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Data Article

Dataset on influence of drying variables on properties of cassava foam produced from white- and yellow-fleshed cassava varieties

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A R T I C L E I N F O

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A B S T R A C T

Freshly harvested cassava has a tendency to deteriorate rapidly in its physiological properties after harvest. Therefore, cassava is often processed using a number of unit operations in order to derive a stable, storable product of acceptable eating quality. Among the unit operations employed, drying is considered as one of the oldest and most important process in arresting deterioration of cassava. In recent times, more researchers are considering foam mat drying as a drying technique for tuber or root crops, although the technique is used, ideally, for fruit juices and dairy. Cassava foam production from white and yellow cassava varieties has been optimized in our previous work [1]. Our data were procured from experimentally measuring mass of cassava foams of white and yellow cassava varieties dried at different temperatures (50, 65, 80 °C) and foam thicknesses (6, 8, 10 mm) over regular drying intervals until no considerable mass change was observed. The mass measurements are the primary datasets used in determination of secondary datasets presented here as moisture removal ratio (MR), effective moisture diffusivity

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(D_{eff}), and drying rate (DR). The MR data were fitted to four thin-layer drying models (Henderson-Pabis, Page, Newton, Two-term), and Page model described the experimental drying data best. The Page model coefficients were analyzed by multiple linear regression (MLR) analysis to show how they are influenced by the drying variables. Drying rate was also fitted by Rational model to fit the DR data and to reflect the two falling rates found. Statistical accuracy and significance were calculated as coefficient of determination (R^2), root mean square error (RMSE) and Chi square (χ^2) and an analysis of variance (ANOVA). Data obtained here are useful as primary data in process and dryer designs and processing of cassava in the cassava industry.

Specifications Table

Subject	Chemical/Food Engineering
Specific subject area	Drying kinetics, Thin-layer empirical modelling, Food processing
Type of data	Table, Chart, Graph, Figure
How data were acquired	Gravimetric measurements, Foam mat drying, modelling, multiple linear regression analyses, Statistical analyses
Data format	Raw and analysed
Parameters for data collection	Mass, Drying temperature, Drying time, Foam thickness
Description of data collection	Raw data collected from gravimetric measurements and time-based intervals during drying. Statistical analyses by multiple linear regression, empirical thin-layer drying models fitting
Data source location	Institute of Agricultural Engineering, Tropics and Subtropics Group, University of Hohenheim, Stuttagrt, Germany Primary data measured from experiments conducted at location.
Data accessibility	With the article
Related research article	O. Ayetigbo, S. Latif, A. Abass, J. Müller, Drying kinetics and effect of drying conditions on selected physicochemical properties of foam from yellow-fleshed and white-fleshed cassava (Manihot esculenta) varieties, Food Bioprod. Process. 127 (2021) 454-464. https://doi.org/10.1016/j.fbp.2021.04.005.

Value of the Data

- Data is important in understanding how drying variables may influence drying kinetics parameters of cassava varieties using the unique drying technique known as foam mat drying.
- Data may be useful for researchers in general, and particularly, food process technicians and food engineers.
- The dataset may be used as basic data in designing drying systems for foam mat drying of cassava
- Data is available as fundamental drying data from experiments conducted, and may also be used for educational and industrial (small scale) purposes.
- From a food technology perspective, the data here is a valuable description of the process of moisture loss in cassava through foam drying, in order to reduce the post-harvest losses associated with cassava, retain labile nutrients (carotenoids), improve the shelf life of cassava, and present cassava in a powder form with safe cyanogenic glucosides level and improved physico-functional properties such as rehydration, water and oil absorption, solubility, and flowability.

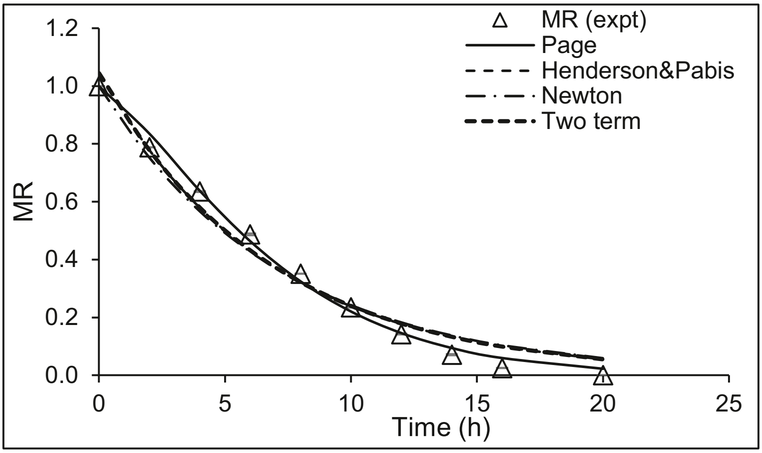

Fig. 1. Fitting accuracy of thin-layer drying models for moisture removal ratio (MR) of white cassava foam dried at 50 °C and foam thickness of 6mm as an example, showing Page model fitting as the best.

1. Data Description

1.1. Moisture removal ratio (MR)

Fig. 1 described at a glance, the accuracy of the fits for the four thin-layer models employed to describe the MR. Basically, the empirical model of Page had the best fit among the models and more accurately describes the MR. Fig. 2 shows the trend of Page model fitted MR curves as influenced by changes in temperature and foam thickness. A compilation of all experimental MR and drying time data and charts as fitted by Page model for the cassava foams and non-foamed pulps (NFP) are shown in the supplementary spreadsheet file (MR vs time – WHITE, and MR vs time – YELLOW tabs). Here, MR decreased with increase in temperature, but increased with foam thickness.

For the practical application of MR to predict the moisture content during drying, MR fitted by four thin-layer drying models (Table 1) showed that the models accurately described MR and were statistically acceptable (coefficient of determination, $R^2 = 0.9602 - 0.9999$; root mean square error, RMSE $= 0.000114 - 0.0727$; chi-square, $\chi^2 = 0.00104 - 0.282$). Again, Page model gave the best statistical accuracy, having the highest R^2, lowest RMSE and χ^2, and a regular trend with increasing temperature and foam thickness. The coefficients of the Page model parameters a and b can be estimated by multiple linear regression (MLR) within the range of drying conditions studied.

For white cassava foam, the following relations were found:

$$a = 0.173 - 0.00504\,T + 0.00848\,F + \mathbf{0.000102}\,T^2 + 0.000821\,F^2 - \mathbf{0.000612}\,T\,F$$
$$(R^2 = 0.9975,\ RMSE = 0.00265,\ \chi 2 = 0.00121) \quad (1)$$

$$b = 0.0639 + 0.0338\,T + 0.0194\,F - 0.000149\,T^2 - 0.000875\,F^2 - 0.0005T\,F$$
$$(R^2 = 0.9842, RMSE = 0.0173,\ \chi 2 = 0.00176) \quad (2)$$

For yellow cassava foam, the following relations were found:

$$a = 0.183 - 0.00631\,T + 0.0177\,F + \mathbf{0.0000967}\,T^2 - 0.000663\,F^2 - 0.000374\,T\,F$$
$$(R^2 = 0.9880, RMSE = 0.00557,\ \chi 2 = 0.00242) \quad (3)$$

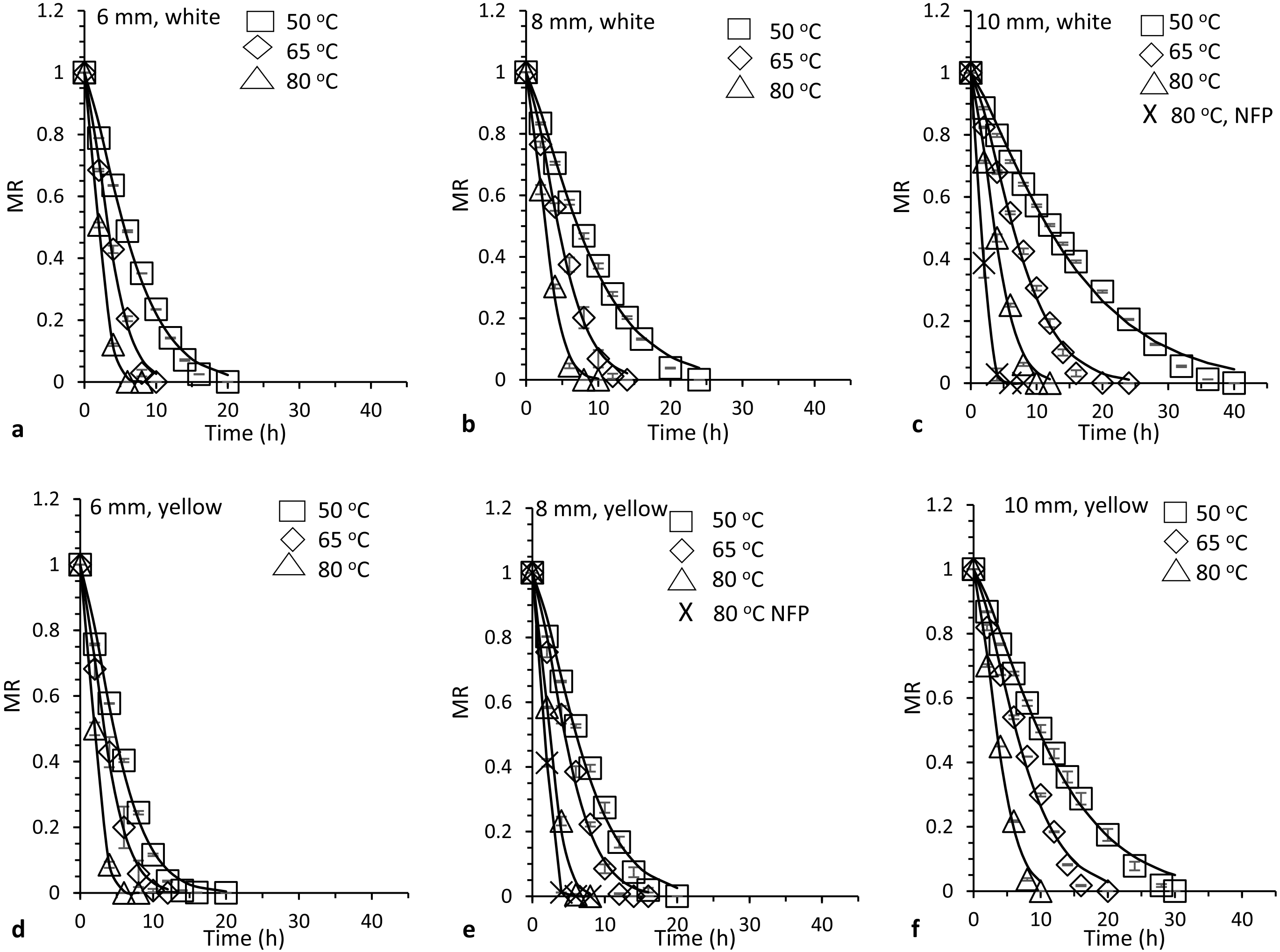

Fig. 2. Moisture removal ratio (*MR*) during drying of white cassava foams (a-c) and yellow cassava foams (d-f) as influenced by changes in temperature and foam thickness. NFP = non-foamed pulp. Error bars represent standard deviation, lines represent Page model fitting.

Table 1
Model coefficients (*a*, *b*, *c*, *d*) and accuracy of four thin-layer drying models for moisture removal ratio (*MR*) during drying of white and yellow cassava foams in comparison to non-foamed pulp (NFP).

Model	Coefficients, accuracy										NFP
Foam thickness		6 mm			8 mm			10 mm			10 mm
Temperature		50 °C	65 °C	80 °C	50 °C	65 °C	80 °C	50 °C	65 °C	80 °C	80 °C
						White					
Page	a	0.0715	0.118	0.211	0.0559	0.0749	0.151	0.0336	0.0495	0.0997	0.252
	b	1.325	1.489	1.678	1.278	1.493	1.569	1.228	1.418	1.521	1.916
	R^2	0.9944	0.9930	0.9997	0.9944	0.9936	0.9957	0.9915	0.9919	0.9934	0.9999
	RMSE	0.0245	0.0301	0.00665	0.0236	0.0278	0.0244	0.0289	0.0299	0.0291	0.000294
	χ^2	0.0558	0.0607	0.0148	0.0644	0.0642	0.0441	0.118	0.0884	0.0696	0.00104
Henderson & Pabis	a	1.047	1.0418	1.0212	1.0445	1.0579	1.0356	1.0391	1.0615	1.0500	1.011
	b	0.148	0.262	0.444	0.111	0.196	0.336	0.0659	0.132	0.245	0.566
	R^2	0.9788	0.9664	0.9775	0.9815	0.9653	0.9698	0.9813	0.9697	0.9649	0.9853
	RMSE	0.0477	0.0659	0.0578	0.0428	0.0650	0.0647	0.0429	0.0583	0.0674	0.0469
	χ^2	0.162	0.174	0.134	0.146	0.218	0.189	0.215	0.251	0.221	0.111
Newton	a	0.142	0.253	0.438	0.106	0.187	0.327	0.0630	0.125	0.235	0.562
	R^2	0.9757	0.9638	0.9769	0.9784	0.9607	0.9681	0.9789	0.9648	0.9616	0.9851
	RMSE	0.0509	0.0685	0.0586	0.0463	0.0692	0.0665	0.0457	0.0628	0.0705	0.0472
	χ^2	0.181	0.184	0.138	0.164	0.239	0.198	0.237	0.282	0.237	0.112
Two-Term	a	0.518	0.785	0.868	0.511	0.540	0.520	0.511	0.529	0.395	0.980
	b	0.147	0.262	0.444	0.111	0.196	0.336	0.0659	0.132	0.245	0.566
	c	0.526	0.257	0.153	0.533	0.518	0.515	0.528	0.532	0.655	0.0304
	d	0.147	0.262	0.444	0.111	0.196	0.336	0.0659	0.132	0.245	0.566
	R^2	0.9787	0.9664	0.9775	0.9815	0.9653	0.9698	0.9813	0.9697	0.9649	0.9853
	RMSE	0.0477	0.0659	0.0578	0.0428	0.0650	0.0647	0.0429	0.0583	0.0674	0.0469
	χ^2	0.164	0.174	0.134	0.146	0.218	0.189	0.215	0.251	0.221	0.111

(*continued on next page*)

Table 1 (*continued*)

Model	Coefficients, accuracy										NFP
Foam thickness		6 mm			8 mm			10 mm			10 mm
Temperature		50 °C	65 °C	80 °C	50 °C	65 °C	80 °C	50 °C	65 °C	80 °C	80 °C
						Yellow					8 mm
											80 °C
Page	a	0.0802	0.125	0.194	0.0566	0.0795	0.168	0.0367	0.0508	0.1056	0.176
	b	1.409	1.444	1.836	1.392	1.448	1.624	1.293	1.419	1.528	2.330
	R^2	0.9939	0.9964	0.9999	0.9904	0.9922	0.9963	0.9912	0.9892	0.9964	0.9999
	RMSE	0.0264	0.0214	0.00248	0.0323	0.0306	0.0234	0.0295	0.0344	0.0306	0.000114
	χ^2	0.0722	0.0399	0.00551	0.0835	0.0956	0.0482	0.103	0.0958	0.0583	0.00606
Henderson & Pabis	a	1.0525	1.0413	1.0215	1.0538	1.0547	1.0307	1.0474	1.0587	1.0458	1.014
	b	0.185	0.261	0.463	0.139	0.195	0.372	0.0822	0.134	0.253	0.555
	R^2	0.9742	0.9752	0.9737	0.9689	0.9684	0.9676	0.9762	0.9652	0.9624	0.9771
	RMSE	0.0547	0.0560	0.0629	0.0582	0.0616	0.0689	0.0486	0.0617	0.0698	0.0592
	χ^2	0.237	0.167	0.146	0.215	0.260	0.172	0.214	0.234	0.181	0.154
Newton	a	0.177	0.253	0.456	0.132	0.186	0.364	0.0781	0.127	0.244	0.550
	R^2	0.9709	0.9729	0.9731	0.9648	0.9647	0.9662	0.9726	0.9602	0.9592	0.9769
	RMSE	0.0580	0.0586	0.0637	0.0619	0.0651	0.0704	0.0521	0.0659	0.0727	0.0595
	χ^2	0.260	0.179	0.150	0.238	0.260	0.178	0.238	0.259	0.193	0.156
Two-Term	a	0.696	0.521	0.226	0.525	0.723	0.696	0.522	0.519	0.512	0.708
	b	0.185	0.261	0.463	0.139	0.195	0.372	0.0817	0.134	0.253	0.555
	c	0.357	0.521	0.795	0.529	0.332	0.335	0.523	0.539	0.533	0.306
	d	0.185	0.261	0.463	0.139	0.195	0.372	0.0817	0.134	0.253	0.555
	R^2	0.9742	0.9752	0.9737	0.9689	0.9684	0.9676	0.9762	0.9652	0.9624	0.9771
	RMSE	0.0547	0.0560	0.0629	0.0582	0.0616	0.0689	0.0486	0.0617	0.0698	0.0592
	χ^2	0.237	0.167	0.146	0.215	0.260	0.172	0.217	0.234	0.181	0.154

R^2 - coefficient of determination, RMSE - root mean square error, χ^2 - Chi square.

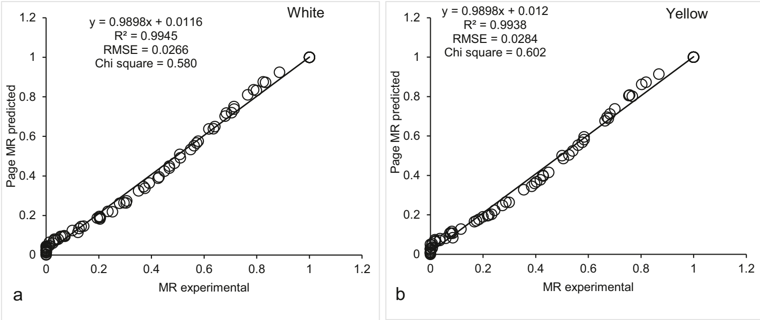

Fig. 3. Accuracy of agreement between experimental moisture removal ratio (MR) and predicted Page model MR for drying of white (a) and yellow (b) cassava foams dried at different temperatures and foam thicknesses. R^2 - coefficient of determination, RMSE - root mean square error.

$$b = 1.701 - 0.0216\,T + 0.0659\,F + 0.000341\,T^2 + 0.0000417\,F^2 - 0.0016T\,F$$
$$(R^2 = 0.9251,\ RMSE = 0.0411,\ \chi 2 = 0.0102) \quad (4)$$

where T (°C) is the temperature, F (mm) is the foam thickness, a (1/h) is the drying constant and b is a dimensionless empirical constant, and bolded coefficients are significant ($P < 0.05$).

The Page model parameter coefficients a and b increased with temperature, but decreased with foam thickness when drying foams of both varieties. Nonetheless, a and b were higher for the drying of NFP than for cassava foam, signifying faster drying.

Fig. 3 revealed that there was good agreement between experimental MR and the MR predicted by Page model, with strong statistical association shown by high R^2 (> 0.9), low RMSE and low χ^2. A pooling of all experimental and Page predicted MR data, the correlation between them, and a calculation of the statistical error are shown in the supplementary spreadsheet file (Pred MR vs Expt MR- WHITE, and Pred MR vs Expt MR- YELLOW tabs).

1.2. Effective moisture diffusivity

Detail values of effective moisture diffusivity (D_{eff}) can be found in our associated work [2]. Table 2 outlays statistical accuracy of Crank's approximate solution of the first three terms of Fick's diffusion expression fitted to the experimental MR data in determining the moisture diffusivity. The statistics reveal good accuracy ($R^2 = 0.9063$ - 0.9561) of the fits. We observe a slight deviation of the fitted MR curves toward the end of the experimental MR data (Fig. 4). The supplementary spreadsheet file (MR vs t for D_{eff} fitting- WHITE, and MR vs t for D_{eff} fitting-YELLOW tabs) shows all the experimental MR data at each drying time (t), and estimates of MR derived from fitting the Crank's solution to Fick's 2nd law of diffusion. Our analyses revealed that increasing the number of terms did not significantly improve the fit accuracy, and overall, supports the theory of two drying rate regimes for the cassava foams.

The Arrhenius temperature dependence of effective moisture diffusivity as portrayed in Fig. 5 showed the linear relationship between effective moisture diffusivity and temperature. A compilation of the drying temperatures, D_{eff}, plots of natural logarithm of D_{eff} versus inverse of $R \cdot (T + 273.15)$ of the cassava foams, and statistical accuracy of the fits are shown in the supplementary spreadsheet file (ln D_{eff} vs 1-RT WHITE, and ln D_{eff} vs 1-RT YELLOW tabs). The good linear accuracy ($R^2 = 0.9611$ – 0.9999) of the relationship was shown at the three foam thicknesses, with only a marginal difference at 8 mm and 10 mm foam thickness.

Table 2
Statistical accuracy of fit for three terms Crank's solution to Fick's 2nd law of diffusion in calculating effective moisture diffusivity (D_{eff}) of white and yellow cassava foams at different temperatures and foam thicknesses.

Drying variables	Statistical accuracy										NFP
Foam thickness		6 mm			8 mm			10 mm			10 mm
Temperature		50 °C	65 °C	80 °C	50 °C	65 °C	80 °C	50 °C	65 °C	80 °C	80 °C
						White					
	R^2	0.9308	0.9243	0.9561	0.9270	0.9119	0.9385	0.9249	0.9140	0.9212	0.9702
	RMSE	0.0861	0.099	0.0807	0.085	0.104	0.0923	0.0861	0.0981	0.1009	0.066
						Yellow					8 mm
											80 °C
	R^2	0.9315	0.9320	0.9522	0.9138	0.9219	0.9374	0.9149	0.9063	0.9169	0.9622
	RMSE	0.0890	0.0929	0.0845	0.0968	0.0966	0.0957	0.0918	0.101	0.1038	0.0759

R^2 - coefficient of determination, RMSE - root mean square error. NFP – non-foamed pulp.

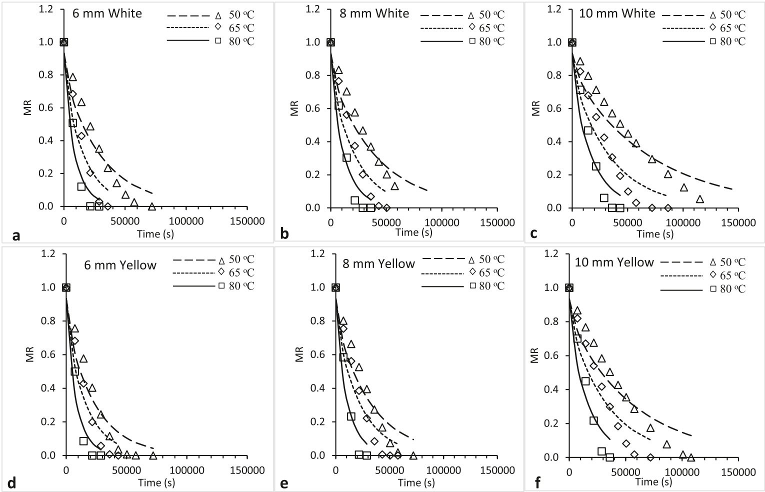

Fig. 4. Moisture removal ratio (MR) fit of Crank's solution to Fick's 2nd law of diffusion in calculating effective moisture diffusivity at different temperatures and foam thicknesses during drying of white (a-c) and yellow cassava (d-f) foams

1.3. Drying rate

In Fig. 6, the drying rate (DR) charts fitted by Rational model shows two distinct regions of drying rates with an approximate transition boundary between both rates. The supplementary spreadsheet file (DR fitting- WHITE, and DR fitting- YELLOW tabs) compiles the experimental data for moisture contents (dry basis), calculated DR, standard deviations for DR, and rational model predicted DR. The DR of the foams show two falling rates which are uniquely different from most other agricultural produce [3] which often have one falling rate.

2. Experimental Design, Materials and Methods

2.1. Materials acquisition

White-fleshed cassava was obtained from an exotic food supermart in Stökach, Stuttgart, Germany specialized in importation of cassava from Costa Rica. Yellow-fleshed cassava was also imported from International Institute of Tropical Agriculture (IITA), Nigeria, to the University of Hohenheim, Stuttgart, Germany, by air cargo. Food grade foaming agent (GMS- glycerol monostearate) and stabilizer (NaCMC – sodium carboxymethyl cellulose) were procured from MRS Scientific Ltd., Essex, UK.

2.2. Preparation of cassava foams

Cassava foams were produced under optimal conditions according to procedures already laid out in the previous report [1].

2.3. Drying experiments

A cabinet dryer (Hordentrockner HT 15, Innotech Ingenieurgesellschaft mbH, Altdorf, Germany) of specifications of dimension of 1.4 × 1.75 × 2.3 m, drying space of 15.7 m^2, 51 per-

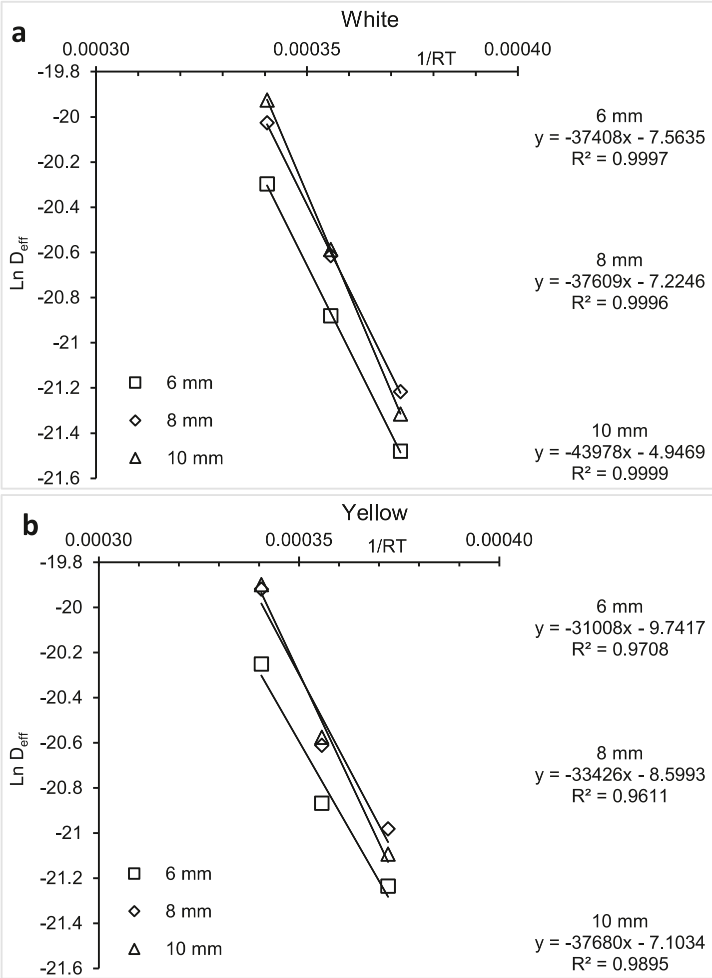

Fig. 5. Linear graphs of plot of Ln D_{eff} versus *1/RT* of the Arrhenius temperature-dependence of moisture diffusivity for drying of white (a) and yellow (b) cassava foams conducted at different temperatures and foam thicknesses. D_{eff} – effective moisture diffusivity, *R* – gas constant, *T* – absolute temperature. R^2 - coefficient of determination.

forated trays stack 100 mm apart, and maximum capacity of 160 kg per batch, was used. Foams were dried in duplicates considering two drying variables, temperature and foam thickness, at three levels each of 50, 65, and 80 °C, and 6 mm, 8 mm, and 10 mm, respectively. In total, 18 drying runs was conducted in a block design per cassava variety. Optimal drying variables in our lab was found to be 80 °C, 10 mm for white cassava foam, and 80 °C, 8 mm for yellow cassava foam [2].

2.4. Drying kinetics

Fick's second law of diffusion was applied to determine the effective moisture diffusivity of the cassava foams during drying, from which Crank [4] developed a mathematical approximate solution to describe diffusion of mass by solving the terms of the Fourier series for mass transfer

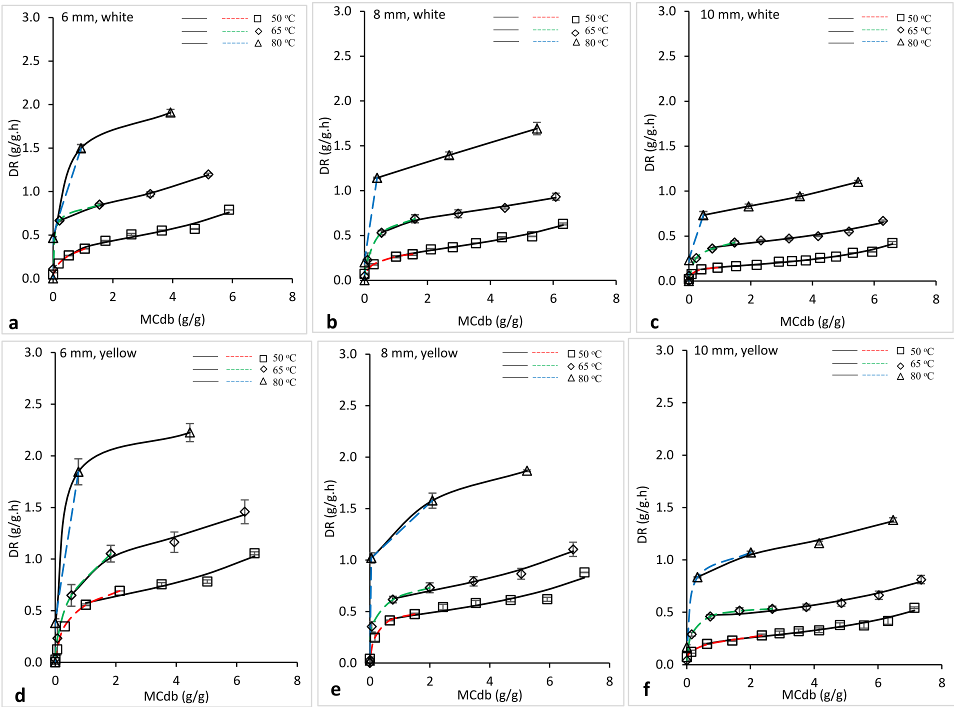

Fig. 6. Drying rate (*DR*) of white (a-c) and yellow (d-f) cassava foams as influenced by different temperatures and foam thicknesses showing two falling rates fitted to the rational model. First falling rate fits are represented by unbroken lines, second falling rate fits are represented by broken lines. MCdb – moisture content in dry basis.

in a slab under certain assumptions such as uniform temperature distribution within product, uni-directional mass transfer, infinite slab dimension, and no resistance to diffusion, as:

$$\eta = \frac{8}{\pi^2}\sum_{n=0}^{\infty}\frac{1}{(2n+1)^2}exp(-(2n+1)^2 \cdot \frac{\pi^2}{4L^2} \cdot D_{eff} \cdot t) \tag{5}$$

where D_{eff} (m^2/s) is the effective moisture diffusivity, L (m) is the thickness of the slab, t (s) is the time, n is the number of terms in the series and η is a dimensionless concentration. The numerical solution for the first three terms of the series was considered, since additional terms had insignificant changes on the solution.

The dimensionless moisture removal ratio *MR* was calculated from the following formula [5]:

$$MR = \frac{8}{\pi^2} \cdot \left[exp\left(-\pi^2\frac{D_{eff} \cdot t}{4L^2}\right) + \frac{exp\left(-9\pi^2\frac{D_{eff} \cdot t}{4L^2}\right)}{9} + \frac{exp\left(-25\pi^2\frac{D_{eff} \cdot t}{4L^2}\right)}{25}\right] = \frac{MC_t - MC_e}{MC_0 - MC_e} \tag{6}$$

where MC_t (g/g) is the moisture content at a given time, MC_0 (g/g) is the initial moisture content, and MC_e (g/g) is the equilibrium moisture content. *MR* was calculated as the quotient of MC_t to MC_0 since equilibrium moisture content MC_e was negligible:

$$MR = \frac{MC_t}{MC_0} \tag{7}$$

MR was modelled by four semi-theoretical drying model equations: Newton, Page, Henderson & Pabis, and two-term, as described in the literature [6]:

$$\text{Newton model}: \quad MR = e^{-a \cdot t} \tag{8}$$

Page model $$MR = e^{\left(-a \cdot t^b\right)} \quad (9)$$

Henderson & Pabis model $$MR = a \cdot \left(e^{-b \cdot t}\right) \quad (10)$$

Two term model $$MR = a \cdot \left(e^{-b \cdot t}\right) + c \cdot \left(e^{-d \cdot t}\right) \quad (11)$$

where *a, b, c* and *d* are model parameters, *t* is drying time (h).

Moisture diffusivity was determined by regression fitting of equation (6). An Arrhenius temperature-dependent relation with diffusivity as shown in equation (12) was fitted to diffusivity data to calculate activation energy and diffusion constant:

$$D_{eff} = D_o \cdot exp\left[\frac{-E_a}{R(T + 273.15)}\right] \quad (12)$$

where D_{eff} (m^2/s) is the effective moisture diffusivity, D_o (m^2/s) is the diffusion constant, E_a (J/mol) is the activation energy, R is the universal gas constant (8.3144598 J/mol K) and T (°C) is the temperature.

Drying rate (*DR*) was calculated as:

$$DR = \frac{MC_t - MC_{t+\Delta t}}{\Delta t} \quad (13)$$

where $MC_{t+\Delta t}$ is the instantaneous moisture content (db) at time $t + \Delta t$, which is the time interval (h).

The relationship between the *DR* and moisture content during drying was fitted by the Rational Model [7]:

$$DR = (a + b \cdot MC) \cdot \frac{1}{1 + c \cdot MC + d \cdot MC^2} \quad (14)$$

where *MC* (g/g) is the moisture content in dry basis, and *a, b, c*, and *d* are the model coefficients.

2.5. Statistical analyses

Data were obtained in duplicates and presented as mean and standard deviation. Multiple regression analysis was made by Microsoft Excel® 2007 (Microsoft, Redmond, WA, USA). Mathematical fitting of experimental data was carried out using Curve Expert professional 2.6 (Hyams Development, 2018). The accuracy of the model fit was evaluated by coefficient of determination (R^2), root mean square error (RMSE), and Chi square (χ^2) [8–11].

$$R^2 = 1 - \left(\frac{\sum_{i=1}^{n}\left(X_{exp} - X_{pred}\right)^2}{\sum_{i=1}^{n}\left(X_{exp} - \bar{X}_{exp}\right)^2}\right) \quad (15)$$

$$RMSE = \sqrt{\frac{1}{n}\sum_{i=1}^{n}\left(X_{pred} - X_{exp}\right)^2} \quad (16)$$

$$\text{Chi square } \left(\chi^2\right) = \sum_{i=1}^{n}\frac{\left(X_{exp} - X_{pred}\right)^2}{X_{pred}} \quad (17)$$

where X_{exp} are the measured values, X_{pred} are the predicted values, and n is the number of observations.

Ethics Statement

Authors did not use any animal or human experimental materials, and are not, therefore, subject to their ethical concerns.

Credit Author Statement

Oluwatoyin Ayetigbo and **Joachim Müller:** Conceptualization, Methodology, Software; **Oluwatoyin Ayetigbo:** Data curation, writing & original draft preparation; **Oluwatoyin Ayetigbo:** Visualization, Investigation; **Joachim Müller, Sajid Latif** and **Adebayo Abass:** Supervision; **Ayetigbo Oluwatoyin, Joachim Müller, Sajid Latif** and **Adebayo Abass:** Writing - reviewing & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships, which have or could be perceived to have influenced the work reported in this article. This work has been approved by the authors, has not been previously published, is not under consideration for publication elsewhere, and will not be published elsewhere in similar form if accepted.

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Supplementary Materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.dib.2021.107192.

References

[1] O. Ayetigbo, S. Latif, A. Abass, J. Müller, Optimization and characterization of foam from white-flesh and yellow-flesh cassava (Manihot esculenta) for powder production, Food Hydrocoll 97 (2019) 1–10, doi:10.1016/j.foodhyd.2019.105205.

[2] O. Ayetigbo, S. Latif, A. Abass, J. Müller, Drying kinetics and effect of drying conditions on selected physicochemical properties of foam from yellow-fleshed and white-fleshed cassava (Manihot esculenta) varieties, Food Bioprod. Process 127 (2021) 454–464, doi:10.1016/j.fbp.2021.04.005.

[3] T. Kudra, C. Ratti, Foam-mat drying: Energy and cost analyses, Can. Biosyst. Eng. /Le Genie Des Biosyst. Au Canada. 48 (2006) 27–32.

[4] J. Crank, The Mathematics Of Diffusion, 2nd ed., Oxford University Press, London, Bristol, England, 1975.

[5] C. Singh, H.K. Sharma, B.C. Sarkar, Kinetics of mass transfer during convective dehydration of coated osmosed pineapple samples, J. Food Process Eng. 34 (2011) 1879–1902, doi:10.1111/j.1745-4530.2009.00503.x.

[6] Z. Erbay, F. Icier, A review of thin layer drying of foods: Theory, modeling, and experimental results, Crit. Rev. Food Sci. Nutr. 50 (2010) 441–464, doi:10.1080/10408390802437063.
[7] E. Tjørve, Shapes and functions of species-area curves: a review of possible models, J. Biogeogr. 30 (2003) 827–835, doi:10.1046/j.1365-2699.2003.00877.x.
[8] C.C. Ferrari, M.D. Hubinger, Evaluation of the mechanical properties and diffusion coefficients of osmodehydrated melon cubes, Int. J. Food Sci. Technol. 43 (2008) 2065–2074, doi:10.1111/j.1365-2621.2008.01824.x.
[9] T.S. Franco, C.A. Perussello, L.N. Ellendersen, M.L. Masson, Effect of process parameters on foam mat drying kinetics of yacon (Smallanthus Sonchifolius) and thin-layer drying modeling of experimental data, J. Food Process Eng. 40 (2017) 1–10, doi:10.1111/jfpe.12264.
[10] S.A. Kim, J.H. Baek, S.J. Lee, S.Y. Choi, W. Hur, S.Y. Lee, A novel method for air drying aloe leaf slices by covering with filter papers as a shrink-proof layer, J. Food Sci. 74 (2009) 462–470, doi:10.1111/j.1750-3841.2009.01342.x.
[11] N.S.M. Salim, Y. Garièpy, V. Raghavan, Design of continuous flow osmotic dehydration and its performance on mass transfer exchange during osmotic dehydration of broccoli stalk slices, Food Bioprocess Technol 9 (2016) 1455–1470, doi:10.1007/s11947-016-1732-z.