MATHEMATICAL MODELLING OF *ANONNA MURICATA* L. (SOURSOP) LEAVES DRYING UNDER DIFFERENT DRYING CONDITIONS

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Abstract
In this study, the thin layer drying behavior of Anonna muricata (Soursop) leaves under three different drying methods; open sun, heat pump and oven drying methods at temperature of 40ºC were evaluated in order to predict the best equation for the drying process from thirteen (13) existing drying Mathematical models. Fresh samples of the leaves were obtained and dried simultaneously under these drying methods and weighed at regular intervals until three consecutive weights were achieved. A precision weighing balance was used in measuring the change in drying weight of the leaves. The drying data; moisture loss and drying rate were obtained and converted to moisture ratio which were fitted to the thirteen mathematical models. The best fit model to describe the thin layer drying of Anonna muricata (Soursop) leaves was achieved based on the model with the highest correlation coefficient (R^2), and lowest reduced chi square (χ^2) , root mean square error (RMSE), Sum of Estimated Error (SEE) and Sum of Square Error (SSE).Modified Henderson and Pabis model, Hii et al and Hii et al mode were found to give the overall best fit from all the models examined for open sun, heat pump and oven drying method respectively. The results gave highest R^2 values of 0.9941, 0.9843 and 0.9987, lowest values of RMSE of0.015102, 0.032891 and 0.010322, lowest values of SEE of 0.016641, 0.034435 and 0.012873 and lowest reduced chi square (χ^2)values of 0.001991, 0.004805 and 0.040539, for open sun, heat pump and oven drying method respectively. Validation of the established model gave good agreement between the experimental and predicted variables, therefore, Modified Henderson and Pabis, Hii et al and Hii et al equation could be used satisfactorily to predict thin layer drying of Anonna muricata (Soursop) leaves for open sun, heat pump and oven drying method respectively.

Keywords: thin layer, mathematical model, drying behavior

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1. INTRODUCTION

Annona muricata L. commonly known as soursop, Graviola, or Guanabana is a small tropical fruit tree that originates from Central America, it is grown in many tropical and sub-tropical regions including some parts of South America, Africa, Asia and Australia (Taylor *et al*., 2007). *A. muricata* is a native plant which is small, upright evergreen tree of about 5-6 *m* height, with large, glossy tree with dark green leaves and it produces a dark green, spiny aggregate fruits made up of berries fused together with associated flower parts. Soursop fruit of about weight more than 4 *kg* of oval or heart-shaped and often irregular lopsided composite is derived from the fusion of many fruitlets (Mudiyanselage and Udara, 2012).Soursop, from time past has been used for various purposes and has been consumed as juice blends, ice creams, sherbets, nectars, syrups, shakes, jams, jellies, preserves, yoghurts, etc.A part of soursop plant that has been reported to contain active compounds is its leaves. The leaves of the plant are thick, shiny on the upper side, obviate, oblate and acuminate to a varying degree and they are used for medicinal purposes to induce sleep, relieve cough and alternating fever(Aulianshah, 2017). Soursop leaves have been studied to have anti uric activity, anti-inflammation, anti-nociceptive and antiulcer genic, anticancer, anti-diabetic, anti-cholesterol and antioxidant(Aulianshah, 2017; Deep *et al*., 2016; Elisya and Murtini, 2015; Hardoko *et al*, 2018; Sousa *et al*, 2010; Taylor *et al*., 2007; Yenrina *et al*, 2015).

Drying process involves the minimizing of water content in products to an acceptable level for marketing, storage or processing (Misha *et al*, 2013). It is also very vital in reduction of weight and volume, minimizing packaging, storage and transportation costs and also allows for storability of the product under ambient temperature (Inyang *et al*, 2017). Drying is a simple process of moisture removal from a product in order to reach the desired moisture content. The main objective of drying apart from extended storage life can also be quality enhancement, ease of handling, further processing and sanitation and is probably the oldest method of food preservation practiced by humankind (Liberty *et al*, 2014).There are four categories of drying processes, namely; solar drying, atmospheric drying, sub atmospheric and novel drying technologies. Solar drying includes sun or natural dryers, solar dryers-direct, solar dryers indirect and hybrid or mixed systems. Atmospheric drying is either continuous or batch. Continuous drying utilizes dryers such as spray dryer, fluidized bed dryer, belt dryer, rotary dryer, tunnel dryer and drum dryer whereas batch drying requires dryers such as kiln dryer, cabinet or compartmental dryer and tower dryer. Sub-atmospheric drying includes vacuum shelf dryer, continuous vacuum dryer and freeze dryer. Novel drying technologies are microwave drying, infra-red radiation drying, electric or magnetic field drying, superheated steam drying, explosion puffing, foam mat drying, acoustic drying and osmotic dehydration (Inyang *et al*., 2017).

Many mathematical models have been proposed to describe the drying processes of different food materials such as the Newton model, Page model, Henderson and Pabis model, logarithmic model, two term exponential model. The drying models are generally classified into three categories which are: the empirical, the semi-empirical and the theoretical models. Mathematical models are very useful in the design and analysis of simultaneous heat and moisture transfer processes. It helps to initiate given process via use of mathematical models as a quick way of studying and evaluating this process for possible design and optimization purposes. It refers to applying the computational mathematical models to predict physical events or behavior of a system. The objective is to replicate the transport phenomena governing a system to predict what will happen in processing conditions to further improve the process. These models have been used to predict the drying behavior of various food materials; green pepper (Akpinar and Bicer, 2008), black tea (Panchariya *et al.*, 2002), garlic (Madamba *et al.*, 1996), mint leaves (Doymaz, 2006), bitter leaves, carrots (Doymaz, 2004; Zielinska and Markowski, 2007), etc.

Fresh *Annona muricata* leaves are highly perishable because of the presence of high moisture content; hence there is need for drying to prolong the shelf- life of the products. Several research studies had been conducted pertaining to soursop fruits(Abubacker *et al.*, 2014; Worrell *et al.*, 1994; Aulianshah, 2017; Enweani *et al.*, 2015; Hasan *et al.*, 2017; Lutchmedial *et al.*, 2004; Luzia and Jorge, 2012; Mudiyanselage and Udara, 2012; Nwokocha *et al.*, 2012; Nwokocha and Williams, 2009; Quek *et al.*, 2013), leaves and its extracts(Abubacker *et al.*, 2014; Asyura *et al.*, 2017; Elisya and Murtini, 2015; Endang and Hasan, 2017; Handayani *et al.*, 2015; Hardoko *et al.*, 2018; Rarassari and Maftuch, 2016; Yenrina *et al.*, 2015), seeds (Lucas *et al.*, 2018)and the stem but less emphases have been made on the drying and modelling of the drying kinetics of the leaves and equally on the methods implemented. This study was carried out to investigate the thin layer drying behaviour of *Annona muricata* leaves using three different techniques; open sun, heat pump and oven drying technique, to fit the drying data to thirteen(13) established mathematical drying models in literature.

2. MATERIALS AND METHODS

This chapter deals with the experimental set-up, methods and technique followed for sun drying, oven drying and heat pump drying of soursop leaves. The preliminary experiment was planned for drying of fresh soursop leaves using three drying methods. The drying data were converted into moisture ratio fitted into different models to know which best fit each drying methods.

Experimental Site

The work was carried out in the Department of Agricultural and Environmental Engineering, School of Engineering and Engineering Technology, Federal University of Technology, Akure (FUTA). Ondo State, Nigeria.

Selection of Raw Materials

Fresh, healthy and matured soursop leaves were selected for conducting the experiments. The leaves were obtained from a local farm in Akure, Ondo state, Nigeria. The leaves were retrieved early in the morning to avoid moisture loss and spoilage. The leaves were removed carefully from the mother plant to ensure uniformity and were transported in a covered polyethylene bag to avoid oxidation and contamination.

Drying Experiment

In this study, fresh healthy soursop leaves (*Annona muricata L.*) were procured from a local farm in Akure, Ondo State. The drying experiments were carried out using open sun drying, heat pump dryer, laboratory oven in the Department of Agricultural Engineering, Federal University of Technology, Akure. The samples were weighed using a digital balance with 0.01g sensitivity at intervals throughout the drying process. The leaves will be dried under three different methods; open sun drying, oven drying (at 40˚C) and heat pump drying. The samples will be dried simultaneously under these three drying methods.

Determination of Moisture Content

Thermal drying method was used in the determination of moisture content of the samples. About 5g of sample were placed in the laboratory oven in triplicate at 105± 3˚C and allowed to dry to a constant weight for 24 hours (Lagha-Benamrouche and Madani, 2013). The moisture content (MC) was calculated by expressing the weight loss upon drying a fraction of the initial weight of sample used. The moisture content of the leaves was determined by gravimetric method which determines the mass loss from the sample by drying at constant weight (AOAC, 2000).

$$M_t = \frac{m_w - m_d}{m_w} \quad (1)$$

Where M_t is the moisture content (g water/ g dry matter), $m_w$the wet mass of sample at a time (g), and $m_d$is the corresponding dry mass of the sample (g)

Mathematical Modeling of the Drying Process

The experimental data obtained from the open sun drying, solar drying and heat pump drying were expressed in terms moisture ratio, drying time and drying rate. The moisture ratio (*MR*) and the drying rate (DR) of the leaves were determined using the equations 2 and 3 (Midilli *et al.*, 2007):

$$MR = \frac{M_t - M_\infty}{M_0 - M_\infty} \quad (2)$$

$$Drying\ rate = \frac{M_{t+dt} - M_t}{dt} \quad (3)$$

For these three drying methods, the equilibrium moisture content (M_∞) was assumed to be zero, therefore the equation simplified then become (Maskan, 2000; Soysal, 2004; Akpinar, 2006; Dadali *et al.*, 2007a, c)

$$MR = \frac{M_t}{M_0} \quad (4)$$

where M_t is the moisture content at any given time (g water/g dry matter), M_o is the initial moisture content (g water/g dry matter), M_∞ is the equilibrium moisture content (g water/g dry matter), $M_{t+dt}$is the moisture content at $t + dt$ (g water/g dry base) and t is drying time (min).

Statistical Analysis

The behaviour of the samples during the process was observed by plotting the moisture ratio against the drying time. The experimental data were fitted to seven thin-layer mathematical models (Table 1) to describe the process. The numerical calculations of the data were done using the software package, Excel 2016 (Microsoft Inc.). The models' parameters were evaluated with the non-linear regression techniques of Marquardt-Levenberg until minimal error was achieved between experimental and calculated values. The coefficient of determination, R^2; normalized root mean square error, *NRMSE*; sum of square of residuals, *SSE* and root mean square error, *RMSE* of the mathematical models were the statistical parameters calculated and used to evaluate the fitting of the models to experimental data. The higher values of the coefficient of determination (R^2) and the lower values of the reduced normalized root mean square error (*NRMSE*), sum of square of residuals (*SSE*) and root mean square error (*RMSE*) were chosen for goodness of fit (Midilli *et al.*, 2007). These parameters were calculated using equations (5) to (8):

Table 1: Thin-layer drying mathematical models employed for the fitting of experimental data

S. No	Model name	Model	Reference
1.	Newton model	$MR = \exp(-kt)$	El-Beltagy and others (2007)
2.	Page model	$MR = \exp(-kt^n)$	Akoy (2014); Tzempelikos and others (2014)
3.	Modified page (II)	$MR = \exp[-(Kt)^n]$	Vega and others (2007)
4	Modified page (III)	$MR = k\exp(-t/d^2)^n$	Kumar and others (2006)
5.	Henderson and Pabis model	$MR = a\exp(-kt^n)$	Meisami-asl and others (2010); Hashim and others (2014)
6.	Modified Henderson and Pabis model	$MR = a\exp(-kt) + b\exp(-gt) + c\exp(-ht)$	Zenoozian and others (2008)
7.	Midilli kucuk model	$MR = a\exp(-kt) + bt$	Darvishi and Hazbavi (2012); Ayadi and others (2014)
8.	Logarithmic model	$MR = a\exp(-kt) + c$	Rayaguru and Routray (2012); Kaur and Singh (2014)
9.	Two-term model	$MR = a\exp(-K_1t) + b\exp(-K_2t)$	Sacilik (2007)
10.	Wang and Smith	$MR = 1 + at + bt^2$	Omolola and others (2014)
11.	Hii and others model	$MR = a\exp(-K_1t^n) + b\exp(-K_2t^n)$	Kumar and others (2012b)
12.	Approximation of diffusion	$MR = a\exp(-kt) + (1-a)\exp(-kbt)$	Yaldýz and Ertekýn (2007)
13.	Weibull model	$MR = \alpha - b\exp(-k_0t^n)$	Tzempelikos and others (2015)

a, b, c and d are constants and coefficients in the drying models.

$$R^2 = \frac{\sum_{i=1}^{N}(\overline{MR}_{exp} - MR_{pre,i})\sum_{i=1}^{N}(\overline{MR}_{exp} - MR_{exp,i})}{\sqrt{\left[\sum_{i=1}^{N}(\overline{MR}_{exp} - MR_{pre,i})^2\right]\left[\sum_{i=1}^{N}(\overline{MR}_{exp} - MR_{exp,i})^2\right]}} \quad (5)$$

$$RMSE = \sqrt{\frac{\sum_{i=1}^{N}(MR_{pre,i} - MR_{exp,i})^2}{N}} \quad (6)$$

$$NRMSE = \sqrt{\frac{1}{N}\left(\frac{\sum_{i=1}^{N}(MR_{exp,i} - MR_{pre,i})^2}{MR_{exp,max} - MR_{exp,min}}\right)} \quad (7)$$

$$SSE = \sum_{i=1}^{N}\left(MR_{pre,i} - MR_{exp,i}\right)^2 \quad (8)$$

Where $MR_{exp,i}$ is the ith experimentally observed moisture ratio, $MR_{pre,i}$ is the ith predicted moisture ratio, N *is* the number of observations, $MR_{exp,max}$ is the maximum experimentally observed moisture ratio, and $MR_{exp,min}$ is the minimum experimentally observed moisture ratio.

3. RESULTS AND DISCUSSION

Results and discussion of the experiment carried out on the drying of *Annona muricata* leaves are presented in the chapter

Determination of Moisture content

The initial moisture content of the fresh sample of the leaves was determined by oven drying method (ASABE STANDARDS, 1993 and AOAC, 2000). The weight before and after drying at 105˚C ±3˚C for 24hours was recorded and moisture content in wet basis was calculated as;

Table 2: The initial moisture content of soursop leaves in triplicate

	A	B	C
Initial Mass	5.49	5.06	5.34
Final Mass	1.52	1.45	1.58
MC_{wb}	**72.3%**	**71.24%**	**70.34%**

The Moisture content of the leave was observed to range from 75% to 80% wet basis.

The Drying Curves

The effects of different drying methods on the drying characteristics of the product are discussed using the following drying curves.

Effect of temperature on the moisture content, moisture ratio and drying rate for open sun drying, heat pump drying and oven drying (at temperature 40˚C ± 4˚C)

The open sun drying, heat pump drying and oven drying (at 40˚C ± 4˚C) dried the soursop leaves at the same ambient temperature, the effect of these drying methods on the drying characteristics are observed from the drying curves below.

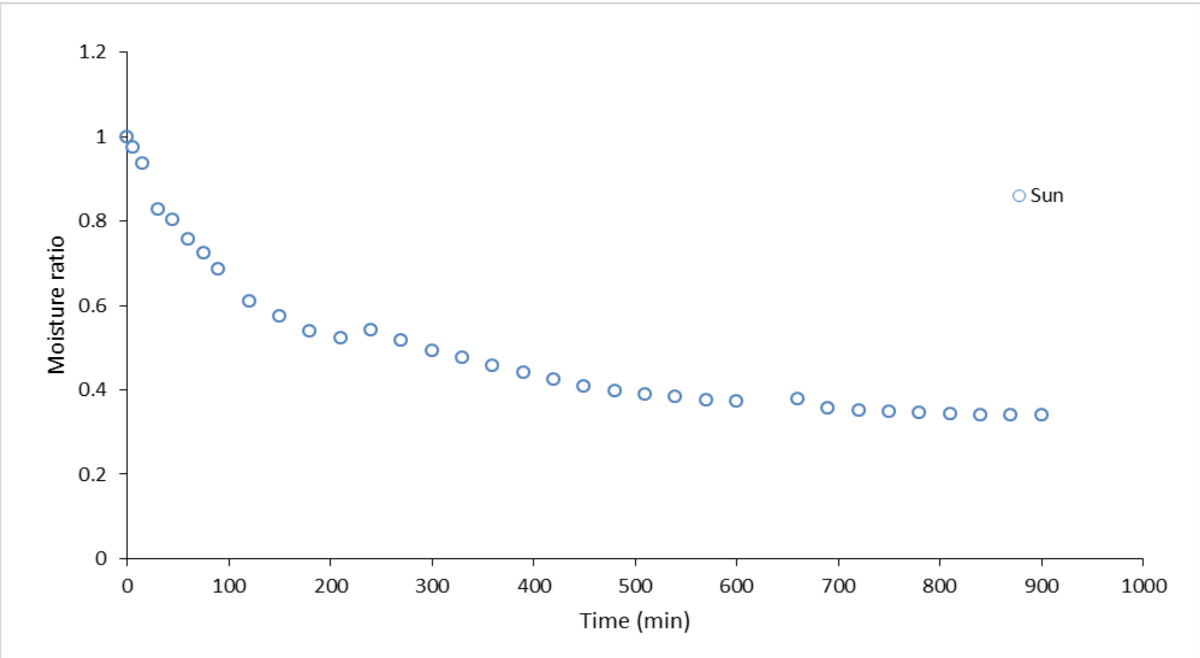

Figure 1. Graph of moisture ratio against time for sun drying

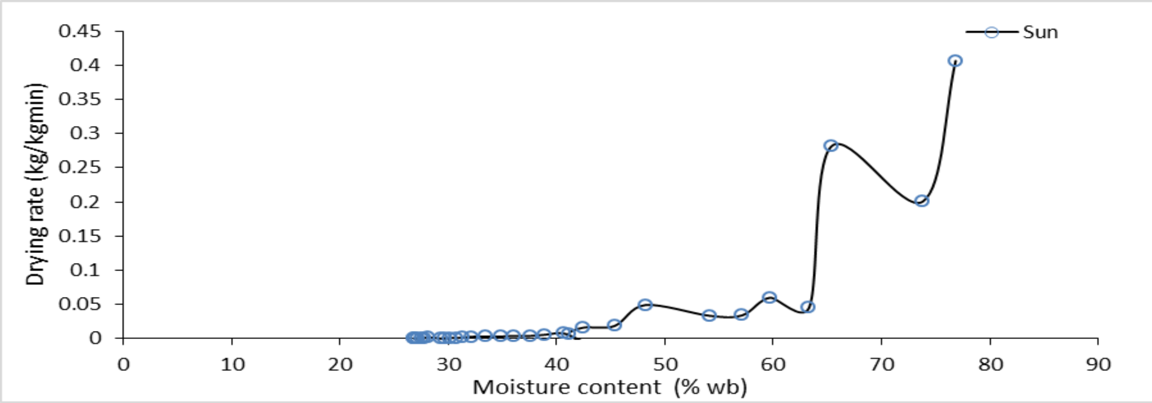

Figure 2. Graph of drying rate against moisture content for open sun drying

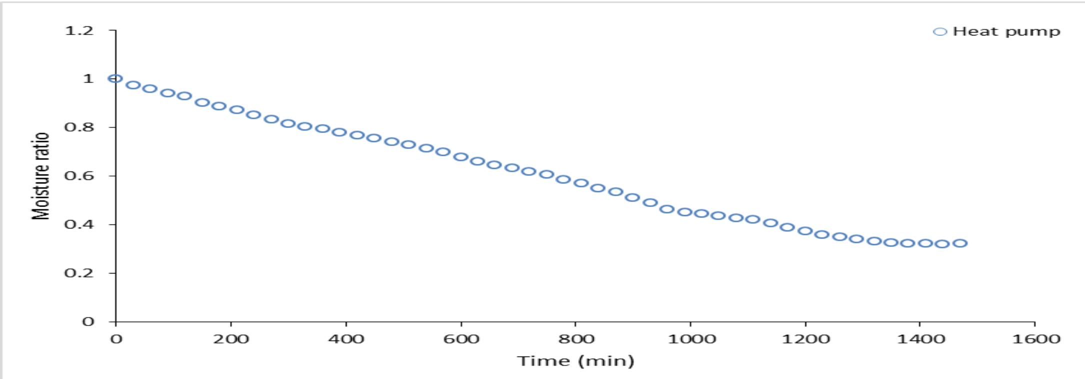

Figure 3. Graph of moisture ratio against time for heat pump drying

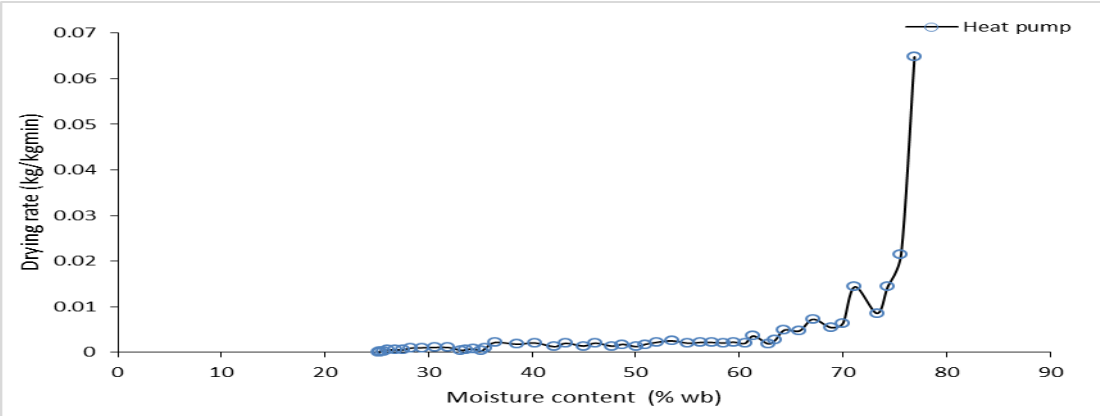

Figure 4. Graph of drying rate against moisture content for heat pump drying

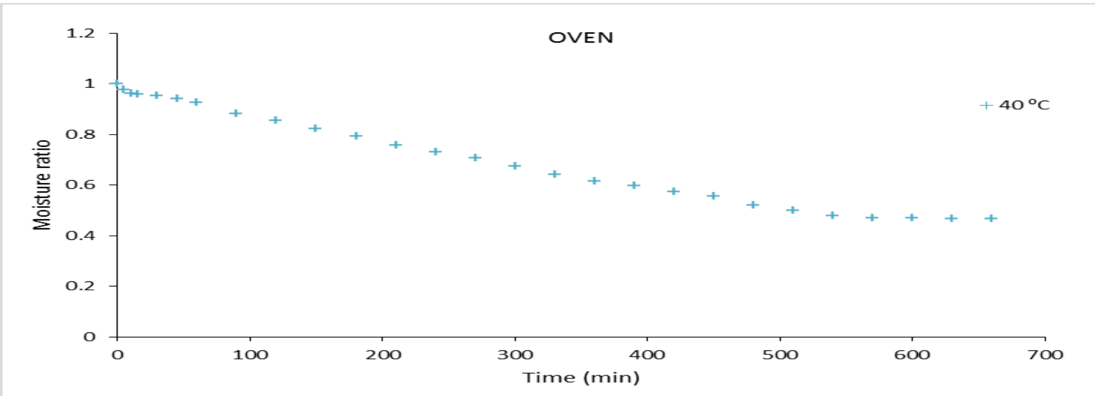

Figure 5. Graph of moisture ratio against time for oven drying at 40ºC

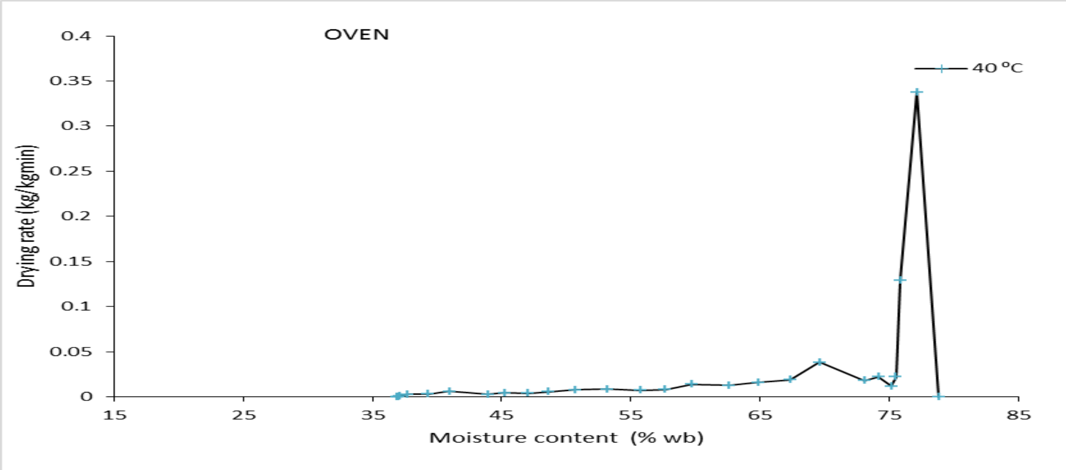

Figure 6. Graph of drying rate against moisture content for oven drying at 40ºC

From the drying curves of moisture ratio against time and drying rate against moisture content given in figure 1, figure 2, figure 3, figure 4, figure 5 and figure 6 for the three methods of drying, it was observed that the initial moisture content of the leaves is the critical moisture content as it does not have a constant drying rate before exhibiting falling drying rate. Unlike sun drying, heat pump drying and oven drying at 40 degrees Celsius exhibit a steady rate of drying, but sun drying tends to fluctuate at unspecific intervals which may be due to the change in ambient temperature and relative humidity of the environment. As observed by Olabinjo *et al.* (2017), sun drying shows an unsteady drying rate which affects final moisture content level. This leaves heat pump drying and oven drying at 40ºC a better option than open sun drying. The final moisture content of oven drying at 40 ºC is 37.7% wet basis which is not safe for drying but heat pump drying has final moisture level lower than the other methods. These results indicated that the heat pump drying is a better method as it exhibits a steady rate of drying as well as a better final moisture content level safe for storage (Chukwunonye *et al.*, 2016).

Mathematical Modelling of Drying Kinetics

Data from moisture content versus time were converted to dimensionless moisture ratio so as to normalize the drying curves. The moisture ratio calculated using Equation (4) at various drying conditions were fitted to thirteen selected thin layer drying models reported by previous studies. These models were evaluated based on statistical tools: coefficient of determination (R^2), sum of square error (*SSE*), sum of estimated error (*SEE*), root mean square error (*RMSE*) and chi-square (X^2) (Alara *et al*., 2017; Chukwunonye *et al*., 2016; Gumus and Banigo, 2015). The obtained results for the three different methods (open sun drying, heat pump drying, oven drying (at 40) are shown in Table. In general, the R^2, RMSE, SEE, X^2, and SSE values for the models ranged between 0.9390 and 0.9941, 0.0151 and 0.0566, 0.0158 and 0.0593, 0.0000 and 0.0048, 0.0078 and 0.1090 respectively for open sun drying; 0.93655 and 0.98429, 0.00329 and 0.0731, 0.0344 and 0.0738, 0.0000 and 0.00544, 0.061662 and 0.304618respectively for heat pump drying ; 0.64805 and 0.999, 0.0104 and 0.1328, 0.0116 and 0.2252, 0.0000 and 0.06068, respectively for oven drying. It can be seen from Table that the highest values of R^2 as well as lowest values of SSE, RMSE, SEE and $X^2$for drying methods open sun drying, heat pump drying and oven drying at the various drying conditions were obtained from the Modified Henderson and Pabis, Hii *et al* and Hii *et al* drying models respectively. Thus, these models were selected as suitable to predict the thin layer drying behaviour of *Annona muricata* leaves. The correlations between the experimental and predicted moisture ratio at different drying conditions are shown in Figures 7 to 9. The selected models showed a good agreement between the experimental and predicted moisture ratio, which is banded around 45° straight line. The obtained results are in agreement with the past studies conducted on *Vernonia amygdalina* leaves under open sun and oven drying.

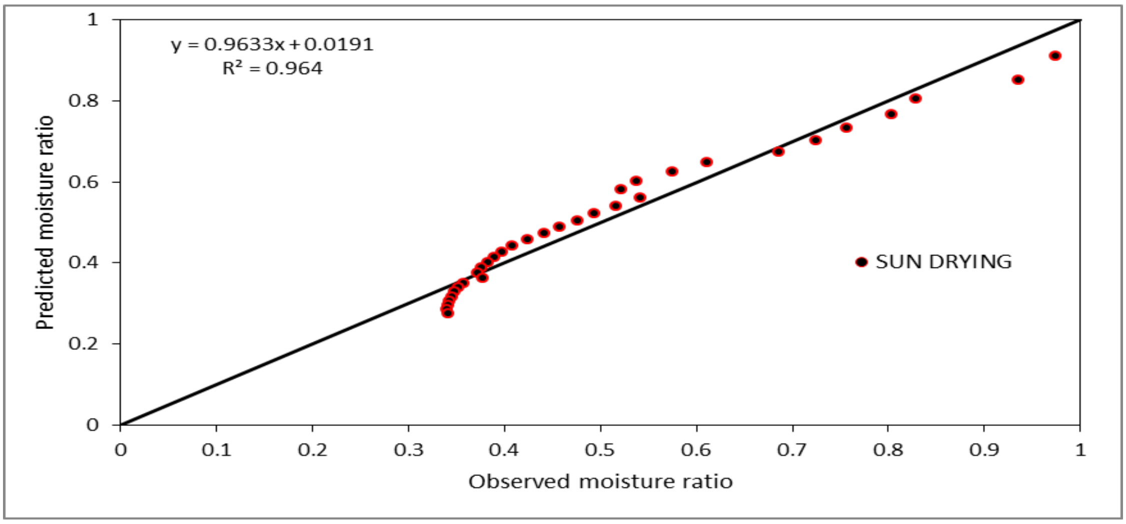

Figure 7. Plot of predicted moisture ratio against observed moisture ratio for sun drying

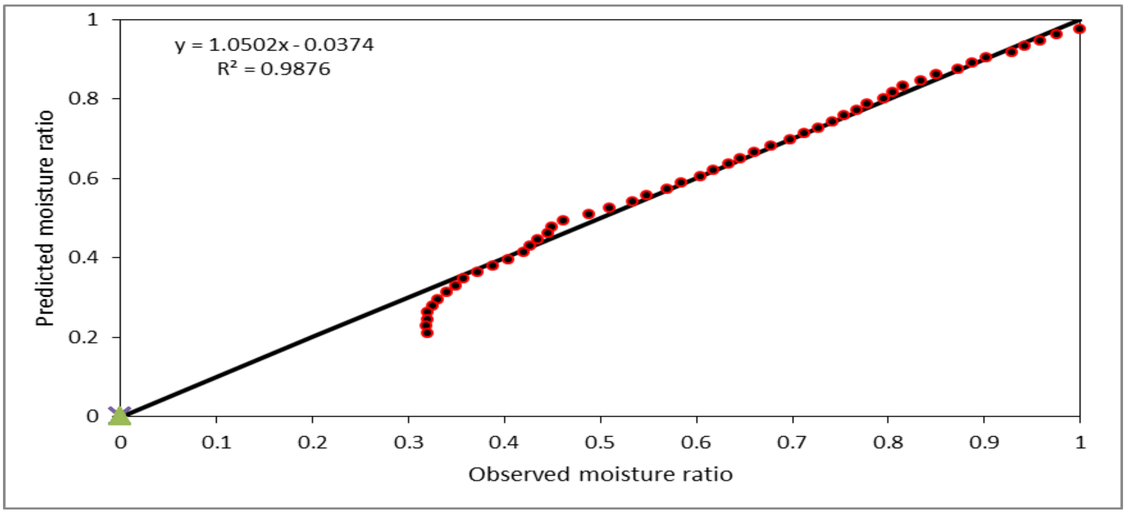

Figure 8. Plot of predicted moisture ratio against observed moisture ratio for heat pump drying

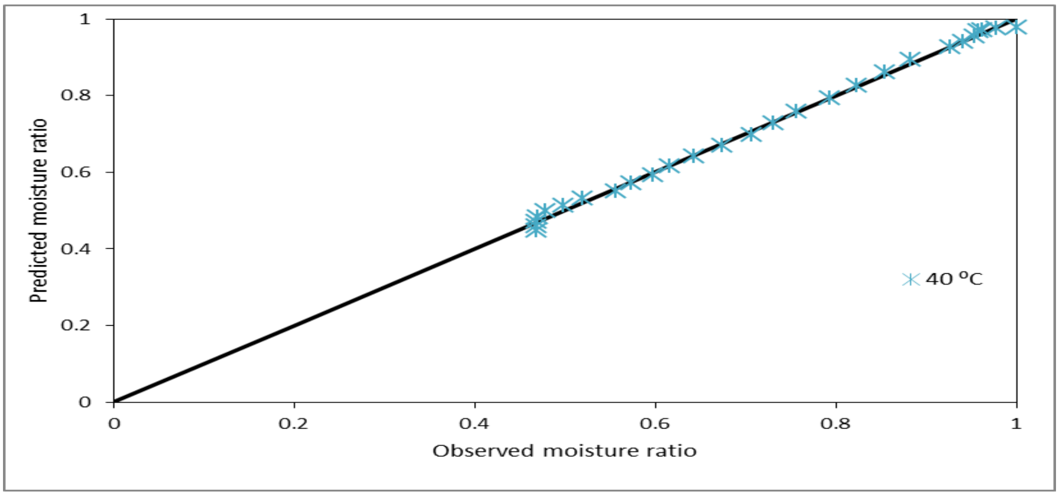

Figure 9. Plot of predicted moisture ratio against observed moisture ratio for oven drying

Table 3: Model Values

System	Model	Model constant	R^2	RMSE	SEE	X^2	SSE
SUN DRYING	Newton	k = 0.0887	0.947864	0.056612	0.057463	0.003302	0.108966
	Henderson and perbis	k = 0.0789, a = 0.9259	0.938953	0.049267	0.050783	0	0.082527
	Page	k = 0.1531, n = 0.7519	0.971816	0.033096	0.034115	0.000876	0.037242
	Logarithmic	k = 0.1968, a = 0.7269, c = 0.3028	0.994071	0.015132	0.015847	0.00173	0.007785
	Two term model	k = 0.1283, g = -0.1068, a = 0.9679, c = 0.0421	0.991791	0.017811	0.018962	0.003151	0.010786
	Verma *et al*	k = -0.0001, g = 0.1946, a = 0.3077	0.994004	0.01822	0.019082	0.003337	0.011287
	Diffusion approach	k = 0.0887, g = 1, a = 38.448	0.947867	0.056612	0.059288	0.003652	0.108966
	Midili kucuk	k = 0.0903, b = 0.0121, a = 0.9475, n = 1.1281	0.977893	0.029265	0.031155	1.14E-10	0.02912
	Wang and smith	a = -0.1038, b = 0.0041	0.980256	0.027872	0.02873	0.001554	0.026413
	Hii *et al*.	k = 0.1159, g = 0.0118, a = 1.6794, c = -0.6522, n = 0.6085	0.964025	0.037272	0.040357	0.004817	0.047232
	Modeified Henderson pabis	k = 0.1542, a = -0.0004, g = 0.1542, b = -0.0004, h = 0.7278, c = 0.205	0.994097	0.015102	0.016641	0.001991	0.007754
	Modified Page I	k = 0.0819, n = 0.7291	0.973108	0.032803	0.033813	0.003273	0.036586
	Modified Page II	k = 1.0587, a = 0.1054, n = 0.6649, L = 0.3809	0.976544	0.030165	0.032113	0.002169	0.030938
Heat pump	Newton	k = 0.0495	0.943429	0.073104	0.073754	0.00544	0.304618
	Henderson and perbis	k = 0.0545, a = 1.075	0.936555	0.06716	0.06837	0	0.257095
	Page	k = 0.0139, n = 1.4514	0.965975	0.049471	0.050362	0.000822	0.1395
	Logarithmic	k = 0.001, a = 30.7788, c = -29.7854	0.982992	0.034228	0.035166	0.003383	0.066778
	Two term model	k = 0.0977, g = 0.124, a = 4.5617, c = -3.6164	0.965189	0.049403	0.051233	0.003863	0.139117
	Verma *et al*	k = -0.0003, g = 0.0009, a = -25.3306	0.983085	0.034329	0.03527	0.002618	0.067174
	Diffusion approach	k = 0.1019, g = 1.0367, a = 23.9843	0.962835	0.050989	0.052386	0.004171	0.148191
	Midili kucuk	k = 0.0087, b = -0.0316, a = 0.9996, n = 0.0093	0.983256	0.033961	0.035219	0.002484	0.065741
	Wang and smith	a = -0.0315, b = 0	0.983595	0.034175	0.034791	0.00378	0.066572
	Hii *et al*.	k = 0.0041, g = -0.0136, a = 2.338, c = -1.3627, n = 1	0.984295	0.032891	0.034435	0.004805	0.061662
	Modeified Henderson pabis	k = -1.5834, a = -0.0091, g = -1.5836, b = -0.0091, h = 4.1395, c = -0.0003	0.984239	0.032949	0.034833	0.004884	0.061881
	Modified Page I	k = 0.0525, n = 1.4478	0.965896	0.04947	0.050361	0.004614	0.139493
	Modified Page II	k = 0.9295, a = 0.1697, n = 1.7374, L = 7.2209	0.971202	0.044699	0.046355	0.0034	0.113886
40 ^{0}C	Newton	k = 0.1968	0.995483	0.01413	0.014399	0.000207	0.005391
	Henderson and perbis	k = 0.1439, a = 0.8569	0.995376	0.012755	0.013255	0.000176	0.004392
	Page	k = 0.3899, n = 0.4632	0.995216	0.013143	0.013659	0.000187	0.004664
	Logarithmic	k = 1.2739, a = 0.5656, c = 0.4654	0.995781	0.012185	0.012924	0.000167	0.004009
	Two term model	k = 1.1237, g = -0.0229, a = 0.6103, c = 0.4166	0.995764	0.01227	0.013294	0.000177	0.004065
	Verma *et al*	k = -0.0293, g = 1.015, a = 0.401	0.99566	0.012596	0.01336	0.000178	0.004284
	Diffusion approach	k = 0.1968, g = 1, a = -6.5094	0.995477	0.014136	0.014993	0.000225	0.005395
	Midili kucuk	k = 0.5817, b = 0.0663, a = 1.0344, n = 0.7948	0.996027	0.011849	0.012838	0.000165	0.003791
	Wang and smith	a = -0.2915, b = 0.0348	0.996706	0.011265	0.011707	0.000137	0.003426
	Hii *et al*.	k = 1.3079, g = -0.0006, a = 0.5191, c = 0.4707, n = 1.4451	0.997311	0.009756	0.010807	0.000117	0.00257
	Modeified Henderson pabis	k = 0.2083, a = -0.0229, g = 0.2083, b = -0.0229, h = 0.6102, c = 1.1237	0.995842	0.012102	0.013723	0.000188	0.003955
	Modified Page I	k = 0.1309, n = 0.4632	0.995245	0.013135	0.013651	0.000186	0.004659
	Modified Page II	k = 1.0635, a = 0.1926, n = 0.4144, L = 0.1264	0.995417	0.012701	0.013761	0.000189	0.004356

Table 3: Model Values

4. CONCLUSIONS

Thirteen thin-layer model equations were used in testing the drying experiment carried out on the thin-layer drying behavior of *Annona muricata* at 40°C.The findings of the study showed that Modified Henderson and Pabis model, Hii et al and Hii et al mode were found to give the overall best fit from all the models examined for open sun, heat pump and oven drying method respectively. The results gave highest R^2 values of 0.9941, 0.9843 and 0.9987, lowest values of RMSE of 0.015102, 0.032891 and 0.010322, lowest values of SEE of 0.016641, 0.034435 and 0.012873 and lowest reduced chi square (χ^2) values of 0.001991, 0.004805 and 0.040539, for open sun, heat pump and oven drying method respectively. Validation of the established model gave good agreement between the experimental and predicted variables, therefore, Modified Henderson and Pabis, Hii et al and Hii et al equation could be used satisfactorily to predict thin layer drying of *Anonna muricata* (Soursop) leaves for open sun, heat pump and oven drying method respectively.

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