African food tradition revisited by research

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Authors for Akpan study: Fliedel G., Maraval I., Lahon M.-C., Forestier N., Grabulos J., Mestres C., Sacca C., Akissoë N., Monteiro M.J., Pintado M., Tomlins K.

Authors in Kenkey study: Aurélie Bechoff, Charlotte Oduro-Yeboah, Wis Amoa, Genevieve Fliedel, Christian Mestres, M. Pintado and Keith I. Tomlins

Author in Kishk Sa'eedi study: Authors: Zahra S. AHMED, Sameh AWAD, Mohamed FATHI, Safaa ABOZED, Habiba"HASSAN WASSEF, Christian MESTRES, Manuela PINTADO and Keith TOMLINS

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Executive summary

In this deliverable the main results of sensory profile of reengineered pro**ducts from group I** are presented. Group I included Akpan and Gowé (Benin), Kenkey (Ghana) and Kishk Sa'eedi (Egypt). In this stage all products were submitted to reengineering process to overcome food safety and product quality issues (identified in the first stage of the project in traditional food) to facilitate their promotion and introduction to EU markets. Although all products were tested in Europe for consumer acceptance, in the case of SENSORY, for Kenkey and Akpan in Europe, the results although not obtained by a trained panel, were generated by Consumers through CATA test. The use of check-all-that-apply (CATA) questions for sensory product characterizations with consumers has been gaining acceptance by several authors (G. Ares and S.R. Jaeger, 2015) and for that we considered an equivalent test to replace the classical descriptive analysis by the trained panel that would take longer time. Due to the restrictions of delayed reengineering processes, we did not have an enough frame time to train adequately the panel. However, the characterisation of product attributes was also achieved. In the case of Gowe, due to restrictions in the productions of reengineered product due to contaminations of raw material, these results for sensory profile could not be obtained, but this was the only case in group I. However, the differences in main attributes were not so far from the traditional ones.

In sensory studies of reengineered products, we´ve tried to integrate quantitative characterization of the perceivable product attributes and in consumer studies hedonic profiles (Worch, Lê, and Punter, 2010). So, in the sensory profiling of a specific group of reengineered products, once performed by a trained panel for a specific group of attributes by a specific African or European country panel, it must be considered unique and reproducible for all other panels that can test the product, afterwards. So in our sensory study of Kishk Sa'eedi as it was performed in Africa or Europe by a trained panel performing quantitative and reproducible characterization of the perceivable (Kishk Sa'eedi) attributes, herein will be used the same results for European sensory description of the product.

Akpan: In terms of consumer perception of sensory attributes performed in Europe for the three Akpan products did not significantly. If we remove the terms such as "artificial", "strong in taste", "floral" due to a manufacturing error (use of a few drops of citronella essential oil instead of citronella infusion as a traditional flavouring of Akpan in Benin), it remains the terms "mealy", "liquid" "drinking yoghurt" that better describe the product and were previously used for describing traditional Akpan product. This means that sensory properties of traditional Akpan were not totally improved during re-engineering to meet French consumer taste.

Kenkey: The results of this study based on CATA testing allowed to provide a basis of understanding on how the reengineered Kenkey (RK) compares to standard commercial Kenkey (SK) in terms of its sensory properties. An interesting finding was that the sensory properties of RK

were very different from that of the standard Ga Kenkey (SK): consumers scored differently the new product from the standard one. RK was globally perceived as too weak whilst SK was too strong. RK was perceived as bland and crumbly and SK as sour, salty and fermented.

Kishk Sa'eedi (KS) was evaluated by a trained panel by QDA and analysed using QFD and PCA analysis. The results of *KS* sensory characteristics provide in depth understanding of the sensory quality criteria as perceived by the sensory trained panel. The present study showed that substantial differences in sensory character were noted between the traditional and re-engineered *KS* in particular, differences in colour, fresh odor, *KS* taste, fracutability and mouth coating. This work showed that the application of techniques could provide the useful information to *KS* and helped to identify the importance of product attributes.

So in general, it can be observed that sensory properties of reengineered products of Akpan and Kenkey did not differed significantly from traditional ones, however the opposite was observed for the new KS compared to the traditional one.

Background

The work encompassed in this deliverable had as main objective the evaluation of sensory profiles of products from group 1 (products include the cereal based products) that were submitted to reengineering process to overcome food safety and product quality issues (identified in the first stage of the project in traditional food) to facilitate their promotion and introduction to EU markets.

The products belonging to this group were Akpan and Gowé (Benin), Kenkey (Ghana) and Kishk Sa'eedi (Egypt). Akpan is a vegetal yoghurt-like product prepared from a partially fermented cooked maize gruel, named *Ogi* in Benin. As *ogi* beverage, Akpan has a widespread level of consumption, popularity and high demand. *Ogi* is a fermented cereal starch extracted from maize/sorghum/millet and used in a variety of ways to make porridge. It is usually mixed with condensed milk, ice and sugar by street vendors just before consumption. It is thirst quenching beverage in Benin, very much appreciated by consumers in urban areas.

Gowé is one of the many popular traditional fermented products locally available and commonly consumed in Bénin. Gowé is a homogenous gelatinised, malted, fermented and cooked paste prepared from sorghum, millet or maize. It is produced by small scale processors and consumed as a thirst quencher, social drink and energy drink. Originally, Gowé is mostly in the centre of Benin, but its consumption is steadily spread to other regions of the country, essentially to the main cities. It is consumed as a beverage after dilution in water and addition of ice, sugar and sometimes milk. It is the preferred beverage of children, pregnant women, sick and old people in Benin.

Kenkey is the principal and most popular fermented food made from maize in Ghana and has been described as one of the best examples of traditional African foods that has played a significant role

through history in food security as well as food safety. There are different types of Kenkey based mainly on the procedure used in preparation and the material used in packaging. Kenkey is a popular traditional and is a staple for most of the peoples in the coastal regions of Ghana. It is a sour tasting cooked stiff porridge of elastic consistency made from fermented whole meal maize dough shaped into balls or cylindrical forms and wrapped in maize husks or plantain leaves.

Kishk Sa'eedi (KS) is a homemade fermented wheat-based stable food that has been produced and eaten in Upper Egypt since the time of the ancient Egyptians. The name "kishk " refers to a group of popular fermented dairy cereal mix products common to Egypt and the Middle East. KS is the undisputed national food of Upper Egyptians where it shares the importance of bread as a basic component of the diet. The production of *KS* is commonly home based and is typically prepared by mixing *Laban Zeer* (buttermilk separated from freshly drawn milk and left to sour in an unglazed earthenware container: the "*zeer*") with coarsely ground parboiled wheat. The milk is fermented alone, then mixed and fermented again with the coarsely ground mature whole wheat that had been previously parboiled and sun dried.

In sensory analysis, one of the most important tools is the quantitative characterization of the perceivable product attributes and usually is referred to as ''descriptive analysis", or''profiling". These methods use trained or expert panels. Because of their routinely use of the type of products in question, and because of dedicated training sessions, these panels seem to be more able to characterize products in an accurate way than naïve consumers (Worch et al, 2010). So, in general trained panels are required for sensory profiles and consumers are required for hedonic profiles.

<u>So for the 4 products from group I we applied the following approach:</u>

Although all products were tested in Europe for consumer acceptance, in the case of SENSORY, for **Kenkey and Akpan** the results herein presented were generated by consumers (n>70) through CATA test, since the use of check-all-that-apply (CATA) questions for sensory product characterizations with consumers has been gaining acceptance by several authors.

Gowe, due to restrictions in the productions of reengineered product owing to contaminations of raw material, these results for sensory profile could not be obtained, but this was the only case in group I.

Kishk Sa'eedi as the product tested in Europe was the same tested in Africa we've used the same results to characterize the attributes in this deliverable, as previously justified.

In the following sections Akpan, Kenkey and Kishk Sa'eedi will be presented individually to better understand the methodology and obtained results for each product.

Detailed report for Akpan

Akpan Summary

Sensory evaluation of the Akpan products was carried out using CATA and JAR techniques that can be applied with consumers out in Montpellier, France. Three Akpan products were tested by 102 consumers: Akpan added with 10% sugar (AS10), Akpan added with 3% spray-dried milk and 8.7% sugar (AMS8.7) and Akpan added with 3% spray-dried milk and 15% sugar (AMS15). Independently of the Akpan tasted, Acidity or Sweetness attributres were scored "Just About Right, as I like" by 56 to 77% of consumers. Odour was perceived differently, depending on consumers. However, Texture was found "Too weak", too liquid by the majority of consumers (49 to 55%) and Taste "too strong" (46 to 54%). The most frequently CATA descriptors checked by consumers which better described Akpan products were: "Artificial", "Floral", "New/Different", "Strong in Taste", "Mealy", followed by "Liquid", "Drinking yoghurt", "Sweet", "Acidic", and "Rough". At the opposite,an "ideal" yoghurt was described as Creamy, Natural, Good for health, Refreshing, Homogeneous, with a texture of a Bulgarian yoghurt-type, Thick, Sweet, Attractive, Nutritious and Milk taste.

Akpan Background

A first study on consumer acceptance of Akpan was carried out previously in France to collect French consumer views on that Beninese yoghurt-like product in view of re-engineering its process. The main improvements concerned sanitary and sensory properties of the product in view of a broader production in Africa and to conquer European market for diaspora but also for Europeans. After re-engineering, French consumers were asked, in this current study, to give their impressions on that "new yoghurt-type product".

Akpan Methodology

Akpan samples

Akpan was prepared in Cirad laboratory from white maize grains provided by UAC, Cotonou, Benin.

Process for making Akpan

The traditional process for making Akpan from white maize grains was described previously by Fliedel et al. (2013). It involves several successive steps such as steeping maize grain, grinding, sieving to separate bran, fermenting and precooking.
In view of reducing the risk of contamination of the product, some of these steps were revisited (Adinsi et al., 2014).

- Soaking the grains was carried out at relatively high temperature (50°C, 15h) to inhibit undesirable microorganisms and prevent the cooking of the grains.
- A pasteurisation step (70°C, 15min) of the sieved material was introduced before fermentation to reduce the load of pathogenic microorganisms, and promote the efficiency of a starter culture (*lactobacillus casei*) during controlled fermentation (42°C, 15h).
- Milk and sugar were added into the sieved material before fermentation, to avoid risk of contamination after cooking.

- A part of Ogui (50%) was added to a boiled citronella infusion and cooked (90°C, 10min). The other part was pasteurized (70°C, 15min).
- After cooling to a temperature below than 70°C, precooked Akpan was mixed with pasteurized Ogui and the mixture was well homogenized to give Akpan ready to taste.

This improved process was applied in Benin to produce re-engineered Akpan products (Adinsi et al., 2014) that were used for consumer tests with Beninese consumers. The proportion of sugar was 15% and the product AMS15. In France, Akpan products were produced according to the same process but several proportions of sugar and milk were tested.

The following three Akpan products were prepared:

1. Akpan added with sugar (10%): AS10 (Benin reference)
2. Akpan added with spray-dried milk (3%) and sugar (8.7%): AMS8.7
3. Akpan added with spray-dried milk (3%) and sugar (15%): AMS15

Sensory evaluation methods

Sensory evaluation was conducted with consumers. This method has been validated by previous studies (Jaeger et al. 2013).

French consumer acceptability of Akpan was performed at Cirad Laboratory of Sensory Analysis in Montpellier with 102 consumers. No information about the product was provided to consumers beforehand. An announcement was sent some days before and on the morning to invite consumers to come and taste “a new type of yoghurt”. A beautiful reward was given to each participant to thank them for coming and for taking time during their working time.

The questionnaire was developed using on-line survey software Qualtrics. Ten computers were provided by our IT department. Each consumer follows instructions step by step by clicking with the mouse on the screen, and begins by answering a questionnaire (personal information, consumption habits) before tasting each Akpan product, one after the other, in a specific random order (30ml in a small clear plastic glass with a little spoon).

Consumers were asked to answer a Check-All-That-Apply (CATA) (Ares et al., 2010; Dooley et al., 2010) table including 20 sensory and 8 perceptions descriptors that have been mentioned in focus groups previously conducted in France and in Benin on traditional maize Akpan products (Fliedel et al., 2013 ; Akissoë et al., 2014). A Just-About-Right (JAR) test was also conducted. Just about right (JAR) scale was used to determine the optimum level of intensity for some sensory attributes of Akpan products. Such “attribute diagnostic” may help to understand why consumers like or dislike this product. Consumers were asked to precise how they perceived texture, taste, odour, sweetness & acidity of each Akpan product, by using a 3-point JAR scale (1 = “Too low than I like”, 2= “Just About Right, as I like” and 3 = “Too high than I like”). Consumers were invited to put a tick/mark in front of the descriptors appropriated to better describe each Akpan sample.

Figure 1. Sensory testing of Akpan with consumers in Cirad, Montpellier, France

Statistical analysis

For the CATA study, frequencies of citation for each descriptor were determined by counting the number of consumers that checked each descriptor for describing Akpan product. Cochran's Q test was carried out for each of the 28 descriptors to evaluate if the CATA method was able to detect differences in consumers' perception for the three Akpan products.
A Principal Component analysis (PCA) was performed on CATA responses for each category of descriptors in order to identify relationships between sensory descriptors & perceptions and Akpan products, and to get a sensory map of the products.
JAR counts were recorded.
All statistical analyses were performed using XLSTAT 2014 (Addinsoft).

Akpan Results and discussion

Just About Right (JAR)

Independently of the product tasted, consumers were satisfied with its acidity or sweetness. These two attributes were scored "Just About Right, as I like" by 56 to 77% of consumers. Odour was perceived differently, depending on the consumers. Some of them found Akpan odour "Too weak" (22 to 32% of answers) or "Just About Right, as I like" (33 to 40%), or "Too strong" for 34 to 38% of them. Texture was found "Too weak", too liquid by the majority of consumers (49 to 55%), mainly for Akpan added with sugar (53% and 55% for AMS8.7 and AMS15 respectively). It was considered "Just About Right" by 41 to 47% of consumers and only few persons (2 to 4%) checked it "too high", too compact. Taste of Akpan products was evaluated "too strong" by most of people (46 to 54%).

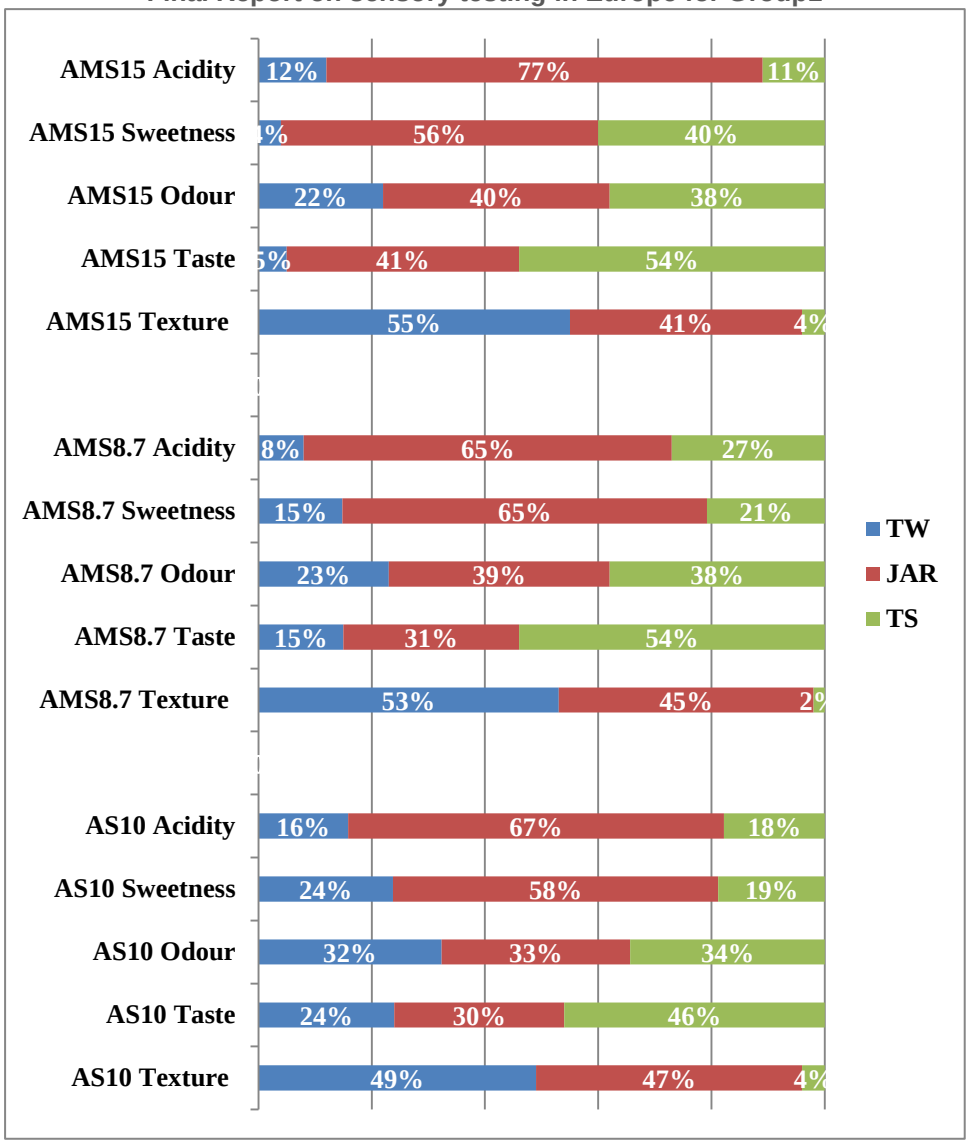


Figure 2. Intensity of some sensory descriptors perceived by French consumers for each Akpan product using a JAR Scale

Where JAR Scale : too weak (TW), JAR (Just About Right, as I like) and too strong (TS) and where Akpan added with 10% sugar (AS10), Akpan added with 3% spray-dried milk and 8.7% sugar (AMS8.7), Akpan added with 3% spray-dried milk and 15% sugar (AMS15).

Check-All-That-Apply Question

After scoring the acceptance and JAR intensity, consumers were invited to choose the most appropriate words among 20 sensory descriptors and eight perception descriptors to best describe each Akpan product. No significant difference (one-way ANOVA P>0,001) was observed in the frequency of citations used by consumers to describe each Akpan product, as shown in Table 3.

The most frequently selected descriptors were considered as the best for describing the products. They were the following : “Artificial”, “Floral”, “New/Different”, “Strong in Taste”, “Mealy” with a frequency of citation between 125 and 100, followed by “Liquid”, “Drinking yoghurt”, “Sweet”, “Acidic”, “Rough”, “Homogeneous”, “Refreshing” with a frequency of citation between 100 and 50. The least used term was “Attractive”, “Good for Health”, “Neutral/Nature”, “Thick”, “Lumps”, “Nutritious” and “Natural”.

Table 1. Frequency of descriptor citations for each Akpan product (Check-All-That-Apply method)

		AS10	AMS 8.7	AMS1 5	Ideal Yoghurt	Frequency	Frequency/category	Average Frequency/ category
Sensory descriptors	Liquid	18	**32**	**37**	3	87	981	16.35
	Bulgarian yoghurt	11	7	9	**36**	27		
	Lumps	3	4	6	0	13		
	Neutral	6	3	2	22	11		
	Soya	8	6	9	6	23		
	Sweet	22	19	**43**	29	84		
	Cereals	16	7	10	11	33		
	Floral	**38**	**30**	**36**	15	104		
	Acidic	10	**32**	15	11	57		
	Fermented	3	13	8	10	24		
	Sour	8	17	7	2	32		
	Milk Taste	2	11	4	26	17		
	Tasteless	16	8	3	1	27		
	Strong in Taste	**30**	**33**	**38**	11	101		
	Mealy	**33**	**32**	**35**	1	100		
	Watery	**23**	6	10	1	39		
	Thick	7	2	4	30	13		
	Creamy	17	12	17	**70**	46		
	Homogeneous	16	18	22	**42**	56		
	Drinking yoghurt	22	**33**	**32**	10	87		
Perceptions	New/Different	**35**	**35**	**34**	16	104	384	16.00
	Refreshing	21	11	23	**48**	55		
	Natural	4	4	7	**51**	15		
	Artificial	**42**	**38**	**43**	1	123		
	Rough	17	25	15	0	57		
	Nutritious	5	5	5	25	15		
	Good for Health	3	2	3	**50**	8		
	Attractive	3	1	3	27	7		
Overall Appreciation		5	5	5				
	Frequency/sample	439	446	480	555			
	Average Frequency/sample	15.68	15.93	17.14	19.82			

The frequent citation of the terms “Artificial”, “Floral”, “New/Different”, “Strong in Taste”, for each Akpan product, may find an explanation: essential oil drops of citronella were used in place of citronella infusion during pre-cooking of Akpan. They have taken over the real taste of Akpan, masking probably specific sensory characteristics and limiting a better acceptance of the product. A majority of people found citronella taste and odour too strong. However, the terms that followed well characterized the product and were certainly more easily checked by consumers who are used to consume other “plant” milk.

AS10, Akpan added with 10% sugar, was described as artificial (42 citations), floral (38), new/different (35), mealy (33), with a strong taste (30), watery (23), with a texture of a drinking yoghurt (22), sweet and refreshing (22 and 21 citations respectively).
Consumers used the same descriptors to describe AMS8.7, Akpan added with 3% spray-dried milk and 8.7% sugar, with almost the same frequencies of citation. AMS8.7 was not perceived refreshing (11 citations only) but it was qualified liquid (32 citations), acidic (32) and rough (25).
AMS15, Akpan added with 3% spray-dried milk and 15% sugar, the sweeter Akpan, was also considered as artificial by consumers (43 citations), sweeter (43 citations), strong in taste (38),

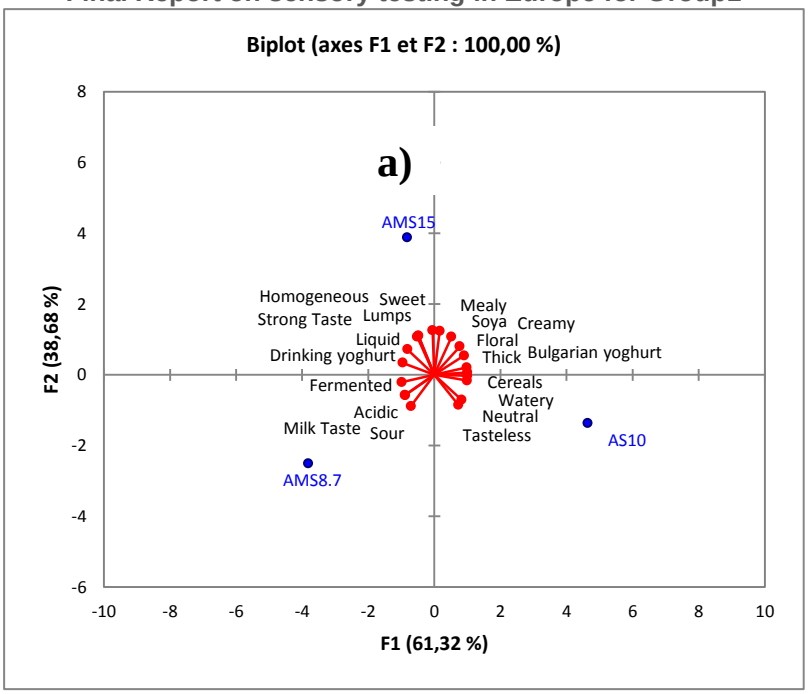
liquid (37), floral (36), mealy (35), new/different (34), with a consistency of a drinking yoghurt (32), and refreshing and homogeneous (23 and 22 citations respectively).

At the end of the questionnaire, consumers were asked to kindly describe an ideal yoghurt on their point of view using the same CATA descriptors than already used for describing the three Akpan products. No significant difference (one-way ANOVA P>0,001) was observed in the number of citations used by consumers to describe an ideal yoghurt and each Akpan product, as shown in Table 3. However, if the frequency of citations is almost the same, the descriptors chosen were completely different for a "perfect" yoghurt compared to those chosen for Akpan products.
The "ideal" yoghurt was described as creamy (70 citations), natural (51 citations), good for health (50), refreshing (48), homogeneous (42), with a texture of a Bulgarian yoghurt-type (36), thick (30), sweet (29), attractive (27), with a milk taste and nutritious (26 and 25 citations respectively). None of these descriptors was used to describe Akpan products unless refreshing, homogeneous and sweet with a lower frequency of citation.

Principal component analysis (PCA) was used to summarize the relationships between sensory characteristics of CATA task and Akpan samples. The PCA plot in Figure 4, explained 100% of the variance, the first and second axes accounting for 61.32% and 38.68% respectively. Regarding perception descriptors of CATA task, the two first axes of PCA explained 100% of the variance, the first and second axes accounting for 83.69% and 16.31% respectively. Most of the variance was explained by the first axis.

The loading of sensory descriptors on PCA plan (Figure 4a) shows that axis 1 was mainly explained by the terms such as Cereals, Watery, Bulgarian yoghurt, Thick, Floral, Neutral, and Tasteless, related to AS10 Akpan (with no milk and 10% sugar) and negatively by the terms such as Fermented, Drinking yoghurt, Acidic, Milk Taste, Liquid and Sour, related to AMS 8.7 Akpan (added with milk and 8.7% sugar). Axis 2 was mainly explained by the terms such as Strong in Taste, Soya, Homogeneous, Creamy, Lumps, Mealy, and Sweet, related to AMS 15 Akpan (added with milk and 15% sugar).

The loading of perception descriptors on the PCA plan (Figure 4b) shows that axis 1 was mainly explained positively by the term such as Refreshing, Artificial, Good for Health and Attractive related to AMS 15 Akpan (added with milk and 15% sugar) and negatively by the terms Rough related to AMS 8.7 Akpan (added with milk and 8.7% sugar). Axis 2 was mainly explained positively by the term New/Different related to AS10 Akpan (with no milk and 10% sugar) and negatively by the term Natural.



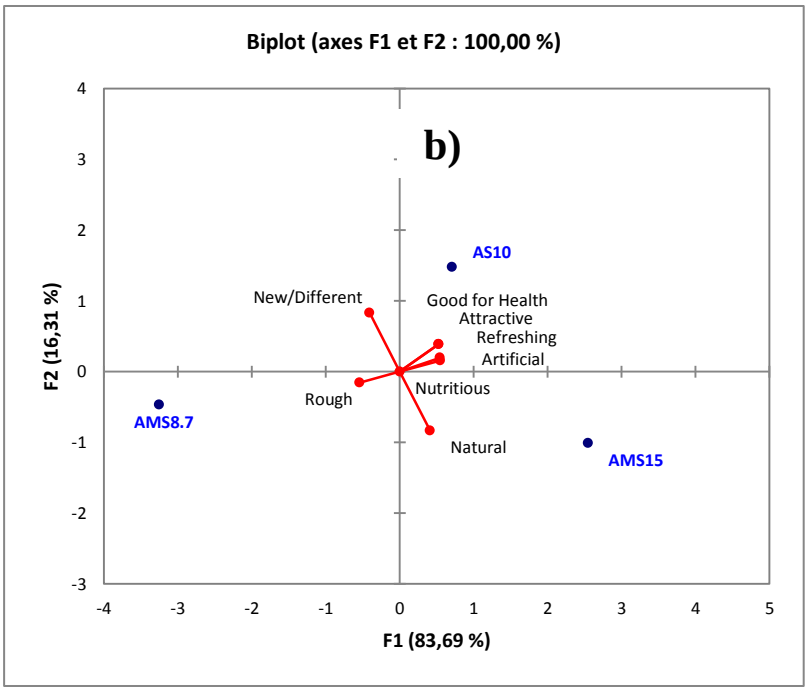


Figure 3. PCA on CATA descriptors: Projection of sensory descriptors a) and projection of perception descriptors b) with Akpan products.

Where Akpan added with 10% sugar (AS10), Akpan added with 3% spray-dried milk and 8.7% sugar (AMS8.7), Akpan added with 3% spray-dried milk and 15% sugar (AMS15).

Akpan Conclusions

In terms of consumer perception, the three Akpan products did not significantly. If we remove the terms such as “artificial”, “strong in taste”, “floral” due to a manufacturing error (use of a few drops of citronella essential oil instead of citronella infusion as a traditional flavouring of Akpan in Benin), it remains the terms “mealy”, “liquid” “drinking yoghurt” that better describe the product and were previously used for describing traditional Akpan product. This means that sensory properties of traditional Akpan were not totally improved during re-engineering to meet French consumer taste.

Re-engineering has focused primarily on improvement of sanitary properties of the product, which was a great achievement and will allow producing Akpan on a larger scale in SMEs in Africa. However, to meet expectations of French consumers who would like a creamy, homogeneous, bulgarian yoghurt-type product, Akpan texture needs to be improved. It must be less liquid, creamier and not mealy. The proportion of uncooked Ogui added to cooked Ogui (to avoid a too thick consistency after starch gelatinization) must be modified, or another alternative must be proposed to reduce consistency of whole cooked Ogui and supressing mealy sensation, while maintaining its creaminess.

Acknowledgements

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Detailed report for Kenkey

Kenkey Summary

The sensory and emotional perceptions of Kenkey products (Standard Kenkey and Reengineered Kenkey) were evaluated using CATA and JAR tests. Overall the sensory properties of the reengineered Kenkey (RK) greatly differed from the standard commercial Ga Kenkey (SK). The following attributes differed between the two products: homogeneous; boring; crumbly; sour; salty; bland; alcoholic; fermented; chewy (Cochran's Q test; $p<0.05$). Overall the taste, smell and colour of the reengineered Kenkey (RK) were too weak (59.5%, 47.9% and 43.0% of respondents respectively) whilst those attributes for the standard Kenkey (SK) were too strong (68.6%, 37.2% and 27.3% of respondents respectively). RK's main characteristics were its bland taste, boring perception and grainy texture. SK was perceived as sour, fermented, salty and also slightly chewy. Both products are perceived as not exciting, not sweet, not really nice and not alcoholic. These results confirmed that the reengineered product (RK) has significantly different characteristics to the standard product (SK). Reengineering greatly modified the sensory characteristics of Kenkey.

Kenkey Background

Kenkey is a major form of maize consumption in Ghana. It presents as dumpling made from fermented maize dough, which is wrapped in maize husks and boiled. Surveys were undertaken to understand what type of reengineered Kenkey should be produced for the international market. A survey of the production and consumption of different types of kenkey, review of regulatoryopportunities, value chain analysis, chemical, textural and microbiological analysis, and sensory and consumer tests were carried out (Amoa et al. 2012). Sensory preference for European consumers showed that reengineered Kenkey should be mild, less acidic, with a bland taste,white colour and soft textured (Amoa et al. 2012). Nsiho or white kenkey made from dehulled maize grains was, therefore, selected for reengineering. L. plantarum and S. cerevisiae were tested as starter culture for white kenkey. Attempts to package kenkey in sausage casing rather than maize husks were not successful. Moulding into cylindrical shapes rather than the traditional round balls has been attractive to consumers (Amoa et al. 2012). This deliverable presents the results of sensory evaluation of Standard Kenkey (Ga Kenkey) compared to Reengineered Kenkey (reengineered Nsiho Kenkey).

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Kenkey Methodology

Ethical assessment and consent

The studies have been assessed and approved by the University of Greenwich Research Ethics Committee and the Ethics Committee at CIRAD. Consent was sought from sensory panellists and from adult consumers participating in this study. Enumerators informed participants about the study and explained that their participation was entirely voluntary, that they could stop the interview at any point and that the responses would be anonymous.

Sensory evaluation methods (QDA / CATA & JAR)

The reengineered Kenkey was processed following methods developed by Charlotte Oduro-Yeboah (Amoa et al. 2012). The processing was conducted under controlled conditions at CIRAD, France by Charlotte and described in the appendix 1. The reengineered Kenkey under vacuum sealed bags was shipped to the UK in a polystyrene box containing freeze gel. The box arrived in good condition and the samples were still cold upon arrival. The standard Kenkey (commercial Ga Kenkey) was bought in an African shop in Gillingham, UK. Both Kenkey products were stored in the fridge between experiments. The samples are presented in the figure 1 below.

Figure 1. Reengineered Kenkey (left) (RK) and standard commercial Kenkey (SK) (right) The total quantity of samples was:

- 9 bags of reengineered Kenkey (RK) (each bag containing 10 balls of Kenkey) made from Ghanean white maize in CIRAD, France
- 4 packs of standard commercial Kenkey (SK) (each pack containing 2 blocks enwrapped in maize leaves) (Ghana Best Ga Kenkey produced by Odeisis Foods Ltd & distributed by Wanis Ltd, UK).

Kenkey products were heated to at least 75°C (core temperature) in the microwave prior to consumption. Whilst still hot, the products were sliced into small portions of approx. 20g. The sliced samples were brought to the canteen where the food was served to consumers (Figure 2).

Figure 2. Preparation of the Kenkey samples: Checking of product core temperature – Slicing of the products – Preparation of samples for transportation- Coding of the samples on plates- Preparation of samples on plates - Poster

At each session, Kenkey samples (coded with 3-figure random numbers) were served on a white plate. Kenkey products were tested blind by consumers and the order in which they were presented was randomised. The only information given to the consumer about the products is that they were made of maize and had been fermented.

Kenkey products were scored by consumers using Check-all-that applies (CATA) and Just-About-Right (JAR) sensory methods. These methods are increasingly becoming important in the field of sensory evaluation and within the course of the AFTER project (2010-14) they have taken more importance. These methods have found to give the same information as QDA but using consumers instead of panellists (Dooley et al. 2010).

JAR scale was used to measure whether colour, texture, smell and taste were of right intensity to the consumer as follows:

- Colour: too light ; JAR ; too dark
- Texture: too soft ; JAR ; too hard
- Smell: too weak ; JAR ; too strong
- Taste: too weak ; JAR ; too strong

CATA was used by the consumers to characterise the product in terms of sensory and emotional terms. The CATA attributes used (15) were as follows:

- Grainy texture
- Chewy
- Speckled
- Fermented
- Alcoholic
- Nice
- Bland
- Sweet
- Salty
- Sour
- Teeth stickyness
- Crumbly
- Boring
- Exciting
- Homogeneous

In addition, because Kenkey is an unusual product in the UK, it was difficult to find panellists who had familiarity with the product and therefore the use of CATA and JAR was proposed instead of classical QDA analysis. CATA and JAR attributes were generated during a preliminary focus group session guided by the panel leader.

Statistical Analysis

CATA and JAR were analysed using Penalty method to understand how the perception of changes in food is linked to the liking of the product. Penalty analysis was used to identify drivers of liking based on based on consumer responses to JAR and CATA. Penalty analysis was carried out on consumer responses to determine the drop in overall liking associated with a deviation from the ideal for each attribute from the JAR or CATA question (Ares *et al.* 2013). A pairwise LSD Fisher test was performed for each CATA or JAR variable to determine whether deviation from the ideal for each attribute (JAR) or perceived presence of the attribute (CATA) caused a significant decrease in overall liking.

Kenkey Results and discussion

Just-About-Right (JAR) test and Penalty analysis

The results of the JAR test are presented in Figure 3. Products were evaluated relating to taste; smell; texture and appearance (colour). The percentage of respondents was indicated in Figure 3.

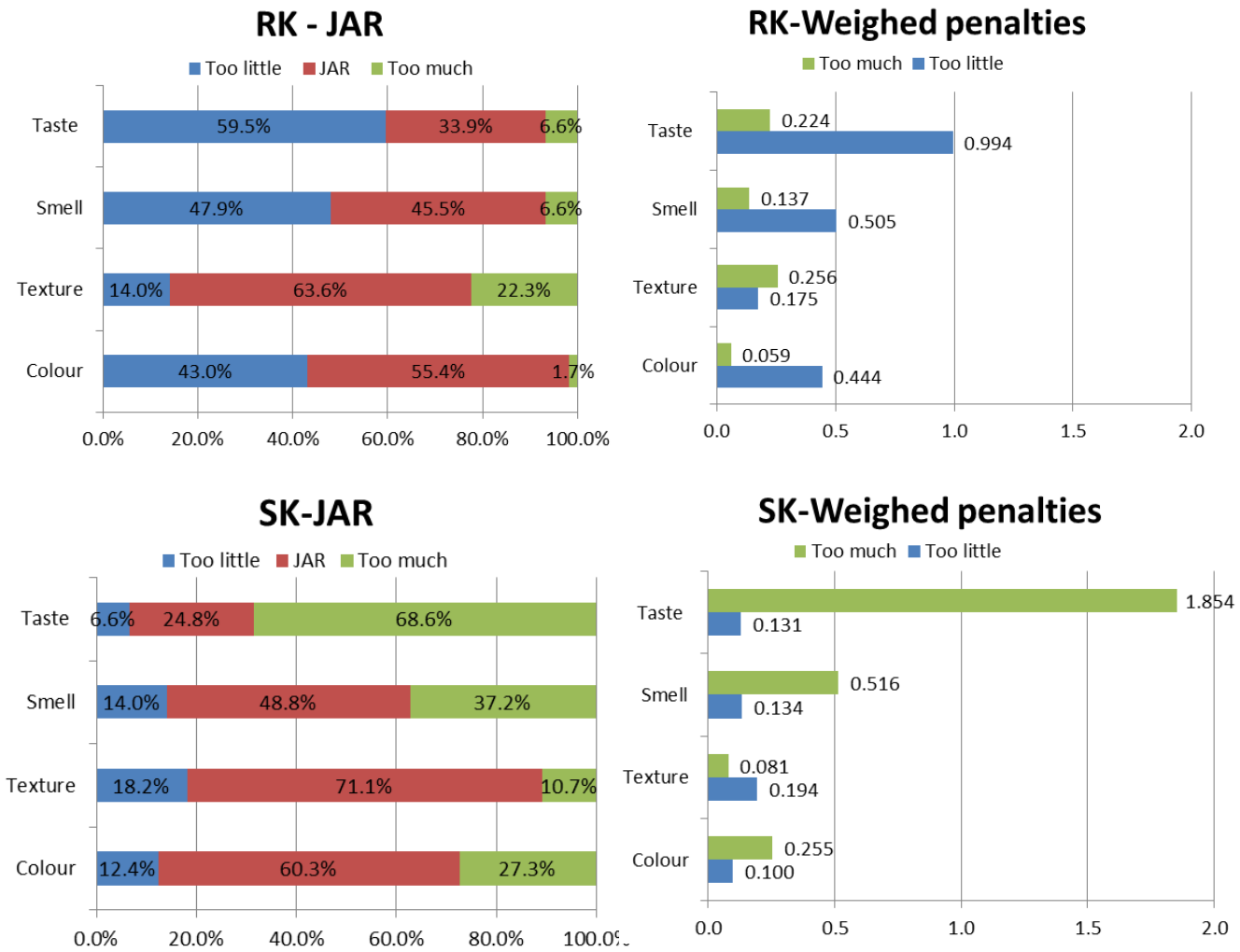


Figure 3. Just-About-Right (JAR) results and Weighed penalties for Reengineered Kenkey (RK) and Standard Commercial Kenkey (SK) Characteristics are significantly deviated from the ideal (JAR) when 'too much' or 'too little' apply to more than 20% of the consumers

For the two products and all the four attributes (colour; texture; smell and taste), penalties were significant; this means that these characteristics were not optimised for the consumer. The taste, smell and colour of the reengineered Kenkey (RK) were too weak (59.5%, 47.9% and 43.0%, respectively), and the texture was slightly too hard (22.3%). The taste, smell and colour of the standard Kenkey (SK) were too strong (68.6%, 37.2% and 27.3%, respectively). To summarise, in terms of basic characteristics (appearance; odour and taste), RK was too weak and SK too strong.

Penalties were significant for all the characteristics of the two samples: therefore a deviation from the ideal characteristics (JAR) will automatically lead to a penalisation in the liking of the product. Strongest penalty was given for SK taste: participants judged the taste too strong and this

significantly affected their liking of the product. Therefore the taste of SK was not suitable for the interviewed consumers in the UK. The fact that RK's taste was too weak might be a constraint though since Kenkey is not eaten as a 'stand-alone' product; accompanying dishes could bring the flavour.

Check-All-That-Applies (CATA) test and Penalty analysis

The Check-All-That-Applies CATA as it is called in the US or Tick-All-That-Applies TATA test in UK-English has become a common tool for the determination of the sensory characteristics of products in the last few years. Dooley et al. (2010) showed that the consumer responses using CATA gave similar results to classical technique QDA with trained sensory panellists for external preference mapping.

The CATA responses (ticked answers) are presented in Figure 4. This shows the frequency of consumer responses (counts) for the CATA attributes. The number of times the attributes are ticked show how important they are perceived by the consumers and therefore a sensory profile and emotional profile can be elaborated using this technique.

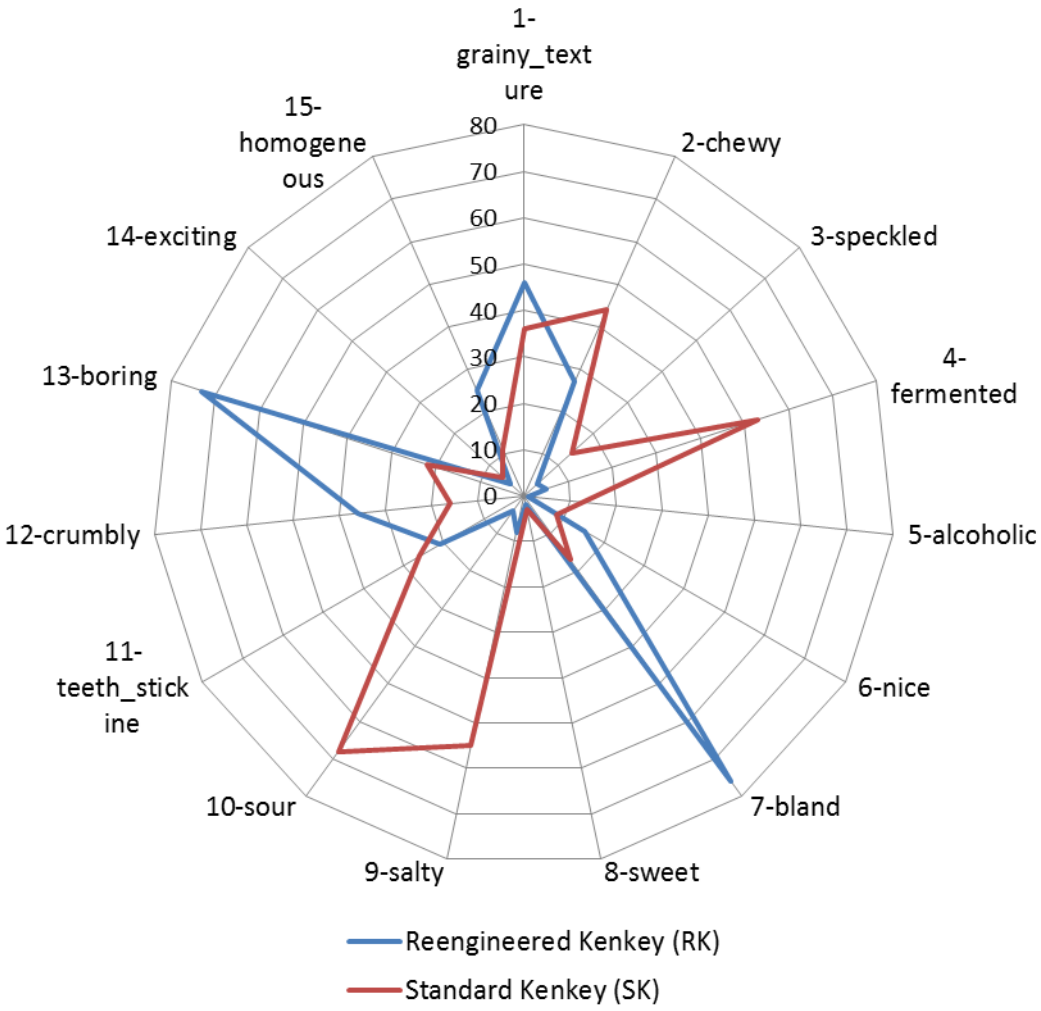
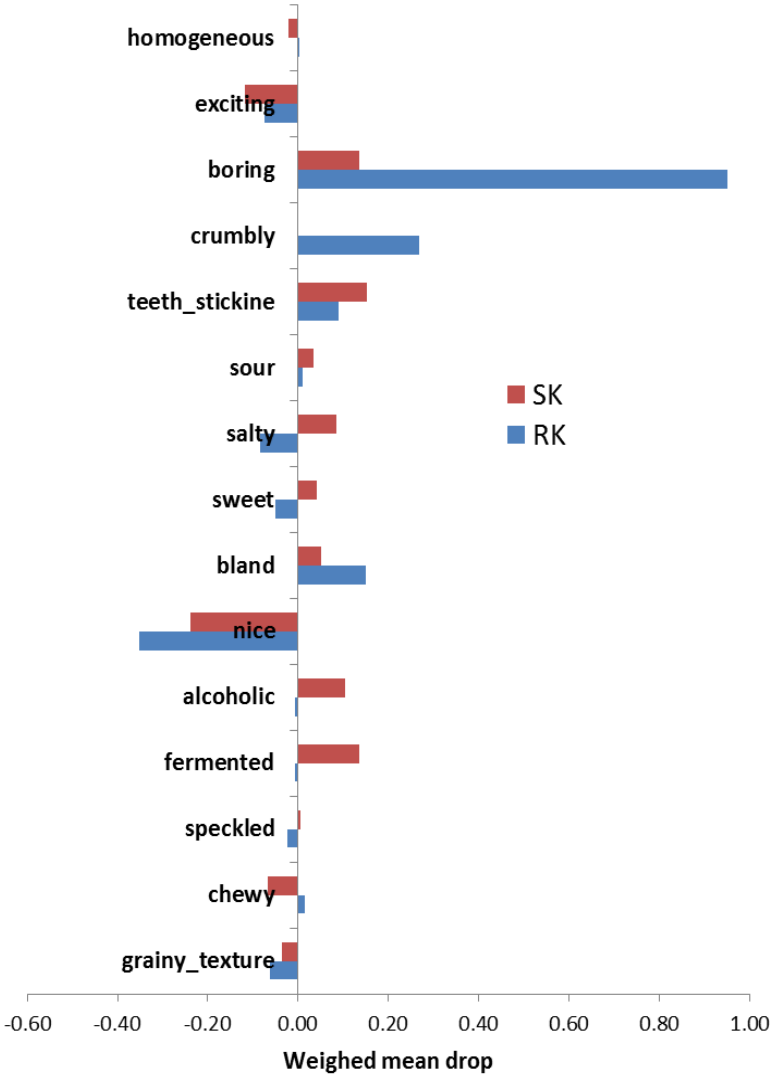


Figure 4. Spider chart for Reengineered Kenkey (RK) and Standard Commercial Kenkey (SK) - counts

RK and SK appear to have clearly distinctive profiles. RK's main characteristics are its bland taste (76 consumers), boring perception (73 consumers) and grainy texture (46 consumers). SK is seen as

sour (68 consumers), fermented (63 consumers) and salty (55 consumers) and also chewy (44 consumers). Both products are perceived as not exciting (4 and 6 consumers for RK and SK, respectively), not sweet (2 and 3 consumers for RK and SK, respectively), not really nice (15 and 8 consumers for RK and SK, respectively) and not alcoholic (1 and 13 consumers for RK and SK, respectively).

Weighed mean drops for CATA attributes are shown in Figure 5. Two attributes boring and crumbly for RK had significant weighed mean drop . Hence scoring of these attributes significantly affected the liking of SK product.



Attribute	p value (Cochran 's Q test)
homogeneous	0.004*
exciting	0.752
boring	<0.0001*
crumbly	0.002*
teeth stickiness	0.424
sour	<0.0001*
salty	<0.0001*
sweet	1
bland	<0.0001*
nice	0.169
alcoholic	0.003
fermented	<0.0001*
speckled	0.034*
chewy	0.007*
grainy texture	0.185

Figure 5. Weighed mean drop per CATA attribute for Reengineered Kenkey (RK) and Standard Commercial Kenkey (SK) and Cochran's Q test.

Significant differences between the CATA counts for the two Kenkey products are indicated by Cochran's Q test. There were significant differences between RK and SK for a majority of attributes : the two products differ in terms of the followings: homogeneous; boring; crumbly; sour; salty; bland; alcoholic; fermented; chewy. These results confirmed that the reengineered product (RK) has significantly different characteristics to the standard product (SK). Hence reengineering modified greatly the sensory characteristics of the product.

Kenkey Conclusion

The results of this research help to provide a basis of understanding on how the reengineered Kenkey (RK) compares to standard commercial Kenkey (SK) in terms of its sensory properties. An interesting finding was that the sensory properties of RK were very different from that of the standard Ga Kenkey (SK): consumers scored differently the new product from the standard one. RK was globally perceived as too weak whilst SK was too strong (JAR). RK was perceived as bland and crumbly and SK as sour, salty and fermented.

Kenkey References

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Detailed report for Kishk Sa'eedi

Kishk Sa'eedi Summary

Kishk Sa'eedi (KS) is an Egyptian indigenous wheat-based fermented food prepared traditionally according to the method applied by Upper Egyptians. The term Sa'eedi is the designation that is given to the people of the Sa'eed or the south of Egypt. Kishk Sa'eedi (KS) is typically prepared by mixing Laban Zeer (buttermilk separated from freshly drawn milk and left to sour in an unglazed earthenware container: the "zeer") with coarsely ground parboiled whole wheat. The Laban Zeer is mixed with the moistened coarsely ground parboiled wheat in a large earthenware magour, to produce a heavy paste called "hama". The milk cereal mixture is then allowed to ferment again and kneaded with the addition of more of the fermented salted milk diluted with water and spiced with cumin before cutting into unformed chunks (of about 3 cm in diameter) or shaped into small balls of about 2 cm in diameter. The shaped product is arranged on a reed mat to dry in the sun and stored in the form of the dried product. This technology is indigenous and is a product of the traditional culinary culture of the people. For consumption, though it can be munched in the dry state, it is often reconstituted in a little water to be consumed as a breakfast meal or cooked in a variety of recipes. Prepared in a number of different ways, it can be served at any of the three main meals. The sensory properties of the traditional Kishk Sa'eedi (*KS)* were previously investigated. This work is done to characterize sensory properties and sensory profile of the re-engineered KS.

Quantitative descriptive analysis (QDA) coupled with principal component analysis (PCA) was used to study the interrelationship among and between sensory attributes. 14 terms regarding appearance, odour, flavour and texture of the samples, was selected and a glossary describing each descriptor was developed. Three *KS* samples were profiled by 11 assessors on about 10-cm unstructured scale using the chosen 14 sensory descriptors. Mean intensity ratings of the descriptive attributes showed that there were significant differences ($p<0.05$) within *KS* samples for all the 14 attributes tested. In general, high ratings for creamy colour, fresh odour, *KS* taste and fracturability are considered as positive effects that would be favoured by panellists while increase in caramel colour, sour taste, denseness and mouth coating are regarded as undesirable.

The re-engineered KS sample percieved as less sour and less salty compared with the traditional ones. With regard to texture quality, re-engineered sample was easy to fracture, and scored higher for grittiness. Meanwhile, the sample was rated lower than the tarditional ones with regard to Kishk taste and fermented odour.

Descriptive sensory evaluations between of the traditional and re-engineered KS samples showed that tastes i.e. sour, salty, and *KS* taste; fracutability and grittiness were discriminating attributes. Fermented odour, color i.e. creamy and caramel; presence of fissure and presence of bran were least discriminating.

Kishk Sa'eedi Background

This document contributes to deliverable 5.5.1.1 " Final report on sensory and African consumer acceptance for Group 1. This deliverable aims to determine the sensory properties and consumer acceptance of the re-engineered Kishk Sa'eedi (*KS*) in an African market namely Egypt. The expected outcome is to furnish knowledge of a product's sensory properties from a scientific as well

as technical viewpoint and a broader understanding of the consumer acceptance in the main production zones and in the trade centers of the *KS*.

Kishk Sa'eedi Materials and methods

The traditional KS was re-engineered and the detailed methodology for re-engineering are explained below (Figure 1).

Figure 1. Picture of reengineered kishk Sa'eedi

Method of preparing the re-engineered kishk Sa'eedi samples

Butter milk fermentation
Three hundreds and eleven isolated strains (isolated from good quality traditional Laban Zeer) have been examined for flavor acceptability in reconstituted skim milk powder to select only strains that produce accepted flavor. The strains that produce acceptable flavor have been screened for preteolytic and esterase activities. The selected strains were then screened according to antagonistic system and antibiotic sensitive. At the end of experimental, 15 strains have been selected and used in fermentations butter milk to produce Laban Zeer. Skimmed milk, full cream milk, butter milk, mixture of Skimmed milk and butter milk, mixture of full cream milk and butter milk, mixture of Skimmed milk and full cream milk have been used in different ratios to produce Laban Zeer like. The best accepted flavor was in full cream milk and butter milk (1:2).

Inoculation Culture concentration
The concentration of inoculated culture was studied with 2, 3, 4 and 5% of culture. The 2% is selected to be used in fermentation the final product. The fermented product is cooled overnight and then concentrated by filtration though thick cheese cloth. The filtration time was studied to reach the 22-25% of dry matter in Laban Zeer. The filtration time is set to be 6 h.

Wheat preparation
Whole wheat grains were manually cleaned and boiled in excess of water till soften. At the end of boiling and after drying the wheat gelatinize to 43.5 (Laboratory measured after boiling, drying ,

and grinding) . Then oven dried and coasrly grinded (PSI 89% measured by sieve analysis technique).

Dough preparation
The ration of dry coarse flour to Laban zeer to was studied at ration of 1:2, 1:3 and 1:4. The ratio of 1:2 is selected as received the highest score for flavor, texture and overall acceptability.

Spicing
Some trials were made with adding cumin and some other trials were made without adding spices. The product made using cumin received high score of acceptability.

Shaping and drying
The KS is manually shaped into small balls or other shapes (see picture). The flat shapes kishk is dried faster at 40 C. The costumers accepted both shapes.

Storage
When Kishk Sa'eedi packed in glass jar, the product become soft and wet, but the product have a good shelf life when t packed in paper bags or cotton bags and kept in dry area.

Sensory evaluation methods
Quantitative descriptive analysis (QDA) coupled with principal component analysis (PCA) was used to evaluate the KS samples from sensorial point of view as follows.

Panel selection and training
11 panellists (3 males, 8 females, age 22-37 Y), identified as familiar and consumers of KS, who had completed a graduate course in sensory analysis, and were previoulsy participated in the traditional KS sensory evaluation study. Panelists were recruited from National Research Centre (NRC) and Faculty of Agriculture. Panelists were then attended previosuly several training sessions. Initial orientation session where panelists received detailed explanation about the descriptive sensory methodology and the purpose of the study was conducted.
They were involved in the focus group discussion and established descriptive terms characterising the appearance, odour, taste, and texture. A list, composed of 14 descriptors regarding appearance, odour, flavour and texture of the samples, was developed.

Individual training on the developed lexicon, which required five 30-minutes sessions. Panelists attained individual training on the different intensities of the developed lexicon using a 10-cm line scale. They were told about the main objective of the test and also a brief explanation of how to answer the KS sensory and questionnaires. Three KS samples (one re-engeniered and two traditional) were used in three successive sensory profiling sessions. The panelists evaluated KS by the developed lexicon (Table1), using a 10-cm line scale.

Table 1: Definitions of the indicated descriptors used for ksihk Sa'eedi

Descriptor	Definition
Appearance	
Creamy colour	colour similar to cream
Caramel colour	colour similar to caramel
Presence of bran particles	degree of containing bran particle
Presence of fissures on the surface	Presence of cracks on the surface of the sample
Odour	

Fermented odour	odour characteristic of fermented wheat dough
Fresh odour	the opposite of aged odour (rancid, musty, stale)
Taste	
Sour taste	taste that is acidic and sharp
Salty taste	tastes of table salt (sodium chloride)
Spicy taste	taste that is describe the cumin and hot pepper taste
kishk taste	taste that is characteristics to kishk Sa'eedi
Texture	
Fracturability	the ability of the sample to crack or crumble, opposite of cohesiveness
Denseness	Compactness the sample after biting completely through with the molars
Grittiness	presence of small, hard particles.
Mouth coating	referred to how the sample adheres to the inside of the mouth surfaces during chewing

Product Evaluation

The KS samples were placed in plastic plates and the panelists evaluated the three samples once during a 60-minutes session and the evaluation was repeated two more times. The three evaluation sessions were separated by at least one hour to eliminate flavor carryover and fatigue effects. All samples were coded with random three-digit numbers and served to the panelists in a randomized complete block design. Assessors were asked to evaluate samples in the same order given to them and answer questionnaires when evaluating each sample. Subjects recorded the intensities of the attributes on about 10-cm scale, where zero indicates the absence of intensity, and ten corresponds to an extreme intensity. They worked in partitioned booths, free from distracting noises and odors. They were provided with room-temperature drinking water, and disposable cup to cleanse their palate.

Statistical analysis

Comparison results between samples among triplicates readings of experimental were treated using the ANOVA test (analysis of variance) with a probability level of ($p>0.05$) using computer program (SPSS, V 18.0). Principal component analysis (correlation matrix) was carried out using XLSTAT (V 5.2, Addinsoft).

Kishk Sa'eedi Results and discussion

Three different *KS* samples were tasted at room temperature in a random 3-digit number coded plastic plate in individual sensory booths. An unstructured line scale, with appropriate anchors, ranging from zero (0) denoting not (e.g. not salty) to ten (10) denoting extreme (e.g. extremely salty) was constructed and used to evaluate the different samples.

Mean intensity ratings of descriptive attributes are tabulated in table (2). Results showed that there were significant differences ($p<0.05$) within *KS* samples for all the 14 attributes tested. In general, high ratings for creamy colour, fresh odour, kishk taste and fracturability are considered as positive effects that would be favoured by panellists while increased in caramel colour, sour taste, denseness and mouth coating are regarded as undesirable.

The re-engineered KS sample percieved as less sour and salty compared with the traditional ones, which is considered as a desirable sensory traits. With regard to texture quality, re-engineered sample was easy to fracture, and scored higher for grittiness. Meanwhile, the sample was rated lower than the tarditional ones with regard to Kishk taste and fermented odour.

Table 2: Mean intensity ratings for the sensory attributes of the traditional and re-engineered *KS* samples

Attribute	Re-eng KS	Mal-B-B9	Mal-B-S35
Creamy coluor	61.8	68.7	59.5
Caramel colour	68.7	41.1	83.1
Presence of bran	59.5	46.7	56.9
Presence of fissures	64.9	63.3	68.7
Fermented odour	41.8	57.9	82.5
Fresh odour	61.8	72.8	53.8
Sour taste	47.3	54.9	83.0
Salty taste	46.0	56.2	65.9
Spicy taste	53.2	44.3	67.3
Kishk taste	57.2	75.2	74.5
Fracutrability	76.0	67.9	48.5
Denseness	68.6	56.1	68.5
Grittiness	72.9	61.2	63.1
Mouth coating	54.3	60.0	64.1

* Values represent means ± standard deviation
Ratings are based on a 100 mm line scale with anchors. 11 trained descriptive panelists rated each attribute for each sample for a total of
3 times in 3 different sessions.

Principal Component Analysis (PCA) was used to study attribute-sample relationships. With PCA, a sensory space was created where samples were positioned in the attribute-sample space according to their characteristic sensory attributes. The distance between a sample and an attribute indicated the extent to which the attribute can be used to describe such sample.
Results indicated that large and significant variations in quality characteristics of re-engineered *KS* were observed compered with tarditional samples ($p \leq 0.05$). The PCA bi-plot (Fig. 2) shows that the data of re-engineered KS was located on the upper left side of PC1 (explaining 70% of the variance).

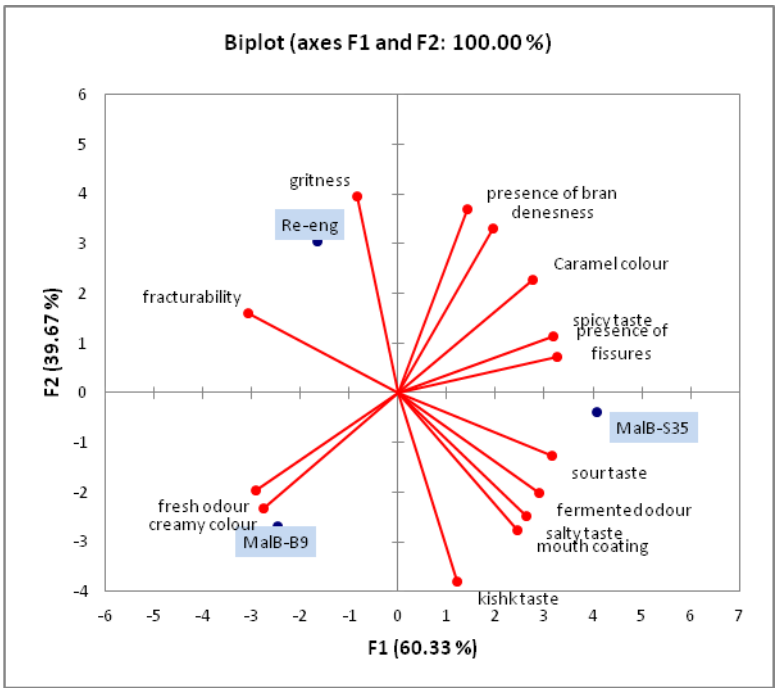

Figure 2: PCA Bi-plot of descriptive sensory attributes of the *KS*[a]

[a]Descriptive sensory attributes are plotted in red color, products in blue color

Kishk Sa'eedi Conclusions

Evaluation of the *KS* sensory characteristics provide in depth understanding of the sensory quality criteria as perceived by the sensory trained panel. The present study showed that substantial differences in sensory character were noted between the traditional and re-engineered *KS* in particular, differences in clour, fresh odor, *KS* taste, fracutability and mouth coating. This work showed that the application of QFD and PCA techniques could provide the useful information to *KS* and helped to identify the importance of product attributes.

Acknowledgements

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