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Research Application Summary

Effect of different pasteurization schemes on baobab nectar quality

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Abstract

The baobab is a multi-purpose tree which is used in many countries for its nutritional and medicinal properties. Due to its sensorial and nutritional properties, it constitutes an opportunity for some processing units to valorize it through the processing of the pulp; one of its derived products is the nectar. The stabilization of this product involves thermal treatments. The aim of this study was to assess the effectiveness of different thermal treatments scales on the microbiological, physicochemical and organoleptic qualities of the baobab nectar. The baobab technological diagram used in selected processing (two thermal treatments) units was documented and realized. For the assessment of different pasteurization scales, a modified technology with one heating was used; the used scales were: (T1) 65°C for 15 minutes, (T2) 75°C for 10 minutes, and (T3) 80°C for 5 minutes. A preference test was performed to find out the preference of consumers for products with two or one thermal treatments. The parameters such as pH, brix value, color and the load of lactic acid bacteria and yeasts and moulds were determined on the freshly produced pasteurized nectar and those stored. The results showed that panelists have a preference for nectar produced with one thermal treatment. There is no significant difference in pH and color whatever the pasteurization scale applied. Lactic acid bacteria were absent in freshly and pasteurized baobab nectar stored for one month at 30°C. All baobab nectars had mould and yeast load in accordance with the standards. A storage experiment integrating processors practices and modified techniques **is** necessary for technological optimization that promotes nutrients retention and safety.

Keywords: Baobab, Benin Republic, color, lactic acid bacteria, nectar, organoleptic characteristics

Résumé

Le baobab est un arbre polyvalent utilisé dans de nombreux pays pour ses propriétés nutritionnelles et médicinales. En raison de ses propriétés sensorielles et nutritionnelles, il constitue une opportunité pour certaines unités de transformation de le valoriser par la transformation de la pulpe; l'un de ses produits dérivés est le nectar. La stabilisation de ce produit implique des traitements thermiques. Le but de cette étude était d'évaluer l'efficacité de différentes échelles de traitements thermiques sur les qualités microbiologiques, physico-chimiques et organoleptiques du nectar de baobab. Le schéma technologique du baobab utilisé dans des unités de traitement sélectionnées (deux traitements thermiques) (deux traitements thermiques) a été documenté et réalisé. Pour l'évaluation des différentes échelles de pasteurisation, une technologie modifiée avec un seul chauffage a été utilisée; les échelles utilisées étaient: (T1) 65 C pendant 15 minutes, (T2) 75 C pendant 10 minutes et (T3) 80 C pendant 5 minutes. Un test de préférence a été réalisé afin de connaître la préférence des consommateurs pour les produits avec deux ou un traitement thermique. Les paramètres tels que le pH, la valeur brix, la couleur et la charge de bactéries lactiques et de levures et moisissures ont été déterminés sur le nectar pasteurisé fraîchement produit et ceux stockés. Les résultats ont montré que les panélistes ont une préférence pour le nectar produit avec un traitement thermique. Il n'y a pas de différence significative de pH et de couleur quelle que soit l'échelle de pasteurisation appliquée. Les bactéries à adide lactique étaient absentes dans le nectar de baobab fraîchement pasteurisé conservé pendant un mois à 30 C. Tous les nectars de baobab avaient une charge de moisissure et de levure conforme aux normes. Une expérience de stockage intégrant les pratiques des transformateurs et les techniques modifiées est nécessaire à l'optimisation technologique qui favorise la rétention et la sécurité des nutriments.

Mots clés: Baobab, République du Bénin, couleur, bactéries à acide lactique, nectar, caractéristiques organoleptiques

Introduction

The baobab (*Adansonia digitata*) tree is commonly encountered under tropical climatic conditions (Akubor, 2017). The consumption of its fruits improves the nutritional quality of African population diet (Parkouda *et al.,* 2007). In West Africa and especially in Benin, baobab (bark, leaves, fruits, seeds) is widely used by local populations for food, therapeutic and economic and/or sociocultural reasons (Assogbadjo *et al.*, 2005; Kouyaté *et al.,* 2011). In Benin, baobab fruit pulp is traditionally valued in the form of beverages (juice and nectars), fermented dough (commonly called Mutchayan in Otamari language), porridge as well as lollipops (Chadare *et al.,* 2008). A very popular and widespread product is the baobab nectar, also called in Senegal "Bouyé juice" (Cissé *et al.,* 2009). Most of those fresh nectars were not stabilized and therefore have limited shelf life. Nowadays, more and more pasteurized baobab nectars are available on Beninese markets, especially in large cities. However, the quality of these commercialized nectars is still unknown. In Benin, the color and viscosity of baobab nectars produced suggest that applied heat treatments are severe. Such an observation was confirmed by the investigations of Gbaguidi *et al.* (2017) during pineapple juice processing. Knowing that baobab is rich in heat sensitive nutrients such as vitamin C, severe heat treatments could significantly reduce the nutritional quality of baobab nectars. Consequently, this study aimed to determine the most appropriate conditions for baobab nectar pasteurization in Benin.

Material and Methods

The baobab pulp used for production was purchased at Dantokpa market in Cotonou. Six commonly visited supermarkets of Cotonou, the economic capitale of Benin, were screened to identify the commercialized baobab nectar brands. The processing diagram of the three most common brands encountered was determined through a process follow-up study. Productions were followed per processing unit to identify the flow diagrams as well as the conditions applied for implementing each unit operation. Based on the flow diagrams used by the processing units, a modified flow diagram was suggested for obtaining a fluid Baobab nectar in the laboratory conditions. This diagram was tested by measuring pH, brix value, color, load on lactic acid bacteria and yeasts.

Using the modified flow diagram, three pasteurization schemes namely (T1): 65°C-15 minutes, (T2): 75°C-10 minutes, and (T3): 80°C-5 minutes were tested. The suggested schemes were compared by measuring pH, brix value, color, load on lactic acid bacteria and yeasts. Subsquently, the most promising product was compared with the conventional product obtained from the processing unit diagram.

A storage test was performed to assess the physico-chemical (pH, brix value and color) and microbial (lactic acid bacteria and yeast counts) characteristics of the nectars after production and after 30 days of storage at 30°C. All analyses and productions were performed in triplicate.

Analyses

Nectar pH was measured with a pH meter according to ISO1842 (EAS, 2000) method. Nectar brix value was determined using an ATAGO digital refractometer according to ISO 2173 (ISO, 2003). Color of baobab nectar was determined using the CR410 Konica Minolta colorimeter to assess L*, a*, b* indexes. For each sample, these parameters were measured in duplicate.

Yeasts counts were assessed on sabouraud agar supplemented with chloramphenicol agar incubated at 25°C for 5 days (ISO 21527-2: 2008). Lactic acid bacteria were enumerated on de Man Rogosa and Sharpe medium after incubated at 30°C for 3 days (ISO 15214: 1998). An analysis of variance followed by a Dunett test was used to compare the baobab nectar characteristics during storage.

Preference test was conducted with 37 baobab nectar common consumers selected as panelists. They were assigned to compare the pasteurized nectar prepared according to the processing unit' diagram and pasteurized nectar according to the modified diagram. In all cases, data were analyzed using the two-tailed binomial test (Watts *et al.,* 1981).

Results

Production of pasteurized baobab nectar according to processors techniques. Pasteurized baobab nectar is usually made from pulp. First, the processors mixed the baobab pulp with water and homogenized. Next, the mixture is sieved to remove the wastes (baobab fibers and seed). To the sieved mash, sugar is added with more water and the mix is cooked for about 30 minutes. At the end of the heating, the nectar is packed in 25 cl glass bottles initially well cleaned. The bottled nectar is pasteurized at 90°C for 25 minutes. The flow diagram for the processing of pasteurized baobab nectar is shown in Figure 1.

Production of baobab nectar using the modified technique in the laboratory. Baobab nectar was made from baobab fruit pulp, hot water and sugar using the below diagram presented in Figure

2. The baobab pulp was sieved to remove some wastes, mixed with hot water at 60°C and homogenised. The obtained mix is packed in sterilezed or initially well cleaned bottles (25cl) and pasteurized at 65°C-15 minutes, 75°C-10 minutes and 80°C- 5 minutes.

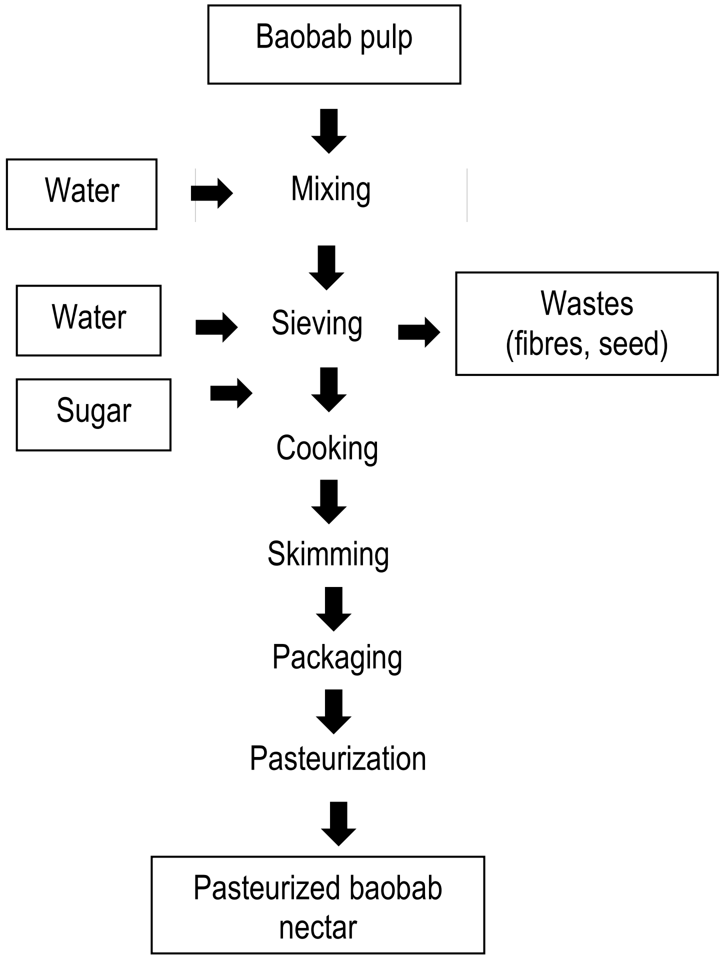

Figure 1. Processing diagram of baobab nectar used by the surveyed processors

Preference of uncooked baobab nectar before pasteurization. The preference test performed with 37 randomly selected panelists revealed that 62.2% of the panelists preferred the pasteurized baobab nectar without cooking (one thermal treatment) while 37.8% preferred the pasteurized nectar with cooking (Table 1).

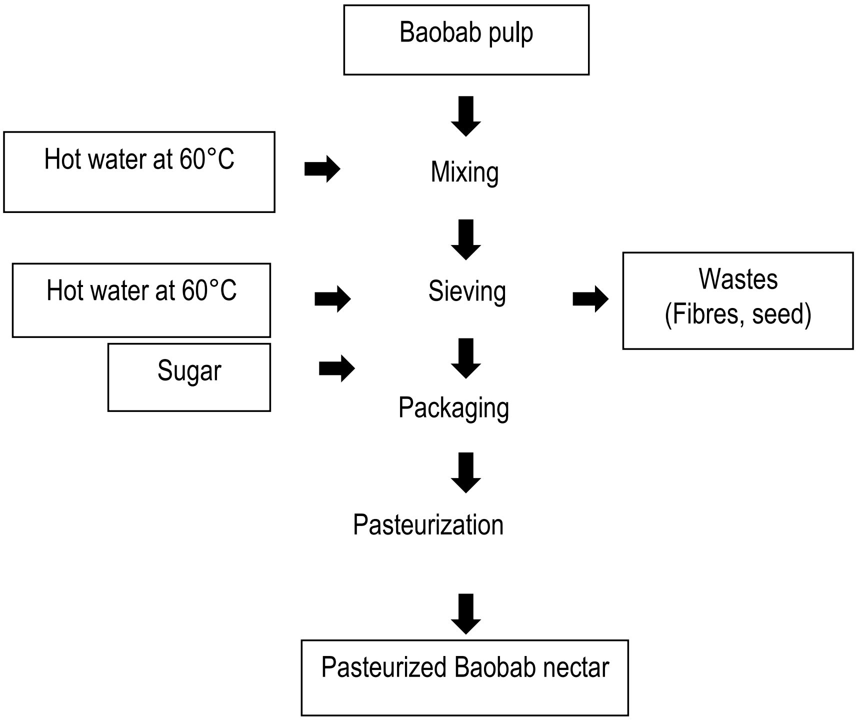

Figure 2. Processing diagram of pasteurized baobab nectar using the modified technique (without cooking)

Table 1. Preference of baobab nectar

Prefered product	Number of panelist	Criteria	Number of tasters per criterion chosen [number (%)]
Pasteurized baobab nectar without cooking	23	Acid taste	52.1
		Sweet taste	65.2
		Texture	43.4
		Aroma	39.1
		Global preference	62,2
Pasteurized baobab nectar with cooking	14	Acid taste	50
		Sweet taste	42.8
		Texture	50
		Aroma	35.7
		Global preference	37,8

Effect of pasteurization on the physico-chemical characteristics of pasteurized baobab nectar. Table 2 shows the physico-chemical characteristics in terms of pH, Brix alue and colour, of baobab nectars according to different pasteurization scales. In general, the characteristics do not vary from one pasteurization scale to another. More specifically, pH values were at about 3 while brix values ranged from 12.97 to 13.15. The color parameters remained also quite stable.

Table 2. Effect of pasteurization on the physico-chemical characteristics of baobab nectar

Treatment	pH	Brix value	L*	a*	b*	ΔE*
T1 (65°C-15 min)	3.15±0.15[a]	13.15±0.02[c]	49.31±0.46[a]	9.13±0,35[a]	18.90±0.97[a]	48.71±0.54[a]
T2 (75°C-10min)	3.01±0.01[a]	13.01±0.03[b]	49.87±0.27[a]	9.16±0,12[a]	19.41±0.17[a]	48.69±0.17[a]
T3 (80°C-05min)	3.10±0.03[a]	12.97±0.04[a]	49.63±0.31[a]	8.86±0,24[a]	18.88±0.24[a]	48.20±0.41[a]

In each column, the same letters indicate they are not significantly different at 5%
L = lightness; a = redness; b = yellowness

Effect of pasteurization on microbiological characteristics of baobab nectar. Table 3 shows the average microbial load of the pasteurized baobab nectar. Lactic acid bacteria were absent whatever the pasteurization scale was applied. The microbial load of yeast and moulds contained in the baobab nectar pasteurized at 65°C was 2.25 log10 CFU/g, while those of nectar pasteurized at 75°C and 80°C were < 1 log10 CFU/g. The higher the pasteurization temperature, the lower the yeast and mould load recorded.

Table 3. Microbiological characteristics of pasteurised baobab nectar

Treatment	Shelf life (days)	Lactic acid bacteria (log10UFC/g)	Yeast and moulds (log10 UFC/g)
T1 (65ºC- 15min)	0	0	2.25
	30	0	2.46
T2 (75ºC- 10min)	0	0	<1
	30	0	2.01
T3 (80ºC- 5min)	0	0	<1
	30	0	1.59

Ability to preserve the pasteurized baobab nectar. Table 4 shows the pH and the brix value values of the pasteurized baobab nectar stored for 30 days. No significant changes were observed between pH values of freshly pasteurized nectar and the samples (65°C and 80°C) and the ones stored for one month at room temperature.

The brix value of pasteurized baobab nectar irrespective of the pasteurization scale decreased during storage while color parameters remained quite stable.

Discussion

To reduce microbial load, the processors apply several thermal treatments which can also reduce nutritional quality of baobab nectar. This study shows that cooking had no influence on the organoleptic characteristics. The effect of pasteurization treatment on pH was not significant at the 5% threshold. Indeed, the parameters measured (pH, Brix value, color) were more intrinsic to the nectar whatever the pasteurization used. Some differences were noticed during storage according to pasteurization scales. The low pH (3.15-3.18) of baobab nectar were favorable good preservation. Similar pH values were found in nectar of Parkia pulp (pH=3) (Ouattara, 2011). Chadare *et al.* (2017) reported that storage at 30°C for one day of non pasteurized baobab milk nectar induced a significant decrease in pH value. The thermal treatment applied in the nectar under investigation may hinder any change in pH value. However, other changes may occur during storage. Indeed, baobab nectar stored at 4°C for 11 days lost 35% of its total sugar content (Cisse *et al.,* 2009). The same tendency was observed in the present study where the brix value of baobab nectar decreased after only one month of storage. As such, a longer storage period would induce a greater decrease. Brix value is an expression of total soluble solids content which includes also sugars. More precise estimation would include measurement of total or individual sugar.

The limit for yeasts and moulds in nectars according to standards is 30 CFU/g (Kenya Standard, 2016). Irrespective of the pasteurization scale, the produced nectars were in accordance with the standard. Indeed, yeast and moulds can grow at temperature range from 0°C to 60°C with a water activity between 0.7 and 0.8 (Alborch *et al.,* 1995). The presence of yeast and moulds in baobab nectar can be explained by their growth in baobab pulp if it is exposed to humidity. On local market and in local processing unit, it is sometimes hard to fully preserve raw material against humidity as mentioned for pulp of *Parkia biglobosa* used to prepare some nectar (Ouattara, 2011). This suggests that the practices of good handling of raw material and good manufacturing practices would help to prevent presence of some microorganisms. In fact at pH lower than 4.5, very limited pathogenic microorganisms can grow except the acidophilic ones (Davidson and Critzer, 2012). As such, distribution temperatures, if not too high may keep for a reasonable time the product with low microbial load if there is no cross contamination during production, packaging and distribution (Chadare *et al.,* 2017).

Table 4. Effect of storage time on the physico-chemical characteristics of baobab nectar

Treatment	Time	Physico-chemical characteristics					
		pH	Brix value	L*	a*	b*	ΔE*
T1 (65°C-15min)	0	3.15±0.15	13.15±0.02	49.31±0.46	9.13±0.35	18.90±0.97	48.71±0.54
	30	3.18±0.01	12.96±0.03	49.11±0.03	9.55±0.31	18.40±0.28	48.67±0.38
		ns	***	ns	ns	ns	ns
T2 (75°C-10min)	0	3.01±0.01	13.01±0.03	49.87±0.27	9.16±0.12	19.41±0.17	48.69±0.17
	30	3.17±0.00	12.86±0.05	49.16±0.18	9.47±0.03	18.80±0.17	47.86±0.23
		***	ns	ns	ns	ns	**
T3 (80°C-5min)	0	3.10±0.03	12.97±0.04	49.63±0.31	8.86±0.24	18.88±0.50	48.20±0.41
	30	3.02±0.02	12 .53±0.02	49.52±0.12	9.92±0.20	19.90±0.02	48.64±0.15
		ns	***	ns	ns	ns	ns

ns: not significant; ***: significant at 1%; **: significant at 5%

L = lightness; a = redness; b = yellowness

Conclusion

Practicing two or one thermal processing does not affect the physico-chemical characteristics of pasteurized baobab nectar. Panelists showed a preference for baobab nectar with one thermal treatment. Pasteurized baobab nectar has a low microbiological load whatever the pasteurization scale provided that the temperature is high enough to inhibit yeasts and moulds. A storage experiment integrating processors practices and modified techniques is necessary for technological optimization that promotes nutrients retention and safety.

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