

# Consumer Testing of Fried Sweetpotato in Rural and Urban Areas in Nigeria

Understanding the Drivers of Trait Preferences and the Development of Multi-user RTB Product Profiles, WP1, Step 4

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Ethics: The activities, which led to the production of this manual, were assessed and approved by the CIRAD Ethics Committee (H2020 ethics self-assessment procedure). When relevant, samples were prepared according to good hygiene and manufacturing practices. When external participants were involved in an activity, they were priorly informed about the objective of the activity and explained that their participation was entirely voluntary, that they could stop the interview at any point and that their responses would be anonymous and securely stored by the research team for research purposes. Written consent (signature) was systematically sought from sensory panellists and from consumers participating in activities.

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# ABSTRACT

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This report is a part of the RTBfoods project WP1 outputs, essentially devoted to consumer testing (Activity 5) of fried sweetpotato. This activity aims to understand the relationships between sensory properties and consumer overall liking of fried sweetpotato. For this purpose, information related to sensory quality characteristics and processing of the fried sweetpotato were collected from previous activities on fried sweetpotato (Activity 3 “Surveys” and Activity 4 “Processing diagnosis”) and used for this current activity.

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The study was conducted in Kwara and Kano States in Nigeria, among 129 consumers of which 49 were women and 80 men. In Kwara, six sweetpotato varieties were evaluated namely; Alausa, Aragbe, Tomude, Elege, Pakurumon and Mother's Delight while in Kano they were seven namely; Dan Izala, Dan China, Dan Barmawa, Dan Madagali, Dan Silver, Mother's Delight and Dan Bakalori. Data were collected on consumer demographics, consumer attitudes and sensory tests (Hedonic/Overall liking, Just About Right (JAR) and Check All That Apply (CATA).

Demographic data showed that Kwara had slightly more women (51%) than men (49%) whereas Kano had significantly more men (78%) than women (22%). Consumers in Kwara were mostly of the Yoruba ethnic group (91%) while those in Kano were Hausa (92%). In both regions, they were mostly Muslims and married. Consumers were a balanced mix of youth, middle aged and elderly in both Kwara and Kano. Those in Kwara had secondary education (30%) and were mostly traders (41%) while in Kano more consumers had tertiary education (32%) and were salary workers (31%). Fried sweetpotato was consumed 2-3 times a week and, with pepper in both Kwara and Kano.

In Kwara, fried sweetpotato from Alausa (7.7) and Aragbe (7.5) were most liked and were significantly different from the least liked Mother's Delight (6.2) while in Kano all the fried sweetpotato samples were liked and the overall liking scores were not significantly different. All the fried sweetpotato samples in Kwara and Kano were scored JAR by more than 50% of consumers for crispiness, mealiness, colour, sugariness and flavour. Regarding CATA, the most cited characteristics (>100 citations) in both regions were: 'Good smell', 'Good taste', 'Satisfying', 'Yellow', 'Filling Soft', 'Dry', 'Crispy', 'Light brown colour', and 'Less sugary'. Mapping of sensory characteristics by Principal Component Analysis in Kwara showed that the most preferred Alausa fried sweetpotato was linked with 'Filling', 'Satisfying', 'Dry', 'Good smell', 'Crispy' and 'Yellow'. The study showed that breeders need to take into consideration differences in preference by different end-users and gender in an effort to enhance adoption and utilisation of sweetpotato varieties.

**Key Words:** sweet potato, fried, hedonic testing, check-all-that-applies, just-about-right test, consumer acceptability, Nigeria, Kwara state, Kano state



# 1 STUDY CONTEXT AND GENERAL OBJECTIVES

The consumer test of fried sweetpotato was the focus of Activity 5 under WP1 of the RTBFoods project. It followed sequentially from Activity 3 on Gendered Food Mapping and Activity 4 – Processing diagnosis and quality characteristics. The main objective of this Activity 5 “Consumer testing” was to understand the consumers’ demand for the quality characteristics of fried sweetpotato. Also, another objective was to provide WP2 with a clear and visual mapping of the most and least liked products associated with high and low quality characteristics, and high and low overall liking scores respectively.

The study was conducted in Kano and Kwara States of Nigeria. In Kwara, six sweetpotato varieties were evaluated namely; Alausa, Aragbe, Tomude, Elege, Pakurumon and Mother’s Delight while in Kano they were seven namely; Dan Izala, Dan China, Dan Barmawa, Dan Madagali, Dan Silver, Mother’s Delight and Dan Bakalori. Protocols developed during participatory processing diagnosis with processors were used for preparation of fried sweetpotatoes. A semi-structured questionnaire was administered for the consumer testing activity constituting demographic information, consumption attitudes, overall liking, JAR test, CATA test and consumer preferences.

## 2 METHODOLOGY

### 2.1 Sampling

Fried sweetpotatoes were prepared from twelve varieties with unique quality characteristics as indicated by the processors in the participatory processing diagnostics and respondents in the gendered food mapping. These were tested among 129 consumers of which 49 were women and 80 men (**Table 1**). The study sites included; Agbamu, Ijagbo and Offa (Kwara State), Bagwai, Garko, Kano rural and Kano city (Kano State).

**Table 1:** Number of consumers (men and women) interviewed in Nigeria

	Kwara State			Kano State				Total
	Agbamu	Ijagbo	Offa	Bagwai	Garko	Kano rural	Kano city	
Women	18	11	7	1	4	4	4	<b>49</b>
Men	10	10	14	18	16	6	6	<b>80</b>
Number of Consumers	28	21	21	19	20	10	10	<b>129</b>

The 16 varieties were selected based on the views obtained from FGD participants during the gendered food mapping. They included; the most preferred varieties (Alausa, Dan Izala, Dan Bakalori and Dan China), moderately preferred varieties (Dan Barmawa, Dan Madagali, Tomude and Pakurumon) and the least preferred varieties (Dan Silver, Aragbe and Elege) which were of varied flesh colour. The best orange-fleshed variety (Mother’s Delight) was also selected. Only Mother’s Delight was found in both Kano and Kwara state whereas other varieties differed between the two locations (Ssali *et al.*, 2021). Consumer testing of fried sweetpotato was conducted in September 2019.

### 2.2 Consumer testing

The consumer test activity followed the method by Fliedel *et al.*, (2018) including; a hedonic test (overall liking), a just-about-right (JAR) test, and a check-all-that-apply (CATA) test.



For the hedonic test, the consumers (n = 129) from Kwara and Kano states were asked independently to assess each fried sweetpotato sample by looking, touching, smelling and tasting, one at a time, in a random order, and score the overall liking using a nine-point hedonic scale (from 1 =“ dislike extremely”, to 9 =“ like extremely”).

JAR test involved evaluating the intensity of 5 sensory attributes identified as important in the previous Activities 3 & 4, using the 3-point scale JAR “Just About Right” scale (1 = “Too low”, too weak, not enough, 2= “Just About Right” and 3 = “Too high, too strong, too much”) for each of the fried sweetpotato samples. The attributes chosen were crispiness, mealiness, colour, sugariness and flavour.

Regarding CATA, consumers were asked to select the quality characteristics that best describe each fried sweetpotato sample from a list of 18 sensory characteristics -the most liked and the least liked collected during the previous Activities 3 & 4, using a “Check-All-That-Apply” (CATA) approach. Finally, consumers were invited to give their opinion and preferences on the fried sweetpotato samples. The CATA quality characteristics (n=18) are shown in **Table 2**. The characteristics are in different font colour depending on whether they were identified during Activity 3, Activity 4 or both.

**Table 2:** Fried sweetpotato quality characteristics identified during the previous Activities 3 & 4 and selected for building the CATA table. Those are the same as for the study in Ghana.

	Quality characteristics of Fried sweetpotat
List of <b>the most liked</b> characteristics	<b>Appearance</b> - Light brown colour - Orange - White - Yellow <b>Odour</b> - Good smell Texture when touching - Soft - Dry <b>Taste</b> - Sugary - Good taste <b>Texture in mouth</b> - Crispy - Soft <b>Perception/Feeling</b> - Filling - Satisfying - Strong
List of <b>the least liked</b> characteristics	<b>Appearance</b> - - <b>Odour</b> - Bad smell <b>Texture when Touching</b> - Hard - <b>Taste</b> - Less sugary - No taste - Burnt <b>Texture in mouth</b> - Hard

\*Blue – Activity 3; Red – Activity 4; Green – Both Activity 3 & 4



Most of the quality characteristics were derived from both the gendered food mapping and participatory processing diagnosis (Activity 3 and 4). Amongst those from Activity 3 was the good smell of sweetpotato. The processors were able to describe the quality characteristics in more detail.

## 2.3 Data analysis

Overall liking of the fried sweetpotato samples was analysed by analysis of variance (one-way ANOVA) to identify significant differences in the scores between the fried sweetpotato samples as tested by the consumers. Multiple pairwise comparisons were applied using the Tukey test, with a confidence interval of 95% at  $p < 0.05$ . An Agglomerative Hierarchical Clustering (AHC) analysis was used to segment consumers into similar groups of overall liking. The influence of socio-demographic characteristics (such as gender, age, ethnicity etc.) and location was tested on different acceptance groups (clusters) using a Chi-square test (SPSS software at  $p < 0.05$ ). For each fried sweetpotato sample, the number of consumers who rated each specific characteristic either 'Just about Right' (JAR), 'Too weak' or 'Too strong' was counted, and the percentage of consumers determined. A Principal Component Analysis (PCA) was conducted on the number of citations for all the CATA quality characteristics, with sweetpotato varieties as the observation labels, and the mean overall liking for each sample as a supplementary quantitative variable. All statistical analyses were performed using XLSTAT 2014 software (Addinsoft).

## 3 RESULTS

### 3.1 Overall liking of the fried sweetpotato samples

Overall liking scores for fried sweetpotato in Kwara state is shown in **Table 3**. Generally, all the varieties in Kwara were liked albeit variably. Three groups of overall liking emerged. Alausa (7.7) and Aragbe (7.5) close to 'like very much' were most liked and were significantly different from the least liked Mother's Delight (6.2) which was only liked slightly.

**Table 3:** Mean overall liking scores for the fried sweetpotato samples tested in Kwara

Fried sweetpotato samples	Mean overall liking scores*	Groups**	
Alausa	7.7	A	
Aragbe	7.5	A	
Tomude	7.1	A	B
Elege	7.1	A	B
Pakurumon	6.8	A	B
Mother's Delight	6.2		B

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

\*\*Different letters correspond to the products, which are significantly different. Tukey test ( $p < 0.05$ ).

A third, intermediate group of moderate liking consisted of Tomude (7.1), Elege (7.1) and Pakurumon (6.8). These were not significantly different from either Alausa and Aragbe or Mother's Delight.

The mean overall liking scores for fried sweetpotato in Kano state are shown in **Table 4**. All the fried sweetpotato samples were liked and the scores were not significantly different.



**Table 4:** Mean overall liking scores for the fried sweetpotato samples tested in Kano

Fried sweetpotato samples	Mean overall liking scores*	Groups**
Dan Izala	7.9	A
Dan China	7.9	A
Dan Barmawa	7.7	A
Dan Madagali	7.7	A
Dan Silver	7.7	A
Mother's Delight	7.4	A
Dan Bakalori	7.3	A

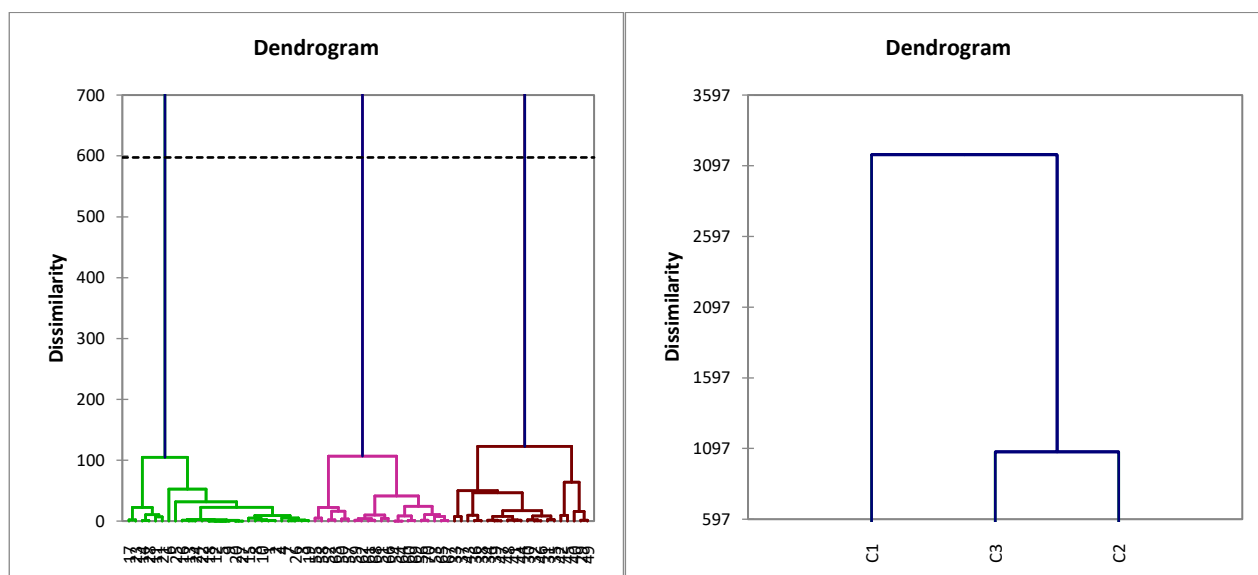
\*Overall liking was rated on a nine-point scale from 1 = dislike extremely, to 9 = like extremely.

\*\*Different letters correspond to the products, which are significantly different. Tukey test ( $p < 0.05$ ).

However, Dan Izala, Dan China, Dan Barmawa, Dan Madagali and Dan Silver were closer to the 'like very much' threshold compared to Mother's Delight and Dan Bakalori which were closer to 'Like moderately'.

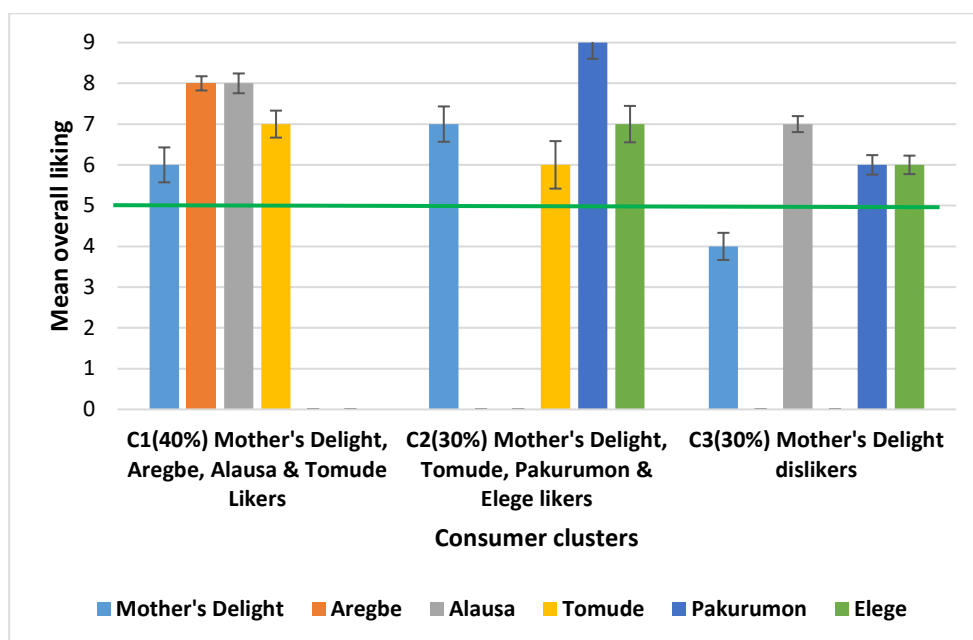
### 3.2 Segmentation of consumers into groups of similar overall liking

The Agglomerative Hierarchical Cluster analysis of mean overall liking scores among consumers of the fried sweetpotatoes in Kwara provided three distinct groups namely; Mother's Delight, Aragbe, Alausa & Tomude likers (40%), Mother's Delight, Tomude, Pakurumon & Elege likers (30%) and Mother's Delight dislikers (30%) (**Figure 1 and Figure 2**).



**Figure 1:** Segmentation of the consumers based on their overall liking scores of the fried sweetpotato in Kwara, Nigeria

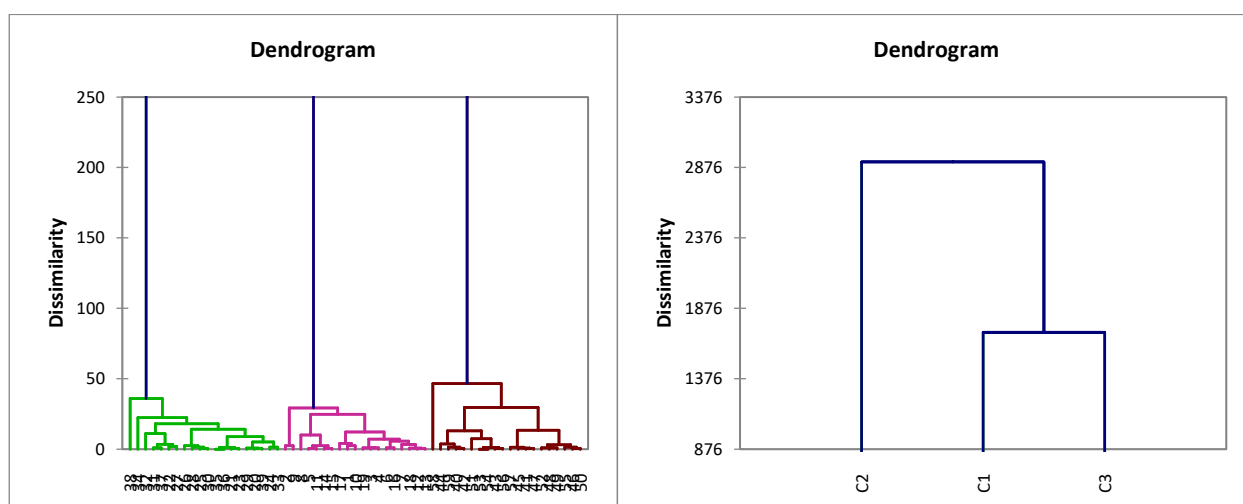




**Figure 2:** Mean overall liking of the fried sweetpotatoes by consumer segment (%) in Kwara, Nigeria (error bars represent the standard error)

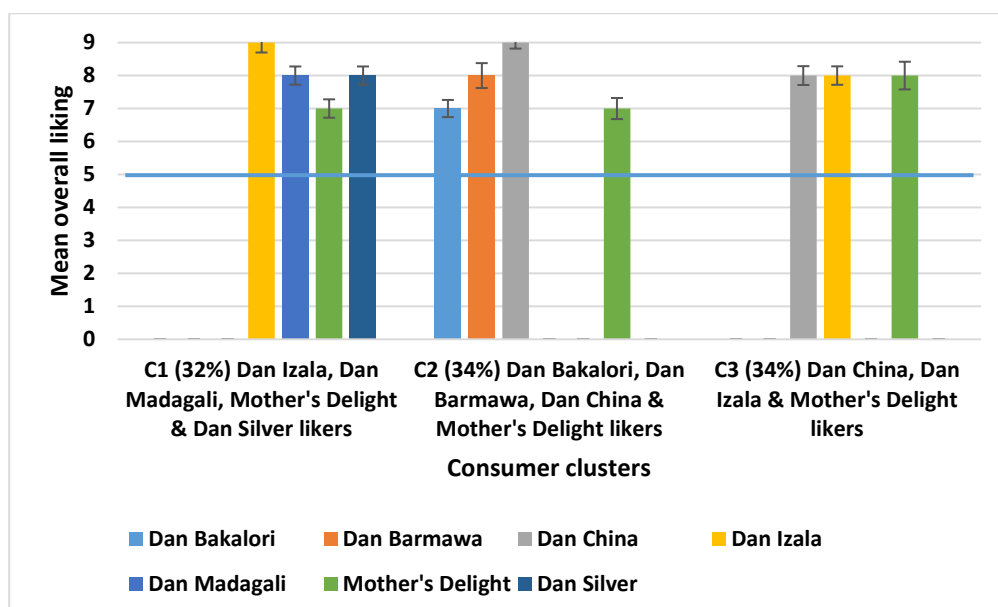
Consumers in the cluster 1 liked all the varieties scoring them 6 (like slightly) to 8 (like very much) corresponding to Mother's Delight and jointly Aragbe and Alausa respectively. Pakurumon with a score of 9 (like extremely) was liked most in cluster 2 with Tomude only liked slightly. Cluster 3 consumers did not like Mother's delight (4, dislike slightly).

The Agglomerative Hierarchical Cluster analysis of mean overall liking scores among consumers of the fried sweetpotatoes in Kano also generated three distinct groups namely; Dan Izala, Dan Madagali, Mother's Delight & Dan Silver likers (32%), Dan Bakalori, Dan Barmawa, Dan China & Mother's Delight likers (34%) and Dan China, Dan Izala & Mother's Delight likers (34%). (**Figure 3 and Figure 4**).



**Figure 3:** Segmentation of the consumers based on their overall liking scores of the fried sweetpotato in Kano, Nigeria





**Figure 4:** Mean overall liking of the fried sweetpotatoes by consumer segment (%) in Kano, Nigeria (error bars represent the standard error)

Consumers in all the clusters liked all the varieties scoring them 7 (like moderately) to 9 (like extremely). Dan Izala and Dan China with a score of 9 (like extremely) were the most liked coming from cluster 1 and 2 respectively. Mother's Delight was liked moderately (7) in cluster 1 and 2 while Dan Bakalori was also liked moderately in cluster 2.

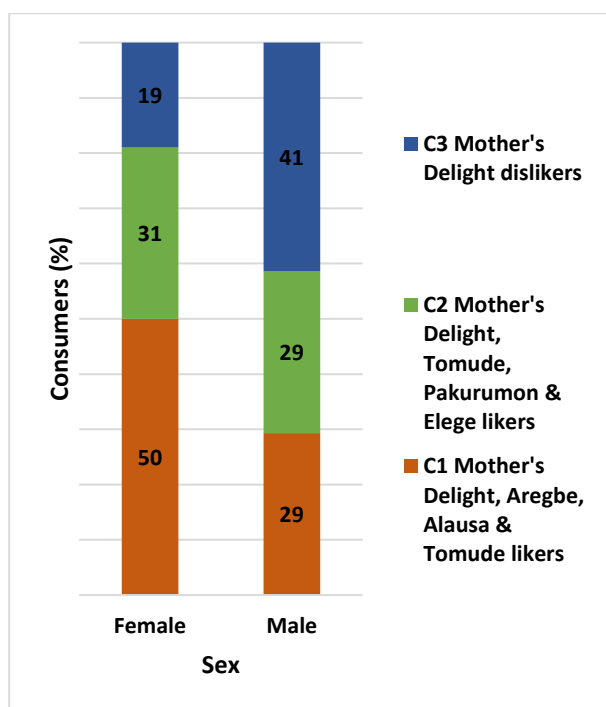
One of the difficulties of the clustering exercise is that not the same varieties were tested by all the consumers: the Agglomerative Hierarchical Clustering for both Kwara and Kano states had a drawback in that it was limited to the testing sublocations. This is because for the most part, different varieties were used at each site. Only Mother's Delight was tested at all locations. The clusters as they are presented here may not therefore give an optimum segmentation but we did not find a better way to present those.

### 3.2.1 Demographic data of the consumers interviewed

Demographic information and cluster distribution of consumers of fried sweetpotatoes in Kwara is shown in **Table 5**. Of the 70 consumers, more were from Agbamu (40%) compared to Ijagbo and Offa (30%). Also, there were slightly more women (51%) than men (49%). An overwhelming majority of consumers were from the Yoruba ethnic group (91%), Muslim religion (64%) and married (73%). Regarding age group there were slightly more consumers in the youthful (18-25) and elderly ( $\geq 56$ ) categories (27%). A fair number of consumers had a secondary education (30%) and the main occupation was trading (41%).

In terms of cluster distribution, more women were in cluster 1 (50%) thus likers of Mother's Delight, Aragbe, Alausa and Tomude whereas more men were Mother's Delight dislikers (41%) (**Figure 5**). However, this difference was not significant ( $p > 0.05$ , Chi-square).





**Figure 5:** Fried sweetpotato consumer segmentation by gender in Kwara, Nigeria

Consumer segmentation varied according to test location. Those in Agbamu were all in cluster 1 (Mother's Delight, Aragbe, Alausa & Tomude likers), Ijagbo in cluster 2 (Mother's Delight, Tomude, Pakurumon & Elege likers) and Offa in cluster 3 (Mother's Delight dislikers). The differences among consumers by location were significant ( $p < 0.05$ , Chi-square).

Also significant differences between consumer clusters were realised for occupation, marital status and religion. Differences between clusters regarding ethnicity, educational level, and age group were not significant.

**Table 5:** Demographic differences of the consumers of fried sweetpotato with respect to cluster – Kwara

		% of consumers (n=70)	C1 Mother's Delight, Aragbe, Alausa & Tomude likers	C2 Mother's Delight, Tomude, Pakurumon & Elege likers	C3 Mother's Delight dislikers	Chi-square test ( $p < 0.05$ )
Consumers			40	30	30	
Location %	Agbamu	40	100	0	0	< 0.0001
	Ijagbo	30	0	100	0	
	Offa	30	0	0	100	
Gender %	Female	51	50	31	19	0.0996
	Male	49	29	29	41	
Ethnicity %	Fulani	1	100	0	0	0.3163
	Ghanaian	3	100	0	0	
	Idoma	1	0	100	0	
	Igala	1	0	0	100	
	Iyagba	1	0	100	0	
	Yoruba	91	39	30	31	
Age Group %	18-25	27	26	26	47	0.2490
	26-35	17	42	33	25	
	36-45	13	44	11	44	

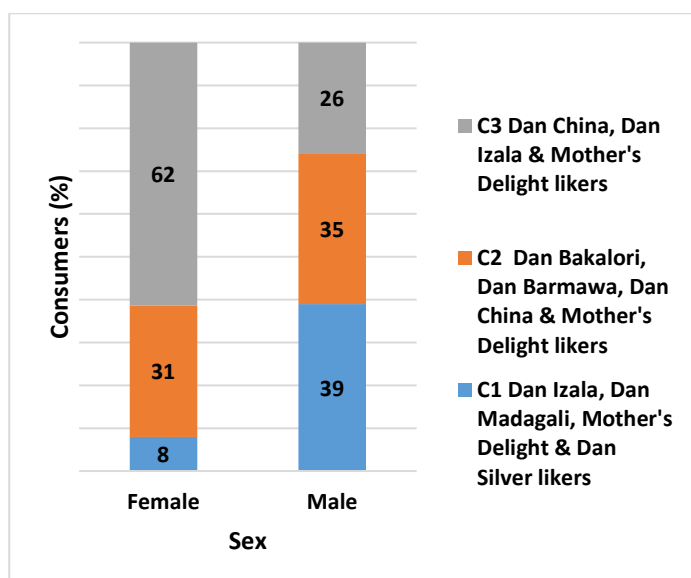


		% of consumers (n=70)	C1 Mother's Delight, Aragbe, Alausa & Tomude likers	C2 Mother's Delight, Tomude, Pakurumon & Elege likers	C3 Mother's Delight dislikers	Chi-square test (p<0.05)
	46-55	16	55	18	27	
	>56	27	42	47	11	
Education level %	Basic (Primary/JHS/Middle)	9	67	17	17	0.1901
	No formal education	14	50	50	0	
	Other	37	46	23	31	
	Secondary	30	24	29	48	
	Tertiary (Training college/Polytechnic/university)	10	29	43	29	
Occupation %	Caterer	1	100	0	0	0.0314
	Footballer	1	0	0	100	
	Full time crop farmer	14	50	30	20	
	Part time crop farmer	1	0	100	0	
	Salary worker	3	50	0	50	
	Student	11	13	0	88	
	Trader	41	52	34	14	
	Tradesman/self-employed (bricklayer, carpenter, tailor, etc)	26	28	39	33	
Marital status %	Married	73%	51	25	24	< 0.0001
	Single	19%	15	15	69	
	Widow	9%	0	100	0	
Religion %	Christian	36%	44	48	8	0.0049
	Muslim	64%	38	20	42	

Demographic information and cluster distribution of consumers of fried sweetpotatoes in Kano is shown in **Table 6**. More consumers were from Garko (34%) and Bagwai (32%) and less so for Kano rural and Kano city (both 17%). Also, there were significantly more men (78%) than women (22%). Most of consumers were from the Hausa ethnic group (92%), Muslims (95%) and married (86%). Regarding age group, there were slightly more 26-35 year old consumers. A good number of consumers had a basic and tertiary education (both 32%). Most consumers indicated that they were salary workers (31%).

Cluster distribution showed that more women were in cluster 3 (62%) thus likers of Dan China, Dan Izala and Mother's Delight. The men were slightly more in cluster 1 (39%) thus likers of Dan Izala, Dan Madagali, Mother's Delight and Dan Silver (**Figure 6**). These differences by sex were significant ( $p<0.05$ , Chi-square).





**Figure 6:** Fried sweetpotato consumer segmentation by gender in Kano, Nigeria

Similar to Kwara state, consumer segmentation varied according to test location. Bagwai represented cluster 1 (Dan Izala, Dan Madagali, Mother's Delight & Dan Silver likers), Garko cluster 2 (Dan Bakalori, Dan Barmawa, Dan China & Mother's Delight likers), Kano rural and city in cluster 3 (Dan China, Dan Izala & Mother's Delight likers). The differences among consumers by location were significant ( $p < 0.05$ , Chi-square).

**Table 6:** Demographic differences of the consumers of fried sweetpotato with respect to cluster – Kano

		% of consumers (n=59)	C1 Dan Izala, Dan Madagali, Mother's Delight & Dan Silver Likers	C2 Dan Bakalori, Dan Barmawa, Dan China & Mother's Delight Likers	C3 Dan China, Dan Izala & Mother's Delight Likers	Chi-square (p<0.05)
Consumers			32	34	34	
Location	Bagwai	32	100	0	0	< 0.0001
	Garko	34	0	100	0	
	Kano	17	0	0	100	
	Kano city	17	0	0	100	
Gender	Female	22	8	31	62	0.0315
	Male	78	39	35	26	
Ethnicity	Fulani	3	50	0	50	0.4998
	Hausa	92	33	37	30	
	Ibo	2	0	0	100	
	Igede	2	0	0	100	
	Nupe	2	0	0	100	
Age Group	18-25	10	50	0	50	0.1126
	26-35	32	42	16	42	
	36-45	22	38	38	23	
	46-55	29	18	53	29	
	>56	7	0	75	25	
Education level	Basic (Primary/JHS/Middle)	32	47	32	21	0.0233
	No formal education	5	67	33	0	
	Other	2	0	100	0	



		% of consumers (n=59)	C1 Dan Izala, Dan Madagali, Mother's Delight & Dan Silver Likers	C2 Dan Bakalori, Dan Barmawa, Dan China & Mother's Delight Likers	C3 Dan China, Dan Izala & Mother's Delight Likers	Chi-square (p<0.05)
	Secondary	17	50	40	10	
	Tertiary (Training college/Polytechnic/university)	32	5	26	68	
	Vocational/technical/commercial	12	29	43	29	
Occupation	Full time crop farmer	29	35	65	0	< 0.0001
	Part time crop farmer	12	71	29	0	
	Salary worker	31	6	22	72	
	Student	15	22	0	78	
	Trader	12	71	29	0	
	Tradesman/self-employed (bricklayer, carpenter, tailor, etc)	2	0	100	0	
Marital status	Married	86	33	37	29	0.1626
	Single	14	25	13	63	
Religion	Christian	3	0	0	100	0.2027
	Muslim	95	34	34	32	
	Traditional	2	0	100	0	

Also significant differences between consumer clusters were realised for education level and occupation. Differences between clusters regarding ethnicity, marital status, religion and age group were not significant.

### 3.2.2 Consumption attitudes

Frequency of consumers of fried sweetpotato in Kwara was mostly two to three times a week (54%) followed distantly by everyday (13%) (**Table 7**). Therefore it was often consumed but not as the main dish.

**Table 7:** Consumption attitudes of the consumers of fried sweetpotato – Kwara

Consumption pattern		% of consumers (n=70)
Consumption frequency	A few times a month	11
	Every day	13
	Once a month	10
	Once a week	11
	Two or three times a week	54
Form of consumption	Plain	6
	Salted	40
	With Pepper	54
	With Tea	3
	Other form (With beans)	10



Consumption pattern		% of consumers (n=70)
Occasion of consumption	Breakfast	20
	Lunch	44
	In between meals	29
	Dinner	6

In addition, fried sweetpotato was mostly consumed with pepper (54%) followed by salted (40%). The other form of consumption was with beans (10%). The consumers reported that fried sweetpotato was mainly consumed at lunch (44%) followed by in between meals (11%).

**Table 8** shows that fried sweetpotato in Kano was mostly consumed two to three times a week (54%) followed distantly by everyday (13%). Therefore it was often consumed.

**Table 8:** Consumption attitudes of the consumers of fried sweetpotato – Kano

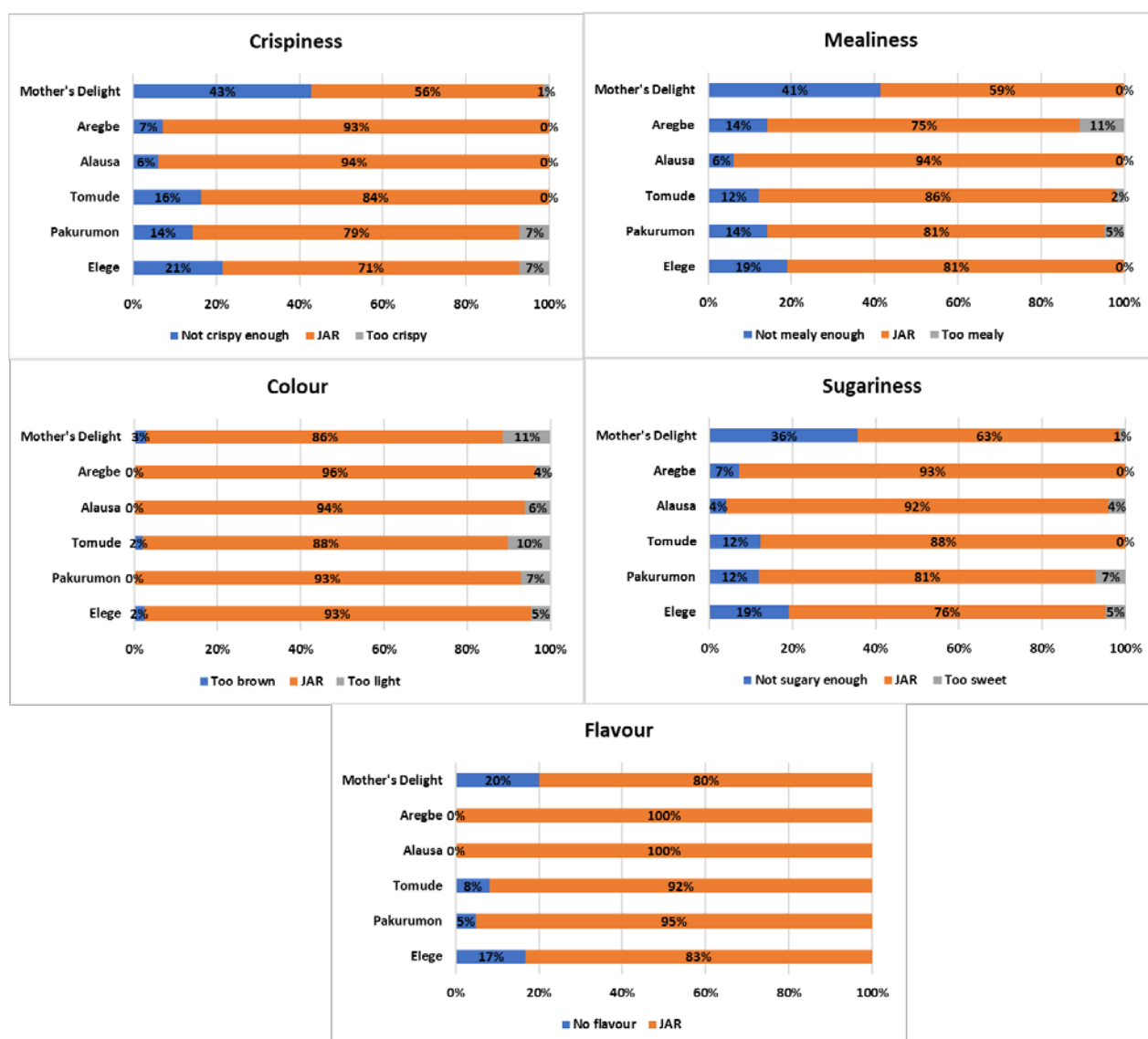
Consumption pattern		% of consumers (n=59)
Consumption frequency	A few times a month	2
	Every day	5
	Once a month	8
	Once a week	29
	Two or three times a week	56
Form of consumption	Plain	12
	Salted	10
	With Akara	2
	With Pepper	34
	With Tea	10
	Other (with sauce)	27
Occasion of consumption	Breakfast	53
	Lunch	20
	Snack (In between meals)	7
	Dinner	15

Similar to Kwara, fried sweetpotato was mostly consumed with pepper (34%). It was also consumed in other forms (with sauce, 27%) as well as plain (12%). Different from consumers in Kwara, those in Kano indicated that fried sweetpotato was mainly consumed at breakfast (53%) followed by lunch (20%).

### 3.3 A Just About Right test (JAR)

The six fried sweetpotatoes in Kwara were scored by consumers for intensity of crispiness, mealiness, colour, sugariness and flavour (**Figure 7**). All the samples were scored JAR for crispiness, mealiness, colour, sugariness and flavour by more than 50% of the consumers. In terms of crispiness, Alausa (94%) and Aragbe (93%) scored highest while Mother's Delight (56%) was lowest. Mother's Delight also had a higher number of consumers rating it 'not crispy enough' (43%).



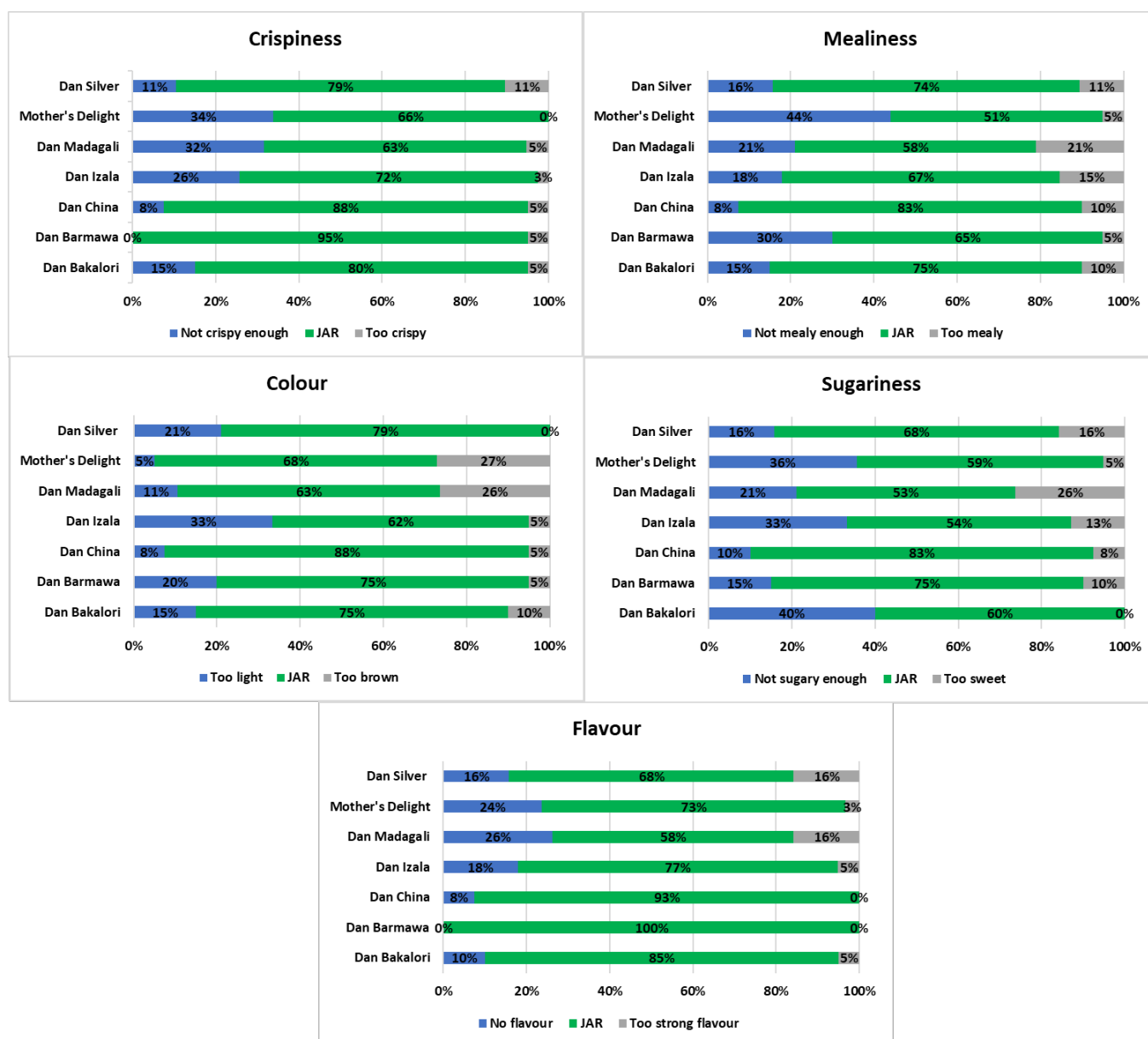


**Figure 7:** Percentage of consumers who scored the five quality attributes (crispiness, mealiness, colour, sugariness and flavour) using a 3-point JAR test in Kwara

Colour and flavour were well appreciated for all the samples with at least 80% of consumers rating them JAR. Generally, Mother's Delight had relatively lower JAR score for all the attributes albeit being above the 50% threshold.

The intensity of crispiness, mealiness, colour, sugariness and flavour of the seven fried sweetpotatoes in Kano is represented in **Figure 8**. Similar to Kwara, all the samples were scored JAR by more than 50% of consumers for the five attributes. Dan Barmawa was highest for crispiness (95% JAR), Dan China for mealiness (83%), colour (88%) and sugariness (83%) while for flavour it was Dan Barmawa (100%).





**Figure 8:** Percentage of consumers who scored the five quality attributes (crispiness, mealiness, colour, sugariness and flavour) using a 3-point JAR test in Kano

A relatively lower number of consumers scored Dan Madagali JAR for crispiness (63%), sugariness (53%) and flavour (58%), Mother's Delight for mealiness (51%), Dan Izala for colour (62%).

### 3.4 Check All That Apply (CATA) test

The frequencies for the most cited sensory characteristics, which best described the fried sweetpotato products in Kwara are shown in **Table 9**. The most cited characteristics (>100 citations) were; Good smell (231), Good taste (224), Satisfying (203), Yellow (200), Filling (173), Soft (162), Dry (132) and Crispy (118). Those cited least ( $\leq 20$  citations) were; Hard (20), Bad smell (14), White (5) and Burnt (1).



**Table 9:** Frequency of citations of each quality characteristic by consumers of fried sweetpotato in Kwara

Quality characteristics/Sample	Elege	Pakurumo	Tomude	Alausa	Aragbe	Mother's Delight	Total
Good smell	36	37	39	47	25	47	231
Good taste	32	39	35	45	27	46	224
Satisfying	29	36	41	40	26	31	203
Yellow	37	34	41	48	26	14	200
Filling	24	29	36	36	22	26	173
Soft	19	24	23	22	13	61	162
Dry	21	22	21	29	17	22	132
Crispy	21	18	25	26	16	12	118
Less sugary	16	14	14	11	8	34	97
Orange	1	4	7	0	1	54	67
Light brown colour	11	9	5	5	2	12	44
No Taste	5	1	3	0	0	15	24
Sugary	4	3	4	4	1	6	22
Strong	3	6	4	2	3	3	21
Hard	6	5	4	3	0	2	20
Bad smell	2	1	4	0	1	6	14
White	1	1	2	0	0	1	5
Burnt	1	0	0	0	0	0	1
<b>Overall Liking</b>	<b>7.1</b>	<b>6.8</b>	<b>7.1</b>	<b>7.7</b>	<b>7.5</b>	<b>6.2</b>	

Of the most cited characteristics, Alausa and Mother's Delight had the highest number of citations for Good smell (47), Good taste (45 and 46 respectively). Tomude was satisfying (41) and Alausa yellow (48), filling (36), dry (29) and crispy (26). More consumers indicated that Mother's Delight was soft (61) and orange (54%).

**Table 10** shows the frequencies for the most cited sensory characteristics, which best described the fried sweetpotato products in Kano. The most cited characteristics (>100 citations) were; Soft (221), Good smell (207), Good taste (174), Light brown colour (134), Less sugary (124), and Satisfying (114). The least cited (<20 citations) were; No Taste (17), Dry (14), Bad smell (14) and Burnt (4)

**Table 10:** Frequency of citations of each quality characteristic by consumers of fried sweetpotato in Kano

Quality characteristics/Sample	Dan Bakalori	Dan Barmawa	Dan China	Dan Izala	Dan Madagali	Mother's Delight	Dan Silver	Total
Soft	13	16	34	34	59	51	14	221
Good smell	18	19	34	29	53	43	11	207
Good taste	17	17	36	19	37	38	10	174
Light brown colour	11	13	21	20	39	19	11	134
Less sugary	14	6	11	16	32	40	5	124
Satisfying	6	9	22	14	30	24	9	114
White	9	6	7	17	26	2	7	74
Yellow	6	4	18	9	21	11	4	73
Filling	2	7	14	11	20	14	4	72
Sugary	1	6	14	13	24	7	5	70
Orange	1	4	6	3	9	43	1	67
Crispy	12	9	13	6	12	5	2	59
Hard	3	2	4	3	10	6	3	31



Quality characteristics/ Sample	Dan Bakalori	Dan Barmawa	Dan China	Dan Izala	Dan Madagali	Mother's Delight	Dan Silver	Total
Strong	6	1	2	3	7	1	3	23
No Taste	0	0	1	4	7	5	0	17
Dry	4	3	1	1	2	0	3	14
Bad smell	1	1	3	2	5	2	0	14
Burnt	3	0	1	0	0	0	0	4
Overall liking	7.3	7.7	7.9	7.9	7.7	7.4	7.7	

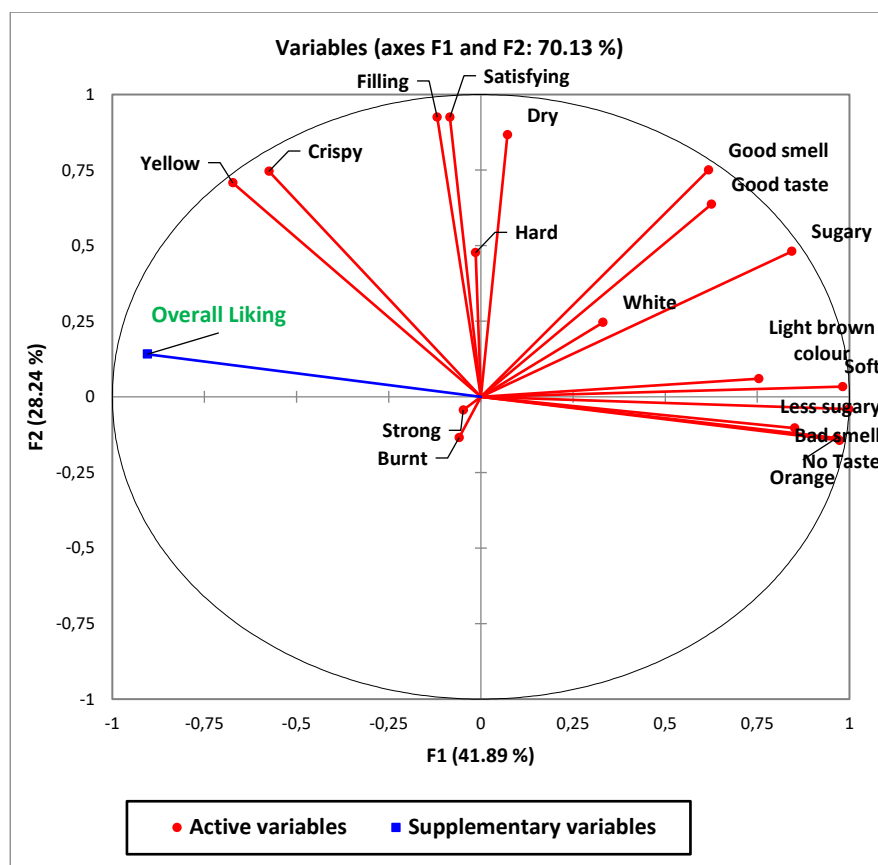
Fried sweetpotatoes with most citations among the leading characteristics were; Dan Madagali for Soft (59), Good smell (53), Light brown colour (39) and Satisfying (30), Mother's Delight for Good taste (38) and Less sugary (40).

### 3.5 Mapping of the sensory characteristics

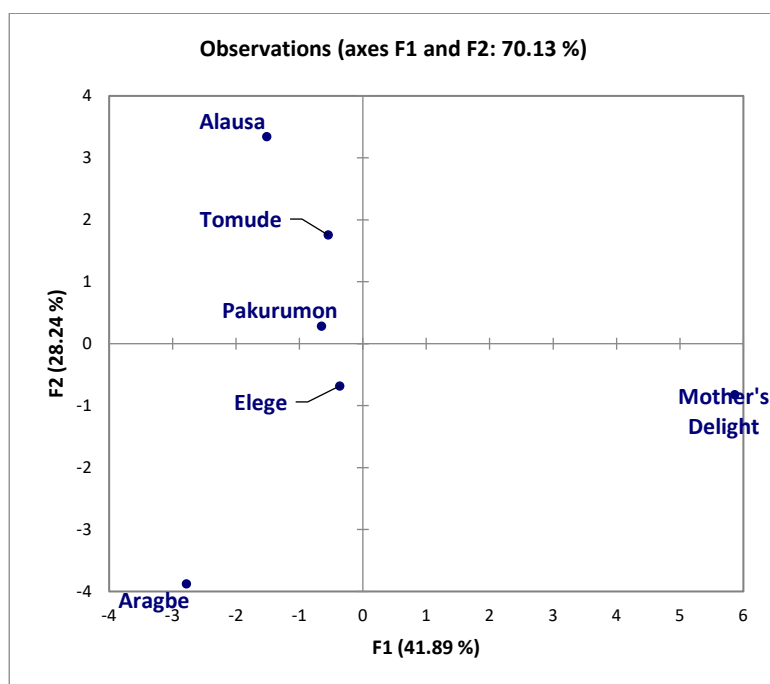
Principal component analysis (PCA) was used to summarize the relationships between CATA sensory characteristics, fried sweetpotato samples, and mean overall liking of each product scored by all the consumers.

The PCA plot for Kwara explained 70.13% of sensory characteristic variance (F1 41.89% and F2 28.24%). Most of the variance was explained by the first axis (**Figure 9**).

A positive mean overall liking was not associated with any characteristic or fried sweetpotato sample. Alausa fried sweetpotato was linked with; Filling, Satisfying, Dry, Good smell, Crispy and Yellow. Fried sweetpotato from Mother's Delight was associated with Less sugary, Soft, , Orange, Sugary, and Light brown colour. However, it was also tagged to 'No Taste' and 'Bad smell'. Elege was associated with 'Hard' and 'Burnt'. Tomude had a weak squared cosine (below 0.5) and was weakly linked with 'Strong' (0.44 squared cosine). Pakurumon and Aragbe were not described by any of the characteristics.

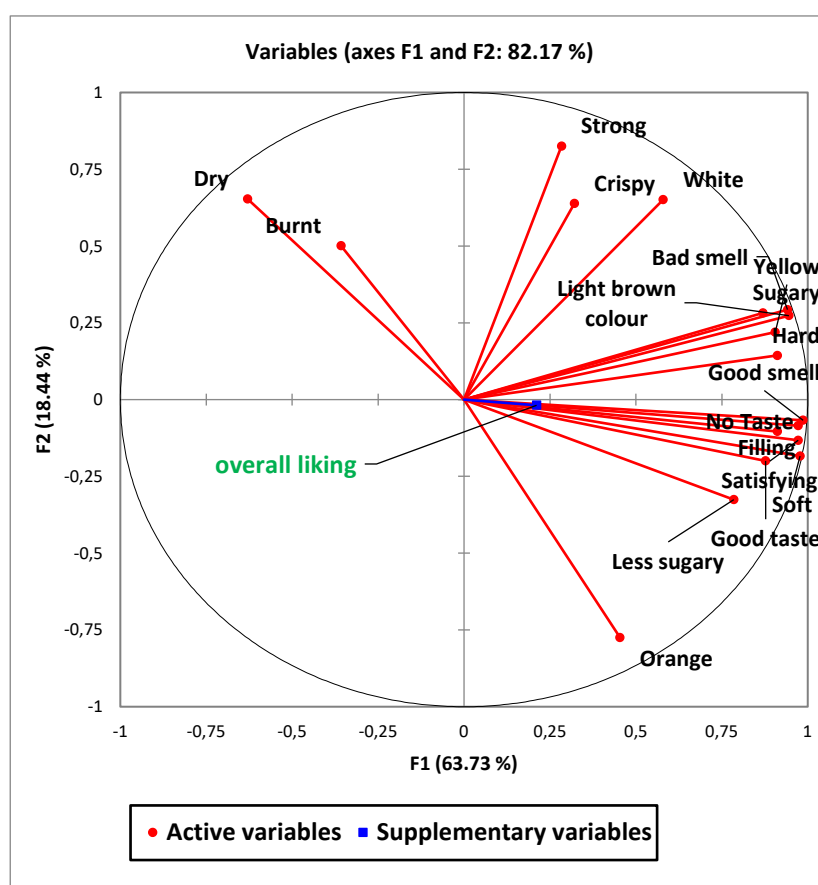




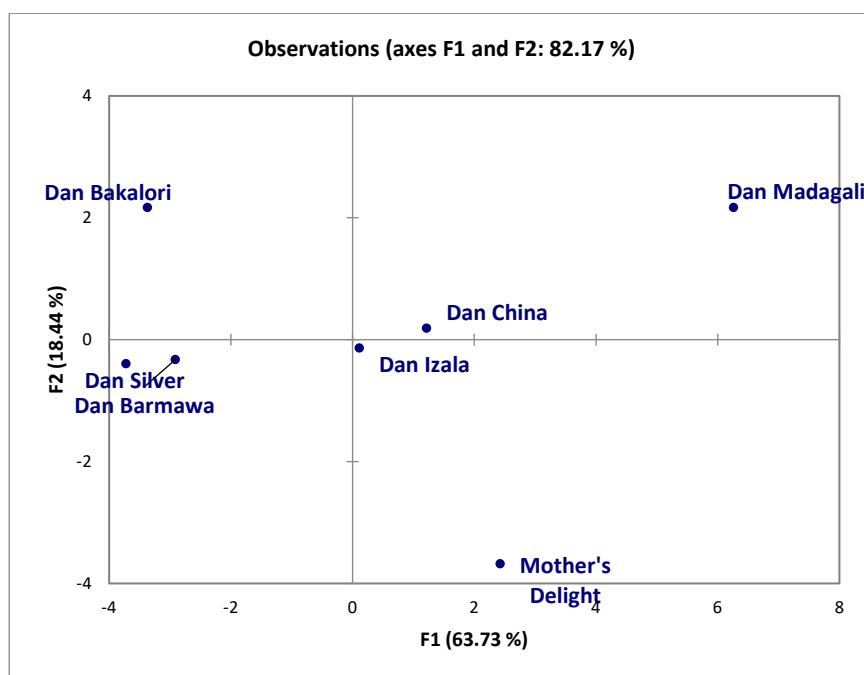


**Figure 9:** Mapping of the sensory characteristics and the overall liking of the fried sweetpotatoes in Kwara

The PCA plot for Kano explained 82.17% of sensory characteristic variance (F1 63.73% and F2 18.44%). Most of the variance was explained by the first axis (**Figure 10**). Similar to Kwara, positive mean overall liking was not associated with any characteristic or fried sweetpotato sample in Kano.







**Figure 10:** Mapping of the sensory characteristics and the overall liking of the fried sweetpotatoes in Kano

Dan Madagali was associated with most of the characteristics such as; Good smell, Soft, Satisfying, Filling, Light brown colour, Hard, Yellow, Good taste, Sugary and Less sugary. It was also linked with negative characteristics such as 'Bad smell' and 'No Taste'. Mother's Delight was described as 'Orange'. Dan Bakalori, Dan Barmawa, Dan China, Dan Izala and Dan Silver were not associated with any of the sensory characteristics.

## 4 DISCUSSION

Demographic data showed that Kwara had slightly more women (51%) than men (49%) whereas Kano had significantly more men (78%) than women (22%). Consumers in Kwara were mostly of the Yoruba ethnic group while those in Kano were Hausa. In both regions they were mostly Muslims and married. Consumers were a balanced mix of youth, middle aged and elderly in both Kwara and Kano. Those in Kwara had secondary education and were mostly traders while in Kano more consumers had tertiary education and were salary workers. In terms of consumption attitude, fried sweetpotato was consumed 2-3 times a week and, with pepper in both Kwara and Kano. Consumers in Kwara indicated that fried sweetpotato was mostly consumed at lunch while those in Kano had theirs at breakfast.

Alausa and Aragbe had the highest overall liking score in Kwara state while Mother's delight had the lowest. This was also corroborated by the Agglomerative Hierarchical Clustering (AHC) where consumers in cluster three (30%) indicated that they disliked Mother's delight slightly. In the JAR test, Mother's Delight had relatively lower score for crispiness, mealiness, colour, sugariness and flavour intensity although all were above the threshold of 50% of consumers. Not surprisingly, Alausa and Aragbe scored highest for intensity rating of these attributes. In addition, the CATA showed that the most liked Alausa had slightly more consumers describing it as; 'Good smell', 'Good taste', 'Yellow', 'Filling', 'Dry' and 'Crispy'. Interestingly, Mother's Delight was also cited for good smell and taste in addition to soft and orange. Mapping of sensory characteristics by principal component analysis showed that Alausa fried sweetpotato was linked with; 'Filling', 'Satisfying', 'Dry', 'Good smell', 'Crispy' and 'Yellow'. Mother's Delight was associated with 'Less sugary', 'Soft', 'Orange', 'Sugary', and 'Light brown colour'. However, it was also tagged to 'No Taste' and 'Bad smell'. This could explain why it was disliked by some consumers. These findings are largely in agreement with



Ssali *et al* (2021) who reported that the yellow-fleshed Alausa was the most preferred and cultivated variety by both men and women in Kwara. Some of the sensory attributes cited included; low sugariness (men). More so, processors in this study indicated that moderate Alausa and Pakurumo were most preferred for frying due desirable sugariness, hardness, (low moisture content), good appearance, crispness and satisfying (filling). In addition, processors indicated that fried sweetpotato from Mother's Delight was not crispy and required 'too much oil to fry'.

In Kano, all the varieties were not significantly different. In fact, all the consumers in the three AHC clusters liked all the fried sweetpotato samples. However, Dan Izala, Dan China, Dan Barmawa, Dan Madagali and Dan Silver were closer to the 'like very much' threshold compared to Mother's Delight and Dan Bakalori which tended towards 'Like moderately'. Consumers could not clearly separate the fried sweetpotato samples in terms of preference. This could perhaps be attributed to the fact that most consumers in Kano were men who may not be able to discern the subtle sensory differences compared to women. Women play an important role in preparation and consumption of sweetpotato in the households (Mwanga *et al.*, 2021). All the samples were scored JAR by more than 50% of consumers for crispiness, mealiness, colour, sugariness and flavour. The CATA in Kano showed that Dan Madagali was most cited for; Soft, Good smell, Light brown colour and Satisfying while Mother's Delight led in terms of Good taste and Less sugary. Mapping of sensory characteristics by principal component analysis in Kano showed Dan Madagali was associated with most of the characteristics such as Good smell, Soft, Satisfying, Filling, Light brown colour, Hard, Yellow, Good taste, Sugary and Less sugary. On the contrary, it was also linked with negative characteristics such as 'Bad smell' and 'No Taste'. Dan Izala, Dan Bakalori and Dan China were mentioned among the main varieties grown in Kano state for various reasons including good taste and softness of the flesh as mentioned by women (Ssali *et al.*, 2021). The processors in this study reported that the most popular Dan Izala and least suitable Dan Silver (according to gendered food mapping) both produced mealy and crispy chunks. Once again, Mother's Delight fried chunks were deemed soft and soggy.

## 5 CONCLUSION

Consumers' assessment of the fried sweetpotato samples was similar to the processors (activity 4) with slight variations. In addition, the gendered food mapping (activity 3) also served up some differences in terms of varietal preference when compared to activities 4 and 5. Therefore, differences in preference by different end-users and gender are key to adoption and utilisation of varieties which breeders need to take note of. The outstanding varieties such as Alausa could be used as a yardstick for preferred characteristics by breeders. In addition, the perceived sensory attributes such as mealiness and crispness are a function of physico-chemical parameters such as dry matter and starch content. Therefore WP2 could explore these further.



## 6 REFERENCES

Fliedel, G., Kleih, U., Bechoff, A. and Forsythe, L., 2018. RTBfoods Step 4: Consumer testing in rural and urban areas.

Mwanga, R.O., Mayanja, S., Swanckaert, J., Nakitto, M., Zum Felde, T., Grüneberg, W., Mudege, N., Moyo, M., Banda, L., Tinyiro, S.E. and Kisakye, S., (2021). Development of a food product profile for boiled and steamed sweetpotato in Uganda for effective breeding. *International journal of food science & technology*, 56(3), pp.1385-1398.

Ssali, R., Carey, E., Imoro, S., Low, J.W., Dery, E.K., Boakye, A., Oduro, I., Omodamiro, R.M., Yusuf, H.L., Etwire, E. and Iyilade, A.O., (2021). Fried sweetpotato user preferences identified in Nigeria and Ghana and implications for trait evaluation. *International Journal of Food Science & Technology*, 56(3), pp.1399-1409.





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