Water Absorption in Chickpea (*C.arietinum*) Cultivars During Soaking

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ABSTRACT

Water absorption in three types of chickpea (large and small kabuli and desi) at 25 and 45°C was investigated. The Peleg model $M_{(t)}=M_o+t/(K_1+K_2t)$ was used to describe the sorption process in various chickpea cultivars at different temperatures. To eliminate size effect on water absorption, medium size samples were studied. SAS PROC REG was used to determine the rate constant K_1, and capacity constant K_2 in the Peleg model for each cultivar at various temperatures.

INTRODUCTION

Chickpea (*Cicer. arietinum*) is known as an important source of protein and starch, grown as specialty crop in Saskatchewan and is exported around the world. There are two main varieties of chickpeas namely desi and kabuli. The kabuli type has thin, white seed coat and desi type has a thick, colored seed coat and has smaller seed than kabuli type (Salunkhe et al., 1985).

Since soaking the grains is usually used before dehulling and cooking, understanding water absorption of different seeds during soaking was considered by researchers. Materials under different conditions of soaking have different water absorption rate and water absorption capacity. Relationship between moisture content of materials versus time during soaking has been expressed by different models. Using short time experimental data for predicting equilibrium moisture content of foods and grains is the major advantage of the Peleg model, it is commonly used to describe absorption characteristic of various materials during soaking (Sopade et al., 1994; Hung et al., 1993; Turhan et al., 2002). The Peleg model is shown as:

$$M_t = M_o \pm \frac{t}{K_1 + K_2 t}$$

where $M_{(t)}$ is moisture content at time t (%), M_o is initial moisture content (%), t is time (h), K_1 and K_2 are the Peleg rate ($h\%^{-1}$) and Peleg capacity constant ($\%^{-1}$) respectively.

The objective of this study was to determine the Peleg constants (K_1 and K_2) of various types of chickpea (large kabuli, small kabuli and desi).

MATERIAL AND METHODS

Various dry chickpea seeds (large and small kabuli, and desi) were procured from Canadian Select Grains (Eston, SK,). The seed was kept in cabinet at 5^{o}C for one month. The initial moisture content at samples was determined by following AACC 44-15A method (AACC, 1999). In order to eliminate the effect of seed size on the soaking trials, medium size grains were used.

Experiments were conducted in distilled water at 25^{o}C and 45^{o}C for each type of chickpea at different duration. Before each experiment samples, containers and distilled water were kept in desired temperature for a few hours to reach the same temperature.

For each duration included in the timetable, five seeds of each type were randomly chosen and weighed, then placed in glass beakers containing 200 ml distilled water. After a specific time, seeds were removed from beakers and dried by spreading on tissue paper for about 5 min in order to absorb the excess water on seeds surface. The loss of soluble solids from soaked chickpeas was calculated by measuring distilled water and drained water in each experiments. A digital chronometer and an electronic weighing balance (Ohous Scale Corp., Model G 160 D,W.Germany) reading to 0.0001 g were used to control soaking duration and measure weight of sample before and after soaking. Tests were done in three replicates.

To calculate Peleg's constants, the Peleg model was arranged to a linear relationship as shows below:

$$\frac{t}{(M_t \quad M_o)} = K_1 + K_2 t$$

According to Peleg (1988); points were intentionally chosen from recorded data, as that extremely small weight gains at the beginning of soaking were not included. Also, data with increasing losses of soluble solids of more than 1% of the initial samples mass were not included.

RESULTS

Values of initial moisture content of samples were 9.85, 10.25 and 10.27% wet basis for large and small kabuli and desi chickpea respectively in which did not significantly differ ($p<0.05$).

The increasing moisture content of samples with respect to soaking time is shown in Fig.1. Absorption curves show that the rate of water absorption increased with increasing temperature. Similar results have been reported for various legume grains such as chickpeas, cowpea, soybean, and peanuts (Turhan et al., 2002; Sayar et al., 2001 and Sopade and Obeka, 1990).

Figure 2 demonstrates soaking time for desi type of chickpeas in which data have been fitted to the Peleg model. It shows that the desi cultivar at 25^{o}C absorbed just a little amount of water before 2h, so recorded data before this time were not used in fitting to the Peleg model. Since the soluble solids losses after 18h of soaking of desi cultivar at 25^{O}C was more than 1% of the initial mass of the samples, recorded data after this time were not used to determine the Peleg constants. The same procedure was done for data from the other two cultivars.

Some researchers such as Sayar et al., 2001 used a soaking time of 11 h and 7h for chickpeas at 20^{O}C and 40^{o}C respectively, and Turhan et al., 2002 predicted this time about 7h for chickpeas at 20^{o}C.

Peleg's model was fitted to experimental data by using PROC REG SAS (SAS, 2001). Constants k_1 and k_2 were obtained at two different temperatures for chickpea samples (Table 1). Results show that Peleg rate constant (k_1) increased with temperature but Peleg capacity constant (k_2) were not relatively affected by temperature for various types of chickpea. The same results were reported by Sopade et al., 1992 for Cowpea, and Turhan et al., 2002 for chickpea.

CONCLUSIONS

1. The Peleg model is acceptable for predicting moisture content of different types of chickpea during soaking.
2. Different soaking times are required to fit the collected data to Peleg model.
3. The Peleg rate constant K_1 increased with temperature.
4. The Peleg capacity constant K_2 was not affected by temperature.

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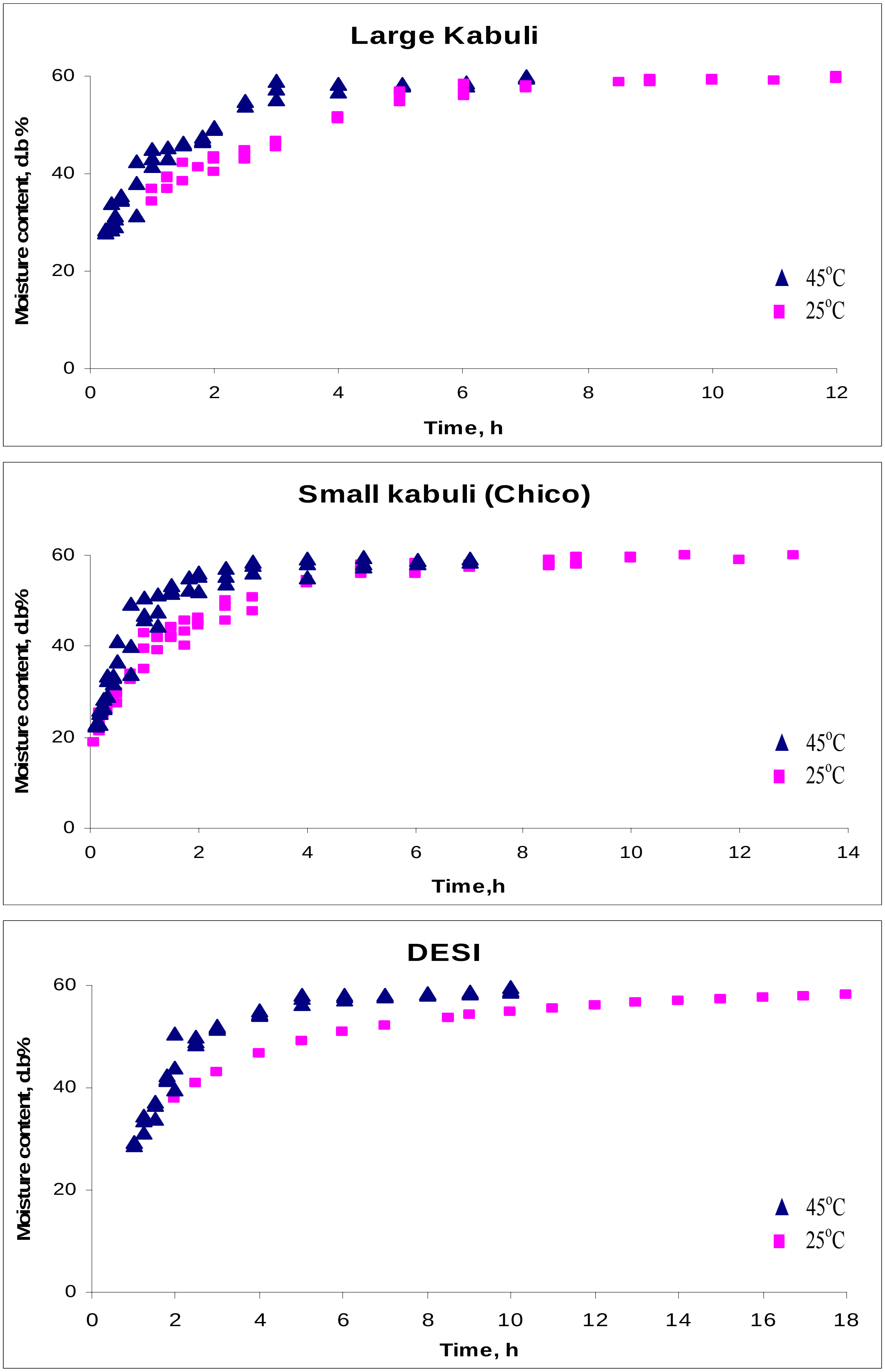

Fig.1- Water absorption curves during soaking of different types of chickpeas at various temperatures.

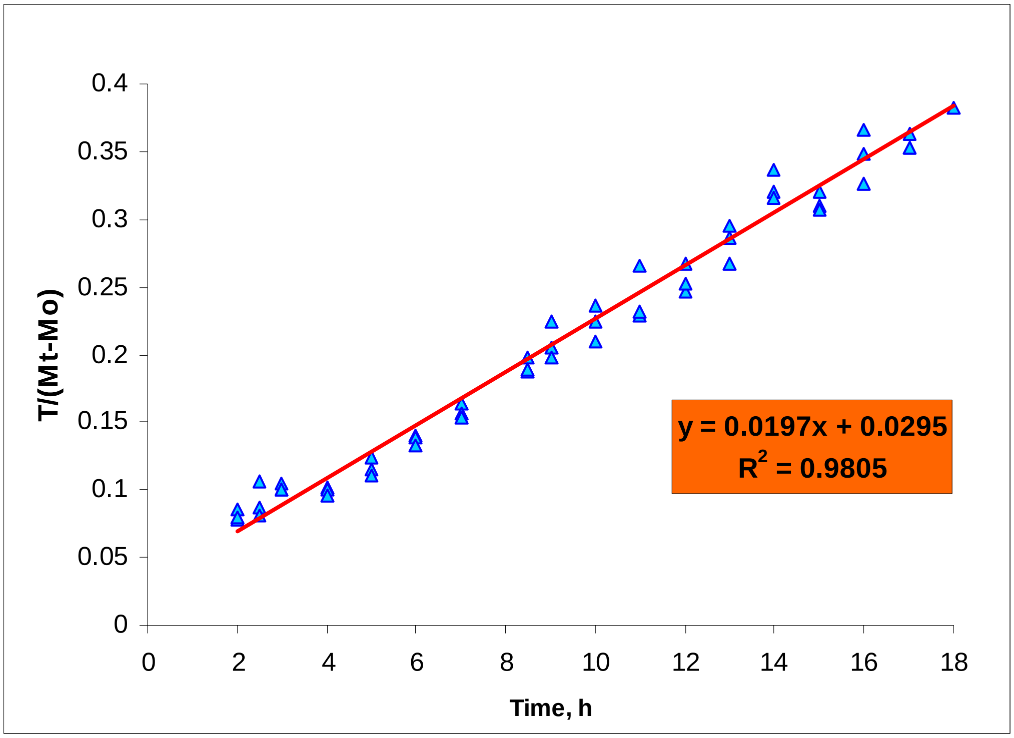

Fig. 2- Fit of the linear model of Peleg's equation to observed moisture content of chickpeas (desi, 25°C).

Table 1. Peleg constants and goodness of fit of Peleg model for water absorption of different types of chickpeas

Type	Temperature, °C	K_1, (h%$^{-1}$)	K_2, (%$^{-1}$)	R^2
Large kabuli				
	25	2.4×10^{-2}	1.8×10^{-2}	0.997
	45	1.2×10^{-2}	1.8×10^{-2}	0.995
Small kabuli (Chico)				
	25	1.6×10^{-2}	1.9×10^{-2}	0.997
	45	0.8×10^{-2}	1.9×10^{-2}	0.996
desi				
	25	2.9×10^{-2}	1.9×10^{-2}	0.981
	45	2.6×10^{-2}	1.7×10^{-2}	0.987