

THE EFFECT OF OVEN AND MICROWAVE DRYING METHODS ON THE DRYING
KINETICS AND PHYSICAL PROPERTIES OF TWO BANANA VARIETIES IN LIMPOPO
PROVINCE, SOUTH AFRICA

BY

OMOLOLA Adewale Olusegun
11637391
B.Tech Food Engineering (Lautech)
MSc Food Technology (University of Ibadan)

SUBMITTED IN FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR
OF PHILOSOPHY IN AGRICULTURE (FOOD SCIENCE AND TECHNOLOGY) AT THE
UNIVERSITY OF VENDA



University of Venda

PROMOTER: PROFESSOR A. I. O. JIDEANI

CO-PROMOTER: DR. P. F. KAPILA

AUGUST 2015

UNIVEN LIBRARY

Library Item : 20152377



ABSTRACT

The effect of oven and microwave drying methods on drying kinetics and quality of *Luvhele* (LBV) and *Mabonde* banana varieties (MBVs) was studied. Drying has become necessary because most fruits are highly perishable owing to their high moisture content and the need to make them available all year round. In addition to preservation, the reduced weight and bulk of dehydrated products decreases packaging, handling and transportation costs. Quality changes associated to drying of fruit products include physical, sensory, nutritional, and microbiological. Thin layer drying of LBV and MBV banana varieties was carried out under controlled oven and microwave drying conditions. Drying temperature and microwave power had great influence on the drying rate of the two banana varieties. The Two-term and Wang and Singh models were found suitable for the description of the oven drying kinetics of LBV and MBV respectively while Verma and Wang and Singh models were found suitable for the description of the microwave drying kinetics of LBV and MBV respectively. The data generated from the application of the above models could be used by engineers in the design of drying equipment for the banana varieties. Moisture diffusivities of the two banana varieties increased with increasing microwave heating power and oven temperature. The values of diffusivity for LBV and MBV under microwave processing (100 – 300 W) lay in the range of 5.26×10^{-10} - 1.97×10^{-9} m²/s and 4.89×10^{-10} – 1.69×10^{-9} m²/s respectively while for oven drying (40 – 60°C) of LBV and MBV, the values of diffusivity lay in the range of 1.80×10^{-11} – 2.28×10^{-11} m²/s and 1.99×10^{-11} – 3.85×10^{-11} m²/s respectively. Scanning electron microscopy revealed that the microstructure of dried LBV and MBV slices were affected by microwave and oven drying conditions. The microstructure of the dried slices were characterized by small or large pores and surface cracks. Optimization of oven and microwave drying conditions of LBV and MBV using response surface methodology revealed that colour and texture (hardness) varied with different drying conditions. Model equations were developed to effectively predict quality parameters at any given microwave power, oven temperature and drying time. Good fit of the models were justified on the basis of non-significant lack of fit value of the models ($p > 0.05$). The coefficient of determination R^2 of the models was relatively high. For LBV and MBV under microwave drying process, the drying conditions of 178.76 W microwave power, 12 min drying time were found optimum for product quality at a desirability of 0.91 for *Luvhele* while 127.67 W microwave power, 12 min drying duration with a desirability of 0.86 was predicted for *Mabonde*. For LBV and MBV under oven drying conditions, the optimum drying conditions for LBV was 47.56°C

drying temperature, 944.87 min drying duration and 40°C drying temperature, 646.17 min drying duration for MBV. The predicted values of colour (hue) and hardness were 74.56° and 2 N for LBV while 69° and 1 N were obtained for MBV. Desirability of the obtained optimum conditions were 0.97 and 0.83 for LBV and MBV respectively.

Keywords: Banana, *luvhele*, *mabonde*, microwave, oven, model, drying kinetics, drying curves, optimization, microstructure, effective moisture diffusivity