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Influence of Some Enzymes Addition on the Rheological Characteristics for Balady Bread Prepared By Sakha 94 Wheat Flour

Walid .M. Youssef [1,2], Hassan H. A. Khalaf [1] and Ashraf M. Sharoba [1]
[1] Food Tech. Dept., Fac. of Agric., Moshtohor, Benha Univ., Egypt.
[2]Holding Company for Food Industry – Egyptian Baking Technology Center
Corresponding author: walidyoussef1@yahoo.com

Abstract

The grain industry occupies an important position domestically and globally as it has a major role in the daily diet of all individuals. Therefore,this study aimed to improve and change rheological properteies of wheat flour (type Sakha 94) using some enzymes as well as investigate the effect of adding these enzymes on making of balady bread with sensory evaluation of final product.The results of this study showed crude protein content was 12.98 and 11.98% for Egyptian wheat (Sakha 94) and wheat flour (72% ext.), respectively. Also, the results showed that the whole wheat grain and wheat flour contain 27.2 and 30.4% wet gluten, respectively. Gluten index recorded 73.32 and 84.6%. Also, results showed increasing dry gluten in wheat flour to be 12.6%. The rheological tests is carried out using the farinograph, extensograph, mixolab and alveograph. All characteristics were improved especially with the blend coded (X1) which consists of 10 ppm glucose oxidase and 3 ppm α-amylase, whereas the dough giving the highest value of stability andresistance after adding this enzymes. The results of sensory evaluation of balady bread indicated that this mixture was the best addition used. Thus, It could be concluded that the addition of enzymes remained as good Organoleptic attributes for balady bread with the third day as well as fifth day compared with control sample and all treatments.

Keywords: Balady bread, Sakha 94, enzymes, Glucose oxidase (GOX) and α-amylase.

Introduction

Wheat is an economic and important crop that provides approximately 20% of food calorie in the world. Egypt has one of the highest wheat per capita consumption levels in the world (200kg/person/year). As well as Egypt is also the world's biggest wheat importer and the General Authority for Supply Commodities (GASC) of the Ministry of Supply and Internal Trade of Egypt (MoSIT) alone is the world's biggest wheat purchaser **(FAO, 2017)**.Common or bread wheat (*Triticum aestivum*) with hard or soft endosperm constitutes about 95% of total production, whereas durum wheat (*Triticum durum*) accounts for 5%. Durum and hard wheat contain more protein (12–16%) than soft wheat (8–10%).Wheat is the major staple crop in Egypt and viewed as a strategic commodity, which is considered a main ingredient in the Egyptian diet. Therefore, the consumers have no other choice except consuming the bread since it is still the cheapest food. Bread is the most common and traditional food around the world. Many additives such as vital gluten, emulsifiers, oxidants, and preservatives were being used to improve the quality of bread and to increase its shelf life. Use of enzymes increasingly in bread making to improve dough and bread quality leading including flexibility, mach inability, stability, loaf volume and crumb structure. On the other hand, the usage of enzymes as bread making improvers instead of chemical ones is more convenient from healthy point of view **(Gerrard and Brown, 2002).**The world enzyme market is in evolution and a growth of 6.8% per year is expected. It is possible to observe that enzymes market for baked goods is expected to increase from 420 million dollars in 2010 to 900 million dollars in 2020 **(Van Oort,2010).** Technical enzymes are produced from three different sources include plants, animals and microorganisms. The role of microorganisms has grown considerably in recent years. The main enzyme activities found in commercial enzyme preparations are starch-degrading enzymes, proteases and pentosanases (**Collar*et al.*, 2005 and Bankar*et al.*, 2009).** The enzymes most frequently used in bread making can be divided into hydrolases, oxidoreductases, proteases, hemicellulases and lipasesuch as α-amylases (EC 3.2.1.1),glucose oxidase (GOX) (β-D-glucose: oxygen 1-oxidoreductase (EC 1.1.2.3.4) and xylanase....,etc. (**Collar*et al.*, 2000 and Sanz Penella *et al.*, 2008).** Most of the starch-converting enzymes belong to the α-amylase family or family 13 glycosyl hydrolases (GH), based on amino acid sequence and structural similarities **(Svensson *et al.*, 2002).** On the other hand, the GOX catalysis the oxidation of glucose to the glucono lactone with the concomitant reduction of the oxygen to hydrogen peroxides.**(Shafisoltani *et al.*, 2014).**Each enzyme can be used individually or as combination of enzymes to improve the rheological properties of the dough and the characteristics of the resulting products. Recent advances in understanding of the dough forming and overall baking processes at the molecular level have focused attention on improvements that can be achieved by application of more specially tailored enzymes alone or in combinations (**Almeida and Chang, 2012)**. Usually, integrated experimental design and optimization followed by chemical analyses, rheological experiments and baking trials are necessary in order to provide answers to the more complicated questions. Therefore, this study aimed to use some enzymes to improve the qualities and characteristics of wheat flour for (type Sakha 94) as well as investigate the effect of adding these enzymes on making of Balady bread with sensory evaluation of final product.

Materials and Methods

Materials:

a. Wheat grains:

In this study Sakha 94 as a type of Egyptian wheat grains for 2016/2017 seasone, it was obtained from Wheat Research Dept, Agricultural Research Station, Sakha, Kafr-El-Sheikh city. Egypt.

b. Enzymes:

Three enzymes were used in this study as follows:

glucose oxidase (GOX)(GRINDAMYL® S759) and fungal α-amylase(GRINDAMYL® A 14000) obtained from International Company for Milling & Bakery Supplies agent (OMEGA) for AB Enzymes Company in Germany, while baking ingredients compressed yeast, sugar and salt were obtained from local market Giza, Egypt.

Methods:

1. Preparation of flour:

Wheat grain was cleaned on the dockage tester (Day Co. Minneapolis, MN.), relying on air aspiration (squirrel - cage fan speed 2,215 rpm) to remove the lower density shriveled kernels and the readily separable foreign matter were discarded. Wheat grain was milled by using a Laboratory mill, Buhler model MLU-202 to (72% extraction rate).

2. Physical Tests:

Hectoliter weight and thousand kernel weight were determined using stander procedures according to **A.A.C.C. (2000).**

3. Chemical analysis:

Moisture, crude protein, ether extract, crude fiber and ash content were determined according to the methods of **A.O.A.C. (2006).** Total carbohydrates were calculated by differences.

4. Gluten characteristics:

Gluten characteristics which include wet gluten, dry gluten, water-binding capacity and gluten index were estimated according to **A.A.C.C. (2000).**

5. Rheological properties of wheat flour:

a. Farinograph and Extensograph test:

Farinograph and Extensograph tests were carried out to determine the water absorption, dough development time, dough stability and dough weakening as well as elasticity, extensibility, proportion number and energy of wheat flour (72% extraction rate) according to the method described in **A.A.C.C. (2000).**

b. Mixolab test:

Dough rheological behavior was studied using Mixolab (Mixolab (Chopin, Tripetteet Renaud, Paris, France) which simultaneously determines dough characteristics during the process of mixing at constant temperature, as well as during the period of constant heating and cooling**Ozturk *et al.* (2008)**.Mixolab analysis was carried out at the water absorption level determined by the Consistograph following the method of**A.A.C.C. (2000).**

C. Alveograph

Alveograph test was carried out in an Alveograph MA 82 (Chopin, Tripetteet Renaud, France) following the approved method 54-30A **(A.A.C.C, 2000).**

d. Falling number (No.) test:

Falling No. was determined according to the method described in **A.A.C.C. (2000).**

6. Preparation of flour:

Addition of enzymes to 1000 g of Sakha 94 wheat flour (72%.Ex.) for making balady bread as follows:

Blend No.	Component
B1	wheat flour of Sakha 94 **(control)**
B2	wheat flour of Sakha 94+ 5 ppm GOX
B3	wheat flour of Sakha 94+ 10 ppm GOX
B4	wheat flour of Sakha 94+ 15 ppmGOX
B5	wheat flour of Sakha 94+ 3 ppm α-amylase
B6	wheat flour of Sakha 94+ 5 ppm α-amylase
B7	wheat flour of Sakha 94+ 10 ppm α-amylase
X1	wheat flour of Sakha 94+ mix(B3+B5+B9)

7. Preparation of Balady bread:

Balady bread was prepared by mixing each 1 kg wheat flour with the enzymes according to the levels of enzymes mentioned above from blend B2 to X1 , as well as with ingredients including 1.5% compressed yeast, 1.5%sodium chloride and water as needed by farinograms. The mixture was well mixed in mixer (250 rpm) for 20 min. The dough was left for fermentation at 30ºC for 15 min. After fermentation, the dough was divided into 125g pieces. Each piece was molded on a wooden board previously covered with fine layer of bran and left to ferment about 15 min at the same mentioned temperature and relative humidity. The fermented dough pieces were baked at 380-400ºC for 1-2 min in electric oven. The loaves were allowed to cool at room temperature before organoleptic evaluation **(Yaseen, 1985).**

7.1. Sensory evaluation of balady bread:

Bread loaves were allowed to cool for about 1h before evaluation. Balady bread loaves were organoleptically evaluated for color (20), appearance (20), taste (20), flavor (20), separation of layers (20) and overall acceptability (100) according to **El-Farra*et al*. (1982).**

8. Statistical analysis:

The statistical analysis was carried out using one-way ANOVA using SPSS, ver. 22 **(IBM Corp. Released 2013)**. Data were treated as a complete randomization design according to **Steel *et al.* (1997)**. Multiple comparisons were carried out applying **Duncun test** the significance level was set at < 0.05.

Results and Discussion

1. Chemical composition and physical characterization

The chemical compositions of whole wheat grain and wheat flour are shownin **Table (1).** The results indicated that the moisture range from 12.6 to 13.6%, crude protein content was 12.98 and 11.98% with whole wheat grain and wheat flour (72% ext.), respectively. On the other hand total carbohydrate was increased to be 72.48% with wheat flour.Egyptian wheat grain (Sakha 94) had the highest value of falling number 437 Sec, while wheat flour the falling number was 380.These results are in agreement with between those obtained by **El-Porai *et al*. (2013), they** found that falling number ranged 379 to 495 sec, as well as gluten index was 84.7 to 87.9& a**.** Crude protein, crude fiber and ash in whole wheat grain were 12.98 %, 2.23% and 1.6, respectively. This result is converging with **Mehasen *et al*. (2014).** Physical characterization for whole wheat grain through thousand kernel weight is one of the most important parameter are used to indicate the grain characters and factors affected of the wheat grain parameters such as genotype and environment, etc. That thousand kernel weight is 47.8g. Hectoliter affected by many factors such as genotype, environment and fertilizer, so Hectoliter recorded 83.1(kg/hectoliter) these results coincided with **(El-Kalla *et al*., 2010 and Nemat *et al*., 2013 and Ali, 2017).** Many studies are shown to presence the relation between the thousand kernel weight and protein content and then quality of wheat products, which depend mainly on genetic factor and environmental condition **(Ramya *et al*., 2010).**As well as the wet gluten, gluten index and dry gluten are shown in **Table (1).** The results showed that the whole wheat grain (Sakha 94) and wheat flour contain 27.2 and 30.4% wet gluten, respectively. Gluten index recorded 73.32 and 84.6%. Also, results showed the increasing of dry gluten in wheat flour to be 12.6%.

Table 1. Chemical composition and physical parameters of whole wheat grain and wheat flour for Sakha 94.

Characteristic	Whole wheat grain	Wheat flour (72% ext.)
Moisture content (%)	12.6	13.6
Ash content (db.) (%)	1.60	0.54
Crude protein (N×5.7) (%)	12.98	11.98
Ether extract (%)	1.41	0.93
Crude fiber (%)	2.23	0.47
Total carbohydrates*	69.18	72.48
Falling Number (Sec.)	437	380
Wet gluten (%)	27.2	30.4
Gluten index (%)	73.32	84.6
Dry gluten (%)	9.2	12.6
Hectoliter (kg/hectoliter)	83.1	
Thousand kernel weight (g)	47.8	

* (calculated by difference)

2. Effect of adding some enzymes to flour wheat (Sakha 94) on rheological properties

2.1. Farinograph properties:

Data in Table (2) show the effect of addition enzymes at different levels to wheat flour (Sakha 94) on Farinograph characteristics. Water absorption increased with adding enzymes, so it was 64.2% in blend coded by (X1) which consists of 10 ppm GOX and 3 ppm α-amylase, while it was 58.2% in control sample. Dough stability was 5 min in control sample and blend B5, while increased dough stability to be 9 min in blend coded (X1). The increased stability time indicated the robustness of the flour and convenience of making balady bread. Mixing tolerance decreased in blend coded (X1) to 20 B.U compared with control 60 B.U as **(Fig 1)** shows. On the other hand, it increased to 80 B.U. after addition of α-amylase as with blend coded B6 and B7 which contains 50 and 10 ppm α-amylase, respectively.

Disulfide bonds play a major role in determining dough properties. Exposure to oxidants can increases dough strength by the oxidation of sulfhydryl groups to disulfide bonds; So GOX promotes the oxidation of sulfhydryl groups and the subsequent formation of disulfide bonds between cysteine moieties and so increase in unextractable polymeric proteins in wheat flour, which was attributed to an increase in disulfide bonding between protein subunits (**Steffolani *et al*., 2010 and Whitney *et al*., 2014)**

On the other hand, α-amylases limite amylopectin re-crystallization and hence amylopectin network formation and consequent water immobilization, ultimately resulting in a softer, more water-plasticized crumb with greater resilience **(Bae *et al*., 2014)**

Table 2. Farinograph properties for dough after adding GOX and α-aAmyleas and Xylanase to Sakha 94 wheat flour (72% ext):

Blend No.	Water absorption %	Mixing time (min)	Stability time (min)	Mixing tolerance index (B.U)	Weakning of dough (B.U)
B1(Control)	58.2	2.5	5.0	60	80
B2	58.4	3.0	5.5	40	60
B3	58.9	4.0	8.0	30	20
B4	59.5	3.5	8.4	30	20
B5	58.2	3.0	5.0	60	90
B6	58.3	2.5	4.0	80	100
B7	58.4	2.5	4.0	80	110
X1	64.2	3.5	9.0	20	20

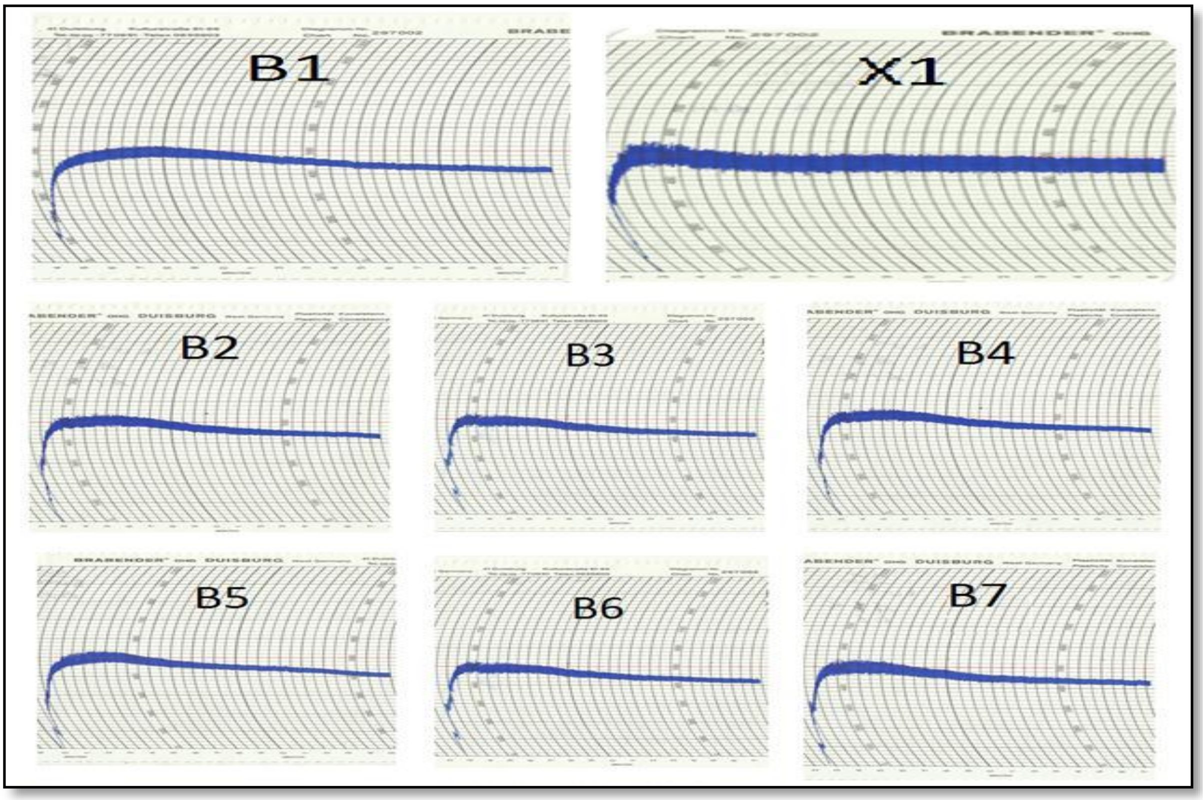

Fig. (1): Farinograph diagrams for wheat flour (Sakha 94) after adding enzymes.

2.2. Extensograph parameters:

Results presented in **Table (3)** and illustrated in **Fig. (2)** showed extensograph parameters for wheat flour (Sakha 94) after adding some enzymes to improve production of balady bread. Data indicate that resistance with control sample was 420 B.U. the mixtures containing GOX recorded highest resistance as B3 and B4 620 and 625 B.U. The highest value was 670 B.U with (X1). The **e**xtensibility (E) showed a value of 130 mm for control (Sakha 94 wheat flour 72%). Increases that value together add enzymes to 160 mm with blend coded (X1).The relative number was dependent on the results of (R) and (E). Therefore, a similar relationship was found of the relative number (R / E) of the dough. These results coincided with **Shafisoltani *et al*. (2014) and EL Rashidy, (2015)**.

Table 3. Extensograph properties for dough after adding GOX and α-amyleas and Xylanase to Sakha 94 wheat flour (72% ext):

Blend No.	Resistant to extension (R) (B.U)	Extensibility (E) (mm)	Proportional number (R\E)	Energy (cm^2)
B1 (Control)	420	130	3.23	108
B2	480	140	3.42	123
B3	620	150	4.13	155
B4	625	145	4.31	156
B5	420	135	3.11	109
B6	410	150	2.73	100
B7	430	135	3.18	112
X1	670	160	4.18	165

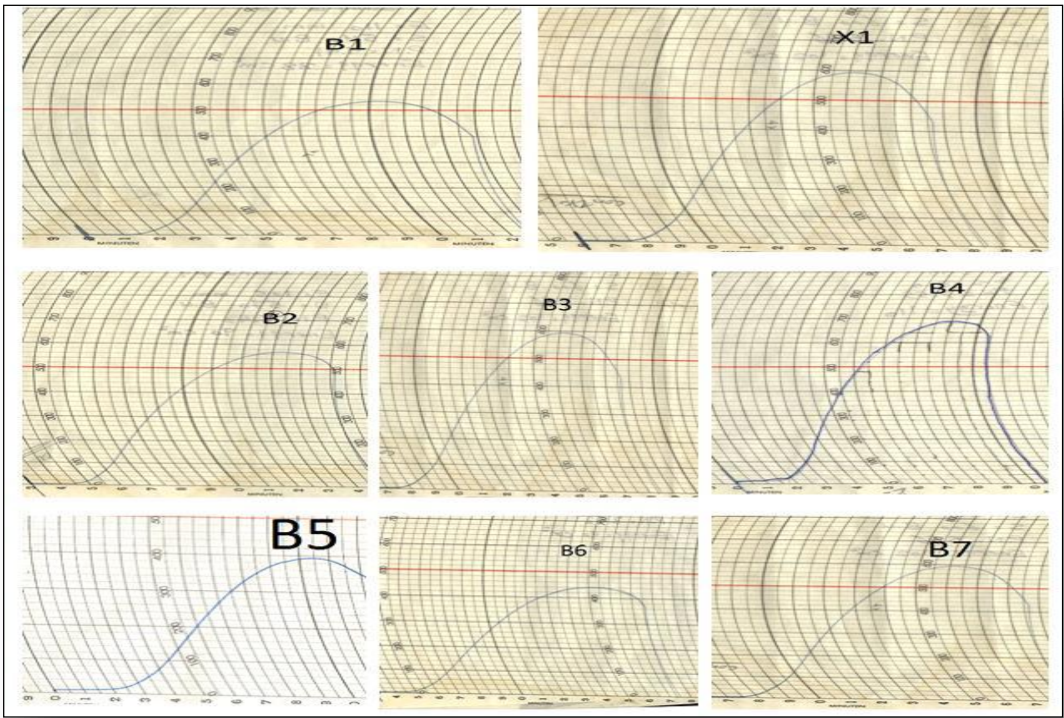

Fig. (2): Extensograph diagrams for wheat flour (sakha 94) after adding enzymes.

2.3. Mixolab parameters of Sakha 94 wheat flour after addition some enzymes:

The results Table (4) and Fig. (3) showed the effect of enzymes addition at different levels on Mixolab properties. The results indicated increasing stability with the adding of enzymes compared with control sample (from 9.63 min to 12.13 min in sample coded (X1) which mixture by 10 ppm GOX and 3 ppm α-amylase. The effect of enzymes was found on the values of dough development with first stage (C1) from 1.28 Nm in control sample to 9.5 Nm in sample (X1), but did not effect in the stage five (C5)in all samples compared with control. Gluten, viscosity and amylase were enhance with all treatment by enzymes**.**

Table 4. Mixolab characteristics of **Sakha 94 wheat flour after addition some enzymes:**

Blend No.	Stability (min)	Absorption	Mixing	Gluten+	Viscosity	Amylase	Retro gradation	C1 (Nm)	C2 (Nm)	C3 (Nm)	C4 (Nm)	C5 (Nm)
B1	9.63	4	2	6	5	7	7	1.28	16.37	25.07	28.60	45.02
B2	10.63	5	2	6	5	8	7	1.36	16.00	23.03	28.87	45.00
B3	10.62	6	3	7	6	8	6	1.73	15.60	22.05	26.23	45.00
B4	10.53	6	4	8	8	8	8	1.35	15.92	44.85	44.90	45.02
B5	9.60	6	2	8	7	8	8	1.43	15.85	23.02	28.83	45.00
B6	9.72	5	4	4	8	8	8	1.15	16.10	28.13	29.78	45.00
B7	9.57	5	4	6	7	8	8	1.28	16.57	27.72	30.38	45.02
X1	12.13	7	8	8	7	8	8	9.50	17.57	25.20	30.22	45.00

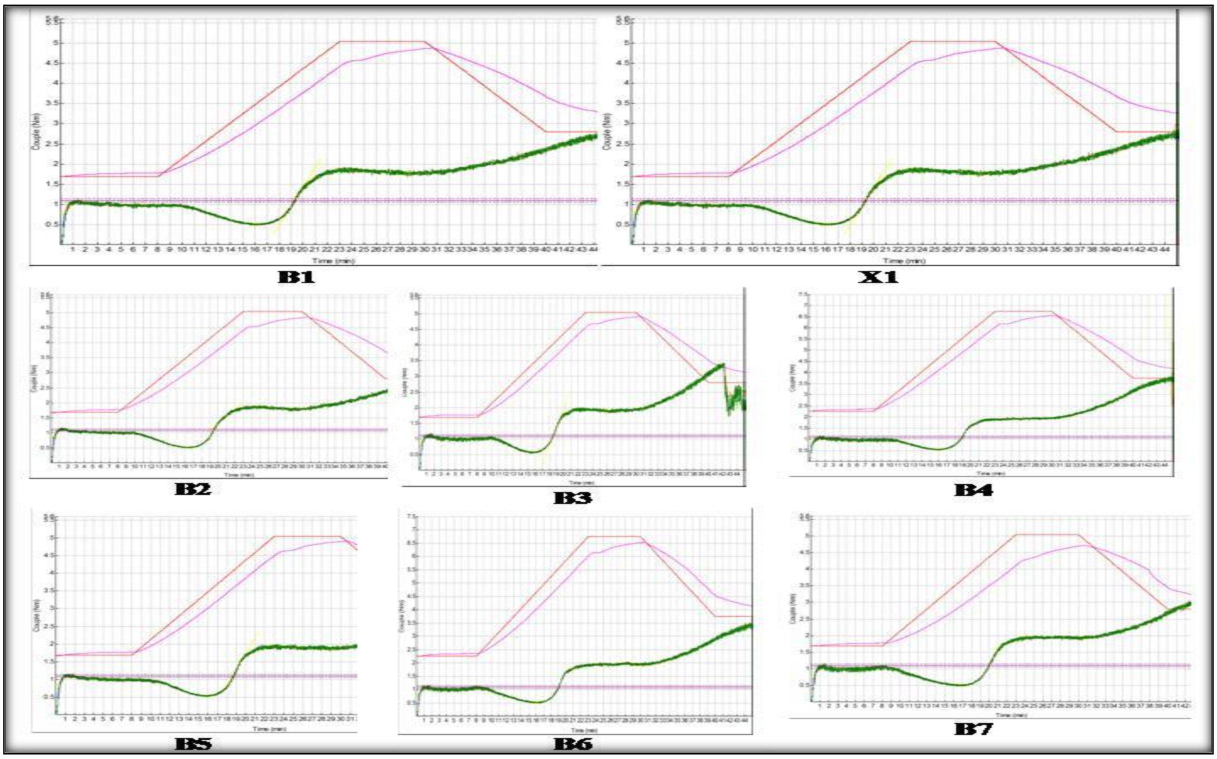

Fig. 3 Mixolab diagrams of **Sakha 94 wheat flour after addition some enzymes**

2. 4. Alveograph characteristicsof Sakha 94 wheat flour after addition some enzymes:

The results in **Table (5)** showed that, the value of resistance (P) was 95 mm in control sample increased to 108 with the wheat flour after adding some enzymes as blend No. (X1). GOX increased covalent cross-linking among proteins markedly into the gluten network Compared to the control sample **(Caballero *et al.*, 2007 and Sahnoun *et al*., 2016).** On the other hand elasticity (L) was decreased in all samples compared with control sample was 100 mm. The resistance to elasticity (P/L) also increased with the use of enzymes, compared to the control sample as **(Fig 4).** Gluten cross-linking enzymes play an important role in the present baking processes. Through different biochemical mechanisms (the oxidative coupling of thiol groups, the crosslink of tyrosine residues due to the action of intermediate reactive compounds such as hydrogen peroxide, the acyl-transfer reaction between amino acid residues), these enzymes promote the formation of covalent bonds between polypeptide chains within a protein or between different proteins, improving functional behaviour of dough during bread-making process (**Caballero*et al*., 2007).**

Table 5. Alveograph characteristics of Sakha 94 wheat flour after addition some enzymes:

Blend (No.)	P (mm)	L (mm)	W(P/L Ratio)
B1 (control)	95	100	0.95
B2	89	93	0.96
B3	98	82	1.20
B4	92	72	1.28
B5	96	86	1.12
B6	94	85	1.11
B7	93	102	0.91
X1	108	77	1.40

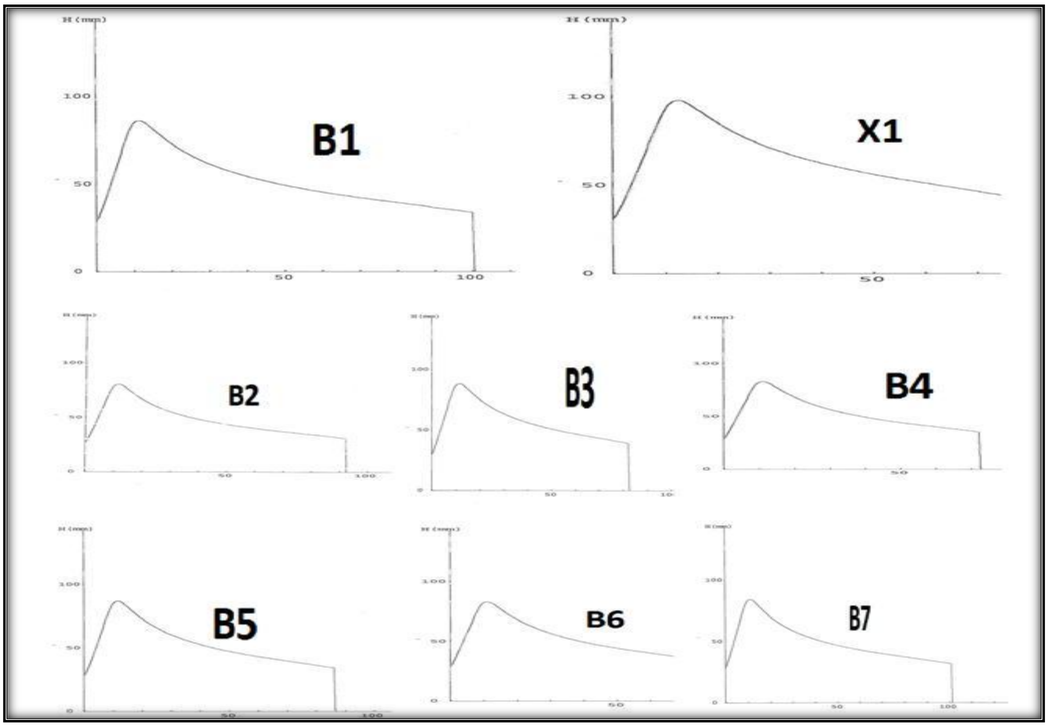

Fig. (4): Alveograph **diagrams of** Sakha 94 wheat flour after addition some enzymes

2.5. Sensory evaluation of balady bread:

Data in **Table (6)** indicated that there are significant differences (p ≤ 0.05) between all enzymes. The results showed that there are a significant difference (P>0.05) between any blend, as well as between storage period. Storage for the fifth day showed significant deterioration in sensory evaluation

The obtained data indicated that treatments coded (X1) giving marked (p ≤ 0.05) improvement in all attributes compared with control samples. Also, these results dramatically agreed with rheological parameters must be referred to the Blend (X1) which consist of 10 ppm GOX and 3 ppm α-amylase gave the best results in all organoleptic attributes. On the other hand, results showed that the blend (X1) remained as good arganoleptic attributes the third day as well as the fifth day compared with control sample and all treatments. During bread storage, the gelatinised starch (amylopectin) network, present in soft, fresh bread, is gradually transformed into an extensive, partially crystalline, permanent amylopectin network, with amylopectin crystallites acting as junction zones. This network increasingly accounts for the bulk rheological behaviour of aging bread crumb. The efficiency of anti-staling amylases can be related to the extent they limit the formation and the strength of the permanent amylopectin network, and the water immobilisation. Conventional alpha-amylases weaken the amylopectin network by cutting the long polymer chains connecting the crystalline regions, but have little effect on amylopectin recrystallisation. In contrast, maltogenic alpha-amylase primarily shortens the amylopectin side chains, thus hindering amylopectin recrystallisation, and the concomitant network formation and water immobilisation(**Hug-Iten *et al*., 2003 and Goesaert *et al*., 2009).**

2.6. Effect of addition some enzymes on alkaline water retention capacity (AWRC) of balady bread:

Effects of addition different concentrations from GOX and α-amylase to wheat flour (Sakha 94) on alkaline water retention capacity (AWRC %) during storage of balady bread for 1,3 and 5 days at 25 °C are shown in **Table (7).** It could be noticed that rate decrease (RD%) of control balady bread increased with increasing storage period. While, addition of enzymes the RD% decrease, so that the freshness increased to these levels and improved the staling rate comparing with control sample. Where the RD % in control sample was 10.9 to 57.01% after storage for 1 to 5 days, respectively. The RD% was 0.6 to 29.43% and 1.5 to 31.8% with blends coded B9 and X1, respectively; While in the same storage periods after addition enzymes. This improvement may be due to increased break down starch to glucose units with production of higher levels of reducing sugars, a factor that would raise the water absorption and increase bread shelf-life **(Azzeh and Amr, 2009 and Yaseen *et al*., 2010).**

Table 6. Sensory evaluation of Balady bread treated by different doses of enzymes:

Organoleptic attributes	Blends No.								Storage periods		
	B1	B2	B3	B4	B5	B6	B7	X1	zero day	Third day	Fifth day
Color	9.5± 7.3^f	12.3± 2.7^d	14.1± 3.04^c	11.7± 2.7^e	15.0± 2.3^b	8.1± 6.2^h	8.7± 6.5^g	16.3± 2.0^a	16.6±1.7^A	11.7±2.06^B	8.2±5.9^C
Appearance	9.5± 7.4^d	11.3± 4.5^c	13.8± 3.2^b	18.8± 4.3^c	15.0± 2.5^a	7.8± 5.6^e	8.5± 7.5^e	15.5± 2.5^a	16.6±2.04^A	11.8±2.2^B	6.5±5.5^C
Taste	9.1± 7.2^{de}	8.9± 6.9^{de}	11.2± 6.5^c	9.6± 5.9^d	12.3± 5.5^b	7.5± 5.9^f	8.5± 6.6^{ed}	13.9± 4.6^a	16.7±1.7^A	11.6±2.5^B	2.1±2.7^C
Flavor	9.3± 7.5^c	9.1± 7.1^{cd}	12.1± 5.4^b	9.8± 4.8^c	11.4± 6.3^b	7.5± 5.8^e	8.4± 6.3^d	13.6± 5.2^a	16.6±2.3^A	11.5±2.4^B	2.3±2.6^C
Separation layers	8.5± 6.6^d	12.1± 2.3^c	14.2± 2.2^b	12.03± 3.4^c	13.5± 3.9^b	8.0± 6.2^d	8.2± 6.2^d	16.4± 2.3^a	16.3±2.2^A	11.5±2.5^B	7.1±5.7^C
Overall acceptability	45.9± 36.3^d	54.2± 22.2^c	64.9± 19.9^b	55.4± 20.1^c	67.2± 18.9^b	39.1± 30.1^f	42.2± 32.1^e	75.0± 15.4^a	82.8±8.4^A	58.0±10.7^B	25.0±21.4^C

Mean values in the same row (as a small letter) & (as a capital letter) with the same letter are not significant different at 0.05 level.

Table 7. Effect of addition some enzymes on alkaline water retention capacity (AWRC %) for Balady bread made from Sakha 94 wheat flour (72% ext) during storage at 25±2°C.

Blend No.	Zero time	Storage period (Day)						Average for blend
		1		3		5		
		AWRC	RD %	AWRC	RD %	AWRC	RD %	
B1(control)	281.2	250.3	10.9	201.1	28.5	120. 9	57.01	213.37±34.9^b
B2	280.1	258.4	7.7	200.2	28.5	122.1	56.41	215.20±35.3^b
B3	280.4	271.3	3.4	210.3	25.0	135.5	51.67	224.37±33.5^b
B4	278.8	257.4	7.6	203.4	27.1	134.5	51.75	218.52±32.2^b
B5	282.5	264.1	6.5	224.3	20.6	127.4	54.91	224.57±34.6^b
B6	280.5	257. 8	8.1	211.4	24.6	125.2	55.36	218.72±34.3^b
B7	280.2	255.5	8.8	215.1	23.2	124.6	55.53	218.85±34.1^b
X1	285.5	281.2	1.5	239.4	16.1	194.5	31.87	250.15±21.3^a
Average for periods	281.1±0.84^a	261.9±3.17^b		213.1±4.28^c		135.6±9.5^d		

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تأثير إضافة بعض الإنزيمات على الخواص الريولوجية للخبز البلدى الفاخر المصنع من دقيق سخا 94

وليد محمد يوسف [1] – حسن على خلف[1] – أشرف مهدى شرويه[1]

[1]قسم الصناعات الغذائية – كلية الزراعة بمشتهر – جامعة بنها – مصر

تحتل صناعة الحبوب مكانه هامه على الصعيد المحلى والعالمى نظراً لدورها الهام فى النظام الغذائى اليومى للأفراد. ولذلك كان الهدف من تلك الدراسة إستخدام مجموعة من الإنزيمات لتحسين الصفات الريولوجية لدقيق قمح سخا 94 (استخلاص 72%) لرفع جودة الخبز البلدى المنتج. اظهرت النتائج ان نسبة البروتين 12.98و 11.98% فى كل من الحبوب الكاملة لقمح سخا 94 والدقيق المتحصل عليه (إستخلاص 72 %) على التوالى. بينما بلغت نسبة الجلوتين الرطب فى كل من الحبوب الكاملة لقمح سخا 94 والدقيق 27.2 و 30.4% على التوالى. سجل مؤشر الجلوتين 73.32 و 84.6 ٪. أيضا عمل جميع الأختبارات الريولوجية بأجهزة الفارينوجراف والأكستنسوجراف و المكسولاب والألفيوجراف وأوضحت النتائج أن جميع الخصائص قد تحسنت خاصة مع خليط الانزيمات المكون من 10 جزء في المليون من إنزيم جلوكوز أوكسيديز + 3 جزء في المليون من إنزيم ألفا اميليز حيث اعطى العجين أعلى قيمة من المقاومة والمطاطية بعد إضافة هذه الأنزيمات مجتمعة بتلك النسب المشار اليها. كما أشارت نتائج التقييم الحسي الى تمتع الخبز البلدي الفاخر الناتج بصفات جيدة للخبز البلدي في اليوم الثالث واليوم الخامس مقارنة مع عينة الكنترول وكذا باقى المعاملات.

الكلمات الدالة: الخبز البلدى- سخا 94- إنزيمات- جلوكوز اكسيديز- ألفا اميليز