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Research article

DEFINITION OF OPTIMAL PROCESSING CONDITIONS FOR PROPOSING SHEA BUTTER SENSORIAL STANDARD VIA IVORIAN CONSUMERS' CRITERIARose-Monde Mégnanou^{1*}, Eric Essoh AKPA¹, Kra Kouassi Abouttou Sévérin¹ and Sébastien Lamine NIAMKÉ.¹Laboratoire de Biotechnologies, UFR Biosciences, Université de Cocody, Abidjan, 22 BP 582 Abidjan 22, Côte d'Ivoire.

* Corresponding author: Mail: megnannour@yahoo.fr

ABSTRACT: Shea butter is extracted from shea fruit kernel following various methods, but the main usual is traditional processing which is subject to uncontrolled variability leading to various qualities. Consumers' preferences about sensorial criteria and their conditions of preparation were determined in this study in order to define their exigencies manufacturing conditions. Hence a survey was realized and variation in nuts drying duration and mode, were also studied, so were kernel quality and roasting duration effects. Chi2 test performed on survey data revealed that consumers mostly preferred whitish (51.90%), odorless (58.40%) and fondant (35.70%) shea butter, mainly for aches treatments (81.80%). Variation study showed that shea butter odor went from slight at the first week of nuts drying, to rancid at the fourth; sound kernels produced beige color and slight odor of butter when mouldy (and rotten) ones gave yellow and rancid butter, so did kernel over-roasting at 15 minutes. Shea butter color changed after five minutes of kernel roasting from beige to khaki (6 min), brown (10 min) and grey (15 min). The texture was fondant independently to drying, kernel quality and roasting duration.

Key words: Shea butter, consumers' preference, sensorial criteria, processing variation.

INTRODUCTION

Shea butter is a vegetable fat extracted from the kernels of the fruit of *Vitellaria paradoxa*, Sapotaceae [1, 2, 3, 4, 5]. In *V. paradoxa* producer countries, such as Côte d'Ivoire, the shea butter is generally prepared in traditional conditions (in the producing areas) and then forwarded to other areas for its marketing at local markets [6]. These traditional shea butters are increasingly required abroad by cosmetic and pharmaceutical industries, to the detriment of solvent extracted shea butters [4]. However, the numerous and uncontrolled traditional processing techniques are responsible for the wide variability of shea butter quality [1, 6, 7, 8].

In order to increase traditional shea butter (*Bio-shea butter*) level, several studies and attempts were made to incorporate appropriate technology into a number of the processing stages have been undertaken [1, 9, 10]. These technologies aimed not only to improve production efficiency, but also to reduce the amount and drudgery of the labor, as well as impact on the environment [1, 4, 5]. Other authors such as Oluwolé *et al.* [11] and some other [7, 8] gave approach about the influences of fruits treatment on shea kernels and butter physicochemical properties. All these studies were realized to obtain shea butter conform with international (industrial) physicochemical criteria. Nevertheless ordinary shea butter consumers in general, and those of Côte d'Ivoire in particular, whom interest are (mainly) focused on shea butter sensorial criteria are generally unsatisfied by shea butter proposed on local markets. The present study aimed to identify (define) traditional processing conditions to prepare Ivoirian consumers' preferential shea butter. Hence, a survey was firstly carried out in order to get consumers criteria of choice. Secondly, shea traditional processing steps such as nuts drying duration and mode, kernel quality and roasting duration were varied to identify for each steppe, the optimal condition.

MATERIAL AND METHODES**Material**

Different samples of shea butter were prepared in laboratory, in conditions of the traditional processing currently used in Dabakala (town in Northern Côte d'Ivoire). Shea fruits used experimentations at laboratory were purchased on Dabakala market and at the train station of Adjamé (Abidjan). As for dried nuts, they were bought with a regular producer of shea butter of Fougolo (a village of Dabakala).

Constitution of the survey population

The survey was carried out in some shea producing areas of Côte d'Ivoire (Dabakala, Ferké, Katiola and Bouaké) and in Abidjan district. People (women and men) of three category of age (Junior, major and senior), with different professions and from various origins were interviewed, mainly in areas of great meeting such as car and bus stations, markets, around (and in) schools and Universities.

About the category of age, junior are people under 25 years, adult, those who have between 25 and 40 years when senior consisted in people with more than 40 years.

Methods

The aqueous traditional process used here, is currently employed in Dabakala to prepare marketed shea butters; it consists in boiling shea kernel paste in two equivalent volumes (or more) of water and removing the floating oil which is then dehydrated in another recipient by heating. Factors which vary in this process are drying duration and mode, kernel quality and roasting time.

1- Variation of nut drying duration

Fresh seeds resulting from shea fruits de-pulping were dipped in two equivalent volumes of boiling water for 20 min and then put on plates for sun drying. Each week, for four weeks, 2 Kg of nuts was de-hilled; the kernels were chopped finely with a kitchen chopper and then roasted at 120 to 150°C for 5 min (by part of 500 g). The roasted chopped kernels were ground with an electric grinder (Moulinex) and the kernels paste was boiled for one hour in 2 equivalent volumes of distilled water. The floating oil of the boiling solution was collected and dehydrated by heating it for 5 min. Each shea butter was stored at home temperature, in a sterile identified box.

2- Variation of drying mode

Two batches of 2.5 Kg of fresh nuts were constituted and after bleaching for 20 minutes, were differently dried for one week, one sundried and the other oven-dried at 50°C. The two batches were then transformed into shea butter following the previous process.

3- Variation of kernel quality

The hills of dried shea nuts (purchased dried nuts), with were removed and the kernels were classified (sorted) according to their aspect (sound, mouldy and rotten). Each quality of kernel was transformed into shea butter following the aqueous process previously described. The three resulting shea butter (sound, mouldy and rotten kernels butters) were stored separately in sterile box.

4- Variation of roasting time

Ten kilograms of previous sound kernels were shopped and separated into seven parts which were roasted at 120 to 150°C, for various times, precisely for zero (0), two (2), four (4), five (5), six (6), ten (10) and fifteen (15) minutes, and then transformed into seven different shea butters, according to the aqueous process.

RESULTS

I- Consumers' sensorial criteria about shea butter

The survey population was mostly constituted of women (62%) and majors (63.43%) as far as the genre and age category were concerned respectively. Concerning the profession, there were more self-employed (39.87%) than other profession, but at the whole, the majority of the population (76.47%) resided in Southern Côte d'Ivoire (District of Abidjan) as the other origin (Northern and Center) represented altogether 23.53% (Table 1).

This population gave various criteria of choice. Indeed, data showed that the respondents distinguished three colors (white, yellow and grey), three odors (odorless, strong and slight smells), three textures (hard, dough and fondant) about shea butter and three purposes of usage which were aches treatment, beauty care and feeding (Figure 1).

Above all, results revealed that the first criteria consumers considered for shea butter choice, was the texture which recorded 85.30% of importance ($\chi^2=95.77$, $1-p=99.99\%$), when the color ($\chi^2=87.56$, $1-p=99.99$) and the odor ($\chi^2=116.29$, $1-p=99.99$) counted for 80% and 75% of interest.

Concerning color, the white one (51.90%) recorded the most important percentage, in opposition to the grey one (1.30%). Yellow shea butter, as for it, registered 29.30%. About the odors, consumers preferentially chose odorless (58.40%) shea butter, compared to slight (17.50%) and strong (4.50%) smelling ones. However color and odors were, consumers opted mostly for fondant (35.70%) shea butter; doughy and hard ones were respectively selected by 22.70 and 29.20% of the respondents (Figure 1).

II- Sensorial variation of shea butter

The shea nuts sun-drying duration did not affect shea butter color and texture, in opposition to the odor which creased from the first to the second week, and then decreased till the fourth week. Indeed at the end of the first week, the odor which was strong became very strong at the end of the second week, and then, changed to slight smell the third week, and rancid at the end of the fourth week (Table 1). The drying mode as for it, did not affect sensorial characteristics after one week (Table 2).

If the texture was fondant for the all shea butter resulting from the different quality of kernels, the odor (smelling) and the color as for them, varied from a quality of kernel to another (Figure 2). In fact, about shea butter color, sound and rotten kernels led to beige color while the mouldy ones produced yellow shea butter. Concerning the smelling (odor), sound kernel gave slight shea butter when the resulting shea butter of mouldy and the rotten kernels were rancid and very rancid, respectively.

Table 1: Survey population characteristics

Respondents' socio-demographical characteristics		Percentage (%)
Genre	Women	62.00
	Men	38.00
Age categories	Junior	17.93
	Major	63.43
	Senior	18.63
Profession categories	Self-employed	39.87
	Civil servant	20.26
	Student	24.18
	Unemployed	15.69
Origin	Northern	15.69
	Southern	76.47
	Center	7.19

Legend: Dominant socio-demographical characteristics with their percentage are in bold.

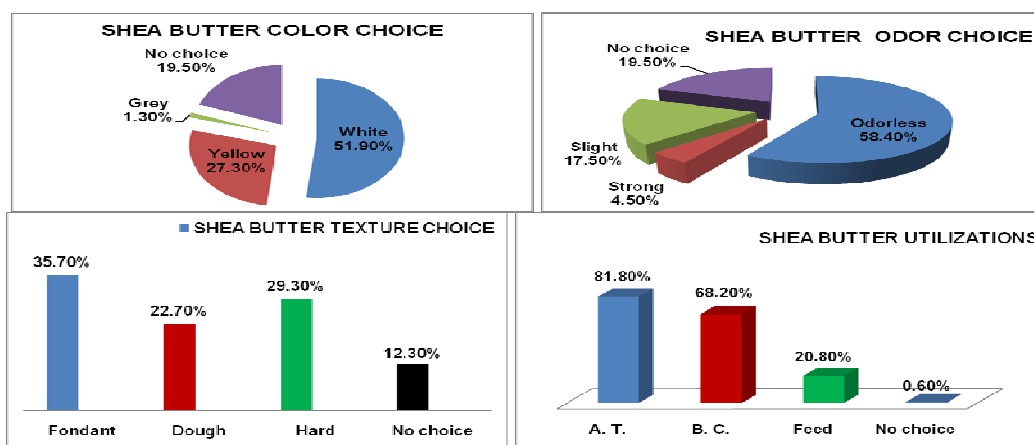


Figure 1: Ivorian consumers' choices about shea butter

Table 1: Shea butter sensorial variation according to nuts drying duration

Shea nuts sun-drying duration	Resulting shea butter color	Resulting shea butter smelling (odor)	Resulting shea butter texture
Week 1	Beige	Strong	Fondant
Week 2	Beige	Very strong	Fondant
Week 3	Beige	Slight	Fondant
Week 4	Beige	Rancid	Fondant

Legend: Odor; the criteria with variation is in bold

Table 2: Shea butter sensorial variation according to nuts drying mode

Shea nuts drying mode	Resulting shea butter color	Resulting shea butter odor	Resulting shea butter texture
Sun-dried shea nuts	Beige	Strong	Fondant
Oven-dried shea nuts	Beige	Strong	Fondant

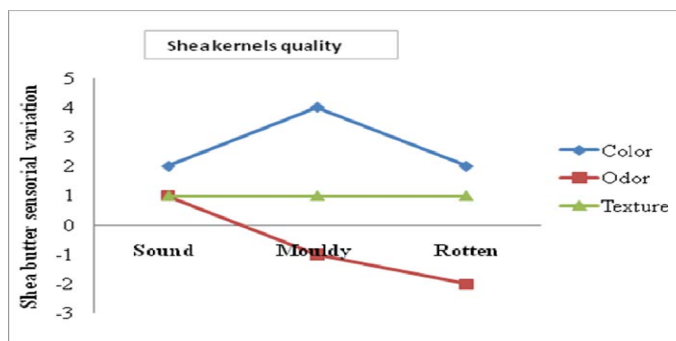


Figure 2: Shea butter sensorial variation according to kernel quality

Legend: Characteristic of the different criteria are represented by numbers according to the following personal correspondence:

- **Color:** 1 = White, 2 = Beige, 3 = Khaki, 4 = Yellow, 5 = Brown, 6 = Grey
- **Odor:** -2 = very rancid, -1 = rancid, 0 = Odorless, 1 = Slight odor, 2 = Strong odor
- **Texture:** 1 = Fondant, 2 = Dough, 3 = Hard.

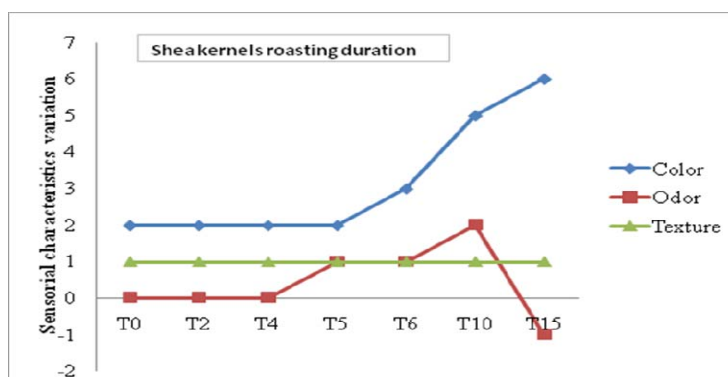


Figure 3: Shea butter sensorial variation according to kernel roasting duration

Legend: Characteristic of the different criteria are represented by numbers according to the following personal correspondence:

- **Color:** 1 = White, 2 = Beige, 3 = Khaki, 4 = Yellow, 5 = Brown, 6 = Grey
- **Odor:** -2 = very rancid, -1 = rancid, 0 = Odorless, 1 = Slight odor, 2 = Strong odor
- **Texture:** 1 = Fondant, 2 = Dough, 3 = Hard.

T0, T2, T4, T5, T6, T10 and T15 correspond to kernel roasting times at 0, 2 and 15 minutes.

Roasting duration also affect shea butter smelling and color, precisely after four (4) minutes, since two (2), four (4), five (5) and unroasted kernels led to beige colored and odorless shea butter, but variation occurred at the fifth minute (Figure 3). Indeed, at five (5), six (6), ten (10) and fifteen (15) minutes, from beige, the color became khaki, brown and grey, respectively. The smelling simultaneously were slight (5 min), slight (6 min), strong (10 min) and rancid (15 min). The texture stayed fondant for the all resulting shea butter.

DISCUSSION

The preferential choice of white, odorless and fondant shea butter by Ivoirian shea butter consumers could be linked to its utilization as ointment in aches treatment and as cream for beauty care, as reported by Carette *et al.* [12] about Ghanaians' shea butter consumers. Nevertheless, the less colored traditional shea butter might be at least dirty white or beige, because of the presence of native pigments in kernels [13, 14, 15, 16, 17] and melanoïdines resulting from kernels roasting [18, 19, 20, 21, 22, 23]. Hence, what consumers considered as white shea butter would be an abusive calling or it would simply consist in refined shea butter [17, 24, 25]. Whatever, refined shea butter would have loosen some medicinal and nutritional properties, consumers utilized shea butter for [26, 27, 28]. Indeed, shea butter would be rich in unsaponifiable compounds and vitamin which might be the essence of its utilization as sun protective cream, aches healing Baume and nutritive cooking oil [6, 29, 30, 31]. However, consumers would be better choosing colored shea butter (the less colored as possible, if they want) instead of totally white one. It would be worth recalling here, that deeper the color would be, stronger the odor would also be as discussed elsewhere [1]; that would be linked to the kernels roasting which would produce volatile (odorant) compounds [23, 32] in addition to pigments [18, 19, 20, 21, 22, 23], but also induce hydrolysis and oxidation reactions of fats components [33, 34]. Consequently, it would be better getting a roasting duration (depending on the amount of kernel in the roasting recipient) as short as possible. For instance, 500 g of shopped dried kernel could be roasted at a maximum duration of 5 minutes between 120-150°C of heating. The resulting shea butter would then, be less colored and odorized. Nevertheless, nuts drying duration could also affect sensorial characteristic, especially the odor which would become as unpleasant as drying duration would be longer, according to some authors [1, 35]. Moreover, for a previous author [35], better the kernel quality would be, better the resulting shea butter could appear. Indeed, shea butter from mouldy and rotten kernels would exhale rancid odor [34, 36, 37], but sometime present coloration. About this latest assessment, let's precise that microorganism, in anhydride conditions, would produce secondary metabolites which could be pigments, but also vitamins and other specific compound depending of the microorganism species [38, 39]. That could explain the color of shea butter resulting from mouldy kernel of the present study, and explain (a little bit) the unpleasant rancid odor of most of marketed shea butter [40, 41]. Hence, shea butter producers/traders would rather not only shorting nuts drying duration to one (1) week but also removing mouldy and rotten kernels, before kernels treatment as recommended by Mégnanou [42]. However, it would be important to indicate that there would exist natural yellow colored shea butter [24, 43, 44] which would be due to the presence of β -carotene as for Nahm [24]; voluntary dyed (by root extracts) shea butter are also reported by Hall *et al.* [1] and Agyente-Badu [45]. According to these authors, the previous proceeding would prevent shea butter from rancidity, but would also confer an attractive effect on consumers following Carette *et al.* [12] discussion.

Taking into account the optimal condition of each step of shea butter preparation, Mégnanou *et al.* [46] proposed an optimized traditional process which would lead to shea butter in conformity with both ordinary consumers' preferential criteria and industrial physicochemical exigencies. It would consist in bleaching fresh nuts, sun-drying them for a maximum of one week, roasting kernel (after excluding mouldy and rotten ones) for five minutes (batches of 500g of shopped kernel) at 120 to 150°C. The resulting shea butter might be conserve in sterile (at least deeply cleaned) recipient, out of sun or other source of heat exposure. Nevertheless, it would be interesting extending that optimized process to higher amount of kernel for bigger exploitation.

CONCLUSION

The preferential sensorial characteristics (white, fondant and odorless) consumers mostly hoped for shea butter would be in reality those of refined shea butter. These exigencies would be linked to the utilization of shea butter as beauty cream and rubbing ointment for aches treatment. Nevertheless, refining would generally remove many compounds responsible of medicinal and nutritional properties of the fat. Hence it would be rather advising them to choose at least dirty white or beige (or yellow un-rancid) with at least a slight odor though if they really need Bio-shea butter, though these properties would be inherent to kernels and specific to that typical fat.

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