

Electrical Dryer for Small Cardamom by Revolving Type Drying Chamber Aimed at Effective Dry

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Abstract—Cardamom is a valuable spice that is obtained from the seeds of a continuing plant. India is the largest producer of small and large cardamom in the world with 54% share in world production followed by Kerala, Karnataka and Nepal and Bhutan. For long-duration storage of cardamom and in order to bring out its aroma, the fresh cardamom capsules (with 80%-85% moisture) has to be dried immediately after harvesting to bring down its moisture content to less than 10% through a drying process. Still a primitive and inefficient (operating efficiency level of about 5%-15%) smoking method (using traditional method) is being used for drying of cardamom resulting in huge wastage of fuel wood (estimated 25,000 MT per year) and poor (burned and darkened) quality of dried cardamom capsules. An electric dryer is an improvement over the use of a wood fuelled fire and is the best choice for drying large quantities of cardamom, especially in places, where there is rainfall during the drying season. The alternate design of electricity based cardamom dryer, which is designed by some essential parts that is 1500W electric heater, air blower or electric fan for exchange the heat from heater to drying chamber and rotating type drying chamber and stepper motor. This paper gives a brief description of efforts made to obtain effective drying of small cardamom under different environmental conditions.

Keywords— Cardamom; Drying; Moisture

1. INTRODUCTION

Cardamom (*Elettaria cardamomum*) the Queen of Spices it enjoys a unique position in the international spices market. Cardamom is original to the southern section of evergreen forests of Western Ghats. Till early seventies India was the main producer and exporter. Now Guatemala has emerged as World's largest producer, offering stiff competition to Indian cardamom in the International market. In India, cardamom is cultivated in the southern states of Kerala, Karnataka and Tamilnadu. The total area under cardamom in India is estimated to be around 79,000 hectares (2012-2013). Cardamom is used for flavouring various food preparations, sweet, beverages and alcohols. It is also used for medicinal purpose, both in Allopathic and Ayurveda systems. The traditional methods of curing, also being insufficient in energy terms, imparts smoky smell and remain colour to the dried cardamom, causing loss of natural green colour and pleasant odour. No data is available on the performance of these traditional methods with reference to fuel consumption, drying temperatures, drying rates etc. Considering that large quantities of fuel wood are being consumed every year on curing and that Kerala is located in the ecologically sensitive region of Western Ghats in

Southern India. It is important to know the drying characteristics of small cardamom and the performance of traditional drying chambers. Traditionally cardamom capsules are spread on a concrete floor to dry using the natural heat from the sun. The capsules should be placed away from direct sunlight to preserve the green colour

(strong sunlight will make the colour fade). This is the simplest and cheapest method, but does not produce the highest quality product. It is only successful in places where the climate is dry and hot. Now a day's enormous development in cardamom drying process but still being consume large quantity of fuel wood it is a reason to deforestation. This paper gives a new alternate design for drying of small cardamom under different environmental conditions.

2. DRYING CHARACTERISTICS OF SMALL CARDAMOM

Cardamom must be dried before it is stored and sold for market. This is the most important part of the process drying as it affects the quality of the final product. It is important to dry the cardamom capsules as soon after harvest as possible to prevent the loss of flavour. Harvesting at the correct stage of maturity is essential to produce high quality cardamom capsules. It is also important that the drying process is as short as possible so that mould does not grow on the capsules and the bright green colour is retained. The drying temperature should be above 50°C-70°C as this affects the colour and delicate flavour of the final product. In most places, cardamom capsules with a good green colour can be sold for a premium price. The moisture content of a fresh cardamom capsule is about 85%. This needs to be reduced to 10%. Storing of cardamom is done after drying. If the drying period is too long mould can start to grow on the cardamom. There are several options available to the small scale processor, depending upon the size of the

business and the local weather conditions at the time of processing. A good dryer should work under different environment conditions even it should dry fresh cardamom capsules at rain season.

A. Demerits Of Wood Consumed Dryer

- This method puts a huge demand on firewood. The smoke from the fire can give the capsules an unpleasant smoked flavour.
- This method operates with very poor operating thermal efficiency of the order of 5-15% resulting in wastage of huge quantities of fuel wood.
- The specific fuel consumption is in the range of high (1 - 2.5 kg fuel wood per kg fresh cardamom).
- Cardamom takes a long time (25-40 h) for drying.
- Non-uniform drying.
- Poor quality loses the original natural colour due to burning and becomes smoky.
- During operation constant attention is required for managing fire, maintaining low flame preventing fire hazards, and turning over the bed of cardamom.

3. ALTERNATE DESIGN

An electric dryer is an improvement over the use of a wood fuelled fire and is the best choice for drying large quantities of cardamom, especially in places, where there is rainfall during the drying season. It is the most expensive of all options but does produce the highest quality product. It is important that the drying temperature does not exceed 50°C-70°C. We present a new design to dry the fresh cardamom capsules with the help of electric heater, air blower and rotating type of drying chamber. It is fitted with an electric fan to maintain air supply for heat transfer, which prevents loss of quality while drying up. From this alternate design wood consumption is neglected and the quality of the product is rich. By the controlled hot air supply decrease the time consumption of drying process. Through the alternate design the aroma or volatile content of dried cardamom is rich.

A. Experimental Set-Up

Fig 3.1 shows the alternate design of electricity based cardamom dryer, which is designed by some essential parts that is 1500W electric heater, air blower or electric fan for exchange the heat from heater to drying chamber and rotating type drying chamber and stepper motor. Fig 1 shows the design of electric heater based cardamom dryer. The electric fan is fixed in the bottom of

the of the frame (0.75m height, 0.30m width) then place electric heater above from electric fan. Then we give 0.2m gab between drying chamber and heater because maximum mixing of heat with flow air from electric fan.

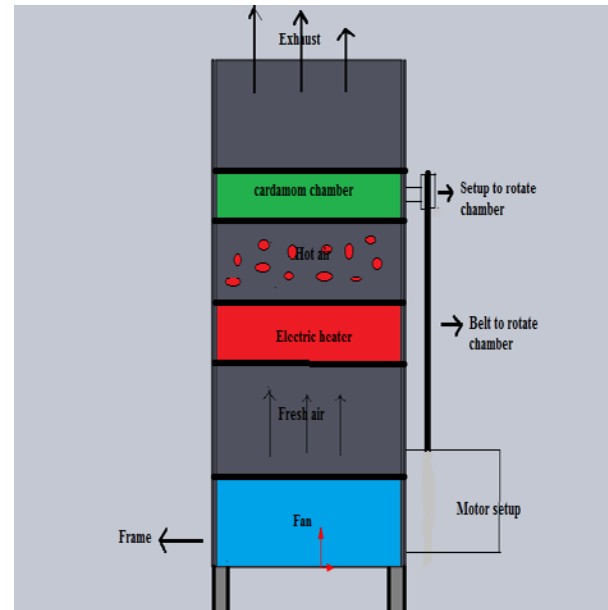


Fig 3.1- Alternate Design

B. Target Of Our Design

- To neglect wood consumption for dry fresh capsules by traditional method.
- To retain the natural green colour of dried cardamom capsules.
- To available in all weather conditions even in rainfall.

C. Electric Heating

Electric heating is any process in which electrical energy is converted to heat. Common applications include space heating, cooking and water heating and industrial processes. The heating element inside every electric heater is an electrical resistor, and works on the principle of Joule heating. An electric current passing through a resistor will convert that electrical energy into heat energy. Most modern electric heating devices use nichrome wire as the active element. Advantages of electric heating methods over other forms include precision control of temperature and distribution of heat energy, combustion not used to develop heat, and the ability to attain temperatures not readily achievable with chemical combustion. Electric heat can be accurately applied at the precise point needed in a process, at high concentration of power per unit area or volume. Electric heating devices can be built in any required size and can be located anywhere within a plant. Electric heating processes are generally clean, quiet, and do not emit much by-product heat to the surroundings. Electrical heating

equipment has a high speed of response, lending it to rapid-cycling mass-production equipment. Fig 3.2 shows electric heating coil.



Fig 3.2- Heating coil

D. Reason For Select Electric Heater

- Controlled temperature distribution to the chamber.
- Quickly attain the required temperature.
- Gladly available source.
- No pollution to environment compared to wood based drying.
- Other fuels like coal, diesel and gas have huge demand.

E. Drying Chamber

This experimental set-up consists of rotating type drying chamber. It is specially designed for efficient drying of fresh cardamom capsules. Modern wood consumed dryers and traditional dryers consist of rectangular or square shaped drying chambers. According to the previous drying chamber the quality of dried capsules is poor and the natural source (wood) consumption is more and takes longer time to dry. We designed a special shape drying chamber for even drying of fresh cardamom capsules. For making of even and complete drying of cardamom we designed rotating type drying chamber with the help of stepper motor. This motor and drying chamber are connected through pulley and belt drive.

F. Reason For Select Rotating Type Drying Chamber

Consider the normal drying chamber there are huge rate of quality loss of cardamom in bottom layer dried capsules due to uneven heat supply. In previous type drying chamber has critical to handling that is loading and

unloading of cardamom capsules. In this case there is no need of equipment for remove the dust of dried capsules. Here after complete drying stop the electric heater and fan then increase the speed of motor and insert a tray at bottom of the chamber to remove dust. This kind of drying chamber reduces the drying time (15-18h) of cardamom.

G. Air Blower

Here we are using electric air blower for forced heat transfer from heater to drying chamber. The air blower also controls the drying rate through speed variation of blower. Air blower sucks atmospheric air and forced supply to the electric heater for heat convection process.

4. COMPARISION BETWEEN WOOD BASED DRYER AND ROTATING TYPE ELECTRIC DRYER

During evaluation fresh cardamom capsules dried by wood based dryer. From that we gather some data through the wood based dryer such as wood consumption, time consumption and quality of final capsules. Then we

<i>DESCRIPTION (for 15kg)</i>	<i>WOOD BASED DRYER</i>	<i>ALTERNATE DRYER</i>
Quantity of fuel	35-45kg of fire wood	25 units of AC current
Drying time	20-23 hours	15-17 hours
Temperature	50-60°C	55-70°C
Final product	Uneven dried capsules	Better quality
Aroma of final product	Less aroma with burn smell	Vast aroma and oil content

compare to our alternate design. Theoretical analysis tabulated by rate of heat transfer, amount of heat generated and drying chamber design. For theoretical analyses we consider 15kg of fresh cardamom capsules.

5. CONCLUSION

From this paper we give suggestion for efficient drying of small cardamom through electric heating coil and rotating type drying chamber. We reduce loss of heat exchange in a traditional method and increase the quality, heat efficiency volatile content and aroma level by our electrical dryer for small cardamom. It can be free from pollution.



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