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TECHNOLOGY****EXPERIMENTAL AND THEORETICAL ANALYSIS OF THE DRYING
KINETICS OF GREEN PEAS****Anirban Nandy*, O.P. Pandey, B.K. Mishra**

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ABSTRACT

The effect of moisture content drying rate for different diameters of green peas at different temperatures is critically analyzed in this paper. The above parameters under different temperatures and diameters are analyzed without using blanching technique. It is observed that the process plays a vital role in the reduction of the moisture content under different temperatures. The drying of green peas was done in a fluidized bed dryer operating at different temperatures. The data obtained from the experiments were subjected to statistical analysis.

KEYWORDS: Air temperature, Drying of green peas, Drying kinetics, Drying of vegetables, Fluidized bed dryer.

INTRODUCTION

These are the days of dehydrated products with high nutritional value. The basic objective in drying of food products is the removal of moisture content at a certain level, so that microbial spoilage and deterioration chemical reactions are minimized [1]. Green peas are characterized by high initial moisture content, so drying becomes an essential operation before storage. There are some basic problems associated with drying of food stuffs such as shrinkage, hydrodynamics of the movement of the particles in the dryer, deterioration of the green pea quality etc. Considering the base thermal efficiencies of the equipment, fluidized based dryer are the most efficient [2].

Filho et al. used fluidized bed dryer to study the dehydration of green peas under atmospheric freeze drying conditions and had shown that it permits to obtain samples with high levels of rehydration ability, floatability and green color [3]. Simal et al., (1956) and Senadeera et al., (2003) have studied the hot air drying of green peas but there are few literature only available on fluidized bed based heat pump dryer. Several researchers (Strommen, 2001; Filho and Mazumder, 2002; Mazumder and Filho, 2003) studied the drying kinetics of green peas using heat pump dryer. One of the basic reasons for using FBD is that the drying rate can be greatly enhanced by agitation of the material being dried or

by fluidization, which improves the mass and heat transfer coefficients (Filho and Mazumder, 2003; Di Matteo et al., 2003).

This subject has been of special interest during recent decades, from which the works of Abid, Gibert and Laguerie (1990); Chancellor (1968); Cobbinah, Laguerie and Gibert (1987); Grabowski, Muzumdar, Ramaswamy and Strumillo (1994); Jariwara and Hoelscher (1970); Kirkwood and Olson (1986); Lee and Kim (1993, 1999); Taracatac, Flores and Chaudhry (1985); Zhou, Mowla, Wang and Rudolph (1998) are of interest.

The objective of the work is to investigate the drying kinetics of green peas i.e. to study the effect of some drying parameters on the progress of the drying process. The temperature is taken within 60 degree Celsius to 80 degree Celsius with diameter having a range of 5 mm to 10mm.

Nomenclature			
T	temperature (°C)	Mc	moisture content (gm/gm db)
t	time (min)	FBD	fluidized bed drier
V	air velocity of drying air	D	diameter (mm)
rd	rate of drying	W_i, W_f	initial and final weight (gm)

MATERIALS AND METHODS

Fluidized bed dryer

In the fluidized bed dryer, hot air or gas is passed at high pressure through a perforated bottom of the container containing green peas to be dried. The green peas are suspended in the stream of air and are lifted from the bottom. This condition is called fluidized state. The hot air is surrounded every green peas to completely dry them. Thus green peas are uniformly dried. The temperature of the hot air and exit air are monitored.

Experimental procedure

The fresh green pea pods were purchased from the local market. Damaged, undeveloped and dry pods were removed manually by visual inspection. The pods were shelled manually and peas were used for further experiments. Fresh green peas (*Pisum sativum*) were used of different diameters. The Initial weight W_i of the green peas of different

diameters were measured and recorded. Initial weight and final weight are important to calculate the moisture content by two processes namely wet basis and dry basis. The samples were dehydrated in a fluidized bed dryer. It consists of four operating sections: temperature control, heater control, air flow rate control and drying test sections. Experiments were done to determine the impact of process variables on the drying kinetics. The variables taken into consideration were: size of the sample, temperature of the air and velocity of the air. The drying actions were carried out at three different sample size of diameters, D , 7.64 mm, 9.13 mm, 9.64 mm. The experiments were carried out at three different temperatures 60°C, 70°C, 80°C. The air velocity was kept constant. The drying process was studied through without blanching technique where the green peas were fed to the dryer directly without any intervention of

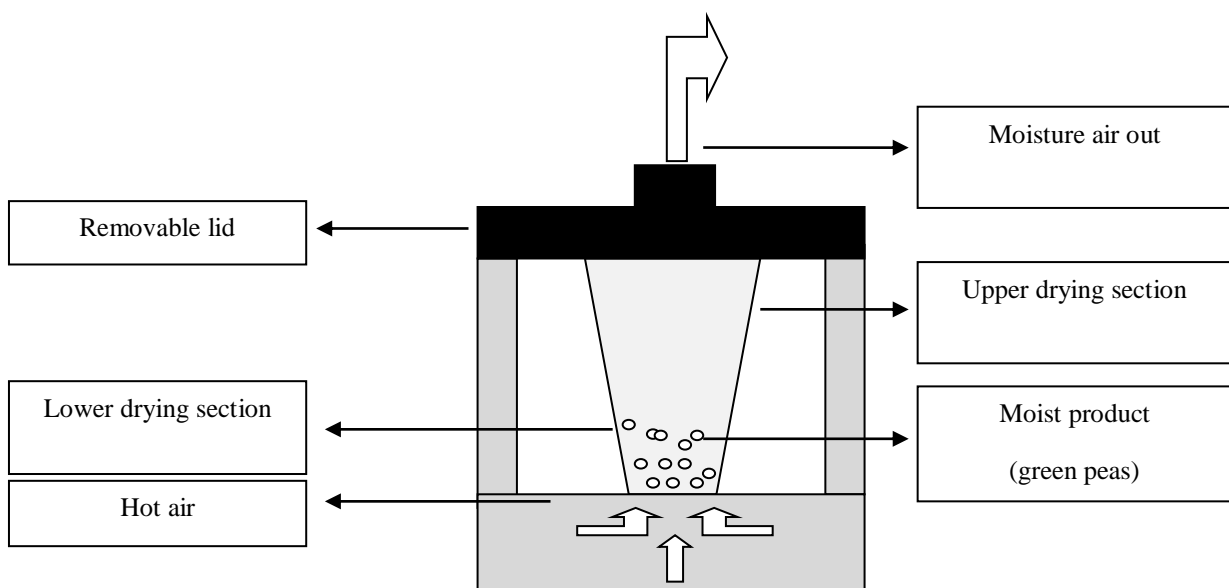


Fig. 1. Schematic diagram of fluidized bed dryer.

boiled water. The experiments were performed and the data were recorded at an interval of 10 minutes. The fluidized bed dryer was efficient enough to show the inlet and outlet temperatures as a consequence constant monitoring on the experiment was trouble-free.

RESULTS AND DISCUSSION

The results of the experiment for the drying of green peas of different diameters are given in Fig. 3. In the figure the effect of different parameters has been shown. The effect of temperature on the drying process of green peas is also shown. It is observed that there is an acceleration of the drying process on increasing the temperature of the drying air from 60°C to 70°C to 80°C. The effect of temperature is important. The variable effect of all

Mathematical modeling

Weight loss was calculated using the following equation:

$$W_f = W_i \times \frac{100 - MC_i}{100 - MC_f}$$

W_i = Initial weight (g)

W_f = Final weight (g)

the three temperatures is shown in Fig. 3. with the help of graphical representation.

Statistical measures

The data obtained from the experiments for drying rate and post-drying qualities were subjected to statistical Analysis of Variance (ANOVA). Randomized block design was used. Suppose that experimental units (individuals or objects to which the treatments are applied) are first separated into groups consisting of k units in such a way that the units within each group are as similar as possible. Within any particular group, the treatments are then randomly allocated so that each unit in a group receives a different treatment. The groups are called blocks, and the experimental design is referred to as a randomized block design. The green pea sample of 7.64 mm diameter seems to dehydrate faster than the 9.13 mm diameter which is again takes less time to dehydrate than 9.94 mm diameter.

ANOVA analysis shows significant effect of temperature on drying kinetics among the types of green peas taken. It can be found that air

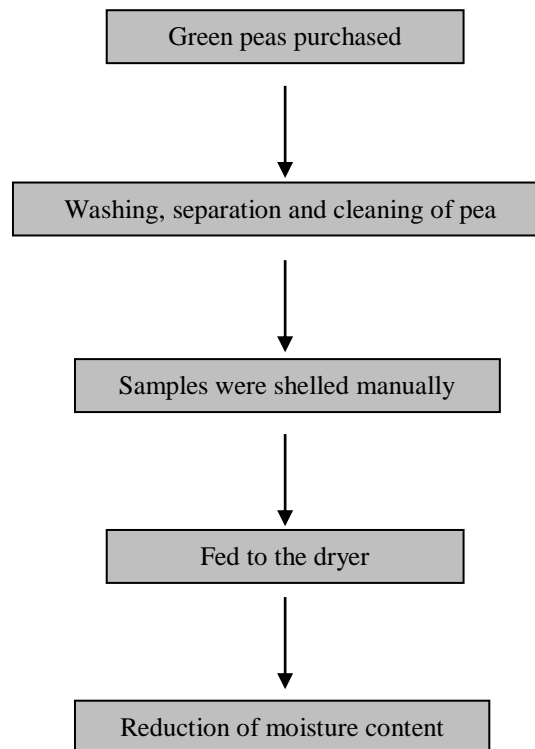


Fig. 2. Flow chart showing the experimental set-up.

temperature is the important factor that has significant influence on drying curve. The change in moisture content with time at different

temperatures was plotted for three different diameters.

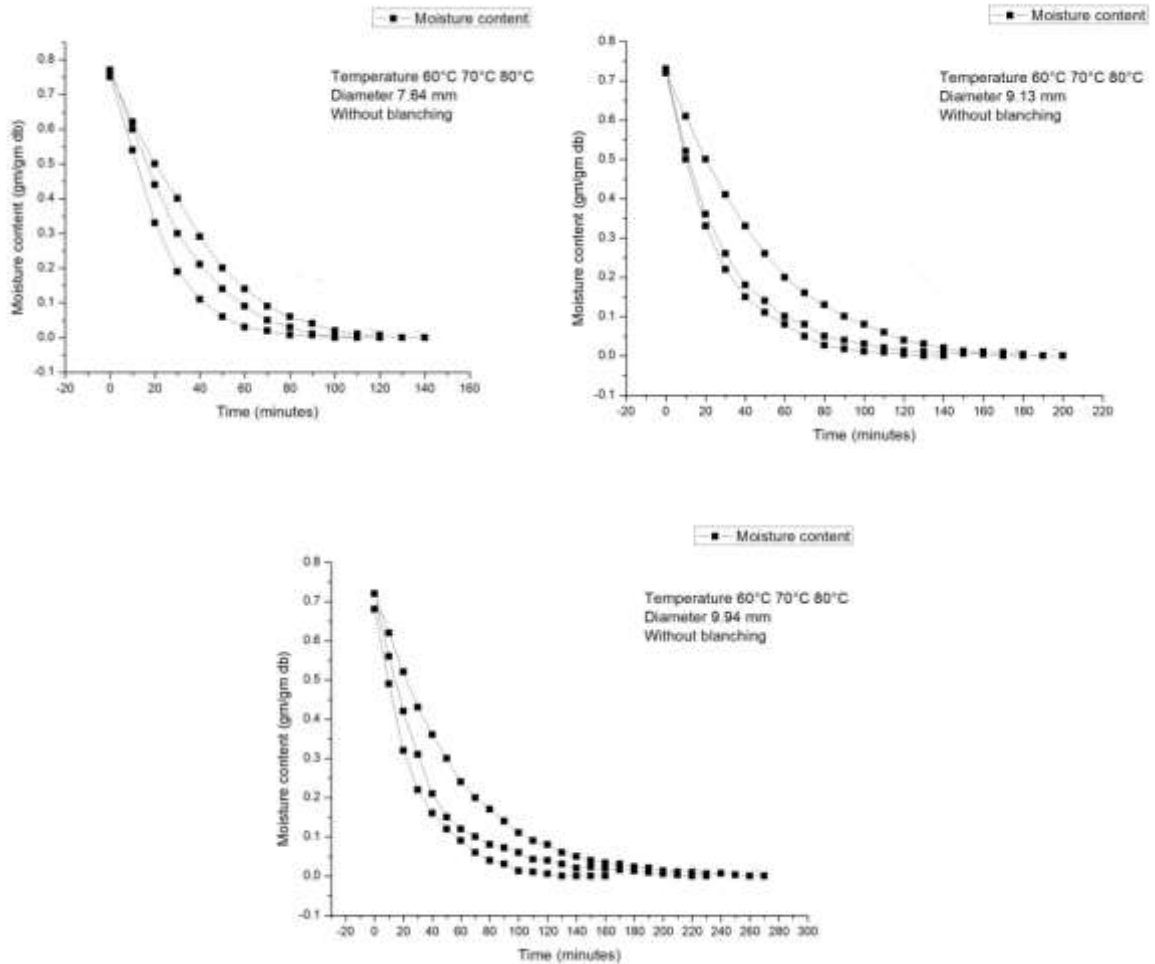


Fig. 3. Drying kinetics of green peas.

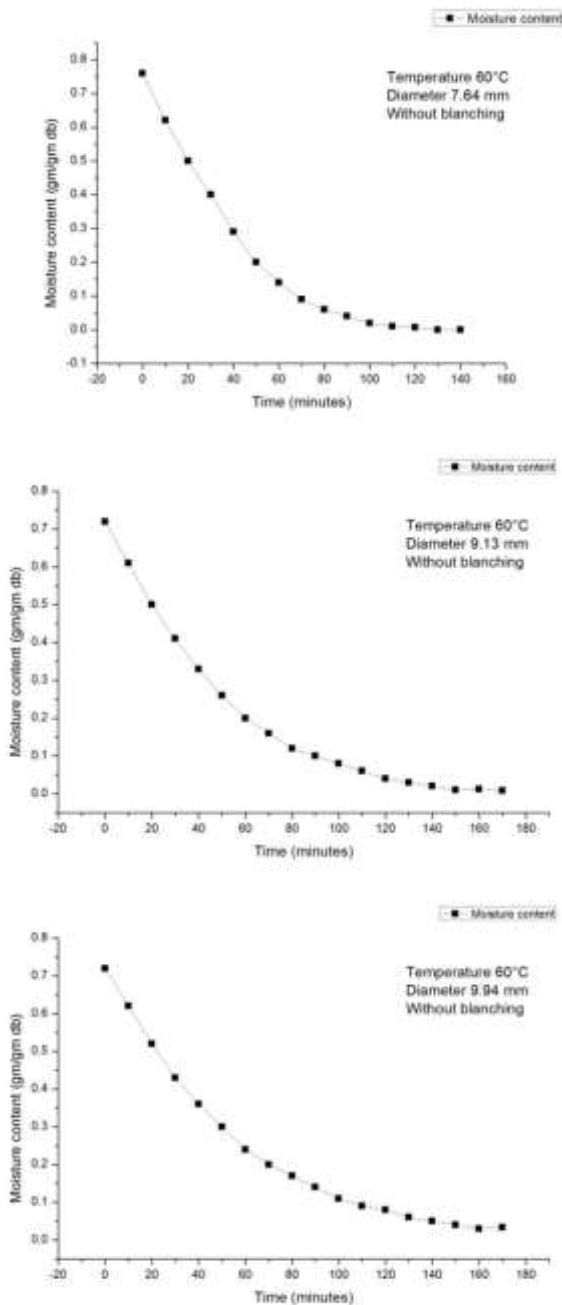


Fig. 4. Drying kinetics of green peas

CONCLUSION

Experimental data of the green peas using a fluidized bed dryer were obtained at different drying conditions with temperature ranging from 60 to 80°C. The drying curves shown above clearly indicate the effect of temperature and also the particle size on the drying kinetics. Three samples of green peas from 7 to 10 mm were taken and from the drying curves it is clear that sample size also has an effect on the drying progress.

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