EVALUATION OF SOLAR THERMAL DRYING POTENTIAL RELATED WITH EXPORT AGRICULTURAL PRODUCT IN SRI LANKA

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ABSTRACT

Sri Lanka is situated close to the equator; therefore most of parts in country receive an abundant solar radiation throughout the year. As estimated in the solar resource map developed by the National Renewable Energy Laboratory (NREL) of the USA, it varies from 4.0 – 4.5 kWh/m^2/day. But solar thermal energy related applications are limited in commercial forms. However, solar energy is the most popular form of energy in day to day life .The one of most common commercial application of solar energy in Sri Lanka is minor export agricultural product drying such as nutmeg, pepper and Cardamom. In general small scale spice producers are used open sun drying techniques for their products. But this method has several drawbacks such as poor quality, high drying time, and contaminations. Solar dryer is providing effective solution for this kind of product drying purposes. This paper presents the overview of solar thermal drying potential related with minor export agricultural product.

Keywords: *Solar energy, open sun drying, solar dryer, drying potential, minor export agriculture*

1. INTRODUCTION

Sri Lanka is a tropical country; hence it has adequate solar energy intensity and a large number of days of sunshine Island –wide. This energy is available free for use for many purposes. However, the vast amount of solar energy available is not utilized to the maximum for the food drying industry, in the country. Solar energy traditionally used by the food industry for drying of spices, fish, vegetables, paddy and agro base products. Generally ,the open sun drying methods is used by the food drying purposes Problems of wastage of product, low quality of dried product, large number of labour requirement ,difficult to bulk handling, difficult to drying rainy days arise[1],

Recently solar dryers were introduced by various organizations institutions and researches, to overcome problems such as destruction of nutrition when exposures sunrays .Nevertheless even today, this technology is not popular in the country. Unutilized solar thermal potential for the food industry is available most parts of country throughout the year. If this potential is utilized, a successful solution can be found for the food drying industry in Sri Lanka. Investors in the food drying industry do not have any clear idea

about how to utilize the solar thermal potential of the country. Absorptivity is most important parameter of drying technology because its gain more energy[2]. Nevertheless, attempts have been made through this research, to quantify the unutilized solar thermal drying potential and present an analysis of potential socio-economic gains for the food industry.

In recommending a solar dryer because it has been shown many salient features that required to be taken in to accountability. Mainly consideration is the location of the country where the dryer is planning to operate[3]. Other factor is income of the target group to be used by the dryer. Because financial strength and period of harvesting are highly influence. Most of small-scale spice producers island-wide provide open sun dried products to local market as a habit. But open sun dried results in an inferior quality product and incompletely dried, due to mould-infections and contaminations though spice such as black pepper, cloves, nutmeg, etc. As a result of wet seasons which coincide with spice harvesting income of the crop is lost and wasting harvest. In addition solar dryers has been shown advantages over heated-air mechanical dryers because it is low running cost and affordable investment of capital, suitability for low capacity. Most of spice drying base solar dryer are satisfies most of the requirements of the small-scale spices producers.

2. METHODOLOGY

2.1. Procedure for Analysis

In this research, two different technologies were selected, open sun drying and solar dryer technology. The necessary information was collected and measured related with two technologies. Three different sectors such as fish drying, spices drying and vegetable drying were selected. Subsequently the measured data was used for calculating the required energy and cost of production with respect to each food item. The collected data and information were tabulated for different foods in Table1& 2.species drying data was collected from "Kandy" and "Matale" District.

Figure 1: SAVIRU Dryer

The total energy consumption of both technologies was calculated. Then energy differences of the two technologies were obtained for each food items. To calculate the total energy all relevant functions were converted to energy form. For example laboure force was converted to energy form. If the same food, the same environmental conditions and the same drying area were considered the reason for the large energy differences for drying the same quantity necessitated calculation of the product. This is the energy present in solar radiation and this quantity of solar energy cannot be captured in the absence of an appropriate technology. Dryer technology is used to capture that unutilized potential. But the maximum temperature should be 60^0C inside the dryer [4] However, there may be other technologies to capture this potential. According to practical data for different food items, these solar thermal potential values were calculated separately for each. After this the commercial value for each selected food item in the food industry was evaluated. Further, the commercial value of that energy was calculated for different food items and land area saved by the unutilized solar potential. Each calculation was based on the production of one metric tone and one month time period were considered. The annual production was not considered for calculation because solar food drying is done in the harvest period only. Otherwise, if the annual product is considered, the rain factor effect must also be included [5].

Table 1: Data for open sun drying

	Pepper	Nutmeg	Clove
Labour energy(MJ/Month)	312	312	312
Drying energy(MJ/Month)	570.72	577.68	626.4
Total energy (MJ/Month)	882.72	889.68	938.4
Mass per batch	40	120	40
Drying time(Days)	3	10	3
Labour days	30	30	30
Number of batch per month	10	3	10
Throughput per batch	15.4	37	13
Cost of Raw material	260	350	580
Price of Final product	900	1500	2000
Total Expenditure	1,34,000	1,56,000	2,62,000
Cost of final product/kg	870.1	1405.4	2015.4
Total income per month	1,38,600	1,66,500	2,60,000
Profit	4600	10,500	-2000

Table 2: Data for solar dryer

	Pepper	Nutmeg	Clove
Labour energy(MJ/Month)	208	52	156
Drying energy(MJ/Month)	1113.6	770.24	939.6
Total energy (MJ/Month)	1321.6	822.24	1095.6
mass per batch	40	120	40
Drying time(Days)	1.5	7	2
Labour days	20	5	15

Number of batch per month	20	4	15
Throuhput per batch	16	37	13
Cost of Raw material	260	350	580
Price of Final product	900	1500	2000
Total Expenditure	2,28,000	1,73,000	3,63,000
Cost of final product/kg	712.5	1168.9	1861.5
Total income per month	2,88,000	2,22,000	3,90,000
Profit	60,000	49,000	27,000
Payback period(days)	38	46	83

Here selection of particular dryer type is called "Saviru Dryer" because it was most popular solar dryer in Sri Lanka.For this study,the following criteria were selected.They are specific locations with an assumed 8 hours of sunshine per day,ignor the rain factors,price factor independent of quality of product,cost of raw material,constant during the period of considered.

3. RESULTS

The collection of data on three different export agro products was analysis. It was found that the, consumption of total energy requirement to make a product using open sun drying technology and solar dryer technology respectively, varied. This energy difference is due to the unutilized solar thermal potential in the food drying process.
It was found through calculation that the quantity varied, for example according to the product pepper, the total energy consumption under two technologies was 5.7MJ/kg and 4.2MJ/kg respectively. However, the numerical value depends on a number of factors like environmental condition, characteristics of food, technology of capturing energy. Actually, the theoretical potential might be higher than the figures calculated above. But, the amount of energy that could be practically captured was calculated. Anyone using or trying to capture this unutilized energy for drying purposes will achieved substantial benefits.Actually, unutilized solar thermal potential was subject to study where all other external factors remained constant and only the drying technologies were varied.However environmental factors such as relative humidity, speed of win and ambient temperature variations are uncontrolled factors.

Table 03: Result comparison of two technologies

	Pepper	Nutmeg	Clove
Labour energy saving MJ/ kg	1.3	2.4	1.6
Throughput increases percentage%	107	33	50
Drying time reduced percentage %	50%	30%	33%
Production cost reduction Rs /Kg	157.5	236.5	154
Payback period(days)	38	46	83

4. CONCLUSION

The conclusion that can be arrived at, based on the utilization of solar thermal drying potential in Sri Lanka is, that utilized solar energy is not utilized for purposes of the food drying industry in Sri Lanka. If this solar energy had been applied to the food drying industry, it would be possible to derive economic benefits for similar industries running at a loss at present in this country. On the other hand, there is also the potential of increasing the volume of profit on industries running as viable concerns at present. According to the findings of this research, it can be seen that selected type of food which can be dried at profitable level.

A suitable technology must be used to capture available drying potential for the minor export agro industry.However, in order to obtain the facility of drying technology, financial investment is necessary. The other very important barrier is lack of knowledge about this technology.The disadvantage of open sun drying methods are ,drying time is long, drying rate cannot controlled, and drying temperature cannot be controlled susceptibility to case hardening and nutritional change. In addition to contamination by dust and insect attack as a result, the quality of the product is not predictable. The objective of dryer technology has been to find good solution to the constraints above. But the facts remain that most other drying technologies involved energy inputs. As such, cost of production had to rise. On the other hand, solar energy is available free, almost throughout the year. Therefore, solar drying technology was developed with the objective of minimizing fuel use and improves the product quality. One such technology is a solar dryer.

5.REFERENCES

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