Research Article

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Determining the heat of desorption for cassava products based on data measured by an automated gravimetric moisture sorption system

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Abstract

BACKGROUND: The isosteric heat of desorption is vital in evaluating the energy performance of food dryers. The isosteric heat of desorption was investigated for different cassava (*Manihot esculenta* Crantz) products prepared as flour or starch, with and without fermentation. An automated moisture sorption gravimetric analyser was used to measure the desorption isotherms over 10–90% relative humidity of the drying air at temperatures ranging from 25 to 65 °C.

RESULTS: Analysis of variance showed an imperceptible contribution of the preparation method in the measured desorption data. This finding also agreed with microscopical images, which revealed the lack of compelling structural differences among different products. A set of empirical sorption equations suggested by the ASAE standard was examined over the measured desorption isotherms. The standard error of estimation was found to be in the acceptable range of 2.36–3.71%. Furthermore, the fulfilment of the enthalpy-entropy compensation theory was considered as an additional criterion in the thermodynamic results of different sorption equations, besides their fitting adequacy. The modified Chung–Pfost equation has proved to be the most suitable equation for cassava products, as it is capable of reflecting the temperature dependency of the isosteric heat of desorption. The net isosteric heat of desorption obtained was in the range of 540–1110 kJ kg^{-1} for 0.10 kg kg^{-1} dry-basis moisture content and 52–108 kJ kg^{-1} for 0.25 kg kg^{-1} dry-basis moisture content.

CONCLUSION: These findings are technologically relevant for optimising common drying technologies such as flash and flatbed dryers.

Keywords: flour; starch; sorption isotherm; thermodynamic properties; drying efficiency

ACRONYMS AND ABBREVIATURES

ANOVA	Analysis of variance
EMC	Equilibrium moisture content
ERH	Equilibrium relative humidity
SEM	Scanning electron microscopy
GAB	Guggenheim-Anderson-de Boer
MRPE	Mean Realtive Percentage Error
SEE	Standard Error of Estimation
kg kg^{-1} db	Kilograms of water per kilogram dry matter
M	Moisture content (kg kg^{-1} db)
$\widehat{\text{ERH}}$	Predicted ERH (decimal values)
T	Temperature (°C)
T^{abs}	Absolute temperature (K)
T_β	Isokinetic temperature (K)
T_{hm}	Harmonic mean temperature (K)
p_i	Parameters of the sorption equations in Table 1

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