Extensibility: A Novel Approach To Objective Assessment of Stretchability In Pounded Yam

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Introduction

Stretchability is one of the key textural attributes of doughy food products such as pounded yam, an important popular food product from yam in West Africa, especially Nigeria. Researchers involved in food quality assessment of pounded yam have faced the challenge of direct instrumental assessment of stretchability. Methods such as Texture Profile Analysis (TPA) has not been able to provide a direct measurement for this important food quality attribute. This study focused on determination of instrumental extensibility as an objective method for assessing stretchability in pounded yam.

Methods

Pounded yam was prepared from 21 yam genotypes from *Dioscorea rotundata* and *D. alata* species

Sensory texture profile analysis (STPA) was conducted by 17 trained panelists to assess the key textural attributes (stretchability, smoothness, mouldability) of pounded yam. (Otegbayo et al, (2021, 2024)

Extensibility of the pounded yam samples was determined at a temperature of about 40oC with a texture analyzer (TA XT2i) using a Kieffer Dough extensibility rig (KFDE). Extensibility (mm), extension area (N.mm), extensogram peak force (N) of the pounded yam samples were determined. About 7 to 27 measurements per replicate were done. The results were analysed statistically by principal component analysis, discriminant analysis and hierarchical classification (cluster analysis).

Results and Discussion

- Pounded yam samples from *D. alata* samples were generally (Fig 1) described as having small lumps (mean score of 5.69), not mouldable, not stretchable, and yellow-cream in colour.
- TDr 89026665 had the highest extensogram peak of 0.265 N, followed by Meccakusa (0.146 N).
- Generally, *D.rotundata* varieties had better extensibility than *D.alata* varieties (Table 1)
- Discriminant analysis showed that TDr1525151, TDr1680007AB, TDr89026665, Meccakusa, TDr1617811, TDr1617604 and TDr1542027 with high extensibility are very different from each other (Fig 2)
- PCA (Fig 3) showed that the first two components of the score plot explained 76.9 % of the variation of data. The genotypes TDr1525151, TDr1680007AB, TDr89026665, Meccakusa, TDr1617811, TDr1617604 were associated with with high extensibility, extension area (extension work done), extensogram peak force (hardness), stretchability, smoothness, cohesiveness/moldability.
- Correlations between KDGE and sensory attributes of pounded yam were significantly associated with smooth, mouldable and cohesive doughs that are stretchable (Fig 4).
- Hence, the stretchability of pounded yam may be estimated from instrumental extensibility measurements.
- The 3-class hierarchical cluster analysis (Fig 5) showed that TDr1525151, TDr1680007AB and TDr89026665 are considered as the best genotypes with highest extensibility. Meccakusa (check landrace), TDr1617811, TDr1617604 and TDr1542027 were yam genotypes with good extensibility. The rest of the genotypes have intermediate to poor extensibility.

Conclusions and recommendations

- The ability of the KFDE extensibility procedure to discriminate among pounded yam samples from various yam genotypes, and the correlation of the STPA and KFDE measurements imply that extensibility using the KFDE may be used as a direct objective method to assess stretchability of pounded yam.
- This robust direct and mid-throughput method can be used for stretchability in other doughy products

References

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- Otegbayo, B., Tanimola, A., Oroniran, O., Maraval, I., Forestier-Chiron, N., Bugaud C. (2021). Sensory Characterization of Pounded Yam. Biophysical Characterization of Quality Traits, WP2. Iwo, Nigeria: RTBfoods Laboratory Standard Operating Procedure, 15 p. https://doi.org/10.18167/agritrop/00597.
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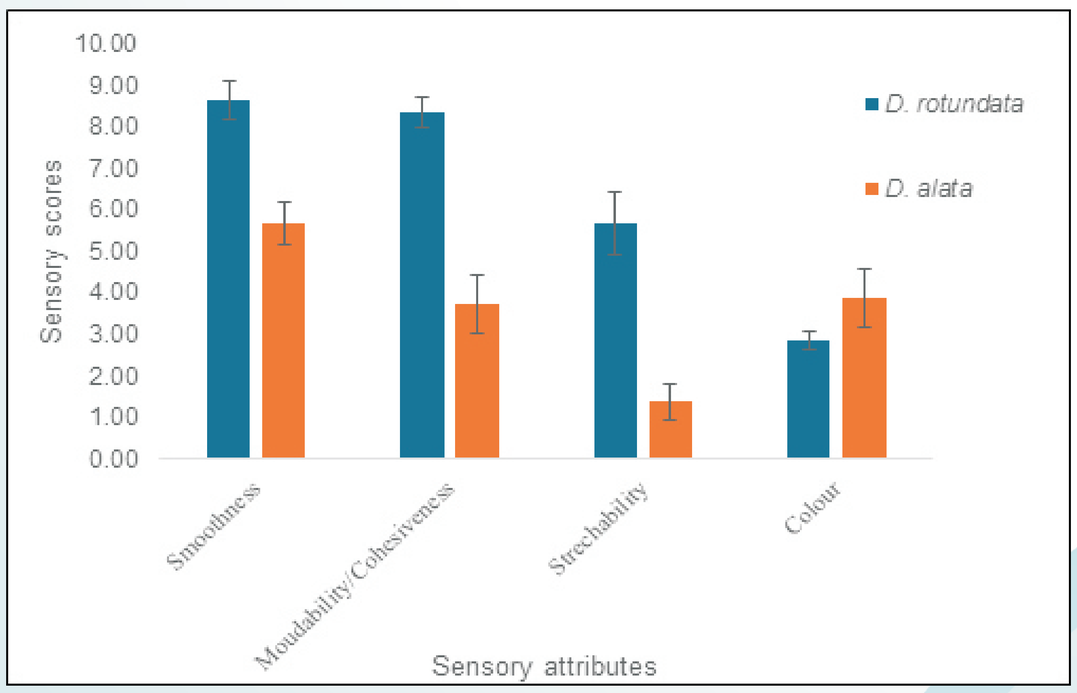

Figure 1: Mean sensory evaluation result of pounded yam from 21 genotypes of D. *rotundata* and *D. alata*

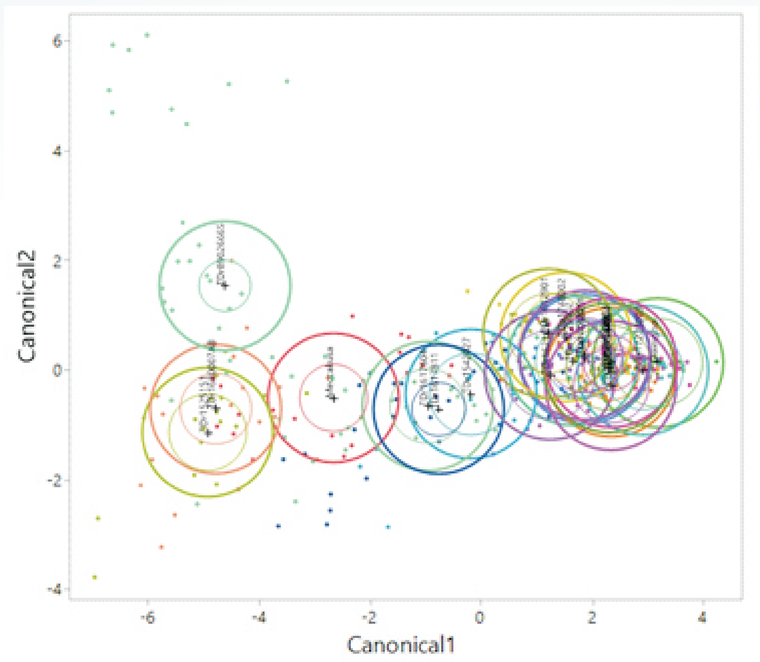

Figure 2: Discriminant chart of pounded yam from 19 yam genotypes

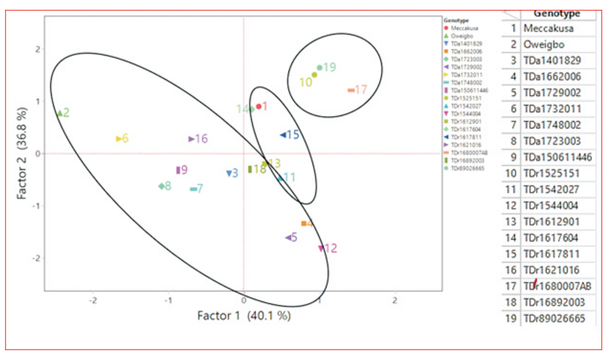

Figure 3: PCA of KDGE + sensory to 3-class hierarchy cluster. Genotypes TDa160403 and TDa160805 have no usable data

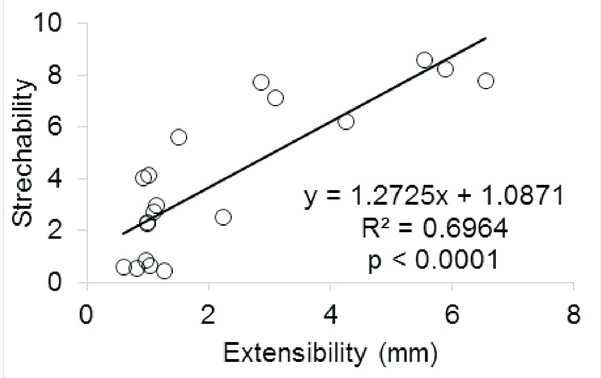

Figure 4a: Correlations between KDGE and sensory attributes pounded yam from 19 genotypes of yam

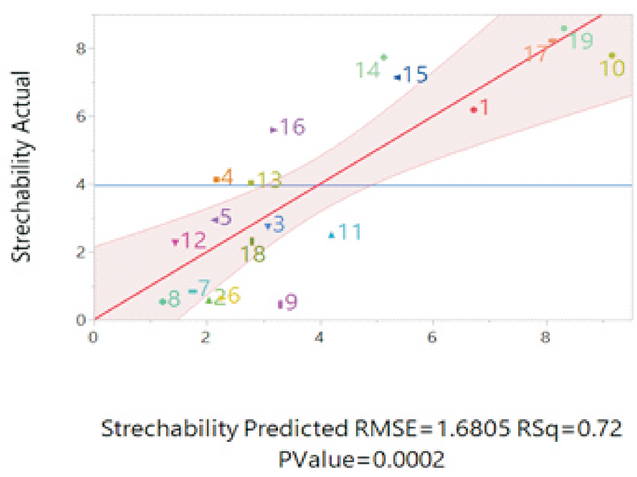

Figure 4b: Predicted versus actual stretchability plot

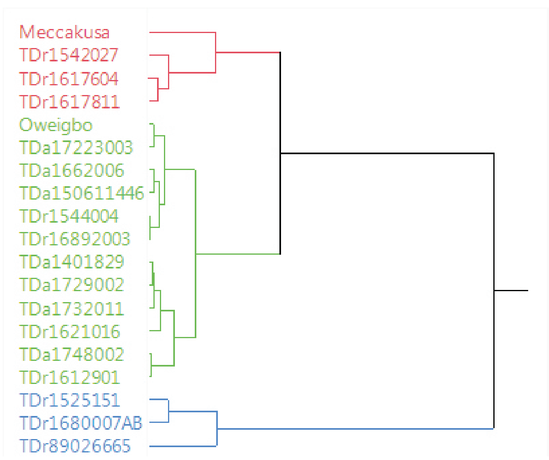

Figure 5 : Hierarchical KDGE pounded yam parameters.

Table 1: Extensogram peak force, Extensibility and Extension Area of pounded samples from Yam Genotypes

Level	Extensogram peak force(N)	Extensibility (mm)	Extension area (N.mm)
Meccakusa	0.147 ^{c}	4.265 ^{c}	0.464 ^{c}
Oweigbo	0.066 ^{ij}	0.605 ^{g}	0.037 ^{e}
TDa1401829	0.085 ^{fghij}	1.105 ^{fg}	0.068 ^{e}
TDa1662006	0.070 ^{ij}	1.017 ^{fg}	0.061 ^{e}
TDa1729002	0.089 ^{efghi}	1.140 ^{fg}	0.085 ^{e}
TDa1732011	0.093 ^{defgh}	1.047 ^{fg}	0.067 ^{e}
TDa1748002	0.112 ^{de}	0.982 ^{fg}	0.072 ^{e}
TDa17223003	0.065 ^{j}	0.817 ^{fg}	0.046 ^{e}
TDa150611446	0.067 ^{ij}	1.266 ^{fg}	0.069 ^{e}
TDr1525151	0.192 ^{b}	6.547 ^{a}	0.779 ^{b}
TDr1542027	0.100 ^{defg}	2.245 ^{e}	0.167 ^{de}
TDr1544004	0.078 ^{hij}	1.000 ^{fg}	0.057 ^{e}
TDr1612901	0.109 ^{de}	0.938 ^{fg}	0.072 ^{e}
TDr1617604	0.112 ^{d}	2.865 ^{de}	0.229 ^{d}
TDr1617811	0.103 ^{def}	3.092 ^{d}	0.205 ^{d}
TDr1621016	0.092 ^{defgh}	1.511 ^{f}	0.104 ^{de}
TDr1680007AB	0.192 $_{b}$	5.890 ^{b}	0.673 ^{b}
TDr16892003	0.077 ^{ghij}	0.993 ^{fg}	0.060 ^{e}
TDr89026665	0.265 ^{a}	5.535 ^{b}	0.908 ^{a}

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