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EFFECT OF TRADITIONAL PROCESSING METHOD AND LEAF-PACKAGING ON SENSORY CHARACTERISTICS OF *OLÈLÈ*, A STEAMED COWPEA PASTE

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Abstract: *Musa paradisiaca, Tectona grandis and Thalia geniculata leaves used in the past as wrapping materials of Olèlè (steamed dough of cowpea enriched to the shrimps and other condiments), are being abandoned in favor of metal cans. This situation contributes to the lost of identity of this traditional food product. Two traditional processing methods which differ in the dehulling techniques are practiced to obtain Olèlè also called Magni magni or Moin moin. The objective of this study was to determine the effect of processing methods and wrapping materials on sensory characteristics of Olèlè and their consumer acceptability. For this purpose, sensory difference and overall acceptability tests and a sensory profile analysis were conducted. Thus, Olèlè differently wrapped was produced the day of the sensory evaluation and appreciated by sensory panelists. Panelists clearly distinguished Olèlè according to the processing method. Sixteen representative descriptors were identified to profile Olèlè. The leaves used for wrapping Olèlè had a significant effect on its sensory characteristics noted by the consumer panel with clearly distinct sensory profiles ($p \leq 0.05$). The overall acceptability test revealed that the Olèlè wrapped in Musa paradisiaca leaves is the most appreciated, followed respectively by those wrapped with Tectona grandis leaves, Thalia geniculata leaves and one packaged in recycled tin cans.*

Keywords*: Vigna unguiculata L., Moin moin, plant leaves, sensory profile, consumer acceptability, tradition.*

1. Introduction

Cowpea (*Vigna unguiculata*) is a well-known leguminous species. It is a very important legume crop in tropical Africa and South and Central America [1]. Different parts of this crop such as the young leaves, green pods and dry seeds are eaten as different food recipes [2]. Among these edible parts, cowpea seeds are more important. About 6.5 million tons of them are annually harvested worldwide especially in West Africa [3]. In this region as well as in Brazil, whole cowpea seeds are processed (dehulled/ground or not, boiled, fried, steamed, etc.) into various dishes and widely consumed by the populations. The steamed seasoned paste called *Moin-moin* or *Olèlè* in Benin and Nigeria is one of the most important cowpea seed dishes. This dish is also known as *Koki* in Cameroon [4], and *Abará, Abala* or *Olelé* in Brazil [5].

The traditional processing methods well described by several authors [5-7] are close, except little differences. After sorting, the cowpea seeds are dehulled by a wet process (washing-soaking and removal

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of cowpea seed coat in water) [5] or by a dry process (reduction of the size of dry cowpea seeds using a mortar or a grain mill and removal of hulls through winnowing) [7]. Wet or dry hulled cowpea seeds are ground in a grain mill. Derived paste or flour is mixed with spices (chilli pepper, garlic, ginger, pepper etc.), salt, onion, water and red palm oil to obtain a fluid dough. In addition to those ingredients mentioned above, addition of cashew nut or peanut [5] and also other ingredients such as fish and boiled egg [6] is involved. The partial substitution of ground cowpea seeds by corn and yam flours is also experienced [8-9]. Whatever the raw materials and the ingredients mixed, the slurry or liquid dough obtained is packaged in pouches made from plant leaves, in aluminium foil, in polyethylene bags, in metal cans and finally steamed to give an irreversible gel-pudding. The recycled tin cans are currently used by all the producers of *Olèlè* interviewed in Benin [10]. The use of plant leaves in food preparation and packaging is characteristic of the traditional practices and their perpetuation helps to keep alive the traditions and the diversity of leaves found in tropical regions of the world [11]. For instance, leaves from the species *Musa sapentium, Musa paradisiaca, Cola nitida* and *Thaumatococcus daniellii* have been used for centuries as natural food wrappers in Nigeria [12]. During the cooking of *Olèlè*, the slurry is steamed together with its wrapping materials. When the latter are leaves, their bioactive compounds can migrate into the paste. This phenomenon may not only improve the bioactive properties of *Olèlè*, but also influence its sensory characteristics. With the growing interest of consumers in sustainable, safer, and healthier products [13], it is essential to understand how wrapping fashions can add advantageous properties to products.

Several studies have been conducted on the physicochemical, proximate and on sensory characteristics of *Olèlè* from cowpea alone or blended with other flours. However, the research on the effect of leaf-packaging, on their acceptance and on sensory characteristics of *Olèlè* affected by the processing methods has not been investigated to date. This study therefore is conducted (1) to assess the consumer's appreciation of *Olèlè's* sensory characteristics as are affected by processing methods on the one hand and by leaf-wrapping on the other hand and (2) to determine the sensory profile of *Olèlè* wrapped with plant leaves. The obtained data will help in documenting the characteristics of *Olèlè* preferred by consumers and give useful information for the cottage industry of *Olèlè* production.

2. Materials and methods

Plant Material

White cowpea seeds, other ingredients (palm oil, pepper, chili pepper, onion, garlic and salt) and wrapping materials (glass jar, recycled tin cans and the leaves from *Musa paradisiaca*, *Tectona grandis* and *Thalia geniculata*) used in this study were purchased from a local market in Porto-Novo, Benin Republic.

Sample preparation

Ten different samples of *Olèlè* were produced the day of the sensory evaluation. The samples included two types of *Olèlè* made by using the process involving a wet dehulling [5] and a second one involving dry dehulling of the cowpea seeds and the addition of maize flour [7]. The two type of *Olèlè* were packaged with five different wrapping materials: glass jar, recycled tin cans (the container currently and universally used by producers of *Olèlè*) and the leaves from *Musa paradisiaca, Tectona grandis and Thalia* *geniculata*. The samples of *Olèlè* packaged in the glass jar were used to evaluate the effect of processing method and the samples packaged in recycled tin cans were chosen as a reference to appreciate the effect of leaf-wrapping. The quantity of ingredients are : red palm oil (200 g), pepper (15 g), chili pepper (45 g), onion (50 g), ginger (15 g), garlic (20 g) and salt (35 g). They were used to process 1 Kg of white cowpea seeds and did not vary for the two processing methods. But the quantity of water was 2 Kg and 3 Kg for the process involving wet dehulling and the process involving dry dehulling. The last processing method also implied an addition of 250 g of maize flour to the mixed paste before steaming.

Sample presentation

Fresh *Olèlè* samples (approximately three hours after steaming) were divided into eight similar portions, served in disposable polystyrene containers with lid and presented to the taster. The presentation order of the samples was randomized and each sample was coded with 3-digit random numbers. Mineral water in plastic bottles were provided to the panelists to rinse their palate between sample tests.

Sensory difference and overall acceptability tests

A total of sixty (60) panelists who were interested in the sensory evaluation of *Olèlè* were recruited among consumer knowing the product and used to eat it at least once a week in Avrankou township in the south of Benin Republic, where the product is largely consumed. The number of panelists involved varied according to the type of analysis. Thus, 36, 50, 32 and 30 panelists were solicited respectively for a triangle test, a paired preference test, a matching test and an analysis of the overall acceptability the first two days of the sensory evaluation.

The triangle test presented previously [14] was carried out to identify if there is a difference between the *Olèlè* resulting from the two different processing methods. Three coded *Olèlè* samples steamed in glass jar were presented to the panelists. Among them, two *Olèlè* samples were the same but are coded differently.

For the paired preference test described earlier [14], samples of *Olèlè* from the two processing methods were compared to determine which product is preferred based on the color, texture, aroma and taste.

To perform the matching test**,** the panelists simultaneously and in a randomly chosen order received four controls coded respectively by the letters A (*Olèlè* wrapped with leaves of *Thalia geniculata*), B (*Olèlè* wrapped with leaves of *Tectona grandis*), C (*Olèlè* wrapped with *Musa paradisiaca* leaves) and D (O*lèlè* packaged in recycled tin cans) and pairs of samples coded by different numbers: 502 and 258 for *A*, 111 and 322 for *B*, 333 and 129 for *C* then 610 and 412 for *D*. In the guideline provided, they were asked to assess each sample independently and then match the control samples (A, B, C, and D) to the coded samples.

The evaluation of the overall acceptability of *Olèlè* packed was carried out through a ranking test already presented [14]. Panelists are asked to rank the coded samples according to acceptance from least acceptable to most acceptable for each given sensory parameter. Thus, texture, color, aroma, and taste of the samples are classified in terms of acceptability, giving each sample a different rating even if it seemed comparable. The sample with the most acceptable appreciation was given a rank of 1, the next a rank of 2 and the next that seemed the least acceptable, a rank of 3. Based on the responses of the panelists, totals per sensory parameter per sample (T) and differences between rank total pairs

(|X - Y|) were calculated according to the following formulas:

$$T = \sum_{n=1}^{4} (\text{Rank value x number of subjects giving the rank}) \quad (1)$$

Differences between rank total pairs (|X - Y|) were determined as follows:

|X-Y| = |T(X) – T(Y)|, with X and Y, the samples. (2)

Identification and selection of descriptors for establishing a sensory profile

For the establishment of the sensory profile, the panel used consisted of 12 panelists (10 women and 2 men). The panelists are selected to participate based on ability to discriminate, communication skills, and task comprehension. The panelists recruited are directly used for the final panel due to their good level of knowledge of the product. Moreover, they were mainly saleswomen of *Olèlè* and daily consumers of the product. The sensory profile of *Olèlè* was established based on the standardized procedure [15]. During the first session, the panelists generated descriptors that could describe the taste, aroma, texture, and color of *Olèlè*. This list is reduced by grouping together the synonymous descriptors or antonyms and eliminating those that are poorly suited to describe *Olèlè*. During session 2, panelists evaluated four samples of *Olèlè* differing in the wrapping (*Thalia geniculata* leaves, *Tectona grandis* leaves, *Musa paradisiaca* leaves and tin cans) but produced by the processing method involving the wet dehulling. The recycled tin cans were considered as a control sample or neutral wrapping.

Statistical analysis

The results of triangle and preference tests were analyzed using a one-tailed binomial test and a two-tailed binomial test at the level of significance of 0.05. Matching test results were analyzed with the Pearson's Chi² test. A principal component analysis (PCA) was applied using R version 4.0.2 software, to the average scores per product and per attribute to determine the correlation between the various descriptors as described in the standardized procedure [15]. The overall acceptability test results were assessed by comparing the rank totals for all possible pairs of samples using the Friedman test.

3. Results and discussion

Discernment of *Olèlè* sensory characteristics

The number of responses relating to the discernment of the *Olèlè* from the processing method involving wet dehulling of cowpea and the *Olèlè* from the process involving dry dehulling of cowpea and the addition of maize flour are given in Table 1.

Table 1:
Number of responses relating to the discernment of *Olèlè* according to the processing method.

Number of panelists	Sample presentation order	Number of correct answers
6	A A (**B**)	5
6	A (**B**) A	6
6	(**B**) A A	6
6	B B (**A**)	5
6	B (**A**) B	6
6	(**A**) B B	5
Total 36		33a

A: Olèlè from the process involving wet dehulling of cowpea seeds; B: Olèlè from the process involving dry dehulling of cowpea seeds and the addition of maize flour; Bold letter in brackets: Intruder
a: Probability of 33 correct answers in 36 trials (p=l/3) was 0.001 according to one-tailed binomial test.

Thirty-three (33) panelists out of 36 were able to correctly identify the different *Olèlè* samples from the two processes. The one-tailed binomial test applied to this result indicated that the level of significance was 0.001. It was concluded that *Olèlè* from the production process involving wet dehulling of cowpea were therefore detectably different from *Olèlè* produced according to the process involving dry dehulling of cowpea and the addition of maize flour. The difference between the *Olèlè* from the two processes would be linked to variations of sensory attributes in general and particularly those related to the appearance such as color and texture. Indeed, the appearance is the first characteristic of a product that can be perceived by the senses [16].

The number of responses relating to the discernment of *Olèlè* packaged with different packaging were presented in Table 2.

Table 2:
Number of responses relating to the discernment of *Olèlè* packaged in different wrapping marerials.

Controls	Samples								Chi-squared	P-value
	111 (B)	129 (C)	258 (A)	322 (B)	333 (C)	412 (D)	502 (A)	610 (D)		
A	1	4	5	0	3	0	17	2	54	$2.352e^{-9}$
B	16	0	0	16	0	0	0	0	96	$2.2e^{-16}$
C	0	14	3	0	12	0	3	0	57.5	$4.754e^{-10}$
D	0	4	0	0	0	16	3	9	58.5	$3.006e$-^{10}

A*: Olèlè wrapped with the leaves of Thalia geniculata; B: Olèlè wrapped with the leaves of Tectona grandis, C: Olèlè packaged with the leaves of Musa paradisiaca, D: Olèlè packaged in recycled tin cans. The letters in brackets designate the samples and those without the controls.*

Twenty two (22) out of the 32 panelists correctly matched the sample of *Olèlè* wrapped with the leaves of *Thalia geniculata* to the control (Table 2). The Pearson test revealed that there is a significant dependence between the sample of *Olèlè* wrapped with *Thalia geniculata* leaves and its control (Khi-2 = 54, p-value = $2.352e^{-09} < 0.05$). This could be explained by the fact that the leaves of *Thalia geniculata* conferred on *Olèlè* distinctive sensory characteristics from those conferred by the leaves of *Tectona grandis*, the leaves of *Musa paradisiaca* and recycled tin cans. Among these characteristics, the most remarkable was the soft texture of the *Olèlè* packaged in the leaves of *Thalia geniculata*. This texture of *Olèlè* indicated that the pores of the leaves of *Thalia geniculata* absorb water weakly. The distinction of *Olèlè* wrapped in the leaves of *Thalia geniculata* and its controls from the other samples would therefore be mainly favored by the less firm texture conferred by the leaves of *Thalia geniculata*. All the panelists correctly matched *Olèlè* wrapped with the leaves of *Tectona grandis* to their control. The Pearson test confirms this trend (Khi-2 = 96, p-value = $2.2e^{-16} < 0.05$). The success of the pairing test of *Olèlè* wrapped with the leaves of *Tectona grandis*, to its controls by all the panelists could mainly be explained by the firm and hard texture and the dark color conferred by the leaves of *Tectona grandis* to the *Olèlè*. Moreover, 26 out of the 32 panelists correctly matched *Olèlè* wrapped with the leaves of *Musa paradisiaca* to the corresponding control. The Pearson test showed that there is a significant dependence between the *Olèlè* packaged with the leaves of *Musa paradisiaca* sample and its controls (Khi-2 = 57.5, p-value = $4.754e^{-10} < 0.05$). Like *Olèlè* wrapped in the other packaging, *Olèlè* wrapped with the leaves of *Musa paradisiaca* has revealed sensory characteristics which are intrinsic and specific to these leaves. The *Olèlè* packaged in these leaves had a very firm and smooth texture. It was also noted that 25 out of the 32 panelists correctly matched *Olèlè* packaged in recycled tin canned samples to its controls with a significant dependence between the sample and its controls (Khi-2 = 58.5; p-value = $3.006e^{-10} < 0.05$). This could be explained by a lack of specific characteristics imparted by metal packaging to the product compared with the leaves. These results are consistent with those of other researchers who indicated that the ancient practice of using leaves as wrappers during the cooking of dishes like *Olèlè* and *Okpra* undoubtedly has a positive impact on their tastes, flavor and overall acceptance [17]. The contribution of plant leaves to the subtle flavor of food products wrapped in them and their potential to act on human health was mentioned previously by authors [18, 19].

Sensory profile of *Olèlè*

To develop the sensory profile of *Olèlè* wrapped with leaves from different plant species or packaged in recycled tin cans, sensory descriptors have previously been researched.

Table 3:

Sensory descriptors of *Olèlè*.

Sensory parameter	Attribute	Description of the attribute
Taste/ Flavor	Salty	Major mouthfeel that sodium chloride gives
	Cooked *Musa paradisiaca* leaf	Flavor associated with steamed *Musa paradisiaca* leaf
	Cooked *Tectona grandis* leaf	Flavor associated with steamed *Tectona grandis* leaf
	Cooked *Thalia geniculata* leaf	Flavor associated with steamed *Thalia geniculata* leaf
	Garlic	Flavor associated with garlic
	Pepper	Flavor associated with pepper
	Chilli pepper	Flavor associated with chilli pepper
	Cowpea	Flavor associated with cooked cowpea
Color	Red	Intensity of the red appearence of *Olèlè*
	Orange-red	Intensity of the orange-red appearence of *Olèlè*
	Orange	Intensity of the orange appearence of *Olèlè*
	Yellow orange	Intensity of the yellow orange appearence of *Olèlè*
	Yellow	Intensity of the yellow appearence of *Olèlè*
	Yellowspotted with black	Intensity of the yellow spotted with black appearence of *Olèlè*
Texture	Firm	Which has no cracks
	Soft	Which can be easily cut
	Hard	Which is difficult to penetrate
	Smooth	Which does not offer roughness and mark
	Rough	Which has cracks and stains
Aroma	Cowpea	Cooking smell associated with steamed cowpea seeds
	Pepper	Spicy smell associated with pepper
	Garlic ;	Sulfur smell associated with garlic
	Cooked *Thalia geniculata* leaves;	Cooking smell associated with steamed *Thalia geniculata* leaf
	Cooked *Musa paradisiaca* leaves;	Cooking smell associated with steamed *Musa paradisiaca* leaf
	Cooked *Tectona grandis* leaves;	Cooking smell associated with *Tectona grandis* leaf
	Onion	Sulfur smell associated with boiled onion bulb
	Ginger	Spicy smell associated with boiled ginger rhizome

Thus, a list of 58 primary descriptors (not mentioned) were generated by the panelists to describe color, aroma, texture and taste of *Olèlè*. A grouping of synonymous or

antonymous primary descriptors has led to reducing these primary descriptors from 58 to 27 (Table 3) and finally to 16 representative descriptors of *Olèlè*.
A principal component analysis (PCA) was applied to the average intensity scores of *Olèlè* differently packaged and affected by attribute to delineate the combinations between the *Olèlè* samples and their representative descriptors. The results of this analysis (Figure 1) indicated that the first two principal components (PC1 and PC2) respectively explained 46.47% and 31.34%, i.e. a total of 77.81% of the variations, which is sufficient to guarantee the interpretation precision.

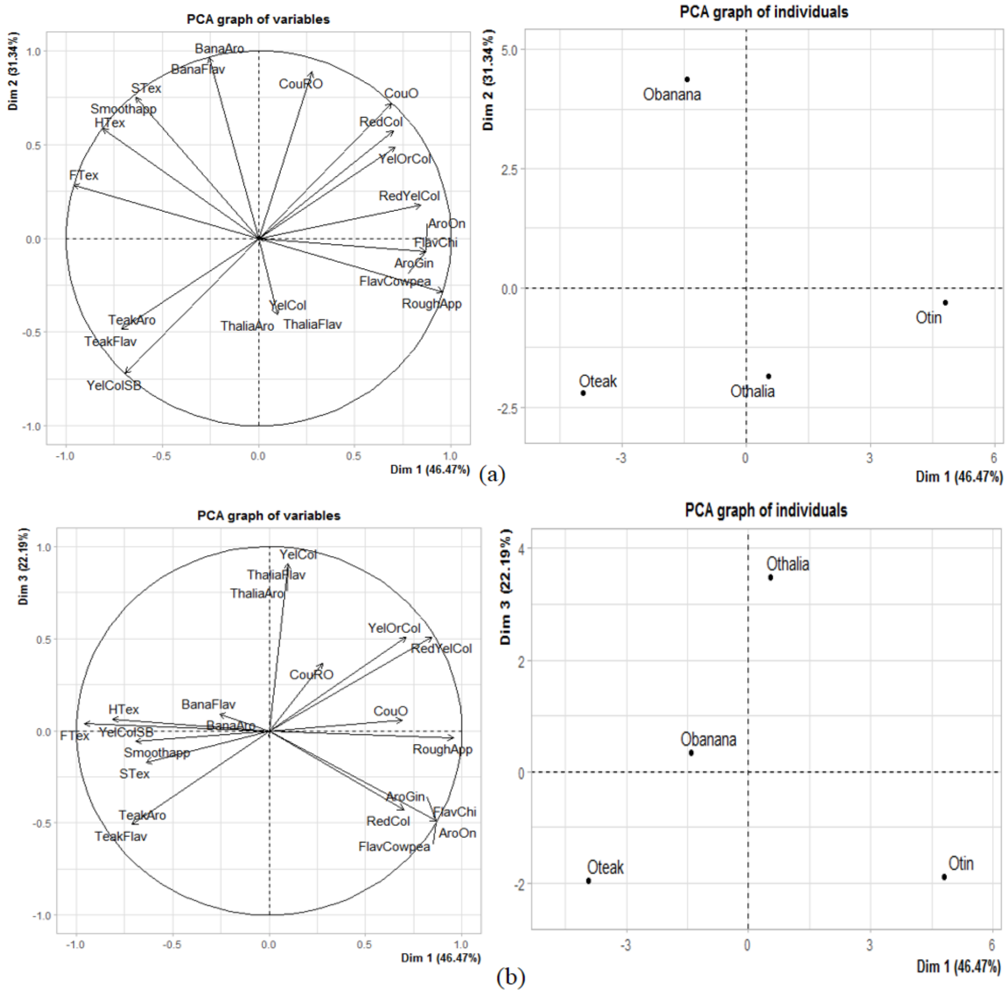

Fig. 1: Circle of correlations of the sensory descriptors and projection of *Olèlè* in the axis systems (PC1 and PC2) (a) and (PC1 and PC3) (b).

TeakAro: Aroma of cooked Tectona grandis leaves ; ThaliaAro: Aroma of cooked Thalia geniculata leaves ; TeakFlav : Taste of cooked Tectona grandis leaves ; ThaliaFlav: Taste of cooked Thalia geniculata leaves; HTex: Hard texture ; FTex: Firm texture ; RedCol: Red color ; YelOrCol: Yellow-orange color; YelCol: Yellow color; RedYelCol : Red-yellow color; FlavCowpea : Cooked cowpea flavor; AroOn : Aroma of onion; AroGin: Aroma of ginger; FlavChi : Taste of chilli pepper; BanaAro: Aroma of cooked Musa paradisiaca leaves ; YelColSB: Yellow spotted with black ; CouO : Orange color ; CouRO : Red-orange color; SmoothApp: Smooth appearance; STex : Soft texture; BanaFlav: Taste of cooked Musa paradisiaca leaves ; Othalia: Olèlè packaged with the leaves of Thalia geniculata; Oteak: Olèlè wrapped with the leaves of Tectona grandis; Obanana: Olèlè wrapped with the leaves of Musa paradisiaca; Otin: Olèlè packaged in recycled tin cans; PCA: Principal component analysis; PC1: First principal component; PC2: Second principal component ; PC3: Third principal component.

However, the correlation analysis indicated that the descriptors: taste of cooked *Thalia geniculata* leaves, yellow color, and aroma of cooked *Thalia geniculata* leaf were not taken into account by either of these first two principal components (PC1 and PC2), but rather by the third (PC3) (Figure 1). As a result, the first three main components comprising 100% of the initial variations will be retained to describe the links between the descriptors and *Olèlè* differently packaged.

On PC3, descriptors such as Taste of cooked *Thalia geniculata* leaf (ThaliaFlav), yellow color (YelCol), Aroma of cooked *Thalia geniculata* leaf (ThaliaAro), and yellow spotted with black color (YelColSB) described *Olèlè* wrapped with the leaves of *Thalia geniculata*.

The sensory profile (Figure 2) developed on the basis of PCA results includes 16 sensory descriptors describing the color, aroma, texture and taste of *Olèlè* wrapped with different packaging. It should be noted that strongly correlated and less discriminating descriptors were not considered. These included: salty taste, taste of pepper, aroma of pepper, flavor of garlic and aroma of garlic.

Olèlè wrapped by *Musa paradisiaca* leaves had a taste of cooked *Musa paradisiaca* leaf; color red orange; characteristic aroma of cooked *Musa paradisiaca* leaf; hard, firm and soft texture and a smooth appearence (Figure 2a). *Olèlè* wrapped with *Tectona grandis* leaves revealed a characteristic taste of cooked *Tectona grandis* leaves; yellow spotted with black, aroma of cooked *Tectona grandis* leaves, a hard and firm texture (Figure 2b).

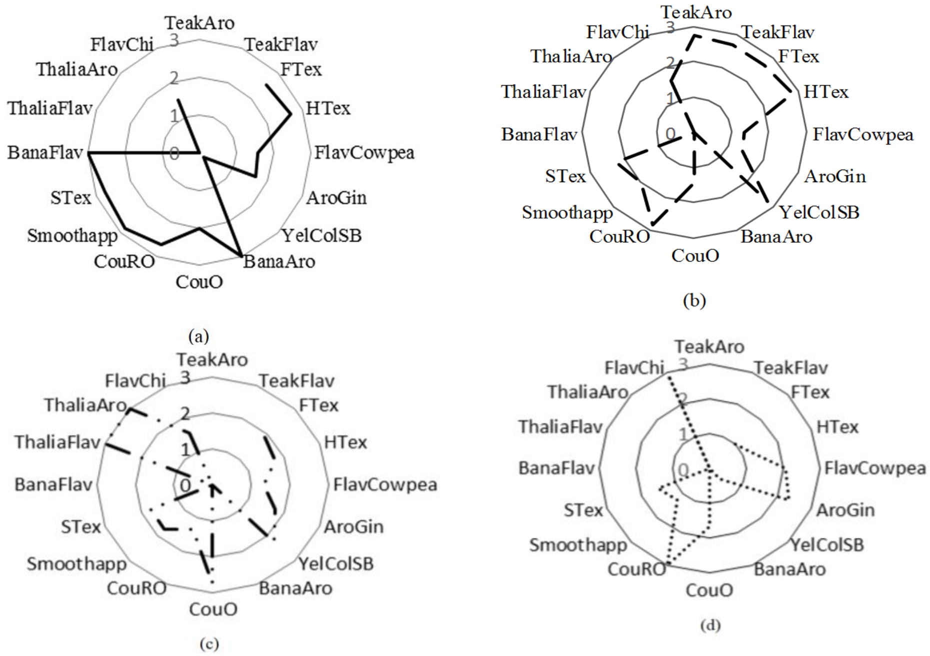

Fig. 2: Profile of *Olèlè* wrapped with the leaves of *Musa paradisiaca* (a), *Tectona grandis* (b), *Thalia geniculata* (c) and recycled tin cans (d).

TeakAro: Aroma of steamed Tectona grandis leaves ; ThaliaAro: Aroma of steamed Thalia geniculata leaves ; TeakFlav : Taste of cooked Tectona grandis leaves ; ThaliaFlav: Taste of cooked Thalia geniculata leaves; HTex: Hard texture ; FTex: Firm texture ; FlavCowpea : Cooked cowpea flavor; AroGin: Ginger flavor; FlavChi : Taste of chilli pepper; BanaAro: Aroma of steamed Musa paradisiaca leaves ; YelColSB: yellow spotted with black ; CouO : Orange color ; CouRO : Red-orange color; SmoothApp: Smooth appearance ; STex : Soft texture; BanaFlav: Flavor associated with steamed Musa paradisiaca leaves.

Olèlè packaged using the leaves of *Thalia geniculata* presented a characteristic taste of cooked *Thalia geniculata* leaf; a color orange; aroma of cooked *Thalia geniculata* leaf; a hard, firm and soft texture that is little noticed (Figure 2c). *Olèlè* packaged in recycled tin cans showed a characteristic, more intense chili taste; red-orange color; ginger aroma; a soft texture slightly noticed (Figure 2d).

Consumer acceptability of *Olèlè*

The total number of panelists preferring *Olèlè* from one processing method over the other varied according to the sensory parameters (Figure 3).

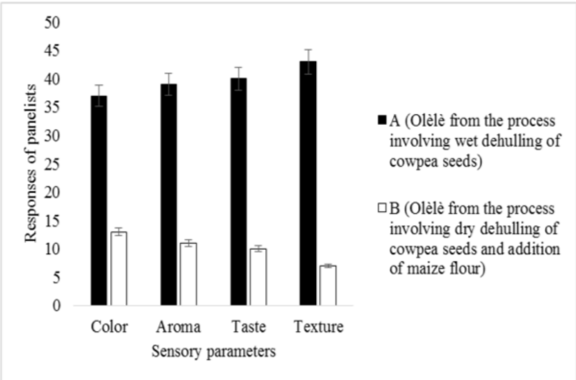

Fig. 3: Judgment of *Olèlè* from two processing methods according to sensory parameters.

Overall, 37 out of the 50 panelists preferred the color of *Olèlè* sample from the processing method involving the wet dehulling of cowpea seeds. The statistical table of a two-tailed binomial test showed that the probability for X= 37 and n = 50 was 0.001 where X represents the number of panelists preferring a sample and n represents the total number of panelists participating in the test. Therefore, the color of *Olèlè* from the process involving the wet dehulling of cowpea seeds was significantly preferred to the color of *Olèlè* from the process involving the dry dehulling of cowpea seeds and addition of the maize flour. Indeed, the two operations, namely the dry dehulling of cowpea seeds and the addition of the maize flour led to a color of *Olèlè* not appreciated by the consumers panel.

Moreover, at least 40 out of the 50 panelistss preferred the taste and the texture of *Olèlè* from the process involving the wet dehulling of cowpea seeds. The statistical table of a two-tailed binomial test showed that the probability for X= 40 and n = 50 is 0.001. Consequently, the taste and the texture of *Olèlè* from the processing method involving the wet dehulling of cowpea seeds were significantly preferred to the taste and the texture of *Olèlè* from the process involving a dry dehulling of cowpea seeds and an addition of the maize flour.

Likewise, the statistical table of a two-tailed binomial test indicated that the probability for X= 39 panelists preferring the aroma of *Olèlè* from the processing method involving wet dehulling of the cowpea seeds out of 50 panelists participating in the test was 0.001. Therefore, the aroma of *Olèlè* from the process involving the wet dehulling of cowpea seeds was significantly preferred for the aroma of *Olèlè* as compared to the process involving the dry dehulling of cowpea seeds. The same trend was observed for the color, taste and texture of *Olèlè* from the processing method involving the wet dehulling of cowpea seeds which were significantly preferred by the majority of panelists ($p \leq 0.05$). As the similar ingredients used to produce *Olèlè* were in the same proportions for the two processing methods, it can be concluded that the maize flour and the dry dehulling used to produce the second type of *Olèlè* could be the cause of its rejection.

A ranking test was conducted to compare four differently wrapped *Olèlè* produced according to the processing method involving wet dehulling based on the taste, the color, the aroma and the texture. The ranked values given to each *Olèlè* sample were totalized and the calculated differences between rank total pairs were presented in Table 4.

Table 4:
Difference between rank total pairs of packaged *Olèlè* compared according to sensory parameters.

Sensory parameters	Differences between rank total pairs					
	|A - B|	|A- C|	|A - D|	|B - C|	|B - D|	|C - D|
Taste	3	6	29	3	32	35
Color	16	6	42	22	26	48
Texture	14	24	34	38	20	59
Aroma	31	22	39	53	8	61

A: Olèlè wrapped with the leaves of Thalia geniculata; B: Olèlè wrapped with the leaves of Tectona grandis; C: Olèlè packaged in recycled tin cans; D: Olèlè wrapped with leaves of Musa paradisiaca.

The tabulated critical value at 5% level of significance for 30 panelists and four samples from the Friedman test table was 26. The differences between rank totals of A: *Olèlè* wrapped with *Thalia geniculata* leaves and B: *Olèlè* wrapped with *Tectona grandis* leaves (A and B) and A and C: *Olèlè* packaged in recycled tin cans (A and C) regarding the taste, the color and the texture were below the critical value of 26. This shows that the acceptability of aroma of A and that of B were significantly different ($p \leq 0.05$). Meanwhile, the sensory characteristics acceptability of A and B on the one hand and A and C on the other hand was not significantly different ($p > 0.05$). Also, the acceptability obtained for the taste and the color of B and C and for the texture and the aroma of B and D did not differ significantly. The differences between rank totals of A and D on the one hand and C and D on the other hand corresponding to taste, color, aroma and texture were above the critical value of 26. So, the acceptability of the sensory characteristics of the aforementioned *Olèlè* pairs (A and D) and (C and D) was significantly different ($p \leq 0.05$). The same trend was observed for the aroma and the texture of *Olèlè* wrapped with *Tectona grandis* leaves and *Olèlè* packaged in recycled tin cans and for the taste, the color and the aroma of *Olèlè* wrapped with *Tectona grandis* leaves and *Olèlè* wrapped with *Musa paradisiaca* leaves. The panelists found the sensory characteristics of *Olèlè* wrapped with *Musa paradisiaca* leaves more acceptable than those of *Olèlè* wrapped with *Thalia geniculata* leaves, *Tectona grandis* leaves and in the tin cans.

4. Conclusion

The effect of the processing method on the one hand and the effect of the plant leaves used for the wrapping on the other hand on sensory characteristics of *Olèlè* were highlighted in this study. *Olèlè* obtained from the processing method involving wet dehulling of the cowpea seeds is more appreciated than that from the method involving dry dehulling of the cowpea seeds and the addition of the maize flour from the point of view of color, taste, aroma and texture. The sensory characteristics of *Olèlè* varied depending on the material used for wrapping. The difference between the *Olèlè* wrapped with different plant leaves was clearly noticeable by the panelists. The sensory profiles established have shown that leaf-wrapping has a remarkable influence on the taste, color, texture and aroma of *Olèlè*. Although the overall acceptability test revealed that *Olèlè* wrapped in *Musa paradisiaca* leaves is the most appreciated, followed by *Olèlè* wrapped with *Tectona grandis* leaves, the one wrapped with *Thalia geniculata* leaves and finally *Olèlè* packed in tin cans, each *Olèlè* wrapped with a different wrapping can have its niche or consumer segment. Other studies on sensory characteristics and consumer acceptance of various *Olèlè* produced by blending cowpea with other cereals or tubers powders will be interesting.

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