas pounded yam samples hammered with a pounding machine have the lowest adhesiveness (33.17 g.sec-1). Adhesiveness describes the amount of force necessary to release the plunger from the sample (Bourne, 2002).

According to the data presented in Table III, it is evident that all the pounded yam samples prepared using mortal and pestle AYM, PYM and LYM had the highest levels of cohesiveness when compared to other pounded yam samples prepared using a pounding machine or an attrition mill. The texture analysis study found a signifi-

Table IV. Sensory evaluation of the pounded yam samples

Samples	Elasticity	Stickiness	Smoothness	Mouldability	Hardness	Appearance	Overall acceptability
AYM	4.93±2.03^{cd}	6.28±1.93^{ab}	6.50±1.72^{ab}	6.98±1.59^{a}	6.23±1.61^{ab}	7.83±1.06^{a}	7.05±1.06^{ab}
AYP	7.25±1.74^{a}	7.18±1.43^{a}	7.13±1.68^{a}	6.60±1.71^{ab}	6.80±1.26^{a}	7.70±1.32^{ab}	7.58±0.98^{a}
AYA	4.42±2.06^{d}	4.85±2.67^{cd}	4.57±2.29^{e}	2.65±1.86^{f}	3.32±2.00^{e}	3.05±2.15^{e}	3.70±1.95^{f}
PYM	4.68±2.39^{cd}	6.18±1.92^{b}	5.93±2.06^{bc}	6.30±1.96^{abc}	5.63±2.23^{bcd}	7.18±1.50^{abc}	6.25±1.86^{cd}
PYP	6.33±1.82^{b}	6.30±1.84^{ab}	6.18±1.75^{bc}	5.90±1.81^{bcd}	6.18±1.62^{abc}	6.83±1.55^{c}	6.73±1.43^{bc}
PYA	4.80±2.36^{cd}	4.23±2.37^{d}	4.95±2.01^{de}	4.08±2.30^{e}	5.00±2.31^{d}	2.98±1.97^{e}	3.88±2.03^{f}
LYM	4.87±1.83^{cd}	5.33±1.88^{bc}	5.46±1.75^{cde}	5.41±1.69^{cd}	5.23±2.24^{cd}	7.00±1.41^{bc}	5.85±1.56^{de}
LYP	5.08±1.98^{cd}	5.38±1.73^{bc}	5.75±2.03^{bcd}	5.60±1.88^{cd}	5.60±1.86^{bcd}	7.25±1.01^{abc}	6.03±1.67^{cd}
LYA	5.65±1.92^{bc}	5.15±1.98^{cd}	5.25±2.17^{cde}	5.12±1.86^{d}	5.42±1.88^{bcd}	3.77±1.82^{d}	5.12±1.84^{e}

Results are expressed as mean ± SD (n = 3). Means with different letter within the same column were significantly different at $p < 0.05$
Note: Sample AYM; pounded yam from Abuja yam using mortar and pestle. Sample AYP; pounded yam from Abuja yam using pounding machine. Sample AYA; pounded yam from Abuja yam using attrition mill. Sample PYM; pounded yam from Pampas yam using mortar and pestle. Sample PYP; pounded yam from Pampas yam using pounding machine. Sample PYP; pounded yam from Pampas yam using attrition mill. Sample LYM; pounded yam from Lagos yam using mortar and pestle. Sample LYP; pounded yam from Lagos yam using pounding machine. Sample LYA; pounded yam from Lagos yam using attrition mill.

cant difference ($p<0.05$) in the cohesiveness of pounded yam samples from different procedures.The samples with significantly low values in the instrumental analysis results were similarly shown to lack cohesion, which was supported by their incapacity to be shaped during sensory evaluation.

Sensory evaluation of pounded yam

Table IV shows the sensory evaluation of pounded yams as influenced by yam varieties and pounding procedures. Based on the results, panelists determined that sample AYP was the pounded yam sample with the maximum elasticity due to its high mean value of 7.25. Pounded yam sample AYA exhibited the lowest elasticity, with a mean of 4.42. Table IV shows a significant difference ($p < 0.05$) across pounded yam samples. Elasticity is the length to which to which the pounded yam can be expanded and it is an important textural attribute of pounded yam (Jaron *et al*. 2015). With respect to the yam variety, it was observed that pounded yam sample made from Abuja yam had the maximum elasticity, while pounded yam samples made from Lagos yam had the lowest elasticity. According to Otegbayo *et al.* (2007), differences in yam variety based on geographical location, soil composition, and fertilizer application might result in differences in the textural features of pounded yam in terms of elasticity. On the influence of pounding techniques on the elasticity of pounded yam, it was found that yam samples hammered with a pounding machine had the maximum elasticity, followed by attrition mills. The decreased flexibility seen in pounded yam samples obtained using mortar and pestle may be related to the low impact applied on the cooked yam during the pounding.

According to the panelists' assessments, AYM had the highest stickiness (7.18), while PYA had the lowest. Stickiness refers to how well the pounded yam adheres to the hand. It was found that all pounded yam samples processed with an attrition mill were rated low for stickiness, meaning that they were stickier than other pounded yam produced using other methods. In terms of varieties, pounded yam samples from Abuja had the highest mean value, while Lagos has the lowest.

This could be as a result of difference in starch content of the yam cultivars and the cooking of the yam can also result cell sepration of the starch granules caused by discharge of amylose from the shattered cells Otegbayo *et al.* (2007). As regards smoothness AYP had the highest mean value (7.13) while AYA was the lowest (4.57) and with significant differences ($p < 0.05$) among the pounded yam samples. Smoothness is characterized with absence of lump in pounded yam. In terms of the effect of pounding methods pounded yam made with pounding machine has the highest rating for smoothness, whereas yam samples hammered with an attrition mill seemed lumpy. The poorer rating (presence of lumps) obtained from pounded yam samples hammered with an attrition mill could be attributed to the escape of a small percentage of coked yam when it is accelerated against the surface of the shaft into the pounded mass exiting the collector. The presence of lumps may contribute to consumers' objections to pounded yam (Afolabi *et al*. 2023b).

According to the results of the mouldability of the pounded yam samples, AYP had the greatest rating (6.98), while AYA had the lowest mean value (2.65). Mouldability refers to the ease with which the pound yam sample may be molded, moulded, or produced. Yam samples crushed with an attrition mill scored lower on mouldability. It was observed that the stickiness of the pounded yam samples influenced their ability to mould or form. In terms of pounded yam hardness, AYP earned the highest rating (mean value of 6.80), while AYA had the lowest (mean value of 3.32). Hardness is defined as the force required to compress the pounded yam. In comparison to other yam cultivars, pounded yam samples made from Abuja yam had the highest value. This could be due to variances in moisture content between the yam varieties. In contrast, pounding yam samples with a pounding machine showed the highest hardness value.

Pounded yam sample AYM had the highest rating for appearance (7.83), while PYA had lowest appearance rating (2.98). In the case of effect of pounding methods, pounded yam samples pounded with attrition mill has was rated lower than other samples. Kareem and Akinode (2018) stated that one of the effect of using attrition mill is dissolved metal from processing equipment and metal rusting. It can be argued that dissolved metals from the attrition mill components that gained entrance int the pounded yam influenced its appearance and, as a result, the panelist's evaluation. In terms of overall acceptability, pounded yam samples made with a pounding machine and mortar and pestle outperformed those made with an attrition mill. The low ratings for all categories the panelists assessed explain the low acceptance. Otegbayo et al. (2018) described pounded yam with good textural quality as stretchable, smooth, mouldable, somewhat sticky, and moderately soft.

Conclusion

The functional and pasting properties of yam starch, and the textural and sensory qualities of pounded yam was evaluated using three different processing methods and *Dioscorea rotundata* cultivars. The results revealed a significant difference in the swelling power, solubility index, and water absorption capacity of yam starches which could have an impact on the quality of the pounded yam. The characteristics of pounded yam made using different yam cultivars and processing methods revealed that all pounded yam samples processed using pounding machine received the highest quality and overall acceptance scores from the sensory panelists. However, pounded yam samples made using an attrition mill had the lowest quality in terms of adhesiveness, smoothness, hardness, mouldability, and appearance.

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