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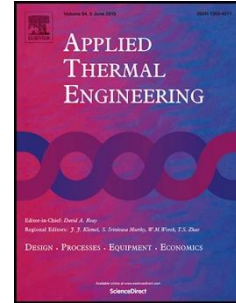
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# Thermal characteristics of heat pump dryer for ginger drying

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## Highlights

- A closed system heat pump dryer was used to dry ginger at 50°C for 200 minutes.
- Drying performance was contrast between air and nitrogen using as drying medium.
- Gained heat at the internal condenser and rejected at the evaporator, input energy at the heater and that total of refrigerant cycle and system and specific moisture extraction rate for air drying were higher than nitrogen.
- Heat gained at external condenser and specific energy consumption for air drying was lower than nitrogen.

Keywords: Closed system, energy consumption, ginger, heat pump dryer, thermal characteristics

Abstract: We discuss the drying performance and energy consumption of a closed system heat pump dryer for ginger drying at 50°C within 200 minutes using air and nitrogen as the drying medium. The fresh ginger at moisture content of 777 was dried by air and nitrogen down to 132 and 89 % dry basis. The Gained heat at the internal condenser was 15.4 and 20.5 MJ and rejected heat at evaporator was 18.6 and 22.9 MJ for air and nitrogen cycles, respectively. Heater provided 62.93 and 65.60 % total input energy of refrigerant cycle while heat gained at external condenser were 37.92 and 28.79 % output for air and nitrogen drying respectively. Air drying required total input energy of 11.6 compare to nitrogen of 12.5 MJ. Specific moisture extraction rate of ginger drying in air was 0.06 while nitrogen was 0.07 kg water/MJ. Specific energy consumption of air drying was 16.67 while nitrogen was 14.29 MJ/kg water.

## 1. Introduction

Presently, medicinal herbs are gaining importance in mainstream healthcare as greater numbers of people seek safer remedies [1]. Zingiberaceae plants (such as *Curcuma longa*, *Alpinia galanga* and *Zingiber officinale*) are widely cultivated in India, China and Southeast Asian countries such as The Philippines, Malaysia and Thailand. Zingiberaceae rhizomes are consumed as a flavouring and spice in traditional foods [2,3,4]. They are also used as domestic remedies, e.g. *Curcuma longa* and *Alpiniagalnaga* for stomach ache [4,5] and powdered dried ginger paste (*Zingiber officinale*) for headaches [6]. Drying is an important process for preserving agricultural products: it reduces the moisture content to a level which allows safe storage over an extended period [7]. Heat pump dryers

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