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EFFECT OF STORING TEMPERATURE AND MIXING OF DRY AND WET FABA BEANS ON EQUILIBRIUM MOISTURE

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ABSTRACT

The main purpose of this work was to study the moisture migration from the wet to the dry Faba bean grains, at different storage conditions, such as storage time, temperature and disturbing the grains. Three different storage temperatures were studied that approximately similar to ambient air temperatures during harvesting and storage seasons namely 28 , 36 and 44 °C .The results show that the process of adsorption and desorption in mixture was very rapid during the first three days . As the storing temperature increases the required time to reach the equilibrium moisture content decreases. Disturbing grains hastened the moisture migration from the wet to the dry grains.

INTRODUCTION

Blending is an expression used in the grain trade for the practice of mixing grains at different moisture contents to obtain a mixture having an intermediate moisture content. In some practices, where, the moisture of grains is important (for example in transporting and storage), the moisture content is greatly affected by temperature. Blending grains at different moisture contents is commonly used in such processes. Hall (1980) reported that the equilibrium moisture content is directly related to the drying and storing of farm crops. The equilibrium moisture content is used to determine whether a product will gain or loss moisture under a given set of air temperature and air relative humidity conditions. Flood and White (1984), Labuza et al (1985), Sokhansanj et al (1986), Banasazek(1990), Fasina (1992), Lamond and Grham(1993), Ghanem(1998) and Ghanem and El-Soaley (1999) studied equilibrium moisture content of agricultural products as affected by different air temperatures and air relative humidity conditions . Fisher and Jones (1939) reported that it was a common practice to partially dry excessively damp wheat by mixing with dry wheat and allowing the mixture to tie for a convenient length of time .

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Hart (1964) reported that liquid diffusion across grain kernel has an effect on moisture migration in the stored grain . The driving force for diffusion of moisture is said to be slowly dependent on grain moisture content . Hemeda et al. (1985) studied some factors affecting the blending of dry and wet corn . They concluded that the moisture interchange between the wet and dry grains was very rapid during the first two days , while no significant change occurred after the forth day . The disturbed treatment reaches the equilibrium faster than the undisturbed . They also stated that as the temperature of corn increased , the difference in moisture content at equilibrium and time required to reach equilibrium decreased . Hemeda and Abd El-Wahab (1994) studied the moisture migration between mixtures of wet and dry wheat grains, at different storage conditions, as storage time, temperature and disturbing the grains . The results showed that the process of adsorption and desorption in mixture was very rapid during the first day. As the storing temperature increases the required time to reach the equilibrium moisture content decreases . Disturbing grains hastened the moisture migration among the wet and dry grains .

The objective of this study is to investigate the relationship of moisture movement among a blend of wet and dry faba beans at different storage conditions , such as storage time and temperature and to study the effect of disturbing the blend on the moisture migration between the wet and dry faba beans , where producers , some times , harvest faba beans at different moisture contents .

MATERIALS AND METHODS

In the present work Faba beans were manually graded and cleaned . A portion of faba beans was rehydrated till its moisture content was 25% . Another portion was over dried at 100 °C till its moisture content was 6 % . The portion of over dried faba beans was slashed by car paint from one side to allow moisture migration without obstacle .The following relation was used for estimating the quantities of dried and rehydrated grains to prepare the mix of samples to reach the equilibrium moisture content (10 %) .

$$0.10 (x + y) = 0.25 y + 0.06 x$$

where :

x : weight of dried faba beans at moisture content of 6 % , gram .

y : weight of rehydrated faba beans at moisture content of 25 %, gram .

When the wet grains (y) is equal to 100 g the calculated dried faba beans (x) required to be mixed is 375 g . Three mixed samples were prepared and individually

put in double polyethylene bags , and stored at three different temperatures of , 28 , 36 and 44 °C respectively and they were disturbed continuously . Three other samples each of them was prepared of wet and dried faba beans were also stored at 28 , 36 and 44 °C respectively without blending . For the determination of moisture content , samples of 2 to 3 grams were grinded and oven dried for one hour at 130 °C . Samples were weighted using Sartorious electrical balance, made in Japan of accuracy 0.0001 g . For determining the drying constant (k) , for all treatments the relations that used by Hemada et al (1994) and many other researchers were employed :

a- For the desorbing moisture :

$$MR = (M-M_e)/(M_o - M_e) = e^{-kt} \quad \text{(1)}$$

b) For the adsorbing moisture :

$$MR = (M_e-M)/(M_e - M_o) = e^{-kt} \quad \text{(2)}$$

Where :

M : Moisture content of grain at any time, % .

M_o : Initial moisture content, % .

M_e : Equilibrium moisture content, % .

t : Elapsed time Hours .

k : Is the drying constant , h^{-1} .

RESULTS AND DISCUSSIONS

Moisture content for mixed and disturbed grains as affected by elapsed time and temperatures were studied . Three different storage temperatures namely : 28 , 36 and 44 °C were studied as shown in Fig.(1) . Results showed that as the storing temperature increases the required time to reach the equilibrium moisture content decreases and also disturbing grains hastened the moisture migration from the wet to the dry grains . At storing temperature of 28 °C eight day swere required to reach the equilibrium moisture content , while, at storing temperatures , of 36 and 44 °C three to four days were required for mixed and disturbed grains to reach the equilibrium moisture content . Moisture adsorption data for grains as affected by elapsed time and temperatures are plotted in Fig.(2) . Results showed that as the storing temperature increases the required time to reach the equilibrium moisture content decreases . At storing temperature of 28 °C eight to nine days were required to reach the equilibrium moisture content and as the storing temperature increases to 36 °C and 44 °C four days were required for bone dried grains to reach the equilibrium moisture

content . Fig.(3) shows also desorption of moisture content through grains . It is clearly revealed that as the storing temperature is increased the required time to reach the equilibrium moisture content decreased. Six days were required to reach the equilibrium moisture content .Fig. (1), (2) and (3) showed that after the first two days or 50 hours the difference between the grains moisture contents and the equilibrium moisture content of the mixed and disturbed grains at 36 and 44 °C were 0.67 % , 0.55% compared to 0.69 % , 0.86 % for the dry beans and 4.1% , 3.73 % for the wet beans respectively . At the storing temperature of 28 °C the difference between the grains moisture contents and the equilibrium moisture content were 1.95 % , 2.43 % and 6.32 % for mixed , dry and wet beans respectively . Fig. (4) , (5) and (6) showed simultaneous desorption and adsorption process for blending ,wet and dry grains at constant storing temperatures , as affected by elapsed time . Regression analysis was employed to test and estimate the experimental data , Table(1) showed calculated drying constant values using the conventional empirical equations (1) and(2) .

Table(1):values of drying constant (k) for mixed , desorption and adsorption processes .

Treatment / Temperature	Mixed and disturbed (desorption&adsorption)	Dry beans (adsorption)	Wet beans desorption
28 °C	0.013	0.0229	0.018
36°C	0.044	0.040	0.027
44°C	0.048	0.023	0.029

SUMMARY AND CONCLUSION

In some practices, where, the moisture of grains is important (for example in transporting and storage), the moisture content is greatly affected by temperature . Blending grains at different moisture contents is commonly used in such processes. Mixing , wet and dry samples of faba beans at three different storing temperatures namely : 28 , 36 and 44 °C were studied to investigate the relationship of moisture movement among a mixture of wet (25 % moisture content) and dry faba beans (6 % moisture content) at different storage conditions , such as storage time , temperature. Also to study the effect of disturbing the mixture on the moisture migration between the wet and the dry faba beans , where producers sometimes harvest faba beans at different moisture contents .

From the previous work we can concluded that :

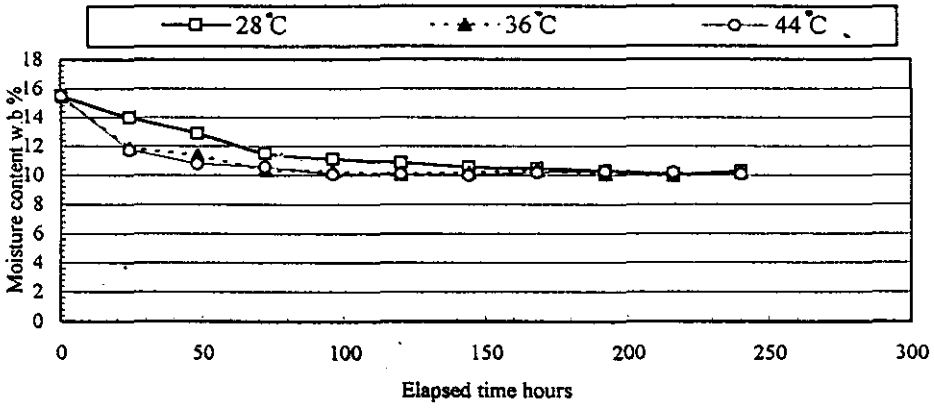


Fig.(1):Moisture content for mixed and disturbed faba beans at different storage temperatures as affected by elapsed time .

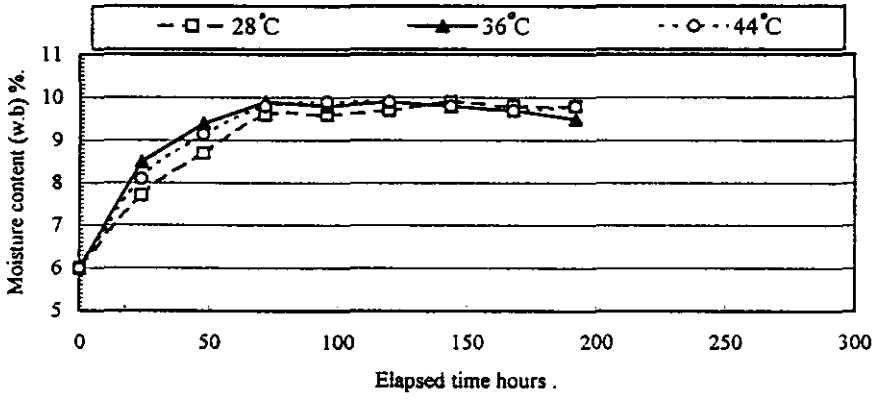
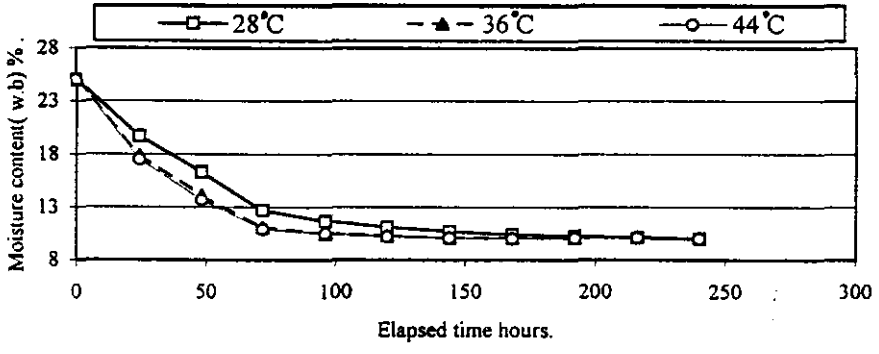


Fig.(2) Moisture adsorption as affected by elapsed time at different storage temperatures for dry faba beans.



Fig(3)Moisture desorption of wet faba beans as affected by elapsed time at different storage temperatures.

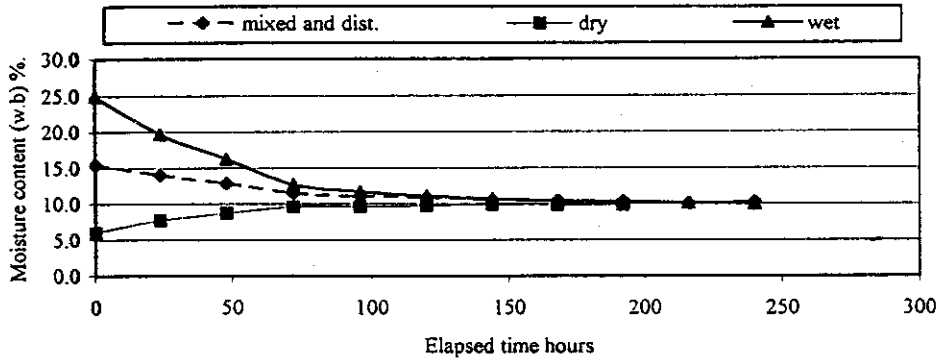


Fig.(4) Moisture content as affected by elapsed time for mixed and disturbed ,dry and wet Faba beans at 28 °C.

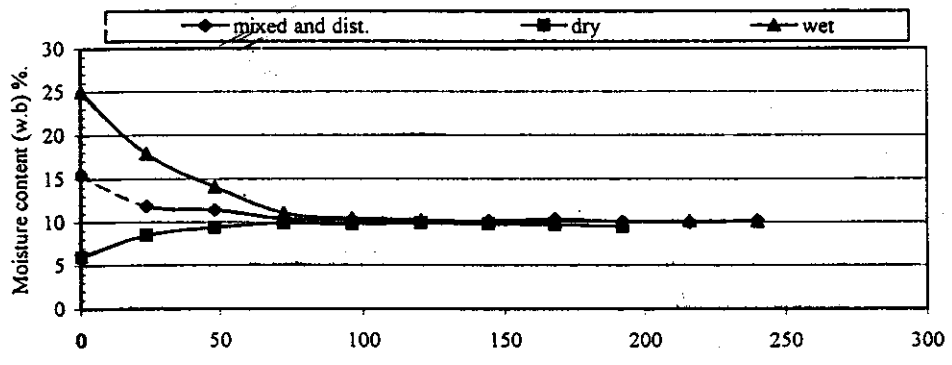


Fig.(5):Moisture content as affected by elapsed time for mixed and disturbed ,dry and wet faba beans at storage teperature of 36 °C.

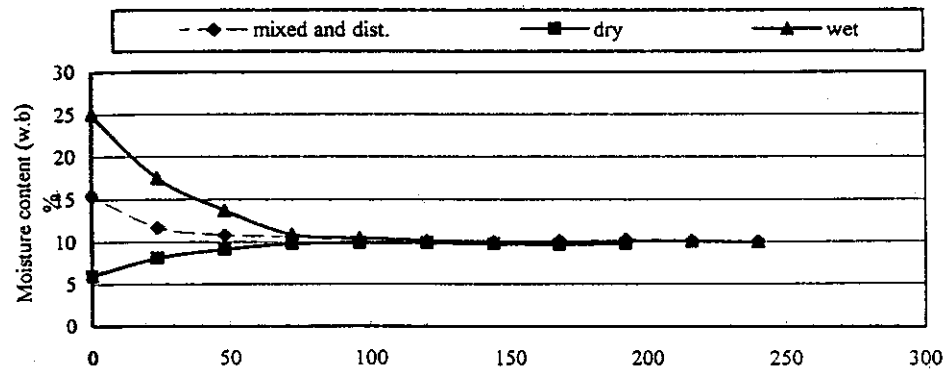


Fig.(6):Moisture content as affected by elapsed time for mixed and disturbed faba beans at storage temperature of 44 °C.

1. The process of adsorption and desorption in grains was very rapid particularly for mixed grains within the first two days .
2. As the storing temperature increases the required time for grains to reach equilibrium moisture content decreases .
3. Disturbing the grains hastend the moisture migration among the dry and wet grains, and reached the equilibrium moisture content at a short time compared with undisturbed grains .

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تأثير درجات حرارة التخزين وخلط الفول البلدى الجاف والرطب على المحتوى الرطوبى التعادلى

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كثيرا ما يحدث خلط للحبوب المختلفة فى المحتوى الرطوبى أثناء عمليات التخزين والنقل بسبب حصاد محاصيل الحبوب بمحتويات رطوبية متفاوتة بهدف تقليل الفقد الناتج عن فرط الحبوب أثناء الحصاد .و يهدف البحث الى دراسة عمليات خلط حبوب الفول البلدى الجاف تماما وبكميات محسوبة (بمحتوى رطوبى ٦ %) الى حبوب الفول البلدى (بمحتوى رطوبى ٢٥ %) للحصول بعد زمن ما الى محتوى رطوبى ١٠ % . كما تم دراسة تأثير عمليات التقلب وعدم التقليب علىالمحتوى التعادلى ايضا. وقد أظهرت النتائج ما يلى :

١. عملية تبادل الرطوبة بين الحبوب الرطبة والجافة فى المخلوط (الامتصاص الفقد) كانت بسرعة عالية فى أول يومين .

٢. كلما إرتفعت درجة حرارة التخزين زادت سرعة الوصول الى المحتوى الرطوبى التعادلى.

٣. تقليب المخلوط يساعد فى الوصول الى المحتوى الرطوبى التعادلى خلال زمن أقل عن معاملة عدم التقليب .

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