Publisher: Asian Economic and Social Society
ISSN (P): 2304-1455, ISSN (E): 2224-4433
Volume 2 No. 2 June 2012.

Indirect Solar Drier for Drying of Hill Products

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Citation: R. K. Aggarwal (2012) "Indirect Solar Drier for Drying of Hill Products", Asian Journal of Agriculture and Rural Development, Vol. 2, No. 2, pp. 201-205.

Indirect Solar Drier for drying of Hill products

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Abstract

An indirect solar drier of 25 kg capacity has been developed fitted with solar cell for running the fan. The bulbs are provided in the solar collector for air heating during clouds and evening & morning for faster drying reducing drying time. 15 such solar driers have been installed in the state. Various hill agricultural crops have been dried in solar drier by the farmers and collected. The market value of dried products has also been compared.

Keywords: Solar drier, drying, hill crops, quality, income generation

Introduction

In Himachal Pradesh known as fruit bowl of India, large quantities of fruits and vegetables are damaged due to perishable nature / bad weather or lack of transportation facilities resulting in loss to the farmers. About 20% tomato, 10% ginger, 10% mushroom, 30% amla (*Emblicaofficinalis*) and 5% apple are generally damages/waste during a year. People in the state dries apple, peach, palm nut, chilly, turmeric, ginger, pomegranate and other local products in open sun resulting poor quality of the dried product due to dust/fungus infection, insects, sudden rains, bacteria and loss due to wetting byrainsqualls wild animals and monkeys etc.. The part of perishable crops like tomatoes and pomegranate harvested during rainy season are wasted due to bad weather. This gives low return to the farmers. The open sun drying requires more time and labour to carry products from inside to outside during bad weather. Solar drying of fruits and vegetables can reduce the losses and improve the quality of products for better price in the market. Several types of driers are available in the country but these are not popular in rural areas due to high costs, technical knowhow, or lack of skill to use these driers [1].

An indirect drier has been developed for the drying of fruits, vegetables, seeds and medicinal plants. This drier reduces the drying time considerably as it provides heat during night through bulbs. The quality of the products improves for better market values. The payback period of the drier is less because the drier will be used throughout the year. The major portion of the initial expenditure on fabrication of drier is on wood, which is easily available with the farmers. Thus, the total cost of the drier has been reduced which can be recovered in shorter span. Pomegranate has great economic importance because of its high acetic nature. Nearly 1000 tones of dried anardana extracted from wild pomegranate fruits costs about $ 3.0 billion. Wild pomegranate is widely found in dried and sub-marginal land of mild hill region of outer Himalayas at an altitude of 400m to 1,800m above mean sea level. In India it grows in vast track of the hill slopes of Jammu & Kashmir, Himachal Pradesh and Utranchal. In Himachal Pradesh it is found in Solan and Sirmour districts in abundance. The size of fresh pomegranate varies from 5.31 cm to 7.53 cm and diameter varies from 4.35 cm to 6.50 cm. The weight ranges between 59.77 gm to 101.0 gm. The average weight of 100 arils is 12.65 gm and its colour is blood red – light pink.

Ginger is one of the important spice crops that are preferred for its therapeutic values. An herbaceous perennial plant, belonging to family Zingiberaceae is believed to be native of south East Asia. It is propagated through rhizomes, leafy stem30-90 cm in height. It is widely used in food beverages, confectioneries and medicine. Total production in the world is 1004546 metric tons and total world area under cultivation is 33826 hectares. The average productivity of the world is 2956 kg/ hectare. Major ginger producing countries in the world are India, Nigeria, China, Thailand, Indonesia, Bangladesh, Philippines and Korea. Nigeria ranks first with respect to area under ginger covering about 56.23% of world total area under ginger followed by India (23.60%), China (4.47%), Indonesia (3.37%) and Bangladesh (2.32%) India ranks first with respect to ginger production contributing about 32.75% of total world's ginger product followed by china (21.41%), Nigeria (12.54%) and Bangladesh (10.80%). India is the largest producer of dry ginger. The total production of ginger in India is 305900 tones in an area of 85100

hectare with an average production of ginger 3.60 metric tones per hectare. In India, Kerala is the highest producer of ginger contributing almost 23.08% of country's total production followed by 19.57% in Meghalaya. Major ginger producing area in country is Karnataka Tamil Nadu, west Bengal, Himachal Pradesh, UP, Orrisa, Gujrat, Maharashtra, Rajasthan and North-Eastern states [3]. In Himachal Pradesh, ginger is one of the important cash crops of mid and lower hills covering an area of 3695 hectares and total production is 37,000 tones. In Himachal Pradesh, this crop is mainly grown in Sirmaur, Solan, Hamirpur, Bilaspur, Mandi and Shimla districts.

Methodology

The drier has been developed under the project funded by the Ministry of Science and Technology, Government of India. A survey was conducted to identifying the drying techniques of the farmers and to identify the commercial crop which are being dried. On the basis of this survey an indirect solar drier has been developed. The design parameters of the drier have been presented in section (i). The results and discussion is presented in section (ii). The economics of drying has been discussed in section (iii).

i. Design parameters of the drier

The solar drier of 25 kg capacity has two components. One a solar collector constructed with water proof board fitted with 4 mm glass at an angle of 30^0 (the latitude of the place) for maximum transmission of solar radiation (drawing is enclosed) [2]. Solar collector with a glass area of 2.4 square meter and volume is $0.693m^3$. The solar collector base has black painted plywood to absorbed solar radiation insulated with saw dust. The drying chamber with dimension of 1.1m*0.7m*1.0m has three removable trays. Each tray with size of 1.02m*0.7m*0.05m is made of iron square mesh in wooden border. Front side of drying chamber is covered by glass having thickness of 6mm. The eight bulbs of 100 W each are provided in the solar collector for heating during rains and after sunset to reduce the drying time. The holes are provided at the bottom (south orientation) in solar collector. A dc fan is provided at top of the drying chamber (north orientation) for air circulation. A solar battery has been attached with the drying chamber to run the fan. A schematic view and camera photograph of solar drier are presented in Fig. 1 and Fig. 2 respectively

ii. Installation solar drier in the field:

Himmothan Paryojana (HMP), Navajbai Sir Ratan Tata Trust (NRTT), Mumbai has sanctioned the project for the installation of 15 solar driers in the state. The main objective of installation of Indirect Solar Drier in the state was to increase the income of the farmers by improving the quality of the dried products, protection from wild animals and saving in time & labour which can be utilized for farm and off farm activities.

In order to assess the potential farmers a survey was required to be conducted under the project in different districts in the state. Accordingly, the detailed survey was conducted to identify the farmers for installation of solar driers and who could contribute in the form of wood required for the fabrication of solar driers. The SHGs working in the field of Post Harvest Products were also identified. The local carpenters who may be interested to get training in the fabrication and upkeep of solar driers and to work in the field were also identified.

Methodology adopted

1. The detailed questionnaires for the survey were developed in Hindi and printed for individual farmers, SHGs and Carpenters (Copy of questionnaires enclosed). The Carpenter engaged under the project was trained and oriented to elicit the correct information and fill up the questionnaires during survey in the field.

2. Six districts were selected for the survey. The criterion adopted was the agro-climatic condition of the districts and which produce crops for commercial drying besides, being nearer to the university headquarter. In these six districts, survey was conducted in sixteen blocks.

3. The respondents were randomly selected, based on the information gathered at the local level. Those farmers were interviewed who were engaged in commercial drying of their products throughout the year.

4. Self-help groups (SHGs) engaged in commercial activities by drying the local products constituted in the village were also interviewed. The breakup of the district, block and villages surveyed is given in Table 1.

Analysis of survey

The other salient points came to light during survey are as under:

- 90 % of women folk are engaged in the drying of products in the traditional way;
- 2 hours at an average daily are spent in the drying process, including handling of products;
- By a conservative calculation arrived at by taking the minimum wage of unskilled worker as fixed by the Govt. (presently $2.5/day), the average cost of labour input by women comes to $1.5 per day;
- Most of self help groups (SHGs), consisting of female members only, are engaged in commercial activities. They market the dried local products of all types for income generation.
- 10 – 25% of crop is damaged after harvesting due to a variety of reasons;

- The time taken in the drying of products by traditional methods is 5 to 15 days depending upon the type of crop and climatic conditions.
- In addition to commercial crops, the farmers dry all types of vegetables, grains, cereals for their own use. Sometimes there are also local specific typical products, like cheese, meat, bari, etc.

Inferences

From the analysis of the survey results the following inferences are drawn:

- Although presently due to non availability of proper technology the solar drier is not in use in rural areas yet it can be gainfully employed for the whole year as and when it is properly introduced and technical knowhow for its operation and maintenance is made available to the farmers. Not only for commercial purposes it can be used for drying the products even for domestic use which the farmers are otherwise importing from the open market.
- Once the utility of the drier is known to the farmers it will itself create demand for the same among the farmers
- The SHGs can become a formidable target group as they are drying their products in traditional ways for commercial marketing proposes.
- When popularized there will be greater demand for maintenance and upkeep of drier which, in turn will generate income to the local carpenters.

Selection of farmer's site

The main part of the project is to fabricate and install 15 solar driers in the field in which **t**he wood for the fabrication of solar drier was given by the beneficiaries as their contribution. The details of the solar drier sites in the state are given in Table 2.

Capacity Building

Awareness Training Camps

The orientation training programmes were conducted to apprise the local community regarding the importance of solar drier for income generation, time saving, better quality of dried products and protection from wild animals. The basic purpose of these training camps is to aware the farmers about the benefits of solar drier after its installation in the field so that they can make up their mind for future.

Users' training programme

After the installation of solar driers in the villages users' camps were organized for the farmers to apprise them about the functioning of solar drier. Do's and don'ts were highlighted.

Technical Training Programme

The technical training programmes of three days duration were organized for carpenters to create workforce for repair and maintenance of solar driers. The carpenters were trained in fabrication of each part of the solar drier. They can fabricate solar drier as per the demand of local farmers.

Monitoring of Solar Driers

One of the major weaknesses was the selection of SHGs. The selection of SHGs are difficult because in the state the SHGs are not financial strong enough to motivate for providing wood etc..During the monitoring it was observed that the farmers have dried their products which have generated more income for example bark of (onion, walnut, pomegranate, Kashmal) were dried to prepare colour for the dying of wool.

The other products dried in the solar drier are: Trigonella, mentha, cabbage, bitter guard, summer squash, coriander, methi, pudina powder, wild apricot, vach (medicinal plant), apple chips, tulsi leaves, leaves of colocasia, brinjal, lavender, cabbage, cauliflowers, parsley, peas, tomato, pumpkin, bottle gourd, ginger, cereals, guava, amla, potato, sunflower seeds, cannabis, wheat corn, wheat &rice, almond, colocasia (Arbi), groundnut, walnut etc..

Reduction in time and labour

During the monitoring of solar driers in the field, the farmers told that the solar driers not only saves the drying time but also saves labour to carry products from outside to inside during morning and evening and even during bad weather. This time saved is utilized in farming.

Income of the farmers

The quality of the dried product has improved considerably. During this season the farmers sold their products at higher price dried in the solar driers. The rates of dried products sold by the farmers in the field have been compared which is presented in Table 3. This table reveals that the increase in income of the farmers is in the range of 29% to 200%.

iii. Economics of drying

The cost per unit capacity of various dried products have been calculated taking into account the cost of drier, labour charges, maintenance charges, electricity charges and depreciation charges [4]. The cost of dried product has been found to be in the range of $0.1 to $0.12 per kg.

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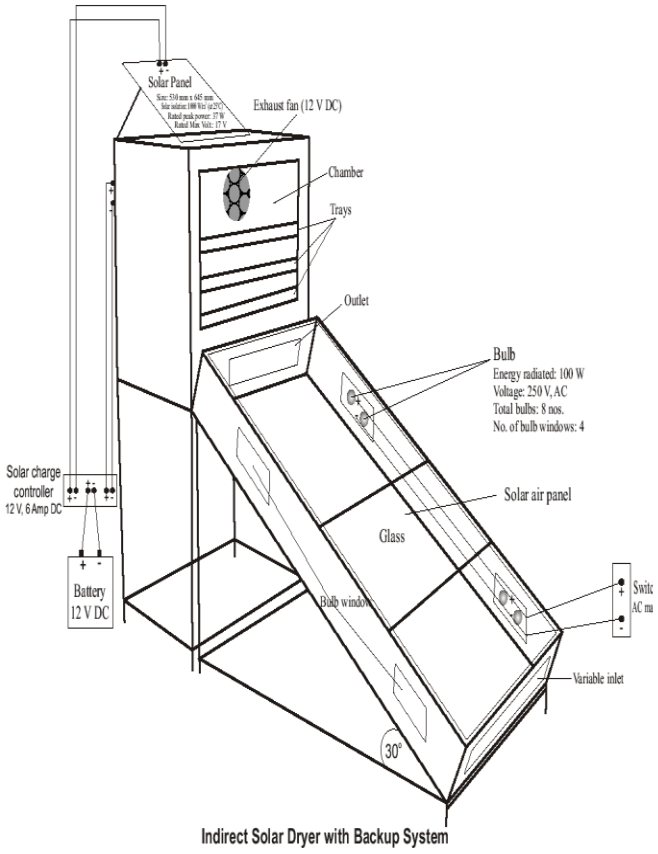

Fig.1. Design of indirect solar drier

Fig. 2. Indirect solar drier

Table 1: The breakup of the district, block and villages surveyed

S. No.	District	Block	Village	Household surveyed	SHGs
1	Solan	3	29	127	15
2	Shimla	1	4	4	Nil
3	Sirmour	2	25	64	1
4	Kullu	2	5	22	4
5	Mandi	6	34	63	14
6	Kinnaur	2	7	54	1
	Total	**16**	**106**	**334**	**35**

Table 2: Geographical data of solar drier locations

S. No.	Location	Altitude (meter)	Latitude	Longitude
1	Thola	1629	$30^0$44’450 N	$77^0$33’146E
2	Thirdhar	2213	$30^0$42’894 N	$77^0$30’144E
3	Sataun	552	$30^0$33’546 N	$77^0$38’545E
4	Bhajond	1486	$30^0$44’175 N	$77^0$22’658E
5	Bhangari	1809	$30^0$46’898 N	$77^0$24’410E
6	Ritab	1596	$30^0$56’410 N	$77^0$19’567E
7	Sanhot	1840	$30^0$53’251 N	$77^0$21’349E
8	Jalana	1216	$30^0$09’748 N	$76^0$59’3338E
9	Nagwain	1192	$31^0$48’468 N	$77^0$10’475E
10	Sharan	1743	$31^0$40’070 N	$77^0$19’650E
11	Kalashan	1650	$31^0$23’116 N	$77^0$08’275E
12	Faigal	1262	$31^0$21’355 N	$77^0$04’972E
13	Sangla	2622	$31^0$25’458 N	$78^0$15’823E
14	Leo	2878	$31^0$53’180 N	$78^0$35’806E
15	Khawangi	2300	$31^0$33’132 N	$78^0$16’367E

Table 3: Rates ($/kg) of dried products in the local market

Product	Open sun dried	Solar drier dried	Increase (%)
Garlic powder	4.0	6.0	50.0
Apricot	1.5	2.7	68.8
Almond	-	6.0	0.0
Turmeric	2.0	4.0	100.0
Ginger (Sounth)	6.0	10.0	66.7
Peas	2.0	6.0	200.0
Turmeric	4.0	6.0	50.0
Red Chili	2.8	3.6	28.6
Apple Chips	2.0	6.0	200.0
Turmeric	1.6	4.0	150.0
Red Chili	2.0	3.0	50.0