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Use of Eco-Friendly Solar Cabinet Dryer for Drying of Agricultural Products- A Boon to Rural Farmers of Manipur

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ABSTRACT

An experiment was carried out on low-cost solar cabinet dryer as a part of the on-farm trial (OFT) for local area suitability and extension of the technology to the rural areas of Manipur. Due to the lack of awareness of appropriate technology for storage and post-harvest management in Manipur, the considerable amount of fruits and vegetables are spoiled after harvest. There is also a lack of sufficient storage and processing facilities in Manipur. These make the losses occur in both ways *i.e.* qualitative and quantitative of the farm produces. In this study, the use of solar energy in the agricultural area to preserve fruits and vegetables were shown to be practical, economical and the environmentally friendly technology. The solar cabinet dryer could save drying duration for different fruits, vegetables, and spices by 2-4d over the traditional open sundry. This technology could be successfully extended in many parts of far-flung areas of Manipur.

Key Words: Dryer, Fruit, Sundry, Solar cabinet, Storage, Vegetable.

INTRODUCTION

In many countries around the world, the use of solar thermal systems in the agricultural area to conserve vegetables, fruits, and other crops has shown to be practical, economical and the responsible approach environmentally. Solar heating systems to dry food and other crops can improve the quality of the product while reducing wasted produce and traditional fuels - thus enhancing the quality of life. However, the availability of useful information lacks in many parts of the countries where solar food processing systems are most needed. The farm sector has an important place in the economy of the state. The performance of agriculture in the state mainly depends on timely rainfall and weather conditions. The settle agriculture is generally practiced in the valley districts while terrace cultivation is practiced in some pockets of the hills where *jhuming* or shifting cultivation is widely adopted in most of the hills.

Manipur is suitable for the development of the horticultural based farming system. Besides, there is ample scope for bringing more land under fruits and vegetable cultivation in the hilly areas as well as in the valley. The average annual productions of fruits and vegetables during the year 2007-08 were 2.74 lakh MT and 0.11 lakh MT respectively. In the absence of proper storage technique, the farmers usually sell their vegetables in the local markets soon after the harvest. Transporting their crop in gunny bags on local transport to markets induced considerable stress on them. Upkeep and storage of fruits and vegetables are most crucial postharvest activity. Due to lack of sufficient storage and processing facilities in most of Manipur, the significant amount of fruits and vegetables are being damaged after harvest. Losses of harvested produced occur in both ways qualitative as well as quantitative. The moisture content in the agricultural products is removed, and then they can be stored

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over an extended period with the minimal attack from the microbial (Kordylas, 1990; Kendall *et al,* 2012). Basumatary *et al* (2013) studied the design, construction, and calibration of a low-cost solar cabinet dryer in Kokrajhar, Assam, India. Emelue *et al* (2015) experimented with solar cabinet for drying food products in Nigeria. Solar drying has many advantages over the traditional system of dryers. Drying is an excellent way to preserve food, and solar food dryers are an appropriate food preservation technology which is an integral part of sustainable agriculture.

The sun drying of food material is one of the oldest agricultural methods related to food storage, but every year, millions of rupees worth of gross product are lost through spoilage. Reasons include ignorance about the preservation of produce, inadequate transportation systems during the harvest season, and the low price the rural farmer receives for their products during the seasons of harvest. Drying of farm produce can change this trend and is used in most of the remote areas, especially those areas with lack of storage and scarcity of power supply, due to this problem; there is difficulty in expanding of the modern storage facility. Unfortunately, many of the rural areas that could be benefited from the solar drying technology lack sufficient information related to how to extend this technology and which technology to use under certain conditions. Many of the latest solar drying technology, as well as significant achievements are not available to reach the farmers level and areas of greatest need. However, Krishi Vigyan Kendra in Manipur has provided a new resource that helps bridge this information void.

MATERIALS AND METHODS

Solar energy is due to the fusion reactions of the sun. The fusion reaction creates very high temperature which produces radiations of shorter wave lengths falls over the solar dryer, the covered glass roof of the solar dryer allows radiations to pass through inside the chamber; these radiations are absorbed inside the chamber of the dryer and are re-radiated with longer wavelength in all directions at the earth's temperature or inside the dryer's temperature. Since longer wavelengths of radiations are not allowed to pass back through the covered glasses, hence thermal energies from the Sun are the trap inside the box. The solar cabinet dryer in its simple form consists of a wooden (or of any other material) box of specific width and length, insulated at its base and preferably at the sides and covered with a transparent roof. The inside, as well as outside surfaces of the box, are coated with black paint and the product to be dried is kept in the trays made of wire mesh bottom. The door is provided on the either of the sides of the dryer for putting and removal of drying trays as and when required. Ventilation holes are made in the bottom through which fresh outside air is sucked automatically. Holes are also provided on the upper back sides of the dryer through which moist warm air escapes. This dryer has given encouraging results and reduced the drying time by one third compared to open sun drying. A simple cabinet solar dryer model having three trays made of locally available materials like wood and roof face covered with glass and painted the wooden body with black paint were tried by different KVKs of Manipur under ICAR Complex for NEH Region, Manipur Centre, Lamphelpat. It is very eco and farmers' friendly technology. It requires low investment for construction, and if the materials are available at farmers' level, it can be furthermore reduced in construction cost. Technology is so simple that local farmers could be trained to make their own low-cost solar dryer and started utilizing it. The on-farm trial (OFT) on solar cabinet dryer conducted by OMEGA SHG under KVK Churachandpur is given in Fig. 1.

RESULTS AND DISCUSSION

Fruits and vegetables were dried using solar cabinet dryer, and at the same time, the same products were compared with drying under open sun. As solar cabinet dryer could absorb infrared radiation from the sunlight, hence it has higher temperature as compared to the open sunlight. The

Fig.1. On farm trial on solar cabinet dryer conducted by OMEGA SHG under KVK Churachandpur district, Manipur

most of the experimental for the drying of fruits and vegetables were conducted during the winter season, and the intensity of the sun was low as compared to the summer season. The average drying hours per day during experiments periods were about 3 hr/ day. The cauliflower could be dried in solar cabinet dryer in 4 d, while in open sundry it took 8 d. It takes 3 d to dry for cabbage in solar cabinet dryer and 7 d in case of open sundry. In case of tomato crop, it takes 3 d to dry in solar cabinet dryer and 6 d in open sundry. The carrot and bitter gourd could be dried in 5 d and 3 d, respectively in solar cabinet dryer and 8d and 5 d, respectively under sundry open condition. The fruit crop gooseberry was dehydrated, and it takes 5 d under solar cabinet dryer and 8 d under open sundry. The spices crops namely turmeric and ginger were also dried, and it takes 4 d for both the crops under solar cabinet dryer and also same 8 d for both crops under open sundry. The details of drying during for different crops are given in Table 1.

The solar cabinet dryer could dry the crops faster than the open sundry. During the experiment, it was observed that cauliflower, cabbage, turmeric and ginger drying duration could be reduced by 4 d while drying in solar cabinet dryer as compared to open sundry. The tomato, carrot and gooseberry crops could reduce their drying duration by 3 d and in case of tomato crop 2 d drying duration could be reduced under solar cabinet dryer as compared to open sundry (Fig. 2).

Table 1. Drying duration for different vegetable, fruit and spices crop under solar cabinet dryer and open sundry conditions.

Sr. No.	Vegetable/Fruit	Drying under Solar Cabinet Dryer (days)	Drying under Open Sundry (days)
1.	Bitter gourd	3	5
2.	Cabbage	3	7
3.	Carrot	5	8
4.	Cauliflower	4	8
5.	Ginger	4	8
6.	Gooseberry	5	8
7.	Tomato	3	6
8.	Turmeric	4	8

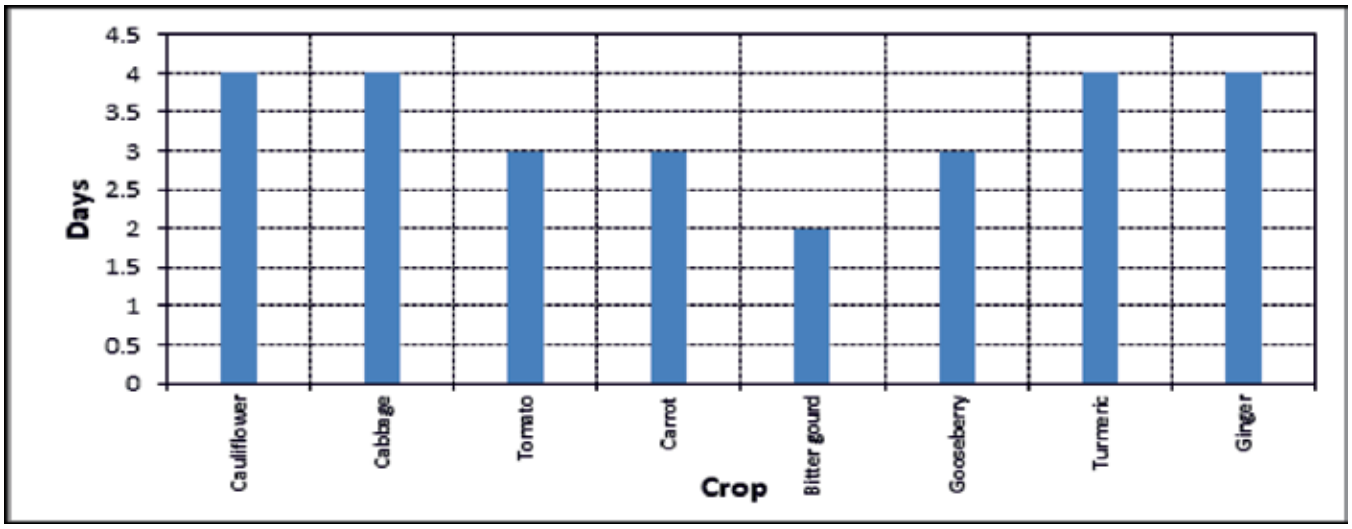

Fig.2. Duration saved in days for drying of different crops under solar cabinet dryer over the traditional open sundry.

The details of different dehydrated crops after drying either under solar cabinet dryer or sundry open conditions are given in Table 2. The unit crop taken for experimental for drying was 1 kg each for all the crops. The crops were dried at the optimum moisture content range 5-10 per cent for storage and post-harvest management. The maximum dry matter was available in gooseberry fruit 0. 38 kg while the minimum was obtained from tomato 0.14 kg. The dry weight of other vegetable crops like cauliflower, cabbage, carrot, and bitter gourd were 0.24, 0.24, 0.14 and 0.20 kg, respectively. The dry weight from spices crop of turmeric and ginger were measured at 0.23 and 0.17 kg , respectively.

Table 2. Dehydrated weight of different crops after drying for storage.

Sr. No.	Crop	Weight of the dried product (kg)
1.	Cauliflower	0.26
2.	Cabbage	0.24
3.	Tomato	0.14
4.	Carrot	0.35
5.	Bitter gourd	0.20
6.	Gooseberry	0.38
7.	Turmeric	0.23
8.	Ginger	0.17

CONCLUSION

Solar cabinet dryer is a robust technology for drying of food products and it is very much suitable for Manipur and will also be useful for other remote areas of north eastern India. The technology wills dramatically reduce the post-harvest losses. In this study the solar cabinet dryer successfully dried several agricultural products of vegetables, fruit and spices crops.

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