CHEMICAL,RHEOLOGICAL AND BAKING QUALITY STUDIES ON TRITICALE AND WHEAT FLOURS.

Attia , Nadia Y. and A.R. Khalil.
Dept. of Soil and Biochem., Fac. of Agric., Moshtohor Zagazig Univ.

ABSTRACT

The chemical composition, rheological properties and baking performance of three triticale and two wheat flour in addition to three mixtures of triticale-wheat flours were studied. Triticale flour was characterized by higher protein content, total sugars and α-amylase activity more than wheat flour. The triticale dough developed readily with low stability indicating deficient gluten quantity and quality in comparison with wheat. Also triticale bread has broken top and pale crust while the mixtures can produce improved bread which has higher score than that of triticale, but lesser than that of wheat.

INTRODUCTION

Triticale, the first "man made" cereal (a hybrid between wheat and rye) is almost ready to take on a commercial role in some countries. However in Egypt, extensive tests are currently being undertaken to introduce this new cereal crop in agriculture application in the new reclamated areas. As with other cereals, the main nutritional component of triticale grain is starch. Also both the carbohydrate content and level of protein are important nutritional factors in the cereal grain. Triticale has about the same starch content as its parental species (Klassen and Hill, 1971);(Berry et al., 1971) but slightly better balance of the essential amino acids because protein and lysine content are generally higher than of wheat (Villegas et al., 1970). The three primary factors that influence bread making quality are protein content of the flour, the protein quality and the level of enzyme activity. Despite the generally higher protein content of triticale whole grain, tne protein content of triticale flour is usually equal to that of wheat flour, a fact indicating that relatively more of the total protein in triticale grain is in the bran. In wheat there exists a higher correlation between tne amount of protein and the amount of gluten, which imparts strength and elasticity to the dough. In triticale, this correlation is much lower. Triticale flour exhibits higher alfa amylase enzyme activity than wheat flour (Pena and Bates, 1982). In bread making, this higher alfa-amylase activity dextrenizes a greater proportion of the starch that gives sticky bread-crumb formation in comparison with wheat. Madle and Tesen (1973) indicated that the bread making characteristics (specially loaf volume) of triticale flour depend also on protease activity. Bushuk and Larter (1982), reported that improved quality of triticale could be obtained by mixing triticale flour and wheat flour.

Therefore, this work was carried out to evaluate the chemical, rheological characteristics and baking quality of three triticale, two wheat

and three wheat triticale mixures in addition to three mixtures of wheat and triticale flours in an attempt to mix triticale flour with wheat flour in bread making to produce good quality bread rich in lysine.

MATERIALS AND METHODS

The grains of; the two bread wheat (Triticum aestivum L.) varieties, Giza 157 and Sakha 69 and the three triticale (X Triticosecale Wittmack) lines B-270 (I), B-2736-298-0M (II) and B-S_2-0AF. 3 (III) used in this study were obtained from Bahtim Res. Stn., Agric. Res. Cent., Ministry of Agriculture, Cairo Egypt. Wheat and triticale flours, 72% extraction, were prepared at Research and Experimental Lab., North Cairo Milling Company.

Chemical constituents; Moisture, Crude Protein (N x 6.25), total carbohydrates, reducing and non-reducing sugars and ash content were carried out according to A.O.A.C. (1980). Alpha amylase activity was determined according to A.O.A.C. (1980) using Falling Number System to determine. Perten liquifaction number (P.L.N) where;

$$PLN = \frac{6000}{50\text{-Falling number}}$$

Rheological properties; The rheological properties of the different doughs were carried out using a Farinograph and Extensograph tests according to A.A.C.C. (1962).

Preparation of bread; The flour of each of the triticale lines was mixed with Sakha 69 flour in ratios of 35% triticale: 65% wheat. Flour samples of 200 gm were mixed with water to form the needed dough. Sodium chloride of 1% as well as yeast of 2% and 2% sugar were added. The previous ingredients were mixed and fermented for 1.0 hr at 30°C. The doughs (100 gm each were placed trays and baked at 200°C for 10 minutes.

Organoleptic evaluation; Panelists were ashed for sensory evaluation of bread appearance, tost, odour, crust color and crumb according to the method of Fance and Wragg(1968).

RESULTS AND DISCUSSION

Chemical constituents:

Data of chemical constituents of wheat and Triticale flours are presented in Table (1). Triticale flours are characterized by higher protein content especially in the third line. Triticale gluten was lower than that of wheat flour as it was soft and sticky. Alfa-amylase activity (PLN) was considerably higher in Triticale flours especially in the second and third line. However, such results is confirmed by that of Pena and Bates (1982) who reported that Triticale flours exhibits higher alfa-amylase activity than wheat flour.

Farinograph test:

The results of this test are shown in Table (2) and illustrated in Figs. (1 and 2). Dough of Triticale flour was characterized by lower

water absorption than wheat dough. This is due to the higher content of gluten in wheat (the major water holding constituent of the flour).

Table (1): Chemical constituents of wheat and Triticale Flours. (Calculated on dry weight basis).

Flour	Moisture %	Protein %	Carbohydrates % T.carbohydrates %	Reducing sugars %	non-Red. sugars %	T. sugars %	Ash %	Gluten wet	Gluten dry	Perten laquifacation number
Wheat										
Giza 157	13.49	4.29	67.15	1.31	2.29	3.60	1.03	30.48	12.31	17.80
Sakha 69	15.85	4.68	69.99	1.25	1.93	3.18	0.80	34.06	16.08	17.24
Triticale										
B-270 (I)	13.61	5.47	71.82	2.42	3.21	5.63	0.63	23.06	9.59	75.95
B-2736-298-0M (II)	13.92	4.59	69.77	2.41	3.54	5.95	0.83	14.13	5.43	139.53
B-S_2-0AF-3 (III)	14.32	8.31	68.83	2.54	3.83	6.37	0.87	20.02	7.50	142.86

Table (2): Farinograph parameters for different wheat, tritical and its mixed flours.

Flour	Water absorption %	Dough development time (min)	Dough stability (min)	Arrival time (min)	Dough weakening (B.U) 10 (min)	Dough weakening (B.U) 20 (min)	Tolerance index (B.U)	Valorimeter value
Wheat								
Giza 157	60.74	4.0	6.50	1.60	50	90	15	61
Sakha 69	63.93	5.0	9.25	1.75	50	95	-	65
Triticale								
B-270 (I)	60.05	1.7	2.25	0.8	170	210	130	32
B-273-298-0M (II)	57.45	2.0	2.50	0.9	140	200	110	37
B-S_2-0AF-3 (III)	59.09	3.0	3.00	1.8	140	230	120	34
Mixtures								
A:Sakha 69+Triticale (I)	59.21	1.5	4.50	1.0	80	140	60	42
B:Sakha 69+Triticale (II)	58.69	2.0	5.00	1.0	75	120	50	40
C:Sakha 69+Triticale (III)	59.05	3.0	4.80	1.0	90	155	70	36

Dough development time, dough stability and arrival time were also lower in Triticale. Weakening of the dough, which is a result of the break down of gluten net work after elapsing an appropriate mixing time, was measured after 10 and 20 minutes. Because of the low content of gluten in Triticale, the weakening values were higher than those of wheat. Although Triticale flours contained more protein than wheat flour, the short development time, low absorption and stability indicate that Triticale has less gluten for dough structure. Also, the higher total sugars, alfa amylase activity, beside Triticale flour may contain more protease which can weaken dough structure than the wheat. These results are in agreement with those reported by Tsen et al.,(1973).

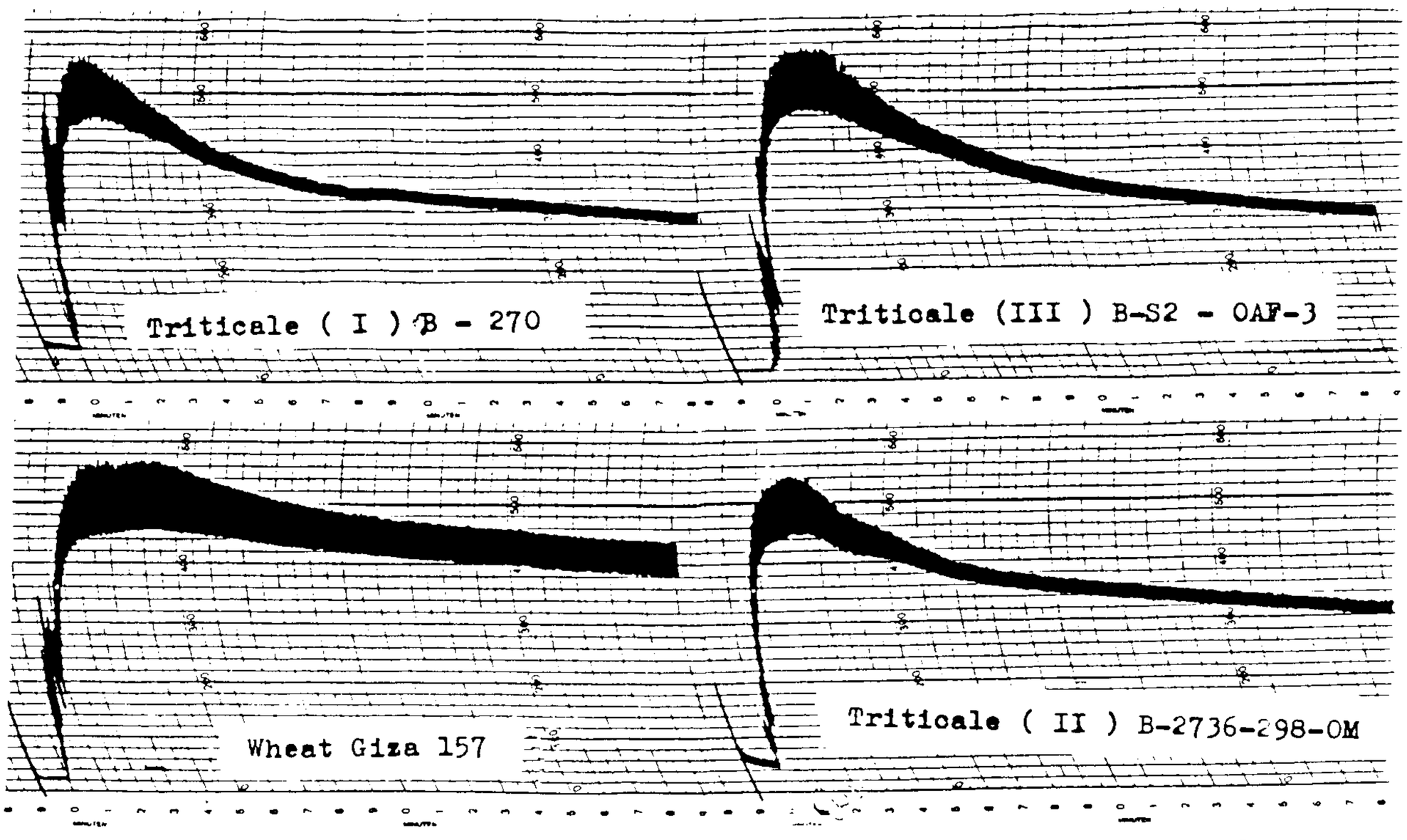

Fig.(1): Farinograph pattern of wheat Giza 157 and different triticale flours.

Of the three Triticale flours, Triticale flour II had lesser protein content, lower absorption, and poorer quality than the others. The obtained results indicate that Triticale in general has less desirable rheological farinograph properties of the dough than wheat. Also the flour

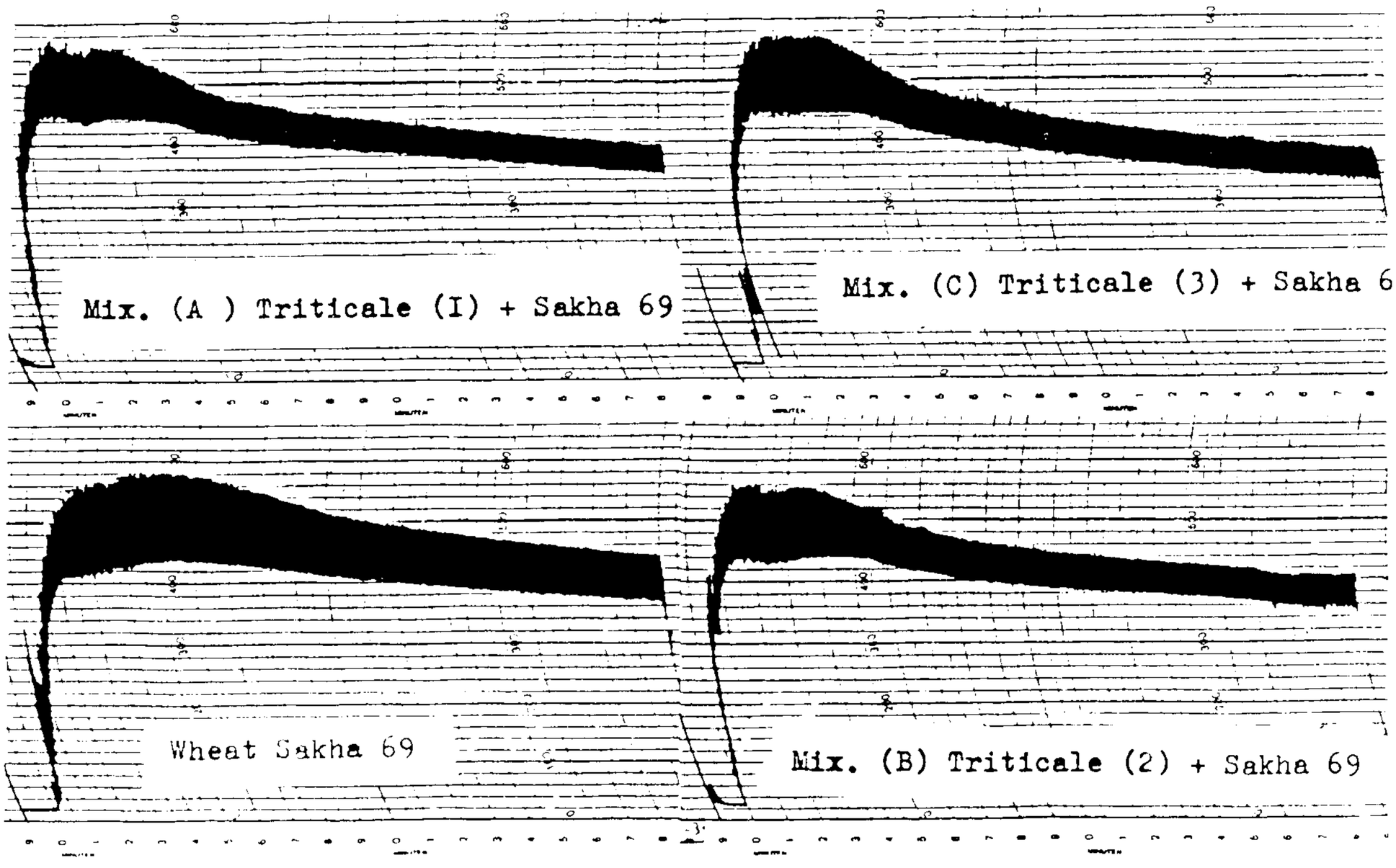

Fig.(2):Farinograph pattern of wheat Sakha 69 and three triticale-wheat flour mix.

of the variety Sakha 69 is stronger than that of Giza 157. Therefore, Sakha 69 was chosen to prepare the suggested dough mixtures of 35% Tritical flour and 65% wheat flour. Mixing the flour of Sakha 69 with Triticale flour improved dough stability and weakening comparing with Triticale since Triticale flour gluten is deficient in quantity and quality as reported by Unrau and Jenkins (1964). Mixtures A and C showed about the same in water absorption, dough stability, dough weakening and arrival time.

Extensograph test:

The results of this test are shown in Table (3).

Table (3): Extensograph pattern of wheat, triticale and its mixtures.

Parameter	Wheat		Triticale			Mixtures		
	Giza 157	Sakha 69	I	II	III	A	B	C
Dough extensability (m.m)	192	186	150	112	152	185	176	189
Resistance to extensability (B.U)	260	400	300	125	295	270	180	195
Dough energy $(Cm)^2$	77.0	119.2	62.8	18.4	43.0	72.1	41.5	61.6
Proportion number R/E	1.35	2.15	2.0	1.12	1.94	1.46	1.02	1.03

Triticale
I = B-270
II = B-2376-298-0M
III = B-S_2-0AF-3

Mixtures
A = 65% Sakha 69+35% B-270
B = 65% Sakha 69+35% B-2376-298-0M
C = 65% Sakha 69+35% B-S_2-0AF-3.

Triticale was characterized by lower extensability, especially line II, compared with wheat. Meantime, resistance to extensability was notably high in Triticale I and III although it was lower than that of Sakha 69. Accordingly, the proportional number was higher in the first and third line. These results may be attributed to the low quantity and quality of Triticale gluten. Regarding mixtures, extensability increased and resistance to extensability decreased especially in mixture C and to some extent in mixture A. Mixture B was characterized by improved extensability and resistance to extensability. In common, Triticale I and its mixture had the best values for most extensograph parameters compared to wheat since mixing Tricale with wheat flours improves Triticale gluten (Unrau and Jenkins,1964).

Baking and organoleptic qualities of produced bread:

The results concerning the quality of the produced bread are shown in Table (4). Triticale flours were unsuitable for bread making. Triticale bread had a broken top and pale crust, this may be because fermentation time is shorter compared with wheat. Prolonged fermentation deleteriously affected Triticale dough. It could readily rupture the weak dough structure during baking as mentioned by Tsen et al. (1973). Also during fermentation, Triticale dough provides the yeast with many nutrients,

including sugars and soluble nitrogenous compounds to boost the yeast activity. The formentation differences between Triticale and wheat flour doughs may result from tne higher activity of amylases and proteases more soluble proteins in Triticale flour (Chen and Bushuk, 1970).

Table (4): Quality of bread produced from wheat, triticale and its mixture according to Fance and Wragg(1968).

Bread	Maximum number 10	Sakha 69	Triticale			Mixture		
			I	II	III	A	B	C
Weight gm	-	89.69	86.72	85.92	86.55	87.05	86.96	88.31
Volume cm^3	-	235	250	200	245	275	245	270
Moisture %	-	41.58	37.60	34.50	35.00	38.67	37.82	35.36
General appearance	10	9	6	3	5	8	5	6
Quality of Crust	10	9	4	2	4	7	5	5
Color of Crumb	10	9	5	5	5	7	6	7
Flavor	10	9	5	5	5	6	6	6
Crumb structure	10	9	5	3	5	7	5	6
Elasticity of crumb	10	9	6	2	5	8	4	7

Triticale

I : B-270
II : B-2376-298-0M
III : $B-S_2$-0AF-3

Mixtures

A: 65% Sakha 69+35% B-270
B: 65% Sakha 69+35% B-2376-298-0M
C: 65% Sakha 69+35% $B-S_2$-0AF-3

Mixing Triticale with wheat flour improved the baking quality of the produced bread specially mixture A which was characterized by higher gluten and lower α-amylase activity followed by mixture C. The obtained results indicate that all the mixtures had lesser scores than wheat bread.

'Such results are in agreement with those of Tsen et al., (1973).

As a general conclusion it can be said that for the baking quality improvement of triticale flower in tne supplement of this flour with wheat flour.

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دراسات كيميائية وحسية عن صفات الخبز الناتج من دقيق الترتيكال والقمح

نادية يحيى عطيه – عبد الخالق ربيع عبد المجيد خليل – قسم الاراضى كلية زراعة مشتهر جامعة الزقازيق

أجرى هذا البحث بغرض دراسة صفات العجين وسلوكه اثناء الخبيز لثلاثه سلالات من الترتيكال وصنفين من القمح وثلاثة مخاليط ترتيكال وقمح .

تميز دقيق الترتيكال بارتفاع محتواه من البروتين الكلى والسكريات الكلية ونشاط انزيم الالفا أميليز بالمقارنه بدقيق القمح .

بالنسبة لصفات العجين : تميز الترتيكال بسرعة تكوين العجين مع قلة فترة الثبات مما يؤكد نقص وقلة كفاءة جلوتين الترتيكال لتكوين العجين بالنسبه لدقيق القمح . عند خلط دقيق الترتيكال مع دقيق القمح تحسنت صفات العجين مقارنه بعجين الترتيكال .

اختبار الاكسنسوجراف ، أظهرت النتائج بوجه عام أن عجينه دقيق الترتيكال أقل انسيابيه من عجينه القمح كما تميزت سلالتين من سلالات الترتيكال بمقاومة عالية للشد عند الخلط تحسنت الانسيابية وانخفضت المقاومة للشد الى حد ما .

تميز الخبز الناتج من الترتيكال بتشقق السطح الخارجى وصفات جوده عموما أقل من الخبز المنتج من القمح وأنه بخلط دقيق الترتيكال مع دقيق القمح تحسنت صفات الخبز