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*(Phoenix dactylifera)*

.(Ashraf Jahani, 2006)

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.(Barreveld ,1993) (

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.(Ashraf Jahani, 2006)

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Doymaz, )

.(2004;Doymaz, 2005; Falade& Abbo, 2007

).(Hashempoor,1999)

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.(Kechaou & Maalej,2000)

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.(Mayor& Sereno,2004)

. (Prado et al., 2000)

(D)

. (Crank, 1975 ;Boudhrioua et al.,2003 )

.( Hamdami et al.,2004 )

( )

et)

.(Youcef-Ali al., 2001

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.(Falade&Abbo, 2007)

... :  
 :  $L_t$  ( ) :  $D$

( )  $t$   
 )  $t$  :  $X$   
 / ( ) :  $X_e$  ( /  
 ( / ) :  $X_0$

$t$  (AOAC, 1990)  
 .(Hernandez et al.,2000)

$$l_t = l_0 * [\Delta l_f + (1 - \Delta l_f) * \frac{X - X_e}{X_0 - X_e}] \quad ( )$$

$$\Delta l_f = \frac{l_f}{l_0} \quad ( )$$

( ) :  $L_f$

( ) :  $L_0$  Sjöholm & Gekas, )

:(Lee et al., 2006 )

$$D = D_0 \exp\left(\frac{-E_a}{RT}\right) \quad ( )$$

) :  $E_a$

( / ) (

) :  $D_0$

( / ) (

( / ( . ) ) :  $R$

(  $R = /$  )

( ) :  $T$

$D_0$

$1/T$   $\ln(D)$

SAS

$\ln(D_0)$   $-E_a/R$

$\ln(MR)$

) /

(

( )  $MR$

:(Kechaou & Maalej,2000)

$$MR = \frac{X - X_e}{X_0 - X_e} = \frac{8}{\pi^2} \sum_{n=0}^{\infty} \left( \frac{1}{2n+1} \right) \exp\left( -\frac{(2n-1)^2 \pi^2 D t}{4l_t^2} \right) \quad ( )$$

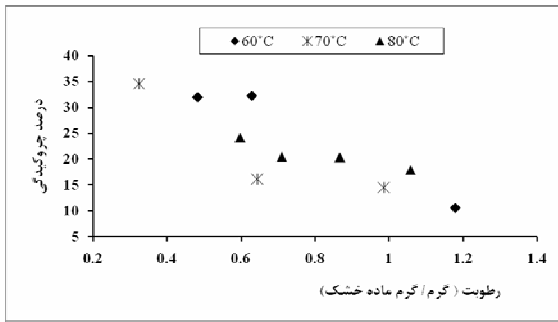
( )

(Kechaou&Maalej, 2000 ;Falade&Abbo, 2007)

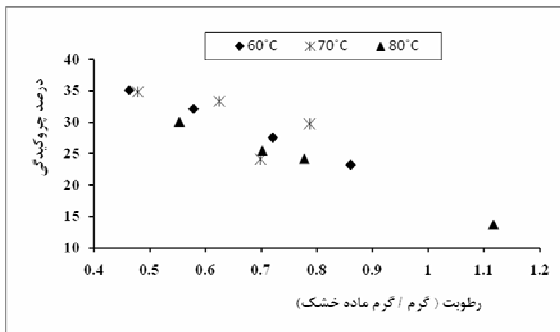
( )

Kechaou& Maalej, 2000; Falade& Abbo, )

(2007; Amellal& Benamara, 2008



( )

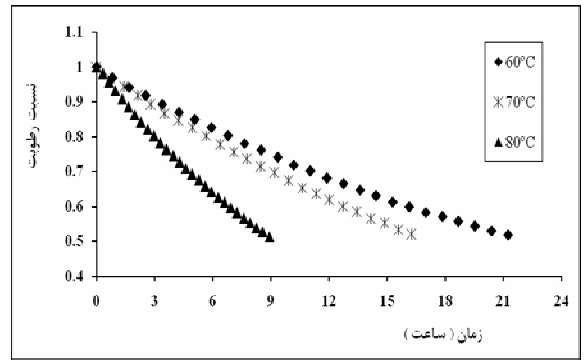


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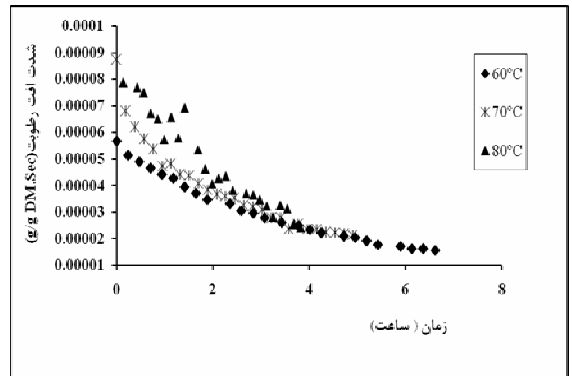
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;Falade&Abbo, Amellal&Benamara,2008 )

( Kechaou&Maalej, 2000 2007;

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°C

(Talla et al., 2004)

وضعیت نمونه	دما (°C)	* براساس قطر اولیه (مترمربع بر ثانیه)	* براساس قطر میانگین (مترمربع بر ثانیه)
با پوسته	۶۰	$۲/۳۴ \times ۱۰^{-۹d}$	$۲/۲۱ \times ۱۰^{-۹c}$
	۷۰	$۲/۴۳ \times ۱۰^{-۹d}$	$۲/۲۲ \times ۱۰^{-۹c}$
	۸۰	$۵/۶۳ \times ۱۰^{-۹c}$	$۵/۴۱ \times ۱۰^{-۹b}$
بدون پوسته	۶۰	$۷/۷۹ \times ۱۰^{-۹bc}$	$۶/۴۳ \times ۱۰^{-۹b}$
	۷۰	$۹/۰۹ \times ۱۰^{-۹b}$	$۶/۹۴ \times ۱۰^{-۹b}$
	۸۰	$۱/۱۹ \times ۱۰^{-۹a}$	$۱/۰۶ \times ۱۰^{-۹a}$

( Al-Muhtaseb et al., 2004 )

(Ratti, 1994)

(  $E_a$  )  $D_0$  ( )

$\times$   $D_0$  .

/  $\times$

/

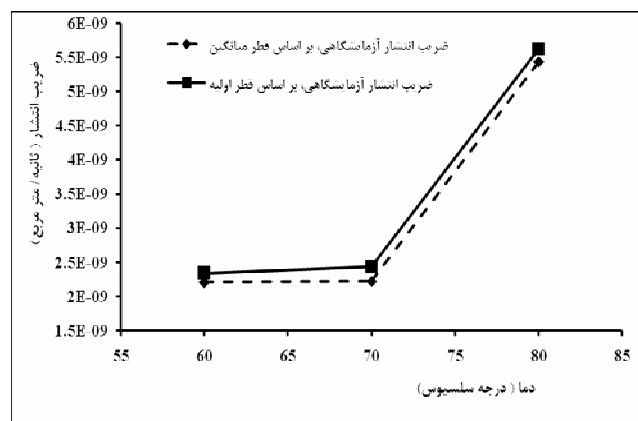
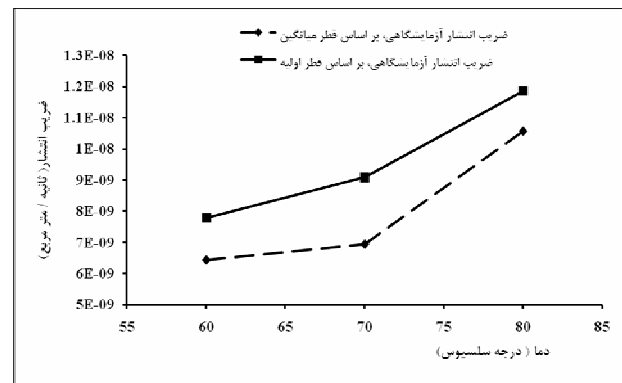
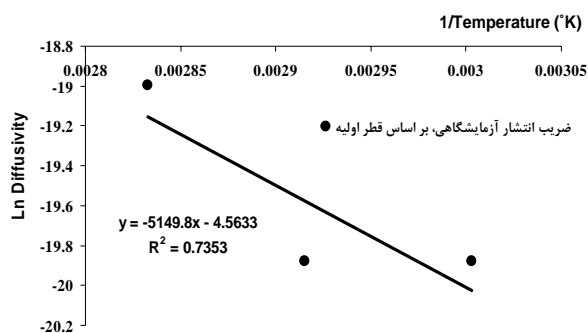
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Falade & Abbo, )

(2007)



$\ln \left( \frac{M_t - M_\infty}{M_0 - M_\infty} \right) = -\frac{D}{L^2} t$

$\ln \left( \frac{M_t - M_\infty}{M_0 - M_\infty} \right) \times \frac{L^2}{t} = -D$

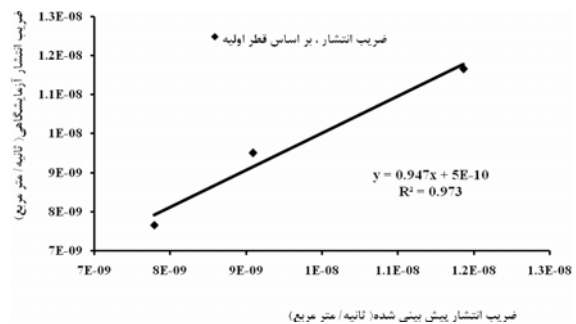
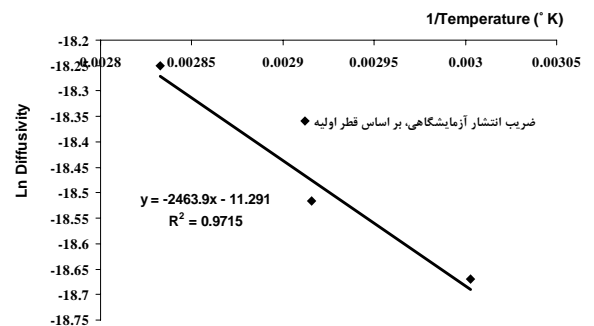
$(^\circ\text{C})$

(Falade & Abbo, 2007)

$( \quad )$

$\ln \left( \frac{M_t - M_\infty}{M_0 - M_\infty} \right) \times \frac{L^2}{t}$

$( \quad )$



## REFERENCES

- Al- Muhtaseb, A. H., Mc Minn, W. A. M. & Magee, T. R. A. (2004). Shrinkage, density and porosity variations during the convective drying of potato starch gel. In: Proceedings of 14<sup>th</sup> International Drying symposium, Sao Paulo, Brazil, pp.1604-1611.
- Amellal, H. & Benamara, S. (2008). Vacuum drying of common date pulp cubes. *Drying Technology*, 26, 378-382.
- AOAC. (1990). Official methods of analysis of the Association of Official Analytical Chemists. No. 934. 06, Arlington, Virginia, USA.
- Ashraf Jahani, A. (2006). *Date palm fruit life*. Tehran: Agricultural sciences. (In Farsi)
- Barrevelde, W.H. (1993). *Date palm products*. FAO Agricultural Service Bulletin No. 101, Rome.
- Boudhrioua N., Bonazzi, C. & Daudin, J. D. (2003). Estimation of moisture diffusivity in gelatin-starch gels using time-dependent concentration-distance curves at constant temperature. *Food Chemistry*, 82, 139-149.
- Crank, J. (1975). *The Mathematics of Diffusion*, 2<sup>nd</sup> ed.,

- Clarendon Press, Oxford.
- Doymaz, I. (2004). Convective air drying characteristic of thin layer carrots. *Journal of Food Engineering*, 61, 359-364.
- Doymaz, I. (2005). Drying characteristics and kinetics of okra. *Journal of Food Engineering*, 69, 275-279.
- Falade, K.O. & Abbo, E. S. (2007). Air-drying and rehydration characteristics of date palm (Phoenix dactylifera L.) fruits. *Journal of Food Engineering*, 79, 724-730.
- Hamdami, N., Monteau, J.Y. & Le bail, A. (2004). Transport properties of a high porosity model food at above and sub-freezing temperatures, Part 2: Evaluation of the effective moisture diffusivity from drying data. *Journal of Food Engineering*, 62, 385-392.
- Hashempoor, M. (1999). *Date palm handbook (General)*. Karaj: Agricultural education. (In Farsi)
- Hernandez, J. A., Pavon, G. & Garcia, M. A. (2000). Analytical solution of mass transfer equation considering shrinkage for modeling food-drying kinetics. *Journal of Food Engineering*, 45, 1-10.
- Kechaou, N. & Maalej, M. (2000). A simplified model for determination of moisture diffusivity of date from experimental drying curves. *Drying Technology*, 18(4), 1109-1125.
- Lee, K. T., Farid, M. & Nguang, S. K. (2006). The mathematical modeling of the rehydration characteristics of fruit. *Journal of Food Engineering*, 72(1), 16-23.
- Mayor, L. & Sereno, A. M. (2004). Modelling shrinkage during convective drying of food materials: a review. *Journal of Food Engineering*, 61, 373-386.
- Prado, M. E. T., Alonso, L.F.T., & Park, K.J. (2000). Shrinkage of dates (Phoenix Dactylifera L.) during drying. *Drying Technology*, 18(1), 295-310.
- Ratti, C. (1994). Shrinkage during drying of foodstuffs. *Journal of Food Engineering*, 23, 91-105.
- Sjoholm, I. & Gekas, V. (1995). Apple shrinkage upon drying. *Journal of Food Engineering*, 25, 123-130.
- Talla, A., Puiggali, J. R., Jomaa, W. & Jannot, Y. (2004). Shrinkage and density evolution during drying of tropical fruits: application to banana. *Journal of Food Engineering*, 64, 103-109.
- Youcef-Ali, S., Messaoudi, H., Desmons, J. Y. & Abene, A. (2001). Determination of the average coefficient of internal moisture transfer during the drying of a thin bed of potato slices. *Journal of Food Engineering*, 48, 95-101.