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EGYPTIAN BALADY BREAD AND BISCUIT QUALITY OF WHEAT AND TRITICALE FLOUR BLENDS

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Triticale flour was evaluated as a partial substitute for wheat flour in Egyptian balady bread and biscuit production. Effects of chemical, rheological and baking properties of wheat and triticale flours on bread and biscuit quality were examined. Wheat flour was partially replaced by triticale flour at ratios of 20, 30, 40, and 50%. Water absorption, mixing tolerance index and dough weakening increased but dough development time and stability decreased by increasing the level of triticale flour. The substitution of wheat flour with triticale at different levels minimized extensibility and dough energy. Triticale flour had a lower falling number than wheat flour, indicating higher amylase activity. Baking properties and sensory evaluation tests showed that 50% of wheat flour could be replaced with triticale flour still providing a good quality of Egyptian balady bread and biscuits. Alkaline water retention capacity as an indicator for staling test revealed that wheat bread was better than wheat-triticale bread regarding freshness.

INTRODUCTION

In Egypt, the total yield of bread grains does not satisfy the needs of the country. The total production of wheat grains covers only about 55% of the total needs. The way to overcome this problem is to search for the native cereal sources which could be used with wheat flour breadmaking.

Triticale (*triticosecale wittmack*) is the first man-made cereal produced by crossing wheat (*Triticum spp*.) and rye (*Secale cereal L*.). The future of this crop is bright because it is environmentally more flexible than other cereals and shows better tolerance to diseases, drought, and pests than its parental species [Darvey *et al*., 2000]. Triticale world production has steadily increased during the past 20 years. Global production in 1980, 1990 and 2000 was estimated in 1.29, 5.44 and 9.6 million metric tons, respectively. Interestingly, average yield improved from 1980 to 2000 from 2.02 to 3.5 tons/ha. In 2002, 3 million hectares were harvested, yielding a total production of 10.3 million metric tons [FAO, 2003]. According to Serna-Saldiver *et al*. [2004], the price of triticale is lower than that of wheat.

From the nutritional point of view, triticale has valuable dietary characteristics such as higher amounts of soluble dietary fiber and better total amino acid composition, in particular higher lysine as compared to wheat [Morey & Evans, 1983; Varughese *et al.,* 1996]. Triticale has been reported to contain 10.2–13.5, 53.0–63.0, 2.3–3.0, 1.1–1.9, 4.3–7.6 and 1.8–2.9%, protein, starch, crude fiber, ether extract, sugars and ash, respectively [Heger & Eggum, 1991].

Satisfactory bread can be produced from triticale by the straight dough-baking method with the appropriate adjustments in water absorption, dough mixing and fermentation time [Beaux & Martin, 1985]. In order to create a wheat-like dough desired viscoelastic properties, the mixing speed, fermentation time, and temperature, final proofing, and time between mixing and first punch must be decreased to compensate for triticale's weak dough strength [Skovmand *et al.,* 1991]. Acceptable breads could be produced using a 1:1 mixture of wheat and triticale flour [Pena & Amaya, 1992].

In Egypt, as well as the Middle East, the most popular type of bread is a flat (balady bread), circular loaf (1 cm thickness, 10 to 30 cm diameter) consisting of two layers. It is commonly made from high extraction flour (82%) and prepared by a straight dough method [Mousa *et al*., 1979]. Balady bread dough is softer (70–75% water), fermented to 2 h and baked at a substantially higher temperature (400–500°C) for 1–2 min.

The present study was designed to evaluate the suitability of partially replacing wheat flour using triticale flour in Egyptian balady breadmaking and biscuit manufacture.

MATERIAL AND METHODS

Materials. Wheat flours (72% for biscuit manufacture and 82% for balady breadmaking) were obtained from North Cairo Flour Mills Company, Egypt. New cultivar of triticale (under registration?) has spike length of 10.33 cm, No of spikes/m^2 340, No. of Grain/Spike 19.67, Grain yield g/m^2 638.4, Grain yield Kg/Fed. 2681.28 and Seed index 4.15, developed at Nobaria experimental station, Egypt during three sessions (2002–2004), under supervision of field crops production, National Research Center through the cooperation with ICARDA and SRMYT projects.

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Preparation of triticale flour. Triticale grains were cleaned, tempered to 15% moisture content, milled using Quadrumat Junior flour mill and sieved to obtain 72% extraction flour.

Preparation of flour blends. Wheat flour (72 or 82% extraction) was well blended with triticale flour to produce individual mixtures containing 20, 30, 40 and 50% replacement levels. All samples were stored in airtight containers and kept at 5–7°C until required.

Rheological properties. Rheological properties of doughs were evaluated using farinograph and extensograph according to AACC methods No. 54-10 and 54-21 [2000], respectively.

Falling number test was carried out according to AACC method No. 56-81B [2000].

Preparation and evaluation of balady bread. Balady bread was prepared by mixing 100 g of wheat flour (82% extraction)/triticale flour blends, 0.5 g of active dry yeast, 1.5 g of sodium chloride, and 75–80 mL of water by hand for about 6 min to form the needed dough. The dough was left to ferment for 1 h at 30°C and 85% relative humidity and was then divided into 125 g pieces. The pieces were arranged on a wooden board that had been sprinkled with a fine layer of bran and were left to ferment for about 45 min at the same temperature and relative humidity. The pieces of fermented dough were flattened to be about 20 cm in diameter. The flattened loaves were proofed at 30–35°C and 85% relative humidity for 15 min and then were baked at 400–500°C for 1–2 min. The loaves of bread were allowed to cool on racks for about 1 h before evaluation. Balady bread loaves were evaluated organoleptically by 15 trained panelists according to El-Farra *et al*. [1982]. The tested characteristics were general appearance (20), separation of layers (20), roundness (15), distribution of crumb (15), crust colour (10), taste (10) and odour (10).

Freshness of bread. Balady bread loaves freshness was tested after wrapping using polyethylene bags and storage at room temperature (1, 3 and 5 days) using Alkaline Water Retention Capacity test (AWRC) according to the method of Yamazaki [1953], as modified by Kitterman & Rubenthaler [1971].

Preparation and evaluation of biscuits. Biscuits were prepared by mixing 100 g of wheat flour 72% extraction and triticale flour blends, 57.77 g of sugar, 28.44 g of shortening, 0.93 g of salt, 1.11 g of sodium bicarbonate, 7.1 mL of water and 14.66 mL of a dextrose solution (5.93%) according to the procedure No(10–50D) described in AACC [2000]. Shortening, sugar and salt were creamed in a Hobart mixer for 2 min to which a mixed flour blend containing dextrose, sodium and ammonium bicarbonate was added and then mixed for further 2 min. Using a wooden rolling pin, the dough was sheeted on an aluminum platform to a uniform thickness of 1 mm. Circular sheeted dough 6.0 cm in diameter was cut and baked at 210°C for 12–15 min. After removal from the oven, the biscuits were allowed to cool for 5 min on the biscuits sheet and were then transferred from the sheet to racks and cooled additionally for 30 min before being bagged in polyethylene and held at room temperature for evaluation.

Weight, volume, specific volume, diameter, thickness and spread ratio of biscuits were recorded. Organoleptic characteristics of biscuits were evaluated with some modifications, according to Zabik & Hoojjat [1984] by 15 trained panelists. The tested characteristics were shape (10), surface color (10), surface characteristics (10), distribution of cell (10), texture (20), mouthfeel (20) and flavour (20).

Chemical analysis. Moisture, ash, protein and fat were determined according to the methods No. 925.10, 923.03, 920.87 and 920.85 respectively as described by AOAC [1990].

Statistical analysis. The results of organoleptic evaluations were evaluated by an analysis of variance and least significant difference (LSD) was calculated according to McClave & Benson [1991].

RESULTS AND DISCUSSION

Chemical composition of wheat and triticale flours

There were slight differences in the approximate chemical composition between wheat and triticale flour (Table 1). This wheat-like composition of triticale is more likely due to the fact that triticale receives two genomes from wheat and only one from rye. Serna-Saldiver *et al*. [2004] reported that refined flour from wheat contained 1.7% more protein, 0.1% less ash, and 0.5% less ether extract than triticale flour. According to Tsen *et al*. [1973] and Darvey *et al*. [2000], the protein and ash contents of triticale are usually higher than those of wheat flour.

Regarding the falling number, wheat flour had a higher falling number (262 s) than triticale flour (170 s), indicating lower amylase activity (Table 1), consequently, addition of triticale flour to wheat flour increased the amylolytic activity of the produced dough. Leon *et al.* [1996] reported falling number values of 62–134 s for 10 different triticale flours. Low values of falling numbers compared with rye characteristics imply a high α-amylase activity [Darvey *et al.,* 2000; Serna-Saldiver *et al.,* 2004].

TABLE 1. Chemical composition (% on dry weight basis) and falling number of wheat and triticale flours*.

Sample	Moisture	Protein (N×5.7)	Fat	Ash	Falling number (sec)
Wheat flour (72%)	11.59	10.86	1.56	0.60	262
Wheat flour (82%)	12.77	11.23	1.77	0.96	285
Triticale flour (72%)	10.02	9.37	1.19	0.75	170

* Each value is an average of at least of three determinations

Rheological properties of doughs

The effect of replacing wheat flour with triticale flour on the farinograph test is presented in Table 2. The triticale dough developed rapidly with a low stability towards mixing, indicating deficient gluten quantity and quality.

TABLE 2. Farinograph characteristics of wheat and triticale flour blends.

Sample	Water absorption (%)	Dough development time (min)	Dough stability (min)	Mixing tolerance index (BU)	Dough weakening (BU)
Wheat flour (control)	64.0	3.8	7.0	80.0	82.0
80% WF* +20%TF**	64.5	3.5	4.8	85.0	110.0
70% WF +30%TF	64.7	3.0	4.0	92.0	120.0
60% WF +40%TF	65.0	2.2	3.3	110.0	125.0
50% WF +50%TF	65.0	2.0	3.0	115.0	130.0

*WF= wheat flour; **TF= triticale flour

Water absorption, mixing tolerance index and dough weakening increased and dough development time and stability decreased by increasing the level of triticale flour. Minimized dough stability may be related to partial breakdown of dough proteins and starch as a result of the action of proteolytic and amylolytic enzymes in triticale flour. The increasing water absorption might be due to that triticale flour contains more fiber and pentosans, which retained more water. Similar findings were observed by Ragaee *et al.* [2001] and Doxastakis *et al*. [2002].

The triticale extensogram indicated that the dough was softer and weaker than that made of wheat (Table 3). Triticale flour has less extensibility and dough energy than wheat flour dough. The substitution of wheat flour with triticale flour at different levels minimized extensibility and dough energy. This decrement may be due to the deficiency of gliadin and glutenin in triticale protein. The proportional number increased as the percentage of triticale flour increased. Such findings were observed by Naeem *et al.* [2002].

TABLE 3. Extensograph characteristics of wheat and triticale flour blends.

Sample	Dough extensibility (mm)	Resistance to extension (BU)	Dough energy (cm^2)	Proportional number R/E*
Wheat flour (control)	160	185	50	1.16
80% WF** +20%TF***	140	190	43	1.36
70% WF +30%TF	115	195	40	1.70
60% WF +40%TF	110	200	42	1.82
50% WF +50%TF	105	200	42	1.90

* Resistance to extension/ extensibility; **WF=wheat flour; ***TF=triticale flour

Effect of triticale flour on balady bread quality

Panelists liked all tested balady bread because of better general appearance and crust colour. That effect may be related to the Maillard reaction that proceeded due to the interactions between librated amino acids and reducing sugars as a result of higher action of proteolytic and amylolytic enzymes in triticale, respectively (Table 4). Hence, the general appearance, crust colour and taste of the breads containing 50% triticale flour were higher than those of the control bread by 32, 26 and 13%, respectively, as revealed in sensory evaluation data.

As above-mentioned results, wheat flour could be replaced up to 50% using triticale flour without drastically affecting bread quality. Such findings were observed by Pena & Amaya [1993], Doxastakis *et al.* [2002] and Naeem *et al.* [2002], according to whom acceptable pan bread can be produced using 1:1 wheat and triricale flour blend.

Freshness of balady bread

The changes occurring in freshness characteristics of balady bread stored for 1, 3 and 5 days at room temperature are shown in Table 5. It could be observed that the control bread sample had the highest values of alkaline water retention capacity, being 340, 280 and 220% at 1, 3 and 5 days of storage, respectively. However, addition of triticale flour to wheat flour caused a noticeable decrease in alkaline water retention capacity values at 1, 3 and 5 days storage compared with the control. Such an effect might be related to the difference in the quantitative distribution of protein fractions and physicochemical properties of starch of wheat and triticale. Such limited information is no sufficient to explain staling. Further research is needed to elucidate why triticale bread stales much faster than wheat bread [Tsen *et al.,* 1973].

TABLE 4. Statistical analysis of sensory evaluation of balady bread as affected by triticale flour (mean values).

Characteristics*	Control	Triticale flour (%)				LSD 0.05
		20	30	40	50	
General appearance (20)	12.85^{b}	13.70^{b}	14.30^{b}	16.90^{a}	16.95^{a}	1.69
Separation of layers (20)	17.75^{a}	14.00^{b}	16.25^{b}	17.75^{a}	17.00^{a}	1.65
Roundness (15)	11.60^{c}	12.00^{bc}	11.25^{c}	13.75^{a}	12.95^{ab}	1.19
Distribution of crumb (15)	11.45^{b}	11.55^{b}	11.60^{b}	13.10^{a}	12.70^{ab}	1.29
Crust colour (10)	6.70^{b}	7.10^{b}	6.95^{b}	8.60^{a}	8.45^{a}	0.76
Taste (10)	7.60^{b}	7.60^{b}	7.70^{b}	8.50^{a}	8.60^{a}	0.79
Odour (10)	8.20	8.30	7.75	8.35	8.70	NS**

Any two values not followed by the same letters are significantly different at 5% level. * Score system, according to El-Farra *et al.* [1982]; ** Not significant (*p* 0.05)

TABLE 5. Freshness properties of balady bread stored at room temperature as determined by alkaline water retention capacity (%).

Sample	Storage period		
	1 day	3 days	5 days
Control bread	340	280	220
80% WF* +20%TF**	320	260	200
70% WF +30%TF	280	240	190
60% WF +40%TF	250	220	180
50% WF +50%TF	250	220	180

*WF=wheat flour, **TF= triticale flour

Effect of triticale flour on biscuit quality:

Effect of triticale flour on biscuit quality is shown Table 6. It is evident that the volume, specific volume and thickness of biscuits prepared by incorporating triticale flour up to 50% level were lower than in the control sample. A slight increase in spread ratio of supplemented samples occurred after baking at all replacement levels, when compared with the control sample. The improvement in spread ratio of biscuit was 7.33% when triticale flour was used at 30 or 40% replacement level. This means that the presence of triticale flour results in weaker dough which is more suitable for biscuit manufacture. Several authors have found a negative correlation between cookie diameter and protein content of flour [Abboud *et al*., 1985; Gaines 1991; Kaldy *et al.,* 1993; Leon *et al*., 1996]. The lower the protein content of flour, the better the quality of the cookies obtained. Saxena *et al* [1992] reported that cookies prepared from soft and medium triticale flours had a significantly higher spread ratio than those prepared from hard triticale flour.

TABLE 6. Baking quality of biscuit as affected by triticale flour.

Measurements	Control	Triticale flour (%)			
		20	30	40	50
Weight (g)	26.35	26.44	26.84	26.09	25.07
Volume (cc)	43.75	41.80	40.75	39.00	35.00
Specific volume (cc/g)	1.66	1.58	1.52	1.49	1.40
Diameter (cm)	7.55	7.45	7.20	7.20	7.05
Thickness (cm)	1.35	1.25	1.20	1.20	1.20
Spread ratio	5.59	5.96	6.00	6.00	5.88
Spread ratio (± %)	0.00	+6.62	+7.33	+7.33	+5.19

With respect to the sensory evaluation, the organoleptic characteristics of biscuit samples made from wheat flour and different levels of triticale flour are summarized in Table 7. There was no significant difference in all sensory properties of biscuit except mouthfeel score between the control sample and those blends which contained triticale flour up to 50%. Biscuits prepared with triticale flour at any addition level received a significantly higher score for mouthfeel, with the highest acceptability. The results obtained indicated that triticale flour could constitute a good alternative for biscuits manufacture. Such results were obtained by Perez *et al*. [2003]. Triticale flours are suitable for cookie manufacture, best quality is related to flours exhibiting low protein content, high prolamine percentage with a high proportion of species with a molecular mass of approximately 34 KDa, low glutenin content with a low proportion of species with a molecular mass >30 KDa, and low content of free sulfhydryl groups [Leon *et al*., 1996].

CONCLUSION

The results obtained indicated that triticale flour may be blended with wheat flour at levels as high as 50% without adversely affecting baking performance of balady bread or biscuits.

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TABLE 7. Statistical analysis of sensory evaluation of biscuit as affected by triticale flour (mean values).

Characteristics*	Control	Triticale flour (%)				LSD 0.05
		20	30	40	50	
Shape (10)	7.76	7.35	7.70	7.76	7.70	NS**
Surface colour (10)	8.23	7.52	7.82	7.94	7.64	NS
Surface characteristics(10)	7.52	6.94	7.64	7.64	7.35	NS
Distribution of cell (10)	7.17	7.05	7.11	7.35	7.52	NS
Texture (20)	15.11	15.05	15.11	15.17	15.70	NS
Mouthfeel (20)	15.23^{b}	15.29^{b}	15.64^{b}	16.29^{ab}	17.17^{a}	1.33
Flavour (20)	15.47	15.29	14.94	16.11	17.00	NS

*Score system; according to Zabik & Hoojjat [1984]; ** Not significant (*P 0.05*)

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