Journal of Food and Dairy Sciences

Journal homepage & Available online at: www.jfds.journals.ekb.eg

Utilization of Germinated Naked Barley Flour in the producing of Balady Bread

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ABSTRACT

The objective of this research was to investigate how incorporating germinated naked barley flour (GNBF) into wheat flour with an 82% extraction rate affects the chemical, physical, and rheological characteristics of balady bread. The study examined various GNBF substitution levels, including 5, 10, 15, and 20 percent, to assess their impact on the bread's properties.Obtained results indicated that the nutritional value of balady bread samples which contained germinated naked barley flour was increased in terms of protein, fiber and ash content were 14.90, 10.50 and 6.60, respectively. The amount of carbohydrates were decreased However, Results of Amino Acids Analyzer showed that the amount of essential and non-essential amino acids were increased in prepared balady bread samples contained germinated naked barley flour in compared with those of bread samples constituted with 100% wheat flour. Therefore, this study also, recommended that the availability of additional germinated naked barley flour at different ratios in the processing of balady bread which led to improvement of its nutritional quality and sensory properties for prepared bread samples.

***Keywords*:** barley, , Bread, , amino acids.

INTRODUCTION

Functional foods are characterized as conventional foods or products derived from food that have been enhanced or modified to boost their nutritional value, thereby improving physiological health outcomes (Shahidi 2012; El-Dreny and El-Hadidy 2020; and Mospah *et al.*, 2023).

Bread is considered one of the most important staple foods consumed globally, and wheat bread is regarded as one of the Egyptian products that best represents the nation. It serves as a source of carbohydrates and is a fundamental component in the diet of both affluent and underprivileged Egyptian consumers El-Soukkary, 2001 and El-Hadidy and Rizk 2018).

Litwinek et al., (2013) report that Egypt's domestic wheat production satisfies only about 50% of the country's total demand, falling short of national requirements. Wheat has been a staple grain for many generations and is a crucial component of the average Egyptian diet. As a result, the per capita consumption of this cereal is among the highest worldwide. According to FAO, Egypt is not only the largest wheat importer but also the top global consumer and per capita bread consumer, as highlighted in a CAPMAS report. This significant reliance on wheat is evident in the increase of average wheat consumption per person from 141.1 kg in 2015 to 150.8 kg in 2021.

Lazaridou and Biliaderis (2007) classify barley-based foods as functional foods, suggesting their potential to reduce blood glucose levels, thereby helping to treat and prevent diabetes and decrease the risk of cardiovascular disease.

Barley is a versatile cereal that thrives in diverse climates, from subarctic to subtropical regions. Currently, most cultivated barley is used for malt production, with the remainder allocated for human or animal consumption. Baik, (2016) notes that specific barley varieties are better suited for particular uses, while some are versatile enough for multiple applications.

Jribi, (2019) points out that the germination process affects barley's functional and sensory characteristics. Sprouting seeds leads to various changes that naturally enhance bioactive compounds, making them valuable ingredients. Their use in the food industry could result in value-added products.

Naked or hulless barley is a grain variety where the bran and endosperm layers remain intact after processing due to the easy separation of the hull. Research indicates growing interest in using it for cereal-based products. Jukić *et al.*, (2022) suggest that incorporating naked barley flour enhances a product's nutritional value by increasing antioxidant levels and soluble fiber (β-glucan) content.

The current study aimed to examine the effects of partially substituting wheat flour (WF) with germinated naked barley flour (GNBF) on the chemical, physical, and rheological properties of processed balady bread.

MATERIALS AND METHODS

Raw Materials:

Naked Barley seeds *(Hordeum vulgare L.)* Giza 130 cultivar was obtained from Barley Research Department, Agriculture Research Center, Kafr El-Sheikh, Egypt.

Wheat flour (82% extraction), compressed yeast, and salt were obtained from local market Desouk city, Kafr El-Sheikh Governarate, Egypt.

Chemicals:

- All analytical chemicals were purchased from Sigma Company for medical materials, Giza, Egypt.

Methods

- **Technical Methods**

Preparation of Germinated Naked Barely seeds:

Preparation of Barley seeds was as follow:-

- **Soaking process:**

Seeds were separated from broken seeds, dust and foreign materials, and then soaked in water for 12 hr overnight.

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DOI: 10.21608/jfds.2025.340282.1180

- **Germination process**

Soaked barley seeds were spread on wet cloth in aluminum baskets for 3-4 days until the sprout began appear then, and then the germinated seeds were dried in a drying oven at 70°C for 4 hours (Kince *et al.,* 2017).

Preparation of germinated naked barley seedling flour

The germinated barley seedlings were cleaned from dust by air pressure, then ground with (Touch Mill machine El-ZENOUKI Group for the manufacture of electrical appliances, Model 40553).

Then packed with polyethylene bags and stored in the Refrigerator at 5°C further analyses were carried out.

Preparation of Balady bread with germinated naked barely Flour:

The basic blends used for making bread were:

Wheat flour 100%, fresh pressed yeast 1%, salt 1% and water as required achieving the best consistency. Naked barley seedlings added with different of ratio 5, 10, 15 and 20٪ replaced from wheat flour. The ingredients were mixed for 12 minutes in a home mixer Touch machine (El-Zenouki Group for the manufacture of electrical appliances, Model 40553)., then left for 2 hours to ferment at room temperature 25-30°C.

Then the dough was cut in a circle into equal parts about 150 grams and left to rest for 45 minutes, then turned into loaves. The loaves were baked in a gas-heated oven (Al Askary industry in Egypt) at 400-500°C for 2 minutes. Moreover the loaves were packed in polyethylene bags after cooling for further analysis by EL-Farra *et al.* (1982).

Table A.Different Balady bread blends:-

Ingredients	Control(c)	Blend1	Blend2	Blend3	Blend4
WF (%)	100	95	90	85	80
NBGF (%)	-	5	10	15	20
Salt (%)	1.5	1.5	1.5	1.5	1.5
Yeast (%)	1	1	1	1	1

WF= Wheat flour; NBGF=Naked Barley Germinated flour.

B. Analytical Techniques

- **Chemical Composition Analysis:**

Nitrogen content was measured using the micro-Kjeldahl method. Protein content was calculated by multiplying the total nitrogen percentage as per A.O.A.C. (2012).Also, Moisture, ash, fat, and fiber content were also determined following A.O.A.C. (2012) guidelines.

- **Carbohydrate Estimation:**

Carbohydrates were calculated by subtracting other components from the initial sample weight:

Carbohydrates = 100 - (% protein + % fat + % ash + % fiber) on a dry weight basis, as per A.O.A.C. (2012).

- **Mineral Content Analysis:**

Iron, manganese, zinc, potassium, calcium, phosphorus, and magnesium levels were assessed at the National Research Center, Giza, Egypt, using atomic absorption spectrophotometry, following A.O.A.C. (2012) protocols.

- **Energy Value Calculation:**

Energy content was computed using James (1995) formula:

Energy value = (% carbohydrate × 4.1) + (% protein × 4.1) + (% fat × 9.1).

- **Amino Acid Profiling:**

Amino acids in wheat and naked barley flour were analyzed using HPLC-Pico-Tag method, as described by Millipore Cooperative (1987), Heinrikson and Meredith (1984), White et al. (1986), and Cohen et al. (1987) at the National Research Center, Giza, Egypt.

- **Amino Acid Scoring:**

Essential amino acid chemical scores were determined using the FAO/WHO/UNU (1985) equation.

- **Protein Efficiency Ratio Estimation:**

Computed Protein Efficiency Ratio (C-PER) was calculated using Alsmeyer et al. (1974) equation:

PER = -0.468 + 0.454 (leucine) - 0.105 (tyrosine).

- **Biological Value Computation:**

Biological Value (BV) was estimated using Farag et al. (1996) equation:

Computed Biological Value (BV) = 49.9 + 10.53C-PER.

Rheological Assessment of Balady Bread Dough:

- **Farinograph Analysis:**

A Brabender Farinograph (type 810105001, No. 941026, West Germany) was used to evaluate water absorption and dough mixing characteristics for various blends, following A.A.C.C. (2012) methods at the Food Tech. Res. Institute, Agric. Res. Center, El-Giza, Egypt.

- **Extensograph Evaluation:**

Extensograph testing was conducted using a Brabender Extensograph (type 86001, No. 9416003, West Germany) according to A.A.C.C. (2012) guidelines at the Food Tech. Res. Institute, Agric. Res. Center, El-Giza, Egypt.

Texture Profile Analysis (TPA) of balady bread samples:

A universal testing machine (Cometech, B type, Taiwan) equipped with software was used to evaluate the texture of balady bread samples. The analysis employed a back extrusion cell with a 3 mm diameter compression disc. Two cycles were performed at a constant crosshead speed of 2 mm/s, compressing to a depth of 10 mm before returning. The resulting force-time curve was used to calculate texture attributes including Resilience (N), gumminess (N), chewiness (N), adhesiveness (N.s), cohesiveness, springiness and resilience, based on the TPA graph as described by Gomez et al., (2007). This analysis was conducted at the Food Tech. Res. Institute, National. Res. Center, El- Dokki. Egypt.

B. Sensory Evaluation:

The prepared Balady bread samples underwent sensory evaluation by a panel of 25 staff members from the Food Industries Department, Faculty of Agriculture, Mansoura University, Egypt. The evaluation followed the method outlined by El-Farra et al. (1982), assessing Taste (20), Crust Color (10), Separation of Layers (15), Rounder (10), Distribution of crumb (10), odour (15), and General Appearance (100).

C. Statistical Analysis:

The collected data underwent statistical analysis using Analysis of Variance (ANOVA) through the Statistical Package of Social Sciences (SPSS) software program version 17 (2008). Significant differences between treatment means were identified using Duncan's Multiple Comparisons at $P \leq 0.05$, as described by Gomez and Gomez, (1984).

RESULTS AND DISCUSSION

Chemical composition of wheat flour (82%) and germinated naked barely flour:

The chemical composition of wheat flour (82%) and germinated naked barely flour were showed in Table)1(.Results showed that Wheat flour contains 13.70% moisture, 11.80% crude protein, 1.90% Crude fat, 1.15% ash, 1.81% crude fiber, 83.34% carbohydrates and Energy value recorded 407.36 calories. These results were higher than those Rababah *et al.* (2019) found that the chemical composition of wheat flour (82% extraction) were 0.84% ash, 1.40% fiber, 12.95% protein (on dry weight basis).

Nassef et al., (2023) and El-Hadidy, *et al.,* (2023) showed that naked barley contains crude protein (12.6%), fat

(2.66-2.85%), ash (1.80-1.95%), and carbohydrates (72.33-79.93%). Su *et al.,* (2021) showed that germinated barley flour had higher protein content than barley flour (11.85-12.08%) and fat (2.27-3.14%).

Table 1. **chemical composition of wheat flour (82%), germinated naked barely flour and Energy:**

Components%	Wheat flour 82%	Germinated naked barely
Moisture	13.70^{a}±0.70	10.50^{b}±0. 20
Crude protein	11.80^{b}±0.17	14.90^{a}±0.16
Ash	1.15^{b}±0.08	6.60^{a}±0.08
Crude fat	1.90^{b}±0.07	3.50^{a}±0.65
Crude fiber	1.81^{b}±0.03	10.50^{a}±0.04
Carbohydrates	83.34^{a}±1.50	65.00^{b}±1.90
Energy value (kcal/100g)	407.36^{a}±2.20	395.44^{b}±1.50

WF = wheat flour GNB= Germinated Naked Barely
Means ± standard deviations with different superscript letters in the same colum are significantly different at (P≤0.05)

Mineral contents of wheat flour (82% extraction) and Germinated Naked Barely flour:

The mineral content of germinated naked barely flour and wheat flour (82% extraction) shown in Table (2). The mineral content of microelements for wheat flour were 2.70, 2.50, and 5.50 mg/100 g for Iron, manganese, and zinc, respectively, and the mineral content of macro elements for wheat flour were 160.30, 21.00, 159, and 155 mg/100 g for potassium, calcium, phosphorus, and magnesium, respectively. The results also showed that the mineral content of microelements of germinated naked barely flour were 14.50, 1.50 and 10.50 mg/100 g for iron, manganese and zinc, respectively. The mineral content of the macro elements germinated naked barely flour were 1200, 120, 350, 13.20 mg/100g for potassium, calcium, phosphorus and magnesium. Respectively, Nassef, *et al.,* (2023) and El-Hadidy, *et al.,* (2023) showed that naked barley contains Ca (22.91-26.73), Fe (2.12-2.44), and zinc (2.10-2.15).

Table 2. **Minerals content of wheat flour and germinated naked barely flour:**

Minerals(mg/100g)	Wheat flour 82%	Germinated naked barely
	Micro elements	
Fe	2.70^{b}±0.20	14.50^{a}±0.40
Mn	2.50^{b}±0.09	1.50^{a}±0.50
Zn	5.50^{b}±0.05	10.50^{a}±0.09
	Macro elements	
K	160.30^{b}±0.50	1200^{a}±3.50
Ca	21.00^{b}±0.30	120^{a}±2.50
P	159^{b}±1.60	350^{a}±1.50
Mg	155^{a}±1.70	13.20^{b}±1.50

WF = wheat flour GNB= Germinated Naked Barely
Means ± standard deviations with different superscript letters in the same colum are significantly different at (P≤0.05)

Amino acids of wheat flour (82%extraction), germinated naked barely flour (g/100g), Computed protein efficiency ratio and Biological Value.

Amino acids profile of the studied wheat flour (82% extraction) and germinated naked barley flour were shown in Table (3) the total essential amino acids in wheat flour (82% extraction) were 33.55g/100g, which was lower than that in germinated naked barley flour (49.95g/100g). Data in the same table recorded that the major essential amino acids in wheat flour were10 amino acids being phenylalanine (5.50g/100g), followed by leucine (4.90g/100g) and valine (4.40g/100g). Meanwhile, the lowest one was tryptophan with 1.09g/100g followed by methionine 1.20g/100g. On the other hand, germinated naked barley flour was considered as a poor source of tryptophan (1.25 g/100 g) followed by methionine (1.30 g/100 g), while valine (8.20 g/100 g), lysine (8.00 g/100 g) and phenylalanine (7.50 g/100 g) were the predominant essential amino acids.The results also showed that the total non-essential amino acids in wheat flour (82% extraction) were (66.8 g/100 g) more than that those of germinated naked barley flour (49.40 g/100 g). Data in the same table also, showed that the predominant non-essential amino acids in wheat flour were glutamic (32.00 g/100 g) and proline (12.00 g/100 g). While the lowest one was Arginine (2.60 g/100 g) followed by alanine (3.50 g/100 g). On the other hand, the majority of non-essential amino acids in germinated naked barley flour were alanine (9.00 g/100 g) followed by arginine (8.50 g/100 g). While the lowest one was proline (3.80 g/100 g).

Table 3. Amino acids of wheat flour (82%extraction), Germinated naked barely flour (g/100g), Computed protein efficiency ratio and Biological Value.

Amino acids	Wheat flour 82%	Germinated naked barely	FAO/WHO/UNU (1985)Pattern
	A)Essential amino acids		
•Lysine	2.80	8.00	5.80
•Isoleucine	3.95	4.00	2.80
•Leucine	4.90	6.30	6.60
•Phenyl alanine+	5.50	7.50	6.30
•Tyrosine	1.90	4.90	-
•Histidine	4.00	1.50	1.90
•Valine	4.40	8.20	3.50
•Theronine	2.00	7.00	3.40
•Methionine	1.20	1.30	2.20
•Tryptophan	1.09	1.25	
Total (EAA)	32.55	49.95	
	B)Non-Essential amino acids		
•Aspartic	5.50	5.30	
•Glutamic	32.00	7.20	
•Proline	12.90	3.80	
•Serine	6.50	6.90	
•Glycine	3.80	7.50	
•Alanine	3.50	9.00	
•Arginine	2.60	8.50	
Total (NEAA)	66.8	48.2	
Total	99.35	98.15	
C-PER	1.557	2.8137	
BV	66.295	79.528	

EAA=Essential Amino Acids. , NEAA=Non-Essential Amino Acids. , C-PER= Computed protein efficiency ratio. , BV=Computed Biological Value.

Lotfy *et al.,* (2021) and El-Hadidy *et al.,* (2023) studied that germinated naked barley contained aspartic, 4.30–5.95; serine, 5.20–7.63; alanine, 9.04–13.09; arginine, 5.65–8.19; tyrosine, 4.17–6.38; proline, 3.14–6.68; threonine, 3.65–7.78; histidine, 1.45–9.06; valine, 6.48–8.38; methionine, 1.12–8.86; isoleucine, 3.95–4.54; leucine, 5.29–10.40; and lysine, 6.60–8.6185. Also, the results revealed that the C-PER value of naked sprouted barley was (2.813) but it was higher than that of wheat flour (1.577). On the other hand, the biological value showed the same trend. The biological value of naked sprouted barley powder was (79.528) but it was higher than that of wheat flour (66.295). These results were consistent with Dhital, A. (2021).

Sensorial evaluation of balady bread samples:

The results in Table (4f) showed that the Germinated naked barley mix which used in balady bread preparing had the lower values for some Quality attributes properties in compared to the other tested items. Moreover, balady bread had the lowest overall acceptability value (82.98). Control Sample (100% WF plus 5, 10, 15 % GNB for balady bread) had the highest overall acceptability characteristics. The sensory acceptability rating led us to conclude that GNB-based country bread could replace WF in this study at 5% without negatively affecting sensory quality, which is a substantial result. El-Dreny and El-Hadidy (2018) and Aslam *et al.,* (2023) found that incorporating 5% barley malt flour was the optimal level for enhancing the sensory characteristics of bread products.

Table 4. Sensory evaluation of balady bread samples:

Sensory properties Balady bread blends	Taste (20)	Crust Color (10)	Separation of Layers (15)	Rounder (10)	Distribution of crumb (10)	Odour (15)	General Appearance (20)	Overall acceptability (100)
Control 100% WF	19.40^a±0.10	9.40^a±0.13	14.80^a±0.10	9.80^a±0.10	9.60^a±0.10	14.50^a±0.12	19.60^a±0.04	97.1
5%NBGF +95% WF	19.10^b±0.15	9.00^b±0.12	14.50^b±0.15	9.60^b±0.05	9.30^b±0.09	14.30^b±0.10	19.00^b±0.03	94.8
10%NBGF +90% WF	18.50^c±0.20	8.47^c±0.10	14.00^c±0.10	9.00^c±0.08	9.00^c±0.13	14.00^c±0.09	18.4^c±0.15	91.73
15%NBGF +85% WF	18.00^d±0.15	8.00^d±0.15	13.50^d±0.20	8.50^d±0.10	8.60^d±0.14	13.50^d±0.20	17.05^d±0.20	87.15
20%NBGF +80% WF	17.00^e±0.30	7.60^e±0.14	13.00^e±0.15	8.00^e±0.13	8.00^e±0.15	13.00^e±0.17	16.38^e±0.30	82.98

WF = wheat flour GNB= Germinated Naked Barely

Means ± standard deviations with different superscript letters in the same colum are significantly different at (P≤0.05)

Chemical composition of balady bread samples prepared with germinated naked barely flour:

The chemical composition of balady bread samples incorporating germinated naked barley (GNB) flour at 5%, 10%, 15%, and 20% replacement levels is presented in Table (5). The findings indicate significant increases (P≤0.05) in crude protein, fat, crude fiber, and ash content in GNB-substituted balady bread compared to the control. The most substantial increase was observed in bread prepared with 20% GNB, followed by the 15% replacement. Conversely, caloric values showed an inverse relationship. The reduction in caloric content may be attributed to the higher levels of crude fiber, fat, and ash in GNB.

In a study by Abdullah *et al.,* (2022) examining the physicochemical composition of flour blends, germinated barley grain flour was utilized in various bread formulations. As the proportion of germinated barley malt flour increased in wheat flour mixtures, moisture, protein, fat, β–glucan, and ash contents rose, while gluten and carbohydrate levels significantly decreased. These changes could be due to variations in protein quality of the flours used and high substitution levels. Similarly, (Hussein *et al.,* 2006 and El-Dreny and El-Hadidy 2018). reported notable increases in ash, fat, fiber, and protein contents when wheat flour was supplemented with germinated barley flour at high replacement levels.

Table 5. Chemical composition of balady bread and Energy value samples replacing with germinated naked barely flour

Blends	Chemical composition %					Energy
	Protein	Total Fat	Ash	Fiber	Carbohydrates	(kcal/100g)
Control100% WF	11.80^e±0.04	1.90^e±0.01	1.15^e±0.07	1.81^e±0.05	83.34^a±0.04	407.36^a±0.10
Blend 1(5% GNBF +95% WF)	11.96^d±0.01	1.98^d±0.02	1.42^d±0.04	2.25^d±0.06	82.39^b±0.06	404.85^b±0.15
Blend 2(10% GNBF +90% WF)	12.11^c±0.02	2.06^c±0.01	1.70^c±0.05	2.68^c±0.09	81.45^c±0.10	402.34^c±0.40
Blend 3(15% GNBF +85% WF)	12.27 ^{b}±0.03	2.14^b±0.01	1.97^b±0.04	3.11^b±0.08	80.51^d±0.15	399.87^d±0.30
Blend 4(20% GNBF +80% WF)	12.48^{a}0.02	2.22^a±0.02	2.24^a±0.03	3.55^a±0.06	79.51^e±0.08	397.36^e±0.50

Means ± standard deviations with different superscript letters in the same colum are significantly different at (P≤ 0.05)

Minerals content of blends with germinated naked barely flour:

Table 6 showed that the mineral content of germinated naked barley flour blends with different ratios of germinated naked barley flour. The mineral content of micronutrients in control blends was 2.70, 1.50, and 10.50 mg/100 g for iron, manganese, and zinc, and the content of macronutrients was 160, 21, 159, and 155 mg/100 g for potassium, calcium, phosphorus, and magnesium, respectively. The results also showed that the mineral content of micronutrients in germinated naked barley flour was (3.30 - 5.06), (1.56- 1.70), and (10.26- 9.50) mg/100 g for iron, manganese, and zinc, while the content of macronutrients was (212.30 - 368.24), (25.90- 40.10), (168.55 - 197.20), and (147.85 - 126.50) mg/100 g for potassium, calcium, phosphorus, and magnesium, respectively. The results obtained were higher than those obtained by Al-Hadidy(2020) and Sagar *et al.* (2020).

Table 6. Minerals content in balady bread blends:

Minerals (mg/100 g)	balady bread blends				
	Control 100% WF	Blend 1 5% GNBF +95% WF	Blend 2 10% GNBF +90% WF	Blend 3 15% GNBF +85% WF	Blend 4 20% GNBF +80% WF
			Micro elements		
Fe	2.70^e±0.10	3.30^d±0.20	3.38^c±0.09	4.48^b±0.10	5.06^a±0.10
Mn	1.50^a±0.01	1.56^b±0.02	1.60^c±0.01	1.65^c±0.02	1.70^d±0.03
Zn	10.50^a±0.09	10.26^b±0.04	10.00^c±0.02	9.75^d±0.01	9.50^e±0.04
			Macro elements		
K	160.00^e±3.70	212.30^d±1.40	264.27^c±3.60	316.26^b±4.40	368.24^a±3.20
Ca	21.00^e±0.30	25.90^d±0.56	30.80^c±1.60	35.85^b±1.40	40.10^a±1.20
P	159.00^e±1.20	168.55^d±1.30	178.10^c±1.10	187.65^b±1.40	197.20^a±1.60
Mg	155.00^a±1.00	147.85^b±1.10	140. 70^c±1.20	133.60^d±1.40	126.50^e±1.70

Rheological properties of flour used in balady bread preparation:

From obtained results in table (7) it can be observed that the water absorption of Wheat Flour was gradually increased with the increasing the amount of GNB. The higher fiber amount of GNB was compared to WF may be the reason for the increased water absorption of WF dough. These results are in agreement with El Hadidy and EL- Dreny, .(2020 (revealed that increasing the amount of fiber sources added to WF resulted in the resulting dough absorbing more water.

Table 7. Farinograph parameters for wheat flour and germinated naked barely flour.

Flour blends	Water Absorption (%)	Arrival time (min)	Dough development(min)	Stability (min)	Degree of softening (B.U)
Control100% WF	56.50	1.0	2.5	4.50	120
Blend 1(5% GNBF +95% WF)	57.90	1.0	3.0	5.50	125
Blend 2(10% GNBF +90% WF)	59.700	1.5	3.5	6.50	130
Blend 3(15% GNBF +85% WF)	51.80	2.0	4.0	7.50	135
Blend 4(20% GNBF +80% WF)	63.50	2.5	4.5	8.00	140

Each value was an average of three determinations ± standard deviation.

WF = wheat flour GNB= Germinated Naked Barely.

Extensograph test:

Results in Table (8) showed that Extensograph parameters for WF and WF- GNB dough. The results of the extensograph of the balady bread mixed significantly by mixing with different levels of GNB flour showed that the elasticity in the Blend 1 replaced by 5% were increased significantly in compared with dough 1(control) was 220. The addition of WF: GNB (95:05) led to an increase in the elasticity in Blend 2, 3, and 4 at ratios of 10, 15, and 20 GNB to 330-450 respectively. The addition of WF: GNB (95:05) also led to a significant decrease in the extensibility in Blend 1 compared to control (115). The decrease in Extensibility in the Blend 2, 3, and 4 at replacement ratios of 10, 15, and 20% 100-90 respectively. Substitution of WF: GNB95:05 increased the proportional number in Blend 3, 4, and 5 by 10, 15, and 20% substitution ratios, to 3.30-5.00, respectively. These results were consistent with El-Hadidy, *et al.*, (2023).

Table 8. Extensograph parameters for different flour blends used in barley bread preparing.

Flour blends	Elasticity (B.U)	Extensibility (mm)	Proportional number	Energy (cm^2)
Control 100% WF	220	115	1.91	95
Blend 1 5% GNBF +95% WF	290	110	2.64	90
Blend 2 10% GNBF +90% WF	330	100	3.30	85
Blend 3 15% GNBF +85% WF	390	95	4.11	80
Blend 4 20% GNBF +80% WF	450	90	5.00	70

Each value was an average of three determinations ± standard deviation.
WF = wheat flour GNB= Germinated Naked Barely.

Textural properties Analysis (TPA) of prepared balady bread blends:

The data in Table (9) showed the Textural properties of balady bread samples with germinated naked barely flour replaced with 5, 10, 15, and 20% of GNB. The results showed that WF: GNB95:05 sample the highest hardness value was 8.30 while bread samples contained WF: GNB with (90:10) have the lowest value was 2.25. Bread samples that contained higher percentages of germinated naked barley flour are more tender which means that adding germinated naked barley flour makes the bread softer it almost observed all bread samples had the same deformation value except for sample with WF100% which had a lowest value of 2.99 which indicateds that addition of barley did not significantly affect the ability of the bread to change the shape under pressure.

Results of Adhesiveness for bread samples contained WF: GNB (95:05) showed the highest value being (25.00gm) while bread sample contained WF (100%) was (1 gm) while other bread samples WF: GNB (90:10), WF: GNB (85:15) and WF: GNB (80:20) have low values of Adhesiveness. These results are in agreement with Gupta, *et al.* (2009). On the other hand Resilience value, there were no significant differences in Resilience between all prepared bread samples were WF (100%) 0.27 and samples WF: GNB (95:05), WF: GNB (90:10), WF: GNB (85:15) and WF: GNB (80:20) were 0.14, 0.19, 0.16 and 0.24 respectively, indicating that the addition of barley did not significantly affect the ability of the bread to regain its original shape. Its Gumminess is 5.31 and it requires greater force to break it compared to other samples. Proper germinated treatment could improve the texture characteristics of mixed bread Cao *et al.* (2023).

Table 9.Textural profile Analysis of different prepared balady bread blends

Measurements	Content bread blends				
	Control WF 100%	Blend1 WF:GNB 95:05	Blend2 WF:GNB 90:10	Blend3 WF:GNB 85:15	Blend4 WF:GNB 80:20
Hardness	6.43	8.30	2.25	6.31	2.80
Deformation	2.99	5.99	5.99	6.00	5.99
Adhesiveness	1.00	25.00	0.00	0.00	0.00
Resilience	0.27	0.14	0.19	0.16	0.24
Cohesiveness	0.77	0.64	0.48	0.66	0.75
Springiness	2.61	7.63	1.85	4.49	4.22
Gumminess	4.93	5.31	1.08	4.19	2.09
Chewiness	131.00	413.00	200.00	192.00	90.00

CONCLUSION

The experimental findings indicate that germination significantly impacted the chemical composition and rheological characteristics of naked barley. Substantial increases were observed in the levels of crude protein, ether extract, ash, and fiber in the germinated samples. Moreover, the germination process led to elevated concentrations of minerals, specifically calcium, iron, and zinc. Furthermore, the rheological properties of the flour derived from germinated naked barley showed improvement, particularly in terms of dough raising capacity.

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الإستفادة من دقيق الشعير المنبت العارى فى تصنيع الخبز البلدى

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الملخص

يهدف هذا البحث إلى دراسة تأثير استبدال دقيق القمح بنسبة استخلاص82 ٪ بدقيق الشعير العاري المنبت (GNBF) بنسب مختلفة 5) ، 10 ، 15 ،20 ٪ (على الخصائص الكيميائية والفيزيائية والريولوجية لعينات الخبز البلدي. اظهرت النتائج المتحصل عليها إلى ارتفاع القيمة الغذائية لعينات الخبز البلدي المحتوي على دقيق الشعير العاري المنبت ايضا ارتفاع محتواها من حيث محتوى البروتين والألياف والرماد بنسبة14.90 ، 10.50 ، 6.60 على التوالي. وانخفض محتواها من الكربوهيدرات بينما اظهرت نتائج الأحماض الأمينية ارتفاع نسبة الأحماض الأمينية الأساسية وغير الأساسية في عينات الخبز البلدي التي تحتوي على دقيق الشعير العاري المنبت مقارنة بعينات الخبز المحتوية على دقيق القمح بنسبة100 ٪ . لذلك، توصى الدراسة أيضًا انه باضافة نسب من دقيق الشعير العاري المنبت الى عينات الخبز البلدي أدت إلى تحسين جودته الغذائية وكذلك خصائصه الحسية.