Infrared fish dryer

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Fish is considered as an important food stuff due to its high protein content and nutritional value. Fresh fish contains up to 80% of water. It is a highly perishable food material and has very short storage life. Drying is the most common preservation technique employed to increase the storage life of fish. It preserves fish by inactivating enzymes and removing the moisture necessary for bacterial and mould growth (Duan *et al.*, 2004). Traditionally fish drying is carried out by open sun drying method which is extremely weather-dependent and has problems such as contamination with dust, soil, sand particles and insect infestation. Therefore new drying techniques and dryers must be designed for hygienic drying of fish. Nowadays, various hot air dryers are being used for drying of food products. However, hot air drying has drawbacks of both long drying time requirement and poor quality (Chou and Chua, 2001).

In recent years, infrared drying has gained popularity as an alternative drying method for foods. Infrared is an electromagnetic wave which can penetrate into the interior of the food, where they are converted into thermal energy and providing a rapid heating mechanism. When infrared is used to heat or to dry foods, the radiation impinges on the exposed material surfaces and penetrates to create internal heating with molecular vibration of the material and the energy of radiation is converted into heat (Ginzburg, 1969). During drying with an infrared heat source, the energy in the form of electromagnetic waves is absorbed directly by the product without any loss to the environment leading to considerable energy savings. Infrared heating offers many advantages over conventional hot air drying. The use of infrared radiation technology for drying has several advantages such as decreased drying time, high energy efficiency, high quality finished products and uniform temperature in the product (Kocabiyik and Tezer, 2009).

ICAR-CIFT has designed and developed an infrared dryer for efficient drying of fish and fishery products. A 5 kg capacity prototype of the red dryer was designed using marine plywood, infrared lamps, heating element and stainless steel trays (Fig. 1). Energy requirement for drying was distributed by eight infrared lamps of 150 W each. Dryer was operated at no load and load conditions. Temperature attained in the dryer under no load condition was 60±0.5 °C within three hours of operation. Drying experiments conducted for fruits and vegetables also showed promising results.

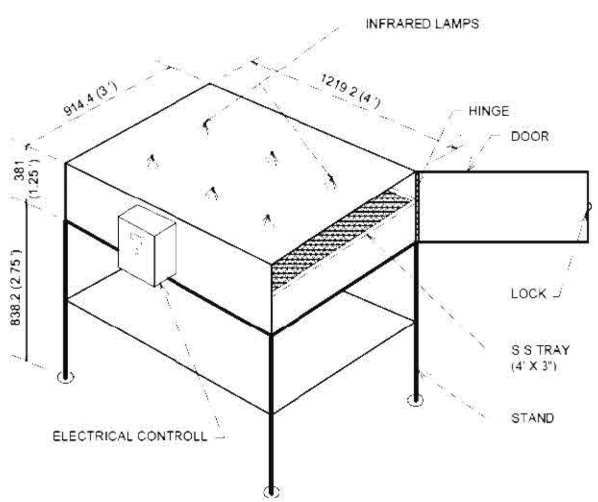

Fig. 1. Infrared dryer prototype

Drying experiments were conducted using different fish species and small shrimps. It was observed that the drying time requirement is less in infrared dryer than conventional electrical dryers. Under no load condition the drying temperature of 63 °C was attained in 0.5 h and the air velocity and relative humidity

Specifications of the infrared dryer prototype

Heat source	:	Electrical
Rating of infrared lamp	:	150 W
No. of lamps	:	6
Dimensions (l x b x h)	:	1.219 x 914 x 0.381m
Tray dimension (l x b)	:	0.9 x 0.60 m
Tray material	:	Stainless steel
Total drying time	:	4-5 h
Loading capacity	:	5 kg
Suitable items for drying	:	Fish and fish products, spices, vegetables, fruits and agro-products

was recorded as 2.5-2.8 m/s and 55-60%, respectively. Performance evaluation of the dryer was conducted using different fish species like, threadfin bream, sardine, shrimps etc. Moisture content of shrimp was reduced from 77 (% wb) to 10 – 12 (% wb) in 5 h of drying at drying temperature of 60 °C, air velocity of 1.5 ms^{-1} and relative humidity of 60%.

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Green synthesis of gold nanoparticles using different reducing agents of aquatic origin

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Nanotechnology exists among the most fastest growing branches in science and engineering because of the unique physical and chemical properties of nano materials, such as novel electronic, optical and magnetic properties, catalytic activity etc. These properties gave applications for nanoscale metals in biotechnology, material science and chemistry. Gold nanoparticles were already used for medical and staining purpose since 16th century Santhoshkumar *et al.*, 2017). The Foods and Drugs Association approved the nano therapeutic approach with nanoparticle-based anticancer drugs (Tiwari *et al.*, 2011). Development of biosensors and biolabels using metal nanoparticles has recently gained extensive importance. Green synthesis of nanoparticles has several advantages over conventional methods involving chemical