Field Scientific Report

Consumer Testing of Pounded Yam 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

Umudike, Nigeria, 2021

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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

The consumer testing for pounded yam was conducted in rural and urban areas of Ebonyi State, South-East Nigeria with 150 consumers disaggregated into 70 women and 80 men. The variety names and code numbers used in parentheses include; TDA 1100477 (289), TDA 1100203 (463), TDR 1100497 (135), and TDR 11/0010 (721). The urban areas were Onueke and Abakaliki; rural (Amagu Izzi and Umuebe Ezzamgbo) and the small town was Nkwagu). Majority of the respondents were civil servants (44.7%), and married (52.7%). Many consumers interviewed consumed the product once a month (32.0%), 30% consumed the product several times a week,14% once a week, while 13% consume it several times a month and and about 11% daily. Consumption frequency indicates that yam consumption in the form of pounded yam is an important menu in the diet of people in the study area. Agglomerative Hierarchical Clustering analysis of the mean overall liking scores, identified four groups of consumers that include; “TDA 1100203 and TDR 1100497 likers” (8%), “TDA 1100477 dislikers” (26%), “all likers” (45%) and “TDR 1100497 dislikers” (21%). There were significant differences (Chi-square; $p < 0.001$) in the overall liking of the three clusters with regards to sociodemographic characteristics. The most liked product sample was TDA 1100203, because it was ‘easy to swallow’, ‘easy to cut’, ‘mouldable’ and had a ‘good aroma’, followed by TDR 1100497 described as ‘sweet taste’, ‘not sticky’, ‘smooth’, and with ‘no lumps’, and TDR 11/0010 because it is ‘easy to pound’, ‘heavy weight’, ‘drawy’ (stretchy), starchy and the least liked TDA 1100477. The least preferred traits include; ‘lumps’, ‘sticky’, ‘dull/dark colour’, ‘not drawy’, ‘too soft’, and ‘bad colour’.

Key Words: yam, pounded, hedonic testing, check-all-that-applies, just-about-right test, consumer acceptability, Nigeria, Ebonyi state

1 STUDY CONTEXT AND GENERAL OBJECTIVES

The main aim of this Activity 5 “Consumer testing” is to understand the consumers’ demand for the quality characteristics of Root, Tuber and Banana products.

Another aim is to provide WP2 with a clear and visual mapping of the most liked products associated with high quality characteristics and high overall liking scores, and of the least liked products associated with low quality characteristics and low overall liking scores.

The activity consists in inviting a large number of consumers to test the 4-5 products made in the previous processing step from varieties with very different quality characteristics.

2 METHODOLOGY

2.1 Sampling

The 4 pounded yam products made by the processors from varieties with very different quality characteristics during the Activity 4 “Processing diagnosis”, were tested by 150 consumers. The pounded yam products were derived from the following varietal names include; TDA 1100477, TDA 1100203, TDR 1100497, and TDR 11/0010. The urban areas were Onueke and Abakaliki; rural (Amagu Izzi and Umuebe Ezzamgbo) and small town (Nkwagu) as shown in Figure 1. Among the 150 consumers, 70 were female and 80 were male (Table 1). Nweke et al (2013) noted that men and women eat yam at about equal frequencies, however where yam food products are diversified such as in Nigeria and Mali, men and women eat different yam products at different frequencies. For example, according to Nweke et al (2013) and Madu et al (2019), in Nigeria, men eat pounded yam more frequently than women.

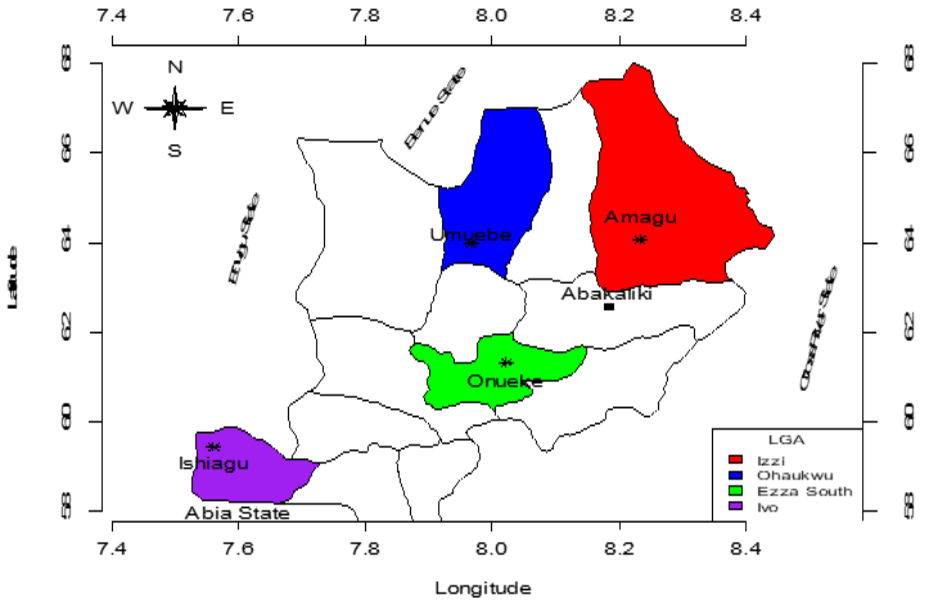

Figure 1 : Map of Ebonyi, South-East Nigeria, showing study locations

Table 1: Number of consumers interviewed in the rural and urban areas of Ebonyi State, South-East Region

		Enyibichiri	Obulechi	Agukpobe	Ebyia	Small town	Urban Area 1	Urban Area 2
Number of Consumers	150	Amagu Izzi	Amagu Izzi	Amagu Izzi	Amagu Izzi	Obinagu Ishiagu	Onueke	Onueke
Women	70	6 (9%)	7 (10%)	5 (7%)	7 (10%)	16 (23%)	14 (20%)	15 (21%)
Men	80	9 (11%)	8 (10%)	10 (12%)	8 (10%)	14 (17%)	16 (20%)	15 (19%)

Note: Figures in parentheses are percentages

2.2 Consumer testing

A method including a hedonic test, a just-about-right (JAR) test, and a check-all-that-apply (CATA) test was used. Consumers (n = 150) from different locations in rural and urban areas were asked individually to look/touch/smell/taste each Product sample, one after the other, in a random order, and 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 pounded yam samples. Four characteristics were identified as important in the previous Activities 3 & 4: Stretchiness (“Not stretchy enough”, JAR, “Too stretchy”), Colour (“Too light”, JAR, “Too dark/dull”), Softness (“Too hard”, JAR, “Too soft”), and Smoothness (“Not smooth enough”, JAR, “Very smooth”). Consumers were then asked to select the quality characteristics that better describe each pounded yam samples, among a list of 23 sensory characteristics: the most liked and the least liked collected during the previous Activities 3 and 4. Finally, consumers were invited to give their opinion and preferences on the pounded yam samples in relation to the pounded yam they usually consume.

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

	Quality characteristics of the ready-to-eat product
List of **the most liked** characteristics	**Appearance** - White - Butter/cream colour odour - odour not offensive **Texture when touching** - Smooth - Stretchy Taste - little sour **Texture in mouth** -easy to swallow - moderately soft Aroma -good aroma After taste

	Quality characteristics of the ready-to-eat product
List of the least liked characteristics	**Appearance** - Dark in colour -Presence of dark particles **Odour** - offensive odour -**Texture when Touching** - Not easy to mould - Sticky **Taste** **Texture in mouth** - too soft -Scatters in the mouth - too hard and difficult to -swallow -Aroma -After taste

2.3 Data analysis

An analysis of variance (ANOVA) was carried out to identify significant differences in overall liking scores between the product samples; TDA 1100477 (289), TDA 1100203 (463), TDR 1100497 (135), and TDR 11/0010 (721) as tested by the 150 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 (clusters). A Chi-square test was carried out to identify significant sociodemographic differences between the clusters. For each Product sample, the number of consumers who judged each specific characteristic either 'Just About Right' (JAR), 'too weak' or 'too strong' were counted, and the percentage of consumers was determined. A Principal Component Analysis (PCA) was used to describe the relationships between frequencies of citation of CATA sensory characteristics and the mean overall liking scores for each Product sample. All statistical analyses were performed using XLSTAT 2019 software (Addinsoft).

3 RESULTS

3.1 Overall liking of the product samples

The overall liking scores for each pounded yam sample tested by consumers in Ebonyi state Southeast Nigeria (n=150 consumers, in Ebonyi state in Southeast Nigeria) were extracted from the "Raw data" worksheet and organized in one column in a new worksheet entitled "ANOVA data", one product below the other, with the corresponding overall liking scores in a second column.

The ANOVA analysis is conducted on another worksheet "ANOVA" using overall liking scores as dependent variable and Product samples as Qualitative explanatory variable and using a Turkey test with a confidence interval of 95% (Table 3).

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

Product Samples	Mean Overall liking scores* (n consumers)	Groups**	
TDA 1100477 (289)	4.7	A	
TDR 11/0010 (721)	6.1		B
TDR 1100497 (135)	6.4		B
TDA 1100203 (463)	6.6		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 ($p<0.05$).

The most liked product samples were TDA 1100203, TDR 1100497, and TDR 11/0010 with a highest mean overall liking score close to 6 (like slightly), with a liking score of 6.6, 6.4 and 6.1 respectively. The least TDA liked sample was TDA 1100477, which was “neither like nor dislike” with a mean overall liking score of 4.7.

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.

In our example, by using an Agglomerative Hierarchical Clustering analysis of the mean overall liking scores, we identified four groups of consumers that we have named “TDA 1100203 and TDR 1100497 likers” (8%) respectively, “TDA 1100477 dislikers”(26%)), “all likers” (45%) and “TDR 1100497 dislikers” (21%). There were significant differences ($P < 0.001$) in the overall liking of the three clusters (Figures 2 and 3).

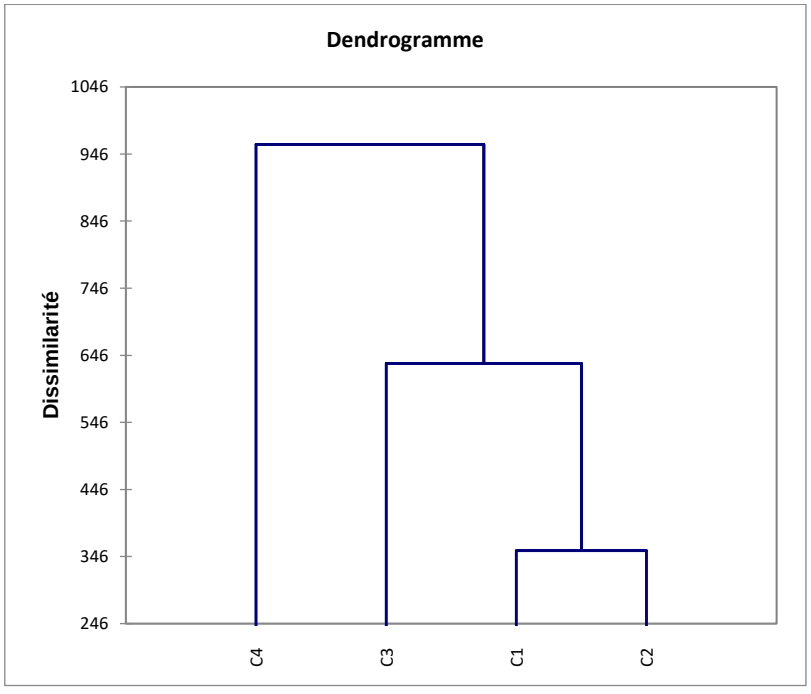

Figure 2: Clustering of the consumers based on their overall liking scores of the product

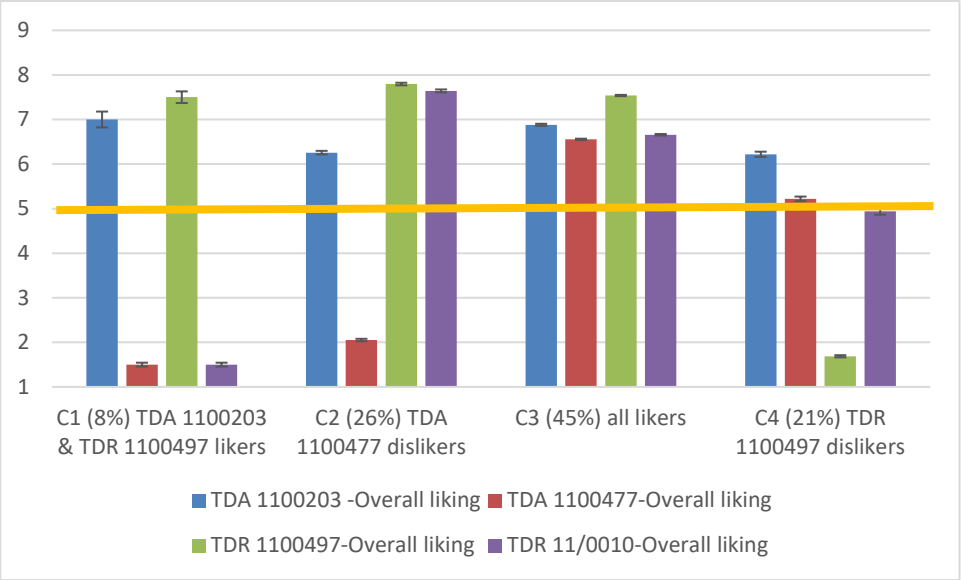

Figure 3: Mean overall liking of the product samples by consumer cluster type (%)

Where: error bars represent the standard error.

3.2.1 Demographic data of the consumers interviewed

Among the 150 consumers interviewed, 47% were women and 53% were men, indicating no significant difference in gender (Chi-square). About 38% were 18-25 years old, 40% were aged between 26-35, 14% were aged between 36-45, 46-55 (1%), while 7% were aged above 56 years old. Age had a significant influence on the cluster consumer belonged to as well as marital status, occupation, and consumption frequency (Chi-square at $p<0.001$). Results show that many of the consumers were youths, Youth in Nigeria includes citizens of the Federal Republic of Nigeria aged 18–29 years according to the new youth policy However, the African youth charter recognizes youth as people between 15–35 (FMYSD, 2019). Many (35 %) of them were students which was significant at 1% level, 44.67% were employed as civil servants, while 17% were engaged in trading (Table 4).

Table 4: Demographic differences of the consumers with respect to cluster division

		C1	C2	C3	C4	Sum	Percentage	Chi-square
State	Ebonyi	12	39	67	32	150	100.0	
Location	Amagu Izzi	5	15	27	13	60	40.0	0.996
	Obinagu Ishiagu	2	9	12	7	30	20.0	
	Onueke	5	15	28	12	60	40.0	
Gender	Women	5	16	36	13	70	46.7	0.488
	Men	7	23	31	19	80	53.3	
Nationality	Nigerian	12	39	67	32	150	100.0	
Country of residence	Nigeria	12	39	67	32	150	100.0	
Ethnicity	Igbo	12	37	65	32	146	97.3	0.543
	Yoruba		2	2		4	2.7	
Age	18-25		22	13	22	57	38.0	<0.0001*
	26-35	12	13	26	9	60	40.0	
	36-45		3	17	1	21	14.0	
	46-55		1			1	0.7	
	56+			11		11	7.3	

		C1	C2	C3	C4	Sum	Percentage	Chi-square
Occupation	Student		23	13	17	53	35.3	<0.0001*
	Artsanship		1			1	0.7	
	Civil Service	12	11	36	8	67	44.7	
	Trading business		3	18	5	26	17.3	
	Employed		1		1	2	1.3	
	Unemployed				1	1	0.7	
Marital status	Single	5	25	9	15	54	36.0	<0.0001*
	Married	7	14	41	17	79	52. 7	
	Widower			17		17	11.3	
Consumption frequency	Every day			11	5	16	10.7	<0.0001*
	Several times a week	6	10	18	11	45	30.0	
	Once a week		16	5		21	14.0	
	Several times a month	1		19		20	13.3	
	Once a month	5	13	14	16	48	32.0	

Many consumers interviewed were used to consuming the product once a month (32%), 30% consumed the product several times a week.,14% once a week, while 13% and 11% consume several times a month and daily respectively (Table 4).

3.2.2 Consumption attitudes

There were no significant differences in men and women's liking with respect to cluster (see Table 4). Many (51% women and 39% men) were all likers (cluster 3), 23% women and 29% men, and 19% women and 24% men dislike TDA 1100477and TDR 1100497respectively. About 7% Women and 9% men were likers of TDA 1100203 and TDR 1100497 (cluster 1). On

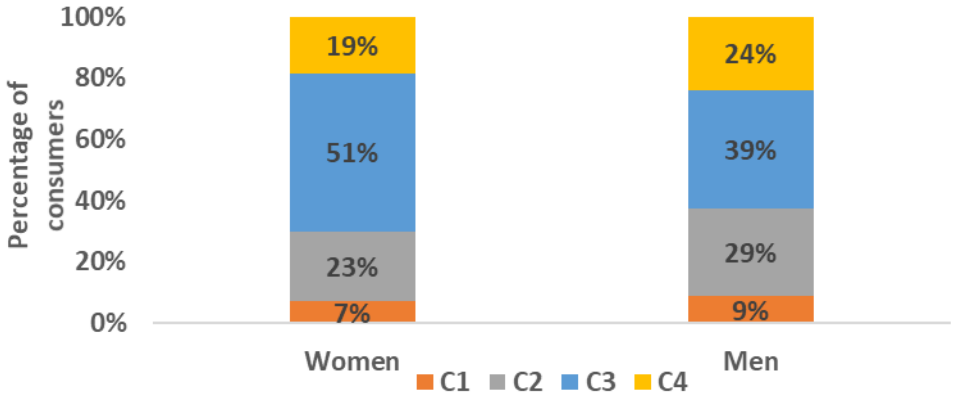

Figure 4: Percentage of consumer cluster type by gender

3.3 A 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 pounded yam samples. Such "descriptor diagnostic" may help understand why consumers like or dislike this pounded yam sample.

Consumers were asked to give their perception of the 'Drawness' (=Stretchiness), Colour, Softness and Smoothness of each Product sample, by using a 3-point JAR scale (1 = "not draw enough" , "too light", "too soft", "not smooth enough" 2= "Just About Right" and 3 = "Too draw", "too dark", "too hard", "very smooth", respectively).

A majority of the consumers were satisfied with the four sensory characteristics of variety TDA 1100203 (463) and TDR 11/0010 (721) product sample: Softness and Colour were scored “Just About Right” by 61%, 59% and 58%, 53% of consumers respectively, the Stretchiness (‘Drawness’) was scored JAR by 70% (TDR 11/0010) and 49% (TDR 1100497) of consumers respectively, and the Smoothness was also scored JAR by 52% (TDR 11/0010) and 48% (TDR 1100497 and TDA 1100203 each) of consumers.

TDA 1100477, TDA 1100203 and TDR 1100497 product samples were perceived as “not draw enough” (=not stretchy enough) by 82%, 54% and 47% of consumers respectively. Moreover, TDA 1100477 Product sample was found “too dark/dull” by 47% of consumers.

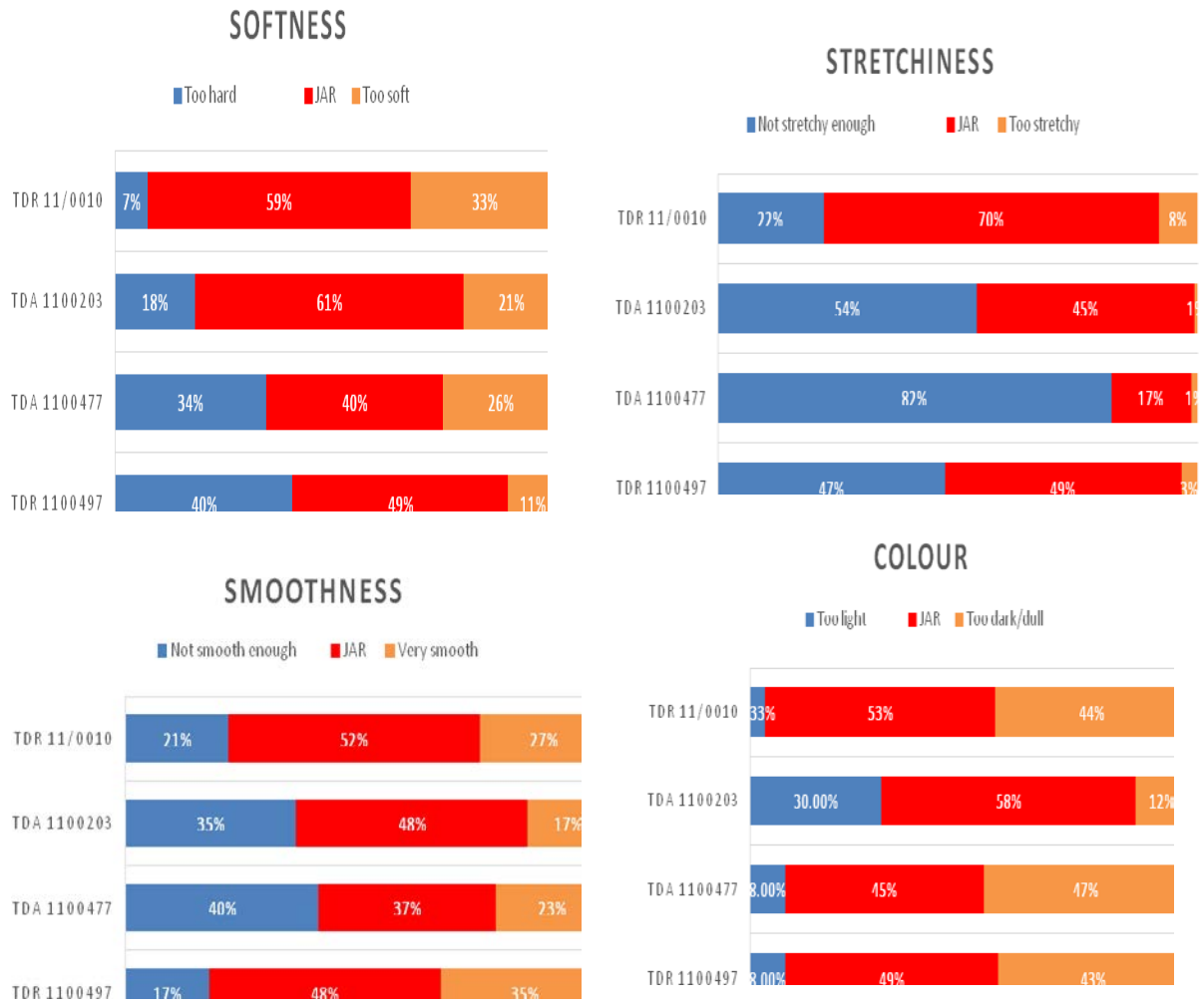

Figure 5: Percentage of consumers who scored the four specific quality characteristics including softness, stretchiness, smoothness and colour

3.4 Check All That Apply (CATA) test

The objective of the CATA test is to show the relationships between hedonic overall liking scores for each Product sample and the frequencies of citation of each CATA sensory characteristic by all the consumers.

After scoring the overall liking and the perception of some specific sensory characteristics, consumers were invited to choose the most appropriate terms among 20-25 sensory characteristics that better describe each Product sample. The frequency of citations given by consumers to describe each Product sample were calculated (Table 5).

The sensory characteristics most frequently cited by the consumers were considered the best for describing the products. They were the following: "Easy to swallow", "Sweet taste", "not sticky" and "Good aroma“ with a frequency of citation range of more than 75 to 129 (out of 150) for all the sample products. Following this were also “Easy to cut”, “Attractive”, and “Mouldability for all the samples (with frequency of citations 74 to 129) except TDA 1100477 which had citations from 47 to 60. Among the frequently used terms were mouldability and good aroma (129 each) for TDR 1100497, and sweet taste (112), attractive (106), not sticky (116), and no lumps (132) for same sample. The most frequently cited was mouldability (TDR 11/0010). These sensory characteristics most frequently cited by the consumers were considered the best for describing the products.

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

Variety	TDR 1100497	TDA 1100477	TDA 1100203	TDR 11/0010
Lumps	22	87	84	38
Sticky	38	76	78	61
Easy to swallow	82	78	109	97
Dark/Dull	11	39	6	58
Moderately soft	34	33	38	39
Yellow	66	0	0	11
Milk/cream	56	67	55	52
Brown	12	6	6	6
White	5	45	72	23
Easy to cut	78	60	106	74
Sweet taste	112	89	96	84
Not drawy	43	78	72	10
Too soft	0	17	6	17
Hard	43	16	18	22
Attractive	106	56	101	79
Starchy	71	61	38	83
Soft	49	33	49	49
Drawy	54	5	32	83
Rises	17	0	6	11
Heavy weight	67	61	61	90
Smooth	82	54	66	79
Bad colour	5	17	17	28
Mouldability	129	47	116	139
No spot	28	27	17	65
Not sticky	116	76	78	80
Easy to pound	48	43	64	77
Good aroma	129	121	110	116
No lumps	132	65	64	101

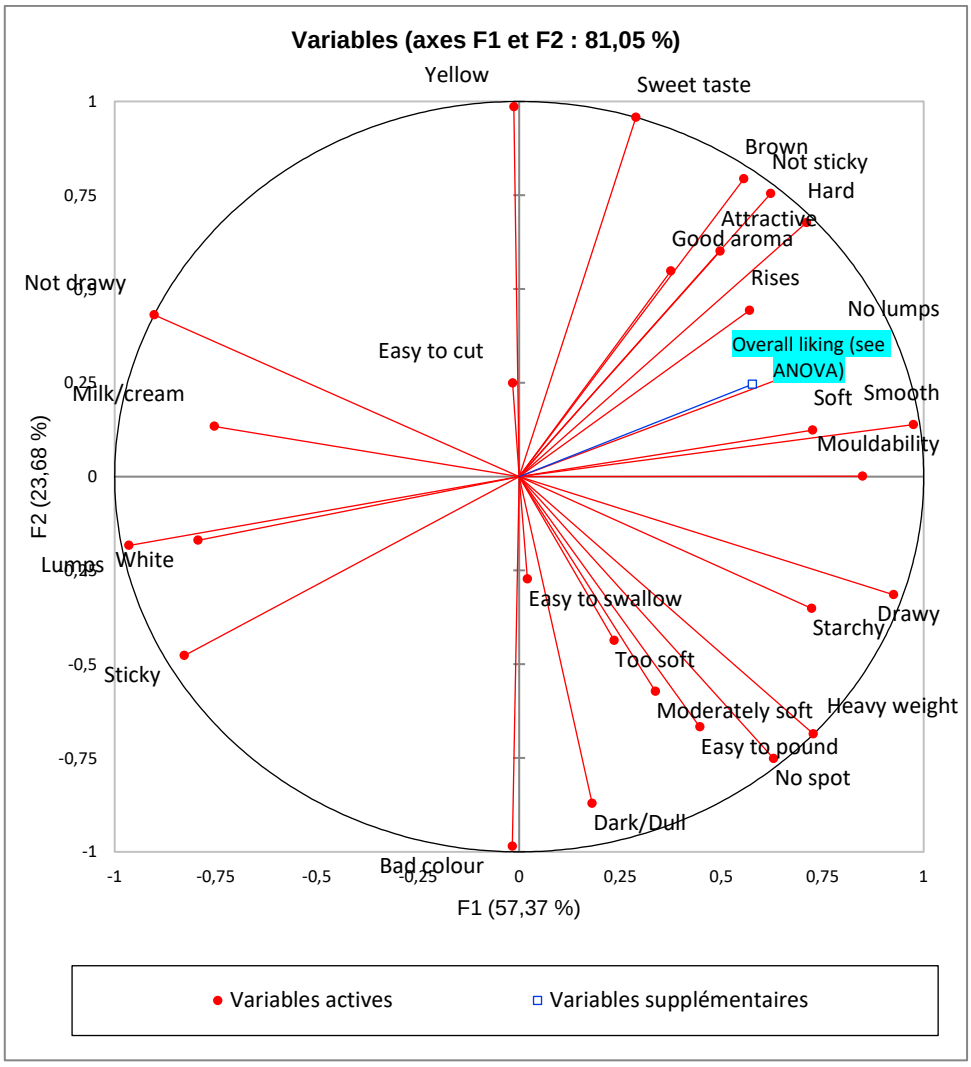
3.5 Sensory mapping of the sensory characteristics

Principal component analysis (PCA) was used to summarize the relationships between CATA sensory characteristics, product samples, and mean overall liking of each product scored by all the consumers. The PCA plot explained 81.1% of the variance of the sensory characteristics, the first and second axes accounting for 57.4% and 23.7% respectively. Most of the variance was explained by the first axis

The loading of sensory characteristics on PCA plan (Figure 5) shows that axis 2 was mainly explained positively by the term such as “White” and negatively by the terms such as “Sticky”, and with “Lumps”, related to the least liked Product sample TDA1100477 (4.693). Also in same axis; TDR 11/0010 was mainly explained positively by the terms such as “No spot”, “Drawy”, “Heavy weight”, “Easy to pound”, “Starchy”, “Moderately soft”, and “Easy to swallow”, and negative terms such as “Too soft” and “Dark/dull”.

Axis 2 was mainly explained positively by the terms such as “Easy to cut” and “Milk/cream” related to the TDA 1100203 Product sample, and negatively by the term such as “Not drawy”. The negative trait such as “Hard” also goes for TDR 1100497 and positive traits such as “Not sticky”, “Attractive”, “No lumps”, “Sweet taste”, “Good aroma”, “Not sticky”, “Smooth”, and “Mouldability”.

A high Mean overall liking scored by consumers was related to the high quality characteristics such as “White”, and “Not drawy”, for Product samples TDA 1100477 and TDA 1100203 respectively which ranked first and second in overall acceptance, followed by “Mouldability” for TDR 1100497 and TDR 11/0010 each, as well as no lumps for TDR 1100497 and “Drawy” (=stretchy) for TDR 11/0010.



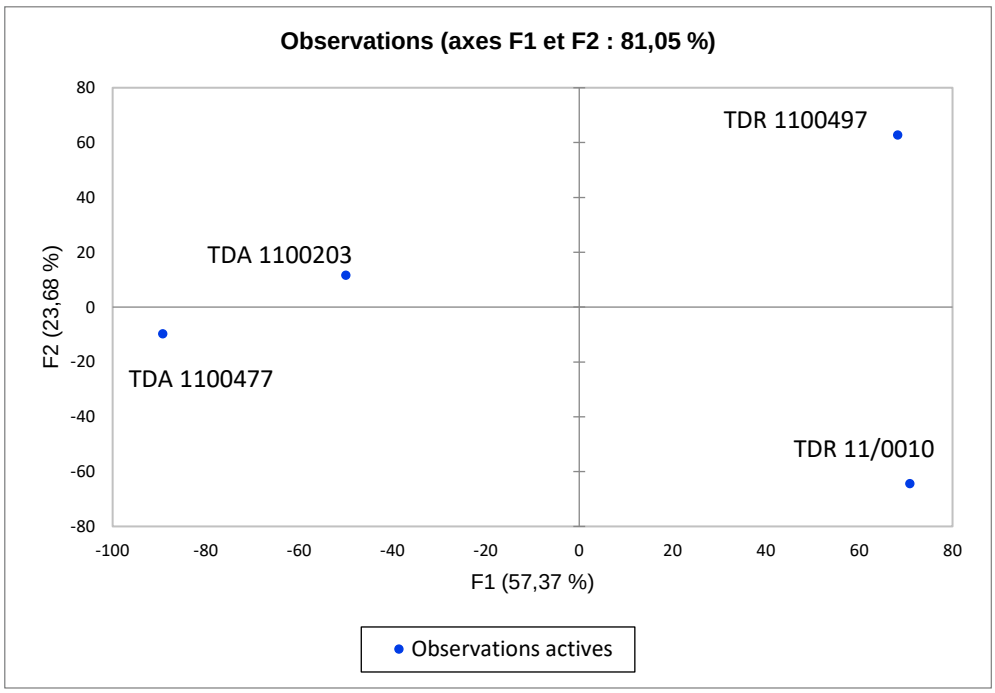


Figure 6: Mapping of the sensory characteristics and the overall liking of the product samples

4 DISCUSSION AND SYNTHESES

The four Product samples were perceived differently by consumers. The least liked product (TDA 1100477) got the lowest mean overall liking score (4.7 'neither like nor dislike'), mainly because it was found having "lumps", being "sticky" and "not stretchy" by the consumers (JAR test). TDA 1100203 was the most liked because it was "easy to swallow", "easy to cut", "mouldable", and had a "good aroma". The terms that better describe the product samples were "no spot", "good aroma", "attractive", "easy to swallow", and "smooth" with frequency counts from 50 to more than 89. Positive terms such as "sweet taste", not sticky", no lumps", and negative terms including "lumps", "sticky", "not stretchy", "too dark", "not smooth" were related to TDR 1100477.

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