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COMPARATIVE STUDY OF SOLAR TUNNEL AND OPEN SUN DRYING FOR MORINGA OLEIFERA LEAVES

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Abstract: Solar tunnel dryer of 10 m x 3 m x 2m size fabricated at workshop of CAET Dediapada and evaluated at college campus without providing north wall effect. A maximum temperature of 46.5°C was recorded at 1 pm inside the solar tunnel dryer and at the same time 32.2 ^{0}C temperatures was observed during open sun drying process. On an average, a total drying time 4 hours were required for solar tunnel dryer to reduce the moisture content of sargva leaves from initial value of 71.6 per cent (w.b.) to a final moisture content of 7.9 per cent (w.b.) while the open sun drying required on an average 7 hours to obtain same level of moisture content which resulted in a net saving in drying time of 38 per cent for solar tunnel dryer over open sun drying.

Keywords: sargva leaves, drying, moisture content, solar tunnel dryer.

Introduction

Leafy vegetables occupy an important position in the Indian diet. India produce about 12% of the total world's production of vegetables but it is not enough to meet this country's requirements [1]. Drumstick leaves (Moringaoleifera) is one of the most useful tropical trees. Presently, one of the most important trends in food and pharmaceutical industries is the growing demand for valuable natural sources of nutritional compounds. Green leafy vegetables are good sources of vitamins and minerals [2]. They are an exceptionally good source of provitamin A, vitamins B, and C, minerals (in particularly iron), and the sulphur-containing amino acids methionine and cystine.

Drying is the reduction of moisture from the products and is the most important process for preserving agricultural products. Sun drying is a traditional method for drying vegetables, fruits and leaves. In this method vegetable, fruits and leaves are spread in a thin layer on the ground and exposed directly to solar radiation. It is the cheapest method but it has many drawbacks such as drying at uncontrolled temperature, uneven drying, and it takes more time. Moreover it is contaminated by dust, insect and rodents therefore dried vegetables become polluted. In comparison to natural sun drying, solar tunnel dryers generate higher

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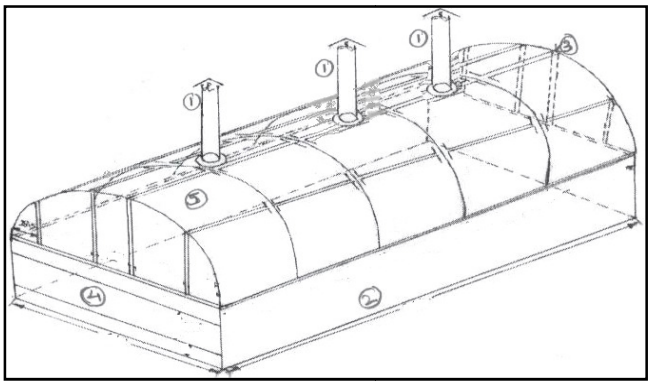
temperature, lower relative humidity, lower product moisture content and reduced spoilage during the drying process [3]. In addition, it takes less time and is relatively inexpensive. Hence solar tunnel drying is better alternative than the natural drying. In the present study a simple low cost solar tunnel dryer has been fabricated. The advantages of this dryer are- it is easy to operate, it requires no training and it is low cost since it is made by locally available materials. It is easy to build and requires semiskilled persons and limited facilities to fabricate.

Materials and methods

The semi-cylindrical tunnel shape was formed by using 6 numbers of MS pipes having 5 m length (Fig. 1). While making semicircular frame by bending these pipes, 3 m diameter cylindrical tunnel was formed. The floor was prepared with cement concrete. The tunnel was covered with UV stabilized polythene sheet of 200 micron size. In one side of the tunnel, a suitable frame and door assembly was fixed. Three chimneys were provided on the roof of the tunnel to remove the moist hot air. After installation, the performance of solar tunnel dryer was evaluated during November 2016 for sargava leaves drying and compared with open sun drying.

Experimental study were carried out under metrological conditions of Dediapada taluka is situated in the Narmada District in south Gujarat (latitude 21^0 66'N, longitude 73^o59'E with an elevation of 169m above mean sea level) [4]. On the basis of measurements, sunshine duration at this location was measured to be about 11 hour per day. However, potential sunshine duration only 8 hour per day (9:00am to 5:00pm) based on higher solar intensity



1- Chimney
2- Drying Chamber
3- Tunnel Frame
4- Dryer opening door
5- Dryer Tunnel with Polythene cover

Figure 1: Solar tunnel dryer for green leaves drying

Table 1: Technical specification of solar tunnel dryer

Sr.	Part	Specifications (m)	Material
1.	Drying chamber	10 x 3 x 2	M. S. angle
2.	Tunnel (Semi circular)	Dia. -3, Ht. - 2	M.S. angle
5.	Drying tray	4 x 1 x 0.25	M.S. angle
6.	Cover of tunnel	4 x 12	UVprotected
7.	Opening Door	1.2 x 1.7	G.I. sheet
8.	Chimney	Ht.–0.43,Dia.–0.15	PVC pipe

The temperature was recorded using a hygrometer with an accuracy of ± 3%. The initial weight and physiological loss in weight at different intervals of time were determined using electronic balance. At every one hour of interval, the reduction in weight due to drying process was recorded, wind speed measured by digital anemometer and solar radiation measured by digital solarimetre.

Moisture Content:

The percentage moisture content was determined by using following formula, (A.O.A.C. 1980)

$$\text{M.C.(w.b.)}\% = \frac{(W_1 - W_2)}{W_1} \times 100$$

Where, W_1= weight of sample before drying, gram

W_2= weight of bone dried sample, gram

Results and discussion

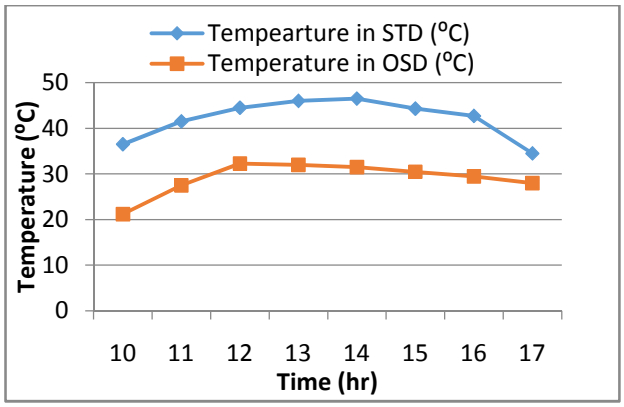


Figure 2. Temperature variations of inside and outside dryer

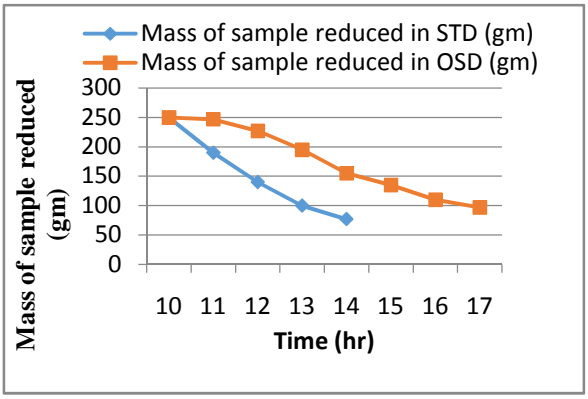


Figure 3. Mass of sample reduced inside and outside dryer

From the Fig:2 it observed that solar tunnel dryer attain a maximum temperature 46.5^{0}C at 1pm and minimum temperature 34.5^0 C at 5pm, Open sun draying observed that maximum temperature 32.3^{0}C at 1 pm and minimum temperature 21.2^{0}C at 10 am. It clear from fig that solar tunnel dryer attain 10^{0}C more temperature than open sun drying. Temperature increases from morning and attained maximum at noon and then declined. This happened because at morning insolation is lower and at noon it is maximum.

The curves in Fig.3 shows the variation in mass of the samples with time. The initial mass of the sargava leaves (at the time when they were subjected to drying process) was 250 gm and was found to reduce to 77gm in STD in the time span of 300 minutes; whereas the in OSD loss of mass up to 97gm was observed in 480 minutes. The reduction of higher moisture takes place during the initial stages of drying in both OSD & STD was observed due to evaporation of free moisture from the outer surface layers and then gets reduced to internal moisture migration from the inner layers to the surface [5]. The solar tunnel dryer showed a quicker moisture removal than that in open sun.

Conclusion

The observation in the present study implies that the temperature of solar tunnel dryer was higher approximately10 ^{0}C higher than that of open sun drying. The performance of solar drying system was highly dependent on solar radiation and ambient temperature. Solar tunnel dryer took 5 hours for drying of sargava leave and open sun drying took 7 hours for the same mass.

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