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Study of the Storage Properties of the Hearth Bread Produced from Whole Wheat and Barley Flour

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ABSTRACT

This study included conducting chemical tests for flour, flour strength tests, and the staling tests of gluten for the studied Hearth bread types during storing period of 2 , 24 , 48 , 72 hour. The results showed that the percentage of moisture, ash, fat, protein, carbohydrates, fiber, pigments, pH and total Phenolic compound in whole wheat flour were (10.00 % , 1.60 % , 1.80 % , 12.50 % , 74.10 % , 1.50 % , 4.389 ppm , 6.30 , 0.38 mg/g) respectively, while for barley flour were (9.00 % , 2.20 % , 4.30 % , 11.30 % , 73.20 % , 2.40 % , 5.712 ppm , 5.60 and 0.55 mg/g) respectively. The results revealed a higher proportion of mineral elements in wheat flour compared with barley flour, also showed that the percentage of wet and dry gluten in whole wheat flour were 37.1 % and 15.2 % respectively, and it were decreased with the increase in the percentage of substitution with barley flour (10 , 20 , 30 , 40 , 50) %. The results of the sediment volume test showed that the percentage was limited in between 23.3 - 30.6 cm^3. The method used to estimate pH was used in the staling test, results showed no significant differences between the types of Hearth bread treatments during staling, and the results of Penetration were ranged 34.0 - 37.5 mm. The results of Alkaline water retention capacity showed no significant differences between the types of studied treatments, which were between 138.566 - 164.012 %.

دراسة صفات الحفظ للصمون الحجري المنتج من طحين الحنطة الكامل والشعير

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الخلاصة

تضمنت هذه الدراسة اجراء الاختبارات الكيميائية للطحين وفحوصات قوة الطحين وفحوصات متابعة التجلد لأنواع الصمون الحجري المدروسة خلال فترة حفظ شملت 2 , 24 , 48 , 72 ساعة. اشارت النتائج الى ان نسبة الرطوبة والرماد والدهن والبروتين والكربوهيدرات والألياف والصبغات وpH والمواد الفينولية الكلية في طحين الحنطة الكامل بلغت (10.00 % ، 1.60 % ، 1.80 % ، 12.50 % ، 74.10 % ، 1.50 % ، 4.389 ppm ، 6.30 ، 0.38 ملغم/غم)على التوالي، اما بالنسبة لطحين الشعير فبلغت (9.00 % ، 2.20 % ، 4.30 % ، 11.30 % ، 73.20 % ، 2.40 % ، 5.712 ppm ، 5.60 ، 0.55 ملغم/غم) على التوالي. لوحظ ارتفاع نسبة العناصر المعدنية في طحين الحنطة عنه في طحين الشعير. بينت النتائج ان نسبة الكلوتين الرطب والجاف في طحين الحنطة الكامل بلغت 37.1 % و 15.2 % على الترتيب، وقد انخفضتا مع زيادة نسب الاستبدال بطحين الشعير (10 , 20 , 30 , 40 , 50) %. اشارت قوة التشرب الى ان النسبة انحصرت بين 2.400 – 3.579 %، في حين اظهرت نتائج اختبار حجم الراسب ان النسبة انحصرت بين 23.3 – 30.6 سم3، استخدمت طريقة تقدير الاس الهيدروجيني في متابعة التجلد التي لم تظهر فروقاً معنوية بين انواع معاملات الصمون الحجري المدروسة اثناء التجلد، وأظهرت الاختراقية مدى بين 34.0 – 37.5 ملم، في حين اظهرت نتائج اختبار سعة استيعاب الماء القاعدي (AWRC) عدم وجود اختلافات معنوية بين انواع المعاملات المدروسة والتي انحصرت بين 138.566 – 164.012 %.

الكلمات المفتاحية :
خصائص الحفظ، الصمون الحجري، طحين الحنطة، طحين الشعير.
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[1] This research was taken from a thesis for the second author

Introduction:

Wheat is one of the oldest cereal crops grown all over the world and It dominates on the world trade. 65 % of wheat were used as staple food for human, 21 % as animal feed and 8 % as seed (Khan et al., 2009) the remaining 6 % is interring in many food industries, these industries vary according to the type of wheat, as the coarse wheat used for production of bulgur, noodles, pasta and others, the soft wheat is used to produce pastries such as cake, biscuit and others, while hard wheat is used to produce bread (Kumar et al., 2011). In recent times, barley has become the target of many scientific and international foundations concerned with health, agriculture and food to entrance this crop in the production of high quality composite flour, because it contains fiber, especially β-glucan, which plays a major role in reducing the risk of chronic heart disease and cholesterol reduction and increases the body's response to insulin in diabetics (Arndt, 2006). At present, barley and wheat are mixed with different percent in the making of bread, cake, noodles, bagel and snacks food. Dhingra and Jood (2001) referred that the mixing barley flour with wheat flour in the bread industry by (10-20) % was acceptable in flavor, appearance and texture, and that the increasing of the percent of barley flour causes a decrease in the volume of laboratory bread.

We must refer that the main problem facing the bread industry is the staling, which are important economic phenomena for bread producers and consumers because a large percentage of the waste of baked products is due to its staling, which affects the national economy (Collar and Rosell, 2013). More research has been focused on this phenomenon for more than a century and a half, and there has been no solution to this problem, and staling remains responsible for these large economic losses (Fadda et al., 2014). Approximately 900 million kg of bread is produced, with a waste rate of 3% (200 million kg) (Hovis, 2011), while Parfitt et al. (2010) reported that the waste of bread in year was 800,000 tons.

The aim of this research is to study storage properties of the Hearth bread produced from whole wheat flour and barley flour by studying (Swelling Power, Volume of Sediment, pH, Penetration, Alkaline Water Retention Capacity), as methods to follow the staling of this kind of bread.

Materials and Methods:

Sources of grain:

Wheat & barley cultivars used in this study are sham 6 & Ibaa, respectively. They were taken from the result crop cultivated from the farmers in the Governorate of Salah al-Din/Alalam. The whole grain were grinded (by us) using the old mill (they are based on grinding the whole grains through internal grinding cylinders, where there is an external lever to control the softness of the flour). The flour was kept in the refrigerator until use.

Materials used in the mixture:

Instant dry yeast was purchased from a local market (Vega brand), Turkish made, salt was purchased from a local market (Aban iodized) Iran made.

Chemical tests for flour:

The percentage of moisture, ash, fat, and protein was estimated according to the AACC (2000) methods 44-16, 08-01, 30-10, 36-10 respectively. Carbohydrates was calculated by the difference in components (Pearson, 1970). The fiber and pigment were estimated according to the two methods 32-05, 14-50 respectively (AACC, 2000). The pH was determined according to the method mentioned by Egan et al. (1981). The total phenolic compound were extracted according to the method of Afify et al. (2012) and estimated according to Gutfinger (1980). Mineral elements were estimated according to the method mentioned in AOAC (2000). The manual wash method was used in estimating both the wet and dry gluten according to method 38-10 (AACC, 2000) and the wet gluten was dried at 100c° for 24 hours.

Flour strength tests:

The dough ball test (Pelshenke test) and the sedimentation value (Zeleny test) were estimated by methods 56-50 and 56-60 respectively (AACC, 2000).

Hearth bread Preparation:-

Barley flour were replaced with wheat flour by percentage (10 , 20 , 30) %, and use this way for preparation hearth bread, according to the way that used in Hearth bread ovens.

100 g flour, 40 ml water, 1.2 g salt, 0.4 g yeast.

Staling tests: -

1 - Swelling Power :- It was determined according to the method followed by Schoch and French (1947).

2 - Volume of Sediment : - It was determined according to Bice and Geddes (1949), by weighting of 6 grams of crumb in a cylinder size 50 ml and adding 25 ml distilled water, then mixing the contents for 15 minutes and leaving them for an hour until noting the sedimentation of all contents of the crumb and the supernant was clear, the volume of the sedimentation (cm^3) was recorded.

3 - pH : - Determination of the pH of the crumb of the different types of the Hearth bread was done according to method 22-14 (AACC, 1984).

4 – Penetration test : - It was estimated according to Alhmad (2013), by using a Penterometer, by putting the Hearth bread in the space of the device and permit its cone to fall on it and wait for a minute, then took the reading by mm and repeated the process three times and take the mean of reading.

5 - Alkaline Water Retention Capacity (AWRC) : - It was determined according to method 56-10 (AACC, 2000).

statistical analysis :

The results of the tests were analyzed using the complete randomized design (CRD) using SAS (2001) to study the effect of the factors studied on the different properties. The mean differences between the averages were measured by testing the least significant difference L.S.D at the probability level of $P<0.05$.

Results and discussion :

Chemical tests of flour:-

Table (1) showed that the moisture content in whole wheat flour was 10 %, which was similar to that found by Jolana and Zlatica (2010), whose noted the moisture content of whole wheat flour was 10.6 %. The same table showed that the moisture content of barley flour was 9 % and it was within the range 7.14-10 % mentioned by Pomeranz (1973), and closed to the results of Saidi et al. (2005) whose found that the moisture in barley Tissa was 9.9%. The moisture content of grain depended on the genetic characteristics, climatic conditions and conditions of agricultural experiments during the growth stages (Mahmood, 2004).

The results in table (1) also revealed that the percentage of ash in wheat flour was 1.6 %, which was similar to that found by Hussein et al. (2013) whose found that this percentage in the wheat flour of Capo cultivar was 1.47 %. The percentage of ash in barley flour was 2.2 %, which agreed with the conclusion of Al-Baiati (2013), whose found that its value of the bright class barley was 2.23 %. Posner (1991) pointed out the importance of measuring the ash percent as an important indicator of the quality of grain, flour and processed products.

The results in the same table showed that the percentage of fat in wheat flour was 1.8 %, which was similar to that of Al-Abdullah (2006), which found that the percentage of fat in the wheat flour was 1.75 % and similar to that of Yaseen et al. (2010) whose found it was 1.7 %. The results revealed in the same table that the percent of fat in barley flour was 4.34 %, which was similar to that reached by Hussein et al. (2013) whose found that the percentage of barley flour Giza-130 was found 4.00 %. Fat is a secondary component when compared to the rest of the other flour components of wheat or barley, but its quantity is an important indicator of the volume of bread, With consideration influence of other components (Panozza et al., 1991).

Table (1) Chemical tests of wheat and barley flour

Class / Test	Wheat	Barley
Moisture (%)	10.000	9.000
Ash (%)	1.600	2.200
Fat (%)	1.800	4.300
Protein (%)	12.500	11.300
Carbohydrate (%)	74.100	73.200
Fiber (%)	1.500	2.400
Pigment (ppm)	4.389	5.712
pH	6.300	5.600
Total Phenolic Compound (mg/g)	0.380	0.550

Table (1) showed that the percentage of protein in wheat flour was 12.5 %, it was closed to the results of Jawad (2007) whose found that the percentage of protein in the wheat flour of the United States of 95 % extraction was 12 % within the range 10-15 % mentioned by Belitz et al. (2009). The results in the same table referred that the proportion of protein in barley flour was 11.3 %, it was closed to the results of Sulaiman (1999), which was found it in barley class 99 (11.76 %). Protein is an important factor in determining the quality of flour produced, high protein content flour gives good quality bread (Sramkova et al., 2009).

Also results in (table-1) indicated that the percentage of carbohydrates in wheat flour was 74.1 %, which was similar to the results of Al-Ali (2006), whose found that the percentage of carbohydrates in Abu Ghraib wheat flour was 73.07 %, and it a percent approach with what found by Fadhil (2016). The same table indicated that the carbohydrate in barley flour reached 73.2 % in barley flour and was closed to the results Erkan et al. (2006).

Table (1) showed that the percentage of fiber in wheat flour was 1.5 % and it was within the range 1.3-1.8 % mentioned by Al-Baraznji (2016), when he was studied the chemical composition, minerals, vitamins, and plant chemicals of some local wheat varieties and their product bulgur. The same table showed was that the percent of fiber in barley flour 2.4 %, and it was approached with the results of Abou-Raya et al. (2014), when they were studied the effect of barley and oats on the rheological properties of bread dough. The percentage of fibers depended on the milling process and extraction rate, increasing with the proportion of bran and outer covers (Dhingra et al., 2012). Kamil et al. (2011) emphasized the importance of studying fiber when determining the quality of pastries and pastas as well as their importance in determining the quality of bread.

The pigments are important for humans in term of health and nutrition, including atherosclerosis, lowering blood pressure and removal of free radicals and cardiovascular diseases and others (Abdel-Aal and Akhtar, 2006). The table (1) showed that the concentration of carotene pigments in wheat and barley were 4.389 , 5.712 ppm respectively, this agreed with Humphries et al. (2004), when they estimated carotene and lutein in wheat, triticale. The different of pigments concentration In grains was depended on environmental conditions, genetic and species (Fratianni et al., 2013).

The results in the same table indicated that the pH values of wheat and barley flour were 6.3 and 5.6 respectively, pH is an indicator of flour acidity and its source return to proteins, salts and other flour contents. These results correspond to what found by Sahi et al. (2014) when they studied the effect of fermentation methods on the content of phytic acid in wheat meal bread.

Table (1) showed that the total phenolic content of wheat flour was 0.38 mg/g. These results were similar to what found by Hung et al. (2009), when they estimated phenolic and antioxidants in wheat flour. Observed from the same table that the value of barley flour was 0.55 mg/g, and was matched to what Daniel et al. (2015), were found when they determined phenolic materials for different types of barley and malt. Its quantity in all grain depended on species, variety and genotypes (Panfil et al., 2014).

Table (2) showed that the minerals content of whole wheat flour (Fe , Zn , K , Mg , Ca) were (5.30 , 3.60 , 450 , 83.30 , 78.10) ppm respectively. These results were similar to those found by Depar et al. (2014), when they studied the genetic diversity of wheat. As well as for barley flour the minerals concentration were (4.90 , 2.87 , 417 , 66.60 , 70.30) ppm respectively. These results were similar to those found by Youssef et al. (2013), when they studied the nutritional evaluation of barley. The differences in the minerals content in both types of grain due to the different chemical composition of each (Lairon, 2009).

Table (2) Mineral elements in wheat and barley flour

Element / Class	Iron Fe	Zinc Zn	Potassium K	Magnesium Mg	Calcium Ca
Wheat (ppm)	5.30	3.60	450	83.30	78.10
Barley (ppm)	4.90	2.87	417	66.60	70.30

The results in Table (3) indicated that the percentage of wet gluten for wheat flour reached 37.1 %, and these results were similar to those found by Al-Ali (2006). Also the same table showed that the values of wet gluten decreased (31.2 , 30.6 , 28.1 , 26.3 , 21.7) %, by increasing the percent of barley substituted (10 , 20 , 30 , 40 , 50) % respectively, as well as for the dry gluten (14.3 , 14.0 , 13.7 , 12.1 , 10.2) % respectively for the studied percent compared with whole wheat flour, which amounted to 15.2 %. Increasing the percent of barley replacement leaded to increase the proportion of non-gluten protein and fiber, which works to reduce the gluten. These results were similar to those found by Hulail (1983) when he used maize and triticale flour with wheat flour in baking mixtures. The difference in the percent of gluten may be due to the genetic and environmental conditions and as was the difference between the wheat varieties (Khan and Zhu, 2001).

Table (3) Wet and dry gluten for whole wheat and composite flour from wheat and barley

Flour type / Test	Whole wheat flour	Composite flour				
		10%	20%	30%	40%	50%
Wet gluten (%)	37.1	31.2	30.6	28.1	26.3	21.7
Dry gluten (%)	15.2	14.3	14.0	13.7	12.1	10.2

Flour strength tests: -

Table (4) showed that the results of Pelshenke test which was an important tested for determine the strength of the gluten and the quality of the wheat. The values of wheat flour and composite flour from wheat and barley. Its value amounted to150 minutes for wheat flour and it was within the range of 108-185 minutes, which was mentioned by Randhawa et al. (2002) when they studied the technological and chemical properties of the Pakistani autumn wheat. The same table indicated that the increase in barley flour replaced by (10 , 20 , 30 , 40 , 50) % led to decrease in these values as it reached (129 , 78 , 49 , 43 , 32) minutes respectively, due to the reduction of gluten and weakness in the gluten network by increasing the percent of barley flour replacement (Holmes, 1989). These results matched with Hulail (1983) when he used corn and triticale flour with wheat flour, and Naseem et al. (2011) when they studied the efficiency of some of the Pakistani wheat varieties appropriate for the pizza industry.

The Zeleny test relied on the Inflammation force of the gluten in medium of diluted lactic acid. Table (4) showed that the value of Zeleny for wheat flour, which was 18 cm^3, it was closed to the results of Butt (1996) and agreed with the results of Randhawa et al. (2002), and Tahseen and Anjum (2014). Anyhow these values decreased with increasing replacement of barley flour (10 , 20 , 30 , 40 , 50) % which amounted to (13 , 12 , 11 , 10 , 9) cm^3 respectively, decreasing may be due to the increase in the percentage of ash that leaded to the reduction of the gluten and increase the

proportion of non-protein gluten, as well as the increase in the percentage of ash indicated to increase in the percentage of bran that was sediment rapidly (Zine El-Abidine, 1979). Greenaway and Watson (1975) was also found that increasing the proportion of proteases were responsible for reducing the value of sedimentation.

Table (4) Flour strength tests

Flour type / Test	Whole wheat flour	Composite flour*				
		10%	20%	30%	40%	50%
Pelshenke (minute)	150	129	78	49	43	32
Zeleny (cm^3)	18	13	12	11	10	9

*from wheat and barley flour.

Staling tests :

1- The Swelling Power

Table (5) showed no significant differences in the values of the swelling power between the Hearth bread produced from white wheat and whole wheat flour and the Hearth bread when replacing barley with percentages (10 , 20 , 30) %, which was (3.579 , 2.400 , 2.567 , 2.783 , 2.618) %, respectively, an increase in the swelling power was observed by increasing the percent of barley substitutes compared to the whole wheat flour, this may be due to the addition of barley which increased the content of fiber, especially beta-glucan which limited the movement of molecules within the food (Temelli, 2002).

Table (5) Swelling Power (%) for the Hearth bread produced from whole wheat flour and barley in proportion (10 , 20 , 30) %

Treatment type	Storage time (hour)				The general mean of the Treatment type
	2	24	48	72	
Hearth bread produced from white wheat flour	4.191	3.649	3.167	2.968	3.579 *a
Hearth bread produced from whole wheat flour	2.842	2.626	2.511	1.657	2.400 a
Hearth bread produced from whole wheat flour with 10% barley	3.235	2.574	2.424	2.102	2.567 a
Hearth bread produced from whole wheat flour with 20% barley	3.479	2.544	2.492	2.270	2.783 a
Hearth bread produced from whole wheat flour with 30% barley	3.031	2.720	2.457	2.291	2.618 a
Mean of storage time	3.356 *a	2.822 b	2.610 bc	2.258 c	
L.S.D	0.3161				

* Similar small letters mean that there are no significant differences at level P<0.05

Also the results indicated that the swelling power decreased with increasing storage time for all treatments as the mean of storage time were (3.356 , 2.822 , 2.610 , 2.258) %, respectively, this was due to the retrogradation of the starch to the crystalline state, and migration of the water from the

crumb to the crust, the phenomenon of staling increase, as decrease the swelling power (Bemiller, 2007). These results were compatible with Hojjati et al. (2013) when they tested the effect of storage on bread properties, and Al-esawi (2016) when he was added some enzymes to improving the laboratorial bread. Replacing the barley in proportion (10 , 20 , 30) % with whole wheat flour increasing the swelling power to (3.235 , 3.478 , 3.031) %, respectively, during the first hour compared with its value the Hearth bread produced from whole wheat flour which amounted to 2.842 %, this may be due to the increasing alpha-amylase activity and beta-glucan in barley and wheat, which leaded to delay the phenomenon of staling. This was observed by Nasser (2010) when he added the alpha-amylase from the normal carp pancreas to bread to improve baking keeping properties, while Mohamed et al. (2008) showed that the addition of beta-glucan delays of bread staling in normal storage conditions.

2- The Volume of Sediment

Table (6) showed significant differences between the mean values of the volume of sediment (30.6 , 23.3 , 25.8) cm^3 for the Hearth bread produced from white and whole wheat flour, and the Hearth bread where barley was replaced by 10%. While no significant differences observed between the Hearth bread produced from replacement barley in proportion (10 , 20) % which were (25.8 , 25.5) cm^3 respectively, while no significant differences were found between the Hearth bread produced from whole wheat flour and the Hearth bread produced from replacement barley by 30 % which were (23.3 , 23.8) cm3 respectively. The same table showed a decrease in the mean values of storage time, which was due to the occurrence of staling and the retrogradation of starch. The same table showed significant differences between intervals 2 , 24 , 48 , 72 hours, which reached (29.6 , 27.0 , 24.6 , 22.0) cm^3, respectively. The same table illustrated that the values of the mean volume of sediment (25.8 , 25.5 , 25.8) cm^3 increased when the barley were added to the mixture by (10 , 20 , 30) % compared with the volume of sediment for the Hearth bread produced from whole wheat flour (23.3 cm^3), this may be due to the presence of alpha-amylase, which caused starch degradation, leading to the increase of dissolved starch, which was reflected in increasing the volume of sediment of the studied treatments. These results were identical to those reached by Alhmad (2013) when studying the qualitative and microbial for flour in Tikrit, and Al-esawi (2016) when he used enzymes to improve the quality and keeping properties of the laboratorial bread.

Table (6) Volume of sediment (cm^3) for the Hearth bread produced from whole wheat flour and barley in proportion (10 , 20 , 30) %

Treatment type	Storage time (hour)				The general mean of the Treatment type
	2	24	48	72	
Hearth bread produced from white wheat flour	36.5	33	28	25	30.6 *a
Hearth bread produced from whole wheat flour	27.3	24	22	20	23.3 c
Hearth bread produced from whole wheat flour with 10% barley	30	27	24	22	25.8 b
Hearth bread produced from whole wheat flour with 20% barley	28	27	26	21	25.5 bc
Hearth bread produced from whole wheat flour with 30% barley	26	24	23	22	23.8 c
Mean of storage time	29.6 *a	27.0 b	24.6 c	22.0 d	
L.S.D	0.6732				

* Similar small letters mean that there are no significant differences at level P<0.05

3 – pH value

Table (7) showed the mean values of the studied treatment, which indicated significant differences between the Hearth bread produced from the white flour with Hearth bread produced from replacement barley by percent 30 % (5.3 , 5.5) respectively, these values have significant differences with whole wheat flour and the Heath bread where barley were replaced by (10 , 20) % which were (5.9 , 5.8 , 5.9) respectively, while there were no significant differences between the Hearth bread produced from whole wheat flour and barley flour replaced by percentages (10 , 20) %, which reached (5.9 , 5.8 , 2.9) respectively. The same table indicated that there were no significant differences between the mean of storage time 2 , 24 , 48 , 72 which were (5.6 , 5.7 , 5.6 , 5.7) respectively. The reason of the difference in pH between treatment may be due to the content of water and soluble starch in bread crumb. These results were closed with Shalaby et al. (2014) when they studied physical and chemical effects on some properties of bread, and Beck et al. (2010) when he was used pH for continued starch retrogradation.

Table (7) The pH of the Hearth bread produced from whole wheat flour and barley in proportion (10 , 20 , 30) %

Treatment type	Storage time (hour)				The general mean of the Treatment type
	2	24	48	72	
Hearth bread produced from white wheat flour	5.4	5.4	5.2	5.3	5.3 *c
Hearth bread produced from whole wheat flour	5.9	5.6	5.9	6.0	5.9 a
Hearth bread produced from whole wheat flour with 10% barley	5.7	5.9	5.7	5.8	5.8 a
Hearth bread produced from whole wheat flour with 20% barley	5.7	5.9	5.7	6.1	5.9 a
Hearth bread produced from whole wheat flour with 30% barley	5.5	5.6	5.6	5.4	5.5 b
Mean of storage time	5.6 *a	5.7 a	5.6 a	5.7 a	
L.S.D	0.0759				

* Similar small letters mean that there are no significant differences at level P<0.05

4- Penetration value

Table (8) revealed the mean values of penetration for the studied treatment, They showed no significant differences between the Hearth bread produced from white and whole wheat flour (37.5 , 36.8) mm respectively, in addition to the absence of significant differences (34.0 , 34.5 , 35.8) mm, when adding barley to the mixture in proportions (10 , 20 , 30) % respectively, while there were significant differences between Hearth bread produced from white wheat flour with treatment that replacement barley in proportions (10 , 20 , 30) %. Also the same table showed the mean storage time, which decreased by increasing the storage period. This may be due to the phenomenon of staling. The high content of replacing barley leaded to increasing the content of fiber causing hardening of the product. Results also showed significant differences in the first and fourth day which amounted to (38.2 , 32.6) mm respectively, while no significant differences between the second and third day, which amounted to (36.6 , 35.2) mm respectively. These results were similar to those by Al-Fukaiky (2002) whose added malt to bread as an improver, and similar to Al-Abid (2005) during his studied on some types of bread.

Table (8) The penetration (mm) for the Hearth bread produced from whole wheat flour and barley in proportion (10 , 20 , 30) %

Treatment type	Storage time (hour)				The general mean of the Treatment type
	2	24	48	72	
Hearth bread produced from white wheat flour	40	38	37	35	37.5 *a
Hearth bread produced from whole wheat flour	39	38	37	33	36.8 ab
Hearth bread produced from whole wheat flour with 10% barley	36	35	33	31	34.0 c
Hearth bread produced from whole wheat flour with 20% barley	37	35	34	32	34.5 c
Hearth bread produced from whole wheat flour with 30% barley	39	37	35	32	35.8 bc
Mean of storage time	38.2 *a	36.6 b	35.2 b	32.6 c	
L.S.D	0.6372				

* Similar small letters mean that there are no significant differences at level P<0.05

5. Alkaline water retention capacity (AWRC)

Table (9) showed that there were no significant differences between the all treatments. They were (138.566 , 142.964 , 164.012 , 162.802 , 162.687) % for the Hearth bread produced from white and whole wheat flour and the Hearth bead that were barley replaced with it by percentage (10 , 20 , 30) % respectively.

Table (9) The AWRC (%) for the Hearth bread produced from whole wheat flour and barley in proportion (10 , 20 , 30) %

Treatment type	Storage time (hour)				The general mean of the Treatment type
	2	24	48	72	
Hearth bread produced from white wheat flour	216.128	161.889	129.960	98.288	138.566 *a
Hearth bread produced from whole wheat flour	199.664	145.712	124.641	101.840	142.964 a
Hearth bread produced from whole wheat flour with 10% barley	184.688	166.256	159.824	145.280	164.012 a
Hearth bread produced from whole wheat flour with 20% barley	173.504	169.760	162.232	145.712	162.802 a
Hearth bread produced from whole wheat flour with 30% barley	181.710	179.792	168.458	120.464	162.687 a
Mean of storage time	191.139 *a	164.696 b	149.023 c	122.317 d	
L.S.D					

* Similar small letters mean that there are no significant differences at level P<0.05

Higher values of AWRC were observed when barley levels (10 , 20 , 30) % were substituted with the Hearth bread produced from white and whole wheat flour, which may be this due to the increase of starch content and polysaccharide. This same what Yaseen et al.(2007) was reached it, and Hussein et al. (2013). The same table showed significant differences between the mean storage time 2 , 24 , 48 , 72 hour, which were (191.139 , 164.696 , 149.023 , 122.317) % respectively.

From the above, the results of this research show the success of some methods that used in a studying staling of Hearth bread and improvement in keeping properties of Hearth bread as shown by some methods of measurement of staling.

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