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Development of infrared food dehydrator

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Abstract
Infrared drying is the latest technology used for drying of food products. There are also ovens present in the market for cooking using infrared light. An infrared dehydrator is developed for drying of Non Timber Forest Produce and Horticultural Crops. A dehydrator is developed which is rectangular in shape and has a drying area of 6.84 square feet. Two infrared bulbs of 250 Wattage each , is used for production of heat and two fans are also attached for circulation of air in it. Two trays made up of wire mesh screens were used for keeping product in it. In a trial a sample of 200 g *Neem* leaves having an initial moisture content of 58% were kept in the fabricated dehydrator. Time taken for drying of product from 58% moisture content to 10% moisture content at different temperatures of 45 °C, 50 °C, 60 °C, 65 °C and 70 °C was 2 hr, 1.5 hr, 1 hr, 0.75 hr and 0.5 hr respectively. The fabrication cost of this machine is around Rs. 7,500.00.

Keywords: Neem, infrared, dehydrator, temperature, entrepreneurship

Introduction

Drying of herbs, vegetables, fruits, grains etc. are practiced since ancient times. The traditional method employed for drying of this agriculture produce is primarily sun light. In traditional method of sun drying the products get affected by dust and environment of the surrounding. There are many types of fruits, vegetables and leaves of many trees which require drying for use as food product and for extension of their shelf life. In villages farmers dry many types of herbs for food and medicine use. There are many mechanical dryers also available but due to their high initial and operation cost they are still practiced by food processors in the Industry only. The application of this infrared dryer/dehydrator will benefit farmers and small entrepreneurs to get high quality product at less processing time.

Neem (*Azadirachta indica.*) is a tree having various uses for human beings. All parts of the Neem tree like leaves, flower and bark is used for medicinal purpose. Its leaves are also used during storage of food grains to prevent its deterioration by grain weevil. Due to many medicinal properties of neem leaves it is generally preserved by drying. Dried neem leaves are also powdered to make it easier for consumption by mixing it in another product. Neem leaves are useful against eczema, chicken pox, herpes, hepatitis, asthma, ulcers, diabetes, gum diseases, malaria etc. Neem powder also has cosmetic use. The machine is developed with the objective to process product with low initial and processing cost. This machine is also capable of protecting the product from dust, dirt etc. and also able to work during night hours. The fabricated machine was tested for its efficiency and dehydration test was tested on neem leaves.

Materials and Methods

A dehydrator was fabricated with MS iron sheet having two trays for keeping product. Aluminium foil was used to make a second layer in the dehydrator touching the MS iron sheet of dehydrator. Two infrared bulb of 250 Watt each was fitted at the bottom portion, inside the dehydrator. In front portion of the dehydrator a square transparent glass is fitted. Behind the dehydrator two fans were fitted on upper portion to suck air from outside atmosphere. Thermal sensors were placed inside the dehydrator and its display was fitted outside the dehydrator. It comes with a relay which is connected to the IR bulb. If the required temperature is achieved, this module can control the output using relay. It has a control range of 50 to 110 degree Celsius. SMPS was also used in the machine. It also embeds the matrix LED Display, in which the measured temperature is shown. Drying area of dehydrator is 3.42 sq. ft. which can hold upmost 3 kg of neem leaves properly. The specification of infrared dehydrator is given in table no. 1 and its cost of construction is given in table no. 2.

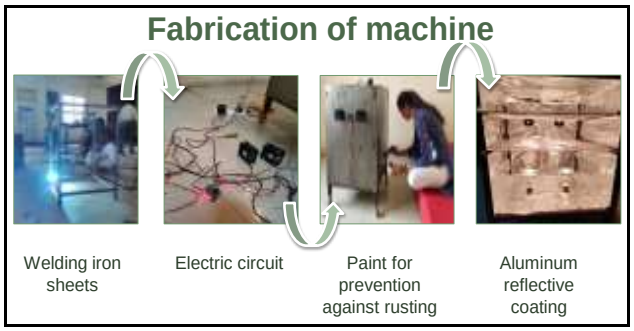

Fig 1: Fabrication of Infrared dehydrator.

Table 1: Dehydrator specification

S. No.	Specifications	Dimensions (lxbxh) in m
1.	Sid Size Dimensions of dehydrator	0.6m x 0.6m x 0.8m
2.	Size of tray	0.59 m x 0.54 m
3.	Distance between trays	0.2 m
4.	Volume (Inside)	2880 m^3
5.	Weight	38.7 kg

Table 2: Cost of construction of Infrared dehydrator

S.no.	Product	Unit	Cost (Rs.)
1.	Iron sheet	1 (8 × 4 in)	2500.00
2.	Infrared bulb	2	1400.00
3.	Thermal sensor	1	200.00
4.	Bulb holder	2	200.00
5.	Inlet fan	2	200.00
6.	Aluminium foil	2	150.00
7.	SMPS	1	150.00
8.	paint	1	70.00
9.	Glass frame	1	90.00
10	Welding and miscellaneous items		2,540.00
Total			7,500.00

Dehydrated neem leaves were prepared in this IR dehydrator. The steps followed for its preparation is given below and its process flow chart is given in Fig.2:

1. Collecting neem leaves from neem tree.
2. Washing it with clean water was done to remove the unwanted dust particles from it.
3. Now the products are kept on a cotton cloth, to absorb the water present on the surface of the leaves. It is left under fan for few hours to complete removal of water molecules present on the outer surface of leaves.
4. Grading was done to separate out the damaged leaves.
5. Leaves put it in the dehydrator for drying.
6. Grinding dried neem leaves

Fig 2: Flowchart for preparation of dried neem leaves

The following formulae were used to find out the moisture content of leaves and Energy efficiency of infrared food dehydrator. Total amount of moisture removed from neem leaves was calculated according to the following formula:

$$\text{Moisture content (\%)} = \frac{\text{Initial weight of sample-final weight of sample}}{\text{Initial weight of sample}} \times 100$$

If, T_1 and T_2 correspond to the inlet and outlet temperature and T_0 represents the ambient air temperature. Then Thermal performance in terms of energy efficiency is calculated by using the following formula.

$$\text{Energy efficiency} = \frac{(T_1-T_2)}{(T_1-T_0)}$$

Results and Discussions

The neem leaves was dried and its powder is made, which is shown in figure no. 3. The initial moisture content of dried leaves was measured to be 58% by using hot air oven drying method. The thermal performance of the dehydrator is shown in table no.3, which shows that as the temperature increases the infrared dehydrator becomes more efficient.

Fig 3: Neem leaves and its powder made after drying it with infrared dehydrator

Table 3: Energy efficiency of IR dehydrator at different temperature

Temp	T_0 ambient air temperature °C	T_1 inlet temperature °C	T_2 outlet temperature °C	Energy efficiency %
45 °C	33	32.5	34.38	3.76
55 °C	33	32.5	37	9
60 °C	34.2	33.7	41.2	13.39
70 °C	34.5	34.1	46.4	30.75

The effect of temperature on time of drying is shown in table no.4, which shows that as the temperature increases the drying time reduces.

Table 4: Effect of temperature on time of drying of neem leaves

Neem leaves (200 g)	Temp (°C)	45	55	60	65	70
	Time (hr)	2	1.5	1	0.75	0.5

The energy consumption for drying neem leaves at different temperature is shown in table no. 5. The result shows that as temperature increases the energy consumption per kg decreases.

Table 5: Energy consumption for drying neem leaves

	Neem leaves (3 kg)			
I	Temp. (°C)	Drying time (hr)	Unit (kWh) consumed for drying 3 kg of neem leaves	Unit (kWh) consumed for drying 1 kg of neem leaves
	45	2.0	1.0	0.33
	55	1.5	0.75	0.25
	60	1.0	0.5	0.17

Summary and Conclusion

This machine is going to be so useful in today's times where people have less time to do household work. It's going to make dehydration easier and save a lot of time and electricity consumption. This infrared dehydrator will also be helpful for people seeking to start a new business related to food processing. The maximum and minimum energy consumption for dehydration of 1 kg of neem leaves at 45 °C and 60 °C were 0.33 Unit (kWh) and 0.17 Unit (kWh) respectively. The maximum energy efficiency of Infrared dehydrator was found when it operates at 70 °C.

References

1. Sudheer KP, Indira V, Peter KV. Post harvest technology of horticultural crops. New India publishing agency, Pitam Pura, New Delhi-110 088; c2007.
2. Sulaiman SHB, Ramli HB, Fadzil ILB. The food dehydrator; c2020.
3. Madhankumar S, Muthukkhumaran KSR, Navaneeth RA, Padmanabhan M, Shriram KM. Design and modelling of automated hot oven food dehydrator. In: 2021 7th International Conference on Advanced Computing and Communication Systems (ICACCS). IEEE; c2021. p. 1130-1134.
4. Jena BN, Saily AS, Nanda SP, Madhusmita M, Swain S. Development of Dehydrator for Domestic Use of Fruits; c2022.
5. Sonal AP, Jayaraj A, Shahana A, Khalai S, Murali A, Rajesh GK, Nighitha MT. Development and performance evaluation of infrared dryer [Doctoral dissertation, Department of Post Harvest-Technology and Agricultural Processing]; c2020.
6. Biswas SR. Monograph of Neem; c2001.
7. Kumar MA, Kumaresan G, Rajakarunakaran S. Performance Evaluation of Heat Pump Dryer in Specific Moisture Evaporation Rate for Various Herbal Leaves. Int J Eng Res Technol (IJERT). 2021;10.
8. Singh P, Tiwari M. Review on Azadirachta Indica. Int J Pharma Life Sci. 2021;2(1 Part A):28-33.
9. Mondal MHT, Shiplu KSP, Sen KP, Roy J, Sarker MSH. Performance evaluation of small scale energy efficient mixed flow dryer for drying of high moisture paddy. Drying Technology; c2019