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ACCELERATED DRYING AND STABILIZATION OF CANOLA SEEDS AND OIL

El-Kholy, M.M. * and A. Tharwat**
*** Agric. Eng. Res. Institute, Dokki, Giza**
**** Agric. Eng. Dept, Fac. of Agric., Mansoura Univ.**

ABSTRACT

A study was carried out to test and evaluate the effect of accelerated drying of canola on seeds moisture content, fungal load on seeds surface and stabilization of the extracted oil using a conduction heating rotary dryer. The drying temperature was set at approximately 95, 105, 115, 125, 135 and 145 °C and the drying time was set at 5, 10, 15, 20, 25 and 30 min. The results showed that all the drying process occurred at the falling rate period in which the rate of evaporation tends to fall as the moisture content decreases and the drying curve decays exponentially towards the equilibrium moisture content. Rapid moisture removal from seeds was obvious in all experiments particularly at higher heating surface temperature and longer exposure time. The results also showed that both the simple and the modified exponential equation models were satisfactorily described the drying behavior of canola seeds and predicted the change in seeds moisture content as indicated by the lower values of standard error of estimate (SE) and the higher coefficient of determination (R^2). Meanwhile, high temperature conduction heating reduced the fungal load in canola seeds in an effective manner. Also, the extracted canola oil was stabilized as indicated from the lower values of free fatty acids of the samples stored under room temperature. In general, it can be said that, the accelerated drying and heat stabilization of canola seeds using the conduction heating rotary dryer may be considered as an effective procedure for moisture reduction, fungal inactivation and oil stabilization.

INTRODUCTION

In Egypt the total productivity of cooking oil represent 15-20% of the total oil requirement while 80-85% is imported from different countries. In the last decade, many efforts were followed in an attempt to narrow the nutritional gap by decreasing the average consumption of oil per person every year while increasing oil quality.

Canola oil is high in oleic acid relative to other vegetable oils and has been competitive in price with other cooking oils. Edible rapeseed oil or canola oil has been used in some countries for the past two decades and was approved for human consumption in the U.S. by the Food and Drug administration in 1985. (Raymer et. al, 1990).

The original condition of canola seeds is probably the most important factor affecting its storage. Freshly harvested canola can maintain a high respiration rate for up to 6 weeks before becoming quiescent. This process often refers to "sweating" and is a very unstable condition for binned canola. Mold growth and respiration produces additional heat and moisture which further increase the temperature within the seed bulk. Eventually the seeds may become heat damaged. The effects of sweating are reduced by drying and storing the crop in dry and cool condition (Thomas, 1984).

The drying rate for canola is less than that for cereals because of the reduced air flow rate through the smaller, more densely packed seeds. As canola offers more resistance to air flow rate than cereal grains, the fan of a dryer operating at the same speed used for grain will produce a higher static pressure but considerably less air flow. This causes the temperature of the hot air plenum to rise unless the fuel flow is reduced (Mills 1989; Jayas and Sokhansan 1989).

For this reason, the most proper method for drying this type of seeds with killing microorganisms is based on the application of fluidized bed heating or direct conduction heating. These techniques not only kill the microorganisms but also inactivate enzymes causing deterioration of seeds oil during temporary or long storage periods. (Dermott and Evans 1980 ; Hendawy, 2003).

El-Sahrigi, et. al., (1999) studied the effectiveness of high temperature short time conduction heating for accelerated drying and sterilization of high moisture rough rice. They found that, the moisture removal rate depends upon heating surface temperature, exposure time and grain feed rate. Also, they mentioned that, the high temperature short time conduction heating distinctly reduced fungal activity in rough rice.

Hendawy, (2003) carried out a study to evaluate the use of high temperature short time conduction heating for rice bran stabilization and the effect of type of storage sacks on safe storage period of the stabilized bran. The results showed that, rice bran moisture content decreased with the increase of heating surface temperature and the exposure time. Quality evaluation tests showed a reduction in fungal growth rate and percentage of free fatty acids (FFA) with the increase of heating surface temperature and exposure time and also for the treatments stored in poly-ethylene sacks in comparison with burlap sacks.

The present study aims to test and evaluate the effect of high temperature short time conduction heating of the freshly harvested canola on seed drying, oil stabilization, and fungal count.

MATERIAL AND METHOD

The conduction heating unit:

An experimental scale rotary conduction heating unit was used for the experimental work. The unit consists of a rotary cylinder (0.6 m diameter and 0.2 m long) made of 1mm galvanized iron sheet enclosed by a fixed insulated cylinder (0.8 m diameter and 0.3 m long). One side of the rotary cylinder connected to a driving mechanism consists of 0.15 m diameter steel flange fixed to the side cover of the rotary cylinder and welded to a steel bar riding with a heavy duty ball bearing. A 0.5 kW low speed motor with different sizes of pullies used for power supply and speed control of the rotary cylinder. The other side of the rotary cylinder serves as an inlet for rice bran samples through a 0.1m diameter center hole. The heat treated bran discharged through a perforated removable sector of the cylinder bottom as shown in Fig. (1). For heating and temperature control of the rotary cylinder surface, two kW electric resistance heaters placed at the inner surface of the fixed insulated cylinder (between the rotary cylinder and the insulated exterior cylinder) to heat the surface of the rotary cylinder. The surface temperature of the rotary cylinder could be raised up to 175°C and maintained within ± 1 °C using a precise digital thermostat controlled by an electric contactor.

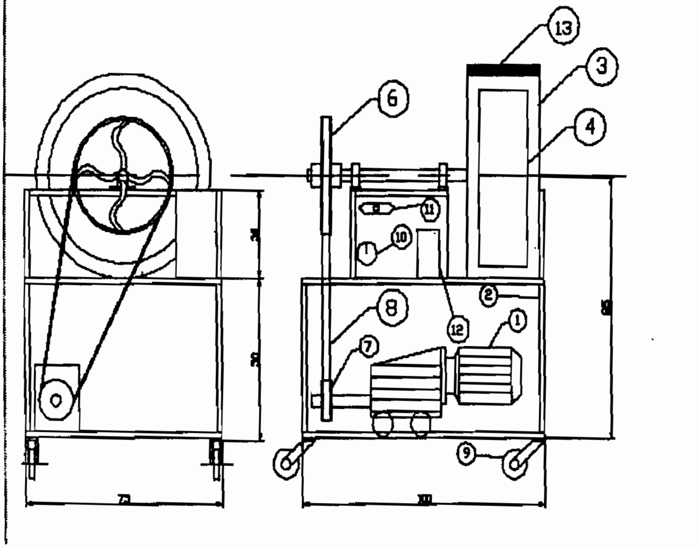

Fig. (1) Schematic diagram for the conduction heating unit.

Test procedure and Measurements:

Freshly harvested canola seeds at an initial moisture content of 36.97 % (d.b.) were used for the drying and heat stabilization processes using the conduction heating rotary dryer unit. The harvested seeds were sieved to separate the foreign matter and the un-filled seeds and then it was stored in deep freezer adjusted at (–5 °C) to suppress fungal growth and minimize quality changes. High temperature short time drying technique (HTST) was applied under six levels of heating surface temperatures (95, 105, 115, 125, 135 and 145 °C) and six levels of exposure time (5, 10, 15, 20, 25 and 30 min). Before each experimental run, seeds samples were taken out from the freezer and left until the initial temperature of seeds approached a level equal to that of room temperature. The samples were kept at insulated container in order to maintain the uniformity of the initial seeds temperature during the experimental work. Drying runs were started after attaining the required heating surface temperature of the drying unit. After heating the seeds (2.5 kg/run) to the required heating time, they were cooled to room temperature in wooden box covered with a perforated aluminum foil to allow escape of vapor during the cooling process. After cooling process, 100 g of seeds were taken out from each dried sample, and then divided into two sub samples, 50 g each, the first one used to precede the fungal colony count and the second was used to determine the seeds final moisture content. The following measurements were preceded during the experimental work:

Moisture content of canola seeds:

The standard A.O.A.C. (1991) moisture measuring method used for determining the seeds moisture content after each drying run. Five grams of canola seeds were placed at 135°C for 3 h, and then kept in a desiccator at room temperature. The dried samples were weighed again using an electronic digital balance and the moisture content of bran was calculated on dry basis.

Surface temperature of the rotary cylinder:

The remote –type infra red spot thermometer model (HT-11) used to measure the rotary cylinder surface temperature of the stabilization heating unit during the rotation process. The emissive of the thermometer was adjusted at 0.85 for iron sheet surfaces and the temperature was measured at different points. The heating surface temperature was considered as the average of the obtained readings.

Bulk temperature of the heat-treated canola seeds:

The bulk temperature of canola seeds was immediately measured at the end of each experimental run. The discharged seeds were received in an insulated iron cylinder and the sensing prop of a one point temperature meter model (A.W. SPERRY DM-8600, Taiwan) with range of 0 to 400 °C was inserted through the seed bulk until reaching a constant reading.

Fungal count in canola seeds:

The spread plate method recommended by Flannigan (1977) used to determine the change in fungal colony count in canola samples. Potato dextrose agar (PDA) at 3.9% concentration was used as a culture medium. Plates were incubated at 37 °C for 4 days and the counts of fungi were determined as colonies/g.

Free Fatty Acids (FFA%) in the extracted canola oil:

Oil samples were extracted from canola seeds by soaking the crushed samples at n-hexane solvent for 24-48 hrs under room temperature. The solvent was completely re-gained by evaporation using a heated water bath at 85 °C and condensing it using a condensation unit. The remained oil samples were filled in glass bottles and used for the required measuring tests. The FFA % of oil samples were calculated as oleic acid using the corresponding acid value of each sample according to the A.O.A.C. (1991) as follows:

$$FFA\ \% = \frac{282 \chi\ 100 \chi\ \mathrm{A.V}}{56.1 \chi\ 1000} \quad \text{..................... (1)}$$

$$FFA\ \% = \frac{A.\mathrm{V}}{1.99}$$

Where:

A.V = Acid value

The values 282 and 56.1 refer to the equivalent weight of oleic acid and the potassium hydroxide (KOH) respectively. It should be mentioned that, to get true results of the free fatty acids, the laboratory tests were conducted after 15 days of samples storage under room condition.

Theoretical considerations:

The simple and the modified exponential drying equations were examined for describing the drying behavior and predicting the change in canola seeds moisture content under the studied accelerated drying technique. The simple exponential equation written as:

$$MR = \frac{M - M_e}{M_o - M_e} = \exp(-k_s t) \quad \ldots\ldots\ldots \ldots\ldots\ldots..(3)$$

While, the modified simple exponential model described by (pabis and Henderson, 1962) written as:

$$MR = \frac{M - M_e}{M_o - M_e} = A.\exp(-k_m t) \quad \ldots\ldots\ldots\ldots\ldots\ldots(4)$$

Where:

MR = Moisture ratio,
M = the moisture content, % (w.b.) at time t.
Mo = the initial moisture content, % (w.b.).
Me = the equilibrium moisture content, % (w.b.).
t = Drying time, min.
K_s, K_m = Drying constants; (1/min).
A = constant, (Dimensionless).

To visualize the suitable mathematical expression, the two models were linearized as follows:

$$\ln(MR) = -k_s.t \quad \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

$$\ln(MR) = \ln A - k_m.t \quad \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

The drying constant (K_s) of the simple exponential model was obtained by applying linear regression analysis to the value ln (MR) and the drying time (t) (equation 4). The slope of the best fit straight line represents the value of the drying constant (K_s). On the other hand, the constants of the modified exponential model (k_m) and (A) were obtained by applying linear regression analysis to the value ln (MR) and the drying time (equation 6). The slope of the fitted line represented the constant (k_m), while the intercept represents the value of constant (A).

The equilibrium moisture content was determined according to Matouk et al., (2001) taking into consideration that, thermodynamically equilibrium occurs when the net exchange of moisture or the rate of drying equal to zero.

RESULTS AND DISCUSSION

Seeds bulk temperature:

Figure (2) presents the change in seeds bulk temperature as related to the exposure time at different levels of heating surface temperature. The results showed that, the seeds bulk temperature increased with the increase of exposure time and approached levels close to that of the heating surface temperature. The recorded seeds bulk temperature at the exposure times of 5 and 30 min were (74.9 - 91.2 °C), (84.6 - 101.4 °C), (85.4 - 107.4 °C), (87.3 - 119.1 °C), (88.6 - 127.4 °C) and (89.9 - 136.7 °C) for the heating surface temperatures of 95,105, 115, 125, 135, and 145 °C respectively. The above mentioned results revealed that, longer exposure time gave a chance for the canola seeds to gain heat until approaching a level close to that of heating surface temperature.

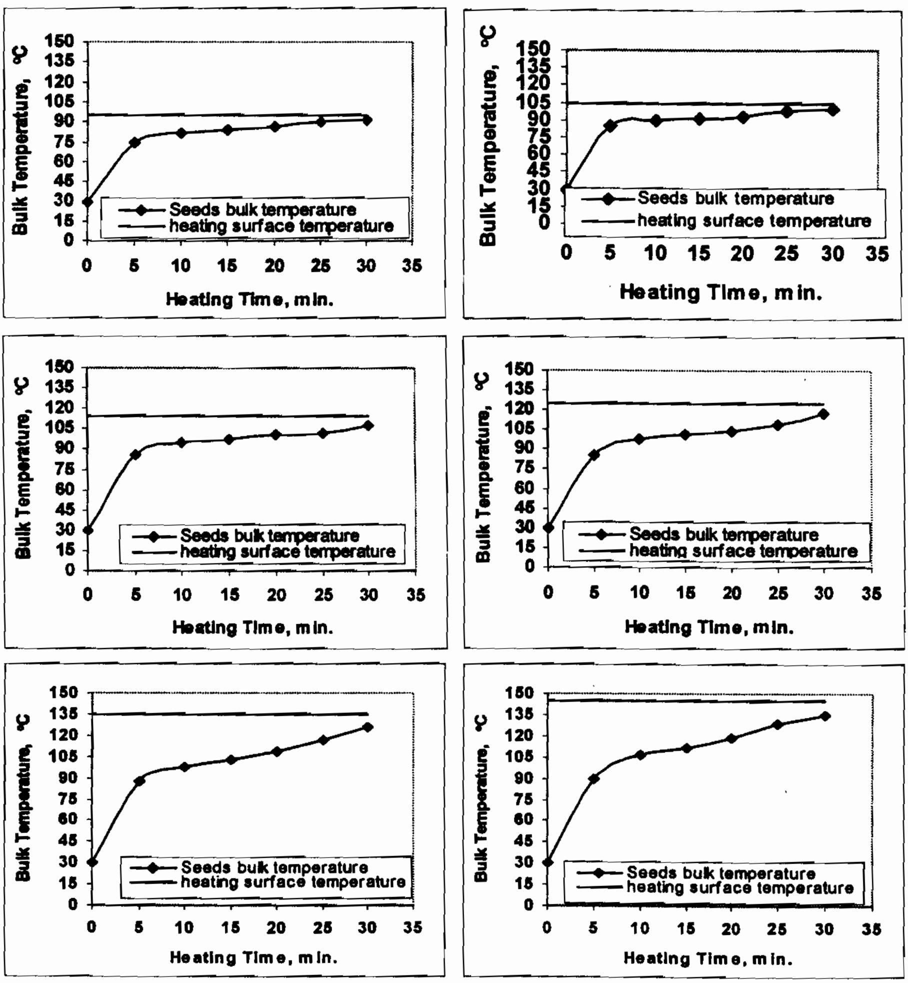

Fig (2): Changes in canola seeds bulk temperature as related to exposure time at diferent cylinder surface temperature.

The dependence of bulk temperature on heating surface temperature and exposure time was described using multiple regression analysis. The empirical equation relating the change in canola seeds bulk temperature with the heating cylinder surface temperature and exposure times was as follows:

$$T_b = 13.82 + 0.5653\,(T) + 1.046\,(t) \quad \text{.......................(7)}$$

$$(R^2 = 0.906 \; ; \; SE = 4.431)$$

Where:

T_b = seeds bulk temperature, (°C)
T = heating surface temperature, (°C)
t = exposure time, (min.)

Seeds moisture content:

The results presented in Fig. (3) Show that all the drying process occurred at the falling rate period in which the rate of evaporation tends to fall as the moisture content decreases and the drying curve decays exponentially towards the equilibrium moisture content. Rapid moisture removal from seeds was obvious in all experiments particularly at higher heating surface temperature and longer exposure duration.

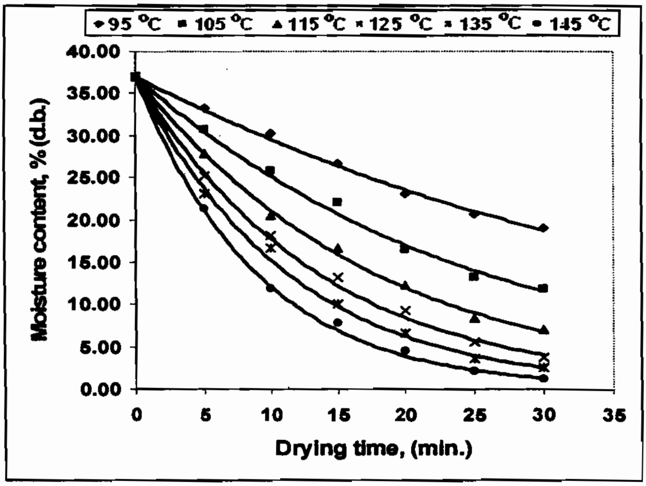

Fig. (3): A typical plot of the moisture content against the drying time at different cylinder surface temperatures.

Equilibrium moisture content (Me):

The equilibrium moisture content of canola seeds (Me) were estimated at different levels of cylinder surface temperature and tabulated in Table (1).

Table (1): Calculated values of the thermodynamically equilibrium moisture content at different drying temperatures.

Drying temperature, (°C)	95 °C	105 °C	115 °C	125 °C	135 °C	145 °C
Equilibrium moisture content, % (d.b.)	7.78	6.56	4.18	2.40	1.20	0.57

As shown in Table (1), the equilibrium moisture content (Me) decreased with the increase of heating surface temperature and it ranged from 0.57 to 7.78 % (d.b). A regression analysis was proceeded to examine the nature of dependence between the equilibrium moisture content (Me) and the heating surface temperatures (T).The regression analysis showed an opposite linear relationship between the equilibrium moisture content (Me) and the heating surface temperature (T) for all levels of drying temperatures as follow:

$$Me = 22.2556 - 0.154\ (T) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (7)$$
$$(SE = 0.5562\ ;\ R^2 = 0.971)$$

Drying constants (K_s, A and K_m):

Table (2) presents the drying constants of the simple and the modified drying equations at different levels of cylinder surface temperature and exposure time.

Table (2): The average calculated values of the drying constants for the different drying tests.

Drying temperature, (°C)	95 °C	105 °C	115 °C	125 °C	135 °C	145 °C
Drying constant (K_s)	0.0361	0.0496	0.072	0.0839	0.1012	0.121
R^2	0.9975	0.9985	0.9953	0.9989	0.9991	0.9931
Constant (A)	1.0042	0.9991	1.0438	1.0064	0.9907	1.1049
Drying constant (K_m)	0.0363	0.0496	0.0718	0.0842	0.1007	0.1272
R^2	0.9975	0.9985	0.9962	0.9990	0.9991	0.9947

From Table (2), it can be seen that the average values of the drying constants (K_s and K_m) varied with the drying temperatures in which they were increased with the increase of drying temperature. While, the values of drying constant (A) were very close and fluctuated between (0.9907 and 1.1049) which could be taken as a constant value of (1.025) in average. To determine the relationship between the drying temperature and the drying constants (K_s and K_m), a simple regression analysis was employed. The drying constants (K_s and K_m) were directly dependent upon the drying temperature as follows:

$$K_s = -\ 0.1254 + 0.001689\ (T) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (8)$$
$$(R^2 = 0.995\ ;\ SE = 0.00246)$$
$$K_m = -\ 0.1343 + 0.0018\ (T) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (9)$$
$$(R^2 = 0.9887\ ;\ SE = 0.00396)$$

Drying curves:

The applicability of the simple and the modified exponential equations for describing the drying behavior of canola seeds and predicting the change of moisture content during the drying process was examined under different levels of drying temperature and exposure time. The observed and the calculated values of moisture content are presented in Table (3). Also, Figures (4 and 5) illustrate the observed and the calculated moisture content of canola seeds in a 45° linear diagram.

In general, the results show that, the reduction rate of seeds moisture content was dependent on the drying temperature and decayed exponentially with the increase of the drying time.

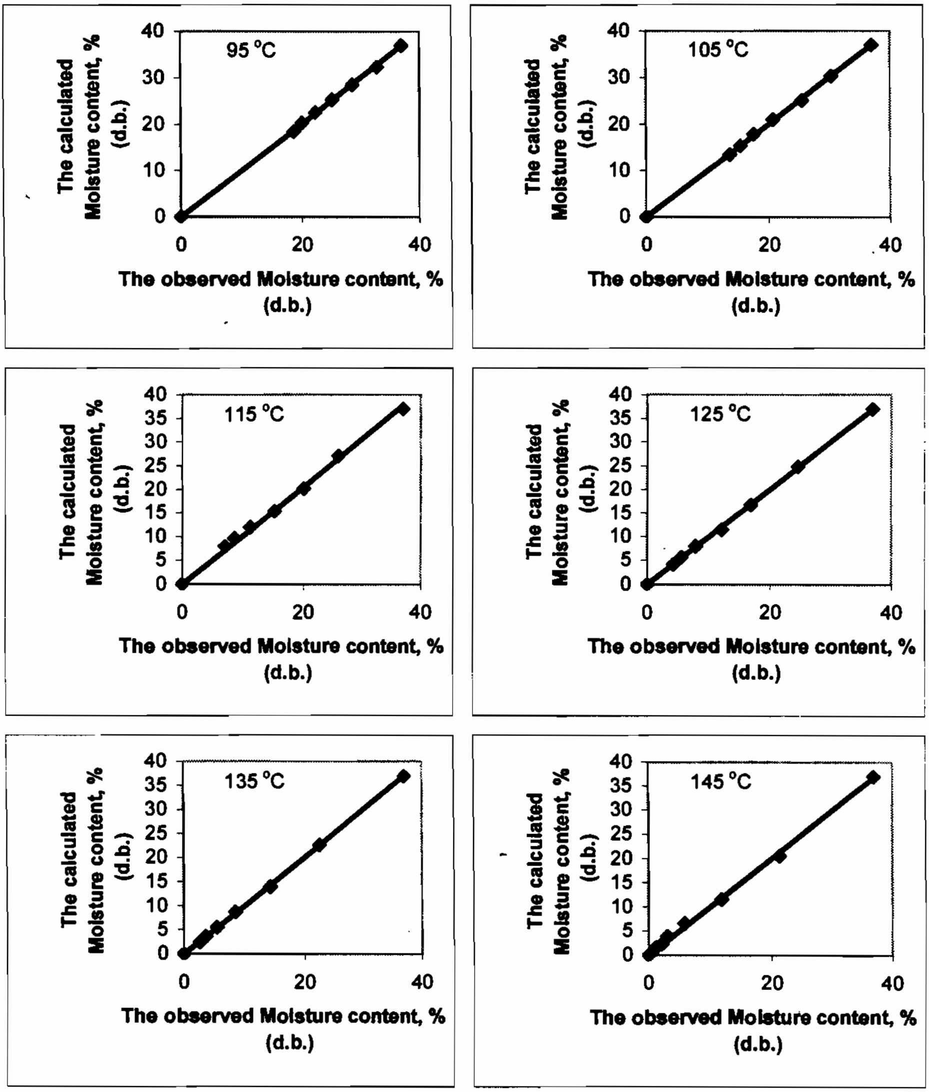

Figure (4): A typical 45 degree plot of the observed and the calculated moisture content using the simple exponential equation.

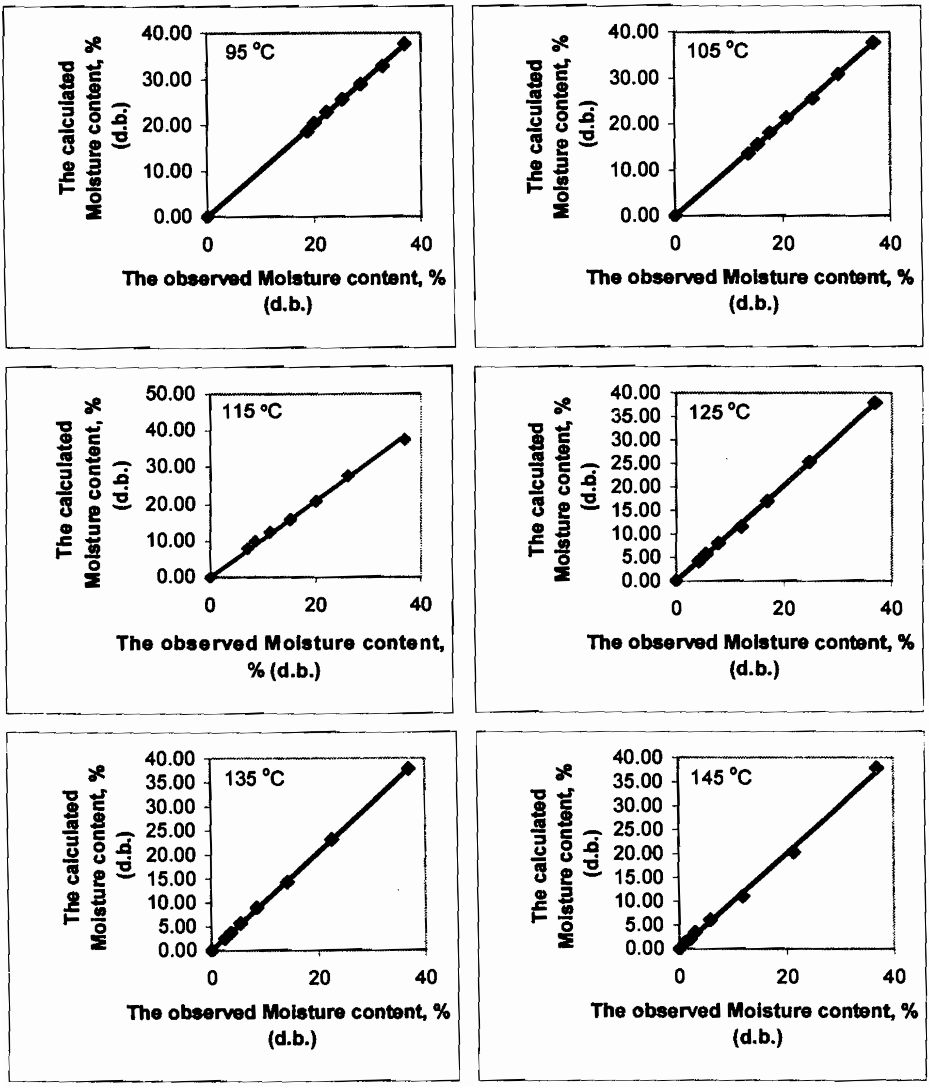

Figure (5): A typical 45 degree plot of the observed and the calculated moisture content using the modified exponential equation.

Table (3): Observed and calculated moisture content of canola seeds.

	95 °C		105 °C		115 °C		125 °C		135 °C		145 °C	
For the simple exponential equation												
	Obs.	**Calc.**	**Obs.**	**Calc.**	**Obs.**	**Calc.**	**Obs.**	**Calc.**	**Obs.**	**Calc.**	**Obs.**	**Calc.**
0	36.97	36.97	36.97	36.97	36.97	36.97	36.97	36.97	36.97	36.97	36.97	36.97
5	32.80	32.33	30.40	30.28	25.90	27.06	24.60	24.73	22.50	22.58	21.30	20.45
10	28.60	28.46	25.50	25.07	20.00	20.14	16.80	16.7	14.20	13.90	11.80	11.42
15	25.20	25.23	20.70	21.01	15.10	15.32	12.00	11.41	8.40	8.67	5.80	6.50
20	22.30	22.53	17.50	17.83	11.10	11.95	7.80	7.94	5.40	5.52	3.00	3.81
25	20.00	20.28	15.30	15.35	8.50	9.60	5.50	5.65	3.53	3.62	2.10	2.34
30	18.70	18.40	13.60	13.42	6.97	7.96	4.20	4.15	2.57	2.47	1.14	1.54
For the modified exponential equation												
	95 °C		**105 °C**		**115 °C**		**125 °C**		**135 °C**		**145 °C**	
	Obs.	**Calc.**	**Obs.**	**Calc.**	**Obs.**	**Calc.**	**Obs.**	**Calc.**	**Obs.**	**Calc.**	**Obs.**	**Calc.**
0	36.97	37.67	36.97	37.73	36.97	37.79	36.97	37.86	36.97	37.88	36.97	37.88
5	32.80	32.90	30.40	30.88	25.90	27.65	24.60	25.29	22.50	23.18	21.30	20.32
10	28.60	28.91	25.50	25.54	20.00	20.57	16.80	17.04	14.20	14.30	11.80	11.03
15	25.20	25.59	20.70	21.37	15.10	15.63	12.00	11.62	8.40	8.93	5.80	6.11
20	22.30	22.82	17.50	18.11	11.10	12.17	7.80	8.06	5.40	5.69	3.00	3.50
25	20.00	20.51	15.30	15.57	8.50	9.76	5.50	5.73	3.53	3.73	2.10	2.12
30	18.70	18.58	13.60	13.59	6.97	8.08	4.20	4.20	2.57	2.54	1.14	1.39

The results of analysis indicated that both the simple and the modified exponential equations satisfactorily described the drying behavior of canola seeds as indicated by low values of standard error of estimate (SE) and the higher correlation coefficients (R^2) as presented in Table (4).

Table (4): Standard error of estimate for the observed and the calculated moisture content of canola seeds.

	Drying temperature, (°C)	95 °C	105 °C	115 °C	125 °C	135 °C	145 °C
For equ. (3)	R^2	0.998	0.998	0.998	0.997	0.998	0.988
	S.E.	0.0037	0.0042	0.0131	0.0053	0.0039	0.0132
For equ. (4)	R^2	0.998	0.998	0.999	0.998	0.991	0.998
	S.E.	0.0034	0.0039	0.0120	0.0053	0.0337	0.0140

Fungi inactivation during conduction heating:

Table (5) presents the change in fungal mortality level as related to the exposure time and the heating surface temperature. The results showed that, the high temperature conduction heating reduced the fungal load in high moisture seeds in an effective manner. Also, higher heating surface temperature and longer exposure time resulted in more fungal load reduction.

As shown in the table, the initial fungal count for canola seeds was 2129 colonies/g, and they decreased to a varied levels depending upon the heating surface temperature and the exposure time. In general, it can be said that, the accelerated drying using the conduction heating technique may be considered as an effective procedure for both seeds drying and fungal inactivation. This would be very beneficial for canola seeds which deteriorate in a short time after harvesting due to the actions of both higher moisture content and higher fungal load.

Table (5): Fungal count (colonies/g) as related to exposure time and drying temperature.

Drying temperature, (° C)	Exposure time, (min)						
	0	5	10	15	20	25	30
95	2129	1195	931	721	582	421	302
105	2129	1012	801	593	391	285	214
115	2129	975	674	431	259	197	119
125	2129	862	521	279	157	95	67
135	2129	719	289	161	91	64	31
145	2129	450	192	102	75	37	19

Free Fatty Acids (FFA%) in the extracted oil:

The presence of lipase enzyme in canola oil hydrolysis it into free fatty acids and glycerol. Also oxidation of free fatty acids leads to produce various off odor compounds such as aldehydes and ketons. The free acids tests were conducted only for the samples which approached the safe storage moisture content of canola seeds in the range of (5-7 % w.b). Table (6) illustrates the change in percent free fatty acids in relation to heating surface temperature and exposure time. The results showed that, the free fatty acids of the control sample (sun dried seeds to a moisture content of about 6.85% (w.b.) approached a level of 17.56 % while it was ranged from 1.63 to 3.97 % for the heat treated samples. The observed increase in the percentage of free fatty acids in the control sample may come from the activity of lipase enzyme which causes a breakdown of a triglyceride into its components.

In general, it can be said that the heating surface temperature of 145 °C and the exposure times of 15 min decreased the moisture content of canola seeds to the safe level of 5.80% (w.b), with a fungal load of 102 colonies/g. and a percentages of free fatty acids of 1.63 %.

Table (6) Percent free fatty acids as related to heating surface temperature and exposure time.

Heating surface temperature, (°C)	Seeds bulk temperature, (°C)	Drying time, (min.)	Seeds moisture content, % (d.b.)	F. F. A., (%)
115	107.4	30	6.97	3.97
125	108.5	25	5.50	2.91
135	108.7	20	5.40	2.49
145	111.5	15	5.80	1.63

CONCLUSIONS

1-Seeds bulk temperature increased with the increase of exposure time and approached levels lower than that of the heating surface temperature.

2-Rapid moisture removal from seeds was clear in all experiments particularly at higher heating surface temperature and longer exposure duration.

3-Both the simple and the modified exponential drying equations satisfactorily described the drying behavior of canola seeds. However, for more simplified application, the simple exponential equation may be used with clear accuracy.

4-The accelerated drying using the conduction heating technique considerably decreased the fungal load and the percentage of free fatty acids.

5-Heating surface temperature of 145 °C and the exposure time of 15 min are recommended to decrease the moisture content of canola seeds to the safe level of 5.8% (w.b), the fungal load to 102 colonies/g. and the percentages of free fatty acids to1.63 %.

REFERENCES

A.O.A.C (1991): Association of Official Agriculture Chemists. Official Methods of Analysis of 15 the ed., D.C. USA.

Dermott T. and D. E. Evans (1980). An evaluation of fludized bed heating as a means of disinfecting wheat. J. Stored prod. Res. Vol. (14):1-12.

El. Sahrigi A.F., A.M. Matouk, H. El-Abd Alla and M.M. El-kholy (1999). Accelerated partial drying and sterilization of high moisture rough rice. Egypt J. of Agric. Res. Vol. 78 (2): 977-991.

Flannigan, B. (1977). Enumeration of fungi and assay for ability to degrade structural and components of grain. In Biodeterioration Investigation Techniques (ed H. Walters) London, Applied Science Publishers, pp. 185-199.

Hendawy Y.T., (2003). "Effect of heat stabilization process on storage period and quality deterioration of rice bran". Unpublished M. Sc. Thesis. Dept. of Agric. Eng., Fac. of Agric., Mansoura Univ.

Jayas, D.S. and S. Sokhansan (1989). Design data on resistance of air flow through canola (rapeseed). ASAE Transactions 32 (1): 295-296.

Matouk, A.M., S.M. Abd El-Latief, Y.M. El-Hadidi, and A. Tharwat, (2001). "Drying of Ear Corn" Part I: The determination of drying parameters. Misr J. Agric. Eng., Vol.18 (2).

Mills J.T. (1989). Spoilage and heating of stored agricultural products prevention, detection, and control. Agric. Canada Ottawa, Ont.Publ. 1823 E.

Pabis, S. and S.M. Henderson (1962). Grain drying theory. III The air grain temperature relationship. J. Agric. Eng. Res. 7, 21–28.

Raymer, P.L.; D.L. Aauld, and K.A. Mahler (1990). Agronomy of canola in the United States. P. 25-35. INF. Shaidi (Ed). Canola and rapeseed production and processing technology.

Thomas, P.M. (1984). Swathing – combining, storage and conditioning of canola. In Canola Growers Manual. Winnipeg, Manitoba : Canola Council of Canada. http:// www.canola.okstate.edu/related sites/index.htm.

التجفيف السريع والتثبيت الحرارى لبذور وزيت الكانولا

محمد مصطفى الخولى[١] و أحمد ثروت محمد [٢]
(١) باحث أول- معهد بحوث الهندسة الزراعية- الدقى - جيزة
(٢) مدرس- قسم الهندسة الزراعية - كلية الزراعة - جامعة المنصورة

أجريت هذة الدراسة على بذور الكانولا ذو المحتوى الرطوبى المرتفع لاختبار وتقييم تأثير عملية التجفيف السريع لفترات زمنية قصيرة باستخدام مجفف دورانى على المحتوى الرطوبى للبذور، الحمل الفطرى على سطح البذرة، وكذلك نسبة الاحماض الدهنية الحرة فى الزيت المستخلص كمؤشر لعملية التثبيت الحرارى للزيت. وقد شملت المتغيرات التجريبية ٦ مستويات لدرجة حرارة سطح اسطوانة التجفيف (٩٥، ١٠٥، ١١٥، ١٢٥، ١٣٥، ١٤٥ درجة مئوية) وكذلك ٦ مستويات لزمن تعرض البذورللحرارة (٥، ١٠، ١٥، ٢٠، ٢٥، ٣٠ دقيقة). أظهرت النتائج المتحصل عليها أن عملية التجفيف قد تمت خلال مرحلة معدل التجفيف المتناقص، كما أن المحتوى الرطوبى للبذور قد تناقص بصورة سريعة حيث زاد معدل التجفيف بزيادة كلا من درجة حرارة سطح اسطوانة التجفيف وكذلك زمن التعرض. من ناحية أخرى أمكن لكل من معدلتى التجفيف الأسية البسيطة والمعدلة وصف عملية التجفيف والتنبؤ بالمحتوى الرطوبى للبذور بصورة مرضية ومتقاربة.أظهرت النتائج أيضا انخفاض الحمل الفطرى لبذور الكانولابدرجات مختلفة حيث تأثرت بكل من درجة حرارة سطح اسطوانة التجفيف وكذلك زمن التعرض. أيضا انخفضت نسبة الأحماض الدهنية الحرة فى الزيت المستخلص من البذور المعاملة حراريا حيث تراوحت بين ١,٦٣- ٣,٩٧% مقارنة بـ ١٧,٥٦ % للبذور المجففة بالطريقة التقليدية وذلك خلال نفس الفترة الزمنية لتخزين الزيت (١٥ يوم بعد عملية الاستخلاص)، مما يبين تأثيرمدى المعاملة الحرارية على التثبيت الحرارى للزيت المستخلص. وبصفة عامة، يمكن اعتبار نظام التجفيف السريع لفترات زمنية قصيرة باستخدام المجفف الدورانى الذى يعمل بخاصية التوصيل الحرارى المباشر مناسبا لخفض كلا من المحتوى الرطوبى للبذور، الحمل الميكروبى، وكذلك نسبة الاحماض الدهنية الحرة فى الزيت المستخلص.