International Journal of Advance Research in Science and Engineering
Vol. No.5, Issue No. 09 , September 2016
www.ijarse.com
IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

# SOLAR GRAPES DRYER: A REVIEW

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## ABSTRACT

*Preserving fruits by drying is an important operation continued from prehistoric period. Drying means moisture removal from the product. Drying is helpful in preserving food product for long time. There has been a remarkable achievement in solar drying of grapes due to sustained research and development associated with the adoption of advanced technologies. Grape is one of the world's largest fruit crop. As per recent survey the world production of grapes is 73,516 million tonnes out of which India accounts for 1.2 million tonnes. The water content in grapes is approximately 81%. In this paper we are going to study the different technique of grapes dryer and sun drying behaviour of seedless grapes. Economical methods of grape drying are described in this paper.*

***Keywords-*** *Collector,Grapes,Moisture, Radiation,Solar dryer*

## I. INTRODUCTION

The earliest method of drying was simply laying the grapes in the sun on mats, roofs or drying floors has several disadvantages like contamination of dust, dirt, insects and adverse climatic conditions like rain, wind etc. This section comprises of the literature review on the studies in the past relation to the solar grapes dryer and present. It also discusses the different types of solar grapes dryer, its advantages and disadvantages. Generally Grapes dryer were classified according to their mode of operations like Active dryer means hybrid solar dryer and Passive dryer means conventionally termed as natural circulation dryer.

### 1.1 Solar Dryer

To protect the grapes from dust, dirt, and adverse conditions like rain, wind the solar dryer would be the best option. As sun energy is available free of cost it is very economical to use the solar dryer for grapes drying. We can install the soar dryer anywhere as per requirement so the transportations will be minimized.

IJARSE
ISSN (O) 2319 - 8354
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Currently solar grapes dryer has less capacity, also they requires more processing time. By increasing collector area we can provide maximum heat to the drying chamber. The quality of dried grapes (raisins) is an important factor which should be considered while studying the methods of solar grapes dryer

## 1.2 Methods of solar grapes dryer

### 1.2.1 Solar grapes dryer by using thermal energy storage by PCM

Phase change material (PCM) used for the purpose of continues drying process. PCM's changes its phase at constant temperature by storing large amount of latent heat and again changes back its phase by releasing the stored heat which is used for heating or drying purpose [5].

**Fig.1.Paraffin wax**

**Advantages**

- Continues drying can be achieved.
- Higher collector efficiency.
- PCM's are used for temperature stabilization and for storing heat with large energy densities.
- PCM starts to condense from liquid to solid phase after the sunset by releasing the stored energy to the cabinet which can be used further for drying purpose.
- Drying time should be less.

**Disadvantages**

- A PCM material has low thermal conductivity.
- Cost is high.
- Degradation of properties when subjected to high thermal cycling at high temperature.

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### 1.2.2 Grapes dryer by using Infrared radiation:

It was used Infrared radiation for drying of grapes. A bank of Infrared LEDs was used as IR radiation. It consists of drying chamber which was designed in such way that inlet air can be uniformly blown through the grapes placed in tray with the help of two exhaust fan. Appropriate sensors were used to measure parameters like humidity, temperature and weight of sample [6].As the Infrared Radiation source is on, the energy was transfer from I.R. source to berries, the moisture came out of the berries through the cracks generated during chemical treatment. It was observed that approximately 60% moisture is removed in 30% of total drying time. The drying time was reduced to 16 to 22 hours against 15 to 20 days required by natural drying process. Number of LEDs was 144. [6]

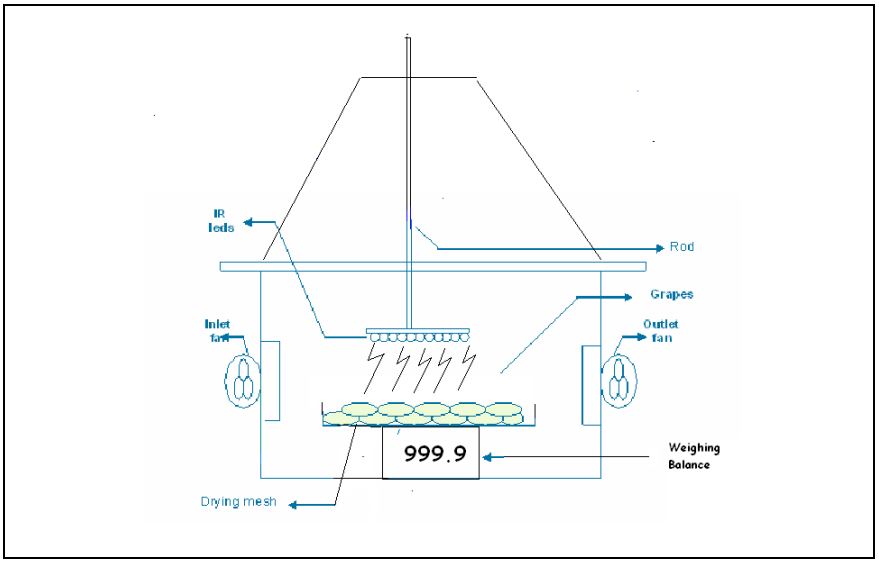


**Fig.2.Infrared Radiation Method**

### Advantages

- Reduced drying time.(16 to 22 hours are required for drying)
- Improved product quality.
- Less floor space and compact system.
- The original colour of grapes was better conserved as the drying take place at low temperature.

### Disadvantages

- High initial cost.
- More maintenance required than solar dryer.
- High running cost.

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### 1.2.3 Mechanical Drying:

After open sun drying artificial mechanical drying came in to practice. But this process is more energy intensive and extensive. In mechanical drying boilers are used to heat incoming air. Fans were used to force the incoming air Mechanized drying is faster than open air and solar drying, and it usually gives a better quality product. Fuel heating usually allows better control of the drying rate than solar heating hence in industrialized region. Open air drying now replaced by mechanized drying. But the equipment is expensive and requires substantial quantities of fuel or electricity to operate so, it would not be an option for smallholder farmer. [3].

**Advantages-**

1. Faster drying rate.
2. Less space required for operation.
3. Better quality of product.

**Disadvantages-**

1. Not affordable for small holder farmers.
2. It requires fuel or electricity for operation hence it is costly.

### 1.2.4 Direct solar dryer

It is simple type of dryer in which material to be dried is placed in an enclosure with transparent cover. Ex- Glass. Heat generate inside chamber by absorbing solar radiation by product itself and internal surface of chamber. Here sun light fall on the surface of glass then things happen fist is some light is absorbed some light is Reflected back from glass some light is transmitted. Dimension of box used is 1 M length and 0.3 Width. Temperature recorded in this cabin dryer is 80° C. drying time required is large due to natural convection of air [1].

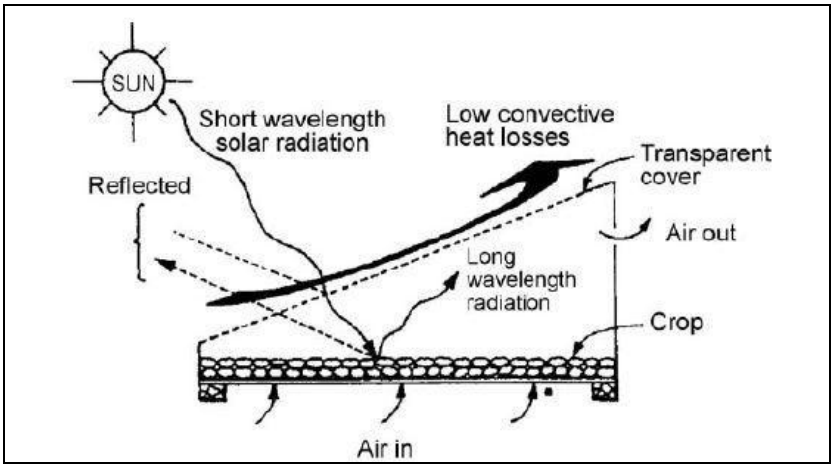


**Fig.3.Direct Solar Dryer**

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ISSN (O) 2319 - 8354
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**Advantages-**

- Contamination of product is avoided due to enclosure with transparent cover.
- Product quality obtained is higher than open to sun dryer.

**Disadvantages**

- More Time required for grapes drying.
- Poor quality of final product. [1]

### 1.2.5 Grapes dryer with mixed mode natural convection type [without blower]

In this mode air enters through open bottom end of the collector and is heated while it passes over the rocks. Dimension of chamber used in this paper is 1m high x 0.3 deep. For circulation windoperated ventilator is placed on top of dryer chamber. It is combination of direct and indirect type of solar dryer. It was found that inside temperature of drying chamber was up to 74% after 12 pm for about 3 hours. Drying rate obtained is 0.62 kg/h and system efficiency obtained is 57.5%. [7]

**Fig.4.Mixed Mode Type Solar Dryer**

**Advantages-**

- Rapid rate of drying than direct solar drying.

**Disadvantages-**

- Capital cost required is higher.
- Cost required for maintenance.

IJARSE
ISSN (O) 2319 - 8354
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- Dry gain obtained over a year is less than indirect type of dryer.
- Due to direct expose in solar energy drying rate is different.

### 1.2.6 Indirect type of solar dryer [with blower]

In this method atmospheric air was heated in flat plate collector or concentrated type solar Collector. This hot air then flow in the cabin with help of blower. This method takes 13hours for removing moisture from 85% to 8%. Moisture from this type of dryer was removed by convection as by diffusion. Temperature obtained in collector is more than direct solar dry. A small dish type solar air heater connected to a drying chamber for drying Grapes. Result show that efficiency improved from 20% at natural flow rate of 0.01 kg/sec to 42.6% at a high convection flow rate of 0.21 kg/sec. It took 13 hours for removing moisture from 85% to 8%. [1]

#### Advantages

- This technique avoids contamination of final product.
- Maintain the quality of product by avoiding direct exposure in solar radiations.
- Time required for drying is less.
- Capital cost is less than mechanized, PCM, infrared radiation.

#### Disadvantages

- Cost required for maintenance only after particular period of time.
- Initial cost is more than natural drying process.

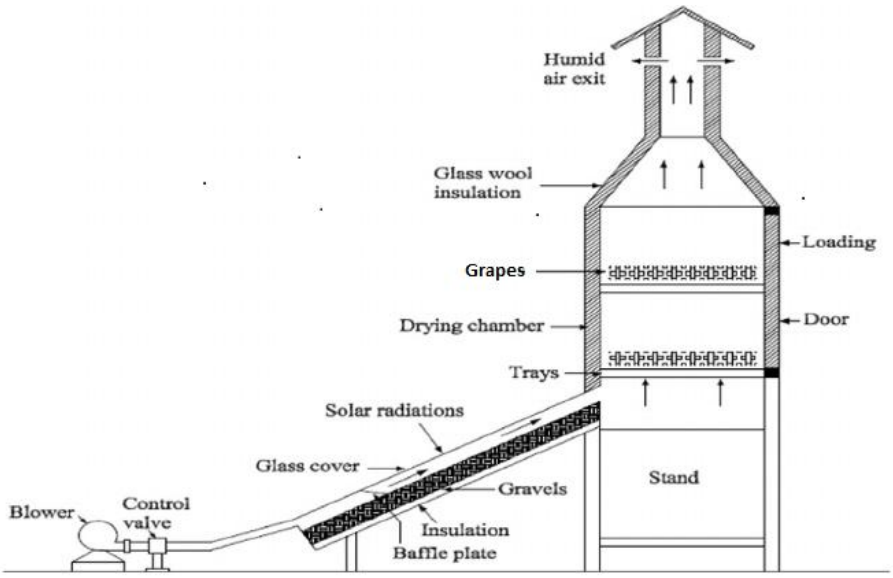


**Fig.5.Indirect Type Solar Dryer**

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

## III. REVIEW ON WORK CARRIED OUT

Ajaykumar Sharma [National Research Centre for Grapes, Pune] has done work on air drying of solar energy for grape drying has been demonstrated to be cost effective and could be an effective alternative to traditional and mechanical drying system. In solar dryer prevailing temperature, wind velocity and humidity were major environmental factors which affect the quality of dried grape. Dipping of grape bunches in solution 50ml ethyl oleade and 25gm potassium carbonate for 2 to4 min is common practice. More recently the Industrial application of microwave heating for the preparation of dried grapes has been reported.

Comparison of drying characteristics of Thompson seedless grapes using combined microwave oven and hot air cabinet dryer was investigated. The drying period of grapes had big difference when the grapes were dried by starting drying in microwave oven for 1 min at 900 W power level compared to other microwave power level of 75 W and finishing drying in hot air cabinet dryer for 120 min. [2]

## CONCLUSION

This review paper mainly consists of methods of grapes drying. In this paper we have discussed Solar grapes dryer by using thermal energy storage by PCM, Grapes dryer by using Infrared radiation, Mechanical drying, Direct solar grapes dryer, Grapes dryer with mixed mode natural convection type [without blower] , and Indirect type of solar dryer [with blower]. It is found that time required for drying in Grapes dryer by using Infrared radiation is too less than other methods. Also drying by indirect type of solar dryer [with blower] method could be one of the best option. Thus this study will help for choosing better method of grapes drying. Natural process has limitations; that grapes suffer through undesirable situations such as effects of dust, dirt, atmospheric pollution and insects. Because of these limitations, the quality of resulting product can be degraded, sometimes beyond edibility. Solar grapes dryer overcomes all above limitations hence it can be used effectively.

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