

LOW COST TERRACE (FLAT SURFACE) SOLAR DRYER

Introduction:-

Drying is one of the oldest methods of food preservation. While drying, the key is to remove moisture as quickly as possible at a temperature that does not seriously affect the flavour, texture, colour and original nutritional values of the food. Different types of solar dryer are available in market but those are mostly expensive and not easy to replicate at grass-root level.

With this contest, trials are conducted at Vigyan ashram, Pabal to develop simple & economical (low cost) solar dryer. The main objective of this dryer is to enhance quality of traditionally terrace dried (open sun) products and explore new applications (product range) from local Vegetables, Fruits, Papad, Fish etc as cottage scaled processing(drying) unit. This document work done so far on project concept, basic design framework, and details of first version of dryer fabricated at Vigyan ashram.

Differences between Open Sun drying & Low Cost Protected Sun Drying

Open Sun Drying	Low cost protected sun Drying
❖ Problem of contamination by birds, insects, etc	❖ No contamination because it is properly covered.
❖ Less hygienic & less clean	❖ Highly hygienic & very clean
❖ Inferior quality products	❖ Best quality products
❖ More loss of Appearance & Color	❖ Less loss of Appearance & color
❖ Un uniform drying	❖ Uniform drying
❖ More nutrient losses	❖ Better nutrient retention
❖ Low profit margins	❖ Best profit margins due to quality products

Objectives:

1. To develop simple, low cost (economical) solar dryer by using locally available material to enhance drying quality of open sun dried products.
2. To evaluate the performance of dryer against various other low cost drying options (mainly open sun drying).

Design Principle of low cost dryer:

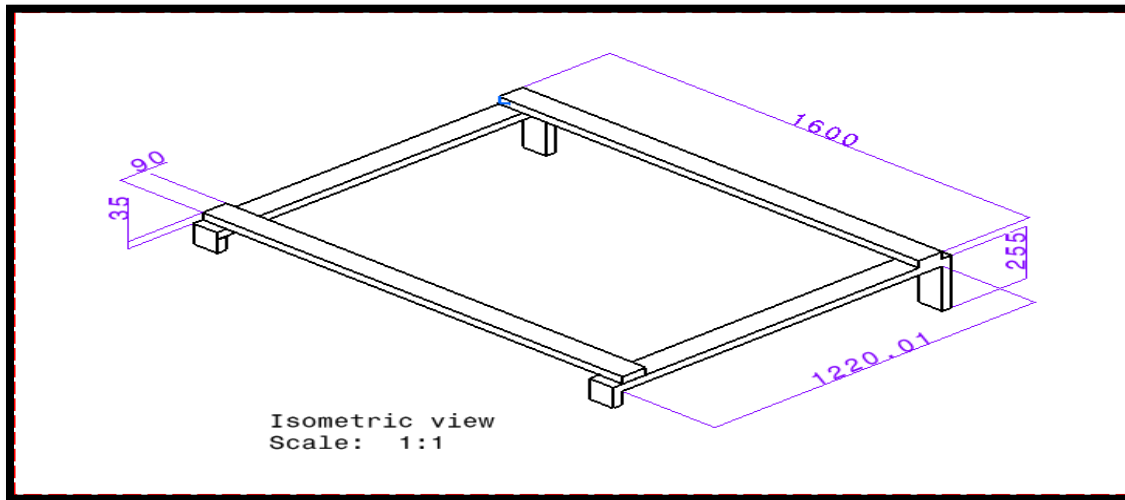
Open sun drying has many problems such as contamination by dust, insect, infestation, loss of natural colour / flavour etc. To overcome these issue following

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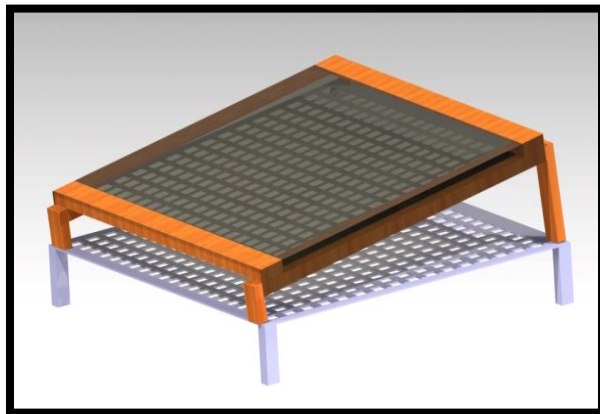
1. Wooden frame is made-up of water resistance wood material and covered it by UV stabilizer film to protect drying material from direct UV rays.
2. A gentle slope provided to wooden frame to remove moisture saturation during drying (water droplets saturate while drying).
3. To maintain natural air flow, drying material placed on elevated mess tray having perforations as per product size / requirement.
4. Protection from dust/dirt, birds etc from all four sides were provided by fixing cotton curtain.

During field trials on leafy vegetables, Amla Candy and Papad drying efficiency was improved with this design mainly due to greenhouse effect (natural heat trapping) and natural air flow inside drying chamber!

Drawing of frame:-



Drawing of pinewood frame



3D view of frame



Open terrace solar dryer

Sr. No.	Parameter	Size
1.	Length of dryer	1600 mm
2.	Width of dryer	1220 mm
3.	Height of front side	255 mm
4.	Height of back side	100 mm

Material used:

Locally available pinewood, UV stabilized film, nut and bolt, profile & spring (used in polyhouse construction).

Fabrication steps:-

1. First Cut pinewood of size 5.3ft and 4ft, each two in quantity.
2. Join pinewood corners with the help of nut and bolts.
3. By above procedure you get the frame of size 5.3ft X 4ft.
4. Provide gentle slope to frame by raising frame legs (20-30 % slope is sufficient as shown in diagram below).
5. Join profile to side of batten.
6. Then cover it by UV stabilized film. Make film tight in profile with the help of spring attach with frame.
7. Fix side curtain in profile and tight it with spring.

Cost of fabrication:

Cost of fabrication of solar dryer is calculated on the basis of material cost. Total cost of solar dryer is mentioned in Table given below:

Sr. No.	Material used	Quantity	Rate (Rs)	Cost (Rs)
1	Pinewood	9.128 kg	30 per kg	274
2	UV stabilize film	2.42 m ²	50 per m ²	121
3	Nut and bolt	16		96
4	Profile and Spring	5.6 m	20 per m	112
5.	Labor cost (15%)			90
6.	Profit (15%)			90
	Total cost			783

The total cost required for fabrication of solar dryer is approximately **Rs.783** including materials, cost of fabrication etc.

Trail 1:- Moringa leaves drying :-

Sr. no.	Specification	Under open terrace dryer
1	Initial weight	10 kg
2	Final weight	2.66 kg
3	Percentage of moisture removed	73.4%
4	Time required for drying	2 days continue



Dried Moringa leaves with flesh green color

Observation and Conclusion:-

Day		Day 1		Day 2	
Time		12pm	4 pm	12pm	4 pm
Temperature In (°c)	Open sun	38	38	37	36
	In dryer	40	39	39	38

- Temperature under dryer is normally 2⁰c higher than atmospheric temperature (open sun drying).
- Sun ray filter through UV stabilize film so better color / flavor retention as compare to open drying.
- Effective drying with moisture level reduced up to 73 % in 15-16 Hr in leafy vegetables. (Final moisture content in product was around 6 %)

Trail 2:- Amla candy drying :-



Amla candy dried under open terrace solar dryer

Sr. no.	Specification	Under open terrace dryer
1	Initial weight	19 kg
2	Final weight	17 kg
3	Percentage of moisture removed	10.52%
4	Time required for drying	3 days

Observation and Conclusion:-

Temperature comparison

Day		Day 1		Day 2		Day 3	
Time		2.30 pm	4pm	12pm	4pm	12 pm	4pm
Temperature In (°c)	Open sun	36	37	35	37	36	37
	In dryer	38	40	38	39	38	40

- Better colour retention.
- Juicy texture as compared to open OR hot air grid powered drying.
- Not contamination from dust and house fly's (which is major issue in Amla candy open sun or shade drying)

Trail 3:- Potato chips drying:-

Sr. no.	Specification	Under open terrace dryer	In open sun
1	Initial weight	2.5 kg	2.5 kg
2	Final weight	250 gm	240 gm
3	Percentage of moisture removed	90%	90.4%
4	Time required for drying	2 days	2days



Chips dried under open terrace drier



Chips dried in open sun

Observation and Conclusion:-

Temperature comparison

Day		Day 1		Day 2	
Time		2.30 pm	4pm	12pm	4 pm
Temperature In (°c)	Open sun	37	38	39	40
	In dryer	40	41	42	42

- Better colour retention.
- Less drying time as compare to open drying with better quality.



Conclusion: –

Simple and low cost solar dryer can be fabricated with locally available material like wooden frame. Field trial conducted on various traditionally dried materials as that of leafy vegetables, fruit candies and potato chips / Papad etc can be dried using this dryer showed with improved drying quality and drying time. Cost of fabrication of this type of dryer is very low as compare to other solar drying options in market and there is no operating cost as it works on natural drying principle. This dryer can be fabricated as local (village) level and used at domestic level as home based equipment or can cottage scaled drying unit. Vigyan ashram is further working on developing business model for cottage scale business and developing innovative recipes from locally available raw material using this dryer design.