African food tradition revisited by research

Project coordinator : Cirad
www.after-fp7.eu

African Food Tradition rEvisited by Research
FP7 n°245025

Start date of project: **01/09/2010**
Duration: **45 months**

Deliverable number: D 4.1.2.2

Title of deliverable: **Report with the list of constraints involved in the processing of products from *Adansonia digitata***

Deliverable type (Report, Prototype, Demonstration, Other): Report

Dissemination level (PU, PP, RE, CO)*: CO

Contractual date of delivery:

Actual date of delivery:

Work-package contributing to the deliverable:

Organisation name of lead contractor for this deliverable: UCAD

Authors: Mady CISSE, Nicolas C.M. AYESSOU, Ndèye Adiara NDIAYE, Cheikh NDIAYE, Alé KANE, Nérovique GEMINA, Djibril DIATTARA, Malick DIOUF, Cheikhou KANE, Fallou Mbacké SAMBE, Mamadou FAYE, Mama SAKHO, Coumba TOURE KANE

This document has been send to :

The coordinator by WP Leader	Date: August 2012
To the Commission by the Coordinator	Date: November 2012

* PU: Public; PP: Restricted to other programme participants (including the Commission Services); RE: Restricted to a group specified by the consortium (including the Commission Services); CO: Confidential, only for members of the consortium (including the Commission Services)

TABLE OF CONTENTS

1. Introduction

Adansonia digitata being used daily by local populations in Africa is of key economic importance among the numerous forest food resources available in the wild (Sidibe and Williams, 2002; Diop et al., 2005; Chadare, et al. 2008). The fruit can be harvested all year round. Since years ago, the growth of small and middle enterprises makes the baobab fruit as an important food for industries.

Baobab fruit, baobab juice and baobab pulp are consumed and used in different ways in Senegal. Its major constraints are the quality changes during production and storage (Cissé *et al*., 2009; Diop *et al*, 2005, Chadare, 2010).

The major problems during processing of baobab pulp are linked to vitamin C loss. An understanding of the various processing parameters is necessary to produce good quality products. In addition, there is a big problem on stabilizing baobab fruit nectar and syrup as well as the dried pulp for its exportation. The organoleptic quality attributes of baobab fruit need to be kept at high level by processing technologies to ensure safety and attractiveness of the final products during storage.

Traditional food products (drink, syrup) from *Adansonia digitata* fruit are generally manufactured at home (in small scale) or small factories, enterprise (in semi industrial scale) with a lack of technical tools to control the quality. It is in this context that many traditional firms manufacturing products from *Adansonia digitata* were diagnosed.

2. Sampling

Manufacturing processes of drink, syrup and powder from baobab were selected for this study. In fact, drink and syrup are the two main products from baobab fruit according the results of the survey (deliverable D 1.1.2.3). Baobab powder is also starting to appear on the local market.

Four companies named Dakar 1, Dakar 2, Thies 2 and Kaolack 1 respectively located in Dakar, Thies and Kaolack were chosen (**Figure 1**) in order to avoid changing of the sample from collection to analysis. Further these three regions are considered to be the largest areas of consumption of products from baobab fruit. In each company the **table 1** indicates the products concerned and some special features.

Table 1. Some special features of the companies

Companies	Region	Products[1]	Number of people working in the production
Dakar 1	Dakar	*Drink, syrup,* powder	12
Dakar 2	Dakar	*Drink, syrup,* jams, powder	3
Thies 2	Thies	*Powder*	5
Kaolack 1	Kaolack	*Drink, syrup,* jams	3

[1] Products involved in the diagnosis are in italic

Figure 1. Location of the companies

3. Methodology

Diagnoses were made with the consent and full cooperation of the companies concerned. For diagnosing a team of two people was chosen. Their role is to monitor all stages of process from raw material to finished product. The team simply note the manufacturing process carried out by the company itself. Moreover, in the preparation of these visits, companies were aware that the fact of our presence should not in any case make them change their way of working at all levels. The team brought with him a temperature sensor, a refractometer, pH paper and a cooler.

4. Results and discussion

4.1. General observation

Three (03) out of the four (04) companies are run by women who also handle the production. Only the process of baobab powder for Thies 2 company is studied. For this latest company, two men are involved in the production of powder.

Production is carried out in family homes. In some cases, some small adjustments were made to separate production area from rooms housing. Production equipment used is rudimentary, artisanal, locally produced.

Operators comply with the good hygiene practices (washing hands, port gown, cap and gloves, change of shoes to go out and washing hands after entry)

4.2. Manufacture of the beverage

Figures 2, 3 and **4** show respectively the process flow diagram for baobab drink according Dakar 1, Dakar 2 and Kaolack 1 companies. The analysis of the figures shows many commonalities and some fundamental differences between processers.

Producers of Dakar 1 and Kaolack 1 after sorting not perform washing unlike to the Dakar 2 company. In the case of the Kaolack 2 company, initial product, obtained after mixing the fruits in the syrup process are incorporated at the steeping. Dakar 1 is the only producer using hot water in order to improve the extraction yield of pulp and speed.

Ratios fruit / water are significantly different from one producer to another. They are 1/6, 1/3 and 1/5 respectively for Dakar 1, Dakar 2 and Kaolack 1. So, final products are significantly different according total soluble solid Difference of quantities of sugar introduced during the formulation stage are the main cause. Kaolack 2 added citric acid to improve taste and stability of the product. Dakar 2 company doesn't perform heat treatment. After interrogation, it is a voluntary option for the company to maintain the best quality of the product.

The **table 2** lists all the steps used in the process flow diagram of baobab, the concerned companies, the equipment used and the conditions (temperature, duration) for performing the step. The analysis of the table shows that all equipment used is not appropriate regardless of the step. All operations are manual. Some important steps such as heat treatment, packaging are not adequately monitored or controlled.

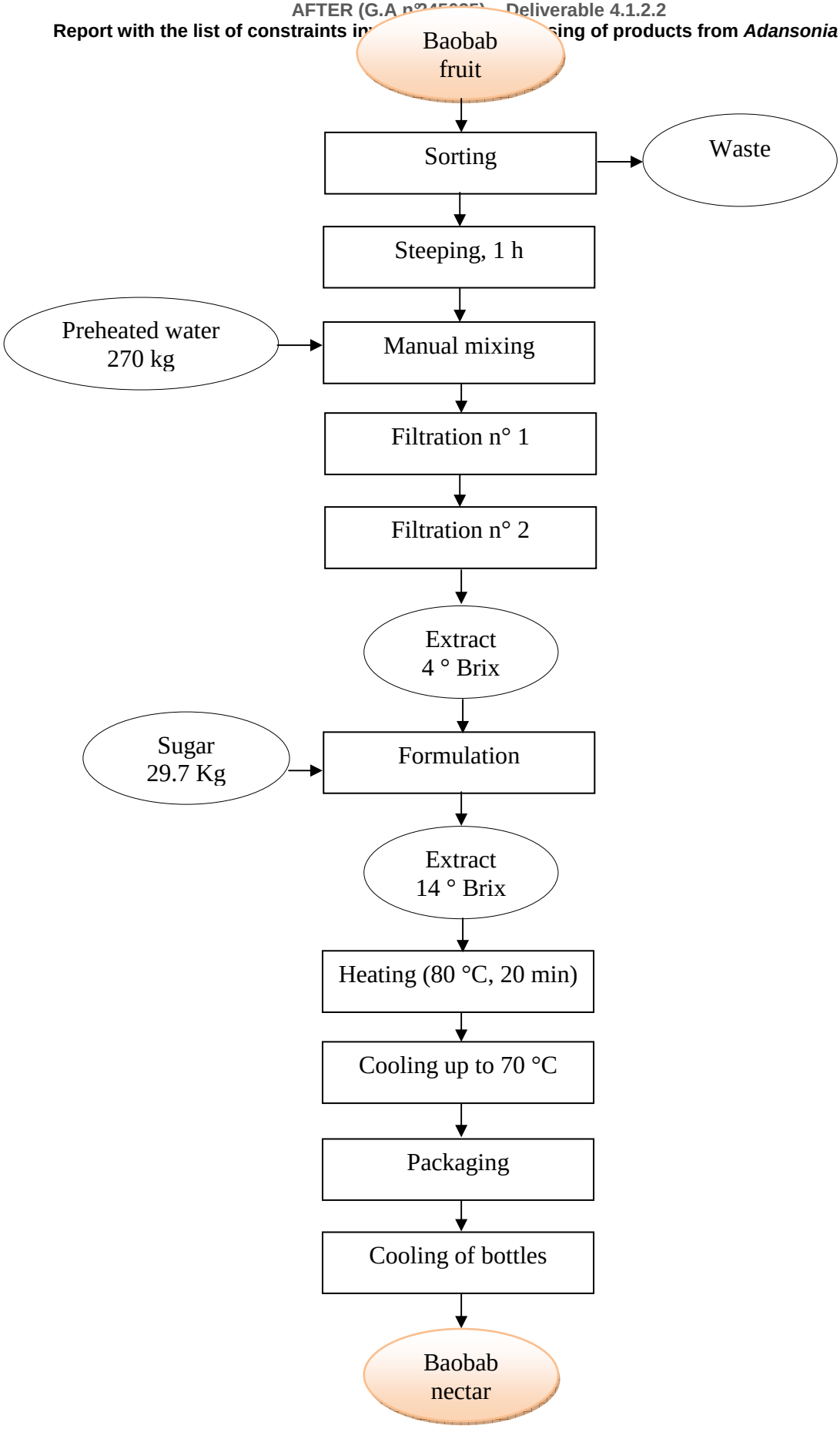

Figure 2. Process flow diagram of baobab nectar according one company (Dakar 1) at Dakar

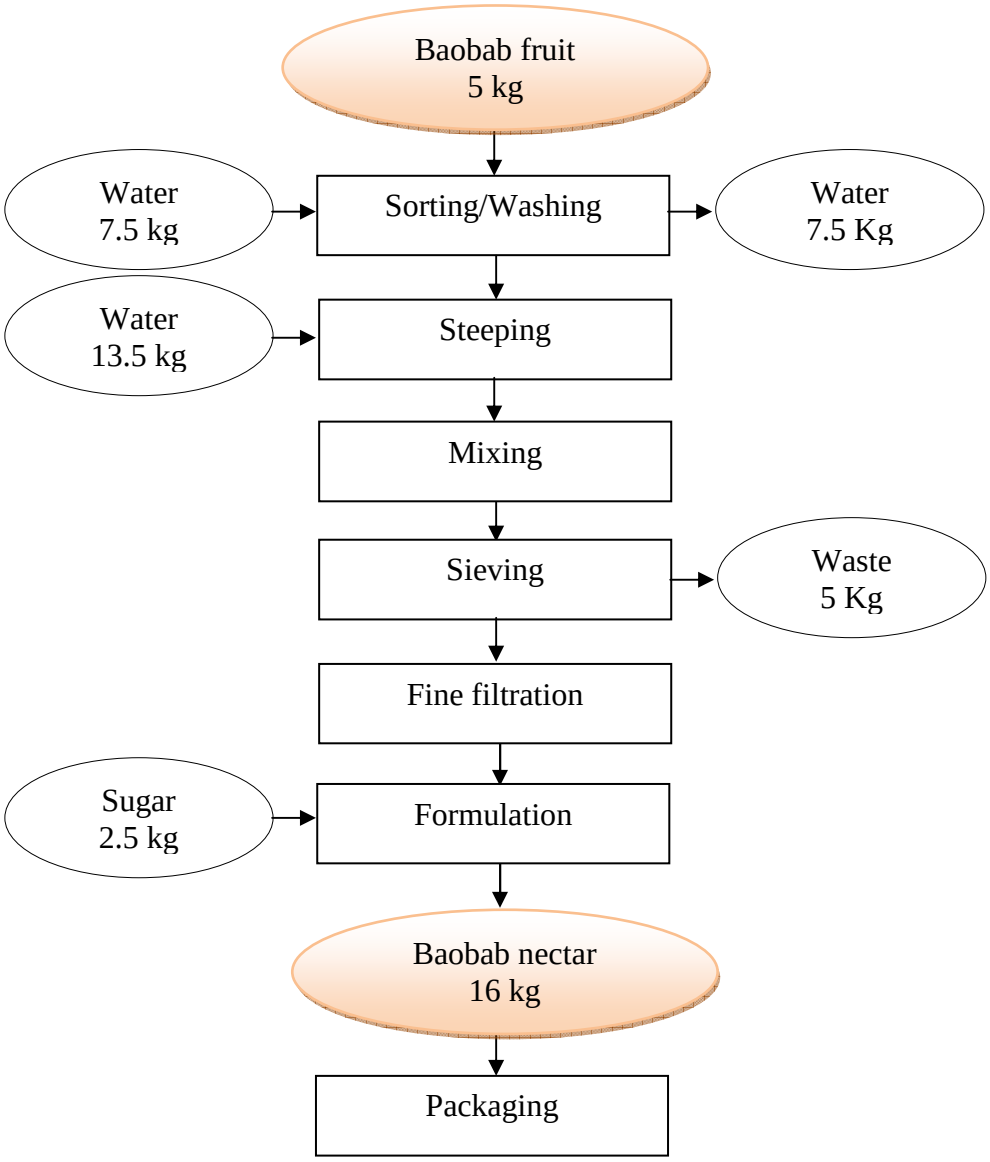

Figure 3. Process flow diagram of baobab nectar according one company (Dakar 2) at Dakar

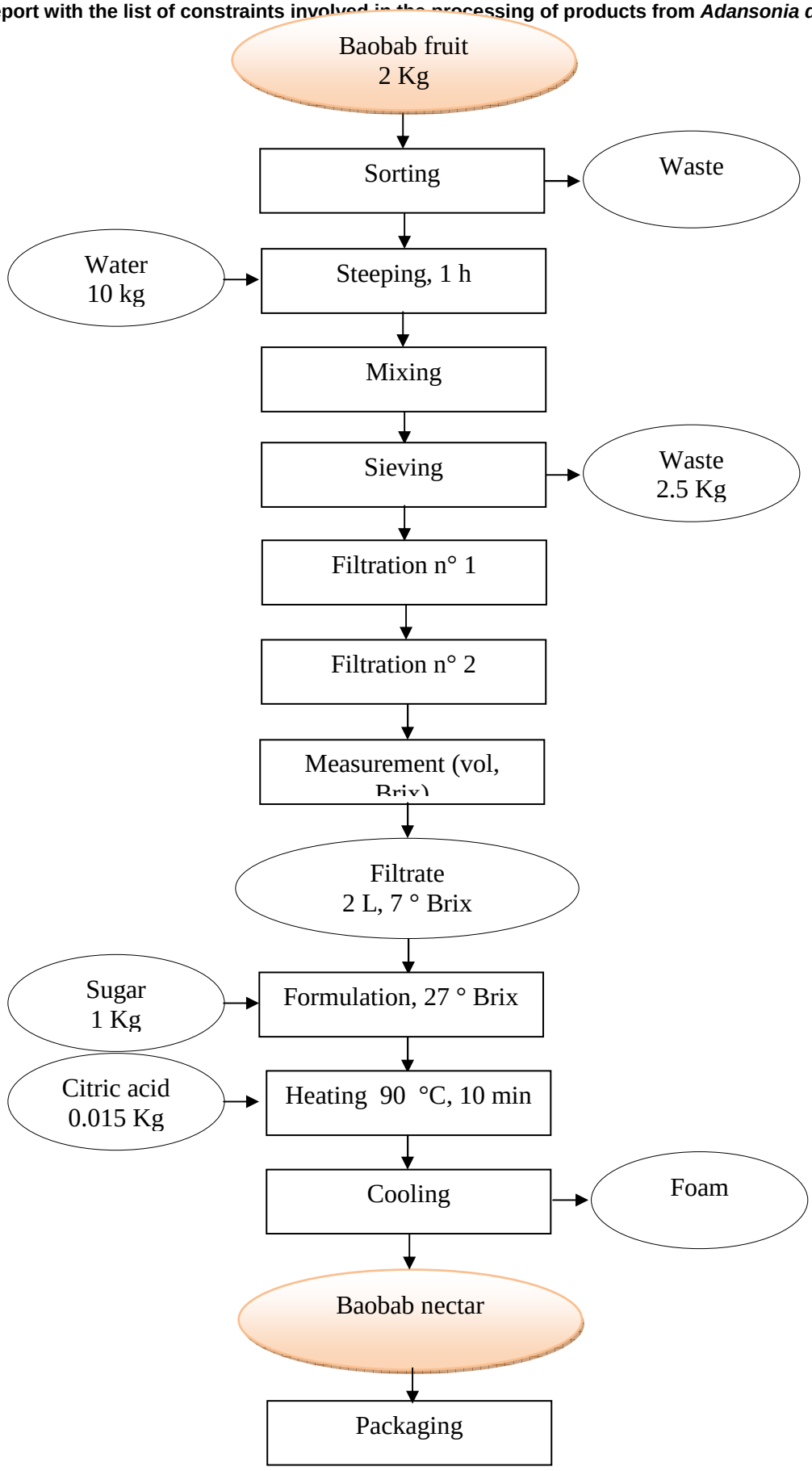

Figure 4. Process flow diagram of baobab nectar according one company**(**Kaolack 1)

Table 2. Lists of all the steps used in the process flow diagram of baobab drink, the concerned companies, the equipment used and the conditions

Stage of process	Dakar 1	Dakar 2	Kaolack 1	Equipment	Conditions (T, t)
Sorting			√	Manual	Room temperature, few minutes
Washing		√		Manual	Room temperature, few minutes
Steeping	√	√	√	Pan, bucket, bowl	Ratio fruit/water : 1/3 to 1/6 Room temperature, 1 à 2 h
Mixing	√	√	√	Manual	Room temperature
Sieving		√		Sieve	
Filtration	√	√	√	Light cloth , cotton wool, sieve	
Measurement			√	Graduated carafe, manual refractometer, mercury thermometer, ordinary balance	
Formulation	√	√	√	Cane sugar from Senegal or Gambia	Room temperature , ° Brix : 14-27
Heating	√		√	Cooking pot, flames obtained by gas combustion skimmer	Temperature > 80 °C Time : 10 -25 min
Cooling	√		√	Pan, bucket, bowl	Cooling with water at ambient temperature until to 70 °C
Packaging	√	√	√	Plastic bottles, glass bottles, plastic bag	To the ambient air, manual, temperature of product
Storage	√	√	√	Domestic refrigerator and freezer	Temperature : 6-10 °C Time : few days to several weeks

4.3 Manufacture of the syrup

Figures 5, 6 and **7** show respectively the process flow diagram for baobab syrup according Dakar 1, Dakar 2 and Kaolack 1 companies. The analysis of the figures shows many commonalities and some fundamental differences between processers.

Process flow diagram of baobab syrup for Dakar 1 and Kaolack 1 producers are exactly the same as that of the beverage. Except the washing step, the Dakar 2 company also uses the same method as the other. Moreover, the same equipment is used. The differences are observed in the proportions fruit /water and the step of formulation. The ratio fruit/water is between 1/1 to 1/2. Total soluble solid of syrup vary from 650 to 750 $g.Kg^{-1}$. The thermal treatment consists in heating to a temperature of 105 ° C. It involves under continues manual stirring. The product is then cooled to room temperature until 70 ° C before packaging. Dakar 2 and Kaolack 1 use citric acid in order to stabilize the product.

Figures 8 show the photos of different steps during the manufacturing of baobab drink or/and syrup.

4.4. List of constraints during the process of drink and syrup

The overall analysis of different manufacturing processes is used to compile the **table 3** that gives the observed constraints for each stage as well as general observations.

4.5. Reengineering

The constraints identified were able to propose some solutions shown in **Table 4**. To improve product quality, ensure consistent quality between batches of production, reengineering step is essential. In this context the optimization of pasteurization schedules and the study of the stability of the company's products Dakar 1 are in progress.

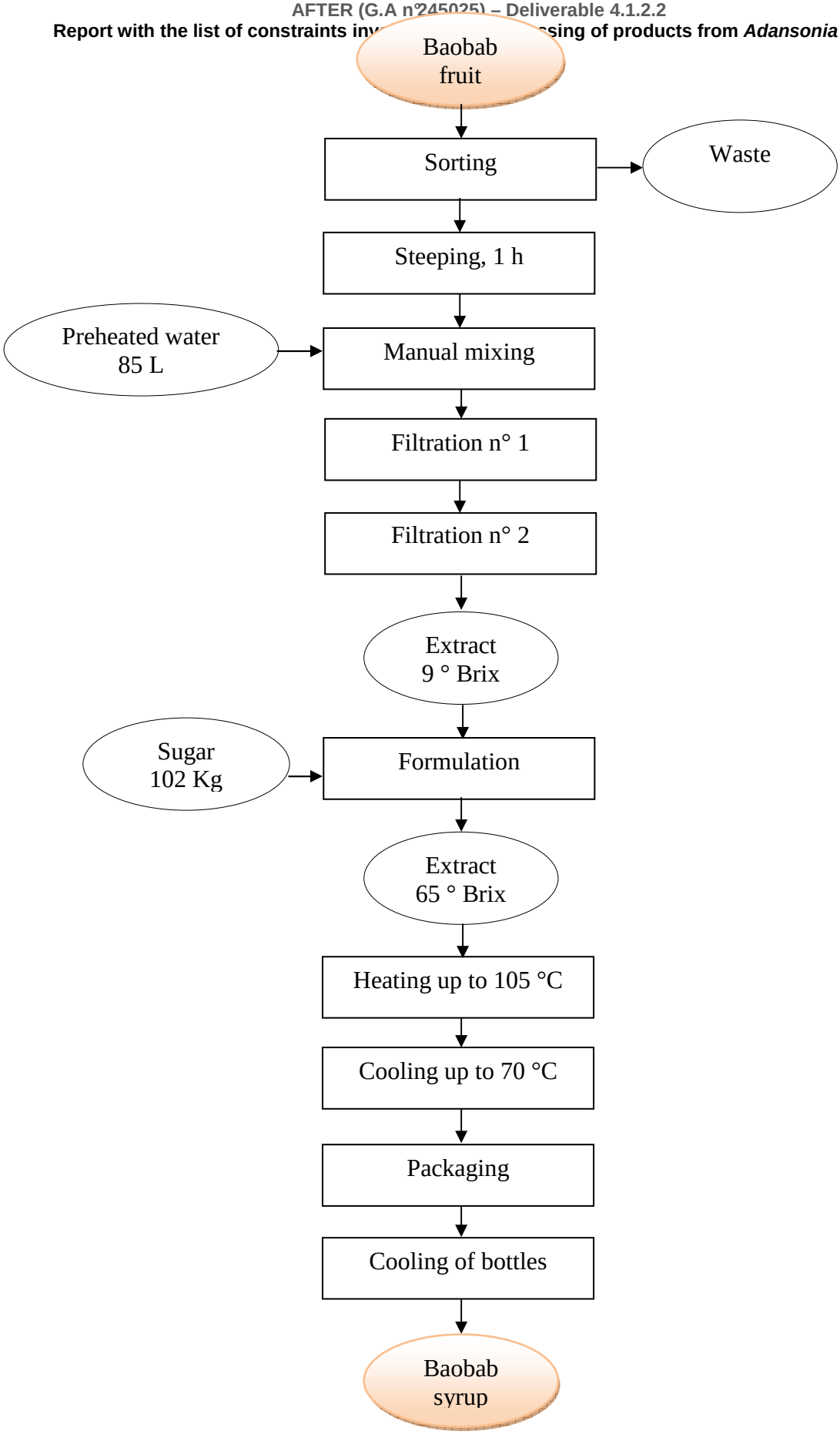

Figure 5. Process flow diagram of baobab syrup according one company (Dakar 1) at Dakar

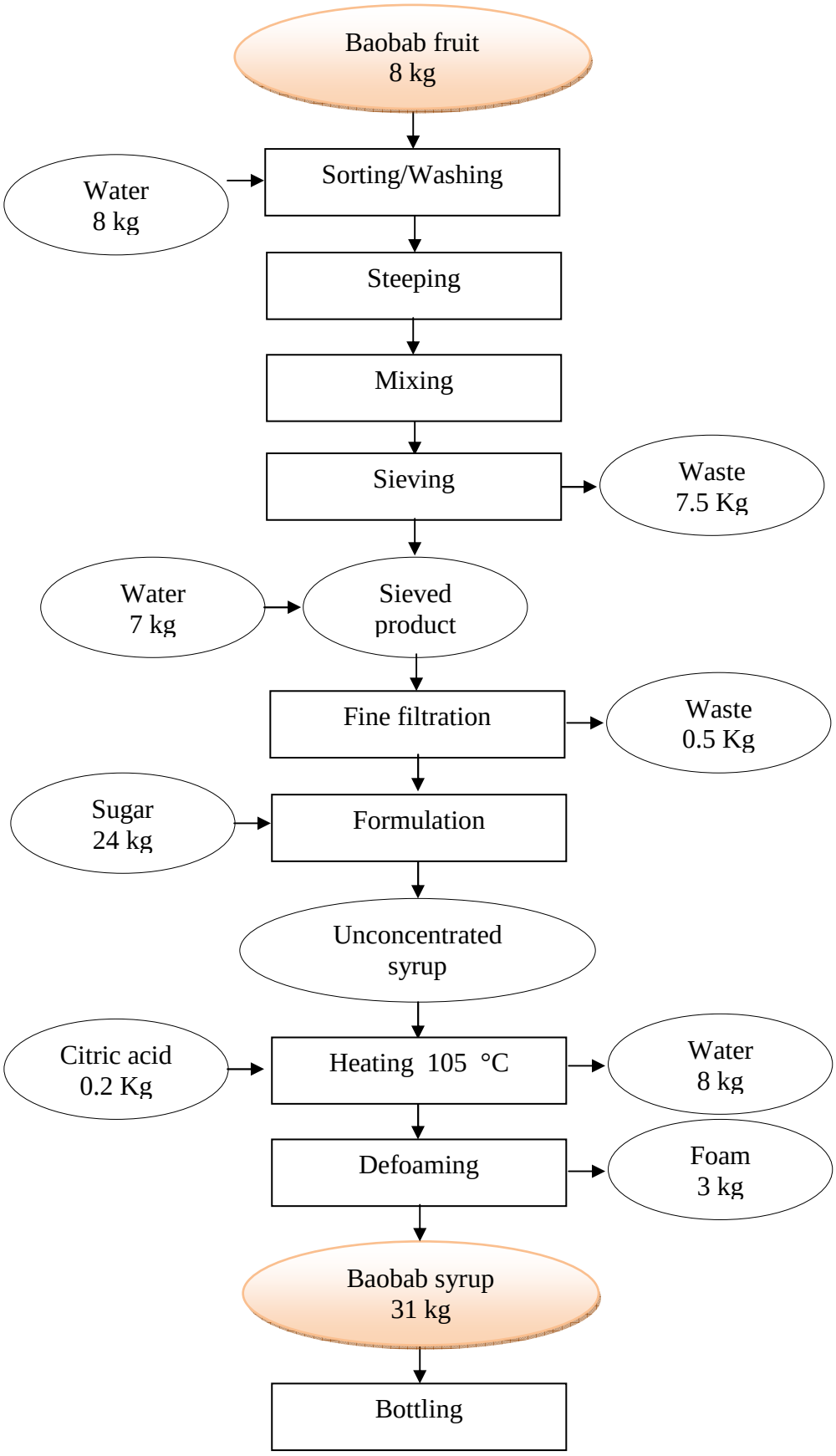

Figure 6. Process flow diagram of baobab syrup according one company (Dakar 2) at Dakar

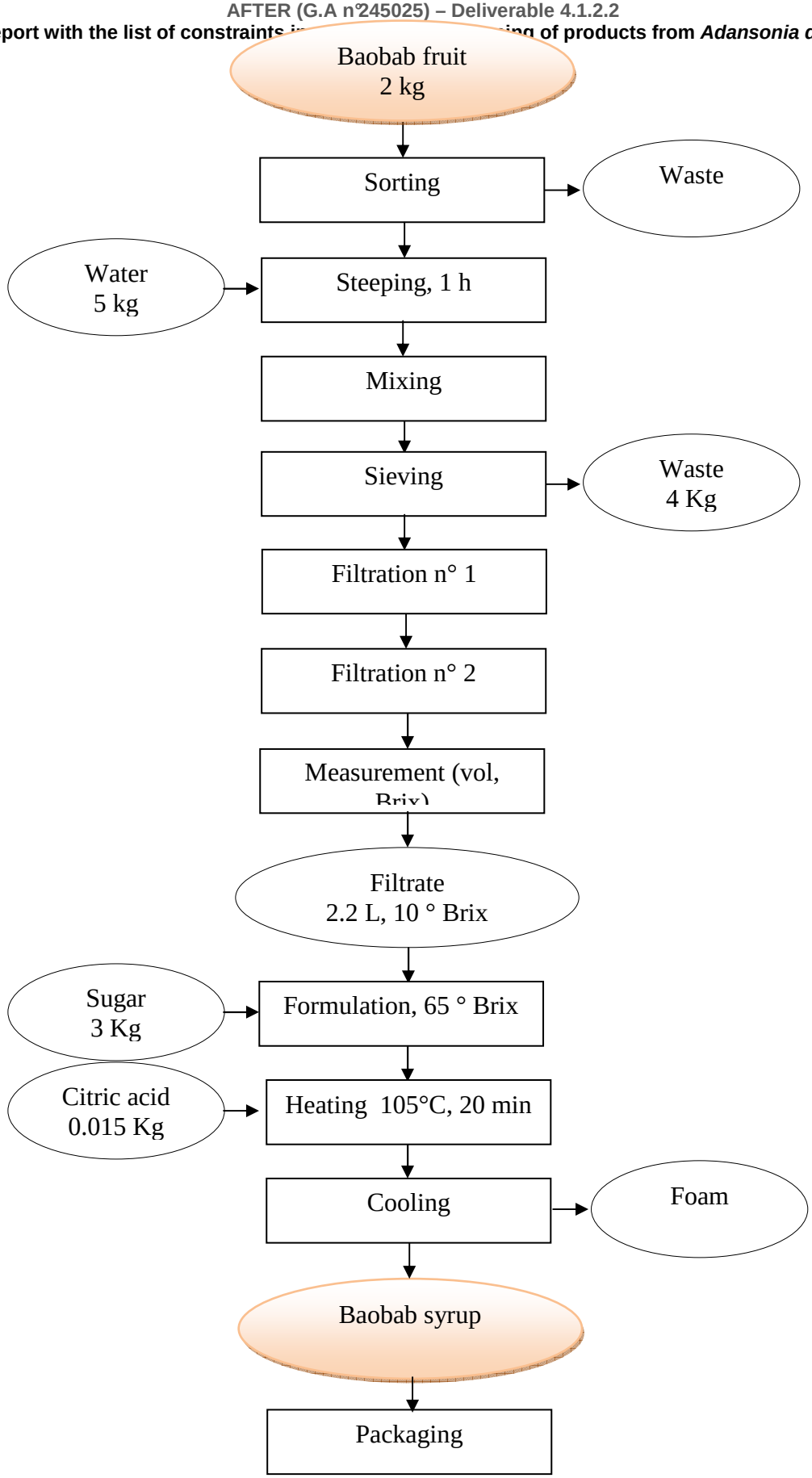

Figure 7. Process flow diagram of baobab syrup according one company (Kaolack1) in Kaolack

Figure 8 . Photos illustrate the various stages of manufacture of baobab drink or/and syrup

Table 3. List of constraints for each stage during the process of baobab drink or/and syrup

	Constraints	Stage	Observations
Drink, syrup	Microbial contamination	All stages	Operations are almost all at room temperature in a domestic environment without special device to improve air quality
Drink, syrup	Gloves	Manual separation, filtration, measurement, heating, packaging	Some structures use inadequate gloves. The gloves used in the heat treatment step cannot avoid burns
Syrup	Difficulties in the mixing	Manual mixing	The extraction of the pulp is not optimal because of the large mass of fruit in a small volume of water. Causing loss of pulp.
Syrup	Sugar dissolves	Formulation	Dissolving the sugar is difficult and slow. It requires a long manual agitation and sometimes it is not completely dissolved thus altering the appearance of the product
Drink, syrup	No control of heat treatment	Heating	Difficulties in applying the good conditions (temperature/time) due to thermal heating by gas stove. Containing material used to be treated the products and the control instruments for temperature are not appropriate.
Drink, syrup	Cooling at air	Cooling	Cooling after heating is slow and source of recontamination of the product before packaging

Table 4. Examples of solutions for reengineering

Stage	Solutions for reengineering
All stages	Have an effective antiseptic, clean containers, use disposable gloves
	Effectively clean and sanitize equipment
	An approach to move forward. Separating at least weighing operations, sorting, soaking and filtration of other operations of the manufacturing process
	Do not prepare different products at the same time to avoid cross-contamination
	Change wash water and disinfection after each preparation of product
Steeping	Optimize this stage; time is between 1 and 2 h. Using dry pulp will be an avenue
Mixing	A system similar to bakery mixers can be offered. It is a vessel equipped with mechanical paddles which can facilitate this mixing step and also formulation (stirring for dissolution of the sugar), especially for high production.
Filtration	Using bag filter system would be a good alternative
Measurement	Use of more precise measuring instruments (scales, graduated test tube, temperature probe)
Formulation	Using sugar syrup
Heating	Use of appropriate equipment (pasteurizer, cooker)
	Optimization scales pasteurization and cooking
Cooling	Use of chilled water
Packaging	Use a packaging for hot filling

4.6. Manufacture of the powder

Adansonia digitata powder is a new product made by a few companies. In our study only Thies 2 company produces powder of baobab. **Figure 9** and **10** give the process diagram.of *Adansonia digitata* powder from Tambacounda and Ziguinchor .Waste 1 and 2 are respectively formed by hull and fibers

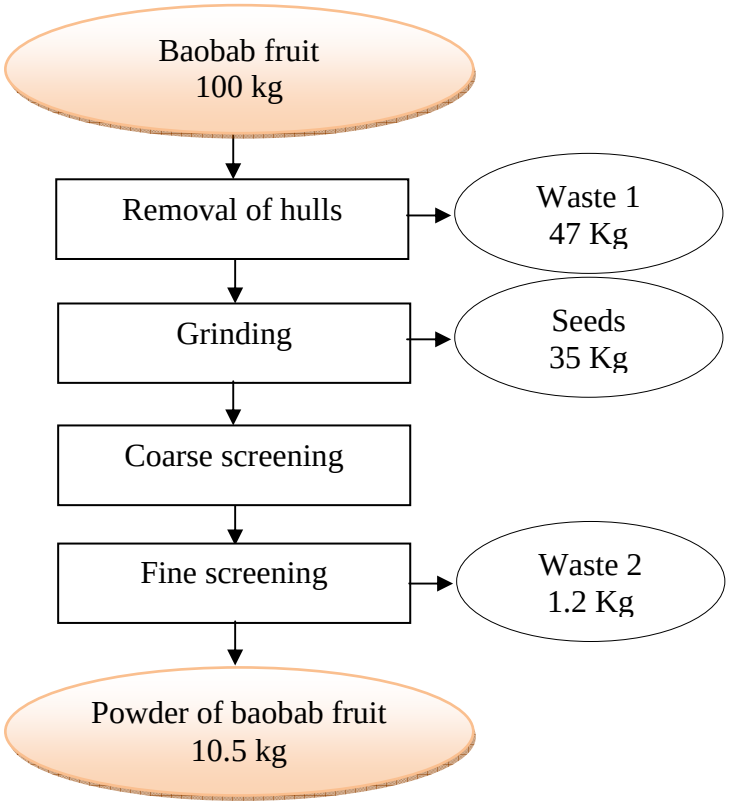

Figure 9. Process flow diagram of baobab powder from baobab fruit of Tambacounda according one company (Thies 2) at Thies

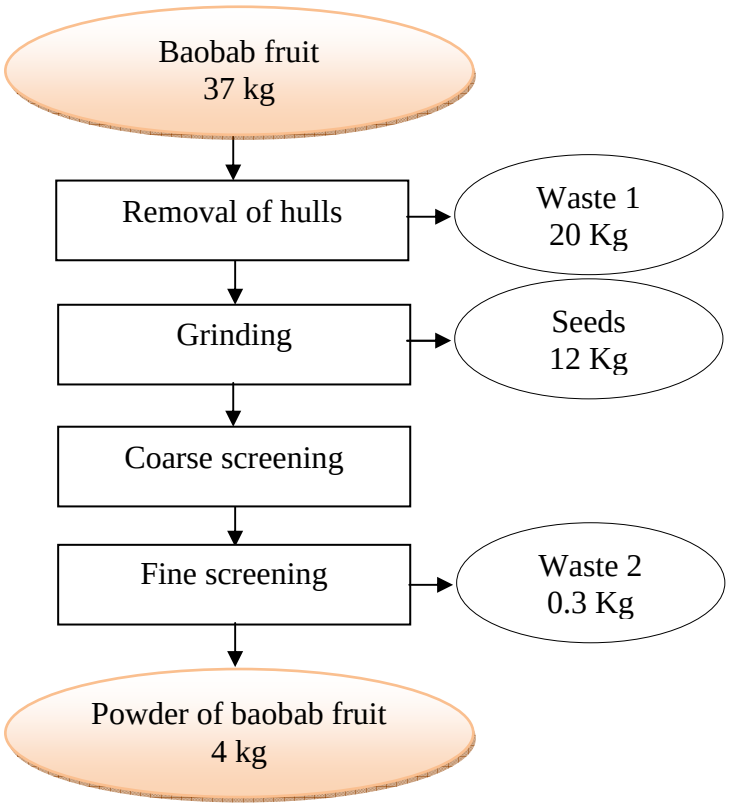

Figure 10. Process flow diagram of baobab powder from baobab fruit of Ziguinchor according one company (Thies 2) at Thies.

The analysis of the figures 9 and 10 are permitted to compile the **Table 5** showing the proportion of each part of baobab fruit.

Table 5. Proportion of each part of baobab fruit

Origin	**Hull**	**Seed**	**Fiber**	**Pulp**
Ziguinchor	54.1	32.5	1.0	10.9
Tambacounda	47.0	35.0	1.2	10.5

The overall analysis of the process is used to compile the **table 6** that gives the observed constraints for each stage as well as some recommendation for reengineering.

Table 6. Constraints and recommendation for reengineering for the production of baobab powder

Steps	Constraints	Reengineering
Removal of hulls	Significant duration	Invest in a device to break the shell (**Figure 11**)
	Requires significant space	
	Painful	
Grinding	Inappropriate grinder	✓ Appropriate grinder
	Heterogeneity in the size of the powder	✓ Screening and calibrating system for the powder
	Labor intensive	
Screening	Dust	✓ Put a lid during the operation
	Painful	
	Risk of contamination	
Vacuum packaging	Significant duration	✓ Appropriate equipment
	Inappropriate equipment	

Figure 11. Equipement to break the shells of hard fruits (http://www.meilleurduchef.com/cgi/mdc/l/fr/boutique/produits/lte-casse_noix_coco.html)

5. Conclusion

As a whole, the working conditions are acceptable within the structure visited. Operators used cover, do not wear jewelry and changed shoes before to go out. However, some measures can be recommended:

- Good hygiene and manufacturing practices can be improve
- Review the dosage of the antiseptic solutions and to create a map of renewal products to avoid the resistor of microorganisms for the cleaning and disinfection solutions.
- Introduce the principle of the forward. At least separate clean and soiled areas. Do not make the entire production process in the same enclosure.
- Consider the implementation of HACCP method.
- Better supply of the raw material in order to have a consistent product quality.

Further work is underway with two companies (Dakar 1 and Thies 2) in the reengineering step. Also, the optimization of pasteurization schedules and the study of the stability of the company's products Dakar 1 and Thies 2 are in progress.

References

Chadare, J. C. (2010). Baobab (Adansonia digitata L.) foods from Benin: Composition, processing and quality. Wageningen University, Wageningen

Cissé, M., Sakho, M., Dornier, M., Diop, C. M., Reynes, M., & Sock, O. 2009. Caractérisation du fruit du baobab et étude de sa transformation en nectar. *Fruits* 64, 19-34.

Diop, A. G., Sakho, M., Dornier, M., Cissé, M., & Reynes, M. 2005. Le baobab africain (Adansonia digitata L.) : principales caractéristiques et utilisations. *Fruits* 61, 55-69.

Sidibé, M., & Williams, J.T. 2002. *Baobab Adansonia digitata L*. Southampton: International Center for Underutilized Crops