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Study on Rehydration Characteristics of Dried Lablab Bean (*Lablab Purpureus)* Seeds

S. PERVIN[1], M. S. ISLAM[2*] & M. N. ISLAM[3]

[1]*Kaliakair Upzilla Parishad, Kaliakair, Gazipur, Bangladesh*
[2]*School of Agriculture and Rural Development, Bangladesh Open University, Gazipur-1705, Bangladesh*
[3]*Department of Food Technology and Rural Industries, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh*

ABSTRACT

The present study was carried out to evaluate the rehydration characteristics of solar and mechanically dried lablab bean (Lablab purpureus (L.) sweet; hitherto Dolichos lablab) seeds. Bean seeds with and without coat were used to study the rehydration properties. The rehydration ratios were higher for both mechanically and solar dried bean seeds without seed coat than those with coat. Mechanically dried without coat bean seeds had rehydration ratio of 2.34 while with coat was 2.06. For mechanically dried samples, the co-efficient of reconstitution were 0.58 and 0.56 for bean seeds without and with coat, respectively, and were higher than those of solar dried samples having co-efficient of reconstitution of 0.54 and 0.52 for bean seeds without and with coat, respectively. For both mechanical and solar drying the rehydration rate constant was higher for bean seeds without coat than those with coat. Both rehydration ratio and rehydration rate indicated that mechanically and solar dried bean seeds samples without coat showed better reconstitution properties than those with coat. Both fresh and dried bean seeds without seed coat gave higher nutrient content than their counterpart with coat. Solar and mechanical dried seeds were good source of nutrients.

Key words: Lablab bean, rehydration ratio, rehydration rate, co-efficient of reconstitution, proximate composition.

INTRODUCTION

Lablab bean (*Lablab purpureus* (L.) sweet; hitherto *Dolichos lablab*) is one of the major winter vegetables of Bangladesh. It is commonly known as country bean in Bangladesh and is widespread throughout the country. Chittagong and Coastal regions are, however, especially reputed for its production (Anonymous, 1988). The ripe and dried bean seeds are also consumed as a split pulse. The annual production of bean in Bangladesh was 49 thousand metric tons during 1997-2000. Lablab bean is rich in protein. The young pods contain 4.5% and dry seeds contain 25.0% protein (Rashid, 1976). In Bangladesh, India and some other countries, the young pods and unripe seeds are used as vegetables and the ripe seeds are used as pulse. Both the pods and seeds are delicious and are popular. This vegetable has the potential to reducing the protein deficiency, to some extent of the people, specially the poor people of Bangladesh. Although drying is one of the oldest and most widely used methods of food preservation, however, its success largely depends on the rehydration (reconstitution) of dried products. The dried products will be acceptable for food

* Corresponding author: Asst. Professor (Agricultural Engineering), SARD, BOU, Gazipur-1705; E-mail: serazsard4@yahoo.com

uses only if a good color, texture, flavor and nutritive value are resumed when these are reconstituted or rehydrated in water. Many factors affect the quality of the dried vegetables during reconstitution which includes the drying methods adopted, pre-treatment, period of soaking, temperature of soaking water, ratio of water to dried product, rate of heating and length of cooking. In formation required for standardization of the methods for particular product is scan and findings are sometimes controversial (Sarker and Setty, 1976). However, some reports have been available regarding the procedures for rehydration and effects of reconstitution media on the quality of the own-dried mechanically dried cabbage (Shams-ud-Din and Shirazi, 1999) and bitter gourds (Shams-ud-Din and Shirazi, 2000). With the above views in consideration, the present study was conducted to investigate the effects drying methods (solar and mechanical), seed coat, pre-soaking and soaking treatments on the reconstitution properties of dried lablab seed beans.

MATERIALS AND METHODS

The study was conducted in the laboratory of the Department of Food Technology and Rural Industries under the Faculty of Agricultural Engineering and Technology, Bangladesh Agricultural University, Mymensingh. The ripe/mature bean (*Lablab purpureous*) seeds collected from local market were used in the study.

Drying methods

Studies on dehydration of bean seeds were conducted using the method of solar and mechanical drying.

Solar Drying

A direct solar dryer which is covered by a oil paper was used for solar drying of bean seeds (with coat and without coat). There is no temperature control system. So, the effect of temperature on the rate of drying cannot be determined. Samples (with known moisture content) were placed in the solar dryer and drying was continued. Samples were taken out at each time interval and weight was determined gravimetrically. Weight loss was used as a measure of the extent of drying. From gravimetric measurement and known initial moisture content, sample moisture content at a definite time interval was determined for analysis of drying behavior.

Mechanical drying

Cabinet dryer, Model OV-165 (Gallen Kamp Company) was used for dehydration of bean. The dryer consists of a chamber in which trays of products could be placed. Air was blown by a fan pass through a heater and then across the trays of products to be dried. The velocity of air was recorded (0.6 m/sec) by an anemometer. To conduct drying experiments the bean seeds were separated from pods by hands and samples were taken for determination of initial moisture content. Without any treatment fresh bean seeds (with or without seed coat) at constant loading density (5.38 kg/m^2) were placed in trays in the drier and drying commenced in the drier at a constant air velocity (0.6 m/sec) and at a specific air dry bulb temperature (48, 58 and 68°C). Weight loss was used as a measure of the extent of drying.

Proximate Composition Analysis

The raw and processed samples were analyzed for the moisture, ash, fat, protein contents and total carbohydrate contents. Moisture content, total ash, crude fat and protein were determined by using AOAC (1984), AOAC 14.006, 7.049 and 2.049 (1975) method. All the determinations were done in triplicate and the result were expressed as mean value. Total carbohydrate content of the sample was determined as total carbohydrate by difference, that is by subtracting the measured protein, fat, ash and moisture from 100 (Pearson, 1970).

Rehydration Properties

Determination of Dehydration ratio

The dehydration ratio of both sun-dried and mechanically dried bean seed (with coat and without coat) was calculated by the following formula:

$$\text{Dehydration ratio} = \frac{\text{Weight of prepared material before drying}}{\text{Weight of dried material}}$$

General procedure for rehydration (reconstitution)

Rehydration means refreshing the dehydrated or dried products in water. Six beakers of each 500 ml capacity were taken and 150 ml of water and 5 g of dried sample were poured into each beaker and kept for 50 or 60 min for presoaking.

The samples were transferred to another six beakers with 150 ml boiling water. When boiling started, counting of time started. After the eating of this liquid portion was drained off and solid content were transferred to a buchner funnel of 4 inch diameter separately fitted with filter paper. The excess water was removed by applying a gentle suction for a few seconds. The rehydrated materials were removed from the funnel and the weights taken individually and finally the following relations were found out:

$$\text{Rehydration ratio} = \frac{\text{Weight of rehydrated material}}{\text{Weight of dehydrated material}}$$

$$\text{Co-efficient of reconstitution} = \frac{\text{Rehydration ratio}}{\text{Dehydration ratio}}$$

Percent water in rehydrated material

The percent water in rehydrated material was determined as per the methods of Ranganna (1992).

$$\text{Percent water in rehydrated material} = \frac{(\text{Drained weight of rehydrated material}) - (\text{Dry matter content in sample taken for rehydration})}{\text{Weight of dehydrated material}} \times 100$$

RESULTS AND DISCUSSION

Proximate composition of fresh and dried bean seeds (without and with coat)

The moisture, ash, fat, protein and total carbohydrate in fresh and dried (mechanical and solar) bean seeds without coat and with coat are presented in Table 1. Solar dried product had slightly higher moisture content for both seeds with or without coat than mechanical dried product possibly due to higher equilibrium relative humidity and lower temperature attained in the solar dryer. Somewhat lower nutrient content given by solar dried product may be attributed to higher moisture content compared to mechanical dried product. Again higher nutrients content given by bean seed without coat for both mechanically and solar dried bean seeds compared to those of bean seeds with coat may be due to lower nutrient content in the seed coat. In general, the dried products had significantly higher amount of nutrient content per unit weight of dried seeds than fresh ones since weight loss due to removal of moisture resulted in the dried product.

Table 1. Proximate composition of fresh and dried bean seeds (without and with coat)

Parameters	Fresh bean seeds		Solar dried bean seeds		Mechanically dried bean seeds	
	Without coat	With coat	Without coat	With coat	Without coat	With coat
M.C. (% wb)	62.00	67.00	12.50	11.6	11.14	10.80
Ash (% wb)	1.45	1.34	3.520	3.35	3.70	3.60
Fat (%)	0.7	0.4	1.1	0.9	1.25	1.0
Protein (% wb)	4.28	3.85	11.60	8.16	10.94	7.09
Total Carbohydrate (%)	31.57	27.41	71.29	75.99	72.97	77.51

Rehydration characteristics of dried bean seeds

To investigate the rehydration characteristics two sequential steps were followed firstly, presoaking was done to asses the most favorable textural criteria of the dried bean seeds. Pre-soaked products were then boiled for final reconstitution. It was found that there is difference between the

rehydration characteristics of bean seeds with coat and without coat even when the products were dried by the same drying method.

Reconstitution characteristics

Initial experiment showed that a minimum rehydration ratio for mechanically dried bean seed without coat was 2.34 and for bean seed with coat the rehydration ratio was 2.06. These were obtained for 50 min and 60 min respectively, pre-soaking before boiling the same pre-soaked water. Pre-soaking of 50 min was more favorable for bean seed without coat and 60 min pre-soaking gives the more favorable condition for bean seed with coat. So, 50 min and 60 min pre-soaking for bean seed without coat and with coat respectively, before boiling was followed throughout the experiment. For solar dried bean seeds without coat and with coat, similar reasons dictated to select the above-mentioned pre-soaking time.

The rehydration test was completed by using the above selected pre-soaked samples, which were boiled individually for 50 min for bean seed without coat and 60 min for bean seed with coat in the pre-soaked water. Initial trials indicated that pre-soaking was advantageous as this treatment gave higher rehydration, softer texture and uniform heating of the product. The various reconstitution data for mechanically dried and solar dried bean seeds (without coat and with coat) are given in Table 2. For mechanically dried bean seeds rehydration ratio for bean seeds without coat was higher than that of bean seeds with coat. For samples without coat rehydration ratio was 2.34 and for those with coat was 2.06. From this result, it is obvious that seed coat has profound effect on rehydration of bean seeds. Cellular and structural disruption during drying without coat with consequent higher rate of drying might have increased the rehydration rate of seeds. Reduced rate of shrinkage of the bean seeds without coat might have also influenced the attained higher rate of rehydration. It is also observed that after 15 min boiling of the pre-soaked sample, the regained weight remained near about the same as the samples approached saturated condition.

Table 2. Effect of drying methods on rehydration characteristics of dried bean seeds (with coat and without coat)

Drying method	Type of seed	Rehydration condition of dried bean seeds	Weight in g of rehydrated sample after boiling for (min.)						Rehydration ratio for maximum solvent absorption	Dehydration ratio	Co-efficient of reconstitution	Moisture content of rehydrated production (% wb)
			10	20	30	40	50	60				
Mechanical drying (MD)	With coat	Pre-soaked for 60 min and boiled in water	4.75	5.45	5.55	5.70	5.98	6.20	2.06	3.68	0.56	56.8
Solar drying (SD)	With coat	Pre-soaked for 60 min and boiled in water	4.46	4.97	5.17	5.30	5.55	5.90	1.97	3.79	0.52	49.2
Mechanical drying (MD)	Without coat	Pre-soaked for 50 min and boiled in water	5.97	6.10	6.27	6.66	7.03	-	2.34	4.03	0.58	51.6
Solar drying (SD)	Without coat	Pre-soaked for 50 min and boiled in water	5.50	6.50	6.95	7.25	7.45	-	2.48	4.59	0.54	47.6

In case of solar dried bean seeds, rehydration ratio for sample without coat was higher than that of sample with coat. For bean seeds without coat and with coat solar dried samples, reyhdration ratio was 2.48 and 1.97, respectively. These variations, though very small, might have occurred due to the reasons that are mentioned for mechanically dried samples. The rehydration ratio values for solar dried samples are almost similar to those of mechanically dried samples, which are shown in Table 2. For mechanically dried samples, the co-efficient of reconstitution were 0.58 and 0.56 for bean seeds without and with coat, respectively, and are higher than those of solar dried samples 0.54 and 0.52 for bean seeds without and with coat, respectively. This indicates that mechanically dried bean seeds possess better reconstitution properties than solar dried counterparts. This behavior may be attributed to the change in rate of drying during two methods (Kueneman *et al.*, 1975). Mechanical drying gives higher rate of drying resulting in higher co-

efficient of reconstitution than solar dried counterparts due to slower drying rate. As compared to the moisture content of the fresh bean seeds without coat (62% m.c. (wb)) and with coat (67% m.c. (wb)) rehydrated samples contained significantly lower moisture content (47.6-51.6 % m.c. wb and 49.2-56.8 % m.c. wb for bean seeds without coat and with coat, respectively). The low moisture content attained following rehydration due to the loss of water during drying process, with resultant increase in the concentration of dissolved substances in the tissue of vegetables. This may lead to the irreversible damage to the texture and these textural changes cause the tissues to shrink. As a result, upon reconstitution (depending on the conditions of drying), they were not able to regain their initial moisture content, volume (or weight) and tenderness.

Rehydration rate and rehydration kinetics

Fig. 1 and 2 showed that the rehydration rate decreased with increase in time but the decreasing rate was higher for products without coat than that with coat. From the above figures it is also observed that the rehydration rate of mechanically dried bean seeds (with and without coat) is higher during the initial period and finally rate of rehydration tends to remain same as time passes indicating commencement of saturation condition. The rate of water uptake is high in the initial period because of the high water activity gradient between the sample and surrounding media (here water) and as time passes this difference reduces with consequent lower rate of rehydration. Similar behavior of rehydration rate was shown by Iqbal (2000) and Iqbal (2003). Plotting rehydration ratio versus time in semi-log coordinate it is possible to demonstrate that rehydration follows first order kinetics with two periods of rehydration as shown in Fig. 3 and 4. Since for both cases, there was only one experimental data up to 10 min equations for the first period was not developed. From the experimental data after 10 min four rate equations for bean seeds as per Heldman (1977) are developed as:

Equations for bean seeds:

RR = 0.0089 t + 1.867 (for mechanically dried without coat bean seeds) - (1)
RR = 0.0085 t + 1.5707 (for mechanically dried with coat bean seeds) - (2)
RR = 0.0169 t + 1.751 (for solar dried without coat bean seeds) - (3)
RR = 0.0089 t + 1.4347 (for solar dried with coat bean seeds) - (4)

** RR = Rehydration Ratio

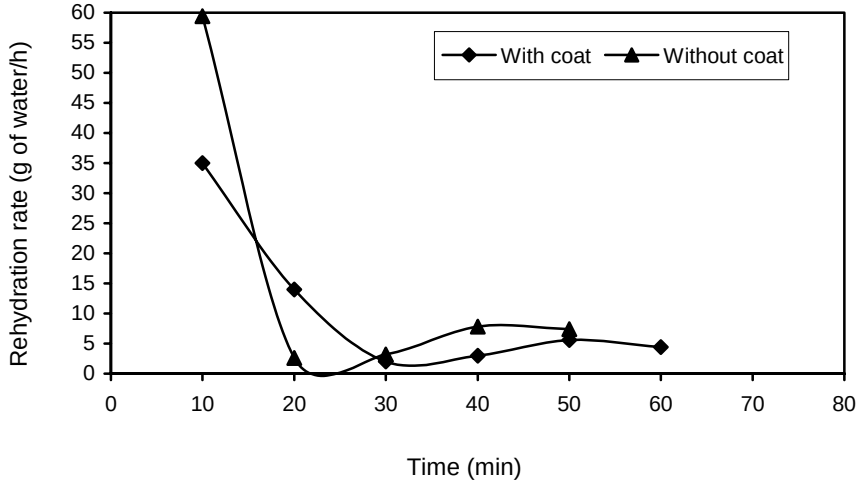

Fig. 1. Rehydration rate curve of Mechanical dried (MD) bean seeds (with coat and without coat)

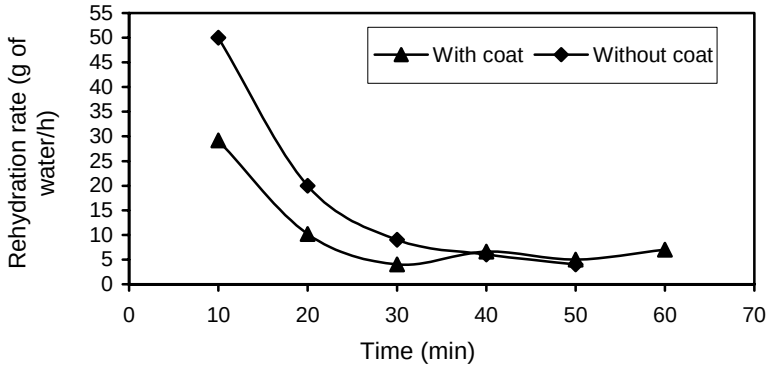

Fig. 2. Rehydration rate curve of solar dried (SD) bean seeds (with coat and without coat)

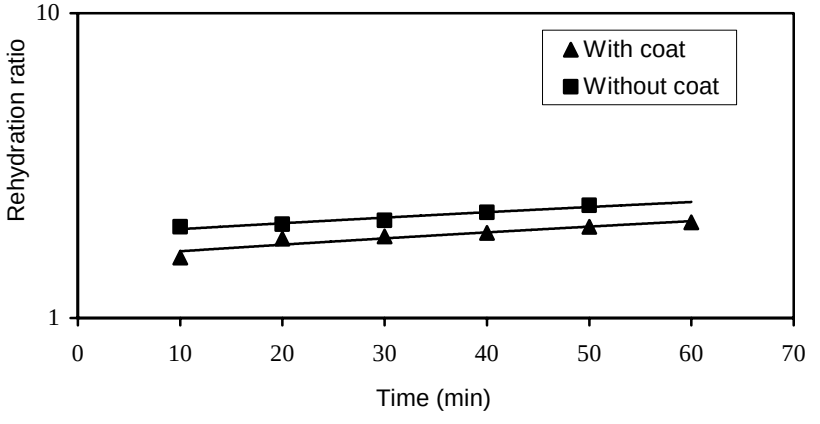

Fig. 3. Change in rehydration ratio with time of bean seeds (with coat and without coat) by mechanical drying

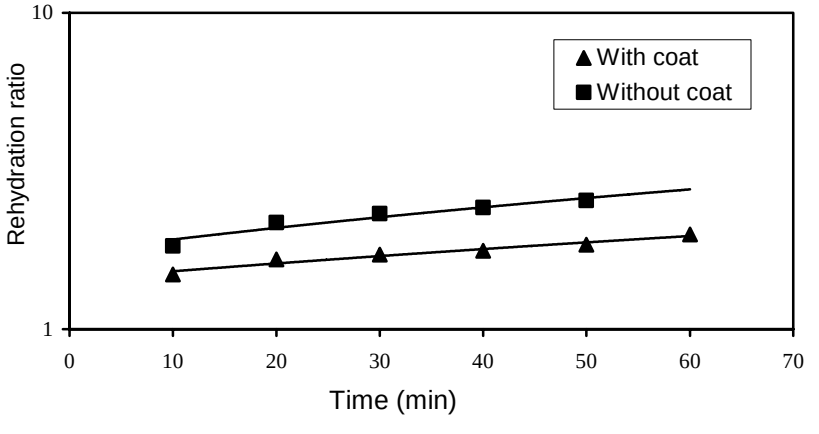

Fig. 4. Change in rehydration ratio with time of bean seeds (with coat and without coat) by solar drying

From the developed equations, it is evident that rehydration rate constant is higher for mechanical and solar dried bean seeds without coat. The results also indicated that rehydration rate constant for solar drying is slightly higher than mechanical drying in the 2nd period. Higher rate constant given by bean seeds without coat as compared to that given by bean seed with coat is attributed to higher mass transfer resistance offered by the seed coat.

CONCLUSION

During rehydration quality test for both mechanically and solar dried bean seeds without coat, rehydration ratio was higher than bean seeds with coat. The difference is attributed to the texture and constituents of the products. Both rehydration ratio and rehydration rate indicated that mechanically and solar dried samples without coat showed better reconstitution properties than those with coat.

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