Relating phenotypic traits, aroma and untargeted metabolomes of boiled Sweet potato from Uganda

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1. INTRODUCTION

Boiled Sweet potato (SP) is a common staple enjoyed in Uganda for its sensory appeal. However, SP breeding programs barely consider incorporation of physicochemical traits related to eating quality as they focus more on agronomic traits. Our project focused on understanding the relationships among the physicochemical and sensory parameters, metabolomes, and volatiles of boiled SP and how they contribute to the diversity among from various SP genotypes.

Keywords: Aroma, boiled sweet potato, sensory, texture, untargeted metabolomics

2. MATERIALS & METHODS

Boiled sweet potato (SP) was produced from nine selected SP varieties harvested in Iganga and Buyende districts of Uganda with diverse phenotypic quality. They were freeze-dried and milled into flour.

- The texture of boiled sweet potato was analyzed by a texture profile analysis (TPA) procedure [1].
- Trained panelists rated boiled SP for twenty-two sensory attributes on ordinal intensity scales ranging from 0 (lowest) to 10 (highest) [2].
- Microstructure, dry matter (DM), pasting properties, total pectin, swelling power, and solubility were determined in the raw and cooked states.
- Aroma composition was obtained by dynamic headspace-GCMS analysis.
- Untargeted metabolomes were analyzed by LCMS analysis.

3. RESULTS

3.1. Relationship between texture, sensory and physicochemical properties of boiled SP

Results show that instrumental hardness was associated with sensory hardness and mealiness, dry matter, swelling power, solubility, and paste viscosities, most evidently with genotype UGP202000232–12 of notable SP-like aroma and chalky appearance.
Instrumental cohesiveness was associated with the genotype D20 which sensorially exhibited pumpkin-like aroma and odor and intense orange color.

Instrumental resilience and springiness were associated with a purple-fleshed genotype that was sensorially fibrous and had good recovery after deformation.

Instrumental chewiness was associated with the genotype UGP202000296–42 which had high DM, sensory bitterness and hardness, and paste breakdown. Tanzania, NAROSPOT 7, UGP202000302–12, and UGP202000161–16 was sensorially moist and smooth.

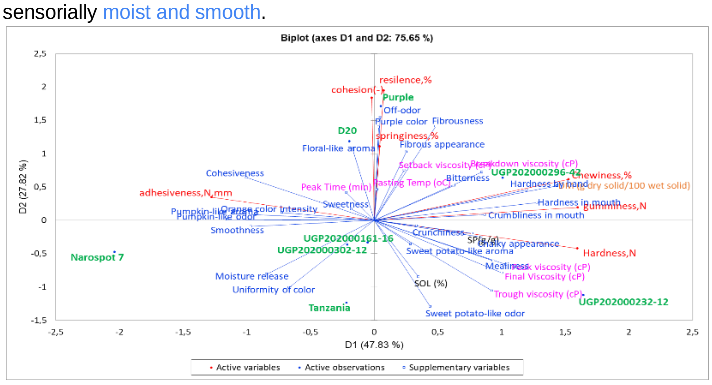

Fig 1. PCA showing the sweet potato genotypes and association among textural, sensory and other physicochemical properties

Table 1. Correlations among textural, sensory and physicochemical properties of boiled SP

Parameter	Hardness	Adhesiveness	Resilience	Cohesion	Springiness	Gumminess	Chewiness
Dry matter (fresh)	**0.7939**	-0.6318	0.3632	0.2326	-0.1094	**0.9110**	**0.8466**
Peak viscosity (cP)	**0.7271**	-0.4171	-0.1618	-0.4453	-0.0236	0.5915	0.5172
Sweet potato-like odor	0.2883	-0.5422	-0.5374	-0.1593	**-0.7630**	0.2259	-0.0354
Pumpkin-like odor	-0.6755	**0.7281**	-0.1227	0.1466	-0.1768	-0.5873	-0.5823
Off-odor	-0.1003	-0.0157	**0.9146**	0.3510	0.3970	0.0317	0.1754
Purple color	-0.0927	-0.0104	**0.8804**	0.2785	0.3350	0.0224	0.1460
Sweet potato-like aroma	0.1321	-0.3685	0.1213	0.0613	**-0.7678**	0.2043	-0.0291
Pumpkin-like aroma	-0.6596	**0.7099**	-0.1031	0.2009	-0.1579	-0.5547	-0.5423
Floral-like aroma	-0.1209	0.2233	0.5114	-0.0101	**0.8679**	-0.1585	0.1045
Hardness in mouth	**0.7176**	-0.6340	0.0015	0.2324	0.1247	**0.7568**	**0.7410**
Moisture release	-0.5450	-0.0266	-0.3004	-0.0140	-0.6218	-0.5695	**-0.7242**
Cohesiveness	**-0.7086**	0.4924	0.3019	0.5163	-0.4100	-0.4756	-0.5166
Hardness by hand	0.6565	-0.5674	0.0662	0.3384	0.1445	**0.7279**	**0.7177**

Scanning electron microscopy (SEM) showed that only UGP202000302–12 and UGP202000232–12 retained intact cells after cooking, with others having a continuous matrix indicative of cell-wall disruption and starch release.

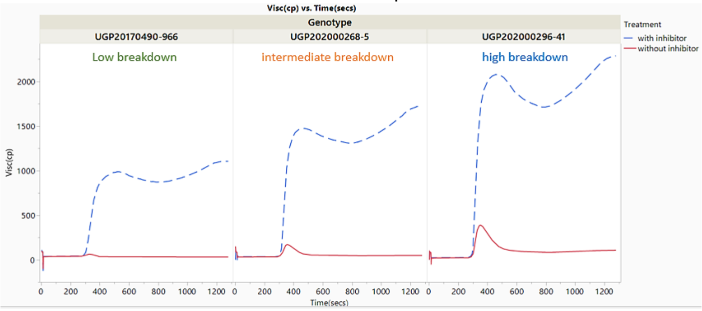

Fig 2. Effect of enzyme inhibition on flour peak & breakdown viscosity of 3 sweet potato genotypes

The decreased activity of β-glucosidase was evidenced by the significant increase in peak viscosity of raw SP flour by $AgNO_3$ inhibition at varying degrees depending on the genotype. The significant diversity among the genotypes was also revealed in the variation in degree of viscosity breakdown in SP.

3.2. Volatile and metabolomic profiles of boiled sweet potato

Boiled SP released 41 identified untargeted aromatic compounds including Ethanol, Toluene, Hexanal, m-xylene, Heptanal, D-Limonene, Eucalyptol, Octanal, Furfural, Benzaldehyde, Linalool, Isopropyl myristate, Phenol and trans-Geranylgeraniol.

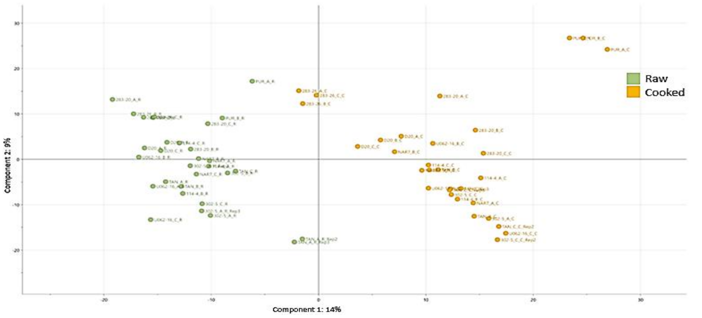

Fig 3. Untargeted metabolomics distinguished raw and cooked sweet potato samples

Untargeted analysis of the SP panel indicates changes in metabolomes composition after cooking, linked to the phenotypic classification based on texture parameters. Raw and cooked SP metabolomes were strongly correlated with textural hardness, gumminess and flour solubility particularly after cooking. Over 150 chemical features were identified as robust differentiators for these textural parameters.

4. CONCLUSION

The physicochemical attributes of SP are associated with texture and sensory perceptions, and may be reliably used to routinely profile SP in breeding programs. Untargeted volatiles and metabolites associated with boiled SP has been identified. This could facilitate understanding the underlying sensory preferences of sweet potato in breed selection.

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6. REFERENCES

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