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Research Paper :

Design and development of solar paraboloid concentrator for ginger drying

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ABSTRACT

A solar paraboloid concentrator of 5 kg/day drying capacity of fresh ginger slices has been designed and developed at College of Technology and Engineering, Udaipur. In this paper attempt has been made to design and developed a solar paraboloid concentrator to dry the ginger slices. The arrangement has been made to circulate air within drying chamber using the 6.96 Wp DC exhaust fan having capacity of 120-180 m^3/hr operated on 18 Wp SPV panel. The study showed that peeled ginger slices took nine hours to dry at 10% (wb) moisture content. The temperature gradient inside the drying chamber was about 65-70^{0}C.

Key words : Solar paraboloid concentrator, Drying of ginger slices

Ginger is an herbaceous perennial plant, which belongs to the order, Scitamineae and the family, Zingiberaceae. The origin of ginger is India and China. It takes its name from the Sanskrit word stringa-vera, which means "with a body like a horn", as in antlers. It is a tropical herb extensively grown for its pungently aromatic underground stem or rhizome which is an important export crop valued for its powder, paste, oil and oleoresin (NEPC, 1999).

Dried ginger is used both as a spice and medicine. It contains an essential oil, which imparts an aroma, an oleoresin (gingerin) responsible for the pungent smell, starch, gums, proteins, carbohydrate, mineral matter and fiber. Dry ginger is utilized for manufacturing of ginger powder, ginger oil, ginger essence, ginger oleoresins, soft drinks, etc. It is also used as flavoring material in food products (Singh *et al.*, 2008).

Drying is a process to remove water from a substance is one of the most frequently and widely used operating processes in daily life and is undeniably an energy-intensive operation (Buig and Deng, 2008). The conventional practice of ginger drying is open sun drying which is a time consuming method (about 96 h) produces inferior quality product with high loss of volatile oil (Prasad *et al.*, 2006). Although many types of solar dryers have been developed during the last two decades (Bala *et al.*, 2003), their applications are still limited, mainly due to their unreliable performance and high investment cost related to a production capacity. A reduction of losses, an improvement of quality of product and an investment cost are also important criteria dictating the adoption of the solar dryer. A number of solar dryers do not meet these criteria. Therefore, development of a well-performed solar dryer is of significant economic importance. It is recommended that indirect type dryers are better for spices because of retention of color, texture and volatiles would be maximum in indirect drying. The objectives of this work are to design and develop a solar paraboloid concentrator for drying ginger slices and to investigate its performance.

METHODOLOGY

System design:

The view of solar paraboloid concentrator for drying of ginger slices is shown in Plate 1. It is essentially consisted of a paraboloid concentrator with mirror glass of 3 mm thickness as a reflecting material. The drying

Table 1 : Design parameter of drying system

1.	Capacity	5 kg fresh ginger slices
2.	Initial moisture content	83 % (wb)
3.	Final moisture content	10 % (wb)
4.	Loading rate (Lr)	1 kg/m^2
5.	Solar insolation	600-650 W/m^2
6.	Ambient temperature (Ta)	30^{0}C
7.	Drying temperature (Td)	65^{0}C
8.	Ambient relative humidity (RH)	50 %
9.	Drying time (td)	7 hours
10.	Specular reflectance of reflector	0.95
11.	Absorptance of absorber	0.78
12.	Intercept factor	0.75