Testing of a Solar Dryer Using Nsukka Beans

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Abstract— *Many farmers around the globe face the problem of preservation of food and other farm produce. A lot of resources are spent by farmers in crop cultivation but at the end, some of these farm produce are being wasted due to lack of food preservation system. The work centred on Nsukka food preservation using solar dryer developed at Nsukka in Nsukka Local Government Area, Enugu State, Nigeria. The experiment showed that the weight of 10Kg beans used was reduced to 6kg after drying. The dryer has efficiency of 40%. The maximum temperature observed inside the dryer during the experiment was 40°C.*

Keywords— Preservation, Drying, Food Storage, Efficiency, Temperature.

I. INTRODUCTION

Drying is a simple process of moisture removal from a product in order to reach the desired moisture content and is energy intensive operation [1].Several process technologies have been employed on an industrial scale to preserve food products; the major ones are canning, freezing, and dehydration [2].

When drying foods, the key is to remove moisture as quickly as possible at a temperature that does not seriously affect the flavor, texture and color of the food [3]. If the temperature is too low in the beginning, microorganisms may grow before the food is adequately dried. If the temperature is too high and the humidity is too low, the food may harden on the surface [4]. This makes it more difficult for moisture to escape and the food does not dry properly. Although drying is a relatively simple method of food preservation, the procedure is not exact [5]. For the preservation of these agricultural products, the convective hot air drying using fossil fuels/grid-electricity is the most common technique employed in commercial dryers around the globe[6]. However, due to unreliable or too expensive for the farmer to utilize them, more emphasis is being paid to solar energy as an alternative source for such applications [7]. In addition, it has tremendous potential especially in several regions of the world, where this source is abundantly available. In past four decades, various types of solar dryers have been designed, developed and tested with the aim of achieving faster drying of food product at a minimum cost. Ekechukwu and Norton [8] presented a comprehensive review on design,construction and operation of different types of solar dryers. However, all these dryers can be broadly grouped into three major types as direct, indirect and mixed mode, depending on arrangement of system components and mode of solar heat utilization [9]. The operation of these dryers is primarily based on the principle of natural or forced air circulation mode. In many rural regions of developing countries, the farmers have been preferably adopting natural convection over forced mode operated dryer, since it is inexpensive to construct and easy to operate without the need of grid connected electricity and supplies of other non-renewable sources of energy. In addition, natural convection cabinet dryer of direct type has been popular among farmers especially in India because of its ability for drying 10–15 kg fruits and vegetables at household level [10, 11]. Selection of solar dryer for a particular food product is primarily governed by quality requirements and economic factors. The common practice in predicting performance of solar energy system is to solve a set of several inter-related steady state heat balance equations representing various components.

II. MATERIALS AND METHOD

Collection of Material

The beans used were harvested from Crop Science Department University of Nigeria, Nsukka on the month of August 2015. The beans were picked to remove chaff that might hinder drying.

Experimental Method.

The beans were weighed and the weight recorded .the beans were then poured into the drying chamber of the solar dryer. The solar dryer were exposed to solar radiation where the painted inside black surface absorbed solar radiation. One of the thermometer used were mounted inside the solar dryer to record the inside temperature while the other temperature was mounted outside to record the atmospheric temperature during the experiment.

III. RESULTS AND DISCUSSION

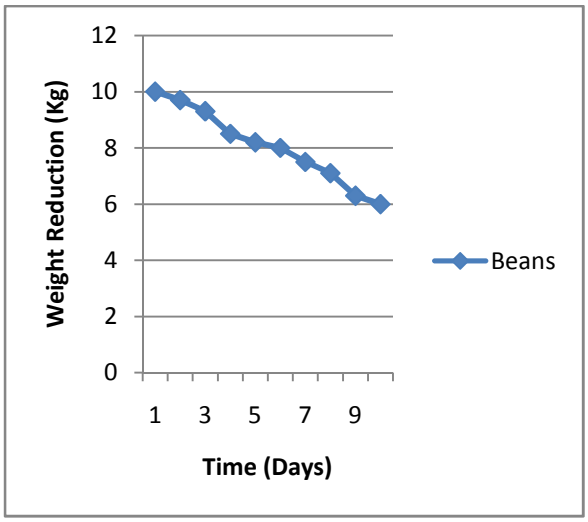

Fig. 1: A graph of weight reduction (Kg) Versus Time (Days).

The experiment shows the solar drying of beans performed at University of Nigeria, Nsukka in Crops Science Department. The 10kg weight beans were exposed to radiation to check the lost in weight after the experiment. It was observed that the weight reduced gradually decreased from 10Kg on day 1 to 6.0 Kg on day 10.this value indicated that solar radiation is very efficient in drying beans and other grains because the nutrient value of the beans was not altered after drying. It was also observed that solar intensity increases the drying rate of beans.

REFERENCES

[1] Ugwuoke E.C and Eze N.N et al (2015), Performance Evaluation of Solar Still, International Journal of Scientific and Technology Resaerch, Nigeria PP 1.

[2] Visavele G.L, Hii C.L, Jangam S.V et al, (2012). Solar Dryer Fundemental,Applications and Innovations ,pp1.

[3] Shukla SK, Sorayan VPS, Gupta SK (2004) Parametric studies of passive/active solar stills by using modified convective mass transfer relations. Int J Ambient Energy 25(3):212–232

[4] [Shukla S.K (2014) Application of Solar Distillation Systems with Phase change Material Storage, Springer-Verlag Berlin Heidelberg,India pp 1.

[5] Shukla SK (2003) Computer modeling of passive solar still by evaluating absorptivity of the basin liner. Int J Ambient Energy 243:123–132

[6] Malik MAS, Tiwari GN, Kumar A, Sodha MS (eds) (1982) Solar distillation a practical study of a wide rang of stills and their optimum design, construction and performance. PergamonPress, New York

[7] Fath H (1998) Solar distillation: a promising alternative for water provision with free energy, a simple technology and a clean environment. Desalination 116:45–56.

[8] Dunkle RV (1961) Solar water distillation: the roof of type still and multiple effect diffusion still, international developments in heat transfer. In: A.S.M.E, Proceeding of International Heat Transfer, part V, University of Colorado, p 895.

[9] Cooper PI (1973) Digital simulation of experimental solar still data. Sol Energy 14:451