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# Standardized Process to Soften African Locus Beans Seeds (*Parkia biglobosa* Benth) by a Traditional Method

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## ABSTRACT

*Daddawa* is a traditional condiment obtained by cooking and fermentation of African locust bean seeds (*Parkia biglobosa* Benth). The cooking process is very long (12-48 h), very difficult and time consuming. Putting in place a rapid and standard method of cooking by study the softening parameters (soaking time, amount of *dalang*, introduction time of *dalang* in cooking liquid) at 96°C would allow for its production. To evaluate the specific softening time, studies of some softening parameters were performed. From these studies, it was noted that the soaking step positively influenced the softening of seeds. Soaking the seeds for more than 48 h did not influence the percentage of dehulled seeds. These percentages were 51.25 ± 2.00% for unsoaked seeds and 90.00 ± 2.00% after soaking for 120 h. *Dalang* at 0.75% (w/w), introduced after 60 min of cooking, facilitates the softening and reduces the cooking time. Maximum dehulling (100%) was possible after 3 h. In this case, a standardized process of softening is possible by soaking for 48 h, using 0.75% *dalang* and introducing it after 60 min of cooking. These specific parameters reduced the softening time to 3 h.

**Keywords:** *dalang*, dehulling, softening parameters, specific softening time
**Abbreviations:** Softening process of *Parkia biglobosa* seeds. Doumta and Tchiégang

## INTRODUCTION

*Daddawa* is a food condiment produced by fermentation of African locust bean seed (*Parkia biglobosa Benth*) (Dakwa *et al*. 2005). This condiment is popular and used by several ethnics groups (*dii*, *foulbé*, *haussa*, *laka*, *mafa*, *mboum*, *mundang*, *ngambaye*) in the northern part of Cameroon. It constitutes an important source of proteins (34-54%) and lipids (19-21%) (Ouoba *et al.* 2003; Doumta and Tchiégang 2011). This traditional highly proteineous condiment, used for flavouring soups and stews, is produced by alkaline fermentation (Dakwa *et al.* 2005). Many difficulties are encountered during the transformation of locust bean seeds into *Daddawa* (Azokpola *et al*. 2006). The most difficult step is the softening and dehulling of locust bean seeds using the traditional method. This method hap is laborious and time consuming due to the hard seed coats, which must be dehulled after a long cooking time (24-72 h) (Achi 2005). At maturity, the coat is dry, therefore by rendering the access to the almond difficult, leading to long cooking time. This was the focus of our study.

Dried bean seeds are cooked in water in order to soften the seed cell walls and the starchy granules within them. Cooking the seeds to the point at which the coat splits depends on it composition and the cooking medium (Kristin 2008). Traditionally, in the softening process, ash is added in cooking medium to facilitate the softening. This is not hygienic and could influence the quality of *daddawa* (pers. obs.). It is therefore important to master the cooking conditions of the seeds. To overcome the cooking and dehulling difficulties for processing and development of improved methods using suitable techniques, the softening conditions need to be mastered.

Our study was carried out to determine some parameters of softening with the aim of identifying suitable pro-cessing methods of cooking which could be rapid, effectively reduce the cooking time by using the traditional method.

## MATERIALS AND METHODS

### Seed sample

Seeds of *P. biglobosa* were bought at the "Grand marché" of Garoua. The selected seeds for experiment were undamaged, discarded from any broken or occasional pebble that sneaks into the bag. See **Fig. 1** for a flow diagram of the methodology.

To reduce the cooking time, the seeds selected used were physically characterized as: moisture content (7.33%), mass (0.35 to 0.55 g), length (1.18 to 1.50 cm), width (0.86 to 1.10 cm) and thickness (0.42 to 0.50 cm). Amount of seed coat was 31% and percentage of dehulled seed up to 70% when they are cooked in distilled water for 10 h (Doumta and Tchiégang 2011).

### Mineral contents of ash salt used

In this study, the alkaline material used was salt from ash known as *dalang*. This ash salt was bought at the "Grand marché" of Garoua. Ash salt is commonly used to facilitate the cooking process in northern-Cameroon as cooking aid and serves the purpose of enhancing the flavour and tenderizing, hence reducing the cooking time of locust bean. This is mainly used as a softening agent in cooking dry seed. *Dalang* salt was used in the form of ash. This ash was obtained after incineration at 550°C for 3 h. The proximate mineral composition (iron, potassium, manganese, magnesium, copper, zinc) of *dalang* ash was determined by using Atomic Absorption Spectrometer AAS 1100 (Perkin –Elmer USA) according to AOAC (1990) method.

### Assessment of softening parameters of *P. biglobosa* seeds

The following parameters: time of softening, amount of alkali, time of introduction of the alkali in cooking medium have been identified as softening parameters after primary investigation (pers. obs.). This was used to reduce cooking time.

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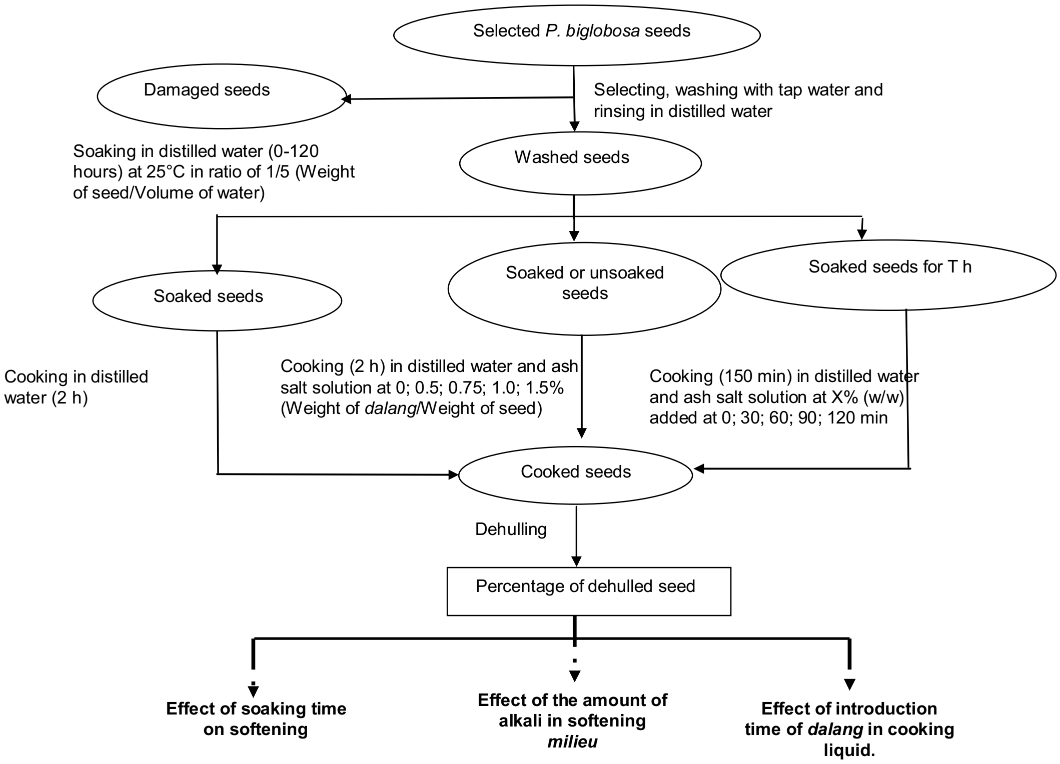


**Fig. 1 Synoptical diagram of work.**

## Effect of the soaking time on the softening

The objective of this section was to determine the necessary time of soaking which can allow the reduction of softening time.

Samples were divided into 7 sub-samples of 100 g each numbered form 0 to 6. These were then soaked for 0, 24, 48, 72, 96 and 120 h in distilled water to tenderize the seed coat and remove the inhibitor materials. Seeds (100 g) were soaked in the proportion of 4/10 (weight of seed/volume of water). The water used in soaking was changed every 24 h to avoid fermentation. Every 24 h, one group of seeds, corresponding to the number of soaking hour was cooked in distilled water for 2 h at 96°C. This time was adopted to facilitate the estimation of dehulled seed (expressed in percentage).

After soaking, seeds (100 g) were cooked in distilled water in the proportion of 4/10 (w/v) (Oboh *et al*. 2008). The cooking temperature was measured using a multi-use thermometer (LCD Portable digital, CE) plunged into the preparation. This operation was repeated every 5 min. Cooking temperature was obtained after stabilisation of the estimated value of the thermometer. The cooking process started effectively when the water began boiling. It was at this instant that the timer was launched. When cooking liquid reduced, boiled water was added to avoid a decrease in temperature. After cooking and cooling, excess of water was drained out and the seeds dehulled by hand. At the same time the number of dehulled seeds was counted. Unsoaked seeds were used as control for this study.

The optimum time of soaking (X hours) at which the percentage of dehulled seeds is highest was adopted for use in the next investigation as the optimum time of soaking.

## Effect of the introduction time of *dalang* in cooking liquid

This study was carried out to determine the cooking time at which it was suitable to introduce the *dalang* in the cooking medium to avoid '*hard to cook*' phenomena which is observed when softening agent is added earlier.

500 g of seed was removed from all samples and divided into five groups of 100 g each numbered 0, 30, 60, 90, 120 min, corresponding to the introduction time of *dalang* in cooking liquid. Cooking process was the same as described previously. The estimation of dehulled seed was expressed in percentage after 2 h 30 min of cooking. This time was adopted to appreciate the estimation of dehulled seed. Introduction time (zero) was used as control.

The introduction time (T) at which the percentage of dehulled seeds is highest was adopted for use in the next investigation. This was considered as optimum introduction time.

## Effect of the amount of *dalang* in softening *milieu*

This study was carried out to determine the optimum amount of *dalang* which will best reduce the softening time. In the traditional method, this quantity is not mastered and varied from 0 to 1.5% w/w (weight of alkalis/weight of seed).

Two groups (soaked and unsoaked) of 600 g seeds each were removed from the whole sample and were then divided into six portions each labelling 0, 0.5, 0.75, 1.0, 1.5% w/w (weight of alkali/weight of seed) according to quantity of *dalang* introduced in softening medium. Soaking and introduction time used were obtained from the previous investigation. The cooking process is previously described. The estimation of dehulled seed was expressed in percentage after 2 h 30 min of cooking. Percentage of dehulled seeds obtained without introduction of *dalang* was used as a control.

The amount of *dalang* Q% (w/w) which gave the best quantity of dehulled seed was adopted as optimum amount of *dalang* for further investigation.

At the end of this investigation, all the parameters which have presented the best percentage of dehulled seeds were used to determine the Specific Softening Time (SST).

## Determination of the specific softening time

The Specific Softening Time (SST) corresponds to the time at which the percentage of dehulled seeds (%DS) is maximum. This was achieved at optimum softening parameters. This study lies on the assessment of the percentage of dehulled seeds when optimum softening parameters are implemented in the cooking process.

In order to demonstrate the relative efficiency and effectiveness of our alkaline cooking process compared to the traditional process, two cooking medium were used: distilled water and *dalang* solution.

Seed was soaked for X hours (obtained from previous study of soaking time) and cooked using proportion of 4/10 (weight of seed/volume of water) in aluminium pot. Q% of *dalang* (amount of alkalis obtained from the previous study of the effect of the amount of alkalis in softening) was added at T hour (obtained from the previous study of the effect of introduction time of *dalang* in cooking liquid).

The samples were cooked for 1, 2, 3, 4, 5 and 6 h. After cooking and cooling, excess water was drained out while the seeds were dehulled manually and the percentage of dehulled seeds (%DS) was determined.

The Specific Softening Time is defined as the time at which we have maximum %DS and observe no variations. SST is drawn from the kinetics of %DS with respect to precise softening parameters which influence softening time.

To determine the percentage of dehulled seed (%DS), 100 boiled seeds were randomly selected following a similar method described by Doumta and Tchiégang (2011). For each experience, the ratio between the number of dehulled seeds and boiled seeds were determined and the relationships established as follow: (%DS) = (number of dehulled seeds/number of boiled seed) × 100.

## Statistical analysis

Analyses were carried out in triplicate. A completely randomized design was used to analyse percentage of dehullind data. The mean values for all parameters were examined for significance by analysis of variance and when significant differences ($P \leq 0.05$) was observed. Mean separation was accomplished by Duncan's multiple range test using STATISTICA software (Statsoft. Inc. 1999). Graphic representations were made using the Sigma Plot graphics package.

## RESULTS AND DISCUSSION

### Proximate composition of *dalang*

The proximate composition of *dalang* presented in **Fig. 2** showed the distribution of mineral contents. From these results, it is observed that potassium (2717.91 ± 1.36 mg/100 g) and sodium (1207.05 ± 0.98 mg/100 g) were the major mineral contents. Whereas phosphorus (429.87 ± 1.14 mg/100 g), magnesium (348.09 ± 1.03 mg/100 g), iron (264.01 ± 0.80 mg/100 g), copper (75.63 ± 0.72 mg/100 g), calcium (71.14 ± 1 mg/100 g), sulphate (71.14 ± 1.002 mg/100 g), chrome (68.97 ± 0.16 mg/100 g), zinc (58.33 ± 0.06 mg/100 g), nickel (61.88 ± 0.16 mg/100 g) and manganese (59.17 ± 0.45 mg/100 g) were present in lesser quantities. This mineral content could help to reduce the softening time by enhancing the pH of cooking solution. According to Kristin (2008) and Kimball (2009) softening can be speeded up by making the water more alkaline.

### Effect of soaking time on the softening

**Fig**. **3** shows that the soaking time influenced ($P \leq 0.05$) the softening of locust beans seeds.

For the same cooking time (2 h) the percentage of dehulled seeds varied with the soaking time. This percentage is lower with un-soaked seeds (51.25 ± 2%). Soaking in distilled water for 24 h increases the percentage of dehulled seed to about 60% (85.25 ± 1%). At 48 h of soaking time, the percentage of dehulled seed increased to about 61% (87.25 ± 4%). After 120 h of soaking, the percentage of dehulled seeds attained 90%. There was no significant difference ($p \leq 0.05$) between percentage of dehulled seeds of soaked samples for 48, 72, 96 and 120 h. These forth samples were different ($P \leq 0.05$) to soaked seeds for 24 h and un-soaked ones. As reported Kristin (2008) and Kimball (2009), pre-soaking the seed overnight in water reduced the cooking time by 25% and increased the percentage of dehulled seed.

The reduction of cooking time can be due to the long soaking time with frequent changes of soaking water. When seeds were soaked, most of the enzymes (pectinase, hemicellulase and cellulose) were activated and hydrolyzed or solubilised some contents (calcium, magnesium, thiamine, riboflavin, niacin, lipid, and carbohydrates) of the seed coat

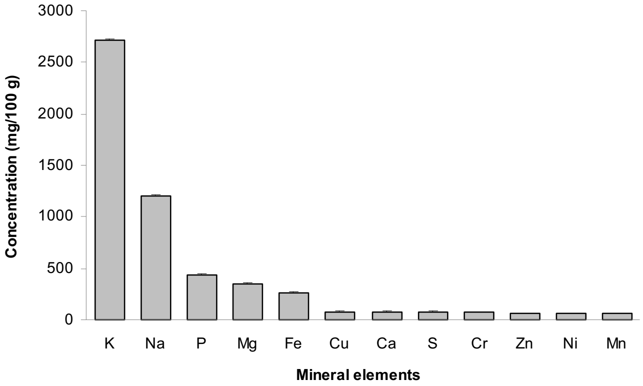


**Fig. 2 Mineral contents of *dalang*.**

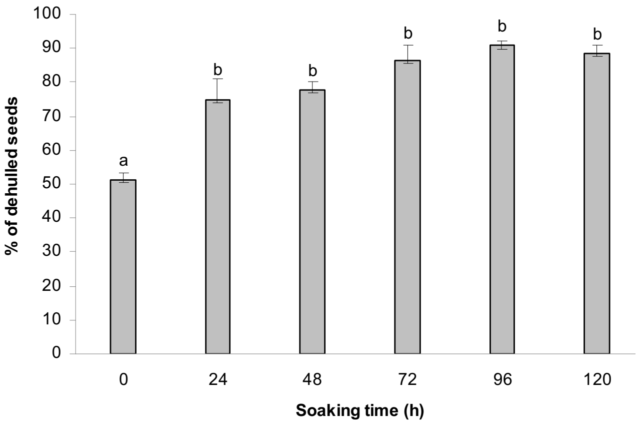


**Fig. 3 Effect of soaking time on the softening of locust beans seeds.** n=3, mean values are shown; SD was always less than 20%. Different letters indicate significant differences according to Duncan's multiple range test ($P \leq 0.05$).

and provoked their loss into the soaking water (Wanjekeche *et al*. 2003; Kimball 2009). This phenomenon contributed to weaken the seed coats with the loss of its firmness.

To reduce the cooking time, optimum soaking time was fixed at 48 h and was used for further investigation.

### Influence of the amount of *dalang* on the softening

**Fig**. **4** shows that cooking with *dalang* influenced ($P \leq 0.05$) the percentage of dehulled seed. The results indicated that, for the same cooking time (2 h 30 min), the percentage of dehulled seeds varied from 51.25 ± 2 to 70.00 ± 7.00% and 71.25 ± 1.00 to 90.00 ± 4.00% respectively for the un-soaked and soaked seeds. Significant difference ($P \leq 0.05$) is observed between soaked and un-soaked samples. Soaked seeds presented large amounts of dehulled seeds. According to quantity of *dalang* introduced (0, 0.5, 0.75, 1.0, 1.5%), the percentage of dehulled seeds were 71.25 ± 1.25, 85.75 ± 2.75, 90.5 ± 1, 89.25 ± 3.25 and 89.5 ± 3.75%, respectively. There were no significant different ($P \leq 0.05$) between percentages of dehulled seeds with the quantity (0.5, 0.75, 1.0, 1.5%) of *dalang* used (**Fig. 4**). This result is contradictory with the finding of Ruhlman (2011) who noticed that the cooking time of bean materials was fastest in deionised water than the water which contained cations. The action of *dalang* could provoke the formation of hole in the seed coat and facilitated the transfers of water from the cooking solution to the cotyledon. This transfer would induce the swelling of seed and the breaking of the inter- and intracellular chain bond (Sriamornsak 2002; Matthew 2012). This could explain why the percentage of dehulled seeds was higher with the *dalang* cooking.

According to this result, the best %DS (90%) was obtained with 0.75% of amount of *dalang* and can be considered as optimum quantity of *dalang* which could be used

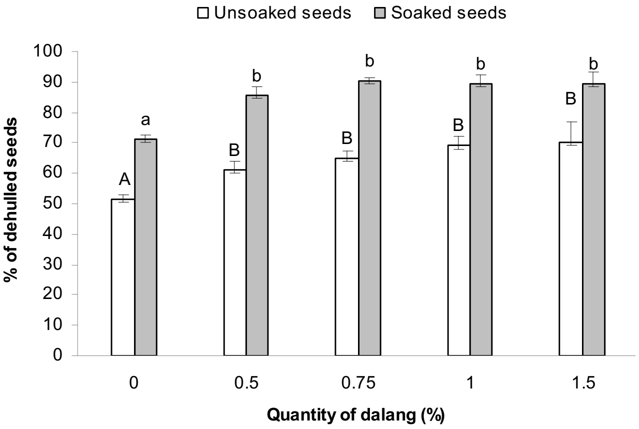


**Fig. 4 Effect of the amount of *dalang* on the percentage of dehulled seed.** n=3, mean values are shown; SD was always less than 20%. Different letters indicate significant differences according to Duncan's multiple range test ($P \leq 0.05$).

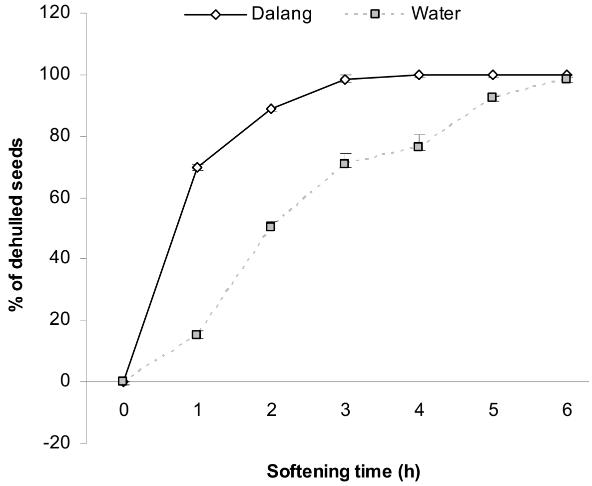


**Fig. 6 Effect of combined parameters identified on softening with the comparison to cooking in distilled water.**

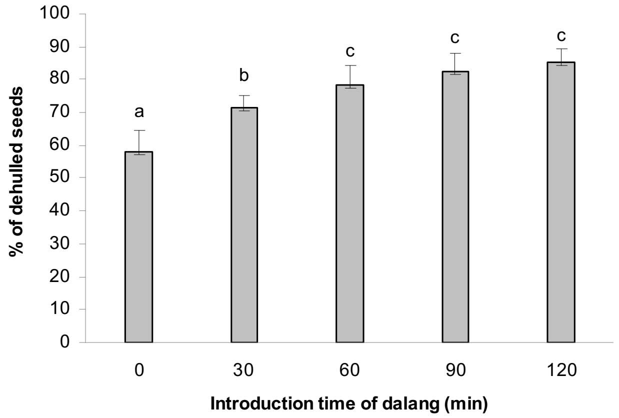


**Fig. 5 Influence of the introduction time of *dalang* in the cooking liquid.** n=3, mean values are shown; SD was always less than 20%. Different letters indicate significant differences according to Duncan's multiple range test ($P \leq 0.05$).

to reduce the cooking time. This quantity was used for further investigation.

## Effect of the introduction time of *dalang* in the cooking liquid

**Fig. 5** shows that the introduction time influenced ($P \leq 0.05$) significantly the percentage of dehulled seeds.

From these results it is observed that the percentage of dehulled seeds was found to range from 58.0 to 90.0%. When *dalang* was added at 30 min the percentage of dehulled seeds was about 71%. At 60, 90 and 120 min, this number attained 78, 82 and 85%, respectively. The low value observed when the *dalang* was added earlier could be due to the formation of calcium pectates which are insoluble and resist cell separation during cooking (Sriamornsak 2002). According to Ruhlman (2011), beans that are cooked in water that contains high divalent cations have a longer cooking time when cations are in the cooking liquid at the beginning of the cooking. This could explain why the percentages of dehulled seeds were lower at zero and 30 min of introduction time. In this study, distilled water used at the beginning of the process, contributed in moving out the pectic substance contents of the seed coat and modified the cell wall structure. When the *dalang* was added at this moment, mono and divalent cations are bound to the free liaison left there by removing the pectic substances and breaking the inter and intra chain bond. This contributed to weaken the intra cellular bond and reduce the cooking time. According to Kristin (2008), these actions would work to slow the softening of beans in four different ways by stabilizing hemicellulose, strengthening cell wall, slowing the swelling of starch granules and cross-linking pectins. Initially, when placed in distilled water, the dried bean seeds can only absorb water through their pores. After 60 min of cooking, the seed coats expand and become hydrated. At that point, water cations can move into the bean through the hilum and the entire seed coat surface. Then the seed becomes soft and dehulls easily. Between adding *dalang* at 60, 90 or 120 min they was no significant differences ($P \leq 0.05$) when the percentage of dehulled seed is concerned. This means that, introduction time of *dalang* in cooking liquid should be up to 60 min.

## Determination of the specific softening time

**Fig. 6** indicates the effect of combined parameters identified on softening with the comparison to cooking in distilled water.

According to these results, it was noticed that the percentage of dehulled seeds increased significantly ($P \leq 0.05$) with the softening time. The percentage of dehulled seeds at the first hour of cooking was 70.00 ± 0.66%. After 3 h, 100% of seed were soft when *dalang* was used. This value was obtained after 6 h of cooking with distilled water. Percentage of dehulled seeds after 3; 4; 5 and 6 h of cooking using *dalang* showed no significant difference ($P \leq 0.05$) between the percentage of dehulled seeds.

According to Kristin (2008), cooking with alkaline salt can reduce the cooking time by nearly 75%. The same result was obtained in this study. The presence of *dalang* in cooking liquid works by helping hemicelluloses dissolve in cooking water and rends out the magnesium from the pectins in the cell wall. This dissolution contributes to weaken the seed coat with the loss of its firmness (Wanjekeche *et al.* 2006; Kimball 2009; Matthew 2012). This loss provokes a disorganization of the cell wall (Sriamornsak 2002). This observation could explain why the percentage of dehulled seeds (100%) was higher with *dalang* solution. Hence, cooking time can be reduced, not by simply pre-soaking the beans for 48 h in distilled water, but by the addition, at precise time (60 min after boiling) of *dalang* at the level of 0.75% to the cooking liquid. Between simply cooking and alkaline cooking, the difference of the cooking time was about 3 h. This corresponded to 50% of reduction of cooking time obtained with simply cooking and 75% of the traditional method (Doumta and Tchiégang 2011).

According to **Fig. 6**, SST could be fixed at 3 h. At this time, 100% of dehulled seed was obtained using *dalang*.

The scheme shown in **Fig. 7** is proposed to reduce cooking time of African locust beans.

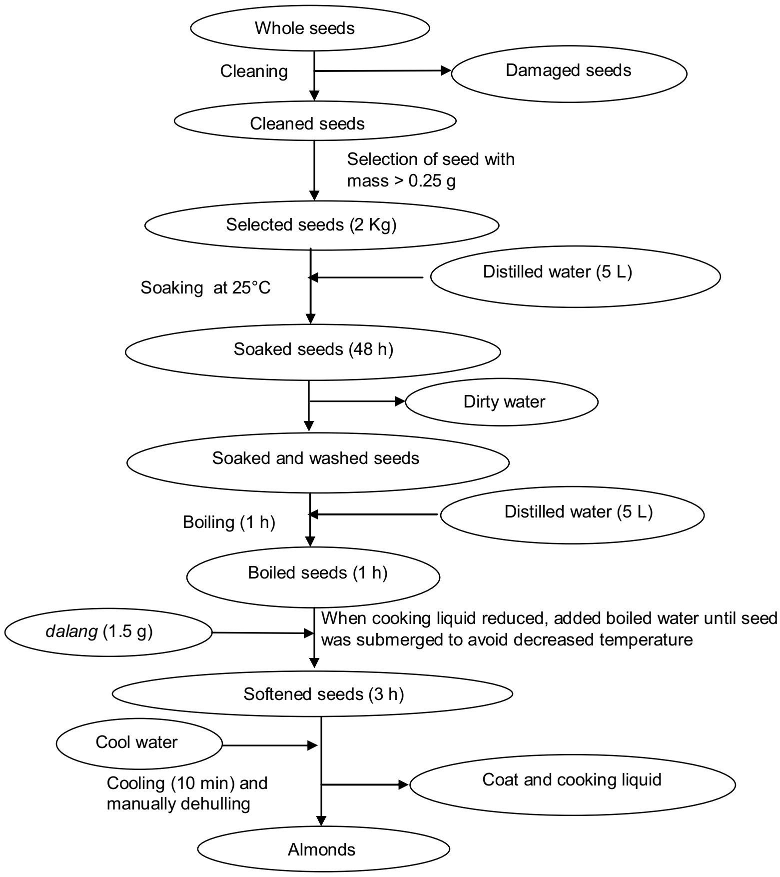


**Fig. 7 Synoptic scheme of seed softening.**

## CONCLUSION

The results of this work showed that the percentage of dehulled seed increases with the cooking time. Cooking African locust beans by using *dalang* could possibly reduce the softening time if the softening parameters are well used. In this case, a standardized process of softening is possible by soaking for 48 h, using 0.75% *dalang* and introducing it after 60 min of cooking. These specific parameters reduced the softening time to 3 h. This method had reduced the cooking time at 75% compared to the traditional cooking process.

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