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A REVIEW ON EFFICIENT GRAPE DRYING TECHNIQUES

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ABSTRACT

Many grape producing farmers are preferring production of Raisins instead of selling fresh grapes because of high selling price of raisins. Raisins are nothing but dry grapes made by drying using sun radiation. The appearance of raisins is small and they are with a wrinkled texture. Generally traditional way of grape drying is sun drying in which grapes are dried in sun light at open ground. This techniques have some disadvantages as lengthy and time consuming process, low quality of raisins etc. The researchers in the field of agricultural engineering and energy engineering are working to provide efficient ways of grape drying.

This paper provides review on the advancement in designs of grape dryers and efficient grape and fruit drying techniques.

Keywords: Solar dryers, Vaccum Dryers, Fruit Dryers.

I. INTRODUCTION

In many nations across the globe, the application of solar thermal systems in the agricultural area to conserve vegetables, fruits, coffee & other crops is very common. Drying fruits under the direct sun light does not involve any cost but it has some limitations, first one is that this process takes long time also there are high possibilities of addition of external contamination as dying material is kept in open for long time.

Open drying of products is a common technique used due to its simplicity from last thousands years, but with time small changes in the open drying technique has been incorporated. But the quality of product is sacrificed in open drying process as it gives poorly dried products. If the improves open drying techniques are adopted then food products can be dried fastly and bitterly even in the rainy season where humid and cloudy climate is present.

Drying means a simple process in which water is removed by vaporizing it, which require a heat source. When water gets vaporized a air flow should be there to carry away that. Flow of air is required to remove vapour away from the product. vapour otherwise product will be cooked. Hence increasing temperature of heat source and velocity of air speed of drying process can be increased. The important objective of drying process is to vaporize the water content from the product and carry it away from the product to reach the minimum level of moisture content required for storage.

Natural drying don't require any investment but it will take more time for drying and delivers low quality of final product as it will be exposed to contaminants like dust.

Solar drying provides high space temperatures is capable to deal with high humidity, This method decreases drying time required to reach final moisture content into the product. The higher temperature in this method will deal with the pests, insects and fungi present in the product if any.

II. LITERATURE REVIEW

Some of the recent and most relevant works are summarized below:

Bala et al. [1] conducted experiments on solar drying of a fruit pineapple, in this study he used solar tunnel drier and from this experiment he found out that the product of drying which is pineapple in the solar tunnel drier, is protected from dust, rain, insects and any other contaminants, and the quality of the pineapple dried in the tunnel drier was higher if compared to product dried sun drying mthod. This study also indicates that the pineapple dried in the solar tunnel drier provides good quality for use as human consumption.

S. Lahsasni et al. [2] conducted thin-layer convective drying tests for prickly pear cladode in the temperature range of 50-60^{0}C and three drying air flow rates (100,200, and 300 m%). It is fin that the drying air temperature is a prime factor which affects the drying kinetics. From the results obtained, it is seen that the falling drying rate period exists. The behaviour of moisture removing process obtained from experimental study and equation for the expression of the drying rate is determined. The equation is evaluated with observed values and it is observed that this equation fits to the experimental data. Drying parameters in this equation are quantified as a result of temperature of drying air.

P.N. Sarsavadia et al. [3] studied solar forced air convection dryer for the effect of mass flow rate of air (2.43, 5.25, 8.09 kg/min), temperature of air (55, 65, 75^{0}C), and fraction of air recycled (up to 90%) on the total energy required to dry onion slices. The drier was supplied with a flat plate solar air heater having each the corrugations and triangular fins to the absorbent material plate. For drying of onion slices from initial wet content of concerning eighty six (wet basis) to final wet content of regarding seven-membered (wet basis), the energy needed per unit mass of water removed throughout while not exploitation recirculation of air was found between 23.548 and 62.117 MJ/kg water. The total percent energy contribution by the solar air heater, electrical heater, and blower was found between 24.5% and 44.5%, 40.2% and 66.9%, and 8.6% and 16.3%, respectively. The energy consumption saving due to amount of air recycled were find out at 65 and 75^0 C temperature of air for the all three airflow rates. The highest saving in total energy usage up to 70.7% was achieved by recycling of the exhaust air. The energy required per unit mass of water removed was found between 12.040 and 38.777 MJ/kg water. The percent energy contribution by the solar air heater, auxiliary heater, and blower was found between 22.4% and 40.9%, 33.6% and 62.6%, and 11.2% and 37.2%, respectively.

Rajkumar Perumal et al. [4] studied that good quality shelf stable dried tomato slices could be produced using vacuum assisted solar drying method. The time required to dry tomato slices was comparatively lower in vacuum solar drying when compared to open sun drying. The drying rate and moisture diffusivity of tomato slices were higher in vacuum assisted solar dryer. It is concluded from this study that the drying time and product temperatures were affected by the environmental factors like temperature induced by solar isolation. From the study, it is also concluded that the colour, rehydration ratio and ascorbic acid retention were higher in vacuum assisted solar dried slices than the open sun dried tomato slices.

V. Belessiotis et al. [5] studied various "Solar Drying" applications & some drying phenomena, in this study they analyzed some common rules which are controlling the drying process. In this study some specially designed solar collectors used in drying and methods and different solar dryers are coupled together.

Mohanraj et al. [6] studied that an indirect forced convection solar drier integrated with different sensible heat storage maternal and tested its performance for drying chili under the metrological conditions of site in Pollachi, India. This dryer system has a flat plate solar air heater with insulated storage tank, a drying compartment and a blower. Drying experiments have been performed at an air flow rate of 0.25 kg/s. Chili drying process in a forced convection solar drier reduces the moisture content from around 72.8% (wet basis) to the final water removal content find out was about 9.1% in 24 h. Average drier efficiency observed was 21%. The drying rate seen was 0.87 kg/kWh.

Abdul Jabbar N. Khalifa et al. [7] conducted an experimental study that investigated the performance of a solely solar drying system and a system equipped with an auxiliary heating element as a supplement to the solar heat. The characteristics these systems are compared to sun drying method. The moisture from Beans and peas are removed in a system which has of two flat plate collectors, a blower, and a drying chamber. The experimentation conducted with four different mass flow rates of air (0.0383, 0.05104, 0.0638, 0.07655m^3/s). As a result the drying time was reduced from 56 hours for sun drying process to 12–14 hours for solar drying and to 8-9 hours for mixed drying process.

S. Vijaya Venkata Ramana et al. [8] studied that solar crop drying method which dries crops with more efficiently and at very low cost than natural sun drying method. A solar food drying system does not rely completely on solar energy to perform dying; it provides removal of moisture by combining combustion of fuel and the thermal energy from sun radiation, which reduces the fossil fuel consumption. The different designs of solar dryers, their characteristics and performance analysis are reviewed. The solar dryers specifically designed or tested using some definite crops of foods like the vegetable dryer, pineapple dryer, grape dryer, and so on are also reviewed with details about their working characteristics and their performance in dying process.

III. CONCLUSIONS

In this paper a review is conducted on emerging solar dying technologies and it has been observed that by using vacuum dryers, solar tunnel dyers different products like pineapple, chili grapes are efficiently dried and these technologies will lead to reduction in time for drying and better qualities of food products.

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