Simulation of Temperature and Moisture Profile of Single Mung Bean Grain Under Infrared Radiation

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Abstract

INTRODUCTION: Mung bean is a good source of protein, vitamins, certain minerals and antioxidant compounds for the vegetarian population of the country. During storage, high moisture content of mung bean leads to the maximum quality and quantity losses due to the growth of fungus and insects. Thus drying of mung bean grains is an important postharvest operation to increase the shelf life of mung bean. Infrared drying of grains has shown advantages over the conventional drying due to its short drying time. In the present study, a model is developed for the mung bean under infrared radiation. COMSOL Multiphysics software is used to study the temperature profile and the moisture change over a period of time and was compared with the experimental results.
USE OF COMSOL MULTIPHYSICS: Two interfaces 'Heat transfer in Solids' and 'Transport of diluted species' were used to develop a model of temperature and moisture content of a mung bean grain assumed to be an ellipsoid. The mathematical equations were solved using finite element method.
RESULTS: Mung bean grain was exposed to infrared radiation for 10 mins. Initial temperature of mung bean was 35°C. After heating for 10 mins maximum temperature of 61.93°C was observed. With simulation, after 10mins maximum temperature of 62.85°C was observed. A significant reduction in moisture content was also observed when overnight soaked mung beans grains with moisture content 35.80% (d.b.) was heated for 10mins. The same trend is expected with the theoretically simulate data.
CONCLUSIONS: In this study, coupled heat and mass transfer model was developed. This model is successfully explaining the temperature profile of the single grain of mung bean during the infrared heating. The % error between the final value of experimental data and theoretically predicted data of temperature profile was found to be very low i.e. 1.46%. Similar results are expected with the moisture profile of the single grain, as the temperature and moisture content of a sample are correlated with each other.

Figures used in the abstract

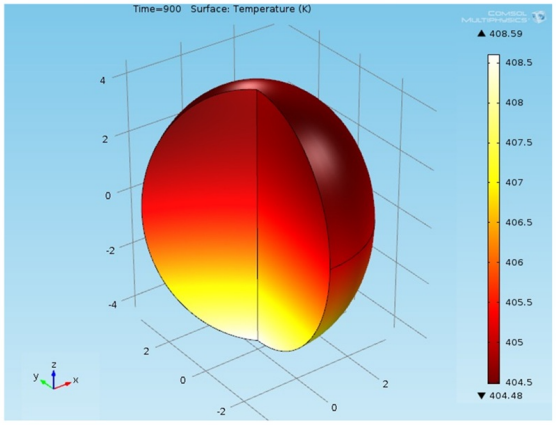

Fig1. 3D Temperature profile of single mung bean grain

Figure 1

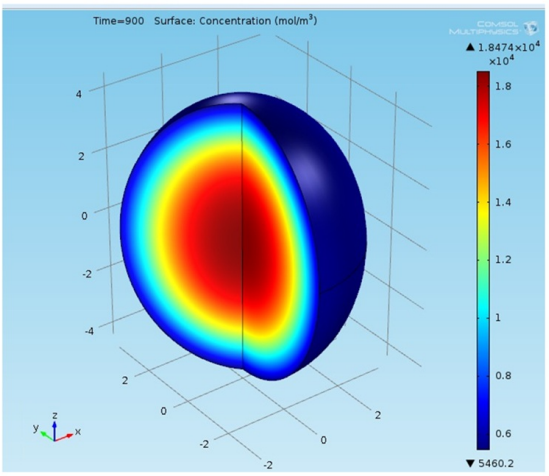

Fig2. 3D Moisture profile of single mung bean grain

Figure 2