© 2018 IJSRST | Volume 4 | Issue 5 | Print ISSN: 2395-6011 | Online ISSN: 2395-602X
Themed Section: Science and Technology

Drying Characteristics of Spinach in Tray dryer and Hot air oven

B. Bhavani[1] ,V. Bhasker [2]

[1]Post Graduate Student ,Department of Food Technology, University College of Technology (A), Osmania University, Hyderabad, Telangana, India

[2]Assistant Professor , Department of Food Technology, University College of Technology (A), Osmania University, Hyderabad, Telangana, India

ABSTRACT

In the present work, spinach samples were dried using two different drying techniques namely tray drying and hot air oven drying. Drying experiments were conducted using a constant air velocity but varying temperature i.e, 60°C and 70°C. Then after 30 minutes the weight of the samples were recorded up to 3 hours and moisture ratio was calculated. It was observed that drying rate enhanced in case of tray drying compared to hot air oven drying with lower drying time.

Keywords: Drying rate, Moisture ratio, Tray drying, Hot air oven drying.

I. INTRODUCTION

Drying (dehydrating) food is one of the oldest and easiest methods of food preservation. Dehydration is the process of removing water or moisture from a food product. Removing moisture from foods makes them smaller and lighter. Dehydrated foods are ideal for backpacking, hiking, and camping because they weigh much less than their non-dried counterparts and do not require refrigeration. Drying food is also a way of preserving seasonal foods for later use.

Drying, in which the water content and activity are decreased, is an important method of preservation and production of a wide variety of products. This method brings about substantial reduction in weight and volume, minimizing packaging, storage and transportation costs, and enables storability of the product under ambient temperatures (Baysal *et al.* 2003).

Foods can be spoiled by micro-organisms and through enzymatic reactions within the food. Bacteria, yeast, and molds must have a sufficient amount of moisture around them to grow and cause spoilage. Reducing the moisture content of food prevents the growth of these spoilage causing micro-organisms and slows down enzymatic reactions that take place within food. The combination of these events helps to prevent spoilage in dried food.

Spinach (*Spinacia oleracea* L.) is a flowering plant in the family Amaranthacea native to central and southwestern Asia. It is an important leaf vegetable now grown throughout the temperate regions of the world. It is a rich source of iron, magnesium and potassium and extraordinarily high in vitamins C, A, E, B_6 and thiamine (Wikipedia Encyclopedia 2007). Spinach is widely used in making various foods like puree, soups and baked products (Baigai and Hashinaga 2001).

Spinach is the one that rapidly perishes after harvest, which is consumed only in the product season. Like other leafy greens spinach has high water content. Drying is one of the preservation methods that has the

capability of extending the consumption period of spinach (Ozkan *et al.* 2007).

II. MATERIALS AND METHODS

Fresh spinach leaves (*Spinacia oleracea* L.) were purchased at a local market in uppal, Hyderabad. They were washed with tap water, and moisture on the wet samples surface was removed with tissue paper. The average moisture content of the spinach samples was 89.7 ± 0.1 % (w.b.) as determined by vacuum drying at 70°C for 24 hours (AOAC 1990).

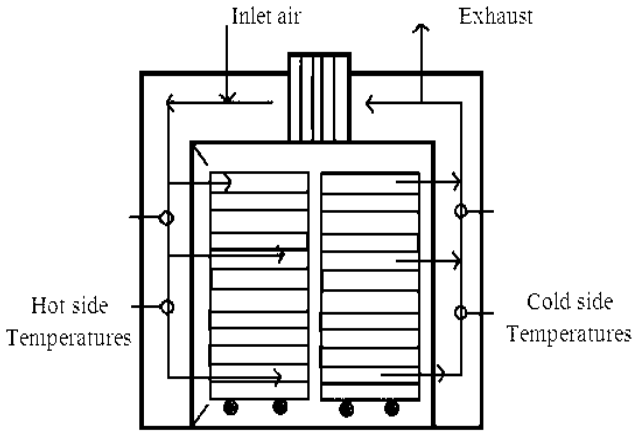

Figure 1. Tray dryer

Tray dryer:

In tray dryer hot air is continuously circulated. Forced convection heating takes place to remove moister from the solids placed in trays. Simultaneously the moist air is removed partially. Wet solid is loaded in to the trays. Trays are placed in the chamber. Fresh air is introduced through in let, which passes through the heaters and gets heated up. The hot air is circulated by means of fans at 2 to 5 metre per second. Turbulent flow lowers the partial vapour pressure in the atmosphere and also reduces the thickness of the air boundary layer. The water is picked up by the air. As the water evaporates from the surface, the water diffuses from the interior of the solids by the capillary action. These events occur in a single pass of air.

The time of contact is short and amount of water picked up in a single pass is small. Therefore the discharged air to the tune of 80 to 90 % is circulated back through the fans. Only 10 to 20% of fresh air is introduced. Moist air is discharged through outlet. Thus constant temperature and uniform air flow over the materials can be maintained for achieving uniform drying. At the end of the drying trays or trucks are pulled out of the chamber and taken to a tray dumping station.

Hot air oven:

The oven uses dry heat to sterilize articles. Generally, they can be operated from 50 to 300°C (122 to 572°F) . There is a thermostat controlling the temperature. These are digitally controlled to maintain the temperature. Their double walled insulation keeps the heat in and conserves energy, the inner layer being a poor conductor and outer layer being metallic. It is used in the sterilization of pharmaceutical products and other materials. It is double walled chamber made of steel.

The principle of operation is based on a fine gravity air convection in an electrically heated chamber of the unit. A two jacket design of the chamber and an automatic control unit ensure a homogenous temperature profile in the chamber, precise course of processes and short recovery time (return to the preset temperature) after door opening. This line of drying ovens is characterized by its economical operation. It is suitable for simple process of drying and heating of common materials.

III. EXPERIMENTAL PROCEDURE

Tray drying:

The drying experiments were performed in tray dryer at constant air velocity and temperature. The dryer was started at about 30 min before the drying

experiments, to achieve steady-state conditions before each drying run.100 grams of spinach was weighed and placed in the dryer. The drying tests were conducted at temperatures of 60°C and 70°C. The weight at every 30 min time interval up to 180 minutes was noted.

Hot-air oven drying:

Weigh accurately about 5 grams of sample in a previously dried and tarred petri plates. Place them in the hot air oven (60°C and 70°C) and dry them. The readings were recorded after every 30 min up to 180 minutes. The samples were cooled in a desiccator and weighed.

Moisture content was determined according to the method described by Ranganna (1986) and moisture ratio was calculated by the method given by Henderson and Perry (1976).

$$MR = e^{-Kt} = M - M_e / M_i - M_e$$

$$K = -\ln MR / t$$

where MR is moisture ratio, M_i is initial moisture content, M_e is equilibrium moisture content, M is moisture content at time t and K is drying constant.

IV. RESULTS AND DISCUSSION

Moisture ratio Vs time graphs have been plotted and they show that drying rate increased with the increase in air temperature and thus reduced the drying time. From the figures below, it is evident that drying curve plotted between moisture ratio and time follows exponential law better at higher temperature i.e. 70°C.

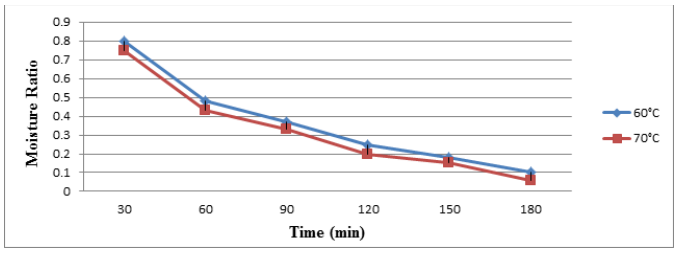

Figure 2. Moisture ratio Vs time for tray drying

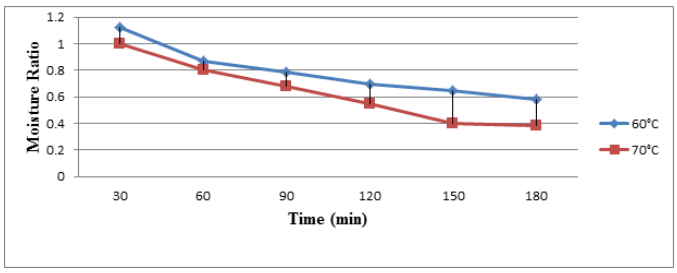

Figure 3. Moisture ratio Vs time for hot air oven drying

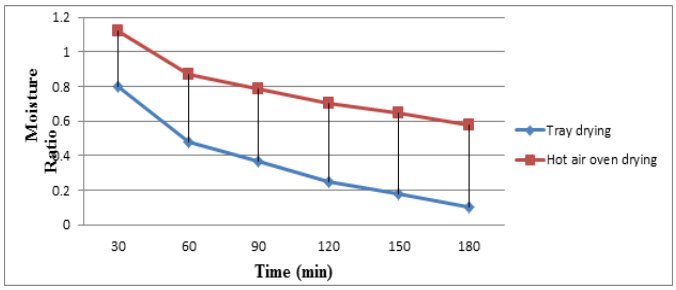

Figure 4. Moisture ratio Vs time for tray drying and hot air oven drying at 60°C

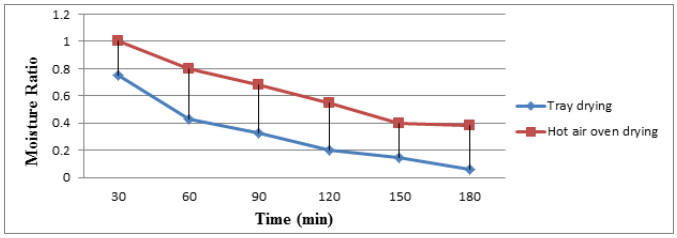

Figure 5. Moisture ratio Vs time for tray drying and hot air oven drying at 70°C

V. CONCLUSION

- ✓ Total drying time considerably reduces with increase in drying air temperature from 60°C to 70°C.
- ✓ Spinach does not initially dry at constant rate .The whole drying took place in falling rate period only.

- ✓ The drying rate increased with increase in temperature and decreased with increase in time.
- ✓ Experiment validates the drying of spinach for exponential model at higher temperature and for better result; temperature must lie between temperature range of 60°C-75°C.
- ✓ Tray drying is effective in drying of spinach when compared to hot air oven drying.
- ✓ It took more time to dry spinach in hot air oven than in tray dryer.

VI. REFERENCES

[1]. A.K. Upadhyaya, Bhupendra Gupta, Sanjeev Garg, Mohan Singh, Mukesh Pandey, Mathematical Modeling of Hot Air Drying of Spinach Leaves in Universal Hot Air Oven, 2012.

[2]. Ankita and K. Prasad, Studies on Kinetics of Moisture Removal from Spinach Leaves, 2013.

[3]. Anupam Ghosh and Uma Ghosh, Effect of processing on nutritional quality of spinach, 2016.

[4]. Bajgai, T.R. and Hashinaga, F. 2001. Drying spinach with a high electric field. Drying Technol. 19, 2331–2341.

[5]. Baysal, T., Icier, F., Ersus, S. and Yildiz, H. 2003. Effects of microwave and infrared drying on the quality of carrot and garlic. Eur. Food Res. Technol. 218, 68–73.

[6]. I. Aliba Ozkan, B. Akbudak, N. Akbudak, Microwave drying characteristics of spinach, 2007.

[7]. Ibrahim Doymaz, Thin-layer drying of spinach leaves in a convective dryer, 2009.

[8]. Prithvi Simha and A. Gugalia, Effect of Different Pre-Treatments on the Drying Characteristics of Spinach Leaves: Thin Layer Modelling and Analysis of Drying Data.

[9]. P.S. Tiwari, Samsher AND B.R. Singh, Effect of drying conditions on rehydration characteristics of spinach. I. Aliba Ozkan, B. Akbudak, N. Akbudak, Microwave drying characteristics of spinach, 2012.

[10]. P Madamba, R Driscollb, and K Buckleb (1996), The Thin-layer Drying Characteristics of Garlic Slices, Journal of Food Engineering, 29, pp. 15-97.

[11]. P Nisha, R Singhal and A Pandit (2004), A study on the degradation kinetics of visual green colour in spinach (Spinacea oleracea L) and the effect of salt therein, Journal of Food Engineering, 64, pp. 135-142.

[12]. W Fernando, A Ahmad, S Abd and Y Shukor Lok (2008), A model for constant temperature drying rates of case hardened slices of papaya and garlic, Journal of Food Engineering, 88, pp. 229-238.

[13]. Wikipedia Encyclopedia 2007.