Experimental Investigation of Drying Potato for Karaikal Climatic Condition

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Abstract. Vegetables play an important and irreplaceable role in the human beings daily life and other living animals on the planet. Henceforth, wastage of vegetables should be kept away by developing techniques for conservation and preservation of vegetables to an extended period. In this article, a double slope solar dryer was designed and fabricated at the terrace of the science block, NIT Puducherry, Karaikal. The decrease in the wetness content of specimens in the double slope solar dryer was empirically inspected for Karaikal climatic conditions. The effect of double slope natural convective based solar dryer in drying of potato compared with open sun drying operation adjacent each other in similar condition. Experiments were carried out to determine the dryer surface temperatures, air temperature, and the percentages of the wet basis wetness content from 11.00 am to 6.00 pm for two days. In the investigation, it was clear that designed and fabricated double slope natural convective solar powered dryer removed the high wetness content about 52.29% and in open drying technique it removed wetness content of 42.99% from the potato slices on first day. On second day similar weighted samples were investigated wetness removed by solar dryer is 51% and 43.92% in open drying. So developed solar dryer removed high amount wetness content and quality of dried potato slices was high when compared to open sun dehydrating. Accordingly, the developed double slope natural convective based solar dryer can be effectively utilized to dry the vegetable samples.

Keywords: Experimental Studies, Double Slope Solar Dryer, Natural Convection, Open Sun Drying, Moisture Content.

1. Introduction
India secure fourth positions in area and generation of potato on the universe, In India out of the total potato delivered 17 percent is wasted, 0.03 percent is sent to other countries, 0.03 percent is prepared and 21.0 percent is utilized as seed. Out of the rest 61.94 percent is utilized for utilization as vegetable/other family activities [1]. Potato processing is a significant part of post-harvest the board and is a fast developing division on the world economy. In India, handling of potatoes constitutes less than 1.0 percent of total yearly generation and there is great scope for potato processing. Potato chip is the most widely recognized prepared potato item in India. Potato chip making includes washing, stripping, blanching, cutting and drying. Among these, drying is one of the unit activities consuming high amount of energy. The consequence of the techno-economic inspection of various drying choices demonstrates that sun powered drying is the least expensive [2].

Potato samples are generally dehydrated in simultaneous rotary dryers of 100 to 300 cm dia and 50 to 1500 cm length. The entry and exit air warmth are around 50 - 100° C. The crisp potato samples are set up by the slices like one utilized in sugar industry. The samples are dehydrated to a last wetness of twelve percent (w.b). An important segment of the dehydrated potato sample is used as livestock feed since it is the most economical technique for protecting sample [3]. Potato slices are
dried utilizing drum dryers. Before dehydrating, the samples experience cleaning, stripping, cutting, precooking, cooling, and mashing [4]. Mashed samples are then blended with a few added substances, to increase the texture and extend the shelf life of the samples; they additionally impact dehydrating procedure. Choy et al. [5] noticed that the general hue different in sample potato were least when exposed to a higher shifting dehydrated warmth. Other drying conditions were RH is 18.9%, 0.0087 kg/kg dehydrated air of absolute humidity, and air speed 2.4 m/s. Their rate decreases in general hue different for potato were 87 percent. Investigation recommended that period-different warmth dehydrating in a heat pump dryer operation has potential for dehydrating samples. Krokida et al. [6] examined the impact of microwave dehydrating on few quality characteristics of dried sample. The investigation demonstrated that microwave & microwave- vacuum dehydrating of sample resulted in decreased hue different contrasted with air-dehydrating. The hue difference of sample during dehydrating can be limited by different methods of pre-treatment. Sulfite treatment, whitening, osmotic and microwave pre-treatment have appeared to decrease the hue difference essentially during convective dehydrating of sample [7]. McMinn and Magee [8] observed the air tunnel dehydrating (warmth 30 - 60°C, speed 1.5 m/s) of potato slices. The consequences of their examination showed that internal porosity of sample cylinders shape sample previously reduce with dehydrating period then it hiked to ten percent at the final dehydrating. The area of shrinkage displayed a linear correlation with respect wetness. The rate of shrinkage amid low- warmth dehydrating were more prominent than at high warmth and coefficient of rehydration higher about four percent with rising dehydrating warmth to 30 - 60°C.

Villareal and Griggs [9] recommended partial dehydrating of sweet potato cuts by dipped in circulate again concentrated sugar arrangement of 60 to 65 percent for a few hours before they are sun powered dried. Combo of microwave and warm air drying inspection has appeared to better the structure and bulk volume of dehydrated mushroom samples. Nonetheless, the geometry and dielectric characters of samples are such that potential for too heat of the middle hamper the utilization of these innovation [10]. Microwave— vacuum dehydrating of mushroom has been investigated by Pappas et al. [11]. The exploratory outcomes showed that microwave— vacuum dehydrating displays prevalent dehydrating execution just as better rehydration qualities. Shobhana et al [12] examined the evolution of generalized dehydrating characteristic curve. The outcomes demonstrates the approach suggested encourages to create single generalized characteristic curve represent sixteen dehydrating kinetics and dimensionless parameter called DPI characterizing the efficacy of potato's dryer setup.

Drying operation utilizing sun power carried out by conventional sun drying and different development sun power dryers. Normal open sun dehydrating is the economical techniques of sunlight power used that generally practiced in the countryside of the developing nations like India, where it is ordinarily utilized as a conventional food conservation method. A few foods items like vegetables samples [13], fish [14], Fruits samples [15], papads [16], pineapple slices and kachris can be solar dehydrated to preserve them for extended time. These items are delicious and need least cooking period. Also sun dehydrated Variety of cherries, carrots and cranberries can be utilized as an expansion cookies, leaves, breads, etc. Nonetheless, open dehydrating is a moderately slow procedure and in this procedure, extensive item losses takes place because of lacking dehydrating, insects, birds and rodents bringing about decrease of item quality. Subsequently, appropriately designed sun power dryers ought to be utilized for drying farming items in developing nations. A few researchers have created plan standards for different classes of sun powered drying arrangements like mixed-mode [17], greenhouse [18], direct [19] and indirect [20]. Among the different dryer development, the mixed mode dryers are noticed that best regarding item drying rate and drying cost [21], [22]. These mixed mode sun power dryers can better the quality of item, while decreasing the utilization of conventional fills.
Aghbashlo et al. [23] reported Page model to be the perfect fitted thin layer dehydrating behaviour of potato samples dehydrated in a semi-mechanical continuous band drier working three different air temperatures with three different air speeds and three different chain linear speeds. Demiray and Tulek [24] contemplated the impact of air three different temperatures on hue difference kinetics of carrot samples was inspected. Pareek and Kaushik [25] investigated the effect of drying techniques (solar dryer, Oven, Fluidized bed and Microwave) on the nature of Indian gooseberry powder amid storage. Surveyed characteristics include: Ascorbic acid, tannins, Total sugars, titrable acridity and reducing sugars. Chaouicha et al. [26] endeavoured to track the effect of different controlling variables of hybrid sun powered drying on the colour contrast as a quality parameter of dehydrated potato samples. It is apparent that, lot of research work is being conveyed out in the zone of sun powered dryer on natural and forced convective techniques for dehydrating vegetables. It is additionally apparent that, no literature review data is found for drying potato by double slope solar dryer. Subsequently, in the present work exploratory examination was carried out on the double slope sun powered dryer to dry the potato and compare the sun powered dryer results with open sun drying.

2. Experimental set-up
The fabricated exploratory arrangement operates on both natural convective double slope solar dryer and plate for open sun dehydrating. The dryer arrangement developed by GI sheet secured with plywood of 2.5 cm thickness all around (base, two sides and two front sides) the drying load. The GI sheet is secured on both inside and outside of the plywood. The top surface is shut with two plane glasses of 0.4 cm thickness with inclination of 10.9°, which is equivalent to the latitude of the area Karaikal. Two aluminium works of 241 cm×74 cm are fabricated. One is fit inside the drying chamber for setting the vegetables items to be dried and another is fit outside the drying chamber for putting the vegetables items to be dried under open drying technique. The sun power dryer work is placed in the chamber to put the items to be dried. An arrangement is made so the work can be moved while stacking or emptying the items. Two hollow pipes are given on both right and left edges to let the atmospheric air into the sun power dryer and a vent gap at a higher height is also provided to let the hot air to go out. The whole setup is placed on four vertical mild steel L-edge plates of 2.5 cm. A same foldable L-point plate is given outwardly of the chamber for keeping an aluminium work for open sun drying. Both the components of the work are same. The photo of the double slope dryer is shows in Fig. 1.

![Figure 1. Photograph of Double Slope Solar Dryer and open drying method for drying Potato](image-url)
3. Results and Discussion

The investigation was done to explore the decrease of the wetness content of the potato in a fabricated sun powered dryer. The investigation was conducted by two days from 11.00 am to 6.00 pm. On first day two equivalent weighted (1312 grams) slices of potato are taken; one lot of slices is put in the sun powered dryer and the second set of slices are placed in open sun drying process. The pyranometer readings and eight thermocouples readings including surrounding temperature are estimated in regular intervals. On day one the variation of the global radiation and mean air temperatures and surfaces temperatures of the sun powered dryer are appeared in Fig.3.

![Figure 2. Photograph of Pyranometer and Data Acquisition Unit](image)

![Figure 3. Variation of the global solar radiation, ambient temperature, average air temperatures and surface plate temperatures of the solar dryer on first day.](image)
From the Fig. 3, it is noticed that, the highest global radiation recorded was 1013.11 W/m² and the highest temperature got was 71.7 °C. The slices dried in open sun drying process lost 565 grams in the range of eight hours while the slices dried in sun powered dryer lost 686 grams. It is noticed that fabricated solar dryer eliminated the high wetness content of 52.29% from the potato slices, whereas, 42.99% the wetness content only eliminated by open sun drying technique.

On second day fresh two equivalent weighted (650 grams) slices of potato are taken; one lot of slices is put in the sun powered dryer and the second set of slices are placed in open sun drying process. On second day the variation of the global radiation and mean air temperatures and surfaces temperatures of the sun powered dryer are appeared in Fig. 4. The pyranometer readings and eight thermocouples readings including surrounding temperature are estimated in regular intervals. It’s observed that highest temperature got was 76.4 °C. The slices dried in open sun drying process lost 260 grams in the range of eight hours while the slices dried in sun powered dryer lost 349 grams. It is noticed that fabricated solar dryer eliminated the high wetness content of 54% from the potato slices, whereas, 40% the wetness content only eliminated by open sun dehydrating technique.

The rate of dehydrating in sun powered dryer is more compare with the open sun dehydrating. The slices dehydrated in the sun based dryer took substantially less time when contrasted with the
open sun drying technique to accomplish similar wetness content. In this manner, the fabricated sun powered dryer setup can be adequately utilized to dry the vegetable items.

4. Conclusion
A double slope solar dryer appropriate has been developed and inspected have been directed to assess the rate decrease of wetness fraction for potato. For double slope sun powered dryer with natural convection, sun based dryer was 10.32% more effective when contrasted with open sun drying in case of potato on first day. During second day solar dryer was 14.21% more effective when compared with open drying. The items dried in the solar dryer took considerably less period when compared with the open sun dehydrating technique. Samples from the solar dryer were observed to better quality. It is reported that the drying time depends mainly on mass flow rate of dehydrating air, global solar radiation and air temperature. Drying rate in the natural convection sun powered dryer is higher than that of the open drying techniques.

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