



RTB Working Paper

Gendered mapping and consumer testing of steamed matooke in urban areas of Uganda

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Abstract

Cooking banana or matooke is a key staple food for Ugandans, usually consumed in steamed form. Breeding interventions over the years have focused on increasing productivity for farmers especially in lieu of resolving constraints such as pests and diseases and adverse weather (drought). However, despite gains in productivity due to improved or superior cultivars, end-user uptake remained lukewarm. As a result, it was important to understand the underlying reasons for this leading to the studies that sought to investigate end-user preferences for the matooke consumed along the value chain beyond farmer fields. The current study focused on exploring the attributes of steamed matooke that are desirable or undesirable for urban consumers segregated by gender, age and income status. This approach is a useful precursor for targeted breeding of cultivars possessing consumers' preferred characteristics.

The study was conducted in Kampala and Wakiso. First, a gendered food mapping involving use of Focus Group Discussions (FGDs) and Individual Interviews (IDIs) was conducted. This was followed by a consumer test with 381 consumers where four steamed matooke samples/cultivars were evaluated namely, Nakitembe, Kibuzi, Ntika and Mpologoma. Steamed-mashed matooke was the most consumed form (97%) and with the highest frequency of consumption (83%). Of the cultivars assessed Kibuzi was most-preferred during the FGDs and also had the highest mean overall liking in the consumer test (7.2). Ntika was least-preferred (5.9). However, differences were observed among income classes and gender groups (sex and age). High- and low-income consumers gravitate towards steamed Kibuzi while for the middle income it was Mpologoma. The females (adult and youth) showed more preference for Mpologoma while the males liked Nakitembe more. The mapping of sensory characteristics showed that the key drivers of overall liking were a yellow color; a nice aroma; attractive looking; sweet (delicious, not sweet like sugar); Homogeneous (one color); good taste and soft. Matooke taste proved a key determinant for the preference of steamed Kibuzi over the other steamed matooke. **It is therefore important to unlock this attribute in terms of sensory quantitative descriptive analysis and physico-chemical characterization, to guide breeding efforts geared towards improving sensory acceptability of matooke cultivars.** Differences were observed in preference among different income and gender categories. Therefore, breeders need to package appropriate products based on the preferences of the various socio-demographic segments, including by gender and income class groupings to enhance new cultivar adoption.

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ACRONYMS

AHC	Agglomerative Hierarchical Clustering
ANOVA	Analysis of Variance
CATA	Check All That Apply
CIAT	International Center for Tropical Agriculture
CIP	International Potato Center
CIRAD	Internationale en Recherche Agronomique pour le Développement
CRP	CGIAR Research Program
EAHB	East African highlands cooking banana
FAO	Food and Agricultural Organisation
FGDs	Focus Group Discussions
HH	Household
IDIs	Individual Interviews
IITA	International Institute of Tropical Agriculture
JAR	Just About Right
PCA	Principal Component Analysis
RTB	Roots, Tubers and Bananas
SWS	(Alliance) Science Writing Support Service
UBOS	Uganda Bureau of Statistics
UGX	Ugandan shilling

Gendered mapping and consumer testing of steamed matooke in urban areas of Uganda

1 INTRODUCTION

Cooking banana alias matooke (*Musa* species) is a key staple and highly valued food commodity in Uganda, greatly contributing to food, nutrition and income security (Geberewold, 2019; Echodu et al., 2019; FAO, 2017). It is an East-African highland cooking banana (EAHB) that is traditionally peeled, mashed, or boiled or steamed in banana leaves after being harvested between three-quarters to full maturity (Muranga et al., 2007). During this process, the color of the pulp changes from a creamy white to a yellowish color depending on the original maturity of the bunch. It is an important source of daily per capita calorie intake providing 17% of Uganda's daily caloric requirements (Fiedler et al., 2013).

However, its production faces several constraints including pests and diseases, poor access to quality planting materials of suitable and preferred cultivars, drought/weather and poor agronomic management practices by farmers. A combination of these challenges has negatively affected yields and ultimately food availability and income for households (Echodu et al., 2019). Considering the above, technological improvements in the form of agricultural innovations such as the development of improved cultivars have been shown to offer potential solutions for farmers to increase crop productivity (World Bank, 2013). However, farmer uptake of such technological innovations has always been low (Meijer et al., 2015). The low uptake has been partly attributed to limited or lack of integration of social aspects such as gender and consumer preferences in technology innovation development. This is evidenced in a mismatch between some of the quality attributes of the new cultivars and those preferred by the stakeholders (Nasirumbi et al., 2017). Moreover, the few studies that have attempted to understand and link crop attributes with social aspects have largely focused on the rural consumers.

It is against this background that this study was initiated under the CGIAR Research Program (CRP) on Roots, Tubers and Bananas (RTB), Cluster 4.1 (Demand-led approaches to drive post-harvest innovation and nutritious RTB products) to understand the attributes of steamed matooke that are preferred by urban consumers segregated by gender, age and income status. This information will feed into the development of improved cultivars of these crops that are aligned to consumer preferences for widespread adoption. The study therefore sought to evaluate the urban consumers' demand for the quality characteristics of steamed matooke as a precursor for targeted breeding of cultivars with consumers' preferred characteristics. Specifically, the study aimed at:

- 1 Understanding the different ways in which urban populations consume matooke

- 2 Identifying the quality characteristics and descriptors of steamed matooke for urban consumers segregated by gender, age and income status
- 3 Understanding how gender, age and income status influence preferences for and prioritization of steamed matooke characteristics

2 METHODOLOGY

The study was implemented in a phased way over a period of 3 years (2019-2021) and it utilized mixed methods involving qualitative and quantitative approaches to achieve an in-depth understanding of the quality characteristics of steamed banana differentiated by sex, age group and income status. Data was collected from persons who consumed steamed bananas using various methods including Focus Group Discussions (FGDs), individual interviews and household surveys and consumer tests. Data was collected in three phases as follows: phase one in 2019 involving conducting FGDs; phase two in 2020 involving individual interviews and household surveys; and phase three in 2021 involving conducting consumer tests. The phases built on each other with the data from the FGDs informing the development of individual interviews and household survey tools, and sampling for the consumer tests. The results of the individual interviews and household surveys aimed to triangulate with those of the consumer tests. Written informed consent was obtained from all study participants across the phases.

2.1 STUDY SITES

The study was conducted in Kampala and Wakiso districts in Central Uganda (Figure 1). Kampala and Wakiso districts were purposively selected as study sites because of their central location in the country. The central region hosts most processing firms and commercialization activities which are linked to major innovations in the matooke subsector (Kabahenda and Kapiriri, 2010).

Kampala is the capital city of Uganda comprising approximately 25 % of Uganda's urban population, and about 5 % of Uganda's total population (Uganda Bureau of Statistics 2014). Its population increased from 1.2 million in 2002 to slightly over 1.51 million people in 2016 (Sabiiti and Katongole, 2016) representing a growth rate of 2 % per year. Kampala's population was projected to be 3.03 million people in 2020 (Uganda Bureau of Statistics 2006). Like in most cities in developing countries, the population growth in Kampala has made access to food in Kampala a critical issue, since the largest proportion of the population depends on the market for their food (Sabiiti and Katongole, 2016).

Wakiso district on the other hand surrounds Kampala with an estimated population of 2.1 million people and a growth rate of 4.9% per year (UBOS, 2014). Unlike most of the country that is 90% rural, Wakiso is about 30% urban (UBOS, 2001). The main occupation in the district is peasant agriculture and retail (petty) trade in the peri-urban areas.

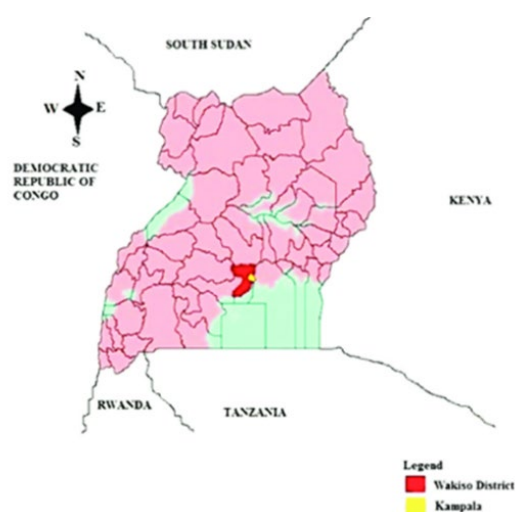


Figure 1: Map of Uganda showing the study districts.

2.2 SAMPLING FRAME

A multi-stage sampling frame was used to select the study sites and participants. In each of the two districts, one urban sub-county and one parish in each sub-county were randomly selected. In each of the selected parishes and in consultation with the local leaders, villages were categorized into low, middle and high income. In each of the districts, two villages per category were included in the study. The criteria used to categorize the income status of the villages were: 1) dominant type of housing; 2) occupation of most households in the community; 3) standard of living and 4) the dominant market (village/ division / supermarket) used by most of the households. The sampling of participating households was based on lists of households provided by the local leaders. Where a randomly selected household was unavailable or declined to participate, they were replaced by another household from the village or income class. The selection of the participants for individual interviews, household surveys and consumer tests followed a stratification by age (youth [<30 years] and adult [> 30 years]) and sex. Systematic sampling was used to select the participants. The FGD participants were purposively selected with the help of local leaders following the sex, age and income status segmentation. This report integrates results from the FGDs and the consumer tests.

2.2.1 FGDS

The FGDs were conducted in November 2019 while the consumer tests were conducted in May 2021. Approximately 200 people participated in the 17 FGDs conducted in separate male, female and mixed groups (male and female) groups (9 female, 4 male, 3 mixed) (Table 1). Each FGD comprised 6-12 people and was conducted by trained facilitators using a semi-structured interview guide.

Table 1: Number of FGDs by sex and age

District	Adult Male	Adult Female	Male youth	Female youth	Mixed group	Total
Kampala	2	4	2	3	3	14
Wakiso	1	1	-	1	-	3
Total	3	5	2	4	3	17

2.2.2 CONSUMER TESTS

A total of 381 consumer tests were conducted including: 187 women and 194 men. There were slightly more consumer participants from Wakiso than Kampala (135). Also, more youths than adults participated (Table 2)

Table 2: Participants of consumer tests by sex, age and income status

District	Sex and Age							Income status			
	Adult Female	Adult Male	Adult Total	Youth Female	Youth Male	Youth Total	Total	High	Middle	Low	Total
Kampala	69	43	112	61	84	145	257	5	127	3	135
Wakiso	25	35	60	32	32	64	124	121		125	246
Grand Total	94	78	172	93	116	209	381	126	127	128	381

2.3 SELECTION AND PREPARATION OF CONSUMER TEST SAMPLES

The consumer tests included four matooke cultivars identified in the FGDs. The cultivars were randomly selected from those **CATEGORIZED** as: 1) overall most-preferred, 2) intermediate and 3) least-preferred cultivars by the FGD respondents. Two cultivars were selected from the most-preferred category, one cultivar from the intermediate and one from the least-preferred. The samples included in the consumer tests were Kibuzi and Nakitembe cultivars under the most-preferred category, Mpologoma cultivar in the category of intermediate preference and Ntika in the category least-preferred cultivars. Preparation involved steaming of the cultivars and it was guided by **STANDARDIZED** protocols previously developed under the RTB foods project.

2.3.1 CONSUMER TEST METHOD

Consumer testing followed a method adapted from Fliedel et al., 2018 and Forsythe et al., (2021). The method consists of three steps namely, a hedonic test for overall liking, a Just-About-Right (JAR) test, and Check-All-That-Apply (CATA) test. Initially, the consumers (n = 381) individually assessed the overall liking of each steamed matooke sample based on a combination of appearance, texture, smell and taste, using a nine-point hedonic scale (from 1 = “dislike extremely”, to 9 = “like extremely”). This was followed by consumers evaluating the intensity of five specific attributes (mouth feel, softness, color, matooke taste and smell) using a 5-point scale JAR “Just About Right” scale (1 = “Much too low”, Much too weak, Much less; 2 = Slightly low, slightly weak, slightly less 3= “Just About Right”; 4 = “Slightly too high, slightly too strong, slightly too much”; 5 = Much too high, much too strong, much too much). Finally, consumers selected from a list of 24 liked and disliked sensory descriptors using a “Check-All-That-Apply” (CATA) approach. consumers then gave an overall opinion after evaluating the steamed matooke samples. A semi-structured questionnaire was administered for the consumer testing activity constituting demographic information, consumption habits, overall liking, JAR test, CATA test and consumer preferences.

2.4 DATA ANALYSIS

For the consumer tests, overall liking data of steamed matooke was analyzed using Analysis of Variance (one-way ANOVA). Means were separated by Multiple pairwise comparisons ($p \leq 0.05$). Agglomerative Hierarchical Clustering (AHC) analysis was used to segregate consumers into similar groups of overall liking. Chi-square test was used to establish the relationships between the different socio-demographic categories and the different consumer clusters (JMP Pro software at $p < 0.05$). Pivot analysis was used to determine the percentage of consumers who assessed the five specific sensory attributes for each steamed matooke sample as being either ‘Much too weak’, ‘Slightly weak ‘Just about Right’ (JAR), ‘Slightly too strong’ or ‘Much too strong’. A Principal Component Analysis (PCA) was conducted on the number of citations for all the CATA quality characteristics. All data was disaggregated and analyzed by respondent gender, respondent category (adult or youth), sex of HH head and income status. All statistical analyses were performed using XLSTAT 2014 software (Addinsoft).

For FGD data, open coding in Excel was done to generate common categories. Content analysis was then undertaken to interpret the emergent issues and extract related information on the major themes of the study.

3 RESULTS

3.1 DEMOGRAPHIC INFORMATION OF THE STUDY PARTICIPANTS

The participants for the consumer tests were mostly from Kampala district (67%), were adults (74%) and included slightly more males (51%). 70% were from male-headed households and 54% of them were the household heads. Various ethnic groups were included, the dominant being the Baganda (54%). This was somewhat expected because the study was conducted in the central districts of Kampala and Wakiso which are at the heart of Buganda region. The participants were from diverse age groups ranging from 18 to over 51 years and most were below 30 years (55%). Most had attained lower secondary education and were full time employees earning a wage. Both married and single persons were included though the married were slightly more and most of them belonged to the Anglican faith (32%).

The FGD participants were also mostly from Kampala and were aged between 17 and 60. Unlike the consumer tests, the majority of the FGD participants were youth with 40% being students. Like the consumer test participants, the majority were male and the average number of years they had spent in school were 12 years, which is equivalent to post-primary in the Uganda education system. Like the consumer tests, the dominant (73%) ethnic group of the FGD participants was Baganda. The characteristics of the consumer test participants are summarized in Table 3.

Table 3: Demographic categories of consumer participants

Demographic Category	Sub-category	% of consumers (n=381)
District	Kampala	33
	Wakiso	67
Sex of respondent	Female	49
	Male	51
Category (Adult/Youth)	Adult	45
	Youth	55
HH Head Sex	Female	30
	Male	70
Ethnic Group	Itesot	4
	Langi	3
	Lugbara	2
	Baganda	54
	Bagisu	3
	Bakiga	2
	Banyankole	23
	Banyoro	3
	Basoga	4
	Batooro	1
Rwandan	2	
Age Group	≤30	55

Demographic Category	Sub-category	% of consumers (n=381)
	31-50	38
	≥51	7
Education level (Average years of school)	Lower secondary (8 - 11 years)	34
	None (0)	2
	Primary (1 - 7 years)	17
	Tertiary (≥14 years)	24
	Upper secondary (12 -13 years)	23
Occupation	Farmer	6
	Full Time wage employed	36
	Part time wage employed	19
	Self-employed	21
	Student	12
	Unemployed	7
Marital status	Divorced	2
	Married	46
	Single	50
	Widowed	3
Income status	High income	33
	Middle income	33
	Low income	34
Religion	Catholic	25
	Islam	17
	Pentecostal	23
	Protestant	32
	Seventh day Adventist	4
Relationship to HH Head	Brother/sister	3
	Daughter	9
	Head	54
	Son	12
	Spouse	22

3.2 CONSUMPTION HABITS

The FGDs explored the most-consumed foods in the study sites and matooke featured among the top three across the across the sex, age and income groups. The other foods included maize bread (*posho*) and rice. By income segment *posho* was the most consumed among the middle-income men while matooke was for the women. The high-income women also reported consuming matooke most. The male and female youth on the other hand identified matooke as their second most-consumed food, the first being rice. The reasons for consuming the foods as demonstrated in the quotes below included 1) the costs associated with the purchase and preparation of food; 2) the social cultural aspects including taste; 3) the health and nutrition benefits; and 4) availability and accessibility of the food types. Table 4 summarizes the reasons for consuming the food types.

“It is affordable and can be sold for as low as UGX 500 /= depending on the number of fingers one is buying,” (Low Income Adult Male FGD).

“It is important for the Baganda as a traditional food. A woman is perceived to be well groomed for marriage based on how well she can prepare a meal of matooke,” (Male Youth FGD).

Table 4: Reasons for food type consumption by age category

Product	Attribute	Reasons for Consumption			
		Male adults	Female adults	Female youth	Male youth
Matooke	Health and nutrition			-It's nutritious	
	Cost effective	Cheap		-cheap	
	Socio-cultural	Traditionally the main food	Traditionally important	Traditionally important	Traditional food
	Taste			Tasty	Tasty
	Others	Readily available	-Can be prepared in a cultivar of ways e.g., “katogo”. -Served with a cultivar of sauces like greens etc. -Brings satisfaction	-Served to children. - Served with cultivar of sauce - Several ways to prepare it - Easy to cook	-Accessible. -Easy to cook. - Sign of good upbringing for a woman
Rice	Cost-effective	Cheap to prepare	Cheap to buy and prepare		Cheap to buy.
	Taste		-Tasty	-Tasty	
	Others	-Expands during preparation providing enough food for the entire family	-It's easy for children to swallow -Best food for children -Has less work -Doesn't require skill to prepare like <i>matooke</i> - Can be eaten without sauce	-Easy to cook	-Easy to prepare. -Cooks fast -Can be eaten without sauce. -Has long shelf life -Can be eaten at any time -Cannot tire eating it daily
Posho	Health and nutrition	-Energy giving -Good for people with ulcers	-It satisfies people -Source of carbohydrates -Energy giving		-Source of energy. -Source of protein
	Cost effective	Cheap to buy	-Cheap to buy -Saves on fuel during preparation		-Cheap to buy.
	Socio-cultural		Grew up eating it		Eaten by young men & women in every community
	Others	-Easy to prepare.	-Fast cooking -Easy to prepare -It keeps somebody warm after eating”		-Easier to cook than matooke. - Long shelf life.

Product	Attribute	Reasons for Consumption			
		Male adults	Female adults	Female youth	Male youth
	Others		-Dessert. -Can be given to children as a snack with just tea or water. -Readily available when other foods are out of season.		

To build on the FGD results, the consumer tests explored the habits and forms in which matooke is consumed. The results are summarized in Table 5. They showed that Matooke is consumed several times a week (54%) with about 41% of the participants consuming it daily. Those consuming several times a week were mostly low income and male youths. Matooke was consumed in different forms including steamed -mashed (97%), katogo (92%), boiled -mashed (32%, boiled unpeeled fingers/empogola (21%) and roasted (20%). The steamed-mashed was reported to be the most frequently consumed form by 83% of the participants. Of these, the middle income and male youths had a slightly higher percentage. The katogo form was largely consumed for breakfast (more for high income and male youths); the roasted form as a snack between meals (more for low income and adult males); the boiled-unpeeled fingers /empogola for dinner, especially the high-income and adult females; while the mashed forms were consumed for lunch (middle income and female youths for boiled-mashed; and middle-income and male youths for steamed-mashed.

Table 5: Consumption form and habits of matooke by sex, age and income status

Category	Response	% Total	Sex & Age category				Income status		
			Adult Female	Adult Male	Youth Female	Youth Male	High	Middle	Low
Do you consume this form?									
Roasted	No	80	22	14	22	22	26	28	26
	Yes	20	3	6	2	9	7	6	7
Katogo	No	8	2	2	2	2	3	3	2
	Yes	92	22	19	23	28	30	30	32
Boiled-mashed	No	68	18	13	17	19	20	25	23
	Yes	32	7	7	7	11	13	9	11
Steamed-mashed	No	3	0	1	1	1	1	1	1
	Yes	97	24	20	24	29	32	33	32
Boiled-unpeeled (Empogola)	No	79	20	16	22	21	25	28	26
	Yes	21	4	5	3	9	8	5	8
Most frequently consumed form									
Roasted	No	100	25	20	24	30	33	33	34
	Yes	0	0	0	0	0	0	0	0
Katogo	No	77	20	20	16	21	24	27	26
	Yes	23	4	5	5	9	9	6	8
Boiled-mashed	No	92	23	18	22	28	30	31	31

Category	Response	% Total	Sex & Age category				Income status		
			Adult Female	Adult Male	Youth Female	Youth Male	High	Middle	Low
	Yes	8	2	2	2	2	3	3	2
Steamed-mashed	No	17	3	4	3	7	7	3	6
	Yes	83	22	17	21	24	26	30	28
Boiled-unpeeled fingers (empogola)	No	99	24	20	24	30	32	33	33
	Yes	1	1	0	0	0	1	0	0
Time of consumption									
Katogo	Breakfast	53	10	11	13	18	22	16	15
	Dinner	11	2	5	1	3	3	1	7
	Lunch	36	7	6	6	18	14	9	13
Boiled-mashed	Breakfast	16	0	6	0	9	3	0	13
	Dinner	9	3	3	3	0	9	0	0
	Lunch	75	19	16	22	19	25	34	16
Steamed-mashed	Breakfast	0	0	0	0	0	0	0	0
	Dinner	19	6	5	4	4	6	7	5
	Lunch	81	19	15	21	25	24	29	28
Boiled-unpeeled (Empogola)	Dinner	75	50	25	0	0	75	0	0
	Lunch	25	0	0	0	25	0	0	25
Roasted	In between meals	100	0	100	0	0	0	0	100
Frequency of consumption of steamed-mashed matooke	Every day	41	12	9	10	10	14	14	13
	Once a week	3	0	1	1	1	1	1	1
	Several times a month	2	0	0	0	2	0	1	1
	Several times a week	54	12	10	14	18	17	17	20

With a focus on the steamed matooke form/ product, the consumer-test participants were asked to evaluate the four samples in terms of similarity to what they usually eat and to indicate the most liked and disliked sample at the end of the consumer test interview (Table 6). Steamed matooke from the Kibuzi cultivar sample was identified by most of the respondents as being closest to what they usually consumed as indicated more by the high income and females (adults and youth). On the contrary, the middle income and male youth consumers indicated that Mpologoma looked more like what they consumed. In addition, Kibuzi was also the most liked by the high income and male youths. The middle-income consumers favored Mpologoma for the most liked. The Ntika cultivar on the other hand produced the most disliked steamed Matooke as indicated mostly by the middle income and male youths.

Table 6: Consumers' perception of steamed matooke samples

Category	Sample	% Total	Gender				Income status		
			Adult Female	Adult Male	Youth Female	Youth Male	High	Middle	Low
Which matooke looks like the one you usually eat	Mpologoma	28	6	4	8	10	5	17	6
	Ntika	13	6	2	3	3	3	5	6
	Nakitembe	22	3	7	3	9	9	6	7
	Kibuzi	37	10	7	10	9	16	6	15
Most disliked steamed matooke	Mpologoma	22	6	6	4	5	9	3	9
	Ntika	43	8	8	9	16	13	16	13
	Nakitembe	26	8	3	9	6	9	7	9
	Kibuzi	10	2	2	2	3	1	7	2
Most liked steamed matooke	Mpologoma	24	5	3	8	8	3	15	6
	Ntika	13	5	2	3	3	2	4	7
	Nakitembe	20	3	7	3	8	9	6	5
	Kibuzi	42	12	9	10	11	19	8	16

These results corroborate those of the FGDs in which the Kibuzi cultivar was among the cultivars identified as most suitable for making steamed matooke by both male and female participants. The other identified cultivars included Nakitembe and Mpologoma, Musakala, Mbwarzirume, Nakabululu and Kisansa. Men and women FGDs in the low-income category converged in selection of Kibuzi as the most suitable cultivar but diverged on the second and third most-preferred. Female and male youth diverged in their selection with the former prioritizing Kisansa and Mpologoma; while the latter selected Nakitembe and Musakala. The FGDs also revealed the traits of importance before and during preparation of steamed matooke as demonstrated in the quotes below and summarized in Table 7.

“The mature banana with little sap saves time. You don’t have to wash your hands after peeling because the sap does not stick. The food also cooks fast, is soft and easy to mash. When the food is ready, it looks very nice and as a woman it gives you pride and a sense of accomplishment when you serve your husband,” (High income Female FGD)

“Dark green mature peel color and large fingered matooke takes less time to peel and it is easy to mash. It is also safer to peel because chances of cutting yourself while peeling are minimal. If fingers are small, you lose a lot of flesh when peeling,” (Male Youth FGD)

Table 7: Traits of importance in preparation of steamed matooke

Before preparation	During preparation
Big and long fingers	Soft to peel/ Easy to peel
Finger feels heavy	Little sap on peeling
Dark green peel color	Soft finger flesh
Peel feels soft	Deep cream finger flesh
	Lacks hard middle 'thing' which makes matooke difficult to mash
	Cooks quickly

3.3 MEAN OVERALL LIKING OF THE SAMPLES

The participants of the consumer tests individually assessed the overall liking of the four steamed matooke samples based on a combination of appearance, texture, smell and taste, using a nine-point hedonic scale (from 1 = “dislike extremely”, to 9 = “like extremely”). Results showed that the samples were liked to varying degrees with three significantly different groups of overall liking emerging ($P < 0.05$, one-way ANOVA) (Table 8). The Kibuzi sample was the most liked with an overall liking of 7.2 (‘like moderately’). A second group consisted of product samples from Mpologoma and Nakitembe (both 6.5) lying between ‘like slightly’ and ‘like moderately’. Lastly, the sample from the Ntika cultivar was close to ‘like slightly’ (5.9).

Table 8: General mean overall liking scores for the steamed matooke samples

Sample	Mean overall liking*
Kibuzi	7.2 ^a
Mpologoma	6.5 ^b
Nakitembe	6.5 ^b
Ntika	5.9 ^c

*Overall liking was rated on a nine-point scale from 1 = dislike extremely, to 9 = like extremely.

**Different letter denotes significant difference between means. Tukey test ($p < 0.05$).

3.3.1 MEAN OVERALL LIKING BY INCOME STATUS

Table 9 presents the overall liking of the samples by income status. All the income categories liked the samples in the range of 5.7 (like slightly) – 7.6 (like very much) however, the overall liking varied across and within the groups. Results for the high-income consumers revealed three significantly different groups ($p < 0.05$) with the Kibuzi sample emerging as the most liked, followed by the Nakitembe sample which was liked moderately while Mpologoma and Ntika cultivar samples were grouped together under the like slightly category. The middle-income consumers' results generated four groups. The Mpologoma sample was the most liked rated close to the region of ‘like very much’. They liked the Kibuzi sample ‘moderately’ and it was intermediate between Mpologoma and Nakitembe samples which they ‘liked slightly’. The Ntika sample was their least liked albeit close to ‘like slightly’ and it was significantly different from the rest. For the low income, like the high-income consumers, the Kibuzi sample was their most liked but they only ‘liked it moderately’. The other samples were grouped together and ‘liked slightly’ thus only two groups emerged for the low-income consumers.

Table 9: Mean overall liking scores by income status

Sample	High Income	Middle Income	Low Income
Mpologoma	5.9 ^{ef}	7.5 ^{ab}	6.1 ^{def}
Ntika	5.7 ^f	5.7 ^f	6.2 ^{def}
Nakitembe	6.7 ^{bcd}	6.5 ^{cde}	6.2 ^{def}
Kibuzi	7.6 ^a	6.9 ^{abcd}	7.1 ^{abc}

*Overall liking was rated on a nine-point scale from 1 = dislike extremely, to 9 = like extremely.

**Different letter denotes significant difference between means. Tukey test ($P < 0.05$).

3.3.2 MEAN OVERALL LIKING BY SEX AND AGE

Mean overall liking was further disaggregated by sex and age (Table 10) and the scores ranged from 6.2 to 7.5. In general, all the samples were liked but Kibuzi was the most liked. Notwithstanding, there were some differences. For the adult females, Kibuzi was close to 'like very much' and significantly different ($p < 0.05$) from Ntika and Nakitembe which were liked slightly. Mpologoma was intermediate with moderate liking. Adult males liking of Kibuzi (like moderately) was significantly different from Ntika (like slightly). For Nakitembe and Mpologoma their liking was intermediate between the two. The female youth their liking of Kibuzi and Mpologoma (like moderately) was significantly different from the least liked Ntika. The male youth rated Kibuzi and Nakitembe (like moderately) more than Ntika (like slightly). This difference was significant. Mpologoma was intermediate between these two groups albeit in the 'like slightly' category.

Table 10: Mean overall liking scores by sex and age

Income status/steamed matooke sample	Female Adults	Male Adult	Female Youth	Male Youth
Mpologoma	6.6 ^{abc}	6.4 ^{bcd}	6.8 ^{abc}	6.2 ^{cd}
Ntika	6.3 ^{bcd}	6.0 ^{cd}	5.6 ^d	5.6 ^d
Nakitembe	6.2 ^{cd}	6.9 ^{abc}	6.1 ^{cd}	6.7 ^{abc}
Kibuzi	7.5 ^a	7.3 ^{ab}	7.3 ^{ab}	6.8 ^{abc}

*Overall liking was rated on a nine-point scale from 1 = dislike extremely, to 9 = like extremely.

**Different letter denotes significant difference between means. Tukey test ($P < 0.05$).

3.3.3 OVERALL LIKING BY SEX OF THE HOUSEHOLD HEAD

Like the other social groupings, an analysis of the mean overall liking based on household headship (Table 11) generated three significantly different groups. For the female-headed households, Kibuzi (7.4) and was most liked ('like moderately') with linking that was significantly different from Nakitembe and Ntika (both 6.1) which were only 'liked slightly'. Mpologoma was intermediate between these groups albeit being closer to the 'like moderately' category. Similarly, Kibuzi (7.1) was the most liked (like moderately) among the male-headed households. This was followed by an intermediate group of Nakitembe (6.6) and Mpologoma (6.3) spanning 'like slightly' and 'like moderately'. Ntika (5.8) was least liked albeit close to 'like slightly'.

Table 11: Mean overall liking by household headship

Income status/steamed matooke sample	Female-headed HH	Male-headed HH
Mpologoma	6.9 ^{abc}	6.3 ^c
Ntika	6.1 ^{cd}	5.8 ^d
Nakitembe	6.1 ^{cd}	6.6 ^{bc}
Kibuzi	7.4 ^a	7.1 ^{ab}

*Overall liking was rated on a nine-point scale from 1 = dislike extremely, to 9 = like extremely.

**Different letter denotes significant difference between means. Tukey test ($P < 0.05$).

3.3.4 SEGMENTATION OF CONSUMERS INTO GROUPS OF SIMILAR OVERALL LIKING

The Agglomerative Hierarchical Cluster analysis of mean overall liking scores produced three clusters namely, All likers (49%), Ntika dislikers (31%) and those who neither liked nor disliked Mpologoma (46%) (Figure 2 and Figure 3). Among the samples, Kibuzi (mean overall liking score 6.8 – 7.9) and Nakitembe (5.8 – 7.2) were liked by consumers (like slightly to like very much) in all three clusters. These were described as having desirable characteristics including: Nice aroma; Moldable; Soft; Attractive; Good taste; Yellow; and Homogeneous (one color) especially among the adult males. Mean overall liking in Ntika dislikers cluster was 3 (dislike moderately) and the dislike was linked to undesirable characteristics such as Not attractive, Whitish cream, Odorless, White color, Tasteless, Firm, Dry and Hard. Some consumers were undecided on whether they liked or disliked Mpologoma (23%). The ambiguity surrounding Mpologoma could be because of its' mixed appreciation by consumers. For example, the middle-income consumers indicated that it was preferred because it was Attractive, Yellow, Soft, Homogeneous (one color), Good taste, Nice aroma, Sticky, Moldable while the high-income category indicated that it was undesirable linking it with characteristics such as; Dry, Not attractive, Firm, Tasteless, Odorless, Whitish cream, Sticky and White color. Interestingly, according to the low-income consumers, Mpologoma was not strongly associated with either of the positive or negative sensory characteristics.

Figure 2: Clustering of the urban consumers based on their overall liking scores of the steamed matooke

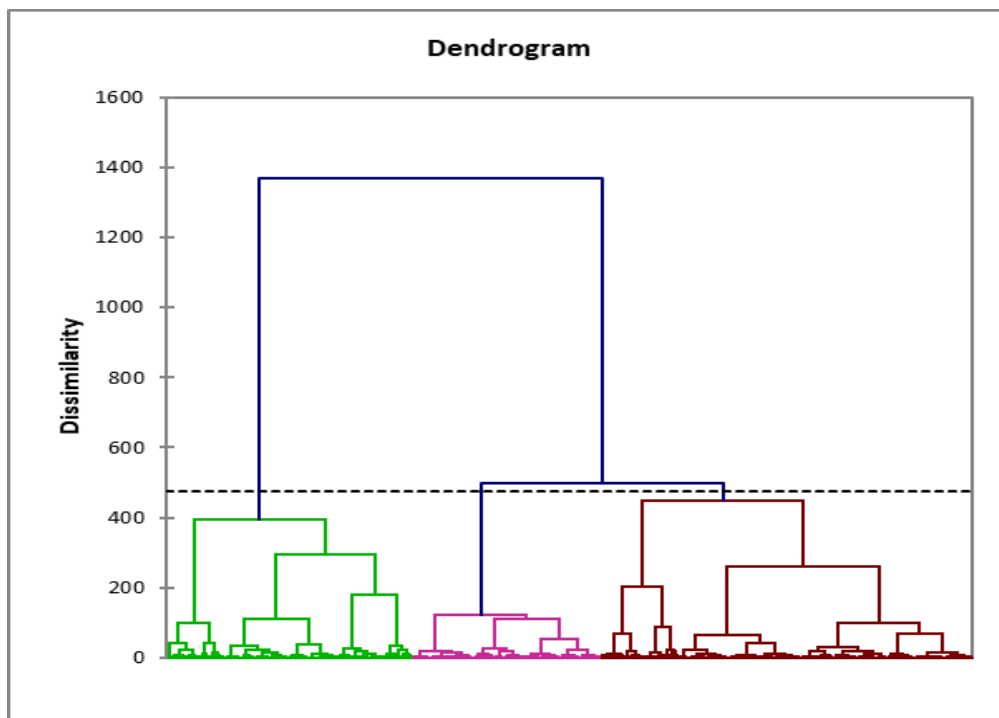
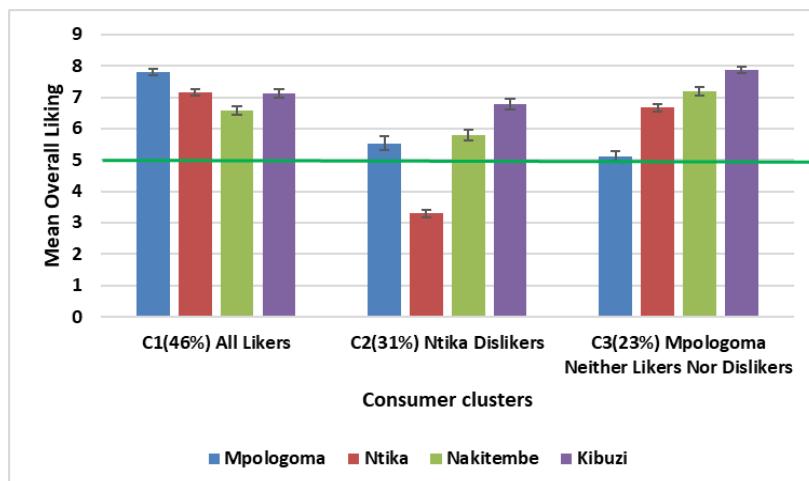


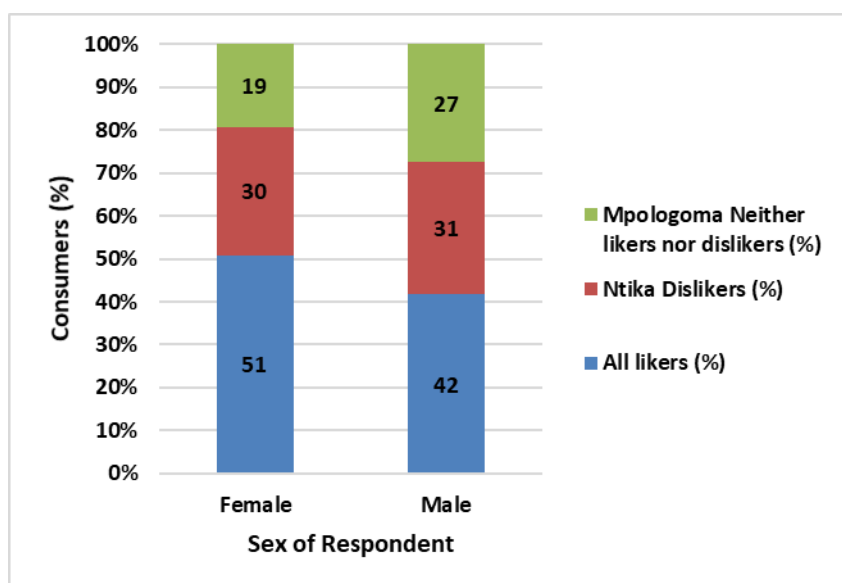
Figure 3: Mean overall liking of the steamed matooke by urban consumer cluster type (%) (error bars represent the standard error)



3.3.5 DEMOGRAPHIC DATA OF THE CONSUMERS INTERVIEWED – BY CLUSTER

Socio-demographic cluster distribution of steamed matooke consumers is shown in Table 12. Regarding the districts, consumers in Kampala were mostly 'All likers' (54%) while those in Wakiso were shared between 'Ntika dislikers' and 'Mpologoma neither likers nor dislikers' (both 35%). These differences in overall liking by consumers in the two districts were significant ($p < 0.05$, chi square). Both male and female respondents were mostly 'All likers' at 42% and 51% respectively (Figure 4). Similarly, both the youth (44%) and adult consumers (47%) were mainly 'All likers'. Regarding household heads, the consumers from female-headed households had more 'All likers' (57%) than their male counterparts (41%). The male-headed households had more consumers amongst both Ntika dislikers (32%) and Mpologoma neither likers nor dislikers (27%). These differences were significant.

Figure 4: Percentage of urban consumer cluster type by sex of respondent



The leading ethnic groups were mostly 'All likers' with the Baganda (53%) having more than the Banyankole (37%). In addition, the Banyankole had slightly more consumers among the 'Ntika dislikers' and 'Mpologoma

neither likers nor dislikers' however, these differences were not significant. All the different age groups were mostly 'All likers. The 18–25-year-olds had slightly more Ntika dislikers (37%) while the 36-45 age group had more Mpologoma neither likers nor dislikers (32%) than the others. Nonetheless, these were not significantly different. For education level, consumers with primary level education had slightly more All likers (56%) while those with no formal education led in terms of disliking Ntika (50%). Consumers with tertiary education had slightly more consumers the Mpologoma neither likers nor dislikers cluster (30%). These too were not significantly different.

Consumers in all occupation categories were mainly All likers. The consumers with fulltime wage employment had slightly more consumers who neither liked nor disliked steamed matooke from Mpologoma (32%). All differences in this category were not significant. The married (47%) and single consumers (43%) were mostly All likers. However, the singles with dislike for Ntika (34%) were slightly more than the marrieds who in turn had more among the Mpologoma neither likers nor dislikers cluster (25%). None of these differences were significant. Differences among the income classes were significant. The middle-income consumers had the most All likers (61%) while the high income had more Mpologoma neither likers nor dislikers cluster (36%) and Ntika dislikers (34%). All the religious groups were mostly All likers and the differences were significant.

Table 12: Demographic differences of consumers with respect to clusters

Demographic Categories	Sub-category	All likers (46%)	Ntika Dislikers (31%)	Mpologoma Neither likers nor dislikers (23%)	Chi-square test (p<0.05)
Consumers		46	30	23	
District	Kampala	54	28	18	< 0.0001
	Wakiso	30	35	35	
Sex of respondent	Female	51	30	19	0.11
	Male	42	31	27	
Respondent Category	Adult	47	29	24	0.72
	Youth	44	34	22	
HH Head Sex	Female	57	28	15	0.01
	Male	41	32	27	
Ethnicity	Itesot	20	60	20	0.54
	Langi	30	40	30	
	Lugbara	33	33	33	
	Muganda	53	27	20	
	Mugisu	50	20	30	
	Mukiga	50	13	38	
	Munyankole	37	32	32	
	Munyoro	33	33	33	
	Musoga	50	29	21	
	Mutooro	50	25	25	
Rwandan	57	29	14		
Age Group	18-25	43	37	20	0.22

Demographic Categories	Sub-category	All likers (46%)	Ntika Dislikers (31%)	Mpologoma Neither likers nor dislikers (23%)	Chi-square test (p<0.05)
	26-35	46	29	25	
	36-45	43	25	32	
	46-55	59	27	15	
	>56	60	10	30	
Education level	Lower secondary	50	31	19	0.26
	None	38	50	13	
	Primary	56	29	16	
	Tertiary	42	28	30	
	Upper secondary	40	31	29	
Occupation	Farmer	47	37	16	0.07
	Fulltime wage employed	41	27	32	
	Part time wage employed	38	30	32	
	Self-employed	46	34	20	
	Student	43	41	16	
	Unemployed	67	14	19	
Marital status	Divorced	86	0	14	0.13
	Married	47	27	25	
	Single	43	34	23	
	Widowed	60	40	0	
Income status	High income	30	34	36	< 0.0001
	Middle income	61	26	13	
	Low income	47	31	22	
Religion	Catholic	41	32	27	0.59
	Islam	43	38	19	
	Pentecostal	53	28	19	
	Protestant	48	28	24	
	Seventh day Adventist	43	21	36	

3.4 A JUST ABOUT RIGHT TEST (JAR)

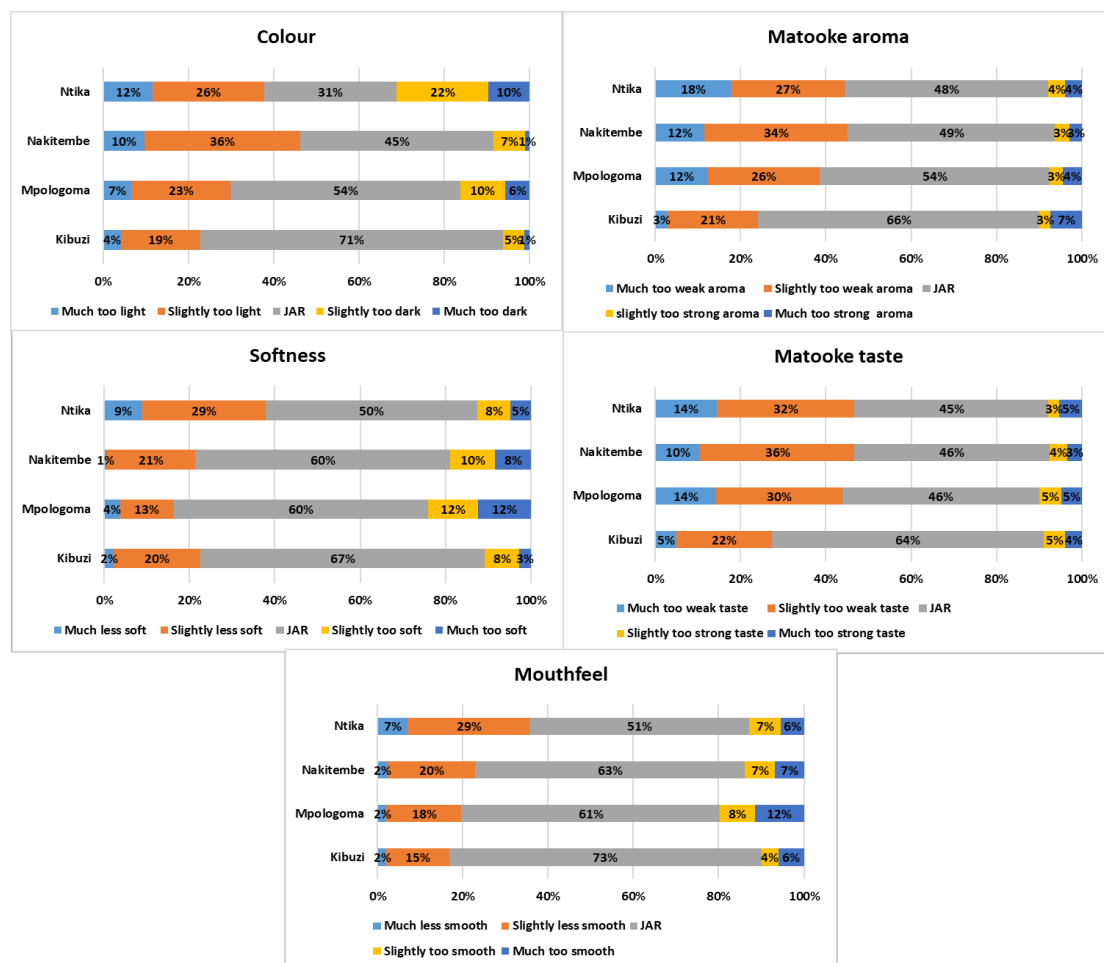
A just about right (JAR) scale was used to determine the perceptions of urban consumers regarding the five important sensory quality attributes namely, color, matooke taste, softness, matooke aroma and mouthfeel.

3.4.1 JAR – OVERALL

As shown in Figure 5, all the four steamed matooke were rated JAR 'Just about right' about softness and mouthfeel by more than 50% of the consumers. Only Mpologoma and Kibuzi were rated JAR for color (54 and

71%) and matooke aroma (54 and 66%) by more than 50% of the consumers. In terms of matooke taste, only Kibuzi (64%) was rated JAR by more than 50% of the consumers. Ntika was least appreciated for color (31% JAR), matooke aroma (48% JAR) and matooke taste (45% JAR).

Figure 5: Percentage of urban consumers who scored the five specific quality characteristics using a 5-point JAR test – general



3.4.2 JAR – INCOME STATUS

The JAR test was also disaggregated by income status as shown in Figure 6. Kibuzi steamed matooke was rated JAR for color by more than 65% of all income classes. Nakitembe and Mpologoma were rated JAR for color only by middle income consumers (56% and 77% respectively). All income classes perceived Ntika as not being JAR with only 29 – 35% of the consumers rating it JAR.

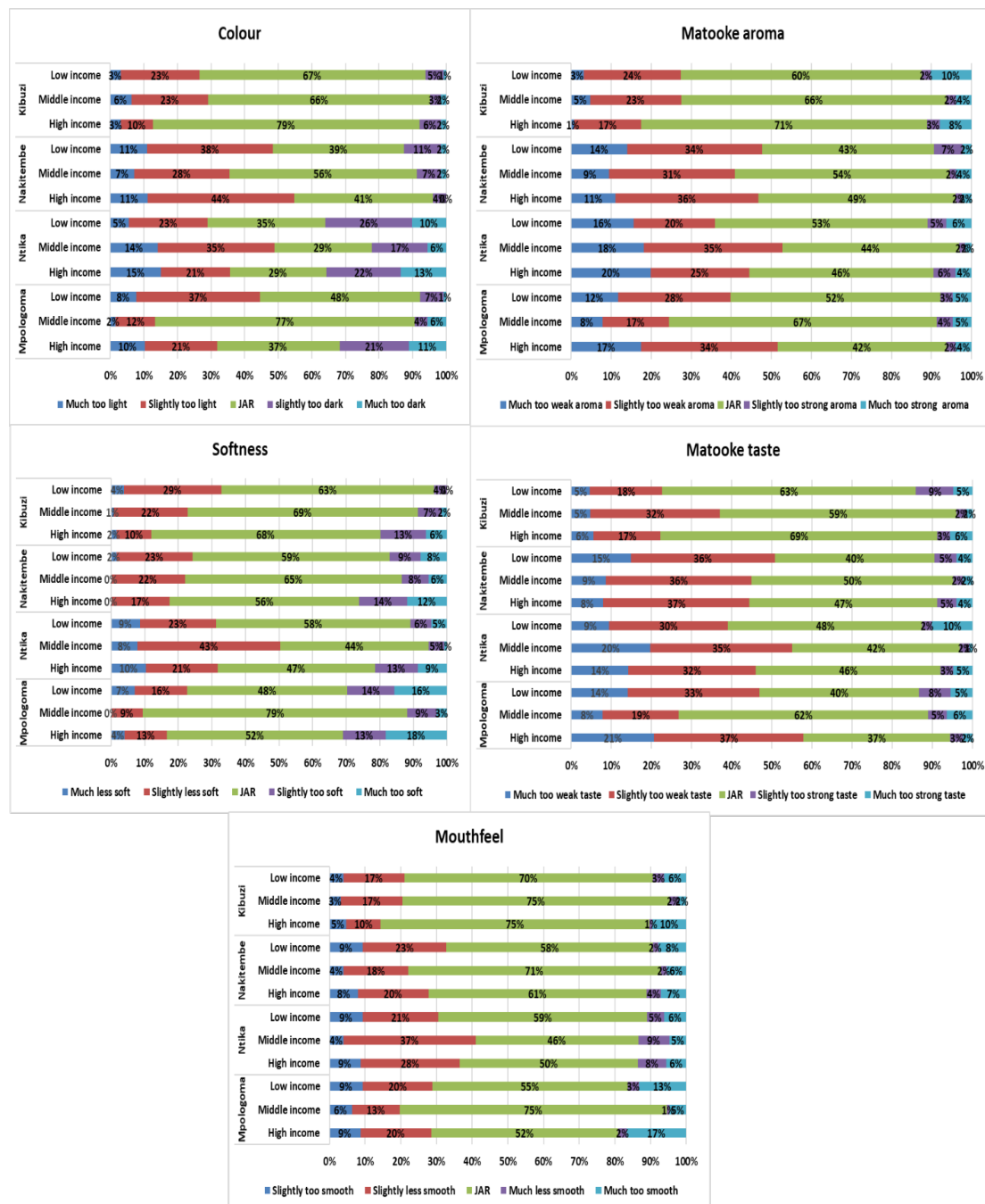
The aroma from Kibuzi was scored JAR by at least 60% of consumers in all income classes. Only middle-income consumers (54%) felt Nakitembe was JAR for matooke aroma. Ntika was rated JAR for aroma only by low-income consumers (53%). Both low (52%) and middle-income consumers (67%) scored Mpologoma as JAR for aroma.

The softness of Kibuzi and Nakitembe was well appreciated by consumers of all income classes as more than 60% of them scored it JAR for the attribute. For Ntika, only the low-income consumers felt its softness was JAR (58%). Mpologoma's softness was JAR according to middle (79%) and high-income consumers (52%).

Steamed matooke of Kibuzi was rated JAR for its matooke taste by more than 50% of consumers from all the income classes. Nakitembe and Mpologoma were only JAR for the middle-income consumers (50 and 62% respectively). Less than 50% of consumers of all income classes felt that Ntika was JAR for matooke taste.

Steamed matooke of Kibuzi’s mouthfeel was well appreciated as JAR by at least 70% of consumers in all income classes. Mouthfeel of Nakitembe and Mpologoma was also rated JAR by more than 50% of consumers from all income classes. Ntika was JAR for mouthfeel according to low (59%) and high-income consumers (50%).

Figure 6: Percentage of urban consumers who scored the five specific quality characteristics using a 5-point JAR test - income status



3.4.3 JAR – GENDER (SEX AND AGE)

Disaggregation of respondents by sex under the JAR test is shown in Figure 7. More than 50% of consumers in all gender categories rated Kibuzi steamed matooke JAR for color. Nakitembe was scored JAR by more than 50% of only youth and adult males. Adult females (54%) and female youth (45%) indicated that it was slightly too light. Less than 50% of consumers of all gender categories rated Ntika JAR for color. Mpologoma was rated JAR by more than 50% of the gender categories except the male youths (49%).

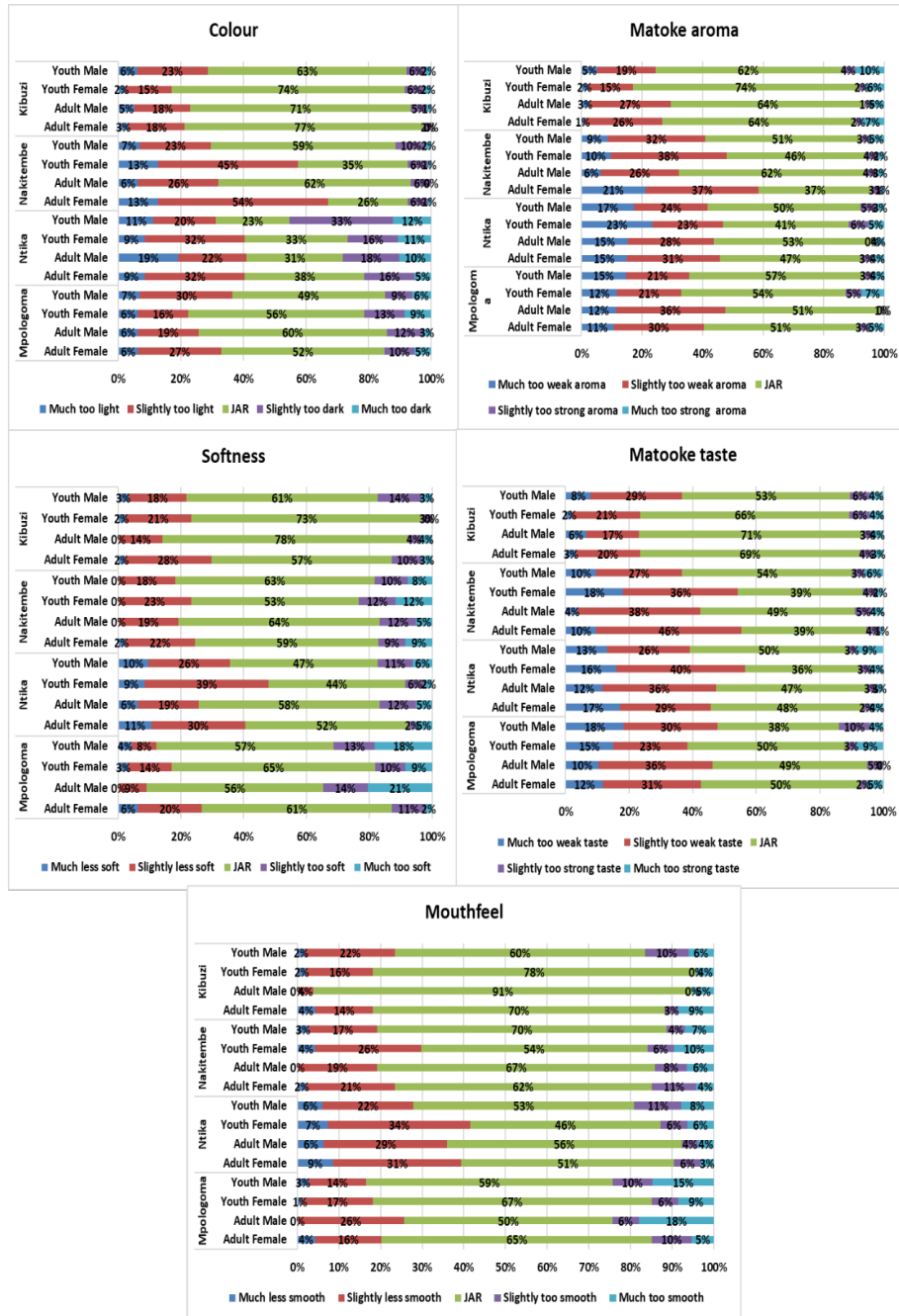
Regarding matooke aroma, more than 50% of all gender categories rated Kibuzi steamed matooke JAR. More than 50% of the male adults and youths also rated Nakitembe JAR for matooke aroma. However, this was different for the female adults and youth where less than 50% of consumers rated it JAR. Several of them indicated that the matooke aroma was slightly weak. Similarly, at least 50% of the males rated Ntika JAR for aroma while for the females, it was less than 50%. More than 50% of all categories rated Mpologoma JAR for aroma.

The softness of Kibuzi, Nakitembe and Mpologoma steamed matooke was rated JAR by more than 50% of consumers in all categories. Ntika was the exception where adults and youth differed. More than 50% of the adult male and females indicated that it was JAR while the male and female youth felt otherwise with less than 50% of them give it a JAR rating.

Similar to color, aroma and softness, Kibuzi steamed matooke was scored JAR by more than 50% of consumers in all the gender categories. Matooke's taste for Nakitembe and Ntika was not JAR according to female youths, adult males and females. The exception was the male youth for which at least 50% of them rated them JAR for taste. Mpologoma was rated JAR for taste by youth and adult females while the adult and male youths did not rate it JAR.

Mouthfeel was judged JAR according to more than 50% of consumers in all gender categories for steamed matooke of Kibuzi, Nakitembe and Mpologoma. The only exception was Ntika where female youth did not rate it JAR for mouthfeel (46%).

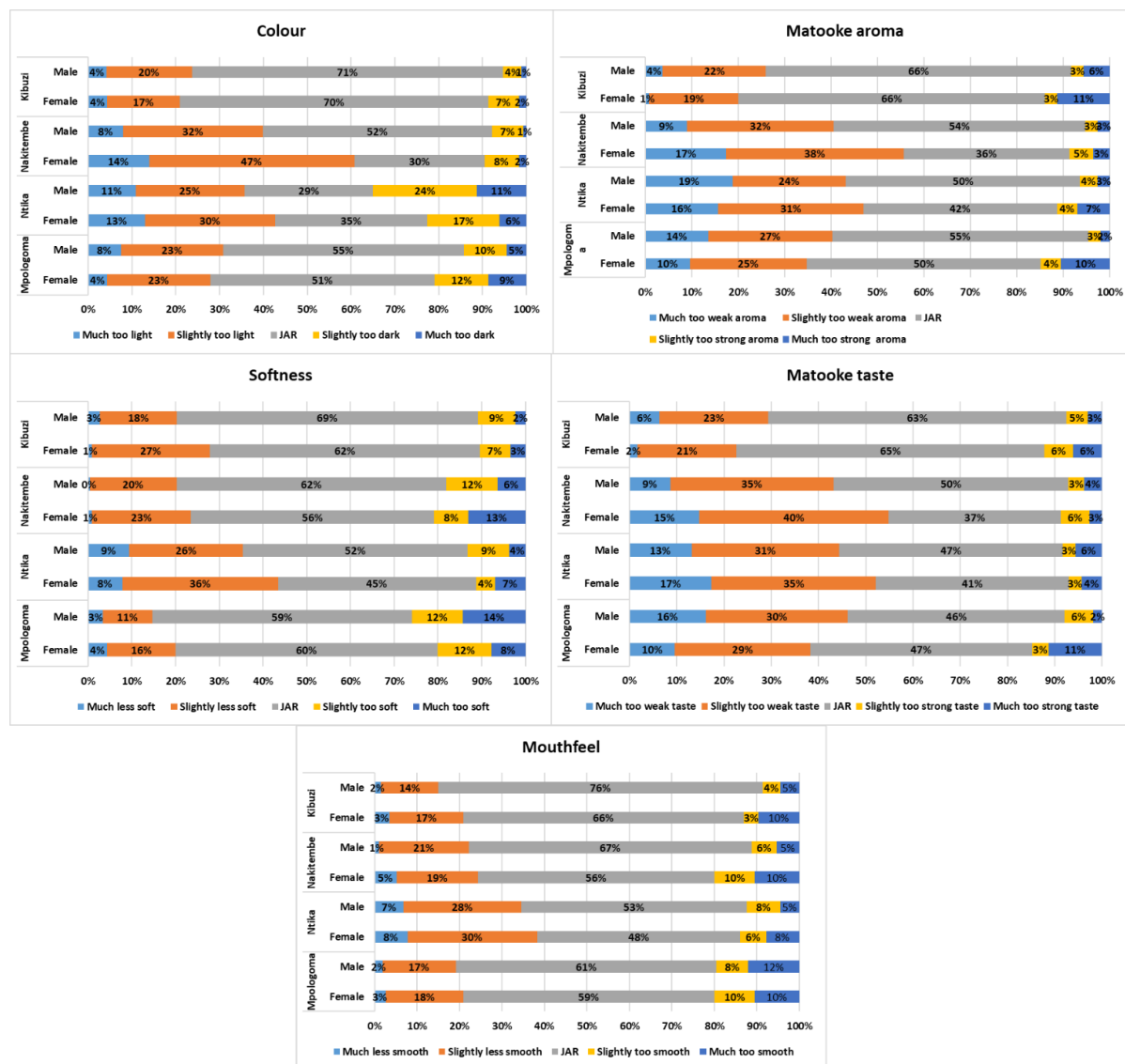
Figure 7: Percentage of urban consumers who scored the five specific quality characteristics using a 5-point JAR test - sex and age



3.4.4 JAR – HOUSEHOLD HEADSHIP

The outcome of the JAR test among consumers from either male or female-headed households is shown in Figure 8.

Figure 8: Percentage of urban consumers who scored the five specific quality characteristics using a 5-point JAR test - sex of HH head



The color of steamed Kibuzi (at least 70%) and Mpologoma (more than 50%) was rated JAR by consumers from both male- and female-headed households. Only consumers from male-headed households appreciated the color of Nakitembe (52% JAR). Ntika's color was not liked by consumers from both male (29% JAR) and female-headed households (35% JAR).

The matooke aroma was liked for steamed Kibuzi and Mpologoma with more than 50% of consumers in both male and female-headed households rating them JAR. The consumers from male-headed households also liked Nakitembe (54% JAR) and Ntika (50%) JAR whereas those from female-headed households did not (36 and 42% JAR respectively).

The softness of steamed Kibuzi, Mpologoma and Nakitembe was liked with more than 50% of consumers from both male- and female-headed households rating them JAR. Consumers from male-headed households liked the softness of Ntika (52% JAR) which was not the same for those from female-headed households (45%).

The matooke taste of steamed Kibuzi was well liked with more than 60% of consumers from both male and female-headed households rating it JAR. In addition, Nakitembe was rated JAR only by consumers from male-headed households (50%). Those from the female-headed households indicated that it had a weak matooke taste (55%). The taste of Ntika and Mpologoma was not liked by consumers on either side as less than 50% rated them JAR for this attribute.

The mouthfeel of steamed Kibuzi, Nakitembe and Mpologoma was scored JAR by more than 50% of consumers from both female and male-headed households. While the consumers from male-headed households liked Ntika’s mouthfeel (53% JAR), those from female-headed households did not (48%) JAR.

3.5 CHECK ALL THAT APPLY (CATA) TEST

Consumers of steamed matooke gave their opinions regarding 24 sensory descriptors (CATA) from which they selected those that best described each of the four steamed matooke samples.

The most-cited sensory characteristics that were associated with the steamed matooke according to the urban consumers in general are summarized in Table 13. The most-cited positive characteristics (>1000 citations) were Soft, Moldable, Yellow and Good taste. These were followed closely by Attractive, Sticky, Nice aroma and Homogeneous (one color) (700 – 1000 citations). On the contrary, cools fast, not attractive, Sweet, Whitish cream and Tasteless were the most-cited negative characteristics (200 – 500 citations). The least-cited characteristics were negative (<100 citations) namely, doesn’t stick together, Dry, White color, Burnt and Bitter.

Steamed Kibuzi was described as Soft (336 citations), Yellow (331), Attractive (325), Good taste (310) and moldable (289). Descriptors for Nakitembe included Soft (326), Moldable (283), Attractive (256), Yellow (254) and Sticky (250). Mpologoma was associated with Soft (317), Moldable (259), Yellow (257), Attractive (249) and Sticky (238). Most of the negative descriptors were cited more for Ntika than the other steamed matooke namely, Cools fast (169), Not attractive (163), Whitish cream (85) and Tasteless (64). Interestingly the most-liked cultivar Kibuzi was also associated with a ‘negative’ term ‘sweet’ (86 citations). However, this could be due to the translation in the local dialects were ‘sweet’ generally refers to ‘delicious. This is further corroborated by the least liked Ntika having the lowest number of citations for sweet (61).

Table 13: Frequency of citations of each quality characteristic by all the urban consumers of steamed matooke

Quality Characteristic/Product name	Mpologoma	Ntika	Nakitembe	Kibuzi	Total
Soft	317	273	326	336	1252
Moldable	259	274	283	289	1105
Yellow	257	173	254	331	1015
Good taste	229	225	239	310	1003

Quality Characteristic/Product name	Mpologoma	Ntika	Nakitembe	Kibuzi	Total
Attractive	249	164	256	325	994
Sticky	238	208	250	201	897
Nice aroma	213	177	208	282	880
Homogeneous (one color)	196	97	197	235	725
Cools fast	82	169	114	118	483
Not attractive	97	163	90	36	386
Sweet	71	61	64	86	282
Whitish cream	56	85	71	15	227
Tasteless	63	64	55	21	203
Little sweet	52	45	54	39	190
Firm	44	54	32	27	157
Odorless	40	45	37	17	139
Texture	30	24	24	29	107
Hard	21	54	10	18	103
Watery	32	20	35	14	101
Doesn't stick together	20	28	16	29	93
Dry	19	38	16	18	91
White color	12	22	16	8	58
Burnt	0	3	3	1	7
Bitter	0	0	1	3	4
Mean Overall liking	6.5	5.9	6.5	7.2	

The sensory descriptors were also disaggregated by income status (Table 14). The most-cited characteristics by high-income consumers were Soft (440), Moldable (349), Good taste (330), Yellow and Nice aroma (both 313). The top characteristics for the middle-income consumers were Soft (406), Moldable (398), Yellow (355), Attractive (344), Good taste (332) and Sticky (320). Low-income consumers cited; Soft (406), Moldable (358), Attractive (356), Yellow (347) and Good taste (341).

Kibuzi had the highest number of citations among the top characteristics as chosen by the high-income consumers namely, Soft, Moldable, Good taste, Yellow, Nice aroma, Attractive and homogeneous color. Mpologoma was cited as sticky. Ntika had higher counts for negative characteristics such as cools fast and not attractive.

Of the top characteristics by middle income consumers, Kibuzi had slightly more citations for soft; Nakitembe was moldable and sticky and Mpologoma led regarding yellow, attractive, good taste, nice aroma and homogeneous color. Ntika had more citations for the negative terms such as cools fast, not attractive and tasteless.

The low-income consumers had Kibuzi with more citations for Attractive, Yellow, Good taste, nice aroma and homogeneous color. Nakitembe was cited for being soft and sticky while Ntika was moldable. On the negative side, Ntika was cited as cooling fast and not attractive.

Table 14: Frequency of citations of each quality characteristic by all the urban consumers of steamed matooke - income status

Annual Income	High Income					Middle Income					Low Income				
	Mpologoma	Ntika	Nakitembe	Kibuzi	Total	Mpologoma	Ntika	Nakitembe	Kibuzi	Total	Mpologoma	Ntika	Nakitembe	Kibuzi	Total
White color	2	4	3	0	9	2	16	8	7	33	8	2	5	1	16
Sweet	13	16	21	32	82	31	14	20	27	92	27	31	23	27	108
Attractive	56	42	80	116	294	104	50	94	96	344	89	72	82	113	356
Tasteless	21	16	12	4	53	17	29	21	14	81	25	19	22	3	69
Bitter	0	0	1	1	2	0	0	0	2	2	0	0	0	0	0
Whitish cream	32	25	29	0	86	3	38	14	9	64	21	22	28	6	77
Burnt	0	2	1	0	3	0	0	0	0	0	0	1	2	1	4
Moldable	73	87	94	95	349	101	93	103	101	398	85	94	86	93	358
Good taste	59	75	81	115	330	95	66	81	90	332	75	84	77	105	341
Odorless	13	10	11	1	35	14	22	16	10	62	13	13	10	6	42
Little sweet	15	15	20	9	59	18	15	12	11	56	19	15	22	19	75
Texture	6	4	6	9	25	17	12	15	13	57	7	8	3	7	25
Cools fast	27	56	35	24	142	23	69	41	51	184	32	44	38	43	157
Yellow	62	50	83	118	313	111	53	91	100	355	84	70	80	113	347
Watery	14	7	6	5	32	4	3	13	8	28	14	10	16	1	41
Nice aroma	67	59	77	110	313	89	53	72	85	299	57	65	59	87	268
Hard	4	13	2	3	22	7	32	5	8	52	10	9	3	7	29
Soft	105	103	112	120	440	111	76	106	113	406	101	94	108	103	406
Homogeneous (one color)	46	32	71	79	228	99	33	70	78	280	51	32	56	78	217
Sticky	79	74	77	60	290	84	67	85	84	320	75	67	88	57	287
Not attractive	53	57	26	3	139	14	64	28	24	130	30	42	36	9	117
Dry	6	6	4	1	17	4	20	7	8	39	9	12	5	9	35
Doesn't stick together	9	6	4	10	29	3	15	7	8	33	8	7	5	11	31
Firm	17	15	12	8	52	16	20	11	8	55	11	19	9	11	50
Overall liking	5.9	5.7	6.7	7.6		7.5	5.7	6.5	6.9		6.1	6.2	6.2	7.1	

Segmentation of the sensory characteristics as cited by the consumers on the basis of their sex and age is shown in Table 15. The most-cited characteristics by adult females were Soft (292), Attractive (254), Moldable (251), Good taste (249), Yellow (231), Nice aroma (212), Sticky (201), Homogeneous (one color) (174) and Cools fast (131). Kibuzi was associated with most of these having had the highest number of citations for Soft, Attractive, Moldable, Good taste, Yellow, Nice aroma and Homogeneous (one color). Nakitembe had more citations for Sticky while Ntika was cited most for the negative characteristic, Cools fast. The adult males similarly cited; Soft (265), Moldable (234), Good taste (220), Yellow (214), Attractive (206), Nice aroma (190), Sticky (187) and Homogeneous (one color) (152). Just like their female counterparts, the adult males associated most of these

characteristics with steamed matooke of Kibuzi with the exception being 'Sticky' which also was linked to Nakitembe with most citations.

The female youths' most cited characteristics were similar to the adults as they were; Soft (312), Moldable (253), Attractive (235), Good taste (232), Yellow (232), Sticky (219), Nice aroma (218), Homogeneous (one color) (180), Cools fast (105) and Not attractive (102). The latter two were negative characteristics. Kibuzi and Mpologoma had the most citations for Soft. More so, Kibuzi also led for Attractive, Good taste, Yellow, Nice aroma and Homogeneous (one color). Nakitembe was cited for Moldable and Sticky. Ntika was most cited for negative characteristics; Cools fast and Not attractive. The most cited characteristics by male youths were Soft (383), Moldable (367), Yellow (338), Good taste (302), Attractive (299), Sticky (290), Nice aroma (260) and Homogeneous (one color) (219). Some negative characteristics also received many citations that is; Cools fast (150), Not attractive (125) and Sweet (103). The characteristic associations with steamed matooke samples for male youths differed from the previous gender groups. Nakitembe was associated with most of the positive characteristics, having most citations for; Soft, Good taste, Attractive, Sticky and Homogeneous (one color). Kibuzi had more citations for Yellow and Nice aroma. Ntika on the other hand was most cited for Moldable. Of the negative characteristics, Kibuzi was most cited for Cools fast while both Kibuzi and Nakitembe led in terms of Sweet. Ntika was most cited for Non-attractive.

Table 15: Frequency of citations of each quality characteristic by all the urban consumers of steamed matooke - sex and age of respondent

Quality characteristic	Adult Female					Adult Male					Youth Female					Youth Male				
	Mpologoma	Ntika	Nakitembe	Kibuzi	Total	Mpologoma	Ntika	Nakitembe	Kibuzi	Total	Mpologoma	Ntika	Nakitembe	Kibuzi	Total	Mpologoma	Ntika	Nakitembe	Kibuzi	Total
White color	5	4	8	1	18	1	3	2	2	8	0	10	5	1	16	6	5	1	4	16
Sweet	16	15	13	22	66	5	9	15	15	44	22	14	10	23	69	28	23	26	26	103
Attractive	65	54	49	86	254	49	29	60	68	206	65	37	52	81	235	70	44	95	90	299
Tasteless	19	17	20	5	61	13	11	8	5	37	13	18	18	4	53	18	18	9	7	52
Bitter	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	1	1	2
Whitish cream	19	22	31	5	77	12	14	5	1	32	14	29	26	5	74	11	20	9	4	44
Burnt	0	0	0	0	0	0	0	0	1	1	0	1	3	0	4	0	2	0	0	2
Mouldable	59	62	62	68	251	51	53	62	68	234	63	62	65	63	253	86	97	94	90	367
Good taste	58	60	50	81	249	47	51	54	68	220	57	45	51	79	232	67	69	84	82	302
Odourless	12	15	16	7	50	10	4	4	2	20	6	12	11	2	31	12	14	6	6	38
Little sweet	13	9	10	9	41	9	9	6	4	28	17	12	18	11	58	13	15	20	15	63
Texture	7	10	9	10	36	3	4	4	4	15	11	5	5	9	30	9	5	6	6	26
Cools fast	22	47	34	28	131	18	37	24	18	97	14	42	22	27	105	28	43	34	45	150
Yellow	57	52	42	80	231	50	31	66	67	214	65	36	50	81	232	85	54	96	103	338
Watery	4	10	13	2	29	10	0	1	3	14	7	5	16	2	30	11	5	5	7	28
Nice aroma	50	45	47	70	212	39	40	50	61	190	66	34	44	74	218	58	58	67	77	260
Hard	10	20	6	6	42	3	7	1	1	12	1	15	2	4	22	7	12	1	7	27
Soft	72	61	79	80	292	65	61	67	72	265	83	69	77	83	312	97	82	103	101	383
Homogeneous (one color)	54	25	36	59	174	38	23	44	47	152	55	23	42	60	180	49	26	75	69	219
Sticky	50	46	63	42	201	55	43	49	40	187	59	51	63	46	219	74	68	75	73	290
Not attractive	22	31	35	6	94	20	34	8	3	65	20	42	32	8	102	35	56	15	19	125

Quality characteristic	Adult Female					Adult Male					Youth Female					Youth Male				
	Mpologoma	Ntika	Nakitembe	Kibuzi	Total	Mpologoma	Ntika	Nakitembe	Kibuzi	Total	Mpologoma	Ntika	Nakitembe	Kibuzi	Total	Mpologoma	Ntika	Nakitembe	Kibuzi	Total
Dry	7	9	5	5	26	2	7	0	1	10	3	10	2	8	23	7	12	9	4	32
Doesn't stick together	10	5	5	11	31	1	7	4	6	18	4	9	4	6	23	5	7	3	6	21
Firm	14	14	4	15	47	7	7	4	2	20	12	15	11	5	43	11	18	13	5	47
overall liking	6.6	6.3	6.2	7.5		6.4	6.0	6.9	7.3		6.8	5.6	6.1	7.3		6.2	5.6	6.7	6.8	

Sensory characteristics cited by the consumers disaggregated by sex of household head are shown in Table 16.

The most-cited positive characteristics by consumers from female-headed households were Soft (374), Moldable (319), Good taste (308), Attractive (306), Yellow (291), Sticky (272) and Nice aroma (269). The negative ones were Cools fast (158), Not Attractive (127), Whitish cream (87), Tasteless (75) and Little sweet (72). Kibuzi had more citations for Soft, Moldable, Good taste, Attractive, Yellow and nice aroma. Nakitembe was sticky. Negative terms 'Cools fast' and 'Not Attractive' were linked to Ntika. Others namely, Whitish cream and Tasteless were linked with Nakitembe while Mpologoma was little sweet.

Consumers from male-headed households similarly cited; Soft (878), Moldable (786), Yellow (724), Good taste (695), Attractive (688), Sticky (625) and Nice aroma (611). The negative characteristics were Cools fast (325), Not Attractive (259), Whitish cream (140), Tasteless (128), Little sweet (118), Odorless (92) and Firm (88).

Just like the female, male-headed households also had higher citations for Soft, Moldable, Yellow, Good taste, Attractive and Nice aroma linked with Kibuzi steamed matooke. Mpologoma was sticky. The negative characteristics namely: Cools fast, Not Attractive, whitish cream and firm were associated with Ntika; Mpologoma was tasteless and odorless; Nakitembe was little sweet.

Table 16: Frequency of citations of each quality characteristic by all the urban consumers of steamed matooke - sex of household head

Quality characteristics	Female-headed HH					Male-headed HH				
	Mpologoma	Ntika	Nakitembe	Kibuzi	Total	Mpologoma	Ntika	Nakitembe	Kibuzi	Total
White color	4	10	10	2	26	8	12	6	6	32
Sweet	25	20	17	29	91	46	41	47	57	191
Attractive	84	58	67	97	306	165	106	189	228	688
Tasteless	18	22	26	9	75	45	42	29	12	128
Bitter	0	0	0	1	1	0	0	1	2	3
Whitish cream	16	26	37	8	87	40	59	34	7	140
Burnt	0	1	3	0	4	0	2	0	1	3
Moldable	77	78	81	83	319	182	196	202	206	786
Good taste	75	72	66	95	308	154	153	173	215	695
Odorless	9	15	17	6	47	31	30	20	11	92
Little sweet	26	12	19	15	72	26	33	35	24	118
Texture	17	15	14	16	62	13	9	10	13	45
Cools fast	21	58	35	44	158	61	111	79	74	325
Yellow	78	59	55	99	291	179	114	199	232	724
Watery	10	9	19	2	40	22	11	16	12	61

Quality characteristics	Female-headed HH					Male-headed HH				
	Mpologoma	Ntika	Nakitembe	Kibuzi	Total	Mpologoma	Ntika	Nakitembe	Kibuzi	Total
Nice aroma	73	51	59	86	269	140	126	149	196	611
Hard	6	26	7	8	47	15	28	3	10	56
Soft	98	77	98	101	374	219	196	228	235	878
Homogeneous (one color)	63	29	48	69	209	133	68	149	166	516
Sticky	73	61	80	58	272	165	147	170	143	625
Not Attractive	26	47	41	13	127	71	116	49	23	259
Dry	6	14	5	9	34	13	24	11	9	57
Doesn't stick together	10	12	5	13	40	10	16	11	16	53
Firm	19	22	12	16	69	25	32	20	11	88
overall liking	6.9	6.1	6.1	7.4		6.3	5.8	6.6	7.1	

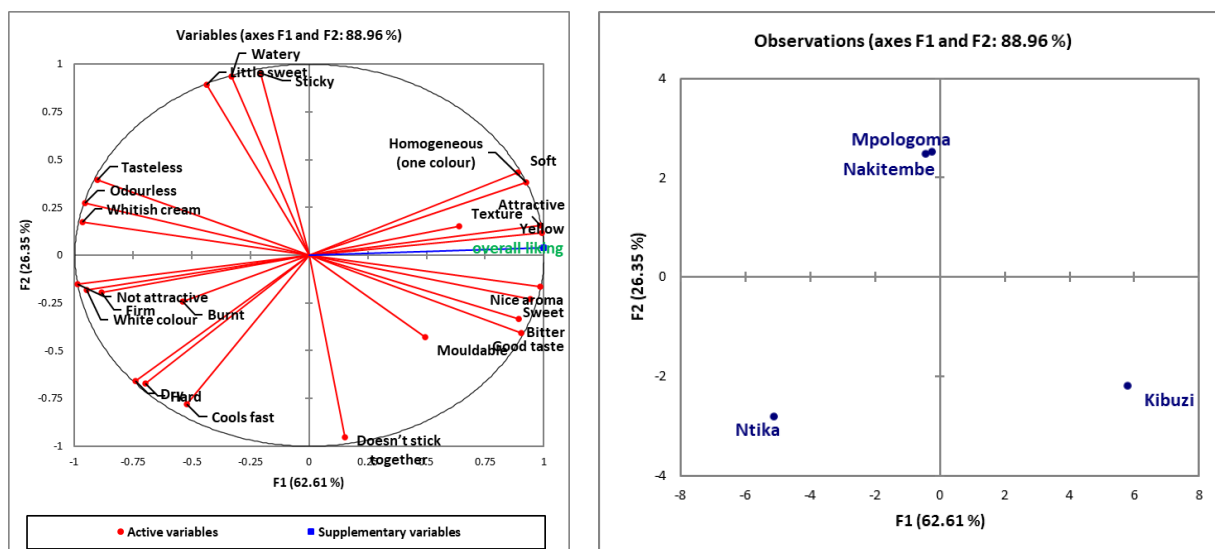
3.6 MAPPING OF THE SENSORY CHARACTERISTICS

Principal component analysis (PCA) was used to summarize the relationships between CATA sensory characteristics, steamed matooke samples and mean overall liking of each product scored by all the consumers.

3.6.1 MAPPING OF THE SENSORY CHARACTERISTICS IN GENERAL

The PCA plot of sensory characteristic variance (88.96%; F1 62.61% and F2 26.35%) of the steamed matooke according to urban consumers in general is shown in Figure 9. The consumers rated Kibuzi steamed matooke highly, as it was associated with; Yellow, Nice aroma, Attractive, Sweet, Homogeneous (one color), Good taste, Bitter and Soft which were also linked with positive meaning overall liking. Nakitembe and Mpologoma were described as, Sticky, Watery and Little sweet. Steamed matooke of Ntika was associated with; Not attractive, Whitish cream, Odourless, Tasteless, Firm, Dry and Hard.

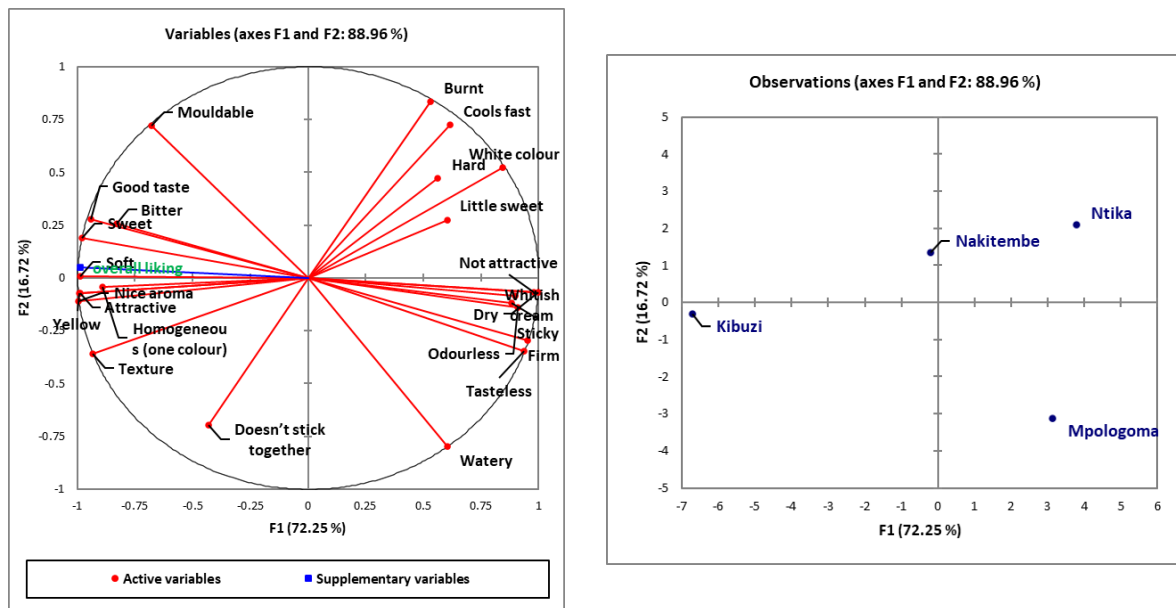
Figure 9: Mapping of the sensory characteristics and overall liking of the steamed matooke



3.6.2 HIGH INCOME

The PCA plot for high income consumers of steamed matooke explained 88.96% of sensory characteristic variance (F1 72.25% and F2 16.72%) (Figure 10). A positive mean overall liking and steamed matooke of Kibuzi were associated with; Nice aroma, Yellow, Soft, Attractive, Sweet, Good taste, Texture, Homogeneous (one color) and Bitter. Nakitembe was reported to be a little sweet. Ntika and to a lesser extent Mpologoma (0.5 correlation), were linked with Dry, Not attractive, Firm, Tasteless, Odorless, Whitish cream, Sticky and White color.

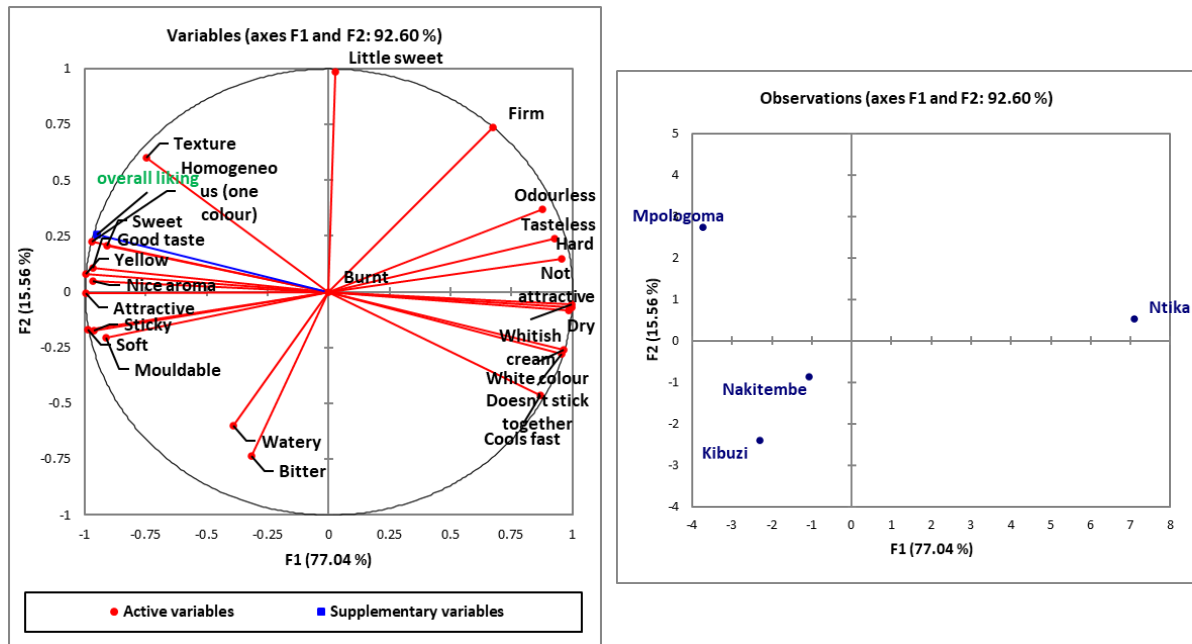
Figure 10: Mapping of the sensory characteristics and the overall liking of the steamed matooke - high income consumers



3.6.3 MIDDLE INCOME

The PCA plot for middle income consumers of steamed matooke explained 92.60% of sensory characteristic variance (F1 77.04% and F2 15.56%) (Figure 11). The middle-income consumers associated the positive mean overall liking with Attractive, Yellow, Soft, Homogeneous (one color), Good taste, Nice aroma, Sticky, Moldable and Sweet. These were linked with the steamed matooke of Mpologoma. Nakitembe was weakly associated with watery while Kibuzi was deemed bitter albeit with a weak correlation. Ntika was described as; Not attractive, Whitish cream, Dry, White color, Hard, doesn't stick together, Tasteless, Odorless and Cools fast.

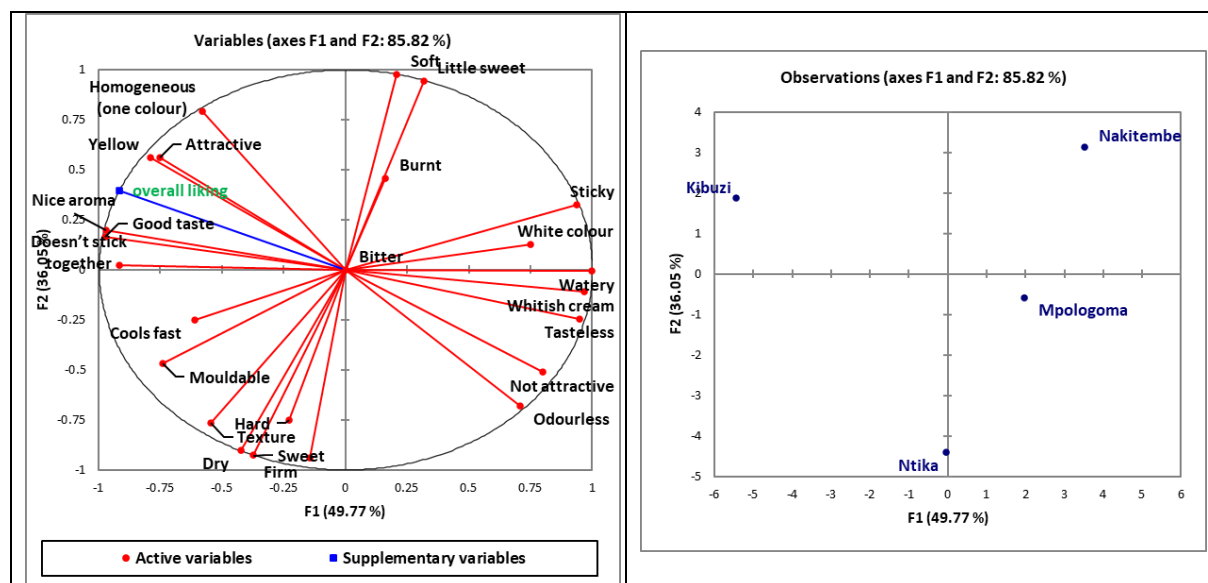
Figure 11: Mapping of the sensory characteristics and overall liking of the steamed matooke - middle income consumers



3.6.4 LOW INCOME

The PCA plot of sensory characteristic variance of steamed matooke according to low-income consumers is shown in Figure 12. The low-income consumers associated positive mean overall liking with; Good taste, Nice aroma, doesn't stick together, Yellow, Attractive and Moldable. These were also linked steamed matooke of Kibuzi. Nakitembe was identified by, Whitish cream, Tasteless, Sticky, Not attractive, White color and Odourless. Ntika steamed matooke was described as, Firm, Sweet, Dry, Texture and Hard. Mpologoma was not associated with any of the characteristics.

Figure 12: Mapping of the sensory characteristics and the overall liking of the steamed matooke - low-income consumers

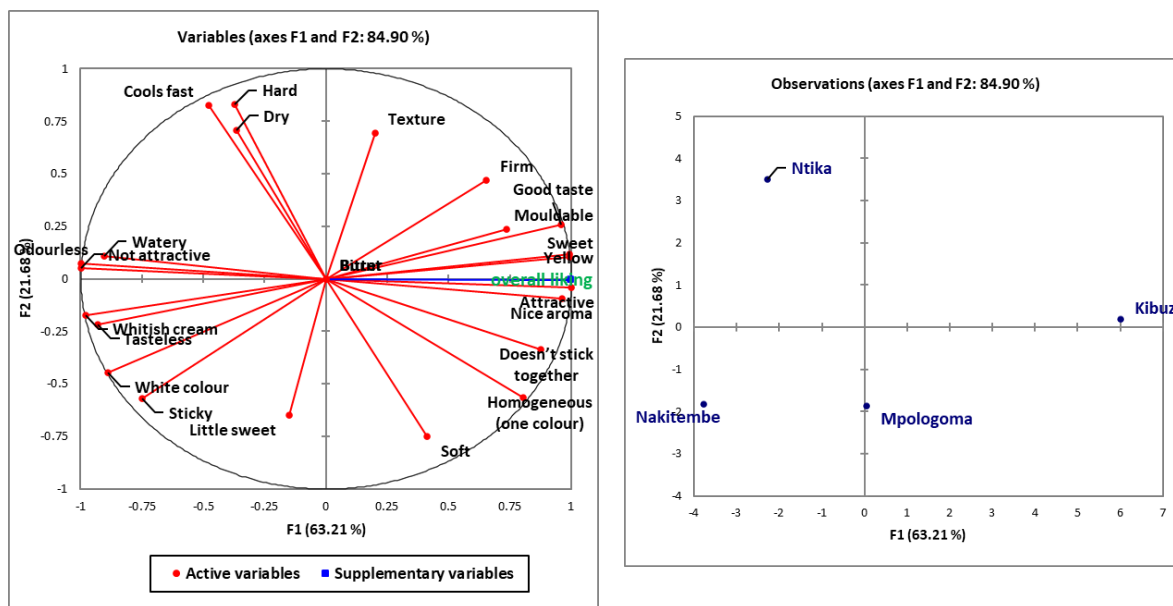


3.7 MAPPING OF THE SENSORY CHARACTERISTICS BY SEX AND AGE

3.7.1 ADULT FEMALE CONSUMERS

The sensory characteristic variance of the steamed matooke as described by adult female consumers is shown in Figure 13. A positive mean overall liking was associated with Attractive, Sweet, Yellow, Nice aroma, Good taste, doesn't stick together, Homogeneous (one color) and Moldable. This association was similar for Kibuzi steamed matooke. Nakitembe was linked with; Not attractive, Odorless, Whitish cream, Tasteless, Watery, White color and Sticky. Ntika was defined by; Hard, Cools fast and Dry. Mpologoma was described as; Little sweet.

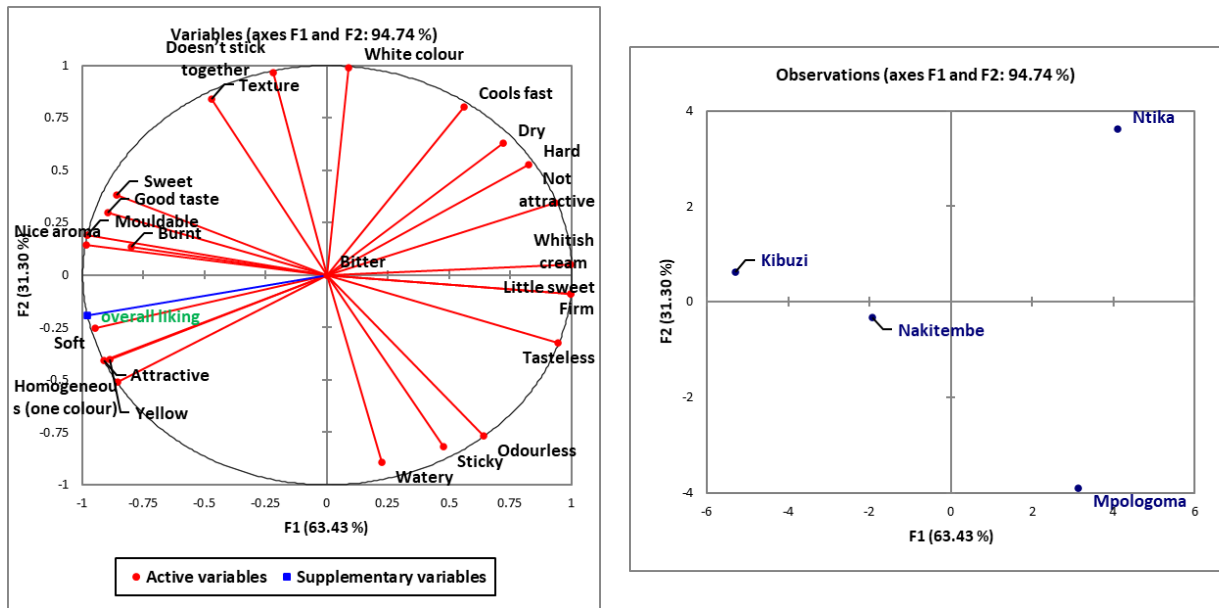
Figure 13: Mapping of the sensory characteristics and the overall liking of the steamed matooke - adult female



3.7.2 ADULT MALE CONSUMERS

The sensory characteristic variance of the steamed matooke as described by adult male consumers is shown in Figure 14. Positive mean overall liking and steamed matooke of Kibuzi were in tandem associated with Nice aroma, Moldable, Soft, Attractive, Good taste, Yellow, Sweet, Homogeneous (one color) and Burnt. This was similar for Nakitembe albeit with a lower squared cosine (0.5). Ntika was described as, Whitish cream, Little sweet, Firm, Tasteless, Not attractive and Dry. Mpologoma was said to be Watery, Sticky and Odorless.

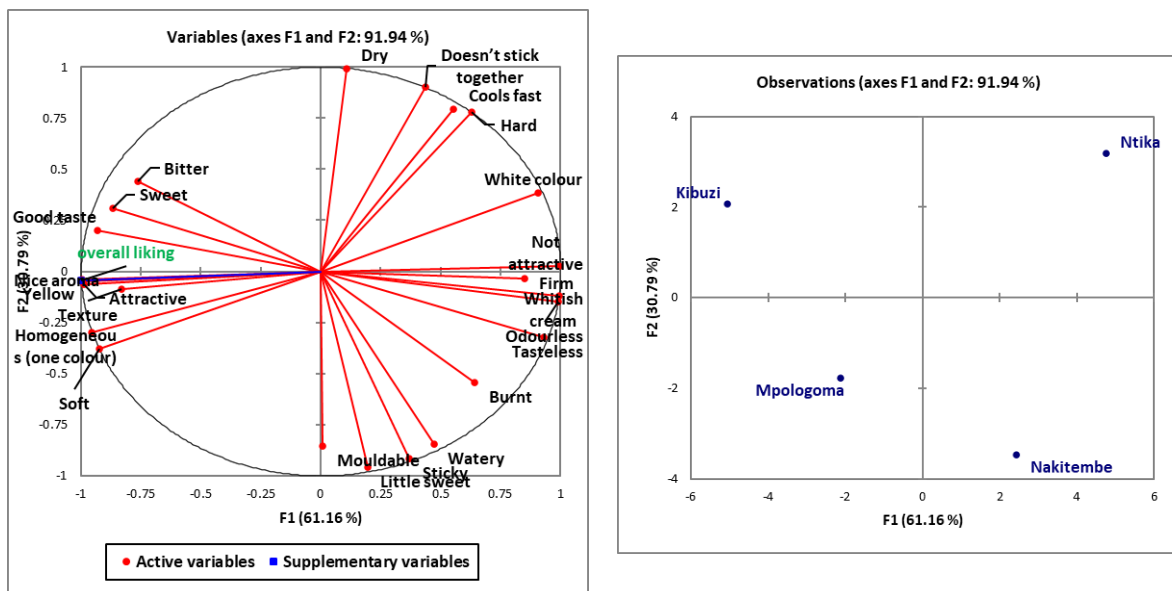
Figure 14: Mapping of the sensory characteristics and the overall liking of the steamed matooke - adult male consumers



3.7.3 FEMALE YOUTH

The PCA plot of the sensory characteristic variance of steamed matooke according to female youth consumers is shown in Figure 15. The positive mean overall liking and Kibuzi steamed matooke were associated with; Nice aroma, Yellow, Attractive, Odorless, Homogeneous (one color), Good taste, Soft, Sweet, and Bitter. Nakitembe was linked with; Little sweet, Sticky, Moldable and Watery. Ntika was defined by; Not attractive, Whitish cream, White color and Firm. Mpologoma had a weak squared cosine (0.4) and was not associated with any characteristic.

Figure 15: Mapping of the sensory characteristics and the overall liking of the steamed matooke - female youth

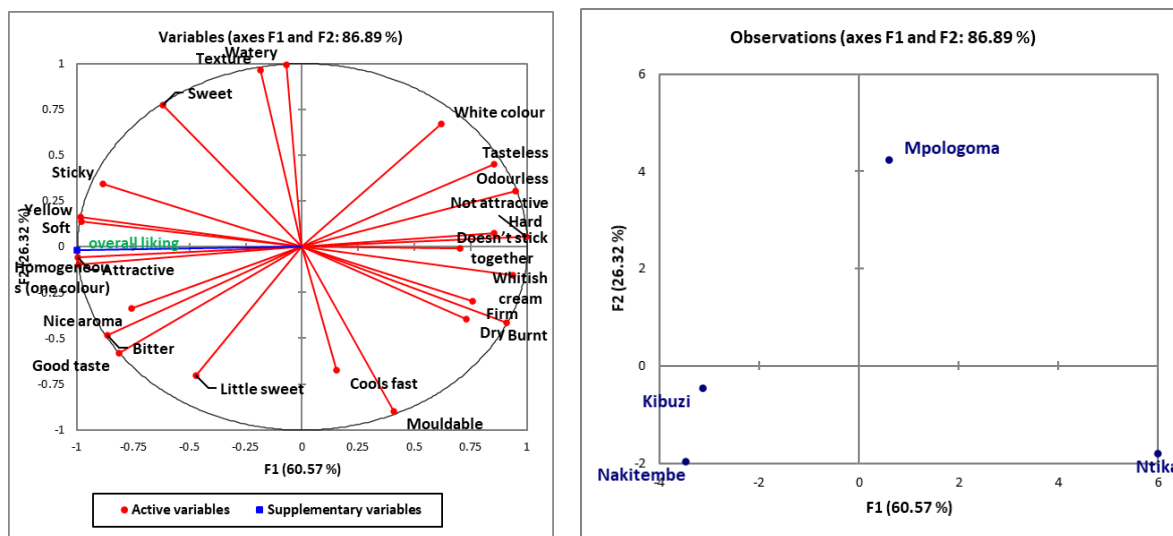


3.7.4 MALE YOUTH

The PCA plot of the sensory characteristic variance of steamed matooke according to male youth consumers is shown in Figure 16. Positive mean overall liking and steamed matooke of Kibuzi and Nakitembe were associated with; Attractive, Homogeneous (one color), Soft, Yellow, Sticky, Bitter, Good taste and Nice aroma. Mpologoma

was linked with; Watery and Sweet. Ntika was described as; Not attractive, Dry, Odorless, Whitish cream, Burnt, Hard, Tasteless and Firm.

Figure 16: Mapping of the sensory characteristics and the overall liking of the steamed matooke - male youth

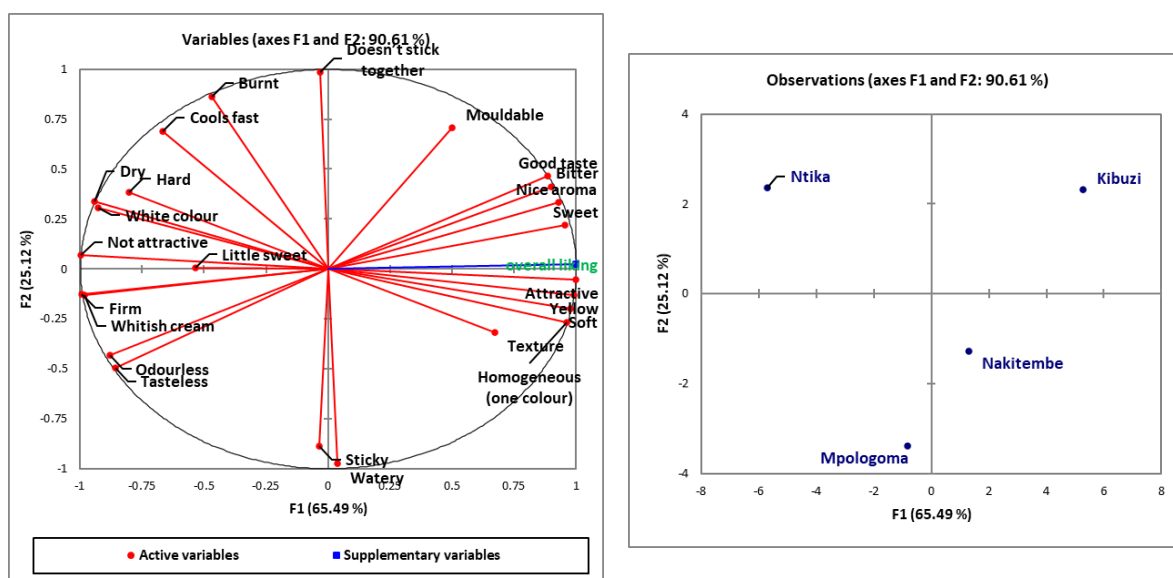


3.8 MAPPING OF THE SENSORY CHARACTERISTICS BY HOUSEHOLD HEADSHIP

3.8.1 MALE HH HEAD

The PCA plot of the sensory characteristic variance of steamed matooke according to consumers from male-headed households is shown in Figure 17. A positive mean overall liking was associated with; Attractive, Yellow, Soft, Homogeneous (one color), Sweet, Nice aroma, Good taste. These too were used to describe steamed matooke from Kibuzi. However, 'Bitter', was also used to describe Kibuzi. Nakitembe was defined by 'Little sweet' while for Mpologoma it was 'Watery' and 'Sticky'. Steamed matooke from Ntika was described as; Not attractive, Firm, Whitish cream, Dry, White color, Odorless and Tasteless.

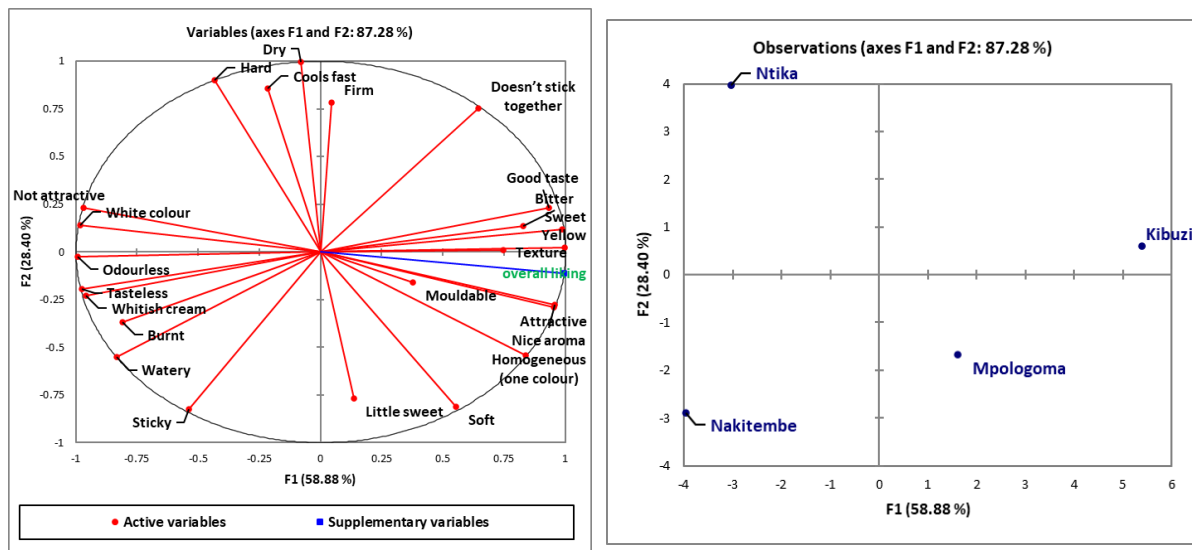
Figure 17: Mapping of the sensory characteristics and the overall liking of the steamed matooke - male HH head



3.8.2 FEMALE HH HEAD

The PCA plot of the sensory characteristic variance of steamed matooke according to consumers from female-headed households is shown in Figure 18. Kibuzi was strongly associated with; Yellow, Sweet, Nice aroma, Attractive, Good taste and Homogeneous (one color). These were also positively linked with overall liking. However, a few consumers associated Kibuzi with ‘bitter’ taste. This perceived bitterness could actually be a slight astringency associated with level of maturity (Kyamuhangire et al., 2006; Nowakunda, 2018). Nakitembe was deemed Odorless, White color, Tasteless, Not attractive, Whitish cream and Watery. In addition, some consumers felt it had a Burnt flavor. Consumers in this category described Ntika as Dry, Hard, cools fast, Firm and Doesn’t stick together. Mpologoma was not strongly associated with any of the descriptors.

Figure 18: Mapping of the sensory characteristics and the overall liking of the steamed matooke - female HH head



4 DISCUSSION

On consumption habits, matooke was consumed in various forms namely steamed-mashed, katogo, boiled-mashed, boiled-unpeeled (empogola) and roasted. However, steamed-mashed was by far the most frequently consumed form. Matooke was consumed severally during the week at lunch time. Therefore, it is a major part of the diets of urban consumers. Matooke consumption is deeply embedded in the culture as a principle starchy food especially in Central Uganda (Hamilton et al., 2016; Sato 2012).

A general opinion of consumers was that Kibuzi steamed matooke was similar to that usually consumed at home. Additionally, Kibuzi was most-liked while Ntika was least-liked. This observation was corroborated by the general mean overall liking scores where Kibuzi was ranked first and Ntika last. Mpologoma and Nakitembe had intermediate liking. Kibuzi, Nakitembe and Mpologoma were among the top cultivars preferred by farmers owing to superior qualities such as soft texture, yellow color and taste in the study by Akankwasa et al., (2021). However, income classes differed in preference of steamed matooke. The high-income consumers liked Kibuzi but less so Mpologoma and Ntika while those with middle-income liked Mpologoma most. Low-income consumers clearly liked Kibuzi most although steamed matooke from the other three cultivars had the same rating.

Kibuzi was most liked by all consumer gender groups albeit to varying degrees. Adult females liked it very much while the adult males, female and male youths liked it moderately. They were unanimous in scoring Ntika as their least-preferred steamed matooke. However, there were further differences among the intermediate cultivars. The females (adult and youth) preferred Mpologoma while the males liked Nakitembe more. This pattern was similar for consumers from the male and female-headed households. These results add to a growing body of literature that has shown gender and age differences in food preferences (Lombardo et al., 2020; Manipa et al., 2017; Velloso Messagia et al., 2013; Caine-Bish et al, 2009). It is therefore important to recognize gender differences regarding specific desired characteristics for balanced and unbiased interventions (Bellon and Reeves, 2002).

Generally, all the four steamed matooke were liked for softness and mouthfeel by most consumers. Steamed Mpologoma and Kibuzi had the right color and matooke aroma while only Kibuzi had the appropriate matooke taste for consumers. There were some differences among the income classes. Middle-income consumers liked the color of Nakitembe and Mpologoma while the other classes did not. Matooke aroma and softness of steamed Ntika was only liked by the low-income consumers. Differences were also observed between sex and age groups. Male respondents (adults and youth) liked steamed Nakitembe's color, aroma and taste while the females did not. According to Akankwasa et al., (2021) women are more discerning of characteristics such as appearance compared to men due to their greater role in household food preparation. Weltzien et al., (2019) and Caron and Marimo (2020) reported that differences in preferences between men and women may be related to their roles in the value chain such as cooking for women. Adult males and females indicated that Ntika had the appropriate softness while for the youths it did not. Subtle differences were observed between consumers from male and female-headed households.

The mapping of sensory characteristics of steamed matooke in general showed that positive mean overall liking was strongly linked with; Yellow, Nice aroma, Attractive, Sweet (delicious, not sweet like sugar), Homogeneous (one color), Good taste and Soft. These characteristics were largely associated with steamed Kibuzi which also had the highest mean overall liking. Steamed Ntika was statistically orthogonal with the lowest mean overall liking and mapped to characteristics such as Not attractive, Whitish cream, Odorless, White color, Tasteless, Firm, Dry and Hard. This trend was observed with the high- and low-income consumers however, those with middle income linked positive overall liking with steamed Mpologoma. These findings are in agreement with Akankwasa et al., 2021 who reported that good aroma, soft texture, yellow color and good taste were the most-preferred characteristics of steamed matooke while the less preferred were; too soft or watery matooke, flat taste, pale yellow color and hard texture. Marimo et al., (2019) recommended assessment of preference by other social segments such as youths and income classes in addition to the male-female nexus. This report adds to the body of knowledge to this effect as it shows differences in preference of steamed matooke by age and income classes.

5 CONCLUSION

The study confirmed that steamed matooke greatly contributes to the diets of urban consumers. Regarding cultivars, steamed Kibuzi was the most liked while Ntika was the least liked in terms of overall liking and mapping of sensory characteristics. Matooke taste proved a key determinant for the preference of steamed Kibuzi over the other steamed matooke. **It is therefore important to unlock this attribute in terms of sensory quantitative descriptive analysis and physico-chemical characterization, to guide breeding efforts geared towards improving sensory acceptability of matooke cultivars.** Differences were observed in preference among different income and gender categories. Therefore, breeders need to package appropriate products based on the preferences of the various socio-demographic segments.

6 REFERENCES

- Akankwasa, K., Marimo, P., Tumuhimbise, R., Asasira, M., Khakasa, E., Mpirirwe, I., Kleih, U., Forsythe, L., Fliedel, G., Dufour, D. and Nowakunda, K., (2021). The East African highland cooking bananas 'Matooke' preferences of farmers and traders: Implications for cultivar development. *International Journal of Food Science & Technology*, 56(3), pp.1124-1134.
- Bellon, M.R. & Reeves, J. (2002). *Quantitative Analysis of Data from Participatory Methods in Plant Breeding*. Mexico, DF: CIMMYT.
- Caine-Bish, Natalie & Scheule, Barbara. (2009). Gender Differences in Food Preferences of School-Aged Children and Adolescents. *The Journal of school health*. 79. 532-40. 10.1111/j.1746-1561.2009.00445.x.
- Caron, C. M., & Marimo, P. (2021). Understanding gender preferences in banana traits may improve design and adoption of new cultivars. CGIAR Gender Platform
- Echodu, R., Edema, H., Wokorach, G., Zawedde, C., Otim, G., Luambano, N., Ateka, E.M. and Asiimwe, T., (2019). Farmers' practices and their knowledge of biotic constraints to sweetpotato production in East Africa. *Physiological and molecular plant pathology*, 105, pp.3-16.
- FAO (2017). *The Future of Food and Agriculture: Trends and Challenges*. FAO, Rome.
<http://www.fao.org/publications/card/en/c/d24d2507-41d9-4ec2-a3f888a489bfe1ad/>
- Fiedler, J.L., Kikulwe, E.M. and Birol, E., (2013). An ex-ante analysis of the impact and cost-effectiveness of biofortified high-provitamin A and high-iron banana in Uganda (Vol. 1277). *Intl Food Policy Res Inst*.
- Fliedel, G., Kleih, U., Bechoff, A. and Forsythe, L., (2018). RTBfoods Step 4: Consumer testing in rural and urban areas.
- Forsythe, L., Tufan, H., Bouniol, A., Kleih, U. and Fliedel, G., (2021). An interdisciplinary and participatory methodology to improve user acceptability of root, tuber and banana cultivars. *International Journal of Food Science & Technology*, 56(3), pp.1115-1123.
- Geberewold, A.Z., (2019). Review on impact of banana bacterial wilt (*Xanthomonas campestris* pv. *Musacerum*) in East and Central Africa. *Cogent Food & Agriculture*, 5(1), p.1586075.
- Hamilton, A., Karamura, D. & Kakudidi, E. (2016). History and conservation of wild and Cultivated plant diversity in Uganda: forest species and banana cultivars as case studies. *Plant diversity*, 1, 26–52.
- Kabahenda, M. and Kapiriri, M., (2010). Analysing the agricultural science and technology innovation systems: A case study of the banana sub-sector in Uganda. In *Technical Centre for Agricultural and Rural Cooperation (CTA) and Regional Universities Forum for Capacity Building in Agriculture (RUFORUM)*.

Kyamuhangire, W., Krekling, T., Reed, E. and Pehrson, R., (2006). The microstructure and tannin content of banana fruit and their likely influence on juice extraction. *Journal of the Science of Food and Agriculture*, 86(12), pp.1908-1915.

Lombardo, M., Aulisa, G., Padua, E., Annino, G., Iellamo, F., Pratesi, A., Caprio, M. and Bellia, A. (2020), "Gender differences in taste and foods habits", *Nutrition & Food Science*, Vol. 50 No. 1, pp. 229-239.

<https://doi.org/10.1108/NFS-04-2019-0132>

Manippa, V., Padulo, C., Van der Laan, L. N., & Brancucci, A. (2017). Gender differences in food choice: effects of superior temporal sulcus stimulation. *Frontiers in human neuroscience*, 11, 597.

Marimo, P., Karamura, D., Tumuhimbise, R., Shimwela, M.M., Bergh, I., Batte, M., Massawe, C., Okurut, A.W., Mbongo, D.B. and Crichton, R., (2019). Post-harvest use of banana in Uganda and Tanzania: Product characteristics and cultivar preferences of male and female farmers. Lima (Peru). CGIAR Research Program on Roots, Tubers and Bananas (RTB). RTB Working Paper. No. 3. Available online at: www.rtb.cgiar.org

Meijer, S.S., Catacutan, D., Ajayi, O.C., Sileshi, G.W. and Nieuwenhuis, M., (2015). The role of knowledge, attitudes and perceptions in the uptake of agricultural and agroforestry innovations among smallholder farmers in sub-Saharan Africa. *International Journal of Agricultural Sustainability*, 13(1), pp.40-54.

Muranga, F.I., Sampath, H., Marlett, J.A. and Ntambi, J.M., (2007). Impact of processing technique on the apparent bioavailability of cooking banana (matooke) starch. *African Journal of Biochemistry Research*, 1(5), pp.072-077.

Nasirumbi Sanya, L., Birungi Kyazze, F., Sseguya, H., Kibwika, P., & Baguma, Y. (2017). Complexity of agricultural technology development processes: Implications for uptake of new hybrid banana cultivars in Central Uganda. *Cogent Food & Agriculture*, 3(1), 1419789.

Nowakunda K. (2018). State of Knowledge on Quality Traits of Fresh & Processed Matooke. The East African Highland Cooking Banana (Matooke). Kampala (Uganda). RTBfoods Project Report, 17 p.

Sabiiti, E.N. and Katongole, C.B., (2016). Role of Peri-urban areas in the food system of Kampala, Uganda. In *Balanced urban Development: Options and strategies for Liveable cities* (pp. 387-392). Springer, Cham.

Sato, Y., (2012). Selection of Principal Starchy Food in a Livelihood System Based on Bananas: The Formation of Food Culture in Buganda, Central Uganda. *Nilo-Ethiopian Studies*, (17), pp.51-62.

UBOS (2001, 2006, 2014). Statistical Abstract.

Velloso Missagia, Simone, & Riveli Oliveira, Solange, & Carvalho Rezende, Daniel (2013). Beauty and the beast: gender differences in food-related behavior. *Revista Brasileira de Marketing*, 12(1),149-165. [fecha de Consulta 23 de Febrero de 2022]. ISSN: Disponible en: <https://www.redalyc.org/articulo.oa?id=471747475010>

Weltzien, E., Rattunde, F., Christinck, A., Isaacs, K. & Ashby, J (2019). Gender and Farmer Preferences for Varietal Traits: Evidence and Issues for Crop Improvement. *Plant Breeding Reviews*, Vol. 43, pp.243-273

World Bank, (2013). *The World Bank annual report 2013*. World Bank Publication



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The CGIAR Research Program on Roots, Tubers and Bananas (RTB) is a partnership collaboration led by the International Potato Center implemented jointly with the Alliance of Bioversity International and the International Center for Tropical Agriculture (CIAT), the International Institute of Tropical Agriculture (IITA), and the Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD), that includes a growing number of research and development partners. RTB brings together research on its mandate crops: bananas and plantains, cassava, potato, sweetpotato, yams, and minor roots and tubers, to improve nutrition and food security and foster greater gender equity especially among some of the world's poorest and most vulnerable populations.

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