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Modelling the drying characteristics of the traditional Indonesian crackers "kerupuk"

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Abstract: An oven drying method was used to dry traditional Indonesian crackers, popularly known as kerupuk, applying drying temperatures of 50, 60 and 70°C and three different flavours, i.e., garlic, chili and seaweed. Newton, Page, Two terms, Midilli, Logarithmic and Henderson & Pabis mathematical models were used to fit the best model while the standard error of estimate (SSE), root mean square error (RMSE) and coefficient of correlation (r) were chosen as the criteria to determine the equation of the best fit drying model. The Midilli model was the best fit for all the kerupuk flavours. The effective moisture diffusivity was in the range of 1.0413×10^{-10}–1.6363×10^{-10} $m^2 \cdot s^{-1}$ for the garlic flavour, 1.0007×10^{-10}–1.5619×10^{-10} $m^2 \cdot s^{-1}$ for the chili flavour and from 1.0000×10^{-10} to 1.6228×10^{-10} $m^2 \cdot s^{-1}$ for the seaweed flavour. The activation energy of the garlic flavour, chili flavour and seaweed flavour kerupuk are 20.64, 20.64 and 22.57 $kJ \cdot mol^{-1}$, respectively. Furthermore, in the present study, the physical properties, i.e., the colour and hardness of the kerupuk crackers after the drying process was investigated.

Keywords: snack; temperature; Midilli; home industry; colour; hardness

A traditional Indonesian cracker, popularly known as kerupuk, is a crispy snack that is eaten together with rice. In Indonesia, kerupuk is primarily produced at home with traditional processes. Drying is traditional and the oldest operational unit which causes water to evaporate into a vapour phase. The drying process used in the food, agricultural, chemical, pharmaceutical and paper industries uses different applications to gain different utilities. In the food industry, foods are dried from their natural form or after handling (Erbay, Icier 2010). The drying process of kerupuk involves sun drying that may take up to 12 hours. However, this results in a suboptimal product quality since the drying process largely depends on the weather. The problem mostly occurs during the rainy season when sunshine is limited. The use of ovens to dry the kerupuk is particularly important during such a season.

Ovens applied in the home industry would avoid the losses by product deterioration and speed up the production process (Susanti et al. 2016). The moisture content of the cracker's slice is a key quality in the drying process (Lertworasirikul 2008). Several mathematical models of the drying kinetics of various agricultural products have been developed by many researchers. For example, Lertworasirikul (2008) studied the drying kinetics of semi-finished cassava crackers. Erbay and Icier (2010) developed the theory and modelling of thin

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layer food drying. Abhay et al. (2016) investigated the drying kinetics of cocoa beans using effective diffusivities and their sensory properties. Rafiee et al. (2010) applied the Henderson and Pabis model of a thin layer drying curve for apple slices.

The quality of the final dried product depends on the drying conditions, so it is important to determine the drying characteristics with an empirical model approach. The application of drying models are used to predict the moisture ratio (MR) or moisture content in a material at drying time (Prasetyo et al. 2018). Therefore, the aim of this paper was to study the modelling drying processes of the kerupuk with three different flavours, to calculate the effective moisture diffusivity, the activation energy and their physical characteristics under different temperatures by the oven method. These drying models are the Newton, Page, Two terms, Midilli, Logarithmic and Henderson & Pabis models.

MATERIAL AND METHODS

Sample preparation. The mixed seasoning, wheat flour and tapioca flour were obtained from Gunungkidul, the Yogyakarta traditional market. Fig. 1 shows that the kerupuk production in a home industry. In the first step, the mixed seasoning consisting of garlic, salt and candlenut were traditionally pounded using a concave stone and followed by a crushing process using a blender. For the variance, chili powder 4% or seaweed powder 5% in stirring process (based on a home industry recipe) was added to the kerupuk dough. The dough was cut into the average sizes of 7.5 × 2.6 × 0.2 cm (length × width × thickness). There were three flavours of kerupuk that were observed in this study, i.e., garlic, chilli and seaweed flavours.

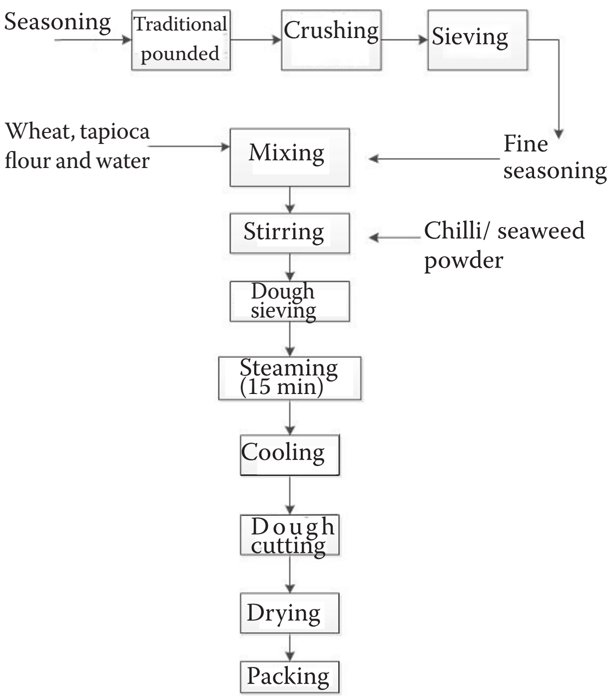

Fig. 1. The kerupuk production in a home industry

Drying procedure. The drying process of kerupuk was conducted in a Memmert U30 oven (Memmert, Germany) (220V, 50/60Hz, 1400 W) whose operating conditions were 88% relative humidity (RH) inside the oven, a temperature of 50, 60 and 70°C, an air circulated system, room temperature of 27.5–31.6°C with 60–64 % RH outside. The temperature variance of 50, 60 and 70°C were chosen due to the temperature around 60°C being a suitable temperature for drying the cracker in order for there to be enough moisture available allowing for its expansion during the frying process (Susanti et al. 2016). 4.5 g of wet kerupuk was placed in tray then dried in the oven. The sample was weighed in an ABJ 220-4M electronic balance (KERN & SOHN GmbH, Germany) (with a capacity of 220 g and readability of 0.1 mg) and recorded in 15 min intervals until a constant weight was found. The weight of the kerupuk samples was taken quickly to avoid any interference with the drying process (Aregbesola et al. 2015). The initial moisture content of the kerupuk was determined by the oven drying method at a temperature of 105°C for 3 h following the Association of Official Analytical Chemists (AOAC) standards (AOAC 2005). The equilibrium moisture content (M_e) was analysed using an AND MX-50 moisture analyser (A&D Company, Japan), at an analysis temperature of 105°C (Sluiter et al. 2008).

Modelling the drying. The drying model to describe the thin layer characteristics can be determined by the dimensionless MR. The relative humidity of the drying air is constant during the drying process and it is assumed that the negligible resistance to the moisture movement to the surface material and the resistance to moisture movement is concentrated on the surface material. MR can be determined using Eq. 1.

$$\mathrm{MR} = \frac{(M_t - M_e)}{(M_i - M_e)} \tag{1}$$

Where: MR – moisture ratio; M_i – the initial moisture content; M_t – the mean moisture content at time t, M_e – the equilibrium moisture content

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All these values are in a dry basis.

The data of MR and time (t) at the different drying temperatures were fit to the Newton, Page, Two terms, Midilli, Henderson & Pabis and Logarithmic models (Table 1.) by a non-linear regression technique, performed using Solver32 DLL (version 14.0.6112.5000) in Microsoft Excel (2010).

Statistical analysis. The standard error of the estimate (SSE), the root mean square error (RMSE) and the coefficient of correlation (*r*) were chosen as the criteria to determine the equation of the best fit drying model (Prasetyo et al. 2018; Aregbesola et al. 2015). *r* is one of the primary criteria for selecting the best equation. The highest *r* is required to determine the drying curve equation. In addition, the lowest SSE and RMSE values are required to evaluate the goodness of the fit (Abhay et al. 2016) (Eqs 2–4):

$$\mathrm{SEE} = \frac{\sum_{i=1}^{N}(MR_{\exp,i} - MR_{\mathrm{pre},i})^2}{df} \tag{2}$$

$$r = \frac{N\sum_{i=1}^{N} MR_{\mathrm{pre},i} MR_{\exp,i}}{\sqrt{\left(N\sum_{i=1}^{N} MR_{\mathrm{pre},i}^2 - \left(\sum_{i=1}^{N} MR_{\mathrm{pre},i}\right)^2\right)}} = \frac{-\sum_{i=1}^{N} MR_{\mathrm{pre},i} \sum_{i=1}^{N} MR_{\exp,i}}{\left(N\sum_{i=1}^{N} MR_{\exp,i}^2 - \left(\sum_{i=1}^{N} MR_{\exp,i}\right)^2\right)} \tag{3}$$

$$RMSE = \left[\frac{1}{N}\sum_{i=1}^{N}(MR_{\mathrm{pre},i} - MR_{\exp,i})^2\right]^{1/2} \tag{4}$$

where: SEE – the standard error of estimate; r – coefficient of correlation N – the number of observation; $MR_{\mathrm{pre},i\ -\ \mathrm{ith}}$ – the predicted moisture ratio values; $\mathrm{MR}_{\exp,i\ -\mathrm{ith}}$ – the experimental moisture ratio values

Determination of the effective diffusivities and activation energy. The kerupuk is assumed to be in an infinite slab form and can be estimated by Fick's second diffusion law for slab geometry, defined as Eq. 5 (Lertworasirikul 2008; Erbay, Icier 2010):

$$\mathrm{MR} = \frac{8}{\pi^2}\sum_{\mathrm{n}=0}^{\infty}\frac{1}{(2\mathrm{n}+1)}\exp\left(-\frac{(2\mathrm{n}+1)^2\pi^2 D_{\mathrm{eff}} t}{4H^2}\right) \tag{5}$$

where: MR – moisture ratio; D_{eff} – the effective diffusivity ($\mathrm{m^2{\cdot}s^{-1}}$); H – the half-thickness of the slab (m); n – the number of terms of the infinite series; t – the drying time (min)

The study assumes negligible shrinkage and external resistance, a uniform initial moisture content, constant diffusion coefficients and temperatures. The logarithmic form in Eq. 6 is the simplified first term of the series for the long drying period.

$$\ln MR = \ln\frac{8}{\pi^2} - \frac{\pi^2 D_{\mathrm{eff}} t}{4H^2} \tag{6}$$

where: D_{eff} – the effective diffusivity ($\mathrm{m^2{\cdot}s^{-1}}$); H – the half-thickness of the slab (m); t – the drying time (min)

Referring to Eq. 6, the effective diffusivity can be determined by plotting ln*MR* against the drying time (*t*) and the slope may be expressed by Eq. 7:

$$\mathrm{Slope} = \frac{\pi^2 D_{\mathrm{eff}}}{4H^2} \tag{7}$$

The activation energy of the kerupuk during the drying process was calculated using Eqs 8–9 (Mirzaee et al. 2009; Olusegun et al. 2019)

$$D_{\mathrm{eff}} = D_0 \exp\left(-\frac{E_{\mathrm{a}}}{\mathrm{R}T}\right) \tag{8}$$

where: D_{eff} – The effective diffusivity ($\mathrm{m^2{\cdot}s^{-1}}$); $E_{\mathrm{a;}}$ – the activation energy ($\mathrm{kJ{\cdot}mol^{-1}}$); R – the universal gas constant (8.314×10^{-3} $\mathrm{kJ{\cdot}mol^{-1}\ K}$); T – temperature

Table 1. The mathematical drying models used for the study

Model name	Model equation	Reference
Newton	MR = exp $(-k_{\mathrm{t}})$	Erbay, Icier (2010); Aregbesola et al. (2015); Djaeni, Sari (2015); Prasetyo et al. (2018);
Page	MR = exp $(-k_{\mathrm{t}}^{\mathrm{n}})$	Rafiee et al. (2010); Erbay, Icier (2010)
Two terms	MR= a exp $(-k_{\mathrm{t}})$ + b exp $(-k_{1\mathrm{t}})$	Erbay, Icier (2010); Aregbesola et al. (2015)
Midilli	MR = a exp (−ktn)+$a_{1\mathrm{t}}$)	Masayu et al. (2017); Erbay, Icier (2010)
Henderson and Pabis	MR = a exp $(-k_{\mathrm{t}})$	Hii et al. (2009)
Logarithmic	MR = a exp $(-k_{\mathrm{t}})$ + c	Akgun, Doymaz (2005)

MR – the moisture ratio; *t* – the drying time; a, a_1, b, c, k, k_1, n – the constants in the models

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$$\ln D_{\text{eff}} = \ln D_0 - \frac{E_a}{RT} \quad (9)$$

where: $\ln D_{\text{eff}}$ were plotted against $1 \cdot T^{-1}$ (the absolute temperature in K) then the slope of the plot is equal to ($-Ea/R$); D_0 – the pre-exponential factor of the Arrhenius equation ($m^2 \cdot s^{-1}$); Ea – the activation energy ($kJ \cdot mol^{-1}$); R – the universal gas constant (8.314×10^{-3} $kJ \cdot mol^{-1}$ K)

Analysis of the physical properties. The kerupuk hardness was measured using a Zwick SA/0.5 Universal Testing Machine (Zwick, Germany). The test speed before reaching the sample was 50 $mm \cdot min^{-1}$ with a pre-load of 0.02 N. The test speed was 10 $mm \cdot min^{-1}$when reaching the sample. The colour of kerupuk was determined by using a Konica Minolta CR-20 (Konica Minolta, Japan) colour reader by the CIE (Commission internationale de l'éclairage) method. The CIE colour scale was estimated by (Mir et al. 2019). The total colour differences (ΔE) were calculated as (Eq. 10):

$$\text{Colour difference} = \sqrt{(\Delta L)^2 + (\Delta a)^2 + (\Delta b)^2} \quad (10)$$

where: ΔL – L sample (L standard); Δa – a sample (a standard); Δb – b sample (b standard)

A kerupuk that used the sun-dried method for 12 h was used for the colour standard and hardness control. The data were analysed statistically using a CoStat 6.400 (version 6.400). The physical properties of the data are presented as the mean with the standard deviation using Duncan's multiple range test ($P < 0.05$).

RESULTS AND DISCUSSION

The drying characteristics of the kerupuk

Table 2 shows the equilibrium moisture content of the different kerupuk types and their required drying time at 50, 60 and 70°C. This implies that the higher drying temperature needs a shorter time for all the flavour of the kerupuk. The kerupuk with the garlic, chili and seaweed flavours require a drying time in the range from 240 to 390 min at temperatures 50–70°C. In a convection drying system, the water is transferred by diffusion from the interior of the food material to the air-food interface and from there to the air stream (Kaveh, Chayjan 2015). The higher drying temperature indicates the greater the heat energy carried by the air stream to evaporate the amount of the water mass from the food surface. This explains the high equilibrium moisture content value at a low drying temperature. The equilibrium moisture content of the kerupuk is in the range from 1.56 to 3.02%. The equilibrium moisture content is the water content in the material that is subjected to vapour pressure which is equal to its environment. The concept of equilibrium moisture content is related to the ability of a food material to maintain its quality from microorganisms and fungi contamination after the drying process. The increase in the drying time causes the remaining water to go to the interior of the food material so it takes a long time to diffuse towards the surface before being evaporated (Prasetyo et al. 2018).

Table 2. The equilibrium moisture content and the drying time of the kerupuk

Kerupuk flavour types	Drying temp. (°C)	Equilibrium MC (%)	Drying time (min)
Garlic	50	3.02	360
	60	1.86	300
	70	1.76	240
Chili	50	2.44	390
	60	1.78	300
	70	1.56	240
Seaweed	50	2.76	360
	60	2.36	300
	70	1.70	240

MC – the moisture content

The correlation between the MR and time is presented in Fig. 2. The experimental curves are then evaluated using the thin layer drying model in Table 3 (In Electronic Supplementary Material). Midilli was selected as the best model for the prediction of the kerupuk with the different flavours during the drying process, resulting from the lower SSE (0.00045) and RMSE values (0.00001) and the higher r value (0.99985). The drying process can be controlled by applying the drying model evaluation. In addition, drying models have been developed to explain the convective drying kinetics of various agricultural products for the use in the design, construction and control of drying systems (Masayu et al. 2017)

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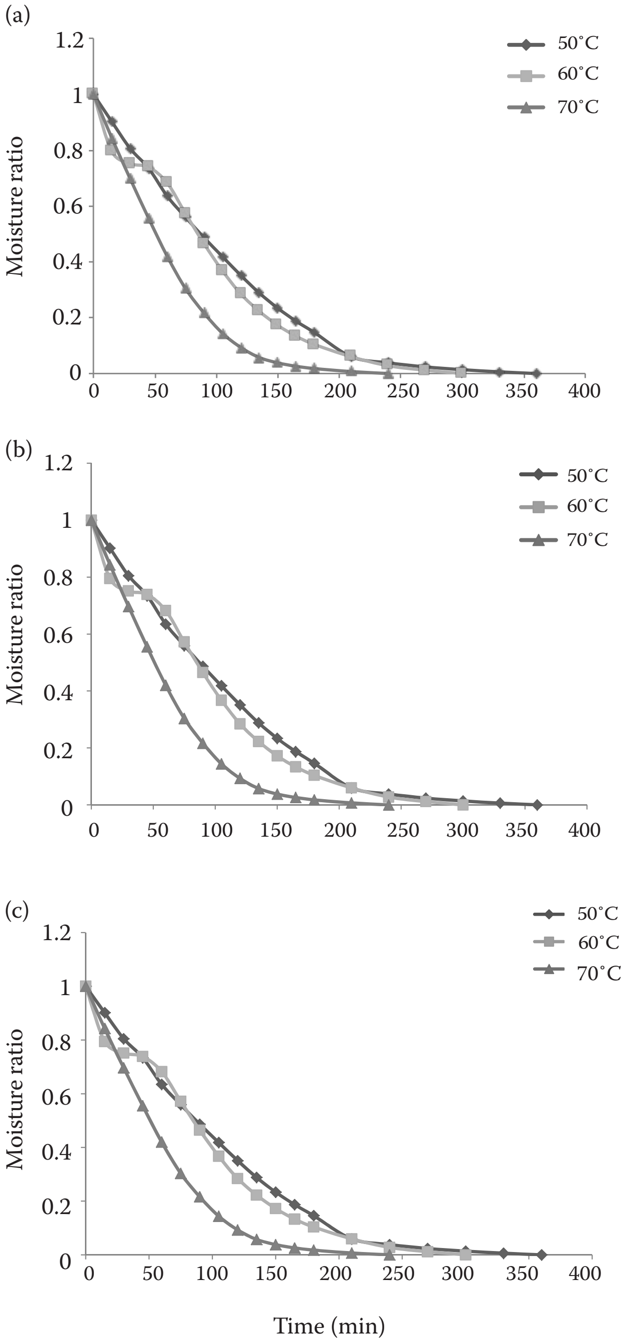

Fig. 2. The correlation between the moisture ratio and the time of the kerupuk flavour at the different temperatures: (a) garlic flavour (b) chili flavour and (c) seaweed flavour

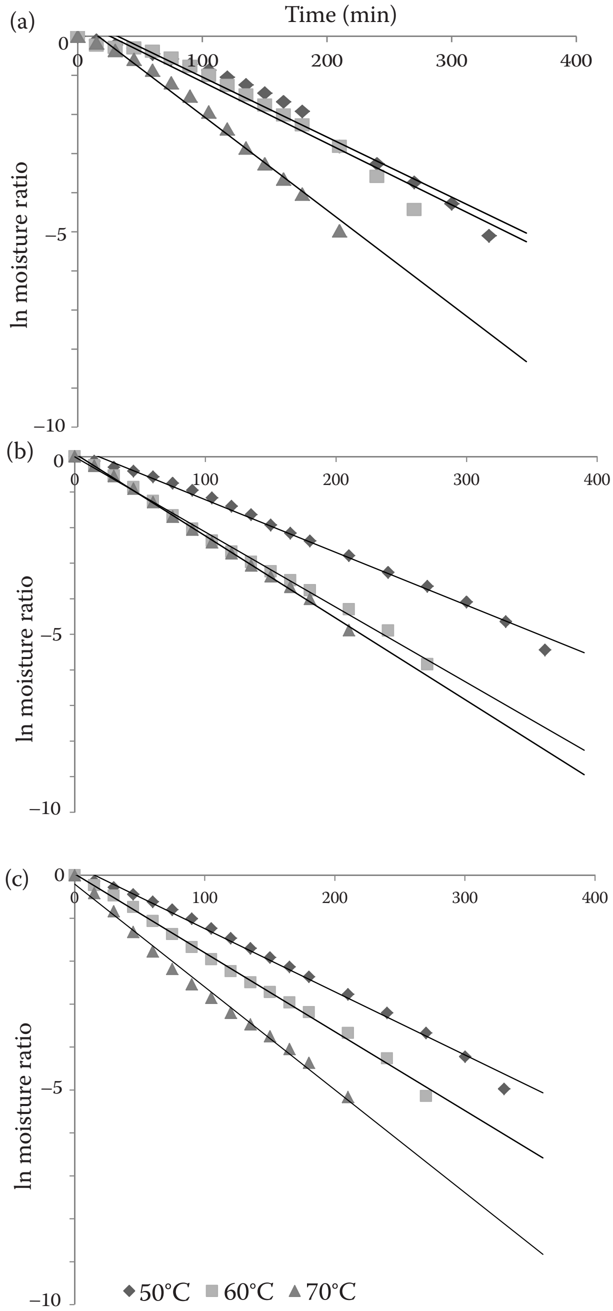

Fig. 3. The ln moisture ratio plot versus time for the different kerupuk flavours: (a) garlic flavour (b) chili flavour and (c) seaweed flavour

Effective diffusivities

The effective diffusivity can be determined by plotting the ln MR against the drying time (Fig. 3) then the slopes of the curves are used for calculating the effective diffusivity values. The values of the effective diffusivity were calculated by using Eq. 7. The equation of fit, R^2 and the effective diffusivity values are shown in Table 4. The results show an increase in the effective moisture diffusivity for all the kerupuk flavours as the drying temperature increased due to the increase in the thermal energy. Evaporation gets quicker at a higher temperature, so the moisture diffusivity is also getting larger (Nugroho, Suherman 2012). The values for the effective moisture diffusivity of the kerupuk ranged from

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Table 4. The effective diffusion coefficients for the *kerupuk* type at the different drying temperatures

Kerpuk type	Temp (°C)	Equation of fit	R^2	D_{eff} ($m^2 \cdot s^{-1}$)
Garlic flavour	50	$-0.0154x + 0.4941$	0.9642	1.0413×10^{-10}
	60	$-0.0157x + 0.4110$	0.9544	1.0616×10^{-10}
	70	$-0.0242x + 0.4014$	0.9841	1.6363×10^{-10}
Chili flavour	50	$-0.0148x + 0.2655$	0.9928	1.0007×10^{-10}
	60	$-0.0211x - 0.0098$	0.9960	1.4267×10^{-10}
	70	$-0.0231x + 0.0772$	0.9984	1.5619×10^{-10}
Seaweed flavour	50	$-0.0147x + 0.2304$	0.9927	1.0000×10^{-10}
	60	$-0.0184x + 0.0357$	0.9967	1.2441×10^{-10}
	70	$-0.0240x - 0.2035$	0.9926	1.6228×10^{-10}

R^2 – The coefficient of determination; D_{eff} – the effective diffusivity ($m^2 \cdot s^{-1}$)

1.0413×10^{-10} to 1.6363×10^{-10} $m^2 \cdot s^{-1}$ for the garlic flavour, from 1.0007×10^{-10} to 1.5619×10^{-10} $m^2 \cdot s^{-1}$ for the chili flavour and ranged from 1.0000×10^{-10} to 1.6228×10^{-10} $m^2 \cdot s^{-1}$ for seaweed flavour. The values of D_{eff} were in the range of 10^{-12} to 10^{-8} for the food materials (Mirzaee et al. 2009; Jha et al. 2015). The expressions in Table 4 show that the best fit for each drying temperature is given by the linear relationship of $R^2 > 0.96$ (Aregbesola et al. 2015).

The activation energy

Fig. 4 shows the linear graph between ln D_{eff} against the absolute temperature (T°C + 273.15). The slope of the straight line is equal to ($-E_a/R$) and by using the Arrhenius relationship, the activation energy for the kerupuk with garlic, chili and seaweed flavours are 20.64, 20.64 and 22.57 $kJ \cdot mol^{-1}$, respectively. More energy is required for the kerupuk with the seaweed flavour to remove the moisture in the inner cavity of the shell through to the shell to the drying air (Aregbesola et al. 2015). The values of the activation energy for most food materials ranged from 12.7 to 110 $kJ \cdot mol^{-1}$ (Mirzaee et al. 2009).

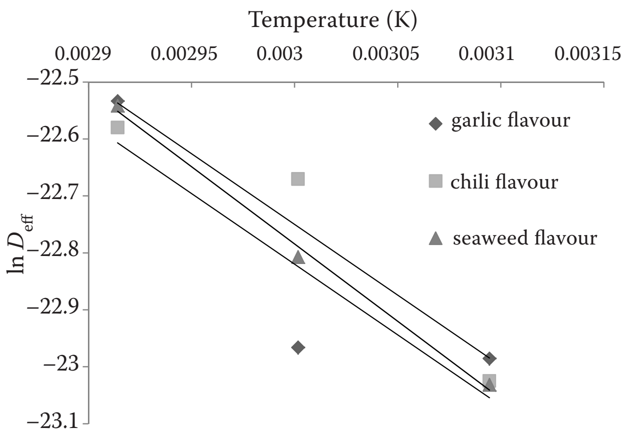

Fig. 4. The Arrhenius-type relationship between the logarithm of effective diffusivity and the absolute temperature

The physical characteristics of the kerupuk

The colour and hardness are important quality characteristics in foodstuff to nearly every consumer and is primarily judged by the consumer (Olusegun et al. 2019; Mir et al. 2019). The results of colour parameters for the kerupuk are presented in Table 5. The lightness of garlic flavour at 50°C decreased compared to sun drying method for 12 h and increased at 60°C ($P < 0.05$). The *a* values dried by the oven method at 50, 60 and 70°C increased compared to the sun drying method. A significant variation ($P < 0.05$) for the garlic flavoured kerupuk were observed in *b* and the total colour difference (ΔE). The lightness, b^* and the colour difference values for the chili flavoured kerupuk dried by the oven method increased in the varying temperatures, however, there were no significant differences ($P > 0.05$). The *a* values also decreased in the oven method compared to the sun drying and no significant difference ($P > 0.05$). The lightness of the seaweed flavoured kerupuk by the oven method drying decreased while the *a* values increased significantly ($P < 0.05$) compared to the sun drying method. The *b* values increased in the varying temperatures by the oven method, but with no significant difference ($P > 0.05$). The total colour difference had no significant difference ($P > 0.05$) at the different temperatures of the drying process. The colour changes during the drying process is due to the browning reaction in the

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Table 5. The physical properties of the kerupuk at the different drying method

Kerpuk type	Parameters	Sun drying 12 h	Oven 50°C	Oven 60°C	Oven 70°C
garlic flavour	L^*	47.7 ± 2.68^{b}	39.2 ± 1.41^{c}	53.5 ± 3.10^{a}	47.7 ± 1.25^{b}
	a^*	2.27 ± 0.90^{c}	5.96 ± 0.38^{a}	4.50 ± 0.90^{b}	3.77 ± 0.45^{b}
	b^*	21.5 ± 2.32^{c}	21.0 ± 19.5^{c}	29.7 ± 0.50^{a}	25.6 ± 0.64^{b}
	ΔE	–	9.34 ± 1.45^{a}	10.5 ± 1.85^{a}	4.45 ± 0.59^{b}
	Hardness (N)	29.6 ± 1.30^{b}	20.9 ± 1.06^{c}	29.5 ± 3.01^{b}	46.3 ± 0.27^{a}
chili flavour	L^*	34.7 ± 1.46^{b}	35.9 ± 2.90^{ab}	39.0 ± 0.90^{a}	38.9 ± 2.54^{a}
	a^*	8.17 ± 0.78^{a}	7.03 ± 1.50^{a}	6.67 ± 1.23^{a}	6.97 ± 2.03^{a}
	b^*	18.0 ± 1.91^{a}	20.9 ± 2.80^{a}	23.5 ± 2.40^{a}	24.3 ± 4.95^{a}
	ΔE	–	4.59 ± 1.87^{a}	7.24 ± 2.47^{a}	8.40 ± 4.30^{a}
	Hardness (N)	33.8 ± 6.76^{ab}	26.1 ± 13.9^{ab}	17.9 ± 7.98^{b}	42.4 ± 9.27^{a}
seaweed flavour	L^*	51.4 ± 1.44^{a}	41.4 ± 2.40^{b}	45.9 ± 3.44^{ab}	45.6 ± 4.84^{ab}
	a^*	1.63 ± 0.83^{b}	4.10 ± 0.70^{a}	3.60 ± 0.52^{a}	4.30 ± 0.20^{a}
	b^*	20.8 ± 1.55^{b}	22.7 ± 1.97^{ab}	25.1 ± 1.80^{ab}	26.4 ± 3.57^{a}
	ΔE	–	10.7 ± 1.93^{a}	7.79 ± 1.94^{a}	9.72 ± 1.84^{a}
	Hardness (N)	12.64 ± 0.61^{c}	38.74 ± 12.14^{ab}	53.47 ± 14.02^{a}	28.79 ± 16.98^{bc}

L^* – the lightness 0 – 100 is a white colour; a^* – the greenness ($-a^*$) to the redness ($+a^*$); b^* – the blueness ($-b^*$) to the yellowness ($+b^*$); ΔE – the total colour differences, the values are the mean ± standard deviation. The different letters in the same row indicate significant differences ($P < 0.05$); L^*, a^* and b^* show the black ($L^* = 0$) to white ($L^* = 100$); the greenness ($-a^*$) to the redness ($+a^*$); and the blueness ($-b^*$) to the yellowness ($+b^*$) (Xiaoyong et al. 2018)

kerupuk components, mainly due to the wheat flour and tapioca flour being the main ingredients. In addition, the moisture migration rate influences the colour changes during the drying process. The different thermal gradient causes different moisture migration rates from the interior to the kerupuk surface which affects the colour degradation and colour change (Anabel et al. 2018; Xiaoyong et al. 2018).

A significant variation ($P < 0.05$) for the garlic flavoured kerupuk were observed in the hardness values, which ranged from 20.9 to 46.3 N. There are no significant differences ($P > 0.05$) in the hardness values of the chili flavoured kerupuk between the sun drying and oven methods while the hardness of the seaweed flavoured kerupuk dried at 50, 60 and 70°C increased significantly ($P < 0.05$) compared to the 12 h sun drying method. Increasing the temperature and drying time in the oven method increased the hardness of the kerupuk which is because of the increasing in moisture content. Conversely, the moisture content decreased and the kerupuk became more fragile which causes it to break easier, therefore, the hardness decreased (Bagheri et al. 2018). The different drying modes have a tendency affect to the taste and chemical properties of the kerupuk because of the frying process after drying, therefore, further study is needed.

CONCLUSION

The Midilli model is the best fit modelling drying method for the three different flavours of kerupuk (with an SSE value of 0.00045, an RMSE value of 0.00001 and a higher r value of 0.99985). The effective moisture diffusivity ranged between 1.0413×10^{-10} to 1.6363×10^{-10} $m^2 \cdot s^{-1}$ for the garlic flavoured kerupuk; between 1.0007×10^{-10} to 1.5619×10^{-10} $m^2 \cdot s^{-1}$ for the chili flavoured kerupuk; and between 1.0000×10^{-10} to 1.6228×10^{-10} $m^2 \cdot s^{-1}$ for the seaweed flavoured kerupuk, whereas, the activation energy of the garlic flavoured, chili flavoured and seaweed flavoured kerupuk are 20.64, 20.64 and 22.57 $kJ \cdot mol^{-1}$, respectively. The differences in the temperatures and the flavours in the kerupuk drying method gave significant variation to the L, a and b colour parameters. At the same time, the hardness of the kerupuk is significantly different at the different drying temperatures, but not significant in the different flavours.

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