AN APPLICATION OF SOLAR DRYER IN ORDER TO REMOVE MOISTURE AND DIFFERENCIATING WITH SAMPLE DRIED IN OPEN AIR

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ABSTRACT

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 solar dryer is one of them which help to preserve our food and many eatable things like vegetable fruits and many more things . In this experiment we find that how much moisture removed from the sample which is present in solar dryer and the sample which is present in ordinary air and we compare both of them by mathematical calculation. In this paper we took green chili, some of the chili we put inside the dryer and some in the ordinary air and then compare their moisture removed with respect to time and temperature. We find that temperature inside the dryer is two times outside the temperature. As per our experiment the maximum peak temperature inside the drying chamber is 75°C during mid-day(3pm) and in an average approximately 60°C-62°C in a full sunny day(10:00AM to 03:00PM). In 6 hours continuous drying in one full sunny day under the same climatic condition and in same time the solar dryer removed a maximum of 30- 40% moisture content from drying chamber for drying of low moisture content food products.

Keywords: Solar dryer, drying chamber.

I. INTRODUCTION

The concept of drying food in order to preserve them is a very ancient technique which the human beings had been using for a long time .Drying in the ancient times was under direct sunlight and the drying technique which is developed in today's modern world is solar drying .This modern technique is far more efficient than the ancient one as it is covered up and hence it protects the food stuffs from dust particles and insects. Preservation of fruit and vegetables are essential now a day, and it has become a part of our life. From ancient times fruits, vegetables and other eatables were kept to dry in the sun in order to preserve them .This is one method by which we can preserve our food items, the other method of food preservation is solar dryer .In this method we preserve the food items by taking out the moisture content from them .The more we heat the air, its moisture absorbing capacity increases. This is the main principle behind the working of solar dryer. This is an economic way of preserving food and that too

using solar energy .No other source of conventional energy is used in this process. In today's world ,where there is rapid demand for conventional fuels and the fact that it will not be available to us in the near future ,in that case the need and development of non conventional sources of energy is good for the future generations .The solar dryer can be of great use in the developing countries such as military feeding and space food formulations etc. One of the main advantages of solar dryer over open sun drying is that it prevents the fruits and vegetables and other eatables away from insects and flies and also from dust particles. In this paper we will do some important calculations based on the observation regarding solar dryer which are as follows:

1. The comparison between different samples before and after being kept in the solar dryer with photographical illustration.
2. Graphs showing the relation between the observations.

Some of the previous work which were done by different scientists on solar dryer are as follows **Dattatreya M. Kadam and D.V.K. Samuel** (2005) develop forced convective system for cauliflower drying. **Ghatrehsamani S.H. et. al**. (2012) develops indirect type forced circulation solar dryer for apricot drying and compare results of indirect solar drying with the mixed mode solar drying. **B. K. Bala and Nipa Debnath** presented comprehensive review of solar dryer developments and potentials for drying of fruits,vegetables, spices, medicinal plants, and fish(2012). **D. R. Pangavhave and R. L. Sawhney** presented the review article of different solar drying technologies with detailed development and performance for grape drying (2002). **O.V. Ekechukwua and B. Norton** discussed the review of solar drying technologies for application of each design type for rural farmers in developing countries (1997). **S. VijayaVenkataRaman** presented comprehensive review of various solar drying technologies with design, development and performance evaluation also discussed the drying in off sunshine hours by using different desiccant materials (2012). **V. Belessiotis and E. Delyannis** presented comprehensive study of different solar drying technologies with fundamental principles and parameters (2010). **Bolin** (1980) discussed the relative merits of five experimental methods for the solar dehydration of fruits, namely: black wooden tray, solar troughs of various materials designed to reflect radiant energy onto bottom of black metal drying trays, cabinet dryers with slanted plate heat collectors with natural convection, utilizing inflated polyethylene (PE) tubes as solar collectors with and without partial air recirculation; and PE semicylinder with a fan blower to be used in inflated hemispheres or as a solar collector, to blow air over the fruit in a cabinet dryer. They reported that utilizing inflated PE tubes method was cheap, 38% faster than sun drying for apricots and could be used as supplementary heat source for conventional dryer. **A.R Celma and F. Cuadros** presented energy and exergy analyses of the drying process of olive mill wastewater (OMW) using an indiret convection solar dryer. **J.K. Afriyie** (2009) tested chimney dependent direct-mode solar crop dryer for different angles.

II. WORKING PRINCIPLES OF SOLAR DRYER

The main principle of this low cost solar cabinet dryer is based on greenhouse effect where the solar heat is trapped inside the drying chamber and thus increases the temperature level. It is a mixed-mode solar cabinet dryer. Here both direct and the indirect solar energy collected in the chamber heats up the food products. The direct solar energy

collected in the chamber converted in to heat energy heats up the food product and thus removes moisture from the food product.

III. EXPERIMENTAL SETUP

Materials required for making the solar dryer:

The materials which are used to make the solar dryer are used in our everyday life .And they are found easily near our locality.

Plywood, Hammer, Nail and glue, wired mesh, Glass, Thermometer, Black paint.

With the help of these things we constructed the solar dryer. The picture is given below:

(A)

(B)

(C)

Figue:(1): (A),(B) underconstruction and (C) fully constructed solar dryer

IV. OBJECT OF THE OBSEVATION

Details of moisture removed during drying (in the month off fab-march) both in outside and the inside chamber are as shown below. Room temperature during drying period was 31^0c. and the comparing the percentage of moisture removed from the solar dryer and the ordinary air(fruit present in the atmosphere) the following table is experimental based data.

TABLE 1 Temperature, weight and %moisture removed in different condition

SI. No	Time	Upper Tray			Lower Tray			Outside Chamber	
		Temperature ^{o}c	Weight (gm)	Moisture Removed	Temperature ^{o}c	Weight (gm)	Moisture Removed	Weight (gm)	Moisture Removed
1.	10:00(AM)	31	250	0.00%	31	250	0.00%	250	0.00%
2.	11:00(AM)	58	225.00	10.00	56	228	8.8	247	1.20
3.	12:00(AM)	63	202.01	19.20	63	206.45	17.42	236.03	5.58
4.	01:00(PM)	66	177.02	29.20	65	184.66	26.13	226.54	9.38
5.	02:00(PM)	71	125.00	50.00	68	128.20	48.72	199.04	20.38

6.	03:00(PM)	75	90.03	64.00	73.97	93.44	62.66	150.00	40.00

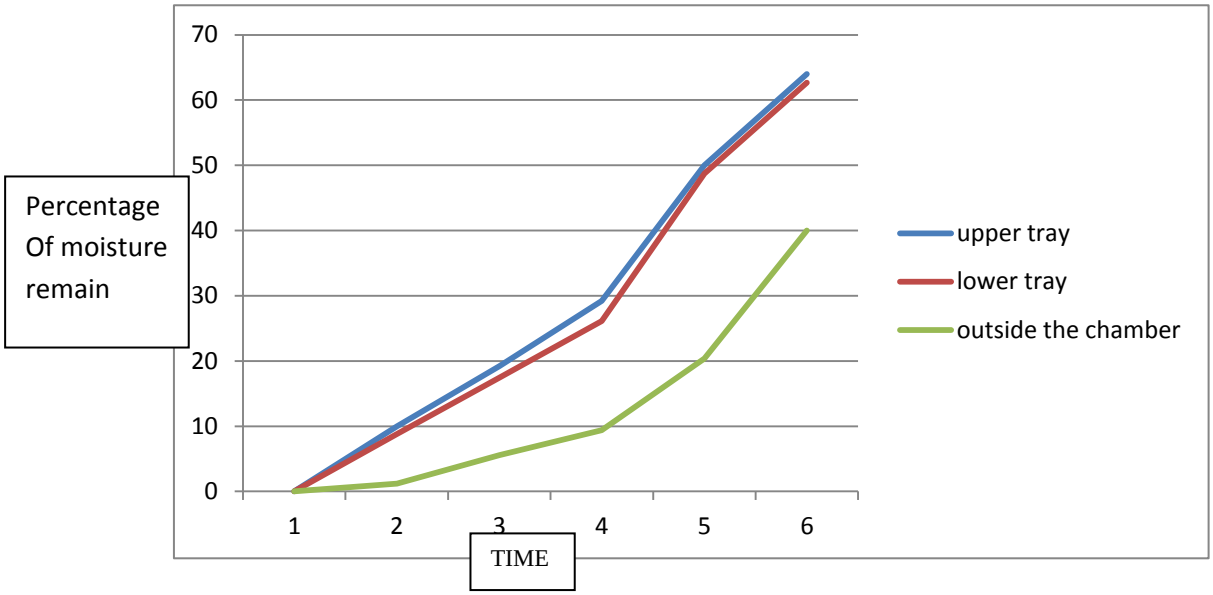
(A)

(B)

(C)

Figure: 2 (A) Chili before drying (B) Inside drying chamber (C) Outside drying chamber

4.1 Graphical Representation of Drying Rate: The following graph represents total moisture % removed per every hour inside and the outside of the chamber. The lower most and the middle graphical line represent moisture content removed in % at inside the chamber. Lower most graphical lines represent the MC removed in % outside the drying chamber. The following represents the MC removed in % with respect to time and the temperature at that point. Since the solar drying does not give constant temperature because of climatic condition; so the moisture % removed varies un-uniformly with time and the varied temperature.



Graphical Representation (Moisture remove vs time)

V. RESULT AND DISCUSSION

After study we have found that the solar cabinet dryer gives more than three-four times heat inside the chamber than that of the outside atmospheric temperature. In 6 hours continuous drying under the same climatic condition and same time it removed 28.73 % (upper tray) and 27.28 % (lower tray) moisture content from inside chamber chili whereas at outside only 12.75% moisture.

VI. CONCLUSION

With the help of this project we find how much solar dryer is more efficient in our Morden generation. The function of solar dryer is more effectively and efficiently with minimal maintenance cost, hence it is easy to access and is affordable by local farmers because of its low cost. There had been a lot of impediments while performing this project. This project can be proved thriving if it is being brought in used for many purposes.

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