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EFFECT OF STORAGE ON SOME PHYSICAL AND CHEMICAL PROPERTIES OF IRAKY BREAD

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ABSTRACT

Four types of Iraky bread were processed namely Rustic loaf, Stony Alsamun, Circulate Alsamun and Baguette, using wheat flour extraction 72% and rustic loaf processed with wheat flour extraction 82% and stored at room temperature for 72 hours. Some physical, chemical and sensory characteristics of bread were performed to determine staling prepares namely, dissolved starch in crumb, the strength of absorption in the crumb, crumbliness, moisture in crumb and crust and pH.

Obtained results showed observed decrease in the values of dissolved starch, the strength of absorption in the crumb, moisture in crumb while an observed increase in crumbliness and moisture in crust.The results also showed a little changes in the processed bread (stony and circulate Alsamun) during the first 8 hours of storage, while an observed changes in all processed bread up to 48 hours of storage. The sensory evaluation showed no significant changes in all prepared bread samples. Results also indicated that all breads samples were no acceptable after 72 hours of storage.

INTRODUCTION

Bread is an important staple food in both developed and developing countries; since it has been an essential element of human diets because it constitutes important source of complex carbohydrates, proteins, minerals and vitamins (Rosell, 2007) Staling is a very complex multistage dynamic process affected by many factors and involving multiple mechanisms operating at different space and time scale (Cauvain, 2012 and He and Hoseney, 1990).

The loss of crispy texture could be associated with slight increase in water content, which induces glass transition in amorphous regions in polymers that were initially in the glassy state (Luyten *et al;* 2004).

Different types of bread varying in moisture are due to the different methods used in the manufacture of bread, and it is important that these differences in moisture content affect the speed of glaciation bread during conservation (Schochand French, 1947).The increase in the permeability of the crust means an increase in the retention of crispness (Hirte *et al;* 2010).The term firmness refers to the force necessary to attain a given deformation (Gil et al;1999). Water may either enhance the molecular mobility of polymer chains or plasticizer between polymers in the bread staling process (Schiraldi and Fessas,2001 and Mee-RyungandWon-Jae 2012).

Crispiness is perceived only for a short time after baking and it is the main attribute that causes consumer rejection (Duizer, 2001). Many surveys have been focused on determining consumer perceptions and preferences for bread products (Lambert *et al;* 2009 and Heenan *et al;* 2008). Accordingly, this study was carried out to investigate the effect of storage on some physical and chemical properties of Iraky Bread.

MATERIALS AND METHODS

MATERIALS

Wheat flour (72%extraction), oils, yeast, salt, sodium carbonate and French improver were obtained from the local market in Mansoura city, Egypt. Wheat flour (82% extraction) were obtained from the mill**.**

Preparation of bread

The mixtures were prepared according to Table (1) for the production types of bread. Diagrams 1, 2, 3 and 4 shows the methods used in the production of each type of bread.

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Table (1) The raw materials used in making of Iraky bread

Types of bread	Flour %	Water %	Yeast (imported) %	Salt %	Sugar %	Sodium carbonate %	Oil %	French improver %
Circular Alsamun	100	40-50	1	2.0	2.5	--	--	--
Stone Alsamun	100	45-55	1	1.5-2	--	--	--	--
Baguette	100	45-55	1	1.5-2	--	--	0.5	0.15-0.4
Rustic loaf	100	45-60	1-2	2.0	--	0.2-01	--	--

Analytical methods

Gross chemical composition of flour:

Moisture, ash, protein, wet and dry gluten, according to the methods described in AACC (1995).Moisture content of the crust and crumb was determined according to the methods described in ICC Method (1994)

Estimation soluble starch in crumb:

Soluble starch in crumb was determined according to Schoch and French (1947).

Estimation the swelling power in the crumb:

Swelling power in the crumb was determined according to the method used by **Schoch and French** (**1947).**The strength of absorption can be calculated as follows:

Swelling Power = C **-** (A + B) / B

Where:

A= weight centrifuge tube , B= weight of the sample ,

C=The weight of sediment with tube

Estimation the crumbliness in the crumb:

The percentage of crumbliness in crumb was determined according to method reported by **Bice and Geddes** (**1949**).The percentage of fragmentation was calculated as follows

The percentage of crumbliness crumb= (A – B)/A

Where:

A= weight original cubes , B= weight of the cubes after fragmentation process

Determination of pH:

pH values of the crumb, was measured according the methods of AOAC (2007).

The sensory evaluation of bread:

Sensory evaluation of bread freshness was carried out by 12 untrained persons. They were asked to mark biting texture that best describe their feeling on a sheet containing six categories rated with values from 1 to 6 according to **(QU All; 1990)** as follows:

Very fresh = 6, fresh = 5, slightly fresh = 4, slightly stale = 3, stale = 2, very stale = 1

Statistical analysis:

All obtained data were statistically analyzed according to the technique of analysis of variance (ANOVA) for the randomized complete block design (RCBD) as published by Gomez (1984) by using means of “MSTAT-C” computer software package. Means of treatments were compared using Duncan's multiple range tests at 5 % level of probability as described by Duncan (1955).

RESULTS AND DISCUSSION

Gross chemical composition of flour

The gross chemical composition of wheat flour (72% and 82% extraction) was determined dry and wet gluten, protein, ash and moisture contents and the results are presented in Table (2). From these results, it could be noticed that wheat flour 72% extraction contained 12.2, 0.83, 35.40, 11.88,11% moisture, ash, wet gluten, dry gluten and protein, respectively. While wheat flour 82% extraction contained 12.47, 1.14, 37.36, 12.38 and 12.14 % (g/100g) for the same components, respectively. From these results it could be noticed that wheat flour 82% extract contained higher moisture, ash, wet gluten, dry gluten and protein than those of wheat flour (72% extraction).

Table (2) Gross chemical composition of flour used in the production of different types of bread

Types of flour	Moisture%	Ash%	Wet gluten%	Dry Gluten%	Protein %
Wheat flour extraction 72%	12.2	0.83	35.40	11.88	11
Wheat flour extraction 82%	12.47	1.14	37.36	12.38	12.14

Effect of storage on moisture content of the crumb and crust:

From Table (3) it could be shown that the highest moisture content between products in the crust of diffract types of bread was in stone Alsamun. Bread Followed by baguette then circular Alsamun at zero time. A constant increase in crust moisture content was noticed in all products all over the examined storage hours. In relevance to zero time , the highest moisture content at 72 hours of storage was noticed in stone Alsamun.

Table (3) Effect of storage on moisture content in the crust for different types of bread (%).

Types of bread	Storage period (hours)				
	0	8	24	48	72
Circular Alsamun	10.39f	11.03f	12.29e	12.09e	12.78e
Stone Alsamun	14.93c	15.76c	16.71b	16.83b	18.63a
Baguette	12.45e	12.70e	14.00d	16.64b	16.70b
F. test	*				

Means with the same letter are not significantly different at P < 0.05.

Table (4) show the moisture content in the crump of breads at different storage periods. In contrast with moisture content of crust , there is a noticeable decrease in crump moisture content in all types of breads in constant trend all over the storage periods. The highest moisture content was observed in stone Alsamun bread.

Table (4) Effect of storage on moisture content in the crumb of different types of bread (%).

Types of bread	Storage period (hours)				
	0	8	24	48	72
Circular Alsamun	39.05e	38.18f	35.57j	33.90k	31.81m
Stone Alsamun	42.76a	42.03b	39.40e	37.92fg	36.69hi
Baguette	41.21c	40.05d	36.75hi	34.04k	33.06L
Rustic loaf	38.22f	37.33gh	36.36i	35.72j	34.08k
F. test	*				

Means with the same letter are not significantly different at P < 0.05.

The results show a difference between the moisture content in the crumb and crust of fresh bread , this difference was maintained during storage, a sharp decrease in moisture content in crumb storage offset was accompanied a slight increase in moisture crust.

From these results, the moisture content was increased in the crust, while lost in the crumb with increasing storage period. It is statistically differences were more pronounced in the crumb than in the crust,the differences were significant for the crumb between the different types of bread, as well as between different periods.This may be attributed to the redistribution of moisture between the interior of bread (crumb) and the outer part (crust), which include the transmission of moisture from the first part to the last part of which is manifestations associated with staling bread

These results are consistent with those of several studies (He and Ponte 1988).

Cuq et al., 2003 and Luyten et al., 2004 reported that the increase in moisture crust occurred through the first day of conservation. And another study (Roudaut et al., 1998; Luyten et al., 2004 and Primo-Martín et al., 2006) showed that arum skim crust keeps the moisture during the conservation and this confirms the role of the cortex in the process of staling.

The obtained results show that the variation in moisture content in different types of bread was due to the different methods used in the manufacture of bread, and it is important that these differences in moisture content affect the speed of glaciation bread during conservation (Schoch, and French.(1947).Kotancilar 2008. and van Nieuwenhuijzen *et al.* (2008) was found that the purpose of study the relationship between the glass transition of bread and the sensorial loss of the crispness, carried out oscillatory sorption experiments to change the characteristic diffusion time and to get insights in the contribution of polymer matrix relaxation to the water sorption.

Others authors claimed that the increase of the shelf life of bread crust relies on its permeability. Because of that the crust has low water vapor permeability and acts as a barrier to water vapor migration. Therefore, an increase in the permeability of the crust would facilitate water migration through the crust. In consequence, the effective diffusion coefficient would increase because the decrease in the resistance of the crust to water migration. In conducting this study, authors increased the permeability of the bread crust by creating small channels through the crust. Finally, they concluded that an increase in the permeability of the crust meant an increase in the retention of crispness (Hirte *et al;* 2010).

Effect of storage on soluble starch in crumb:

The obtained results showed soluble starch content in four examined bread types (circular alsamun ,stone alsamun , baguette and rustic loaf). A way from differences in starch content among bread types. There were an obvious decrease in soluble starch content gradually during the tested storage times. Bread types circular alsamun scored the higher soluble starch content 4/100 g at zero time with a gradual decrease through storage till it reached 2/100g after 72 hrs of storage .

All other types of breads showed relevant trend in soluble starch decrease through the first 72hrs of storage however , rustic loaf showed the lowest start contents of soluble starch as well as the lowest end content at 72 hr time paint .They lose of soluble starch was approximately 50% of the initial content in all tested breads after 72 hrs of storage .

The results are in agreement with (Mee and Won, 2012), differences between bread types in starch content may due to the initial content of flour from starch in relation to extraction percentage .

There is a clear correlation between fiber content and starch content expressed in extraction percentage, It is clear in rustic loaf which mad from 82% wheat flour had the lowest soluble starch content compared with the other three types of bread which were mad from 72% (White flour).

Table (5) Effect of storage on soluble starch content in four bread types (g/100g) on dry weight basis.

Types of bread	Storage period (hours)				
	0	8	24	48	72
Circular Alsamun	4.0A	3.13C	2.61DE	2.42EF	2.00G
Stone Alsamun	2.81D	2.31F	2.00G	1.78G	1.22IG
Baguette	3.41B	2.75D	2.24F	1.90G	1.55H
Rustic loaf	1.91G	1.49H	1.33HI	1.07JK	0.94K
F. test	*				

Means with the same letter are not significantly different at P < 0.05.

Data in Table (5) show that the percentage of starch dissolved in the crumb was decreases gradually with increasing duration of storge have shown significant differences in the rustic loaf distinct types of bread with the other. Values were used from the rustic loaf. Nethermost in all period's conservation

There is no agreement in the scientific literature change the proportion of soluble starch during baking Remember, as we find that the majority of studies and references refer to decrease the amount of starch dissolved with the increasing age of the bread ((Gil et al.1999), but we find some of the studies did not show clear differences in the amount of starch dissolved during the period of conservation and an example of the results of a study that (Bechtel et al,1953 and Schiraldi and Fessas 2001). It is well known that a good amount of starch in fresh bread there in case of soluble (Schoch, and French, 1947).), and that this amount is reduced gradually during glaciations bread, and believes that the phenomenon crystalline retro gradation effect on the ability of starch soluble as in this case, the crystals starchy size prevents survival condition dissolved (Stauffer, 2000) . That differences morale between the types of bread may be due to the differences existing in the basic ingredients for baking (Mee and Won-Jae 2012) and the results obtained from the loaf as in Table (5) underscores the importance of moisture content in bread on the amount of starch dissolved in the crumb and take a look at the moisture content mantel as in the table (4).The rustic loaf was distinct from other types of bread decrease moisture content mantel during the first hours of freshness ,a period in which the starch is dissolved in the crumb higher levels. Finally, it is logical to assume the presence of water in the crumb is necessary to provide the aqueous solubility of the starch disposable.

Effect of storage on swelling power:

Data presented in Table (6) showed the swelling power measured in the crump of tested bread after 0,8,24,48 and 72 hours of production. At zero time , there was no significant difference between stone alsamun, baguette and circular alsamun .

However ,swelling power of rustic loaf was obviously lower than those of other types of soluble starch content in the same tested types of bread, A decrease in swelling power all over the storage periods was main toured in all bread types .

It could be due to the crystallization of starch (retro gradation) which increase the percentage of insoluble starch as long as moisture content in the crump decreases due to immigration to the crust another possible reason to this phenomenon content in the flour may reduce .

The swelling power of bread (**Stauffer ,2000**), reported that initial content of moisture at zero time affects the ability of crump to re-absorb water again.

Table (6) Effect of storage on Swelling Power in crumb for different types of bread.

Types of bread	Storage period (hours)				
	0	8	24	48	72
Circular Alsamun	3.29^{AB}	2.41^{CD}	2.06^{DEF}	1.85^{DEFG}	1.41^{FGHI}
Stone Alsamun	3.80^{A}	2.98^{BC}	1.70^{EFGH}	1.38^{GHI}	1.32^{GHI}
Baguette	3.56^{AB}	2.98^{BC}	2.36^{CDE}	2.16^{DE}	2.10^{DE}
Rustic loaf	2.08^{DE}	1.70^{EFGH}	1.31^{GHI}	1.08^{HI}	0.91^{I}
F. test	*				

Means with the same letter are not significantly different at P < 0.05.

BaikandChinachoti, 2000 and Hojjati and Behzad 2013, they stated that the moisture content and a_w greatly contribute to crust.

This may be due to decline in the ability of the crumb to absorb water as a result of staling to the phenomenon of regression to the case of crystalline starch (Retro gradation) (Cuq *et al.,*2003 and Luyten *et al.,* 2004) case, which become less starch in preparation for melting.

Effect of storage on crumbliness:

Effect of storage periods on crumbliness of bread types as shown in table (7). Crumbliness property was highly affected by prolonged storage time in all three tested types of breads (circular alsamun , stone alsamun and baguette) which were produced from 72% wheat flour all of bread types showed similar trend of increasing Crumbliness with increased storage time . At zero time it was 3.39% , 4.40% and 4.77% in Circular Alsamun, Stone Alsamun and baguette , respectively . While after eight hours they increased significantly to reach 5.99 , 5.76 and 7.07% respectively, After 24 and 48 hours of storage the increase in Crumbliness was maintained to score 7.94 , 8.65 and 11.56% in Circular Alsamun, Stone Alsamun and baguette, The greatest scores of Crumbliness was recorded after 72hours to reach 12.76 , 15.03 and 22.7 % for Circular Alsamun, Stone Alsamun and baguette breads.

Table (7) Effect of storage on crumbliness in crumb (%) for different types of bread.

Types of bread	Storage period (hours)				
	0	8	24	48	72
Circular Alsamun	3.39^{L}	5.49^{J}	7.94^{H}	10.42^{F}	12.76^{D}
Stone Alsamun	4.40^{K}	5.76^{J}	8.65^{E}	11.51^{E}	15.03^{C}
Baguette	4.77^{K}	7.07^{I}	11.56^{E}	15.81^{B}	22.70^{A}
F. test	*				

Means with the same letter are not significantly different at P < 0.05.

Many researchers explained (Hoseney , 1990 and Cuq *et al.,* 2003) that the disintegration of the crumb increases with increasing conservation and the results shown in the table (7) agree with this view, was among the researchers (Gray and Bemiller, 2003 and Cauvain, 2012) that the biggest change is accompanied by staling crumb bread while conservation is turned. It is really a complex attribute resulting from multiple sensations that involves numerous physical parameters, combining molecular, structural and manufacturing process as well as storage conditions (Roudaut *et al.,* 2002 and Primo-Martin *et al.,* 2006) .

Nevertheless, all baked products have a very small shelf life and their quality is highly dependent on the period of time between baking and consumption (Bárcenas *et al;* 2003).This is worth mentioning that the fragmentation of the excess negative impact on the viability of cutting types of bread and this is what it cares about the factory and the consumer alike.

Effect of storage on pH:

Data in Table (8) show that the effect of storage on pH value of bread types .As shown from the same table the pH values of bread types ranged between 5.04 -7.18 at zero time . Bice and geddes, 1949 stated that the pH ranged between 5 – 5.6.

There was a light decrease in pH value all over the next storage period in all types of bread but it could be said that storage time had no significant effect an pH value in all tested bread types regard less differences in chemical composition between them. The high pH (7.18) in rustic loaf could be due to its high protein content with amphoteric properties and use of sodium bicarbonate (soda)in mix.

Table (8) Effect of storage on pH in crumb for different types of bread.

Types of bread	Storage period (hours)				
	0	8	24	48	72
Circular Alsamun	6.07^{B}	6.03^{B}	6.03^{B}	6.03^{B}	6.04^{B}
Stone Alsamun	5.04^{E}	5.10^{E}	5.10^{A}	5.38^{CDE}	5.32^{DE}
Baguette	5.83^{BC}	5.65^{BCD}	5.36^{CDE}	5.50^{CDE}	5.52^{CDE}
Rustic loaf	7.18^{A}	7.20^{A}	7.05^{A}	7.08^{A}	7.00^{A}
F. test	*				

Means with the same letter are not significantly different at P < 0.05.

The importance of pH in the baking industry are well known (Beck *et al.,*2010) they reported that the pH can be used in the follow –up rebound phenomenon of starch case amorphous to crystalline.

Effect of storage on sensory evaluation of bread

Sensory evaluation of tested bread after storage periods. Presented data in Table (9) showed an obvious effect of storage period on consumer acceptability of bread, at zero time the scored values were reflecting overall acceptability of products themselves.

Circular Alsamun was the most acceptable type of bread at zero time , however , cylindrical baguette was the least one . A noticeable decrease in acceptability was recorded after 8 hr, Expectedly , the higher decrease in consumer acceptably was recorded after 48 hours in all types of bread. After 72 hours, all types were almost rejected from consumers due to staling characteristic were appeared strongly.

Table (9) Effect of storage on sensory evaluation of bread

Types of bread	Storage period (hours)				
	0	**8**	**24**	**48**	**72**
Circular Alsamun	5.04^{A}	4.52^{AB}	3.44^{CDE}	1.85^{FG}	1.37^{G}
Stone Alsamun	5.01^{A}	4.62^{A}	3.46^{CDE}	2.63^{DEF}	1.21^{G}
Baguette	4.61^{A}	3.55^{CD}	3.24^{CDE}	2.54^{EF}	1.60^{G}
Rustic loaf	4.83^{A}	3.59^{C}	3.72^{BC}	3.13^{CDE}	1.34^{G}
F. test	*				

Means with the same letter are not significantly different at P < 0.05.

Average consumer depends on the senses as a basis for estimating the age of bread and also in the case of other food products as a result of the sensory evaluation that are considered crucial decision in assessing the accepted bread. (Curic *et al.,*2008;QUAIl *et al.,* 1990 and Duizer2001) could identify the extent of the link and the relationship between the sensory evaluation of the hand and the other tests used in the follow-up to the changes associated with staling bread on the other hand. The resulted obtained from sensory evaluation as shown in Table (9) clearly showed decline to accept residents of the bread, the more time saved and the values of the degree of rejection after (48) hours from most of the production models except the bread loaf.

CONCLUSION

Obtained results showed an observed decrease in the values of dissolved starch, the strength of absorption in the crumb, moisture in crumb, while an observed increase in crumbliness and moisture in crust. Results also showed a little changes in the processed bread (Stony and Circulate Alsamun) during the first 8 hours from storage while an observed changes in all processed bread up to 48 hours of storage, The sensory evaluation showed no significant changes in all prepared bread samples. All breads samples were non-acceptable after 72 hours of storage.

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تأثير التخزين علي بعض الصفات الفيزيائية والكيميائية للخبز العراقي

محمد طه شلبي، مسعد عبد العزيز أبوريه ، رانيا إبراهيم الجمال و حيدر عبد علي حمزه الجنابي
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مهندس في الشركة العامة لتجارة الحبوب/ السيطرة النوعية / وزارة التجارة

اجري هذا البحث لتصنيع أربعة أصناف من الخبز العراقي (الخبز الريفي ، الصمون الحجري ، الصمون الدائري والفرنسي) باستخدام دقيق القمح استخلاص ٧٢% و باستخدام دقيق القمح استخلاص ٨٢% للخبز الريفي وتم تخزين الخبز علي درجة حرارة الغرفة لمدة ٧٢ ساعة.

تم إجراء كل من الاختبارات الطبيعية والكيماوية والحسيه لتقدير البيات(نسبة النشا المذاب في اللبابة وقوة الامتصاص والرطوبة في القشرة والقصره و الهشاشه والتقييم الحسي) اثبتت النتائج المستحصل عليها ان هنالك انخفاض معنوي في قيم النشا المذاب وقوة الامتصاص والرطوبة في اللبابة بينما كانت هناك زيادة ملحوظة في قيم الهشاشه والرطوبة في القشرة وبشكل عام أظهرت النتائج وجود تغيرات طفيفة في أصناف الخبز الصمون (الحجري والدائري) خلال الـ ٨ ساعة الاولى من التخزين ثم تغيرات معنوية واضحة في جميع أصناف الخبز لغايه ٤٨ ساعة من التخزين. بينما أعطت نتائج التقييم الحسي عدم وجود فروق معنوية لجميع عينات الخبز المصنع.

حيث تم رفض المستهلك لجميع عينات الخبر بعد ٧٢ ساعه تحت ظروف التخزين التي حددتها الدراسة.

توصي الدراسه بانة لا يمكن إعتماد اختبار واحد فى تقدير سرعة تجلد الخبز و لابد من إستعمال أكثر من اختبار لهذا الغرض . كما يجب تفسير نتائج االاختبارات المختلفة بحذر تام والأخذ بنظر الإعتبار نوع الخبز وظروف الإنتاج عند الحكم على المنتج . أن معظم أنواع الخبز التى تمت دراستها يتعرض للتغير السريع بعد ٢٤ ساعة من التخزين ، لذا فإن عدم إقتناء المستهلك للخبز لفترة تتجاوز يوم واحد من الإنتاج يعرض الإنتاج للتغير في صفاته فى حالة حفظه تحت ظروف الخزن الإعتيادية التى حددتها الدراسة .