iJPPHT
e ISSN-2231-6426
Volume 9 | Issue 1 | June, 2018 | 10-14
■ Visit us: *www.researchjournal.co.in*
International Journal of Processing and Post Harvest Technology

RESEARCH PAPER
DOI: 10.15740/HAS/IJPPHT/9.1/10-14

Performance assessment of solar dryer for processing perishable vegetables

■ Binapani Deka* **and** Mousumi Phukon
Krishi Vigyan Kendra (AAU), **Jorhat (Assam) India**
Email : dbinapani@gmail.com

*Author for Correspondence

■ **Research chronicle : Received :** 01.05.2018; **Revised :** 13.05.2018; **Accepted :** 21.05.2018

SUMMARY :

Drying is the moisture removing process from the products. Drying is very important process applicable for agricultural and industrial products. Drying reduces the bacterial growth in the products. It will helpful for preserving the products for long time. Open air and uncontrolled sun drying is still the most common method used to preserve and process Agricultural product. But uncontrolled drying suffers from serious problem of wind born dust, infestation by insect, product may be totally damaged. Solar drying is the oldest method of products drying. Local made solar dryers have been developed and used to dry agricultural products in order to improve shelf-life. The objective of this study is to see the advantages of solar dryer on their effectiveness in the drying of agricultural products. The findings showed that the solar dryer is beneficial than the sun drying techniques. Solar dryers have shortcomings. They are of little use during cloudy weather. During fair weather they can work too well. Although solar dryers involve an initial expense, they produce better looking, better tasting, and more nutritious foods, enhancing both their food value and their marketability. They are faster, safer and more efficient than traditional sun drying techniques.

KEY WORDS : Solar dryer, Processing perishable, Vegetables

How to cite this paper : Deka, Binapani and Phukon, Mousumi (2018). Performance assessment of solar dryer for processing perishable vegetables. *Internat. J. Proc. & Post Harvest Technol.,* **9** (1) : 10-14. **DOI: 10.15740/HAS/IJPPHT/9.1/10-14.**

Food drying is a very simple, ancient skill. It is one of the most accessible and the most widespread processing technology. Sun drying of fruits and vegetables is still practiced largely unchanged from ancient times. Traditional sun drying takes place by storing the product under direct sunlight. Sun drying is only possible in areas where, in an average year, the weather allows foods to be dried immediately after harvest. The main advantages of sun drying are low capital and operating costs and the fact that little expertise is required. The main disadvantages of this method are contamination, theft or damage by birds, rats or insects; slow or intermittent drying and no protection from rain or dew that wets the product, encourages mould growth and may result in a relatively high final moisture content. Direct exposure to sunlight reduces the quality (colour and

vitamin content) of some fruits and vegetables. Moreover, since sun drying depends on uncontrolled factors, production of uniform and standard products is not expected. Solar dryer is the best alternative technology to avoid disadvantages of conventional drying methods. Solar drying is the oldest method of products drying. Solar dryer is the simple devices used to collect the solar radiations and transfer that radiation in the form of heat energy and this heat energy then transfer to product for drying. Due to the current trends towards higher cost of fossil fuels and uncertainty regarding future cost and availability, use of solar energy in food processing will probably increase and become more economically feasible in the near future. The principle that lies behind the design of solar dryers is relative and absolute humidity is very important in drying. Air can take up moisture, but only up to a limit. This limit is the absolute (maximum) humidity, and it is temperature dependent. When air passes over a moist food it will take up moisture until it is virtually fully saturated, that is until absolute humidity has been reached. But, the capacity of the air for taking up this moisture is dependent on its temperature. When the temperature is higher, then higher the absolute humidity and there will be larger the uptake of moisture. If air is warmed, the amount of moisture in it remains the same, but the relative humidity falls and the air is, therefore, enabled to take up more moisture from it's surrounding.

Mushrooms are edible fungi of commercial importance and their cultivation and consumption have increased substantially due to their nutritional value, delicacy and flavour. It is rich in vitamins C, D_2, B_2 and Mg, P, Ca, dietary fibers and amino acids. Another important ingredient of mushroom is the polysaccharide compound beta-glucan, which enhances cellular immune function. But mushrooms are extremely perishable and the shelf-life of fresh mushrooms is only about 24 hrs at ambient conditions and 7-10 days even with refrigerated storage because of its high moisture content and rich nutrients that spoil easily and quickly. Again, various physiological and morphological changes occur after harvest, which make these mushrooms unacceptable for consumption. Therefore, mushrooms are usually dried to extend the shelf-life. Hence, these should be consumed or processed immediately after harvesting. Drying is one of the important process by which mushrooms can be preserved. As mushrooms are very sensitive to temperature, choosing the right drying method is very much important. The mushroom growers use to dry mushrooms under sun, which yields unhygienic and poor quality dried products. Due to long drying time and over-heating of surface during sun drying, the problems of darkening of colour, loss in flavour and decrease in re-hydration ability occur. Mechanical driers can be used, but it requires fossil fuel and electrical energy. Since drying is an energy conservation process, it is not economic to use mechanical dryers. Therefore, low cost dryers have been developed and used to dry agricultural products like mushroom, *Bhoot jolokia* in order to improve shelf-life and marketability.

A variety of chillies of different shapes, sizes and varying degrees of heat quotient can be found in the Northeast, but the Bhoot jolokia is one of the most popular varieties. It grows in small shrubs and has been scientifically proven to be one of the two hottest chillies in the world. The chillies are hand-plucked by villagers and marketed. But they tend to spoil really fast. There are two methods of drying. The first is smoke drying, in which the chillies are spread out in a woven basket over the fireplace; sun-drying is not recommended because that can make the chillies lose colour. It's important to let the chillies retain colour and texture. Another safe method for drying is using solar dryer.

This paper presents experimental studies of solar drying of mushrooms and *Bhoot jolokia* using low cost solar dryer. The present study was conducted during 2015-17 to know the existing practices of farmers for drying and to test the performance of solar dryer, their proficiencies and their advantages.

Objectives of the study:

– To reduce wastage of overflow of seasonal vegetables which can be use in off season to procure better nutrition.

– To study the efficiency of solar dryer in terms of time required for drying, sensory experiences of the products and to study the shelf-life of the dried products.

EXPERIMENTAL METHODS

The study was conducted under the agies of Home Science component of Krishi Vigyan Kendra, Jorhat, Assam Agricultural University in 2015-17. Low cost solar dryers have been constructed by local carpenter. The dryers were placed on raised platform. Mushrooms used for solar drying were collected from the mushroom

Fig. A : Training on mushroom cultivation

Fig. E : Demonstration on mushroom cultivation

Fig. B: Drying of mushrooms and hena leaves

Fig. F : Drying of mushrooms

Fig. C : Farmers showed interest to use solar dryer

Fig. G : Drying of bhoot jolokia

Fig. D : Packaging of dried mushrooms

Fig. H : Labelling of dried mushrooms

growers of SHGs and *Bhoot jolokia* were collected from local farmers. Tests on solar drying of mushrooms and *Bhoot jolokia* were carried out at 6 villages of Jorhat district of Assam from 2015 - 2017.

The samples of mushrooms and *Bhoot jolokia* were placed on the tray of the dryer in a single layer. Drying was started at about 9 to 10 am. Weight loss of the product during drying period was also measured with an electronic balance. The sun dried control samples were weighed as well. All these data were recorded at one hour interval. Drying of product was stopped at about 4 to 5 pm. Then samples were collected and after cooling kept in a sealed container. To compare the performance of the solar dryer with that of the natural sun drying, control samples of Mushrooms and *Bhoot jolokia* were placed on trays in single layer beside the dryer. Both experimental and control samples were dried simultaneously under the same weather condition.

EXPERIMENTAL FINDINGS AND ANALYSIS

Before loading into the dryer, *Bhoot jolokia* were washed and treated with 2 per cent potassium metabisulfite solution for 1s and 10s and put into dryer. Naturally dried *Bhoot jolokia* loss their bright red colour. The potassium metabisulfite treated and solar dried *Bhoot jolokia* preserve their colour to the largest extent.

Perusal of data presented in Table 1 reflects that drying time for raw mushrooms takes two full sunny days whereas open drying takes four days. In case of open drying colour becomes darker than solar drying. Products becomes crispy in case of solar drying. It has been understood from the results that better quality products can be produced economically. Tests of the solar dryer showed the potentiality of the solar dryer for drying of mushrooms and *Bhoot jolokia*. Numerous tests in the different regions of the tropics and subtropics have shown that fruits, vegetables, cereals, grain, legumes, oil seeds, spices, fish and even meat can be dried properly in the plastic covered solar tunnel dryer (Esper and Muhlbauer, 1993; Esper *et al*., 1994 and Bala and Mondal, 2001). From the present study it was found worth adoption since the products get the market and the quality of the product was reflected in its price. There is a considerable reduction in drying time of mushrooms and *Bhoot jolokia* in solar dryer as compared to sun drying of mushrooms and *Bhoot jolokia*. The solar dried products are protected from dirt, pest and the final products are a quality dried product. Several studies have been reported on drying of mushrooms (Giri and Prasad, 2007 and Kotwaliwale *et al*., 2007). Although many studies have been reported on solar drying of fruits and vegetables (Karim and Hawlader, 2005), limited studies have been reported on solar drying of mushrooms (Mastekbayeva *et al.*, 1999; Bala and Woods, 1994; Bala *et al.*, 2009 and Middili *et al.*, 2001). Respondents of the present study realized that construction of solar dryer is very simple and it can be constructed using locally available materials by the local craft man. Similar investigation related to the present investigation was also carried out by Karim (2005); Sharma *et al.* (1995); Shukla and Singh (2007); Simate (2003); Torringa *et al.* (2001) and Walde *et al*. (2006).

Conclusion:

Solar dryers have some advantages over sun drying when correctly designed. They give faster drying rates by heating the air to 10-30^0 C above ambient, which causes the air to move faster through the dryer, reduces its humidity and deters insects. The faster drying reduces the risk of spoilage, improves quality of the product and gives a longer shelf-life. However, care is needed when drying vegetables to prevent too rapid drying, which will prevent complete drying and would result in case of hardening and subsequent mould growth. Solar dryers also protect vegetables form dust, insects, birds and animals. Dryers can be constructed from locally available

Table 1 : Drying five of row mushroom

Sr. No.	Parameters	Solar drying (Mushroom)	Sun drying (Mushroom)	Solar drying (Bhoot jolokia)	Sun drying (Bhoot jolokia)
1.	Drying time	2 full sunny days	4 full sunny days	2 full sunny days	4 full sunny days
2.	Colour	Fair	darker	Orange	Light brown
3.	Dryness	Crispy	Not crispy	Crispy	Not crispy
4.	Temperature	62^0	32^0	62^0	32^0
5.	% Moisture after drying	8.23 %	15.38 %	7.5 %	13.25 %

materials at a relatively low capital cost and there are no fuel costs. Thus, they can be useful in areas where fuel or electricity are expensive. Solar food drying can be used in most areas but how quickly the food dries is affected by many variables, especially the amount of sunlight and relative humidity. Typical drying times in solar dryers range from 1 to 3 days depending on sun, air movement, humidity and the type of food to be dried.

LITERATURE CITED

Bala, B.K. and Woods, J.L. (1994). Simulation of the indirect natural convection solar drying of rough rice. *Sol Energy* **53** (3) : 259-266.

Bala, B.K. and Mondal, M.R.A (2001). Experimental investigation of solar drying of fish using solar tunnel dryer. *Dry Technol.*, **19** (2): 1-10.

Bala, B. K., Morshed, M. A. and Rahman, M. F. (2009). Solar drying of mushroom using solar tunnel dryer. *Internat. Solar Food Process. Conference*, 1-11.

Esper, A. and Muhlbaure, W. (1993). Development and dissemination of solar tunnel drier. *ISES Sol World Cong, Budapest,* **8** : 22-25.

Esper, A., Hensel, O. and Muhlbauer, W. (1994). PV-Driven solar tunnel dryer. *Agric. Engg. Conference*, Bangkok, Dec. 6-9.

Giri, S.K. and Prasad, S. (2007). Drying kinetics and rehydration characteristics of microwave-vacuum and convective hot-air dried mushrooms. *J. Food Engg.,* **78** : 512–521.

Karim, M.A. (2005). Hawlader, MNA. Mathematical modeling and experimental investigation of tropical fruits drying. *Internat. J. Heat Mass Trans.,* **48** : 4914 - 4925.

Kotwaliwale, N., Bakane, P. and Verma, A.(2007). Changes in textural and optical properties of oyster mushroom during hot air drying. *J. Food Engg.,* **78**: 1207–1211.

Mastekbayeva, G.A., Bhatta, C.P., Leon, M.A. and Kumar, S.(1999). Experimental studies on hybrid dryer. Presented at ISES Sol World Cong, Israel, 4-9 July 1999.

Middili, A., Olgun, H. and Ayhan, T. (2001). Experimental studies on mushroom and pollen drying. *Intetnat. J. Energy Res.,* **23** (13) : 1143–1152.

Sharma, V.K., Colalgelo, A. and Spagna, G. (1995). Experimental investigation of different solar dryers suitable for fruits and vegetables drying. *Renew Energy,* **6**(4): 413-424.

Shukla, B.D. and Singh, S.P. (2007). Osmo-convective drying of cauliflower, mushroom and green pea. *J. Food Engg.,* **80** : 741–747.

Simate, I. N. (2003). Optimization of mixed mode and indirect mode natural convection solar dryers. *Renew Energy,* **28** : 435-453.

Torringa, E., Esveld, E., Scheewe, I., Van den Berg and Bartels, P. (2001). Osmotic dehydration as a pretreatment before combined microwave-hot air drying of mushrooms. *J. Food Engg.,* **49**: 185–191.

Walde, S.G., Velu, V., Jyothirmayi, T. and Math, R.G. (2006). Effects of pretreatments and drying methods on dehydration of mushroom. *J. Food Engg.,* **74** : 108–115.