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Production and Evaluation of Balady Bread by Utilization of Some Barley Varieties Resistant to Climate Changes

Hoda H. Hafez[1], Amira M. A. Abd El-Salam[1] and Esmat S. Mohamed[2]

[1]Department of Bread and Pasta Research, Food Technology Research Institute, Agricultural Research Center, Giza, Egypt.
[2]Biotechnology Department, Higher Institute for Agriculture Co-Operation, Shubra El Kheima, Cairo, Egypt.

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ABSTRACT

In this study, balady bread was made by substituting three varieties of whole barley flour (WBF) Giza 126, Giza 132, and Giza 138 at two levels 30 and 35% for wheat flour 82% extraction in an effort to close the gap between wheat production and consumption as well as to enhance the nutritional and functional quality of bread. Prior to milling for the purpose of making flour and bread, the barley and wheat grains were assessed for their physical properties, such as the weight of 1000 grains and hectoliter. The qualities of chemical composition, rheological properties, sensory and staling of bread, staling, and water activity were evaluated. In comparison among the three barley varieties (Giza 126, Giza 132 and Giza 138). Giza 138 recorded the greatest results in the hectoliter and 1000 grain weight. The replacement of wheat flour by WBF led to an increase in water absorption, dough development time, and arrival time when the WBF ratio was raised. The dough energy, expansibility rheology, and extension were all reduced as the WBF ratio increased. WBF-wheat bread had a high acceptance rate up to a replacement ratio of 30%, and the higher replacement of wheat flour with whole barely flour led to increments in the protein, ash, fat, and crude fiber contents. By replacement more barley flour to the bread mixture, the texture profile analysis (TPA) revealed a rise in hardness. Barley flour can be mixed with wheat flour to provide balady bread that is acceptable to the consumer until 35 %. Also, replacement of barley flour at 35% produced some changes in some aspects of the bread's texture, color, or crumb distribution, but nevertheless produced bread of a consumer-acceptable standard. The outcomes also demonstrated that Giza 138, a higher grade of barley, produced better overall bread quality that was considered acceptable by consumers when compared to the other two types (Giza 126 and Giza 132). Measurements of water activity predicted that the developed bread would be stable and safe.

Keywords: whole barley flour, wheat flour, balady bread.

1. Introduction

Barley (*Hordeum vulgare* L.) is considered the fifth among all crops (Shaban *et al.,* 2020). Barley is grown in a variety of regions in the world. The Agriculture Ministry made every effort to produce high-yielding cultivars that could be grown in recently reclaimed fields and were tolerant of harsh circumstances and low soil fertility (Verstegen *et al.,* 2014)

Around 40 to 60% of the world's agricultural lands are affected by drought stress, which is the principal factor restricting crop production globally (Shahryari and Mollasadeghi, 2011).

In many parts of the world, barley has a significant deal of potential for adaptation. It is regarded as one of the most significant crops, coming in fourth place behind rice, wheat, and maize in terms of global cereal crop production. It can withstand abiotic conditions such as salinity, drought, frost, and heat well. In some places, it is primarily utilized for human food and animal feeding (Zhou, 2009).

Corresponding Author: Hoda H. Hafez, Department of Bread and Pasta Research, Food Technology Research Institute, Agricultural Research Center, Giza, Egypt.

The primary grain crop in Egypt is barley, which is farmed on the North West Coast, in North Sinai, and on recently reclaimed lands. It is necessary to develop barley varieties with great production potential. Another possibility is to grow early-maturing barley varieties before cotton and promote Egyptian wheat production for bread making to close the gap between wheat production and consumption (Zhou*,* 2009).

Since cereals are a consistent diet around the world, it is important to use them in the optimal combinations to meet daily health needs (Shaban *et al.,* 2020).

Because whole grain like barley and oat contain beta glucan, phytochemicals, and antioxidants, they were regarded as useful grains (Sharma and Gujral 2010).

Barley (*Hordeum vulgare* L.*)* like oat products, are an excellent source of beta-glucan soluble fiber. The beta-glucan content of whole grain barley is equivalent to, or greater than that found in whole-grain oats. In a weight-for weight comparison, whole-grain barley is lower in fat, protein and calories and higher in total dietary fiber than whole-grain oats. Consumption of whole-grain barley products is consistent with the "2005 Dietary Guidelines for Americans" that recommend eating at least three servings of whole grains daily (Koeksel *et al.,* 1999 and Hidalgo *et al.,* 2016).

Particularly, eating whole grain foods has been linked to decreased risks of type 2 diabetes, heart disease, and weight gain (Jones 2006 and Ye *et al.,* 2012).

Almost everywhere, the world makes flat bread. Such as tortillas, chapattis, pitas, parottas, yufkas, tandoori rotis, barbaris, taftoons, lavas, ciabattas, baatis, and kulchas as well as gyro bread. Compared to high volume pan bread, certain flat bread has very different properties (Coskuner *et al.,* 1999).

For all Egyptian consumers, balady bread is one of the most essential part of their diet. One of the oldest foods, bread is regarded as the staple meal in many nations, especially those that are in developing nations. The kinds of bread vary depending on the common culture in each nation. (Nashmi and Naser 2022).

This study aims to close the gap between wheat production and wheat consumption, moreover, enhancing the nutritional and functional qualities of balady bread. So bread, was produced from three varieties of whole barley flour Giza 126, Giza 132, and Giza 138 with substituted for wheat flour (Misr 3) at two levels 30 and 35%. The produced bread was evaluated for the chemical, physical characteristics, and sensory properties.

2. Materials and Methods

2.1. Materials

- Misr 3 wheat grains and three varieties of barley (Giza 126, 132, and 138) were obtained from the Field Crops Research Institute at the Agricultural Research Centre in Giza, Egypt.

-Active dry yeast, sugar (sucrose) and salt (sodium chloride) were purchased from the local market in Giza, Egypt and bread improver were purchased from golden pack.

-All chemicals used in the experiments (H_2SO_4, NaOH and HCl) were of analytical grade, these chemicals were purchased from El-masryia Company, Giza, Egypt.

2.2. Methods

Technological methods

2.2.1. Physical properties of wheat and barley grains:

Physical parameters for wheat and barley grains include the weight of 1000 grains, the weight of a hectolitre, and the weight of an Ardab according to Williams *et al.* (1988).

2.2.2. Milling procedure

The Giza 126, Giza 132, Giza 138 barley varieties and Misr 3 wheat whole grains were modified for moisture content to 14% moisture for 24 hours before being milled individually into whole meal barley flour (WBF) or whole wheat flour. Wheat flour was then sieved through a 0.5 mm sieve to obtain flour, which had similar properties to flour with an 82% extraction.

2.2.3. Preparation of Balady Bread

Balady bread was made using the technique outlined by Faridi and Rubenthaler (1984). In order to make bread, 100 g of wheat flour (82% extraction), 1.5% w/w salt, 1% w/w active dry yeast, and

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water as determined by farinograph were combined (Table 1). Ingredients were blended to form a dough, which was divided into 160 g pieces after resting for 10 minutes. The dough pieces were laid out on a tray that had been lightly dusted with wheat bran and allowed to ferment for 40 minutes at 30±2˚C and 85% relative humidity (final proving). The pieces were subsequently formed out to a diameter of about 15 cm and baked immediately for 1-2 minutes at 450–500°C (Food Technology Department, Agricultural Research Centre (ARC), Giza, Egypt). Following baking, loaves were allowed to cool at room temperature before being packed in polyethylene bags to stop moisture loss, and then they were stored at room temperature (18.2 ±2 °C).

Table 1: Formulas of barley/ wheat flour blends used for production of balady bread.

Ingredients (g)	Control	Sample 1 (S1)	Sample 2 (S2)	Sample 3 (S3)	Sample 4 (S4)	Sample 5 (S5)	Sample 6 (S6)
Wheat flour 82 %	1000	700	650	700	650	700	650
Barley flour Giza 126	-	300	350	-	-	-	-
Barley flour Giza 132	-	-	-	300	350	-	-
Barley flour Giza 138	-	-	-	-	-	300	350
Active dry yeast	10	10	10	10	10	10	10
Sugar (sucrose)	10	10	10	10	10	10	10
Salt(sodium chloride)	15	15	15	15	15	15	15
Bread improver	1	1	1	1	1	1	1
Water %	65	71	74	72	73	70	72

2.3. Chemical analysis

Chemical analysis was determined according to AOAC (2005). Tests on wheat flour, three varieties of barley flour and bread loaves were determined for moisture, protein, fat, fiber, and ash.
-Available carbohydrates percent (%) = 100- (protein+ fat+ fibre+ ash) according to Fraser and Holmes (1959).

- The following calculation was used to determine total calories:

Total calories = (9 X fat) + (4 X protein) + (4 X total carbohydrates). according to James (1995).

2.4. Mineral content determination of

In accordance with AOAC (2005) the minerals Ca, Fe, and Zn in the manufactured bread were measured using an Atomic absorption Spectrophotometer (1100 Bperkin Elmer).

2.5. Rheological parameters

The extensograph and farinograph apparatus were applied to determine the rheological properties in Department of bread and dough at the Food Technology Research Institution in Giza, Egypt, to assess the rheological properties of each of the aforementioned flour portions under inquiry, as reported by AACC (2010).

2.6. Texture analysis by profile

Using a Texture Profile Analyzer (TPA) in accordance with Meullenet *et al.* (1998), the hardness, cohesiveness, and springiness of the crumbs were assessed. A standardized testing instrument (Brook field Engineering Lab. Inc., Middleboro, MA 02346- 1031, USA) was used to determine the characteristics of bread texture.

2.7. Balady Bread loaves' freshness

Balady bread staling was evaluated using the method of Yamazaki (1953) as modified by Kitterman and Rubanthaler (1971), after being wrapped in polyethylene bags and stored at room temperature (27±3°C) for 1, 2, and 3 days.

Alkaline Water Retention Capacity AWRC (%) is calculated as following equation = (Weight of tube with sample after centrifugation - Weight of tube with empty sample)/Weight of sample x 100.

2.8. Sensory evaluation of balady bread

The bread samples were evaluated according to Faridi and Rubenthaler (1984) with some modifications, 10 trained panelists from the staff of the Food Technology Research Institute, Agric. Res. Centre, Giza, Egypt, conducted the sensory evaluation of balady bread for the freshly baked bread i.e. appearance (15), layer separation (15), crumb texture (15), crust color (15), taste (20), odor (20), and general acceptability (100).

2.9. Statistical analysis

The Data was analyzed using CoStat, version 3.03 for personal computers according to Snedecor and Cochran (1980). The tests used ANOVA test and descriptive statistics test. A treatment effects (LSD) was assumed to be statistically significant at P≤0.05.

3. Results and Discussion

Table (2) provided information on the physical characteristics of various wheat and barley grain varieties. Data demonstrated that wheat grains had the greatest hectoliter and grain weight values. When compared to Giza 126 and Giza 132. Giza 138 among the barley types had the highest hectolitre value. The lowest determine in 1000 grain weight and hectoliter was reported in Giza 126. The weight of 1000 grains is a good indication on the potential flour yield in grains. The variations may result from environmental and genetic factors.

Table 2: Physical characteristics for different varieties of wheat and barley grains.

Grains types	Weight of 1000 grain (g)	Weight of ¼ litre (g)	Weight of hectolitre (kg/hectolitre)	Weight of Ardab* (kg)
Wheat (Misr 3)	49.4^{a}±0.4	202.3^{a}±0.3	80.88^{a}±0.4	160.38^{a}±1.0
Barley Giza 126	40.32^{b}±0.3	151.1^{c}±0.5	60.44^{c}±0.4	119.8^{c}±0.5
Barley Giza 132	40.97^{b}±0.5	$150.^{c}$±0.5	60.36^{c}±0.3	119.6^{c}±0.6
Barley Giza 138	50.01^{a}±0.5	167.9^{b}±0.5	67.16^{b}±0.25	133.6^{b}±0.3

-Values are means of three replicates ±SD, number in the same row followed by the same letter are not significantly different at 0.05 level of probability.
*Ardab: 120 kg

3.1. Chemical constitution whole meal and wheat flours of several barley varieties

Data shown in Table (3) Barley flour has a slightly greater protein level than wheat flour (11.51%), ranging from 12.03% to 12.54%. Whole barely flour varieties had a higher ash percentage than wheat flour (1.52%), ranging from 2.32% to 2.61%. These results are in accordance with those published by Abo-ELnaga (2002), who discovered that barley flour had a greater ash concentration (2.40%) than wheat flour (1.45%).

Table 3: Chemical composition of raw materials (on dry weight basis)

Sample	Protein %	Fat %	Ash %	Fiber %	Available carbohydrates %	Calories Kcal/100g
Wheat flour (ext. 82 %)	11.51^{b}±0.5	2.23^{b}±0.2	1.52^{b}±0.5	1.52^{b}±0.5	83.22^{a}±0.5	398.99^{a}±0.2
WBF Giza 126	12.03^{a}±0.5	3.34^{a}±0.3	2.61^{a}±0.5	3.51^{a}±0.5	78.51^{c}±0.2	392.22^{d}±0.2
WBF Giza 132	12.21^{a}±0.5	3.32^{a}±0.5	2.53^{a}±0.5	3.35^{a}±0.3	79.59^{b}±0.4	397.08^{b}±0.5
WBF Giza 138	12.54^{a}±0.2	3.41^{a}±0.2	2.32^{a}±0.3	3.15^{a}±0.3	78.58^{c}±0.5	395.17^{c}±0.5

-Values are means of three replicates ±SD, number in the same column followed by the same letter are not significantly different at 0.05 level of probability.

The removal of the germ and bran from the endosperm in white flour during the grinding process is responsible for the decrease in ash concentration in wheat flour when compared to barley flour. Likewise, the milling and sieving process induced a partial separation of the germ, which has a higher oil content than the hull, according to Shaban (2006). Clearly, whole barley flour had a greater fat content (3.32% to 3.41%) than wheat flour (2.23%). Whole barley flour has more crude fibre (3.15–3.51%) than wheat flour (1.52%), as would be expected. Compared to whole barley flour, wheat flour

(82% extraction) had a greater carbohydrate content. These results closely match with those of El-Taib *et al.* (2018), who ascertained that barley flour (82% extract) had higher levels of protein, lipids, ash, and crude fiber than wheat flour (13.63%, 3.18%, 2.77%, and 4.53, respectively). While these contents were, correspondingly, 12.26, 0.49, 1.21, and 0.59 in wheat flour. According to data, variety Giza 138 had the highest levels of protein and fat, whereas Giza 126 had the highest levels of fibre and ash. When compared to the three varieties of barley flour, wheat flour had significantly more calories and carbohydrates.

3.2. Rheological characteristics.

3.2.1. Farinograph test

Table (4) exhibits the rheological characteristics (Farinograph) of whole barley flour added to wheat flour. Water absorption increased progressively when WBF was added, rising from 65% for the control wheat flour sample to 73% in S4. It is widely known that a dough's ability to absorb water increased as the amount of fibre in the dough increased Sudha *et al.* (2007). According to Rosell *et al.* (2001), the hydroxyl groups of the fibre structure interact with the hydrogen bonds in water to increase the tendency of flour to hold water. In addition, compared to the matching control (1 minute), the dough development time for WF combined with WBF increased and varied between 1.3 and 1.8 minutes. However, the dough replacement with all types of WBF had a shorter dough stability time (min), as the presence of the fiber particle disrupted the starch-gluten network, resulting in a shorter dough stability time. The degree of softening (B.U.) went up as WBF increased, reaching its highest point in S2 WBF. El-Taib *et al.* (2018) reported that the degree of weakening (BU) was elevated gradually by the increasing ratios of barley flour and that it can be linked to a decrease in the amount of wheat gluten in the dough Mekhael (2005) support our findings. The fiber and protein content of these varieties may be responsible for the variations in water absorption, arrival time, dough stability, and degree of weakening between WBF types.

Table 4: Farinograph parameters of wheat flour WF and WF replacement with whole barley flour WBF.

Sample	Water absorption %	Arrival time min	Dough stability min	Degree of dough weakening BU
Control	65	1.0	5.0	70
S1	71	1.5	4.5	80
S2	74	1.8	4.3	85
S3	72	1.4	4.4	75
S4	73	1.5	4.4	80
S5	70	1.3	4.6	73
S6	72	1.4	4.7	75

-Control: wheat flour WF –S1:70WF+30WBF(Giza126), S2:65WF+35WBF(Giza126), S3:70WF+30WBF(Giza132), S4: 65WF+35WBF(Giza132), S5: 70 % WF+30WBF(Giza138), S6: 65WF+35WBF(Giza138).

3.2.2. Extensograph test

Extensograph test in Table (5) has the data shown how increasing WBF decreased the dough's resistance to extension, and the extensibility showed the similar trend. These results are consistent with those of El-Taib *et al.* (2018) who noted that dough extensibility decreased noticeably as the percentage of WBF increased. According to Sullivan *et al.* (2010) mixtures with a greater distance before rupture (high extensibility) and a greater force required to rupture the dough (high maximal resistance to elasticity) are more likely to have good bread-making properties. Additionally, they claimed that the addition of barley flour level decreased the resistance to dough expansion. The proportional number (P.N.) was shown to have slightly declined from 4.45 for the control sample, with S4 showing the lowest value. According to Fahmy and Abd-Elmaksoud (2020), the inclusion of WBF led to a decline in the proportion no. By raising the WBF %, the values for dough energy (cm2) decreased, indicating that the addition of barley flour makes dough better suited for baking biscuits (Shaban 2006).

Table 5: Extensograph parameters of wheat flour WF replacemented with whole barley flour WBF.

Sample	Resistance to extension BU	Extensibility Mm	Proportion no.	Energy cm2
Control	490	110	4.45	70
S1	410	95	4.32	50
S2	440	102	4.31	45
S3	430	107	4.02	60
S4	420	105	4.0	62
S5	450	108	4.17	65
S6	440	109	4.03	63

-Control: wheat flour WF,S1: 70WF +30WBF(Giza126), S2:65WF+35WBF(Giza126), S3:70WF+30WBF(Giza132), S4: 65WF+35WBF(Giza132), S5: 70 % WF+30WBF(Giza138), S6: 65WF+35WBF(Giza138).

3.3. Chemical components of bread made from wheat and barley flour

The collected information regarding the chemical makeup of bread sample is shown in Table (6). WBF and WF were blended at amounts of 30 WBF/70 WF and 35 WBF/65 WF to make bread. Protein contents increased somewhat but significantly as a result of the addition of barley. In comparison to the control, which was at 11.21%, it ranged from 11.75 to 12.45%. In a similar vein, raising WBF increased the amount of ash and crude fibers in bread when compared to control bread; this could be explained by the higher amount of ash and fiber in WBF when compared to WF. The amount of fat in the samples varied significantly. The amount of carbohydrates significantly decreased as a result of replacement. These findings are in line with those of Skrbic and Cvejanov (2011), who reported that barley flour-supplemented biscuits had higher levels of protein, ash, and crude fibre than control did. The recent findings demonstrated that the addition of barley to bakery products is likely to increase their nutritional value by raising their protein, fat, ash, and fibre content while lowering their carbohydrate level.

Table 6: Chemical composition of produced wheat and barley bread (on dry weight basis).

Sample	Protein (%)	Fat (%)	Ash (%)	Fiber (%)	Carbohydrates (%)	Calories Kcal/100g
Control	$11.21^{b}\pm0.2$	$2.01^{b}\pm0.5$	1.33b±0.3	$1.2^{b}\pm0.6$	$84.25^{a}\pm0.2$	$399.93^{a}\pm0.5$
S1	$11.75^{b}\pm0.5$	$2.98^{a}\pm0.5$	$1.95^{a}\pm0.5$	$3.0^{a}\pm0.4$	$80.32^{b}\pm0.3$	$395.1^{c}\pm0.4$
S2	$12.0^{a}\pm0.3$	$3.12^{a}\pm0.5$	$2.31^{a}\pm0.2$	$3.22^{a}\pm0.2$	$79.35^{c}\pm0.4$	$393.48^{d}\pm0.4$
S3	$11.81^{b}\pm0.5$	$2.81^{a}\pm0.5$	$1.84^{a}\pm0.2$	$2.95^{a}\pm0.3$	$80.59^{b}\pm0.5$	$394.89^{d}\pm0.4$
S4	$12.2^{a}\pm0.2$	$3.0^{a}\pm0.5$	$2.25^{a}\pm0.2$	$3.11^{a}\pm0.4$	$79.44^{c}\pm0.2$	$393.56^{d}\pm0.5$
S5	$11.91^{a}\pm0.4$	$3.11^{a}\pm0.5$	$1.75^{a}\pm0.2$	$2.81^{a}\pm0.5$	$80.42^{b}\pm0.2$	$397.31^{b}\pm0.3$
S6	$12.45^{a}\pm0.4$	$3.22^{a}\pm0.2$	$2.19^{a}\pm0.2$	$3.04^{a}\pm0.2$	$79.0^{c}\pm0.5$	$394.78^{d}\pm0.3$

Control: wheat flour WF –S1:70WF+30WBF(Giza126)- S2:65WF+35WBF(Giza126) S3:70WF+30WBF(Giza132) S4: 65WF+35WBF(Giza132) S5: 70 % WF+30WBF(Giza138)
S6: 65WF+35WBF(Giza138).
-Values are means of three replicates ±SD, number in the same column followed by the same letter are not significantly different at 0.05 level of probability.

3.4. Minerals content of bread produced

Table 7 lists the minerals that are present in bread. WBF and WF were blended at 30 WBF/70 WF and 35 WBF/65 WF to make bread. Ca, Fe, and Zn levels significantly enhanced after WBF substitution. These minerals' contents increased somewhat but significantly due to increased barley inclusion. Similarly, an increase in WBF (Giza 138) led to a rise in the Ca, Fe, and Zn contents of bread, which was subsequently followed by bread made with WBF from Giza 132 and WBF from Giza 126. These findings are consistent with those made by Fahmy and Abd -Elmaksoud (2020), who claimed that incorporating barley flour increased the amount of minerals compared to controls. According to the current findings, adding barley to bread items will improve their nutritional value by boosting their protein, ash, fiber, and mineral contents while lowering their carbohydrate level.

Table 7: Minerals content of produced wheat and barley bread.

Samples	Ca mg/100g	Fe mg/100g	Zn mg/100g
Control	20.54[e]±0.5	1.21[d]±0.2	0.11[c]±0.1
S1	25.71[d]±0.3	1.54[c]±0.4	0.62[b]±0.3
S2	26.3[c]±0.2	2.51[a]±0.49	0.68[ab]±0.2
S3	26.21[c]±0.2	1.50[c]±0.2	0.69[a]±0.2
S4	27.11[b]±0.2	1.52[c]±0.1	0.71[a]±0.1
S5	27.53[b]±0.5	1.60[b]±0.2	0.72[a]±0.02
S6	28.71[a]±0.3	1.67[b]±0.2	0.79[a]±0.1

Control: wheat flour WF ,S1:70WF+30WBF(Giza126),S2:65WF+35WBF(Giza126), S3:70WF+30WBF(Giza132), S4: 65WF+35WBF(Giza132), S5: 70 % WF+30WBF(Giza138), S6: 65WF+35WBF(Giza138)
-Values are means of three replicates ±SD, number in the same column followed by the same letter are not significantly different at 0.05 level of probability.

3.5. Texture analysis of balady bread

Data reported in Table (8) demonstrated the texture analysis of balady bread manufactured from wheat flour (control) and WBF with various types throughout time spent storing at room temperature (27±3 ^{5}C). Whereas adding WBF and storing the bread boosted the hardness and adhesiveness, control wheat flour bread had the lowest hardness rating. When compared to other barley bread, WBF Giza 138 had the lowest hardness. Barley bread also had high adhesiveness formulations documented. Higher levels for other factors were noted by bread. Additionally, barley bread recorded higher values for other parameters beyond adhesiveness. These outcomes are most likely the result of the creation of dextrin with a high water absorption rate and beta-glucans. The crumb hardness is a significant quality component in baked goods as well because it is closely related to how consumers feel the freshness of the bread, according to Ahlborn *et al.* (2005). The results corroborated Sobczylc's (2008) claim that hardness is a key factor in determining how long bread and confectionery may be stored. Additionally, Malik *et al.* (2015) showed that when the fiber content increased, the hardness of the multigrain bread samples increased. The resilience of the bread samples decreased with the increase in the fiber content, less the amount of composite flours, more desirable is the chewiness. The WBF bread with Giza 138 had the best texture among the samples in terms of hardness, chewiness, and resilience; this may be because this variety of barley has a higher protein content than other varieties of barley.

Table 8: Texture analysis of balady bread.

	Storage (hours)	control	S1	S2	S3	S4	S5	S6
Hardness (N)	1	23	34	35	35	35	25	26
	24	26	45	37	36	37	27	27
	48	32	46	39	37	38	33	35
Adhesiveness (mJ)	1	5	6	7	9	9	9	8
	24	8	7	8	10	11	10	8.6
	48	9	10	12	11	11.9	11	10
Resilience	1	0.11	0.01	0.01	0.02	0.12	0.11	0.11
	24	0.11	0.01	0.01	0.01	0.01	0.01	0.01
	48	0.05	0.01	0.03	0.01	0.01	0.01	0.03

Control: wheat flour WF, S1:70WF+30WBF (Giza126), S2:65WF+35WBF(Giza126), S3:70WF+30WBF(Giza132), S4: 65WF+35WBF(Giza132), S5: 70 % WF+30WBF(Giza138), S6: 65WF+35WBF(Giza138).

3.6. Sensory evaluation of the balady bread

Table 9 displays the sensory assessment of the balady bread. By employing various concentrations of barley varieties in comparison to the control, the addition of barley flour did not significantly alter the odor of the bread. Additionally, the taste results were extremely similar to those of wheat control bread. S5 was nearly equal to the control in terms of overall acceptance. According to Wani *et al.* (2016) at 15% replacement or above, sensory examination of flat bread made from composite flours made of wheat and pulses revealed a substantial drop in color, taste, aroma, breakability, and overall acceptability scores. According to Gupta *et al.* (2011) and Malik *et al.* (2015), the texture of the bread is correlated with the bread's outward hardness or softness. The degree to which bread is rough, smooth, firm, or soft can be determined by its texture, which is a property that can be felt. Also, these outcomes are comparable to those published by Sanful and Darko (2010). The unfavourable flavor gets worse as highly additional oat and barley are added to the samples, according to Gupta *et al.* (2011). Balady bread made with barley flour tasted and smelled comparable to the control Fahmy and Abd-Elmaksoud (2020). Data in Table (9) showed that the Giza 138-produced Balady bread had the highest sensory attributes among the others barley bread.

Table 9: Sensory evaluation of produced wheat and barley bread.

Samples	Appearance 15	Separation of layers 15	Crumb texture 15	Crust color 15	Taste 20	Odor 20	Overall acceptability 100
Con.	$14.5^{a}\pm0.5$	$14.5^{a}\pm0.2$	$14.5^{a}\pm0.5$	$14^{a}\pm0.50$	$19.5^{a}\pm0.50$	$19.8^{a}\pm0.3$	$96.8^{a}\pm0.8$
S1	$14^{a}\pm0.50$	$13^{b}\pm1.0$	$13^{b}\pm1.0$	$12^{b}\pm1.00$	$19.1^{a}\pm0.20$	$19.5^{a}\pm0.5$	$90.5^{c}\pm0.5$
S2	$13.5^{ab}\pm0.2$	$12.3^{b}\pm0.3$	$12.5^{bc}\pm1.0$	$11.5^{b}\pm0.5$	$18.5^{ab}\pm0.5$	$19.5^{a}\pm0.3$	$87.8^{d}\pm0.4$
S3	$14^{a}\pm0.30$	$13.2^{b}\pm0.2$	$14^{a}\pm0.50$	$12.2^{b}\pm1.0$	$19.1^{a}\pm0.50$	$19^{ab}\pm0.5$	$91.5^{b}\pm0.5$
S4	$13.5^{ab}\pm0.3$	$12.1^{c}\pm0.5$	$13.2^{b}\pm1.0$	$11.5^{b}\pm0.5$	$18.5^{ba}\pm0.4$	$19.5^{a}\pm0.2$	$88.3^{d}\pm0.3$
S5	$14.5^{a}\pm0.3$	$13.4^{b}\pm0.4$	$14.5^{a}\pm0.5$	$12.5^{b}\pm0.5$	$19^{a}\pm0.30$	$19.3^{ab}\pm0.3$	$93.2^{a}\pm0.2$
S6	$14^{a}\pm1.00$	$13^{b}\pm1.0$	$14^{a}\pm1.0$	$12.1^{b}\pm1.0$	$18^{ab}\pm0.4$	$19.5^{a}\pm0.2$	$90.6^{c}\pm0.6$

Values are means of three replicates ±SD, number in the same column followed by the same letter are not signifsaicantly different at 0.05 level of probability.
Control: wheat flour WF, S1:70WF+30WBF(Giza126), S2:65WF+35WBF(Giza126), S3:70WF+30WBF(Giza132), S4: 65WF+35WBF(Giza132), S5: 70 % WF+30WBF(Giza138), S6: 65WF+35WBF(Giza138).

3.7. Staling of balady bread made with wheat flour and varied whole barley flour for the alkaline water retention capacity (AWRC)

Data in Table (10), at zero, 24 and 48 hours after baking, reveal the alkaline water retention capacity (AWRC) of balady bread made with wheat flour and WBF at various levels. The data showed that throughout the storage period, all bread samples' AWRC scores (poor freshness) gradually decreased Abo-Elnga (2002). Bread in the control group had the lowest AWRC values at zero, 24 hours, and 48 hours of storage. The bread lost the most freshness after 48 hours of storage, when control bread observed a 42.45% decrease in freshness.

Table 10: The alkaline water retention capacity (AWRC) of balady bread.

Sample	AWRC % Zero time	AWRC% 24 hr	Rate of decrease %	AWRC % 48 hr	Rate of decrease %
Control	392.24d±2.0	285.24e±1	27.27a±0.2	225.71d±1.0	42.45a±0.5
S1	404.21b±1.0	295.54d±1	26.88a±0.5	253.81c±1.0	37.21b±0.5
S2	410.03a±2.0	300.51c±0.5	26.71a±0.5	259.32b±2.0	36.75b±0.5
S3	403.31b±2.0	303.28b±2.0	24.8b±2.0	260.04b±1.0	35.52c±1.0
S4	405b±2.0	302.41b±1	25.3ab±1.0	266.32a±2.0	34.27d±0.3
S5	399.51c±0.5	310.21a±1	22.35c±1.0	270.11a±1.0	32.23e±1.0
S6	404.31b±2.0	309a±1	23.56c±2.0	268.41a±2.0	33.61d±0.5

Values are means of three replicates ±SD, number in the same column followed by the same letter are not significantly different at 0.05 level of probability.
Control: wheat flour WF, S1:70WF+30WBF(Giza126), S2:65WF+35WBF(Giza126), S3:70WF+30WBF(Giza132), S4: 65WF+35WBF(Giza132), S5: 70 % WF+30WBF(Giza138), S6: 65WF+35WBF(Giza138).

At various storage dates, balady bread produced with wheat flour and three different kinds of barley at varied substitution rates 30% and 35%performed better than the control sample and had higher AWRC readings. Consequently, the percentage of freshness loss was lower than with the control bread. These findings indicate that compared to WBF Giza 126 and G132, WBF Giza 138 generated an improvement in bread freshness when replacing wheat flour. Different quantities of WBF added to the wheat flour caused an increase in AWRC.

From the alkaline water retention capacity, or staling or retrogradation, which reflects the starch granules' ability to swell. The conclusion is that the inclusion of very small amounts of oil prevented the baking items from ageing too quickly and slightly enhanced their freshness.

4. Conclusion

This work aims at to solve the problem of wheat export, close the gap between wheat production and consumption, and enhance the nutritional and functional qualities of balady bread. For the purpose to make balady bread, three types of whole barley flour Giza 126, Giza 132, and Giza 138 were substituted for wheat flour of Misr 3 at levels of 30 and 35% by investigating all the technically, sensory, and chemical characteristics. In comparison with the 3 varieties of barley, it was discovered that barley flour (Giza 138) had better values for 1000 grain weight and hectoliter. With an increase in the WBF ratio, water absorption, dough development, and arrival time all gradually climbed. The stability of the dough was reduced by the addition of WBF. With an increase in the WBF ratio, the dough's energy, expansibility rheology, and extension were all reduced. According to the study, barley flour may replace 30% to 35% of the wheat flour in balady bread loaves, while some barley flour substitutions may have a negative impact on how well the bread is received by consumers. However, the resulting bread loaves are observed to be tougher, deeper in color, and irregularly shaped when the barley flour content is increased above these limitations; thus, less respectable bread. The findings also indicated that bread made with barley flour has a reduced carbohydrate level but a higher protein, fat, fibre, ash, Fe, Ca and Zn content.

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