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Experimental Analysis of Cabinet Solar Dryer for Food Drying

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ABSTRACT

The solar drying of agricultural produce is extensively practiced in most parts of the world. It has found special significance among the rural Deputations living in Mediterranean type climates. These areas are characterized by dry warm summer Jock which makes drying particularly attractive. To reduce this contamination and improve product quality, it is essential that the drying matter be enclosed and dehydrated under cover. In addition, sun drying methods cannot often either effectively or evenly reduce moisture contents to the low levels required. This frequently results in aim properly dried material, which cannot be stored for a satisfactory length of time. In order to counteract these difficulties while still using solar energy, it has been undertaken of a simple solar cabinet dryer.

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I. INTRODUCTION

Solar dryers:

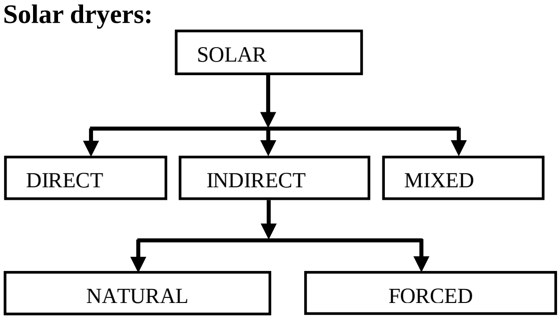

Fig. 1 Classification of solar dryers

Solar dryers used for grape drying are broadly classified as shown in the figure 1.

1.2. 1. Direct type solar dryers:

In the direct type of solar dryer, solar radiation passes through a transparent cover, usually glass, to be incident on the grapes placed for drying. The glass cover reduces direct convective losses to the surroundings and increases temperature inside the dryer.

1.2. 1. 1. Solar cabinet dryer:

A solar cabinet dryer loaded with grapes to be dried is shown in figure 2. It is a small hot box, usually made up of wood and having a length of about three times its width. The sides and bottom of the cabinet are painted black internally for absorbing solar radiation transmitted through the glass cover. Ventilation holes are provided at the bottom and holes are also provided on the upper sides of the dryer. Grapes are spread on aluminum trays, having wire mesh at the bottom and exposed to solar radiation, the temperature of grapes rises resulting in evaporation of moisture.

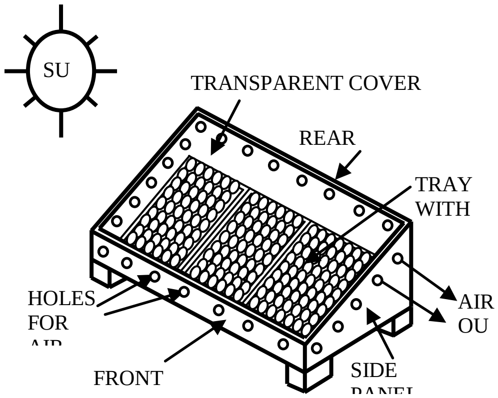

Fig. 2 Solar cabinet dryer

II. OPERATION OF THE DRYER

Introduction of Operation

The dryer operation is not complicated. The produce to be dryer should be pre-treated in the usual manner (i.e. blanched and fumigated) and placed on the Perforated trays, at a loading rate of about 1.5 lbs./ft.'s (7.5 kg's/meter sq.) of drying area.

A small thermometer inserted into one of the ventilation ports will prove very handy, the thermometer bulb should be shielded from the direct rays of the sun. The upper temperature limits which can be withstood by agricultural produce vary substantially.

Where the matter might suffer from the direct sun-rays or where the light colour of the produce reflects much of the incident radiation, it is advisable to cover the loaded trays in the dryer with a black plastic mesh or black gauze. This should not inhibit the flow or air through the trays, but will absorb the radiation and transmit the heat to the produce through conduction and convection. The resultant temperature increase can be controlled by opening the rear access doors. This approximate temperature control system can easily be mastered with time and experience.

The following table gives some indication of the temperature limits and possible throughputs available with a dryer of the size and specifications shown in this pamphlet. The table should hold for drier, cloudless Mediterranean type climates. The yields should be suitably modified for the cloudy, more humid temperate and tropical regimes.

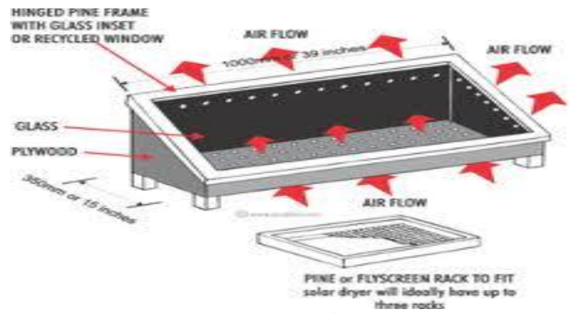

Fig. 3 Operation of the dryer

IV. DRYING-OVERVIEW

A. Introduction

Drying preserves foods by removing enough moisture from food to prevent decay and spoilage. Water content of properly dried food varies from 5 to 25 percent depending on the food. Successful drying depends on:

a) Enough heat to draw out moisture, without cooking the food;
b) Dry air to absorb the released moisture; and
c) Adequate air circulation to carry off the moisture.

When drying foods, the key is to remove moisture as quickly as possible at a temperature that does not seriously affect the flavour, texture and colour of the food.

How long you can keep the food?

Dried foods will keep a minimum of six months in storage under the proper conditions.

Utilization and processing

Put dry-fruit for 2-4 hours in warm water and let it swell up.

Put Vegetables for two hours in cold water and let it swell up. If the vegetable was boiled before drying one hour is enough. Put Fungi-Slices 3-4 hours in warm water. Pour leaves with boiling water and let it for 5 minutes. Let Roots and woods for several hours in water. Leave beans for 6-8 hours in water.

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V. BENEFITS OF SOLAR DRYING

A. Introduction

a) Dried foods are tasty, nutritious, the nutritional value and flavour of food is only minimally affected by drying.
b) Dried foods are high in fiber and carbohydrates and low in fat, making them healthy food choices.
c) Vitamin A is retained during drying.
d) Storage space is minimal, easy-to-store.

e) Transportation costs are reduced; dried Products weigh only about 1/6 of the fresh food product.
f) The energy input is less than what is needed to freeze or can easy-to-prepare. Solar food drying is a very simple skill.
g) Longer storage of dried products (because of more complete drying).
h) Can open new markets and income and is a good start-up technology. It improves the bargaining position of farmers. Sometimes farmers sell at very low prices during the harvest season.
i) You can have up to 50% more productivity in agriculture.
j) For diabetics dried fruit prepared without adding sugar is a healthy choice instead of desserts.
k) Dried fruit can be used in stews, soups and casseroles or enjoyed as snacks. It can also be added to cereals for breakfast or used in making ice cream and baked products.

Compared with open-air drying

a) Protection of the drying products from insects but also from birds, dogs, especially for drying meat and fish
b) The product is hygienic because microorganisms, insects and flies are killed.
c) Protection of rain.
d) Protection of pollution by dust etc.
e) Protection of the wind which can blow away the food.
f) Reduction of drying time (reduces changes through spoilage).
g) No need to turn the product because air passes both sides of the product.
h) No loss of colours of the product (tomato, paprika powder etc).
i) Drying is faster because inside the dryer it is warmer than outside.
j) Less risk of spoilage because of the speed of drying. (if the drying process is slow the fruit start to ferment and the product is spoilt).
k) It is labour saving. The product can be left in the dryer overnight or during rain.
l) The quality of the product is better in terms of nutrients, hygiene and colour.

But

a) More expensive than with direct sun drying (Solar dryer costs about 100 $).
b) If you have huge quantities to dry you need big dryers.

- **Can be used for**

- Fruits (apples, apricots, grapes, pineapples and banana taste great when dried, melon, plums, beets, mangoes, dates, figs)
- Vegetables (cabbage, broccoli, peppers, herbs, onions, squash, tomatoes, asparagus, celery, potatoes, peas, carrots, peppers, cassava, yams, red cedar, mahogany)
- Corn, maize, rise, cassava, cocoa
- Fish, meat, mushrooms
- Spices (dried chilli peppers, garlic)
- Medical plants
- Tea, coffee, cacao, tobacco, cashew and macadamia, milk, hay, copra (kernel of the coconut)
- But also clothing, wool, kindling and also for treating timber.

Easily dried: Apples, apricots, coconuts, dates, figs, guavas, and plums are fruits that dry quite easily, while avocados, bananas, breadfruit, and grapes. Most vegetables, chillies, corn, potatoes, cassava root, onion flakes, and the leaves of various herbs and spices.

More difficult to dry: Asparagus, beets, broccoli, carrots, celery, various greens, pumpkin, squash and tomatoes.
- Fruits are ideal for preservation by drying since they are high in sugar and acid, which act to preserve the dried fruit.
- Vegetables are more challenging to preserve since they are low in sugar and acid
- Drying meat requires extreme caution since it is high in protein what invites microbial growth
- Fish drying, for example, requires thorough cleaning of the drier after each batch.

Preparation of food:-
Use only ripe, good-quality fruit and vegetables.
- Remember, processing cannot improve poor-quality fruit or vegetables
- Wash fresh fruits and ripe vegetables.
- Thick Food should be cut into thin slices, less than 1.25 cm or pre-cooked
- Blackberries need to be removed the seed before drying, if adapted.

VI. STEPS FOR DRYING FOOD

Steps:
1. Selection (fresh, undamaged products).
2. Cleaning (washing & disinfection).
3. Preparation (peeling, slicing etc).
4. Pre-treatment (e.g., blanching, anti-discoloration by coating with vitamin C, de-waxing by briefly boiling and quenching, and sulphurization by soaking or fumigating. Fish is often salted).
5. Drying.
6. Cooling down.

6. Packaging: Glass, airtight jars or plastic containers. Later for selling sealed in Plastic-bags. Plastic freezer bags are safe and durable. It requires packaging to prevent insect losses and to avoid re-gaining moisture.
7. Storage: dry, dark, cold
8. All stored food should be checked periodically for weevils

Reusing: Vegetables are best reconstituted by covering with cold water until they are near original size. They can be added in their dry form to soups/stews. Vegetables can also be ground into powders and used for instant soups or flavouring.

VII. ACTUAL VIEW OF OUR SOLAR DRYER

Actual Dryer:

Fig. 4 Actual view of our solar dryer

Fig. 5 Actual view of our solar dryer

VIII. PICTORIAL DIFFERENCE

Onion:

Fig. 6 Inside onion after drying Fig. 7 Outside onion after drying

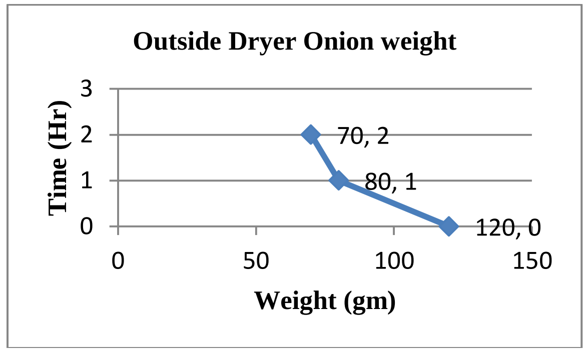

Fig. 8 Graph of the onion outside dryer

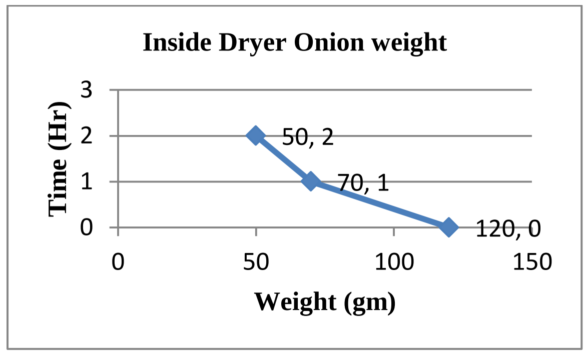

Fig. 9 Graph of the onion inside dryer

The fig. 8 and fig. 9 shows the variation of the weight due to removing of the moisture. In the graph on the 'x' axis is represented by the time and the 'y' axis the weight is indicated. There are two reading are taken out as respect to time and the point is plotted on the graph. On the first hour the weight is decrease as compare to other the material which is putted on the outside. Again at second hour the variation is occurring which is shown in the graph. Weight in the onion reduced as shown in the linearly on the graph

Chillies:

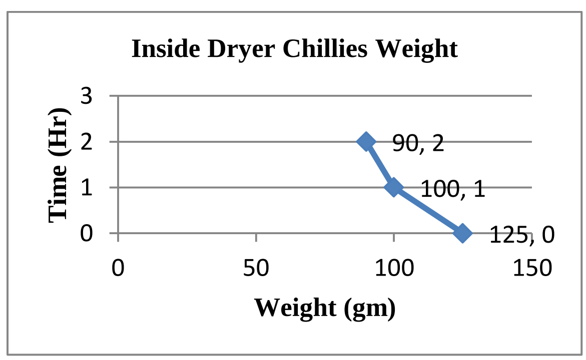

Fig. 10 Graph of the chillies inside dryer

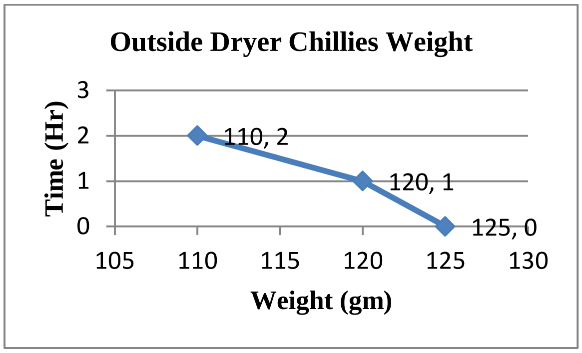

Fig. 11 Graph of the chillies outside dryer

The fig. 10 and fig.11 shows the variation of the weight due to removing of the moisture. In the graph on the 'x' axis is represented by the time and the 'y' axis the weight is indicated. There are two reading are taken out with respect to time and the point is plotted on the graph. On the first hour the weight is decrease as compare to other the material which is putted on the outside. Again at second hour the variation is occurring which shown in the graph. The weight in the chillies reduced as shown in the linearly on the graph.

Potatoes:

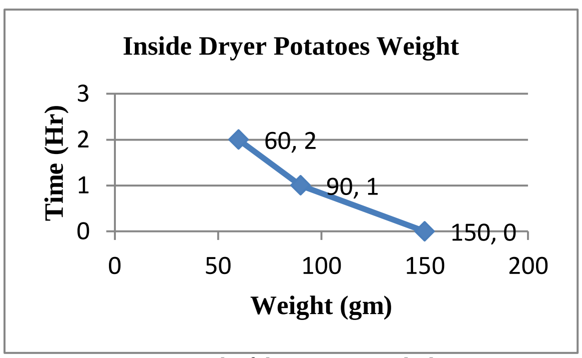

Fig. 12 Graph of the potatoes inside dryer

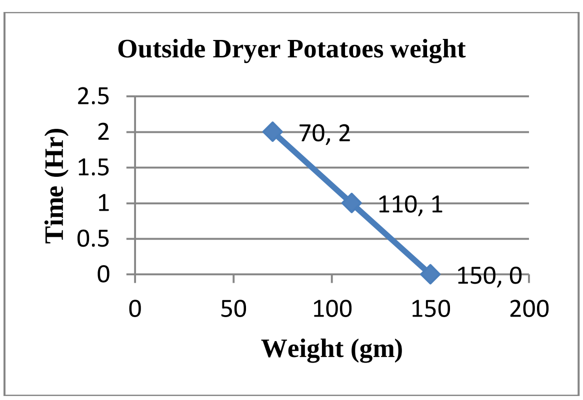

Fig. 13 Graph of the potatoes outside dryer

The fig. 12 and fig. 13 shows the variation of the weight due to removing of the moisture. In the graph on the 'x' axis is represented by the time and the 'y' axis the weight is indicated. There are two reading are taken out as respect to time and the point is plotted on the graph. On the first hour the weight is decrease as compare to other the material which is putted on the outside. Again at second hour the variation is occurring which shown in the graph weight in the potatoes reduced as shown in the linearly on the graph.

IX. CONCLUSION

It is necessary to move forward and implement solar drying processing technologies from household to medium-scale commercial systems. Advances in technology have already been demonstrated, with methodologies proven.

Private enterprises, in combination with Non Governmental Organizations need to acquire and put into practice the technology that exists now. Solar dryer systems improve the quality of the product, while reducing wasted produce and traditional fuels.

Solar dried products reduce storage and transportation costs as well as associated problems from climatic effects. Solar dryers are a cost-effective solution to food preservation in sunny climates. Implementing the use of solar drying systems will result in significant savings to farmers and open new marks.

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