

Design & Development of Hot Air Dryer for Cashew Nut

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ABSTRACT: In present scenario control the moisture content in raw cashew nut for better production is an attention of many researchers. Present papers explore the design, development and fabrication of Hot air dryer in the organisation, which can be used as manual operating device for control of moisture content in the raw cashew nut. Hot air is used in this work for controlling the moisture content. A prototype set up is developed to dry the raw cashew nut. A box like set up has a rotary drum made of iron wire to dry the 2 to 3.5 kg raw cashew nut at a time. Nuts get dry due to the flow of hot air from the bottom side of the set up. A lid provide from upper side to feed the raw cashew nut in the rotary drum. A machine of this type can be manufactured for small organisation and village level applications in the developing countries where bulk of the world cashew is produced.

KEYWORDS: Whole kernel out (WKO), Hot air, Moisture, Scooping, Efficiency

I. INTRODUCTION

Cashew nut is mainly made up of kernel and shell Fig 1, as components of the cashew nut have numerous economic uses, the cashew nut is of significant economic importance. The shell liquid (CNSL) is a by-product of the cashew nut and is a natural source of saturated and unsaturated long-chain phenol. The kernel of the cashew nut is high in oil and protein content, constituting about 40-57% and 21%, respectively [1].The conventional method of drying cashew nut has been done by manually drying the cashew nut in the open drying yard. But it is not possible during rainy season due to cloudy atmosphere.

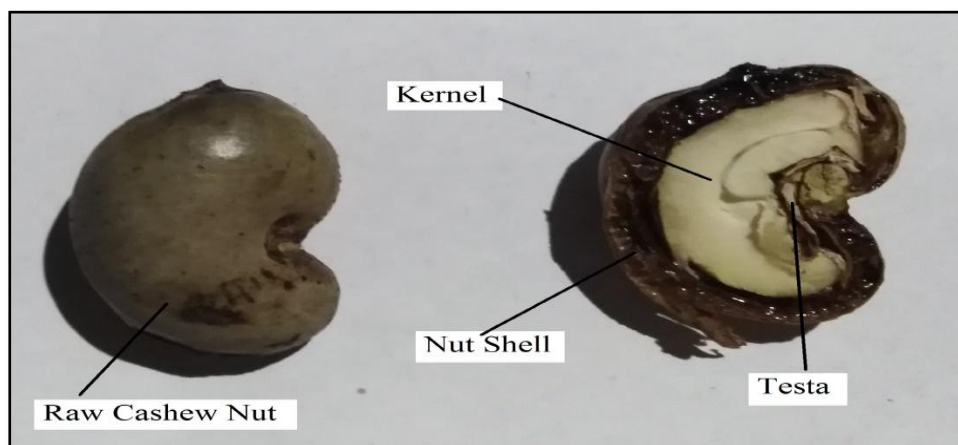


Fig. 1 Cashew Nut

Cashew nut farmers don't earn much more profits in spite of being a producer of dry fruits due to lack of processing facilities in technical as well as the managing level [2,4].The objective of this approach is to design and develop a hot air dryer to reduce moisture content from raw cashew nut and execute it for better performance.

1.1 Some details of Hot air

Hot air drying applications include primary, the evaporation of water or another liquid such as a solvent from the surface being dried. Evaporation occurs as heated air circulates over and around the surface being dried [5, 6]. The addition of heat in a body increases its temperature while the removing of heat from body results in a temperature decrease. How much a given amount of heat will increase temperature of a body depends on the mass and heat capacity of the body.

1.2 Objective of an Analysis

1. To design, develop and fabricate an Hot air dryer in organisation, to explore its use in reduce moisture from raw cashew nut kernel to achieve reduction in unscooped& uncut cashew
2. To provide solution in the form of design of Hot air dryer to overcome scooping problem
3. To reduce the overall time required for cashew nut kernel process to achieve better production.

II. DESIGN & FABRICATION OF AN HOT AIR DRYER

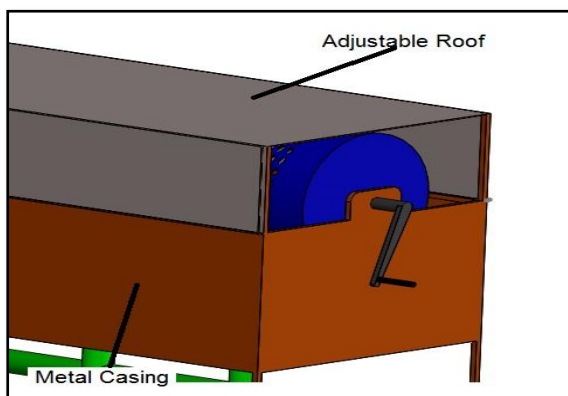
2.1 Philosophy of Design

The Hot air dryer was conceived as a village-level, low-cost, simple-to-operate and easy-to-fabricate manuallyoperated device capable to reducing moisture content from raw cashew nut.

2.2 Prototype Machine Description

The machine is a simple device, which allows for adjustment of moisture content from raw cashew nuts before shelling. It comprises of four major components assembled together by welding to form a compact device. The components are: the metal casing, the rotating drum which is supported by metal casing, the heating gun, and the lever arm.

The Metal Casing: The metal casing is made of mild steel welded into a rectangular box, with an opening on the upper side for the feeding of raw cashew nut into the rotary drum [3]. The metal casing as shown in the Fig. 2



(a) The 3-D Solid model of casing

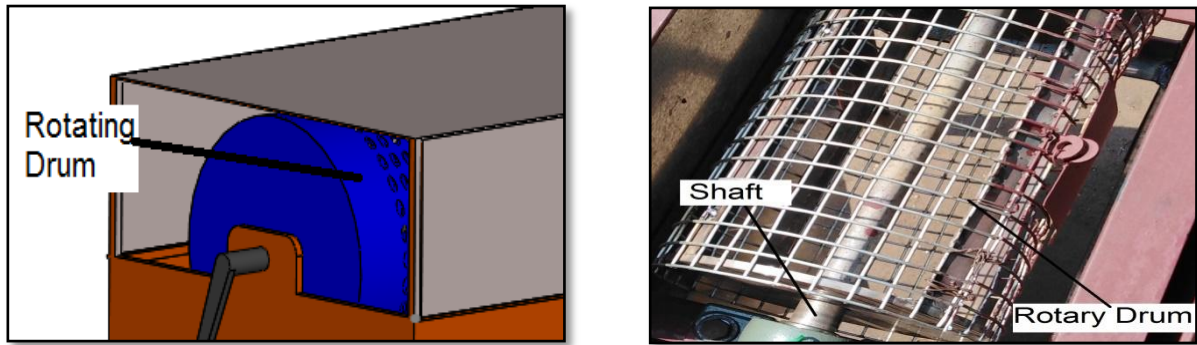


(b) The fabricated casing

Fig.2.Casing of hot air dryer

After the processing on the raw cashew nut, the dried raw cashew nut removes from the output section which on the left side of metal casing.

Rotating drum: This is an iron wire drum of dimension 305 mm × 153 mm with wire thickness 1mm dimensioned to accommodate 3.5 kg cashew nuts of various sizes dry in a single run. It is supported at the casing by a foot step bearing mounted on the metal case to allow the rotate drum inside it as shown in the Fig.3.



(a)The 3-D Solid model of rotating drum

(b) The fabricated rotating drum

Fig.3. Rotating drum of hot air dryer

The rotating drum has small lid to feed raw cashew nut. After the loaded the rotating drum with raw cashew nuts lid to be closed.

Heating gun: The heating nozzles are attached to the metal casing from bottom side as shown in the Fig.3. The hot air duct supply a hot air from hot air gun to the rotating drum through the nozzles. The clearance between nozzle and rotating drum is 100 mm. The temperature range of hot air gun is from 80°Cto the 360°C .

Lever arm: The lever arm is attached to the end of the shaft of rotating drum. The rotating force is applied through the lever arm and supported at the casing by a foot step bearing mounted on the metal casing. On activating the lever, the rotating drum start rotating inside the casing.

2.3 Preliminary Investigation

Dry-boiled cashew nuts were obtained from PARANJAPE AGRO PRODUCTS (INDIA) PVT LTD cashew nut processing factory in Ratnagiri. Some properties such as dimension (length, thickness and width) and moisture content were determined.

2.4 Design

2.4.1 The rotating drum

The average of raw cashew nut processing is 30 kg/hr. According to the processing of raw cashew nut the volume required to dry the cashew nut was calculated as follows:

$$\text{Volume} = \frac{\pi}{4} \times (\text{diameter})^2 \times \text{Length} \quad (1)$$

$$= 0.0072 \text{ m}^3$$

For calculating the capacity of rotating drum used equation (1) value.

$$\text{Capacity} = \text{Volume} \times \text{Diameter}$$

$$= 3.6 \text{ Kg}$$

In order to get prior idea about the portable difficulties, that may arise during fabrication of hot air dryer. A 3-D solid model of total test set up was created as shown in the Fig. 4.

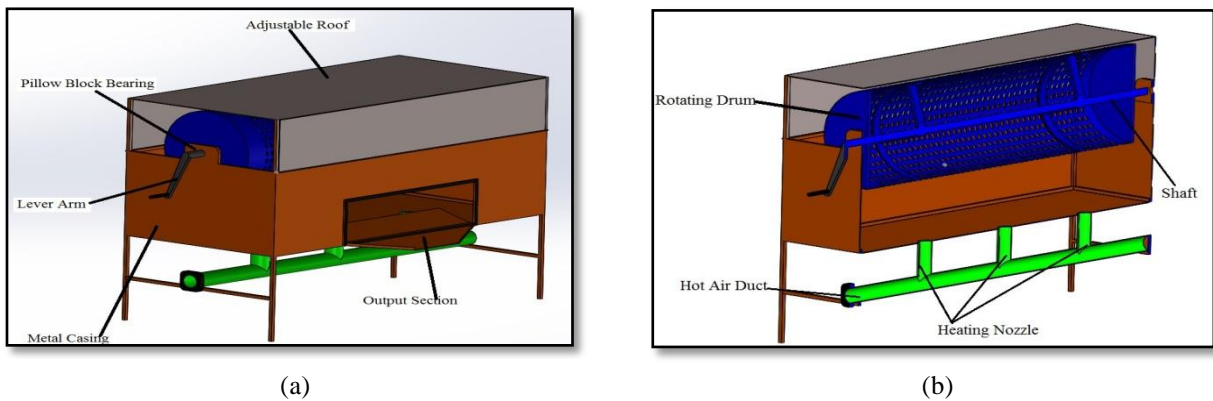


Fig.4. Complete 3-D Solid model of hot air dryer

After designing of hot air dryer with theoretical formulation, the total hot air dryer assembly was fabricated in the laboratory with four main parts as metal casing, rotating drum, hot air gun and lever arm as stated above.

III. EXPERIMENTAL RESULTS AND DISCUSSION

Figure 5 illustrates test setup prepared in the organisation. At present, the control on the moisture content from raw cashew nut is still a technical problem in the world [7]. This paper presents a novel adaptive hot air dryer to control moisture content from raw cashew nut designed by our studying team. This research will help to improve the production efficiency of cashew nuts and reduce the time and control the moisture. Also it helps to increase the whole kernel out rate (WKO).



Fig.5. Fabricated Hot air dryer

The demand of huge production can easily be coped off also cashew processing may be so cheapest. This solution developed is optimal and reliable enough in order to get good quality in the cashew nut processing. This machine can be developed with full automation to increase the rate of cashew nut processing



IV. CONCLUSION

In this work, primary objective to design and develop an Air Dryer For cashew nut, to control moisture is achieved. The designed Air dryer can provide maximum expected Whole Kernel Out rate (WKO) which was calculated initially by the theoretical formulation. However, precise manufacturing of air dryer can give improved performance since the moisture content in it will be reduced to most of the extent. Such design may lead to increase in a production rate with reduced moisture content. A device of this nature can be manufactured in small machine shops in the developing countries for small entrepreneurs and village level applications. However, results obtained from this analysis will be extremely useful while making such new designs for further studies and research work.

REFERENCES

- [1] Jie Gong, Wen Xia, Yun-Fei Fu, Hui Huang, Fan Zhang, Yi-Jun Liu, PengFei Zhao, A Review on the Cashew Nut Shelling Techniques, Vol.3 No.4, 2016, pp. 133-138.
- [2] Pradeep N, Sasikala D, Design and development of smart cashew nut shelling, inspection & grading machine, JCPS Volume 9, Issue 4, October - December 2016
- [3] S. J. Ojolo, B. S.Ogunsina , Development of a Cashew Nut Cracking Device , Agricultural Engineering International . The CIGR EjournalManuscript PM 06 030. Vol. IX. June, 2007
- [4] B. Karthik, E. Manikandan, Automatic Cashew Nut Cutting Machine, IJSRD - International Journal for Scientific Research & Development| Vol. 5, Issue 05, 2017
- [5] Zahra Mazandarani, NargesMirsaeidghazi, Mehdi Kaviani, Mohammad Ali Shariati, Drying of agriculture products using hot air oven and microwave method, Indian Journal of Research in Pharmacy and Biotechnology 2(6) November December 2014
- [6] Heat consideration in hot air drying , <https://techblog.ctgclean.com>
- [7] SourabhGaikwad , Dr. K.P. Kolhe , A Review of Cashew Nut Shelling Machine for Cashew nut Growers ,International Journal of Science, Engineering and Technology Research ,Volume 6, Issue 10, October 2017