

Consumer Testing of Eba 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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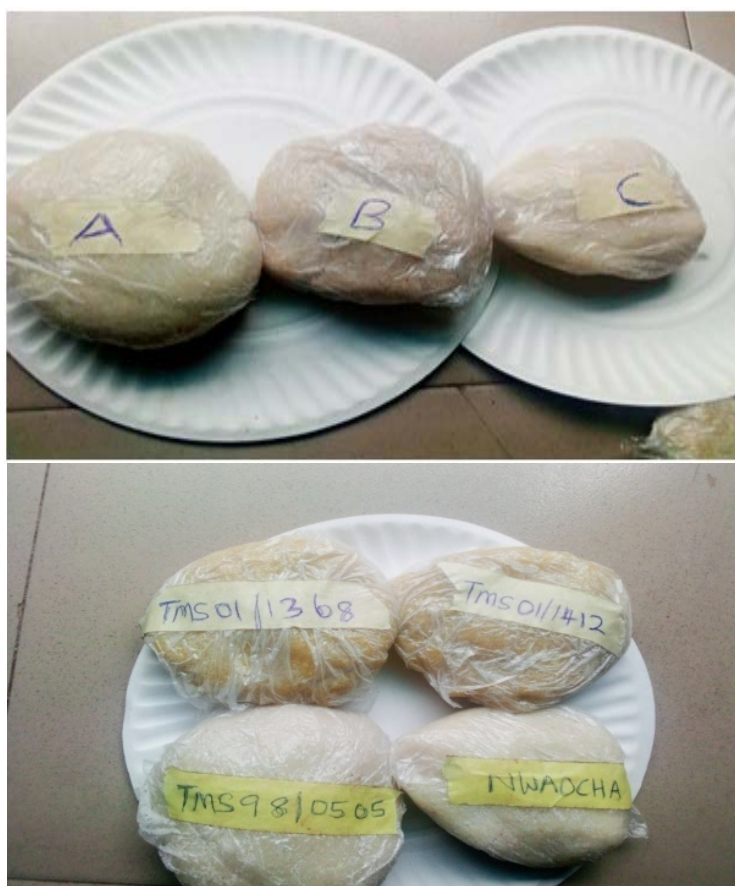
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Ethics: The activities, which led to the production of this manual, were assessed and approved by the CIRAD Ethics Committee (H2020 ethics self-assessment procedure). When relevant, samples were prepared according to good hygiene and manufacturing 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 panelists and from consumers participating in activities.

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ABSTRACT

Consumer testing of Eba was conducted in rural and urban areas of Imo state in South-East Nigeria using hedonic, Just-About-Right (JAR) and CATA tests. A majority (69.3%) of the consumers interviewed (n=150) were women and only a third (30.7%) were men. Four Eba products were made from varieties with different quality characteristics during the Activity 4 “Processing diagnosis”, and were tested with consumers in Activity 5. The Eba products were processed from the following cultivars: improved varieties: TMS 01/1368, TMS 01/1412, TMS 98/0505 and local: Nwaocha. The most liked Eba samples were TMS 98/0505 with a mean overall liking score of 6.1 followed by Nwaocha and TMS 01/1412 with a medium score close to 5, ‘neither like nor dislike’ (5.4 and 4.8, respectively). The least liked was TMS 01/1368 sample with a mean overall liking score of 2.1 (‘dislike very much’). TMS 01/1412 and 01/1368 were from recently developed biofortified yellow cassava varieties while Nwaocha and TMS 98/0505 were from white cassava varieties. The Agglomerative Hierarchical Clustering analysis of the mean overall liking scores identified three groups of consumers. No variety fulfilled the hedonic acceptability expectations for all groups of consumers (this means that there were no cluster of ‘all likers’) while TMS 01/1368 was scored lower than 3 for all groups of consumers.

The graphic representation of sensory characteristics on PCA plan highlighted the high quality characteristics of eba in Y axis, while the poor quality characteristics were reported in X axis. The most liked Eba samples (TMS 98/0505 and Nwocha) were associated to the high quality characteristics such as ‘good aroma’, ‘yellow’, ‘stretchy’, ‘smooth’, ‘not mouldable’, ‘sour’ but also ‘fibre/dirt/particles’. An important observation was that the smoothness of the four eba samples evaluated was considered JAR by only 31.3 to 39.2% of consumers and could explain the low score i.e. 6.1 (like slightly) given to the highest quality Eba sample. Lack of smoothness and lumps in the product may highlight that the eba samples may not have been processed from gari in an optimal manner (i.e. inadequate water temperature, water amount, stirring time...).

Key Words: Cassava, Eba, hedonic testing, Check-All-That-Apply analysis, consumer liking, consumption habits, Just-About-Right analysis, sensory quality characteristics.

1 STUDY CONTEXT AND GENERAL OBJECTIVES

Some sensory characteristics of Eba were collected during previous Activity 3 on Gendered Food Mapping and Activity 4 on processing diagnosis and quality characteristics. The final activity (Activity 5) under WP1 of the RTBFoods project was focused on consumer testing. The main aim of this Activity 5 is to understand the consumers' demand for the quality characteristics of Eba, a cooked dough made from Gari, a traditional cassava granulated and fermented product, in Nigeria.

Another aim is to provide WP2, a clear and visual mapping of the most liked Eba samples associated with high quality characteristics and high overall liking scores, and of the least liked Eba samples associated with low quality characteristics and low overall liking scores. The activity consists in inviting regular consumers of eba to test the 4 samples of Eba made in the Activity 4 from varieties with different quality characteristics.

2 METHODOLOGY

Here are some instructions for the processing of cassava roots into gari and eba (please see activity 4 for details) (Figure 1):

- Peel off the brown outer covering with knife until the white part is seen.
- Wash with clean water using a basin. Grate the cassava using a grater.
- Dewater using a presser until water stops dripping off the bag. Allow the dewatered pulp to ferment for two days.
- Sieve the dried pulp using sieve so as to remove the chaff.
- Toast over a medium heat using firewood toasting pot and stirrer.
- Cool the toasted gari by spreading it out on a clean mat.
- For the preparation of eba, pour gari into a bowl, pour hot water over gari (or pour the hot water first and then sprinkle gari), stir with iron-steel or wooden spoon (or cover without stirring).

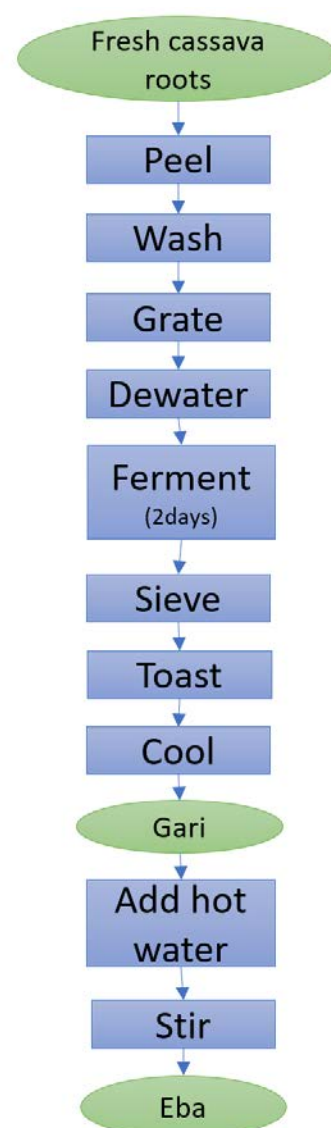


Figure 1 Flow chart showing the processing of cassava roots into gari and eba

2.1 Sampling

The four Eba products made by the processors from varieties with different quality characteristics during the Activity 4 “Processing diagnosis” (Fig 1), were tested by 150 consumers of Igbo ethnicity including 104 women and 46 men (Table 1). The Eba products were made from the following cultivars: TMS/01/1368 (improved biofortified yellow variety), TMS/01/1412 (improved biofortified yellow variety), Nwaocha (local variety), TMS/98/0505 (improved white variety). The consumer testing tests for Eba were carried out in Imo State, Southeast region of Nigeria. The locations were Akwakuma (city), Nworieubi (rural/villages) and Ubomiri (small town) (Table 1).

Table 1: Number of consumers interviewed in the rural and urban areas of Imo state

Count of Consumers	Akwakuma City	Nworieubi Rural	Ubomiri Small town	Grand Total
Female	45	41	18	104
Male	15	19	12	46
Grand Total	60	60	30	150

2.2 Consumer testing

An hedonic test, a just-about-right (JAR) test, and a check-all-that-apply (CATA) test were carried out. Consumers (n = 150) from Imo state in rural and urban areas were asked individually to look, touch, smell, taste each Eba sample, one after the other, in random order.

First, the consumers were asked to score the overall liking using a nine-point hedonic scale (from 1. “dislike extremely”, to 9. “like extremely”). Consumers were also asked to assess how they perceived the intensity of three most important characteristics using the 3-point JAR “Just-About-Right” scale (1 = “too low, too weak, not enough”, 2 = “Just-About-Right” and 3 = “too high, too strong, too much”), respectively for each of the Eba samples. The three characteristics were identified as important in the previous Activities 3 & 4: Smoothness (“not smooth enough”, JAR, “too smooth”), Colour (“too light”, JAR, “too dark”) and Sourness (“not sour enough”, JAR, “too sour”). Consumers were then asked to select the quality characteristics that better describe each Eba sample, among a list of 23 sensory characteristics comprising of the most liked and the least liked characteristics collected during the previous Activities 3 and 4 (Table 2). Finally, consumers were invited to give their opinion and preferences about the Eba samples in relation to the Eba they usually consume.

Table 2: Quality characteristics identified during the previous activities 3 & 4 and selected for building the CATA table

	Quality characteristics of Eba product
List of the most liked characteristics	<p>Appearance</p> <ul style="list-style-type: none"> - Butter/cream colour - Yellow - Neat <p>Texture when touched</p> <ul style="list-style-type: none"> - Stretchy - Mouldable - No lumps <p>Taste</p> <ul style="list-style-type: none"> - Not sour - Sweet - Good taste

	Quality characteristics of Eba product
	Texture in the mouth - No lumps - Smooth - Moderately soft Aroma - Good aroma
List of the least liked characteristics	Appearance - Dull/dark/brown - Fibre/dirt/particles Odour - Offensive odour Texture when Touched - Not mouldable - Too Sticky - Not stretchy Taste - Sour - No taste Texture in the mouth - Too soft - Too hard

2.3 Data analysis

An analysis of variance (one-way ANOVA) was carried out to identify significant differences in the overall liking scores between the four Eba samples as tested by the consumers. Multiple pairwise comparisons were applied using the Tukey test, with a confidence interval of 95% at $p < 0.05$ ($n = 150$ consumers). An Agglomerative Hierarchical Clustering (AHC) analysis was used to organize consumers into similar groups of overall liking. A Chi-square test at $p < 0.05$ was carried out to determine whether there were significant socio-demographic differences between clusters. For each Eba sample, the number of consumers who judged each specific characteristic either 'Just- About-Right' (JAR), 'too weak' or 'too strong' was counted, and the percentage of consumers (out of 150) was determined. A Principal Component Analysis (PCA) was conducted on the number of citations for all the CATA quality characteristics, with Eba 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 2019 software (Addinsoft).

3 RESULTS

3.1 Overall liking of the product samples

The mean overall liking scores for each Eba sample tested by consumers in Southeast Nigeria (here $n = 150$ consumers), significantly differed between the four varieties at $p < 0.05$ (one-way ANOVA) (Table 3).

Table 3: Mean overall liking scores for the four Eba samples tested

Eba samples	Mean Overall liking scores		Groups
	(n=150)		
TMS 01/1368	2.1	A	
TMS 01/1412	4.8		B
Nwaocha	5.4		B
TMS 98/0505	6.1		C

*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 ($p < 0.05$).

The most liked Eba sample was TMS 98/0505 with a mean overall liking score close to 6 ('like slightly'), followed by Nwaocha and TMS 01/1412 with a mean overall liking score close to 5 ('neither like nor dislike'). The least liked was the TMS 01/1368 sample with a mean overall liking score of 2.1 ('dislike very much'). Although some of those varieties were acceptable (with an overall liking score > 5 'neither like nor dislike') the acceptability was not very high (maximum around 6 'like slightly' for TMS 98/0505). TMS/98/0505 has the highest percentage rating of dry matter content of the same raw material, which was significantly different at 1% level of probability. Dry matter of grated mash was highest in Nwaocha (58.3%) and low in TMS/01/1368 (56.6%) and the difference in dry matter may explain the differences in consumer liking.

3.2 Segmentation of consumers into groups of similar overall liking

The aim of an Agglomerative Hierarchical Clustering (AHC) analysis is to create homogeneous clusters of consumers who have similar overall liking scores. It is useful to classify consumers who have been interviewed randomly, into similar groups.

Using an Agglomerative Hierarchical Clustering analysis of the mean overall liking scores, we identified three groups of consumers namely 'TMS 98/0505 & TMS 01/1412 likers' (C1), 'TMS 01/1368 & TMS 98/0505 dislikers' (C2), and 'TMS 01/1368 & TMS 01/1412 dislikers' (C3). These three clusters contained 38%, 25%, and 37% of all the consumers interviewed, respectively. There were significant differences ($p < 0.001$) in the overall liking of the three clusters (Figure 2 and Figure 3). No variety except TMS 98/0505 and Nwaocha fulfilled the hedonic expectations for all groups of consumers. It was noted that TMS 01/1368 scored lower than three for all groups of consumers.

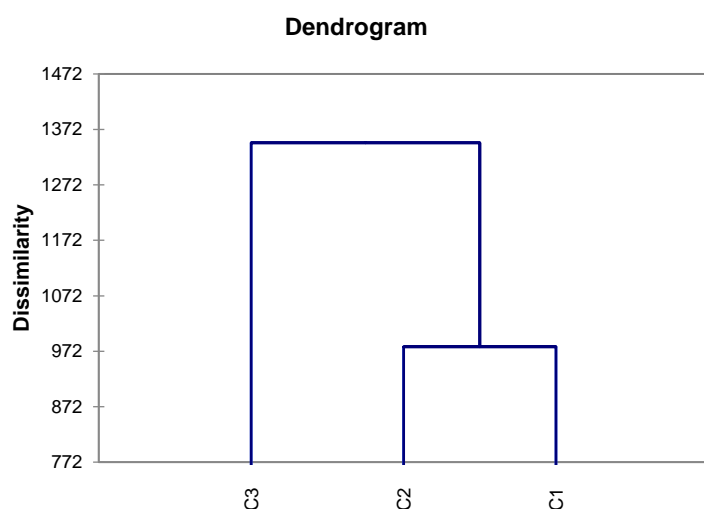
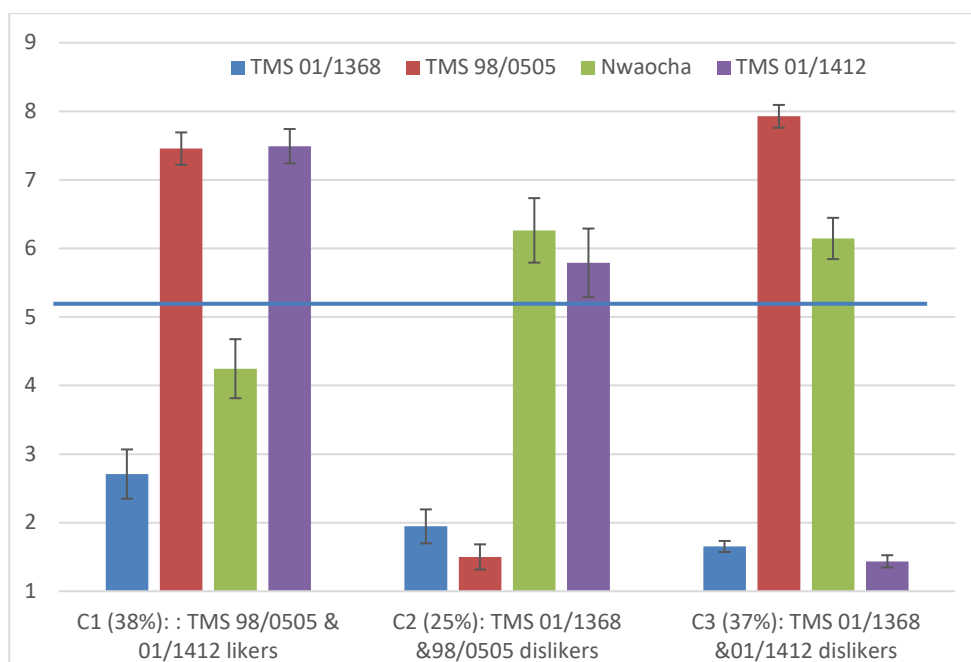


Figure 2 Clustering of the consumers based on their overall liking scores of the Eba samples



Where: error bars represent the standard error.

Figure 3 Mean overall liking of the Eba samples by consumer cluster type (%)

3.3 Demographic data of the consumers interviewed

Among the 150 consumers interviewed, 30.7% were women and 69.3% were men (Table 4). About 16.7% were 18-25 years old, 36.0%, 62.0% and 64.0% were aged between 26-35, 36-45 and 46-55 years old respectively. About 14.3% were aged between 55 years and above. Results show that many of the consumers were below 50 years. Many (50.7%) of them were employed as traders.

Table 4 Socio-demographic description of the consumers with respect to cluster division

		C1	C2	C3	Sum	Chi-square test (p-value)
Consumers	Total	57	38	55	150	
State	Imo	57	38	55	150	
Location	Akwakuma	22	12	26	60	0.598
	Nworieubi	22	18	20	60	
	Ubomiri	13	8	9	30	
Gender	Female	42	27	35	104	0.497
	Male	15	11	20	46	
Ethnicity	Igbo	57	38	55	150	-
Marital status	Single	14	9	12	35	0.804
	Married	35	22	36	93	
	Widower	7	7	6	20	
	Other	0	0	1	1	
Age	18-25	11	8	6	25	0.384
	26-35	16	10	28	54	
	36-45	42	21	30	93	
	46-55	32	16	48	96	

		C1	C2	C3	Sum	Chi-square test (p-value)
	56+	80	70	65	215	
Occupation	Student	10	6	6	22	0.576
	Artisanship	7	3	3	13	
	Civil Service	1	2	3	6	
	Trading business	27	17	32	76	
	Employed	1	1	4	6	
	Unemployed	11	9	7	27	
Consumption frequency	Every day	25	20	28	73	0.818
	Several times a week	24	12	23	59	
	Once a week	3	3	3	9	
	Several times a month	2	1	0	3	
	Once a month	3	1	1	5	

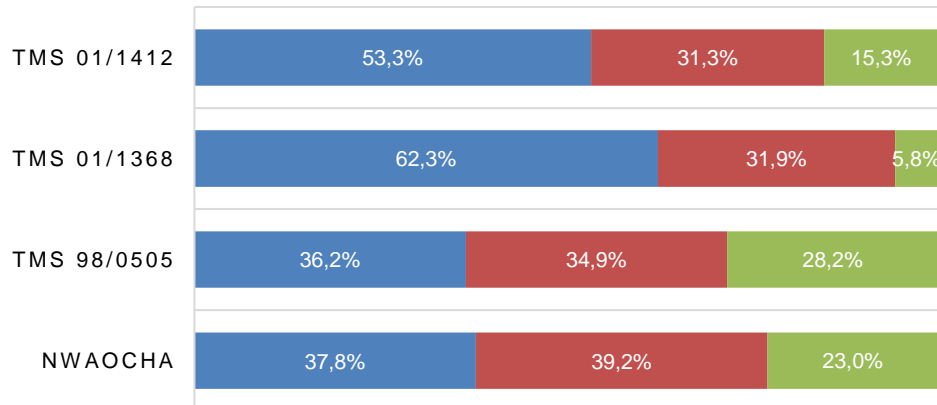
There are no significant socio-demographic (gender, location, marital status, age, occupation, consumption frequency) differences with respect to cluster division (Chi-square test, $p < 0.05$).

3.4 Just About Right test (JAR)

Just-about-right (JAR) scale was used to determine the optimum level of intensity as perceived by the consumers for some important sensory quality characteristics of the Eba samples (Figure 4). Such “descriptors’ diagnostic” may help understand why consumers like or dislike *specific* Eba samples. JAR test revealed that for ‘smoothness’, no variety received a score of JAR higher than 50% (Figure 4). Inversely, more than 50% of consumers were satisfied with the ‘colour’ and the ‘sourness’ of Nwaocha and TMS 98/0505 Eba samples (52-59%) that were from white varieties of cassava. For each quality characteristic, the comparison of the three JAR levels of Nwaocha and TMS 98/0505 varieties showed that, the majority of the consumers considered these varieties as JAR. The Eba sample TMS 01/1412 was considered as ‘too dark’ and ‘not smooth enough’ by 51.0% and 53.3% of consumers respectively. TMS 01/1368 was found ‘too light’, ‘not smooth enough’ and ‘not sour enough’ by 88.4%, 69.3% and 89.8% of consumers respectively.

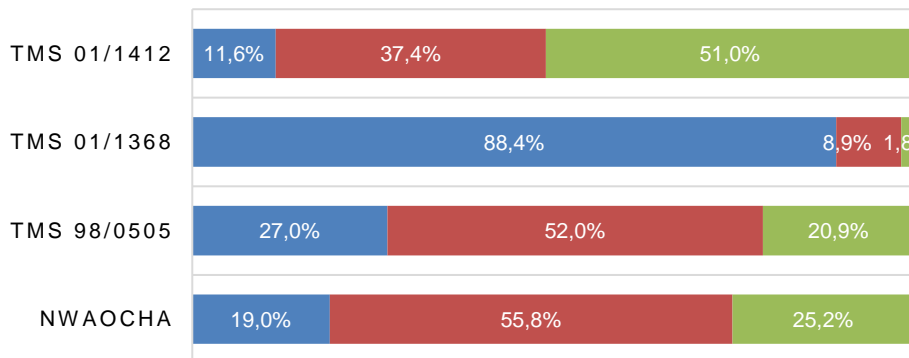
SMOOTHNESS

■ Not smooth enough ■ JAR ■ Too smooth



COLOUR

■ Too light ■ JAR ■ Too dark



SOURNESS

■ Not sour enough ■ JAR ■ Too sour

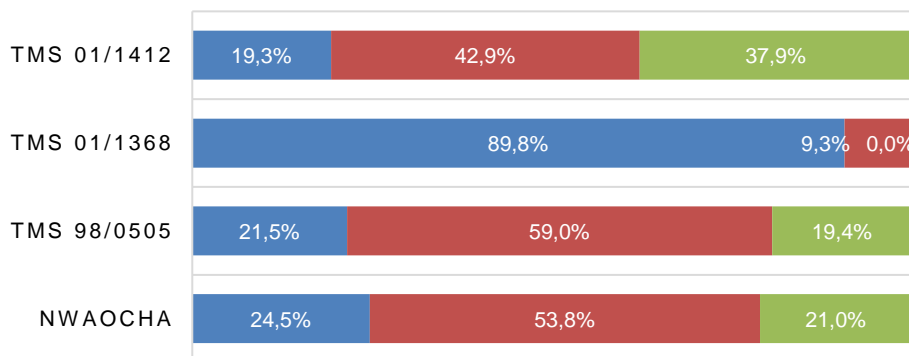


Figure 4 Percentage of consumers who scored the three specific quality characteristics

3.5 Sensory profiling of the Eba samples established by Check All That Apply (CATA) test

The sensory characteristics most frequently cited by the consumers were considered the best for describing the products, especially for Nwaocha (Table 6). The same most cited and least cited terms were found for the local variety Nwaocha. Other varieties like TMS 98/0505, TMS 01/1368 and TMS 01/1412 also ranked high for same characteristics. The most important quality characteristics were 'moderately soft' (414 citations), followed by 'no lumps' (406), 'mouldable' (392), 'neat' (385), 'good taste' (338), 'not stretchy' (334), and 'good aroma' (322). The least cited characteristics include: 'too hard' (56), 'sweet' (98) 'less lumps' (117), and 'no taste' (120).

Table 5 Count of citations of each quality characteristic by all the consumers

Variety	Mouldable	Neat	Too sticky	Offensive odour	No lumps	Sour	Sweet	Not stretchy	Moderately soft	Less lumps	No taste
Nwaocha	109	96	57	40	97	41	16	77	105	40	14
TMS 98/0505	104	108	56	32	106	34	15	81	102	27	17
TMS 01/1368	91	110	57	108	120	19	43	87	115	28	72
TMS 01/1412	88	71	78	53	83	50	24	89	92	22	17
Total	392	385	248	233	406	144	98	334	414	117	120

Variety	Butter/cream colour	Good taste	Good aroma	Not sour	Too soft	Smooth	Stretchy	Too hard	Dull/dark/brown	Not mouldable	Yellow	fibre/dirt/particles
Nwaocha	49	80	97	30	24	96	56	10	40	33	55	43
TMS 98/0505	35	93	100	40	26	101	50	11	31	39	80	30
TMS 01/1368	108	104	41	118	42	16	24	20	63	12	5	1
TMS 01/1412	26	61	84	19	27	67	44	15	63	52	57	64
Total	218	338	322	207	119	280	174	56	197	136	197	138

The PCA plot (Figure 5) explained 97.8% of the variance of the sensory characteristics, the first and second axes accounting for 83.3 % and 14.5 % respectively. Most of the variance was explained by the first axis. The loading of sensory characteristics on PCA plan shows that axis 2 (Y axis) was mainly explained negatively by the terms such as 'good aroma', 'yellow', 'stretchy', 'smooth', 'not mouldable', 'sour' and also 'no fibre/dirt/particles', related to a high mean overall liking and the most liked Eba samples (TMS 98/0505 and Nwocha, with a score of 6.1 and 5.4 respectively, 'like slightly'). These characteristics can be considered as high quality of Eba as confirmed in the PCA by the positive correlation between overall liking and them. Axis 1 (X axis) was explained positively by the terms such as 'no taste', 'too soft', 'not sour', 'butter/cream colour', 'offensive odour', 'sweet', 'too hard', moderately soft' and 'no lumps' related to a low overall liking and the least liked Eba sample TMS 01/1368. Consequently, axis 1 highlighted the characteristics of poor quality of Eba while axis 2 is for its high quality.

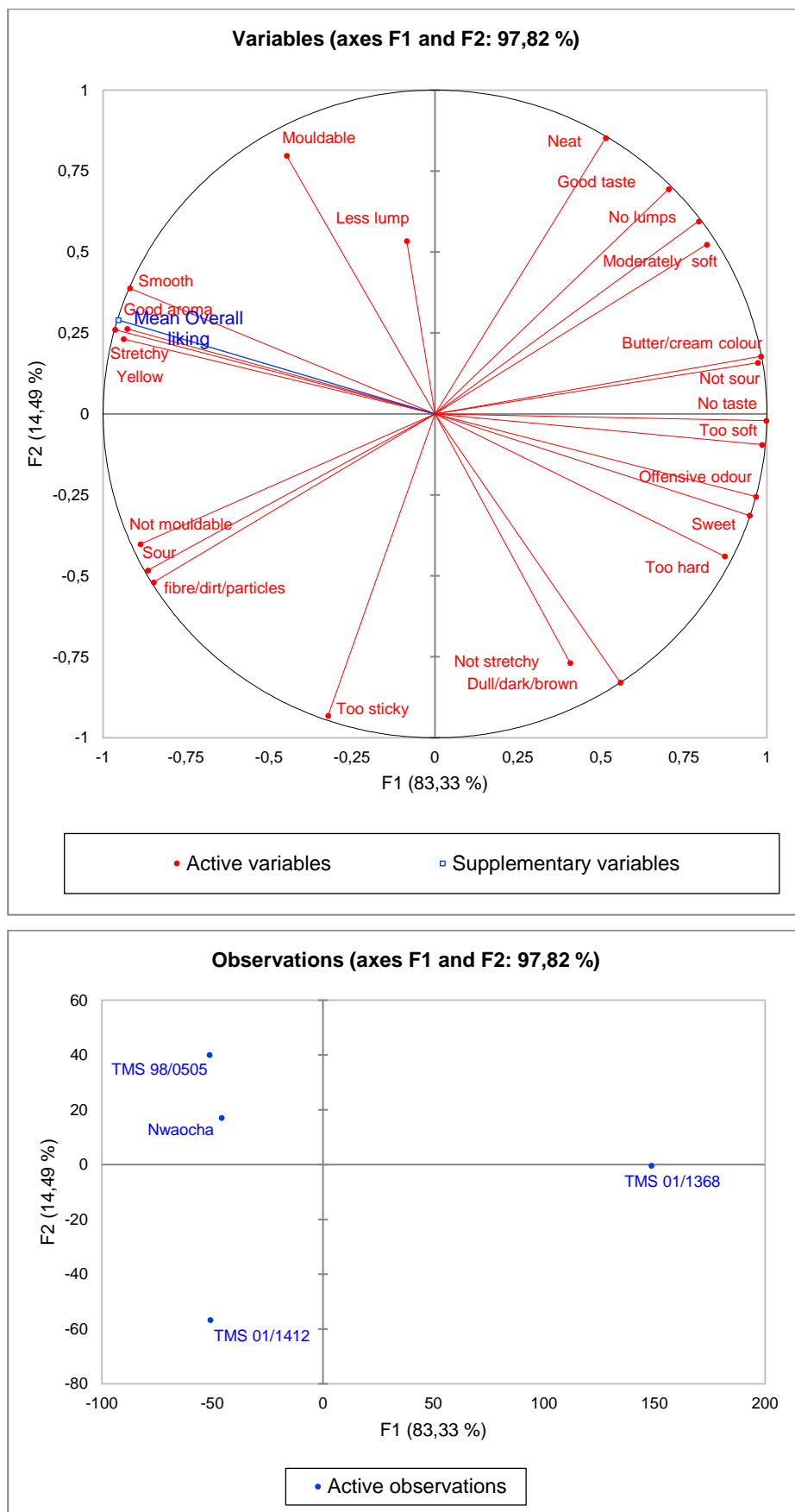


Figure 5 Mapping of the sensory characteristics and the overall liking of the product samples

4 SYNTHESIS AND CONCLUSION

Results show that the four Eba samples were perceived differently by consumers. TMS 98/0505 with a mean overall liking score close to 6 ('like slightly') ranked highest, followed by Nwaocha and TMS 01/1412 (overall liking score close to 5 –'neither like nor dislike'). The least liked was the TMS 01/1368 sample with a mean overall liking score of 2.1 ('dislike very much'). The results highlighted three consumer clusters. Generally, more than 50% of consumers were satisfied with the colour and the sourness of Nwaocha and TMS 98/0505 samples. The Eba sample from yellow biofortified variety TMS 01/1412 was considered as 'too dark' and 'not smooth enough' by a majority of the consumers. Many consumers indicated that Eba also from biofortified cassava TMS 01/1368 as 'too light', 'not smooth enough' and 'not sour enough'. The best sensory characteristics for describing the products include: 'moderately soft', 'no lumps', 'mouldable', 'neat', 'good taste', 'not stretchy', 'good aroma' and 'smooth'. Among the least cited were: 'too hard', 'sweet', 'less lumps', and 'no taste'. Sensory characteristics on PCA were mainly explained negatively (-) on the X axis by traits such as 'good aroma', 'yellow', 'stretchy', 'smooth', 'not mouldable', 'sour' and also 'no fibre/dirt/particles', for Eba samples such as TMS 98/0505 and Nwocha, which ranked higher in terms of overall liking. Also, these were explained positively (+) on the X axis by terms such as 'no taste', 'too soft', 'not sour', 'butter/cream colour', 'offensive odour', 'sweet', 'too hard', moderately soft' and 'no lumps' that related to the least liked Eba sample, TMS 01/1368.



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