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Production of Balady Bread from Wheat Flour and Different Ratio of Durum Flour (by - product)

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ABSTRACT

Balady bread is the main food item consumed in Egypt. In the present study, the wheat flour 87.5 % extraction rate (which is used in balady bread) was substituted with by-product from durum flour at levels 20, 30, and 40% to utilize in balady bread production. Rheological properties, chemical composition, and sensory properties of the manufactured balady bread were evaluated. The results of the Mixolab data showed that adding more durum flour produces a gradual increase in water absorption, dough development time, and stability time. Regarding the chemical composition of balady bread, it was noticed that the protein increased in the balady bread product formulae when the level substitution of durum flour was increased. Sensory evaluation indicated that, at durum flour replacement levels of 20, 30, and 40%, no significant variations were seen between the control sample and the balady bread samples. Alkaline water retention capacity (freshness) revealed that balady bread blends were better than bread control. All of the balady bread blends' freshness declined with time, as did the bread control when compared to the zero-time period. Substitution of balady bread with durum flour decreased the balady bread cost. It might be suggested that Egyptian balady bread made from wheat flour and up to 40% durum flour can be manufactured with low cost and high acceptance ratings.

Keywords: Balady bread, Mixolab, wheat flour, durum flour, freshness.

1. Introduction

In many countries, bread is a basic and staple diet that gives people energy and nutrients. Most places in the world make flatbreads. Tortilla, chapatti, pita, balady, and barbari bread are a few examples. Different flatbread types have different characteristics (Shaban *et al.,* 2020). The quality factors associated with the chosen raw material only have a partial influence on the bread's quality. The qualities of flour, the quality of the wheat, and the baking techniques used are just a few of the numerous variables that affect the complicated concept of bread quality. The primary component of a recipe for flatbread, flour influences the texture and sense of aspects of the baked good (Mondal and Datta, 2008).

The most common kind of bread in Egypt is called balady bread, since 90% of Egyptian families consume the subsidized balady bread in their daily meal (Sarhan *et al.,* 2010). The daily production of balady bread in Egypt reaches 240 million loaves with an average of about 3 loaves per capita a day (Lahham *et al.,* 2013). Balady bread loaf is made up of two separate layers and has a circular form with an average diameter of 20 cm and thickness of 1 cm. It is often created using a straight dough process with high-extraction flour (82%) as the primary ingredient. With 70–75% water, the dough is more soft is allowed to ferment for two hours before being baked for 1-2 minutes at a temperature that is much higher (400 to 500 degrees Celsius) (Yaseen *et al.,* 2007). Because of the higher moisture content of balady bread, the durability period of the produced bread doesn't exceed three days when it is packaged stored under ambient conditions (EOSQ, 1994).

Wheat flour is traditionally used to make bread in Egypt. Approximately half of the required wheat is imported due to excessive demand. Due to the country's incapacity to maintain its import of wheat for the production of wheat-based goods, some wheat alternatives must be used while baking

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bread. Making bread with a different type of flour was first introduced many years ago. (Ahmed *et al.,* 2020)

Removing the bran and grinding the endosperm into tiny, fine grains are the two main objectives of milling wheat (Tawfeuk and Gomaa, 2017). During the break stage of milling common wheat, coarse farina (CF) is produced, and during the size stage it is decreased. The granular starch material known as farina is created during the milling or extrusion process (Korompokis *et al.,* 2021). Wheat can be broadly classified into two groups based on its various raw materials: semolina, which is primarily manufactured from durum wheat, and wheat farina, which is primarily made from common wheat. (*Triticum Turgidum* L. var. durum Desf.) (Zhou *et al.,* 2023). The percentage of flour that comes from the size and reduction processes can be 30% and 40%, respectively. The mechanical characteristics of the endosperm, which determine the ability to decompose finely ground flour particles, are linked to the kinetics of durum flour reduction (Greffeuille *et al.,* 2007).

In wheat bread recipes, intact or broken wheat kernels with intact cell clusters can be utilized to reduce the digestion of starch, however the resulting bread crumb is very dense Zhou *et al.* (2023) produced noodles different particle size durum flour. They found that the amount of protein and starch, the sedimentation value and the glutenin swelling index both experienced a significant decline. as durum flour particle size (150–800 µm) increased, while dietary fiber content sharply increased. Additionally, the dough's water absorption, stability, and extensibility declined while its resistance to extension and thermal stability increased. The aim of this work to evaluate the quality of adding durum flour of wheat flour 87.5 % to improve its staling properties and nutritional values.

2. Materials and Methods

Materials

Wheat flour (87.5 % extract) had been obtained from Ministry of Supply and Internal Trading Egyptian.

Durum flour (by-product) production was obtained from Regina Company for Pasta and Food Industries, Sadat City, Menoufia, Egypt. Dry yeast and salt were coming from a local market, Giza, Egypt.

Methods

Balady bread preparation

Table (1) shows the balady bread formulations. Balady bread was produced in line with the procedure outlined by **Sallam *et al.* (1995).**

Table 1: Formulae of balady breads

Ingredients	Bread samples			
	Control	T_1	T_2	T_3
Wheat flour 87.5% ext.(WF)	100	80	70	60
Durum flour	--	20	30	40

To make balady bread, 100 grams of wheat flour 87.5% extraction (WF) were combined with durum flour at levels of 20, 30 and 40% separately, 0.5 g of dried active yeast, 0.75 g of salt, were added per 100 g, respectively. Balady bread was prepared in the Food Technology Research Institute's experimental bakery.

Chemical Composition

Moisture, protein, crude fiber, fat and ash content were assessed according to the method described in A.O.A.C. (2010). Total carbohydrate content was calculated by difference on dry weight basis.

Total Energy were computed use the equation formula that by FAO (1982). Where:

$$\text{Total energy (k. cal /100 g)} = 4\ (\text{carbohydrate\%} + \text{protein \%}) + 9\ (\text{fat\%}).$$

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Rheological properties

Using a Mixolab analyzer, the rheological characteristics of each flour sample were examined in accordance with the ICC Standard procedure 173 (ICC 2006). The torque (Nm) obtained as the dough moves between two blades for mixing and mixing blends and is subjected to changes in temperature and mixing stress can be continuously measured by this instrument, providing specific information on the behavior of the ingredients in dough (water, protein, and starch). To conduct the test, a consistent dough sample must be prepared.

The following were determined: gluten index (GI), dry gluten (DG), wet gluten (WG), and falling number (FN) for each sample using standard methods of A.A.C.C. (2010).

Water Activity

The Water Activity (aw) was determined using a rotronic Hygro Lab EA10-SCS (Switzerland) aw meter as described by Czuchajowska *et al.* (1989). All measurements were conducted in triplicate.

Determination of bread freshness

Freshness of bread (fresh and/or stored for 1, 2, and 3 days) at room temperature, was assessed by determination of Alkaline Water Retention Capacity (ARWC) and Staling rate (SR) using two calculation equation by using TPA parameter, according to A new methodology of Abd-El-Khalek *et al.* (2019).

"AWRC%, the equation is "267.87202 – (12.75744 DAY) – (0.78029 Moist) + (0.081151 HRD) – (0.32979 ADH) + (56.71653 COH) – (0.12323 CHW)".
"SR% = 3.08970 + (6.19603 DAY) + (0.042659 Moist) - (0.023519 HRD) - (0.21145 ADH) - (4.44416 COH) + (0.00938 CHW) is the calculation."
DAY: storage period in the case of AWRC, (0, 1, 2, or 3), and (1, 2 or 3) in the case of SR, Moist: Moisture content (%), HRD: Hardness (N). Adhesiveness, or ADH (m J), CHW: chewiness (m J), COH: Cohesiveness.

Determination of Texture Profile Analysis

The A.A.C.C. (2010) method was followed for the purpose of conducting Texture Profile Analysis (TPA) using the Brookfield CT3 instrument (The address is Brookfield Engineering Laboratories, Inc., MA 02346-1031, USA). Use of a small-scale holder TA-JPA fixture to punch through bread samples with a maximum 12.7 mm diameter probe allowed for the modification of the procedure for use with flat bread. Before the testing, the bread loaves were cut into four pieces with care, every of which was utilized on one of the three trial days (0, 1, 2, or 3 days). The quarter(s) were stored in polyethylene bags for testing on subsequent days. Every bread quarter had two sites of penetration, avoiding non-representative regions". The test conditions that were employed were as follows:" 8.0 mm is the target, 1.50 N" is the trigger load, Test qualities, as outlined in the operating instruction booklet, were ascertained, including cohesiveness, adhesiveness, resilience, springiness, gumminess, chewiness; and hardness (average of two cycles).

Physical properties of balady bread

The weight, size, and specific loaf weight were used to assess the bread's qualities 30 minutes after it was taken out of the oven (A.A.C.C. 2010).

Sensory evaluation of bread

Ten panelists from the Bread and Pastry Research Department of the Food Technology Research Institute's Agric Research Center evaluated each sample. The sensory evaluation of the balady bread loaves focused on their general appearance, layer separation, crumb texture, crust color, taste and flavor were determined according to Sallam *et al.* (1995).

Statistical Analysis

The procedure described by McClave and Benson (1991) was used for statistically analyzing the data using variance and, at the 0.05 levels, the least significant difference (L.S.D.).

3. Results and Discussion

3.1. Chemical analysis of raw materials and its blends

Data presented in Table (2), showed the chemical analysis for raw materials and its flour blends used in the preparation of balady bread. It could be demonstrated that durum flour contained the highest protein content (13.54%) whereas it was the lowest values in crude fiber, fat and total carbohydrate (0.74, 0.89 and 84.62%, respectively) compared with wheat flour 87.5 % and other blends. These results agree with those reported by Barkat *et al.* (2013). They reported the content of wheat flour 87.5 % extraction rate was as follow: protein 13%; ash 1.1% and total dietary fiber 11.1%. Scanlon *et al.* (1988) found that the durum flour has a protein level ranging from 12.0 to 12.5%.

Table 2: Chemical analysis of raw materials and its blends (%on dry weight basis).

Components (%)	Raw materials		Blends			
	Durum flour	Wheat flour (87.5% extr.)	T_1 (20% durum flour)	T_2 (30% durum flour)	T3 (40% durum flour)	L.S.D.
Moisture	12.56	13.28	13.12	13.08	13..03	0.250
Protein	13.54	12.40	12.63	12.74	12.86	0.397
Ash	0.95	1.09	1.01	0.94	0.91	0.066
Crude fiber	0.74	0.99	0.89	0.86	0.84	0.084
Fat	0.89	1.03	0.98	0.96	0.95	0.321
Total Carbohydrate	84.62	85.48	85.38	85.36	85.28	0.319

Rheological properties of dough

The obtained data in Table (3) indicated that water absorption (wa) was aligned 53.0, 54.3, 55.6 and 57.0 % corresponding to the flour control and blends 20, 30 and 40% durum flour, respectively. This resulted may be attributed the durum flour had high value of wet gluten and gluten index compared with wheat flour (control). Stronger flours require more mixing time than control flour, and mixing time is a good indicator of protein quality. The torque at C1, indicating the maximum dough consistency and flour water absorption, ranged from 1.1 to 1.8 Nm.

Table 3: Mixolab test of wheat flour (87.5% ext.) with different levels of durum flour

Mixolab parameters	Durum flour	Wheat flour with different levels of durum flour			
		Control	20%	30%	40%
Water absorption (%)	57.6	53.0	54.3	55.6	57.0
Dough development time (min)	1.8	1.1	1.4	1.5	1.7
Stability time (min)	9.9	4.25	6.33	8.97	9.83
Torque C1 (Nm)	1.16	1.19	1.19	1.14	1.09
Torque C 2 (Nm)	0.50	0.44	0.46	0.47	0.48
Protein weakening (Nm) (C1-C2).	0.66	0.75	0. 73	0.67	0.61
Torque C3 rate of starch gelatinization (Nm)	1.93	2.31	1.97	1.96	2.04
C3 temperature dough (°C)	81.2	84.8	78.6	83.2	84.9
C4 (Nm) hot gel Stability	2.08	2.05	2.00	1 .91	1.86
C4 temperature dough (°C)	87.6	87.3	86.2	85.7	86.0
C5 (Nm) Starch retrogradation	3.69	3.81	3.80	2.97	3.54
C5 temperature dough (°C)	55.4	56.0	55.4	54.0	56.1
Gelatinization temperature (°C)	67	68	67	67	67

The dough's weakening due to the decrease in protein is measured by C2. The dough was exposed to mechanical and thermal stress, resulting in minimum torque values of 0.44, 0.46, and 0.47 Nm for control, 20 and 30%, and maximum torque values of 0.48 Nm in 40% of the dough samples. The other results, for blend 40% and the control sample, varied from 0.61 to 0.75 Nm, which corresponded to the protein weakening percentage (C1-C2) of the blends. The highest value at C3 (Rate of starch gelatinization) point was noticed in control for (2.31 Nm), while the lowest value was found in blend 20% (1.97 Nm). This may be described by the blend's lipid and protein content. An indication of starch gelatinization during heating is C3 (Hadnadev *et al.,* 2011; Moza and Gujral, 2018). Rosell and colleagues, (2010) demonstrated that the presence of water in the medium and fiber was the primary variable influencing the behavior of starch swelling and gelatinization influenced the starch association's pasting and gelling characteristics in the dough matrix, which had a significant effect on the structure and behavior of the dough during the cooling and heating processes. An indication of enzymatic hydrolysis and hot gel stability is the torque at C4 (Awolu, 2017 and Elemo *et al*., 2017). The most stable hot gel was indicated by durum flour, which had the maximum value of 2.08 Nm. The last stage (C5) describes how the product's shelf life will be stable and indicates the retrograding of starch throughout the cooling phase. In this concern, (Rosell *et al*., 2010; Moza and Gujral, 2018) reported that as a result of amylose chains recrystallizing upon cooling, starch gels with soluble fiber's beneficial effects on delayed starch retrogradation were created. Soluble fibers can keep the system hydrated by absorbing water, which could cause a delay.

Gluten content

One of the main factors influencing wheat flour's strength and quality in baking is its gluten concentration. The technological quality of wheat flour (87.5% extr.) with varying amounts of durum flour was assessed by measuring the amount of gluten and falling number. The data in Table (4) showed that used in this study showed low wet and dry gluten content of 25.43 and 8.44%., respectively. The addition of durum flour to wheat flour caused increase in the amount of wet gluten, dry gluten and falling number. Differences in the falling number and gluten content of wheat flour and blends are reflected in difference in protein content. These results may be attributed to durum flour (by-product of milling hard wheat) so that has high content of protein. This result agrees with that reported by Sissons (2008) who reported that the durum flour has high value of wet gluten and falling number compared with soft wheat flour. Greffeuille *et al.* (2007) found that the bread with durum wheat has high falling number compared with wheat flour.

Table 4: Gluten content and the falling number of wheat flour (87.5 % extract) with different levels of durum flour.

Properties	Raw materials		Blends		
	Durum flour	Wheat flour (87.5 %ext.)	20%	30%	40%
Falling number (sec.)	439	399	410	418	423
Wet gluten%	28.19	25.43	26.31	26.92	27.12
Dry gluten %	9.17	8.44	8.57	8.69	8.86
Gluten index%	91.93	83.97	85.17	86.44	87.16

Chemical analysis of the produced balady bread

Data from Table (5) showed that the maximum value of protein content was 40% durum flour followed by 30% and 20%. It ranged from 13.75 to 12.80 % while, the energy value was 401.35 kcal /100g in control. The protein content of control balady bread was 12.64%. The slightly increase of protein content can be attributed to the durum flour having high protein content 13.54 %. The ash, crude fiber and fat content of balady studied were slightly decreased with the increase in substitution present with durum flour (20, 30 and 40 %). This result matches up with the study results of Maleki *et al.* (1980), who reported that the total carbohydrate of balady bread ranged from 86.11 to 85.53%.

Table 5: Chemical analysis of produced balady bread with different levels of durum flour (% on dry weight basis).

Components (%)	Balady bread from wheat flour and its blends				
	Control	20%	30%	40%	L.S.D
Moisture	37.21	36.45	36.27	36.34	0.546
Protein	12.64	12.80	13.34	13.75	0.460
Ash	1.05	1.01	0.99	0.97	0.143
Crude fiber	1.02	0.98	0.94	0.91	0.235
Fat	1.11	1.02	0.97	0.95	0.427
Total Carbohydrate	85.20	85.12	84.70	84.33	0.365
Energy value (k.cal./ 100g)	401.35	400.86	400.89	400.87	0.216

Physical properties of balady bread

Data in Table (6) illustrated the physical properties of studied balady bread. The range of water activity content was 0.89 to 0.91. In the control, the water activity was 0.89, both parameters reduced with replacement in loaves of (20 and 40%) (El-Fadaly, 2015).

The ascending order for layer separation characteristics of balady bread were WF (control) 75.94%, followed by 20, 30 and 40% durum flour. This result attributed to different properties of starch granules and fiber contents of studied cereals.

Table 6: Physical properties for studied balady bread formula.

Samples	Water activity (zero time)	Balady bread weight (g)			
		Weight of loaf	Upper layer	Lower layer	% Layer separation
Control	0.89	114.77	49.54	65.23	75.94
20% durum flour	0.90	109.45	47.83	61.62	77.02
30% durum flour	0.91	113.42	49.40	64.02	77.76
40% durum flour	0.91	111.22	48.95	62.27	78.60
L.S.D	0.0231	1.5942	0.7451	0.8456	0.6743

Texture analysis and staling of balady bread

The information in Table (7) demonstrated that the balady bread's moisture content was decreased with increase in storage time of all treatment. The hardness (HRD), Adhesiveness (ADH) and chewiness (CHW) of balady bread were increased as the storage period increased for all treatments in study. There was a negative correlation between cohesiveness and storage duration. According to Rasmussen and Hansen (2001), bread firmness and bread storage for three days were positively correlated.

These results may be due to change of amylose molecule from helixes in zero time to liner cause by time period and make amylose group. The staling of balady bread improve by increase in durum flour. This improve in staling of balady bread might be the result of durum flour's higher protein content than wheat flour. This result agreed with the findings of Raffo *et al.* (2003) and Shaban *et al.* (2020). Because durum wheat flour has a strong ability to bind water, they established that using durum wheat flour has been proven to be helpful for improving the bread-making qualities of low-grade soft wheat, commonly used in increasing the associated product's shelf life. Maleki *et al.* (1980) reported that the protein quality of bread has positive relationship with the staling rate of bread.

Sensory evaluation of produced balady bread

Data in Table (8) shows the sensory evaluation of balady bread made from WF (87.5% extraction) substitution with durum flour at different levels ratio 20, 30 and 40%. The sensory evaluation included the general appearance, layer separation, crumb texture, crust color, taste and flavor. The results showed that, non - significant differences for balady bread fortified with durum flour at 20, 30 and 40% levels in all parameters compared with WF control bread. On the other hand, sensory properties of balady bread were increased with increasing the levels of durum flour and significant quality reduction. This result agrees with that reported by Hussain *et al.* (2010) and Raffo *et al.* (2003).

Table 7: Texture analysis and staling of produced balady bread.

Samples	Day	Moisture	HRD (N)	ADH (mJ)	COH	CHW (mJ)	AWRC%	SR%
Control	Zero	37.12	23.05	5.31	0.38	248.7	229.93	----
	24hr	34.17	26.16	7.40	0.18	302.0	201.12	10.59
	48hr	30.87	35.69	9.40	0.11	417.0	172.91	17.39
20% durum flour	Zero	36.89	21.01	4.80	0.38	245.4	230.52	---
	24hr	35.06	25.16	6.50	0.15	293.7	199.97	10.90
	48hr	31.34	32.59	5.53	0.10	398.4	175.30	18.17
30% durum flour	Zero	36.87	20.59	4.60	0.37	244.0	230.17	-----
	24hr	35.47	24.29	5.70	0.14	282.4	199.94	11.05
	48hr	32.65	30.25	5.32	0.10	372.4	177.36	18.09
40% durum flour	Zero	36.89	18.65	4.20	0.37	244.5	230.07	-----
	24hr	35.84	23.49	4.90	0.13	276.2	200.77	11.23
	48hr	32.97	30.09	4.40	0.10	362.4	178.63	18.21

Where: Hardness (HRD), adhesiveness (ADH), cohesiveness (COH), and chewiness (CHW).

Table 8: Sensory evaluation of produced balady bread

Samples	General appearance (15)	Layer separation (15)	Crumb texture (15)	Crust color (15)	Taste (20)	Flavor (20)
Control	14.30±0.07 b	14.30±0.06 b	14.00±0.08 b	14.20±0.09 b	19.20±0.14 b	19.20±0.06 b
20% durum flour	14.86±0.05 a	14.90±0.03 a	14.85±0.02 a	14.90±0.07 a	19.80±0.09 a	19.88±0.07 a
30% durum flour	14.92±0.03 a	14.90±0.02 a	14.95±0.07 a	14.90±0.05 a	19.88±0.04 a	19.93±0.04 a
40% durum flour	15.00±0.01 a	15.00±0.01 a	15.00±0.02 a	14.95±0.06 a	19.95±0.03 a	19.98±0.02 a
L.S.D.	0.3512	0.2481	0.3782	0.2465	0.2341	0.2561

4. Conclusion

From the obtained results it can be concluded that durum flour (by-product) can be used to improve balady bread by up to 40% in balady bread loaves without adversely influencing the bread's acceptance by consumers. Also, it reduced in cost production of bread. This study was also helpful in exploring the nutritional quality of baked goods and gave very interesting characteristics such as crumb color, crumb structure, and good taste.

Reference

A.A.C.C., 2010. Approved Methods of Analysis of AACC International. 11th ed., St. Paul, Minnesota, USA.

A.O.A.C., 2010. Official Methods of Analysis of Association of Official Chemists. 18th Ed., Washington, D.C., USA

Abd-El-Khalek, M.H., Thanaa A.M. Amer and Manal S. Helal, 2019. Determination of the stallion rate of Egyptian balady bread by using texture profile analysis (TPA): a new method. J. Agric. Sci. Ain Shams Univ., 27 (5): 2527- 2538.

Ahmed, A.E.S., R.Z. Atia, and M.M. El-Genbeihy, 2020. Substitution of Wheat Flour by Local Cereals and Pulses Flour “An approach to overcome wheat gap in Egypt. Alexandria Journal of Agricultural Sciences, 65(2):111-137.

Awolu, O.O., 2017. Optimization of the functional characteristics, pasting and rheological properties of pearl millet-based composite flour. Heliyon., 3(2):1-17.

Barakat, A.S., R.G. Ali, and N.A. Ali, 2013. Effect of extraction rate and particles size of wheat flour on balady bread quality. Egypt. J. Agric. Res., 91(1): 117.

Czuchajowska, Z., Y. Pomeranz, and H.C. Jeffers, 1989. Water activity and moisture content of dough and bread. Cereal Chemistry, 66(2): 128-132.

Elemo, G.N., P.I. Olubunmi, O.O. Akinyele, B.A. Wahab, and G.O. Oluwasina, 2017. Rheological characteristics and baking quality of flours from Nigerian grown wheat. African. J. Food Sci., 11(12):376-382.

El-Fadaly, ESSM. 2015. Technological and biological studies on some food cereal crops, Ph.D. Department of Food Industries Faculty of Agriculture, Mansoura University, Egypt.

EOSQ, 1994. Durability periods of food products. Egyptian Organization for Standardization & Quality. Egyptian Standard, 2613.

FAO Food and Agriculture Organization, 1982. Food Composition Tables for the Near East, F.A.O., Food and Nutrition, Paper, 26.

Greffeuille, V., J. Abécassis, N. Barouh, P. Villeneuve, F. Mabille, C.B. L'Helgouac'h, and V. Lullien-Pellerin, 2007. Analysis of the milling reduction of bread wheat farina: Physical and biochemical characterization. Journal of Cereal Science, 451: 97-105.

Gujral, H.S. and C.M. Rosell, 2004. Improvement of the bread making quality of rice flour by glucose oxidase. Food Research International, 37(1): 75-81.

Hadnadev. D.T., A. Torbica, and H. Miroslav, 2011. Rheological properties of wheat flour substitutes /alternative crops assessed by Mixolab. J. Food Sci., 328-334.

Hussein, A.M.S., M.M. Kamil and G.H. Ragab, 2010. Technological Properties of some Egyptian New Wheat Varieties. Journal of 1171. American Science, 6 (10): 1160

ICC, 2006. Whole Meal and Flour from *T. aestivum* Determination of Rheological Behavior as a Function of Mixing and Temperature Increase Standard Method No. 173. International Association for Cereal Science and Technology.

Korompokis, K., L.J. Deleu, and J.A. Delcour, 2021. The impact of incorporating coarse wheat farina containing intact endosperm cells in a bread recipe on bread characteristics and starch digestibility. Journal of Cereal Science, 102:103333.

Lahham, N., H. Adel, H. Youssef, M. Rabee and H. Samir, 2013. Egyptian food observatory: Food monitoring and evaluation system. Quarterly Bulletin of IDSC and WFP, 11: 1-15.

Maleki, M., R.C. Hoseney, and P.J. Mattern, 1980. Effect of loaf volume, moisture content and protein quality on the softness and staling rate of bread. Cereal Chem., 57 (2): 138- 140.

McClave, J. and G. Benson, 1991. Statistics for business and economics. Dellen Publishing, Fifth Edition. San Francisco, USA.

Mondal, A. and A.K. Datta, 2008. Bread Baking-A Review. J. Food Eng., 86: 465-476.

Moza, J. and H.S. Gujral, 2018. Mixolab, retrogradation and digestibility behaviour of chapatti made from hulless barley flours. J. Cereal Sci., 79:383-389.

Raffo, A., A. Pasqualone, F. Sinesio, F. Paoletti, G. Quaglia, and R. Simeone, 2003. Influence of durum wheat cultivar on the sensory profile and staling rate of Altamura bread. European Food Research and Technology, 218: 49-55.

Rasmussen P.H. and A. Hansen 2001. Staling of wheat bread stored in modified atmosphere. LWT-Food Sci. Technol., 34(7): 487-491.

Rosell, C.M., E. Santon, and C. Collar, 2010. Physical characterization of fiber-enriched bread doughs by dual mixing and temperature constraint using the Mixolab. Eur. Food Res. Technol., 2314:535-544.

Sallam, I., M. Abd El-Magid, N. Hegazy, and W. Abou Zaid, 1995. Effect of packaging and storage on bread containing additives to retard stalling. Egypt. J. Food Sci., 23(1): 133-145.

Sarhan, N.M., B. Farag and M. Haridy, 2010. Subsidized bread in Egypt: Facts and figures. Information and Decision Support Center. The Egyptian Cabinet,pp 2-11.

Scanlon, M.G., J.E. Dexte and C.G. Biliaderis, 1988. Particle size related physical properties produced by smooth roll reduction of hard red spring wheat farina. Cereal Chem., 65 (6): 486 – 492.

Shaban, H.H., M.A. Ashgan, and M. Abo-Elnga, 2020. Utilization of wheat alternative to produce flat bread with high nutritional value. Bull. Fac. Agric. Cairo Univ., 71:147-156.

Sissons, M., 2008. Role of durum wheat composition on the quality of pasta and bread. Food, 2(2): 75-90.

Tawfeuk, H.Z. and R.A. Gomaa, 2017. Physico-Chemical, Rheological and Technological Evaluation of New Bread Wheat Varieties Grown in Toshka, Aswan (Egypt) by Mixolab. Journal of Food and Dairy Sciences, 8(3): 163-168.

Yaseen, A.A., A.A. Shouk and M.M. Selim, 2007. Egyptian balady bread and biscuits of wheat and triticale flour blends. Polish Journal of Food and Nutritional Sciences, 57(1): 25-30.

Zhou, H., C. Liu, J. Shang, and X. Zheng, 2023. Effect of adding wheat *(Triticum aestivum L.*) farina with varied integrity of endosperm cell wall on dough characteristics, dried noodles quality and starch digestibility. International Journal of Biological Macromolecules, 243: 125076.