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Evaluation of Productivity, Physico-Chemical and Technological Characteristics of Some New Egyptian Wheat Varieties

[1*]Seham, Y. Gebreil & [2]Mohamed, M. Mohamed

[1]Department of Crops Technology Research, Food Technology Research Institute (FTRI), Agricultural Research Center, 12619, Giza, Egypt

[2]Wheat Research Department, Field Crops Research Institute, Agricultural Research Center, 12619 Giza, Egypt

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ABSTRACT

This study aims to investigate the quality potential of three new Egyptian wheat varieties (Misr 4, Benisweif 7, and Benisweif 8). Misr 4 as a new bread wheat variety compared with Sids 1 as an old bread wheat variety, Benisweif (7 and 8) as a new durum wheat variety compared with Sohag 4 as an old durum wheat variety. A field experiment was conducted during the two seasons of 2018–2019 and 2019–2020. Chemical, physical, yield extraction (%), rheological, and technological characteristics have been analyzed. Bread wheat varieties were milled to obtain wheat flour (82% extraction). Durum wheat varieties were milled to obtain semolina extraction. In the second season, the protein content recorded the highest in Misr 4 (13.38%) compared with Sids 1 as bread wheat. while Benisweif 8 had the highest protein content of 13.25% compared with Benisweif 7 and Sohag 4 as durum wheat. The rheological properties were measured by Farinograph and Extensograph. The results from Farinogram showed the highest dough stability value in Misr 4 as bread wheat (10.5 min), but was 6.5 min in Benisweif 8 as durum wheat. Extensogram results were similar to those of the Farinogram. After that, produce a specific end product: bread from bread wheat flour (82% ext.), pasta from durum wheat semolina. These findings contribute to taking into account Egypt's Sustainable Agricultural Development Strategy (SADS) for 2030. In particular, the new wheat varieties (Misr 4 and Benisweif 8), which produce high grain yields and quality.

1. Introduction

Wheat (Triticum spp.) has been an important source of human nutrition for thousands of years. Bread (*Triticum aestivum* L.) and durum (*Triticum turgidum* L. spp. durum Desf.) wheat are two cereal species well adapted to Mediterranean environments, with bread being the main end-product of bread wheat, whereas durum wheat is mainly used to produce semolina for the pasta industry (Lopez-Castaneda and Richards 1994). Bread wheat (*Triticum aestivum L.)* is a hexaploid species with 2n = 6x = 42 (Sleper and Poehlman 2006; Shehu et al., 2022). Durum wheat (T. turgidum subsp. durum, 2n = 4x = 28, AABB) (Shewry 2009). The wheat crop is one of the most important human food sources in the world. In Egypt has been considered the first staple food crop for more than 7000 years. Wheat waste is also used to feed animals. The amount of cultivated area in Egypt reached 3.43 million feddans (one faddan = 4200 m^2) in the 2020–2021 growing season, with an average grain yield of 19.0 ardab/faddan, or 7.00 ton/ha (Economic Affairs Annual Report, 2021). Wheat grows across most governorates of Egypt, and the cultivation of durum wheat is prevalent in Middle and Upper Egypt, where it produces high-quality semolina, which plays a major role in producing macaroni and other pasta products extracted from durum wheat flour. (Sadek et al., 2011).

*Corresponding Author
Email: Sehamgebreil13@yahoo.com

Nowadays, the main task of the genetic improvement of common wheat is focused on the establishment of breeding lines and varieties with increased yield potential, minimizing the losses due to environmental stresses, with improving grain quality (Silva et al., 2019).

Numerous countries, including Egypt, depending mostly on wheat flour, and its wastes are utilised to feed animals (Milad et al., 2013). There was a gap between wheat production and consumption's people in Egypt, the Egyptian wheat production is about 8.9 m tons while the consumption is about 20 m tons (USDA 2022). To reduce the gap we need to increase the potential of wheat cultivars and increase the wheat growing areas. Therefore, new wheat varieties developed by the National Program for Wheat Research, such as Gemmiza 7, Giza 168, Sohag 3, and Sakha 93, had been characterized with the highest yield and pest resistance (Anon 2005).

By improving grain yield and productivity, the Egyptian government plans to gradually reduce its reliance on imported wheat (Kherallah et al., 2000). Breeding high-yield cultivars can increase wheat yield production per unit of land area (Khan et al., 2009). Wheat cultivars differ in parameters for growth and yield and their constituents (El-Sayed et al., 2018).

(Ferrarl et al., 2014) ascertained that gluten content is an important factor that determines flour quality. Gluten is a plastic-elastic protein fraction of wheat flour that influences the physical properties of dough (Xiao-lan et al., 2009). In recent years, the interest of breeders in technological qualities has increased as the milling industry requires high-quality material for processing. Improving these grain characteristics is a complex task given the negative correlations between productivity and quality (Marcheva 2021). The percentage of grain protein in durum and bread wheat varies as well; usually, durum contains a higher percentage than bread wheat (Brankovic et al., 2018).

Protein content ranges from 12–16% for durum and other hard wheat to 8–10% for soft wheat (USDA/NASS 2001). The beneficial characteristics of flour considerably depend on the gluten proteins. The quality of gluten varies depending on many factors, such as wheat variety and conditions for cultivation (Caballero et al., 2007). Based on the varieties, the chemical and physical characteristics of whole wheat grains would significantly differ and affect the processing and quality of end-products (Ndolo and Beta 2013). Balady bread is among the most important components of the meal for both rich and poor Egyptian consumers (El-Soukkary 2001). Pasta products are extremely prevalent owing to their nutrient components, long periods of availability in the market, affordability, ease of getting ready, and additionally, easy transportation (Gupta et al., 2021).

This study aims to evaluate the productivity, physico-chemical, rheological characteristics, and technological quality of three new Egyptian wheat varieties (Misr 4, Benisweif 7, and 8) compared with old Egyptian wheat varieties (Sids 1 and Sohag 4) during seasons (2018–2019 and 2019–2020), which can influence the quality of their based products.

2. Materials and Methods

Materials

Wheat varieties

Three new Egyptian wheat varieties, including Misr 4 as a new bread wheat variety compared with Sids 1 as an old bread wheat variety and Benisweif (7 and 8) as a new durum wheat variety compared with Sohag 4 as an old durum wheat variety, were obtained from the Field Crops Research Institute, Agriculture Research Center, Giza, Egypt. Each cultivar is evaluated in two successive growing seasons: 2018–2019 and 2019–2020.

The names, pedigree, and selection history of the studied varieties are presented in Table 1. Granulated sugar, instant dry yeast, and table salt were obtained from the local market in Giza, Egypt. The chemicals used in this study were analytical reagent grade.

Table 1. Name, pedigree and selection history of the studied wheat cultivars

Name	Pedigree and selection history	Origin
Misr 4	NS732/HER/3/PRL/ SARA// TSI/VEE 5/6/FRET 2/5/WHEAR/SOKOLL. CM SA09Y007125-050Y- 050ZTM-0NJ-099NJ-0B-0EG.	Egypt
Sids 1	HD2172/Pavon "S"//1158.57/Maya 74"S" S 46-45D-25D-15D-05D	Egypt
Benisweif 7	CBC509CHILE//SOOTY_9/RASCON_37/9/USDA595/3/D67.3/ RABI//CRA/4/ALO/5/ HUI/YAV_1/6/ARDENTE/7/HUI/YAV7 9/8/POD_9. CDSS02-Y01233T-0T0PB-0Y-0M -26Y-0Y-0SD.	Egypt
Benisweif 8	SOOTY_9/RASCON_37//STORLOM/5/TOSKA_2 6/RASCON_37//SNITAN/4/ ARMENT//SRN_3/N IGRIS_4/3/CANELO_9.1/6/RISSA/GAN//POHO_ 1/3/PLATA_3// CREX/ALLA*2/4/ARMENT//SRN _3//NIGRIS_4/3/CANELO_9.1. CDSS07Y00575T-099Y099M-13Y-1M-04Y-0B-0EG	Egypt
Sohag 4	Ajaia-I6//Hora/Jro/3/Ga/4/Zar/S/Suok-7/6/Stot//Altar84/Aid. CDSSB007785-0T0PY-0M-0Y-129Y-0M-0Y-IB-0SH.	Egypt

Methods

Field trial design

This experiment was conducted at Sids, agricultural Research Station Farm, Egypt, during the two winter growing seasons of 2018–2019 and 2019–2020. Five wheat cultivars were studied. The names and pedigree of all cultivars are presented in Table 1. The experiment was laid out in a randomized complete block design (RCBD) with three replications. The plot area was 3.6 m^2, consisting of 6 rows 3 m long and 0.2 m apart. All the agricultural practices were applied as recommended. The measured characteristics were 1000-kernel weight (g), recorded as an average of three random samples of 1000 kernels from clean grains in each plot. Yield and yield components: The number of kernels in spike 1 was estimated as the average number of grains from ten spikes randomly taken from each plot. The number of spikes m-2 was estimated as the number of fertile spikes in a guarded square meter within each plot before harvesting. Grain yield (kg/plot) was estimated as the weight of grains in each plot. All the data were calculated according to (Eisenhart and Russell 1966).

Physico-chemical, rheological, and technological characteristics

Preparation of wheat samples

Five kilograms of each wheat sample variety were cleaned manually to remove dirt, impurities, and other foreign grains. Wheat grain samples were conditioned to 14 and 16% moisture content for soft wheat and durum wheat, respectively, at 40°C for 18–24 h. Wheat grains are milled by a laboratory mill using CDI auto-chopping. According to the method described in the AACC method (2000), The extraction rate of flour samples (bread wheat varieties) was adjusted to a recurrence rate of 82% extraction. Durum wheat varieties were milled on a Buhler semolina mill to produce semolina.

Physico-chemical characteristics

The thousand kernel weight and hectoliter weight of different wheat varieties were determined using stander procedures according to (AACC 2002). Using a farinator, kernels were sliced, and the vitreous kernels were counted. The flour extraction yield was determined as a percentage of the flour from the mass of grains milled (A.A.C.C., 2002). Semolina extraction rate (%) was milled according to (AACC 2002) on a laboratory mill, model Brabender. Color parameters: The external color of grains and cooked pasta samples was measured using a hand-held chromameter (model CR-400, Konica Minolta, Japan). Color parameters were expressed as the values L =lightness (0 = black, 100 = white), a (-a = greenness, +a = redness), and b (-b = blueness, +b = yellowness). All measurements were averages of three replicates.

Chemical analysis

Moisture, crude protein, ether extract, ash, and crude fiber content were determined according to the methods of (AOAC 2005). Total carbohydrate was calculated by differences.

Potassium, calcium, magnesium, zinc, and iron contents were determined in samples according to the method outlined in the (AOAC, 2019) using the Agilent Technologies Microwave Plasma Atomic Emission Spectrometers (Model 4210 MPAES, USA). Phosphorus was determined by the colorimetric method of (Trough and Mayer 1929). After extracting flour (82% ext.) from bread wheat varieties and semolina from durum wheat varieties, the two seasons were mixed to investigate their rheological and technological characteristics.

Rheological properties of wheat flour (82%), and semolina

Farinograph test

A farinograph instrument (Barbender Duis Burg type 810105001 No. 941026, made in West Germany) was used to determine the water absorption and characteristics of the dough under investigation. The following parameters were obtained from the Farinograms, except the percentage of water absorption, which was recorded directly from the Farinograph instrument: arrival time (min), dough development time (min), dough stability, and degree of softening (B.U.) as described in the (AACC 2002).

Extensograph test

The extensograph test was carried out according to the method described in (AACC 2002). An extensograph (Barbender Duis Bur G, type 860001 No. 946003, made in West Germany) was used to measure the following parameters: dough elasticity (B.U.), dough extensibility (mm), proportional number (P.N.), and dough energy (cm^2).

Gluten content

which includes wet gluten and dry gluten, was estimated according to AACC 2002.

Balady bread preparation and baking

The baking ingredients included 100 g of wheat flour (82% extraction) baked into balady bread (14% moisture basis), 1 g of instant dry yeast, and 1 g of table salt. All ingredients were mixed with the time and amount of water estimated from the Farinograph parameters. The formed soft dough was left to rest for one hour in the fermenter at 35–37°C and 80 % relative humidity, then moved to a box of wood and enabled to ferment for another 30 minutes in the fermentor at 35–37 °C and 80 % relative humidity. The dough was manually portioned into 120–130 g portions, placed on wooden racks that had a layer of fine bran on them, and then dusted with flour. After proofing for 15 minutes, dough pieces were dusted again with flour, flattened, and degassed by gentle hand pressing, and then baked in a hot steel belt oven at 450–500°C for 1-2 minutes in the oven. Bread loaves were allowed to cool on racks for about one hour before assessment, then stored for 24, 48, and 72 hours, according to the method described by (Faridi and Rubenthaler 1984).

Sensory evaluation of balady bread

Balady bread samples were sensorial evaluated after baking by 10 panelists who were members of the Department of Crops Technology Research, Food Technology Research Institute, Agriculture Research Center, Giza, Egypt. All samples were provided on white plates at the ambient temperature. The panelists were asked to evaluate each sample of the balady bread for appearance, crust color, crumb color, taste, separation of layers, texture, aroma, roundness, and overall acceptability. The balady bread samples were rated on a 1–9-point hedonic scale (1 = dislike extremely, 2 = dislike very much, 3 = dislike moderately, 4 = dislike slightly, 5 = neither like nor dislike, 6 = like slightly, 7 = like moderately, 8 = like very much, and 9 = like extremely) according to (Stone and Sidel 1992). Scores were collected and analyzed statistically.

Physical properties of balady bread

Loaf volume (cm^3) was determined by measurement of rapeseed displacement after the bread had been dried at room temperature for one day to harden its surface. Specific volume (cm^3/g) was calculated by dividing the volume (cm^3) by the weight (g) according to (AACC 2000).

Percentage of alkaline water retention capacity (AWRC%) and staling rates (SR%)

Alkaline water retention capacity (AWRC %) and staling rates (%SR) were calculated using the Alkaline Water Retention Capacity Method, according to (Yamazaki 1953): Briefly, one gram of each dried ground balady bread sample was put in a 15-ml tube (W1), then 5 ml of 0.1 N $NaHCO_3$ were added and mixed for 30 s and were let at room temperature (30°C) for 20 min. The slurry was centrifuged at 3000 rpm for 15 min, the supernatant was discarded, and tubes were let to drip upside down for 10 min. Dried tubes were then weighed (W2). The percentage of AWRC was calculated using the following equation (1):

$$AWRC\ (\%) = \frac{W_2 - W_1}{W_1} \times 100 \qquad (1)$$

Where: alkaline water retention capacity; W1: weight of tube containing the dry sample; W2: weight of tube containing the dripped sample.

Analyses were conducted in triplicate at zero time and after 24, 48, and 72 hours.

The percentage of staling rate (freshness) of balady bread was evaluated every day during storage at room temperature (30°C) according to the method explained by (Yamazaki, 1953).

The percentage of staling rate (SR%) was calculated by the following equation (2):

$$SR(\%) = \frac{AWRC_0 - AWRC_n}{AWRC_0} \times 100 \qquad (2)$$

Where, SR (%): Percentage of staling rates, AWRC0: Alkaline water retention capacity at zero time, AWRCn: Alkaline water retention capacity after 24, 48 and 72 hours.

Pasta processing

Different samples of spaghetti were prepared by using Pasta Matic 700 (Simac Machine Corporation, Milano, Italy) according to the method described by (Breen et al., 1977).

Sensory evaluation of pasta

Sensory evaluation was conducted by 10 panelists from the Department of Crops Technology Research, Food Technology Research Institute, according to the method described by (Bashir et al., 2012). The pasta samples were cooked in boiled distilled water until they reached the optimal cooking time obtained, drained for 2 minutes, and then served to the panelists. A 9-point descriptive scorecard that included appearance, color, taste, odor, texture, stickiness, and overall acceptability were evaluated using a 9-point hedonic scale test, with 9 = likely extremely, 5 = neither like nor dislike, and 1 = dislike extremely.

Cooking quality of pasta

The quality of the cooking analysis of pasta includes measurements of the optimum cooking time, the weight increase, and the cooking loss of pasta samples, which were determined using the (AACC 2000).

The optimal cooking time of pasta samples is determined by cooking 10 grams of pasta in 250 ml of boiling distilled water, removing one piece of pasta from the cooking water every 30 seconds, and then squeezing the pasta piece between two glass slides. The optimal cooking time of pasta is corresponding to the time taken for the disappearance of the center starch core of the cooked pasta (AACC, 2000).

The weight increase of pasta

The weight increase of pasta was determined by (Walsh and Gilles, 1971). The value was calculated by weighing the cooked pasta after drainage. The increase in weight was recorded as a percentage of the starting weight equation (3).

$$weight\ increase\ of\ pasta = \frac{weight\ of\ cooked\ pasta - weight\ of\ uncooked\ pasta}{weight\ of\ uncooked\ pasta} \times 100 \qquad (3)$$

Cooking loss (%)

Ten grams of pasta were weighed and cooked in 250 ml of boiling distilled water for about 9 min., and the optimum cooking time (OCT) was recorded for each blend (AACC, 2000, method 66-50). The cooked pasta was immediately drained using a Buchner funnel held directly above the cooking pan to retain the cooking water. The drained pasta was patted dry with a paper towel and weighed. The cooking pan containing water from cooking and rinsing was dried at 105°C in a drying oven for 16 hours until a constant weight was achieved, and the increase in weight was recorded. Three measurements were taken for each sample. The cooking loss and water absorption (%) were calculated using the following equations (4):

$$\text{Cookingloss (\%)} = \frac{\text{weight of cooking water after drying}}{\text{weight of dried pasta}} \times 100 \quad (4)$$

Texture characteristics

Texture profile analysis (TPA) was determined using a universal testing machine (Cometech, B type, Taiwan), provided with software. An aluminum 4 mm-diameter cylinder probe was used in a texture profile analysis (TPA) double compression test to penetrate to 50% depth at a 1 mm/s speed test. Firmness (N), gumminess (N), chewiness (N), cohesiveness (Ratio), and springiness (mm) were calculated from the TPA graphic. Both springiness and resilience provide information about the after-stress recovery capacity. But, while the former refers to retarded recovery, the latter concerns instantaneous recovery (immediately after the first compression, while the probe moves up). Texture analyses were carried out, after removing the crust, in 40*40*30 mm-size samples (Bourne, 2003).

Statistical Analysis

Costat statistical software version 6.400 was used to analyze the data. The collected data were analyzed from three repetitions of any experiment and were statistically analyzed for means and standard deviations in triplicate. The data were subjected to one-way analysis of variance (ANOVA) at p $p \leq 0.05$, followed by Duncan's new multiple range tests, to assess differences between the sample means (Snedecor and Cochran, 1994).

Results and Discussions

The analysis of variance for agronomic characteristics is shown in Table 2.

Bread Wheat

For grain yield and its component, results showed that, among the investigated cultivars, genotype Misr 4 revealed the best values for all characteristics, significantly superior to Sids 1 in the two seasons (2018–2019 and 2019–2020). The extent of variability for any trait is very important for the improvement of a crop through breeding.

Durum Wheat

For grain yield and its component, results in the same Table 2. showed that, among the investigated cultivars, genotype Benisweif 8 revealed the best values for all characteristics in the two studied seasons. These results agree with (Arab, 2016 and Al-Sayaydeh et al., 2023).

Table 2. The analysis of variance for earliness and agronomic characters

Varieties	1000KW	# Kernel Spike^{-1}	# of spike/m^2	Grain Yield (kg/plot)
		Bread wheat		
		2018/2019		
Misr 4	52.14±0.41^a	70.03±1.00^a	397.66±5.50^a	3.35±0.01^a
Sids 1	48.95±0.39^b	62.66±0.26^b	357.33±1.12^b	2.97±0.02^b
		2019/2020		
Misr 4	58.60±0.62^a	73. 5±0.45^a	406.66±11.54^a	3.11±0.08^a
Sids 1	49.70±0.2^b	68.9±0.45^b	393.33±7.63^a	2.72±0.06^b
		Durum wheat		
		2018/2019		
Benisweif 7	43.53±0.90^c	69.66±8.62^a	341.33±2.30^b	2.17±0.06^b
Benisweif 8	54.75±0.47^a	82.00±1.00^a	492.00±6.35^a	2.94±0.14^a
Sohag 4	51.26±0.20^b	82.66±6.80^a	534.664±0.21^a	2.90±0.03^a
		2019/2020		
Benisweif 7	53.98±0.88^a	84.00±1.00^a	482.33±1.52^c	1.95±0.04^c
Benisweif 8	54.00±0.87^a	82.66±0.40^a	499.00±2.00^a	3.30±0.03^a
Sohag 4	51.83±0.27^b	84.33±1.15^a	487.66±3.21^b	3.08±0.01^b

The number in the same column followed by the same superscript are not significantly different at $p < 0.05$.

Physico-chemical properties, rheological, and technological characteristics

Wheat quality can be widely defined into physical, chemical, rheological, and technological characteristics. Physical grain quality attributes include thousand kernel weight, hectoliter weight, vitreousness, and color parameters, all of which can influence chemical and/or processing characteristics (Marcheva, 2021 and Giunta et al., 2019). Tables 3 and 4 give the mean values of the physical qualities, flour or semolina yield (%), and chemical analysis of Egyptian wheat varieties that are new (Misr 4, Benisweif 7, and Benisweif 8) and old (Sids 1 and Sohag 4). The physical characteristics, flour yield (%), and chemical analysis findings for the new bread wheat variety (Misr 4) and the old bread wheat variety (Sids 1) were displayed in Table 3. The tabulated results showed that Misr 4 outperformed the old wheat variety (Sids 1) in terms of thousand-kernel weight (52.25–58.66 g), hectoliter (82.70–82.90 kg/hl), and vitreousness (88.56%–91.39%) during the 2018–2019 and 2019–2020 seasons, respectively. This means that the new wheat variety Misr 4 had more weight in 1000 kernels and hectoliters and then would have a high flour yield, which was significantly the highest flour yield of Misr 4 up to 69.31 and 70.06% during the tested seasons compared to Sids 1. The results are in agreement with (Mpofu et al., 2006), who found that test weight (hectoliter) values in six red and white hard spring wheat genotypes ranged from 74.1 to 83.8 kg/hl. In addition, (Shalaby et al., 2023) reported that the test weight and 1000 kernel weight values of different soft wheat varieties ranged from 65.44 to 56.83 kg/hl and 38.29 to 47.86g, respectively. Also, the color determination of wheat kernels is an important characteristic of the end product's color quality, as presented in Table 3. Misr 4 had the highest values of L, a, and b compared with Sids 1. Misr 4 recorded the highest *L* values *(*64.72 and 65.14) compared with Sids 1 (62.66 and 62.85) for the two seasons, respectively. This means that Misr 4 would produce wheat flour whiter than Sids 1. Whiteness, or brightness, is one of the most important criteria for flour grade (Zhang, 2003). In the same Table 3., the chemical composition of whole-meal wheat varieties is presented. Determining moisture content is an essential first step in assessing wheat or flour quality. From tabulated data, results indicated that the new wheat flour variety (Misr 4) contained higher values of moisture (8.76–8.85%), protein (13.18–13.38%), and fat (2.20–2.19%), respectively. On the other hand, the new bread wheat (Misr 4) contained lower values of ash (2.22–2.04%), crude fiber (2.16–2.28%), and carbohydrates (80.24–80.11%), respectively, during the two seasons compared to the old wheat flour variety (Sids 1). Several studies have revealed differences in the chemical makeup of different wheat varieties. (Rachoń and Szumilo, 2009) reported that the contents of protein, fat, fiber, carbohydrate, and ash of some bread wheat varieties ranged from 11.0–12.10%, 1.90–2.10%, 2.10–2.90%, 81.30–83.10%, and 1.60–2.0%, respectively. The entire wheat sample meal's mineral composition matched those found by (Shewry et al., 2023) quite well.

Table 3. displays the mineral contents (i.e.) of two bread wheat varieties. According to the findings, during the two tested seasons, the novel bread wheat variety Misr 4 had higher levels of phosphorus, calcium, and magnesium (4820.0–4866.0, 359.0-349.9, and 1153.0–1155.5 mg/kg), respectively, than the Sids 1 variety. On the contrary, Misr 4 had the lowest mineral content of potassium, zinc, and iron compared to Sids 1 for all tested seasons. The recommended daily allowance (RDA) of K, Mg, Ca, Fe, and Zn ranged from 4.700–5000, 310–420, 1000 –1200, 8–18, 8–11, and 2.5–5.0 mg per day, respectively (Anon., 2013). This indicates that the wheat flour of bread wheat is rich in Mg, Fe, and Zn and can afford part of the mineral nutrient requirements. According to (Biel et al., 2021), the mineral concentrations of whole wheat flour (T. aestivum) ranged from 4740–6450 mg/kg for K, 310–370 mg/kg for Ca, 1040–1740 mg/kg for Mg, 58–94 mg/kg for Fe, and 17.8–38.8 mg/kg for Zn, these results are consistent with their findings.

Table 3. Physical characteristics, chemical composition and mineral content of new Egyptian bread wheat varieties during seasons (2018/2019 and 2019/2020).

Parameters	Bread wheat			
	First season (2018/2019)		Second season (2019/2020)	
	Misr 4	Sids 1	Misr 4	Sids 1
Physical characteristics				
1000 Kernel weight (g)	52.25±0.23[a]	49.06±0.14[b]	58.66±0.02[a]	49.99±0.05[b]
Hectoliter (kg/hl)	82.70±0.20[a]	81.03±0.06[b]	82.90±0.05[a]	81.82±0.00[b]
Vitreousness (%)	88.56±0.15[a]	71.36±0.06[b]	91.39±0.01[a]	82.05±0.05[b]
Flour yield (%)	69.31±0.02[a]	66.89±0.03[b]	70.06±0.06[a]	66.98±0.04[b]
L*	64.72±0.04[a]	62.66±0.03[b]	65.14±0.02[a]	62.85±0.05[b]
a*	5.11±0.01 [a]	5.08±0.01[a]	5.01 ±0.01[a]	4.97±0.03 [a]
b*	18.02± 0.01[a]	17.03±0.01[b]	18.18±0.00[a]	17.93±0.01[b]
Chemical composition**				
Moisture	8.76±0.03[a]	8.66±0.01[b]	8.85±0.00[a]	8.70±0.01[b]
Protein	13.18±0.01[a]	10.21±0.01[b]	13.38±0.01[a]	10.42±0.01[b]
Fat	2.20±0.01[a]	2.06±0.01[b]	2.19±0.01[a]	2.17±0.01[a]
Ash	2.22±0.01[b]	2.25±0.01[a]	2.04±0.01[b]	2.24±0.01[a]
Crude fiber	2.16±0.01[b]	2.28±0.01[a]	2.28±0.01[b]	2.52±0.00[a]
Total carbohydrates	80.24±0.03[b]	83.20±0.01[a]	80.11±0.02[b]	82.65±0.01[a]
Mineral content (mg/kg)				
Potassium	3811.0	3820.3	3767.8	3811.3
Phosphorus	4820.0	4788.5	4866.0	4770.5
Calcium	359.0	358.7	349.9	336.8
Magnesium	1153.0	1151.8	1155.5	1151.5
Zinc	38.20	39.90	37.15	38.22
Iron	51.75	53.85	51.65	52.85

L* (lightness with L = 100 for lightness, and L = zero for darkness), a* [(chromaticity on greenness (-) to redness (+)], b* [(chromaticity on blueness (-) to yellowness (+)]. **Chemical composition was calculated as (%) on dry weight basis except for moisture. Means followed by different letters in the same row are significantly different at $p < 0.05$.

Furthermore, Table 4 displays the physical properties, flour yield percentage, and chemical analysis results for the new durum wheat varieties (Benisweif 7 and 8) and the old durum wheat variety (Sohag 4). Results showed that Benisweif 8 had significantly the highest values of thousand-kernel weight (55.04-54.02), hectoliter (84.06–84.58 kg/hl), and vitreousness (96.03–96.39%) during the seasons (2018–2019 and 2019–2020), respectively, followed by Benisweif 7 compared with the old wheat variety (Sohag 4). This means that if the new wheat variety Benisweif 8 had more kernel weight and hectoliter, then it would have a high semolina yield, which was significantly the highest semolina yield, up to 71.07% in the second season compared to other tested durum wheat varieties. Regarding the color parameters of wheat kernels, they are important characteristics for the end product's color quality, as presented in Table 4. Benisweif 7 and 8 had the slightly lowest values of the L parameter. While Benisweif 8 had the highest significantly higher a and b values compared to Benisweif 7 and Sohag 4, these results indicated that Benisweif 8 had a higher yellowness value (due to its high carotenoid contents) compared with Benisweif 7 and Sohag 4. This would produce semolina of a highly preferable color.

In the same Table 4., the chemical composition of whole meal durum wheat varieties is presented. From tabulated data, results indicated that the new durum wheat variety (Benisweif 8) contained the highest values of protein (12.77–13.25%) and fat (2.23–2.21%) during the studied seasons. And the lowest values of ash, crude fiber, and carbohydrates. The amount of ash in flour not only reveals the amount of bran that remains but also serves as an indicator of milling performance and extract yield that can be expected during milling. The ash content in flour can cause color changes, giving the end product a deeper dark color. Many products, especially those that require white flour, have a low ash content, while others, such as whole wheat flour, contain a high amount of ash (Trajkovic et al., 1983). While the durum wheat varieties Benisweif 7 and Sohag 4 contained the same significant values of protein, fat, and carbohydrates in the first season and the same significant values of protein, ash, crude fiber, and carbohydrates in the second season, The mineral content (i.e., potassium, phosphorus, calcium, magnesium, zinc, and iron) of three durum wheat grain varieties is presented in Table 4.

Table 4. Physical characteristics, chemical composition and minerals content of new Egyptian durum wheat varieties at seasons (2018/2019 and 2019/2020).

Parameters	Durum wheat					
	First season (2018/2019)			Second season (2019/2020)		
	Banisweif 7	Banisweif 8	Sohag 4	Banisweif 7	Banisweif 8	Sohag 4
Physical characteristics						
1000 Kernel weight (g)	43.5±0.05[c]	55.04±0.13[a]	51.26±0.20[b]	53.98±0.14[a]	54.02±0.06[a]	51.86±0.09[b]
Hectoliter (kg/hl)	82.01±0.02[c]	84.06±0.02[a]	83.04±0.04[b]	83.63±0.28[b]	84.58±0.03[a]	83.23±0.05[c]
Vitreousness (%)	94.6±0.10[b]	96.03±0.05[a]	94.5±0.10[b]	94.95±0.01[b]	96.39±0.01[a]	94.93±0.01[b]
Semolina yield (%)	68.81±0.01[b]	70.97±0.04[a]	70.95±0.05[a]	70.93±0.06[b]	71.07±0.02[a]	69.96±0.03[c]
L*	61.18± 0.01[a]	61.14±0.02[a]	61.19±0.06[a]	61.38±0.01[b]	61.20±0.01[c]	61.42±0.02[a]
a*	6.17±0.01[b]	6.23±0.00[a]	6.17±0.00[b]	6.20±0.01[b]	6.26±0.01[a]	6.20±0.01[b]
b*	19.02± 0.01[b]	19.32±0.01[a]	19.03±0.01[b]	19.36±0.00[b]	19.38±0.02[a]	19.33±0.01[c]
Chemical composition**						
Moisture	8.21±0.01[c]	8.83±0.01[b]	8.88±0.01[a]	8.68±0.01[b]	8.99±0.01[a]	8.60±0.01[c]
Protein	12.50±0.01[b]	12.77±0.01[a]	12.52±0.02[b]	13.15±0.01[b]	13.25±0.01[a]	13.16±0.01[b]
Fat	2.21±0.00[b]	2.23±0.01[a]	2.22±0.01[ab]	2.17±0.01[b]	2.21±0.01[a]	2.21±0.01[a]
Ash	2.28±0.01[a]	2.26±0.02[b]	2.27±0.01[b]	2.29±0.01[a]	2.26±0.01[b]	2.28±0.01[a]
Crude fiber	2.38±0.01[a]	2.27±0.01[c]	2.36±0.01[b]	2.32±0.01[a]	2.28±0.01[b]	2.33±0.01[a]
Total carbohydrates	80.63±0.02[a]	80.47±0.02[b]	80.63±0.02[a]	80.07±0.01[a]	80.00±0.02[c]	80.02±0.02[b]
Mineral content (mg/kg)						
Potassium	4396.8	4271.8	4367.3	4382.5	4122.8	4355.5
Phosphorus	3626.8	3617.8	3590.3	3630.0	3622.5	3592.8
Calcium	377.5	332.0	368.5	387.3	346.5	376.0
Magnesium	882.5	865.5	867.3	899.8	870.0	874.8
Zinc	49.00	51.71	51.35	50.25	51.75	50.75
Iron	71.85	73.65	70.65	71.80	71.50	70.75

L* (lightness with L = 100 for lightness, and L = zero for darkness), a* [(chromaticity on greenness (-) to redness (+)], b* [(chromaticity on blueness (-) to yellowness (+)]. **Chemical composition was calculated as (%) on dry weight basis except for moisture. Means followed by different letters in the same row are significantly different at $p < 0.05$.

The data revealed that the new durum wheat varieties Benisweif 7 contained the highest amounts of potassium, phosphorus, calcium, and magnesium (4396.8–4382.5, 3626.8–3630.0, 377.5–387.3, and 882.5–899.8 mg/kg), followed by Sohag and Benisweif 8 during the tested seasons, respectively. On the contrary, Benisweif 8 had the highest contents of zinc and iron compared with the other tested wheat varieties. The difference in protein content between bread wheat flour and durum wheat flour and the corresponding flours has been reported by numerous researchers (Assefa et al., 2023; Amir et al., 2020). There were some differences in the mineral and trace element concentrations in the data reported for genotypes and environmental effects. (Rodríguez et al., 2011). Moreover, (Ficco et al., 2009) analyzed the mineral content of a whole set of 84 Italian durum wheat cultivars and reported values for K, Zn, and Fe similar to our results.

Rheological properties

The technological quality of wheat flour is determined by the sum of different flour properties that influence the properties of the dough, its behavior during processing, and ultimately the final product. It is determined by various chemical, physical, and rheological tests (Zivancev et al., 2009). The rheological properties of different types of wheat flour dough were measured using brabender, farinograph, and extensograph instruments.

Farinogram parameters

All bread wheat flour dough produced from 82% extraction and semolina durum dough for all wheat varieties for the two seasons were rheologically tested by using Farinograph. Data presented in Table 5 show that the wheat flour dough (82% extraction rate) of the new bread wheat (Misr 4) sample had higher values of water absorption, arrival time, and dough development time (61.2%, 1.5 min., and 2.5 min.), respectively, than that of the old bread wheat (Sids 1) (60%, 1.0 min., and 1.5 min.), respectively. Regarding dough stability and degree of softening, it was found that Misr 4 showed a long period of dough stability of 10.5 minutes, with low values of dough softening being 40 B.U. On the contrary, Sids 1 resulted in the shortest period of dough stability being 2.5 minutes and the highest value of dough softening being 90 B.U. From the same results (Table 4), it could also be observed that the new durum wheat variety Benisweif 8 had the highest values of water absorption and dough stability (69.0% and 6.5 min.), respectively, with the lowest value of degree of softening (80 B.U.) compared with the other samples. On the other hand, Benisweif 7 and Sohag 4 had the same values of dough development time, dough stability, and degree of softening (2.0 min., 4.5 min., and 110 B.U.), respectively.

(Torbica et al., 2011) showed that water absorption might be influenced by the amount of proteins and starch found in wheat flour and their different properties compared to other wheat flours.

Dough stability is a particularly important index for dough strength and is related to protein in the sulfhydryl group, which usually causes a softening or degradation of dough (Ismail, 2007). The higher fiber content may cause decreased dough stability, resulting in a breakdown of the gluten matrix (Ismail, 2007). These results may be attributed to the finding that Misr 4 and Benisweif 8 had the highest contents of protein, which caused increases in water absorption percentage, dough development time, and dough stability time compared to the other tested varieties. These results are in agreement with those reported by (Sergey et al., 2023; Ibrahim, 2011, and Paucean et al., 2016).

Extensogram parameters

Wheat flour and semolina dough were rheologically evaluated by the Extensograph. Results in Table 5 showed that the elasticity in Misr 4 was 400 B.U. higher than that in Sids 1 (200 B.U.). The highest proportional number was noted for Misr 4, indicating a balance of protein characteristics and dough quality in this variety. From the same Table 5, Benisweif 8 as a new durum wheat variety recorded the highest values of elasticity, P.N., and energy (340 B.U., 3.40 and 61 cm^2), respectively, among the other semolina durum wheat verities, followed by Benisweif 7 (250 B.U., 1.92 and 58 cm^2), respectively. The increase in proportional numbers was mainly due to increases in elasticity and decreases in extensibility. Similar results were obtained by (Seleiman et al., 2010).

Gluten content is a measurement of gluten strength and gas retention. Results in Table 5. revealed that Misr 4 had a higher wet and dry gluten content than Sids 1. Regarding the durum wheat variety, Benisweif 8 recorded the highest wet and dry gluten content, followed by Benisweif 7 and Sohag 4. These data show that both the wet and dry gluten contents increased in tandem with the rise in protein contents. It is well known that there is a relationship between the wet and dry gluten content of wheat and its protein content (Ionescu et al., 2010).

Table 5. Rheological properties of doughs from some new Egyptian (flour bread and semolina durum) wheat varieties

Parameters	Bread wheat			Durum wheat	
	Misr 4	Sids 1	Benisweif 7	Benisweif 8	Sohag 4
Farinograph parameters					
Water absorption (%)	61.2	60.0	68.5	69.0	63.0
Arrival time (min)	1.5	1.0	1.5	1.5	1.0
Dough development time (min)	2.5	1.5	2.0	2.0	2.0
Dough stability (min)	10.5	2.5	4.5	6.5	4.5
Degree of softening (B.U)	40	90	110	80	110
Extensograph parameters					
Elasticity (B.U)	400	200	250	340	230
Extensibility (mm)	80	130	130	100	125
Proportional number(P.N)	5.00	1.54	1.92	3.40	1.84
Energy (cm^2)	50	45	58	61	52
Gluten content					
Wet gluten (%)	33.01±0.03[a]	26.22±0.04[b]	30.24±0.01[b]	31.34±0.03[a]	29.01±0.02[c]
Dry gluten (%)	10.92±0.01[a]	8.1 ± 0.03[b]	10.21±0.02[a]	10.25±0.02[a]	10.00±0.03[b]

Means followed by different letters in the same row are significantly different at $p < 0.05$.

Sensory evaluation and proximate chemical composition of balady bread

Sensory evaluation of balady bread loaves produced from the studied bread wheat varieties (Misr 4 and Sids 1), i.e., appearance, crust color, crumb color, taste, separation of layers, texture, aroma, roundness, and overall acceptability (Table 6.), The new bread wheat (Misr 4) improved most organoleptic characteristics of the produced balady bread loaves (appearance, crust color, crumb color, texture, and overall acceptability). (Torbica et al., 2011) concluded that Triticum aestivum flour expressed better flour-improvement properties. Those improvements were mostly related to the cross-linking degree of gluten complex proteins. This was reflected in a more regular bread shape, better bread crumb, and bread crust elasticity. The chemical composition of balady bread produced from Misr 4 and Sids 1 wheat flour (82% extraction) is shown in Table 6. Loaves produced from Misr 4 recorded significantly the highest content of moisture and protein (36.67 and 15.39%), respectively. while, the lowest contents of ash, crude fiber and carbohydrates comparing with loaves produced from Sids 1. Protein content is traditionally recognized as the most infantile factor affecting the quality of wheat bread (Shewry et al., 1986).

Misr 4

Sids 1

Figure 1. Photograph of balady bread produced from Misr 4 and Sids 1 wheat flour (82% extraction).

Table 6. Sensory evaluation and proximate chemical composition of balady bread prepared from bread wheat varieties.

Parameters	Misr 4	Sids 1
Sensory evaluation		
Appearance	8.95±0.15[a]	8.50±0.57[b]
Crust color	8.95±0.16[a]	8.55±0.43[b]
Crumb color	8.90±0.21[a]	8.30±0.42[b]
Taste	8.95±0.15[a]	8.90±0.21[a]
Separation of layers	8.95±0.15[a]	8.70±0.48[a]
Texture	8.90±0.21[a]	8.60±0.51[b]
Aroma	8.95±0.15[a]	8.70±0.42[a]
Roundness	8.90±0.21[a]	8.80±0.42[a]
Overall acceptability	8.95±0.15[a]	8.50±0.62[b]
Chemical composition*		
Moisture	36.67±0.01[a]	36.36±0.02[b]
Protein	15.39±0.02[a]	14.64±0.02[b]
Ash	1.70±0.01[b]	1.83±0.03[a]
Crude fiber	0.93±0.01[b]	1.07±0.01[a]
Fat	1.55±0.01[a]	1.54±0.01[a]
Total carbohydrates	80.43±0.02[b]	80.92±0.03[a]

*Chemical composition was calculated as (%) on dry weight basis except for moisture. Means followed by different letters in the same row are significantly different at $p < 0.05$.

Physical properties of wheat Balady bread

Quality attributes of balady bread weight (g), volume (cm^3), and specific volume (cm^3/g)) produced from Misr 4 and Sids 1 wheat flour (82% extraction) were presented in Table 7. The results in Table 7. indicated that balady bread produced using Misr 4 had significantly ($p \leq 0.05$) higher volume and specific volume values than balady bread produced from Sids 1. Because it was compact, the balady bread produced using Sids 1 had the lowest volume and specific volume value. These data supported the findings of the rheological properties of the dough (Table 5.), which indicated that the Sids 1 sample's decreased loaf volume could be attributed to both decrease in the percentage of wet and dry gluten and an increase in fiber content , as indicated by Table 3. in comparison to sample Misr 4. Furthermore, it concurs with (Izydorczyk et al., 2001).

Table 7. Physical properties of balady bread prepared by using bread wheat flour varieties (82% extraction)

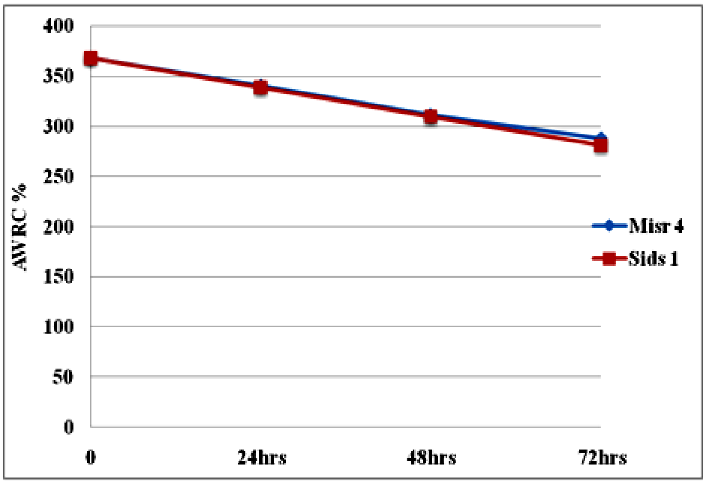
Samples of balady bread	Loaf Weight (g)	Loaf Volume (cm3)	Specific volume (cm3/g)
Misr 4	88.99±0.15[a]	672±1.00[a]	7.55±0.00[a]
Sids 1	89.01±0.31[a]	621±1.00[b]	6.97±0.02[b]

Means followed by different letters in the same column are significantly different at $p < 0.05$.

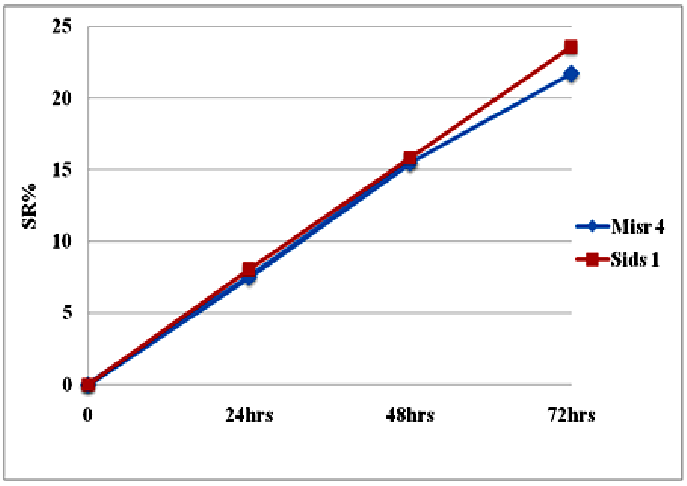
Alkaline Water Retention Capacity (AWRC%) and Staling Rate (SR%) of Balady Bread

AWRC and SR percent of bread samples was used as an indicator for freshness. The changes in the aforementioned parameters at the different storage times are illustrated in Figure 2., by a linear model. Generally, AWRC values were 368.0, 340.3, 311.0 and 288.0 % for the storage periods 0, 24, 48 and 72 hours, respectively. In contrast, Sids 1 recorded 368.3, 338.6, 310 and 281.3%. On the contrary, the staling rate of balady bread samples increased as the storage time increased. Staling rate of bread sample (Misr 4) was increased from 7.5% at 24 h to become 21.7 % at the end of the storage period compared with 8.0 to 23.6 for bread sample sids 1. These findings agree with those of (Seleem 2000), who discovered that a high protein content often results in a lower staling rate. As shown in Table 3., Misr 4 variety is higher in protein content (13.18 and 13.38%) than Sids 1 variety (10.21 and 10.42%) during the two seasons, respectively.

The results are in agreement with several previous studies on the changes in %SR of bread during storage (Obadi et al., 2018). (Licciadello, et al., 2014) reported that a good correlation between starch retrogradation, and the overall quality of bread during ageing. It was attributed to the principle that such gelatinized starch possesses a higher water-binding capacity which, conversely, decreases in crystallized starch. Thus, bread samples showed an increase in SR% during ageing.



a) AWRC (%)



b) SR (%)

a) Alkaline Water Retention Capacity (AWRC%) b) Staling Rate (SR%).

Figure 2. The changes in the Alkaline Water Retention Capacity (AWRC%) and Staling Rate (SR%) during balady bread samples storage periods (Zero, 24, 48 and 72 hours) at room temperature

Pasta characteristics

Pasta characteristics of semolina durum wheat varieties (Benisweif 7, Benisweif 8 and Sohag 4) were evaluated by sensory evaluation, chemical composition, color parameters, cooking quality, and texture characteristics as presented in Table 8. The chemical composition of pasta is presented in Table 8. No significant differences ($p \leq 0.05$) were observed in the moisture and fat content of all tested pasta samples. Benisweif 8 had the highest protein content (13.46%), while it had the lowest ash, crude fiber, and total carbohydrate content (0.97, 0.86, and 83.89%), respectively. (Herken et al., 2007) determined protein, ash, and carbohydrates in macaroni samples, which were 11.65, 1.08, and 78.22%, respectively. Adequate amounts of gluten protein are necessary to impart desirable attributes of mechanical strength and cooking quality to pasta (Kulkarni et al., 1987). The sensory properties of pasta prepared from different semolina wheat varieties were evaluated organoleptically for their appearance, color, taste, odor, texture, stickiness, and overall acceptability, as presented in Table 8. Results showed an increase in most sensory parameters of pasta prepared from semolina Benisweif 8 but no significant difference ($p \leq 0.05$) between Benisweif 7 and Sohag 4 varieties. From the data tabulated in Table 8, pasta prepared from Benisweif 7 had the highest L value (76.69), followed by Sohag 4 and then Benisweif 8. However, in contrast, Benisweif 8 had the highest a and b values (3.43 and 24.54) compared with Benisweif 7 and Sohag 4 varieties. The above results indicated that wheat grain of the durum variety (Benisweif 8) had higher yellowness values (due to high carotenoid contents) compared to Benisweif 7 and Sohag 4. This indicates the preferred color characteristics of durum wheat semolina for pasta production. However, a slight difference in color values was recorded between the pasta samples. The amber color of some durum wheat results from endosperm pigments seen through the translucent exterior layers (Matz, 1991). Durum wheat has a dense structure with high protein content and high gluten strength and is used to produce pasta, semolina, couscous, and Arabic flat bread (Spak, 2000). Data from the statistical analysis of cooking quality parameters of pasta prepared from different semolina wheats is presented in Table 8. The optimum cooking time required for pasta prepared from semolina in Benisweif 8 was 9.83 min, while 9.66 min was required for Benisweif 7 and Sohag 4, respectively.

The highest weight increase (230.10%) was noticed for pasta prepared from the Semolina Benisweif 8 variety, while the lowest (228.01%) was for pasta prepared from the Semolina Benisweif 7 variety. This weight increase could be attributed to the quality of the protein in the pasta samples. (Izydorczyk et al., 2004) showed that the cooked weight of noodles increased when cooking time increased.

The protein contents may also be combined with starch for the weight of the final pasta. The measurement of the cooking loss of pasta is one of the important parameters in assessing its overall quality. Cooking loss has been associated with both starch pasting properties and protein quality (Batey and Curtin, 2000). The quality of the residue in the cooking water measured the total soluble solids after cooking macaroni in a fixed volume of water for 10 minutes at 100 ^{o}C.A pasta sample prepared from the Semolina Benisweif 8 variety had the lowest cooking loss value (8.32%), the same as Sohag 4 (8.32%). On the other hand, pasta prepared from semolina (Benisweif 7) had the highest cooking loss (8.67%). Cooking loss is an indicator of the pasta's resistance to cooking; using low levels of cooking loss is preferred (Nagao, 1996). (Izydorczyk et al., 2004) stated that cooking loss could be attributed to weak protein-starch interaction and/or a destroyed protein matrix. A high-quality pasta should absorb twice its weight in water, according to (Hummel, 1966). The variation in cooking loss among all samples may refer to the protein content of each sample. (Giovanna et al., 2022) stated that spaghetti with high protein content was significantly lower in cooking loss than that with low protein. The texture characteristics of pasta are presented on the same table. Results showed that there was no significant difference ($p \leq 0.05$) between the two pasta samples (Benisweif 8 and Sohag 4) in firmness, gumminess, chewiness, cohesiveness, and springiness. On the contrary, Benisweif 7 had the lowest values of all texture characteristics. These differences might be attributed to the protein content. (Messia et al., 2021) reported that spaghetti firmness improved with increasing protein content. (Oak et al., 2006) reported that protein content and gluten strength were correlated with cooked firmness.

On the other hand, pasta made from a low protein variety (Benisweif 7) with higher cooking loss and a lower firmness (4.43N) value had a slight decrease in organoleptic scores and texture parameters; similar results were obtained by (Hatcher et al., 2009). Generally, it could be concluded that good-palatable pasta with cooking quality could be produced from the semolina of the new Egyptian Benisweif 8.

Table 8. Chemical composition, sensory characteristics and cooking Quality of pasta prepared from semolina durum wheat varieties.

Parameters	Benisweif 7	Benisweif 8	Sohag 4
		chemical composition**	
Moisture	9.01±0.01^{a}	9.00±0.01^{a}	9.02±0.00^{a}
Protein	13.24±0.01^{c}	13.46±0.01^{a}	13.29±0.01^{b}
Ash	0.99±0.01^{a}	0.97±0.01^{b}	0.98±0.00^{b}
Crude fiber	0.88±0.00^{a}	0.86±0.01^{b}	0.86±0.01^{b}
Fat	0.82±0.01^{a}	0.82±0.01^{a}	0.82±0.01^{a}
Total carbohydrates	84.07±0.01^{a}	83.89±0.01^{b}	84.05±0.01^{a}
		Sensory evaluation	
Appearance	8.90±0.21^{a}	8.95±0.16^{a}	8.95±0.16^{a}
Color	8.95±0.16^{a}	9.0±0.0.00^{a}	8.90±0.21^{a}
Taste	8.90±0.21^{a}	8.95±0.16^{a}	8.85±0.34^{a}
Odor	8.90±0.21^{a}	8.95±0.16^{a}	8.90±0.21^{a}
Texture	8.90±0.21^{a}	8.95±0.16^{a}	8.90±0.21^{a}
Stickiness	8.90±0.21^{a}	9.00±0. 00^{a}	8.80±0.35^{a}
Overall acceptable	8.75±0.43^{a}	9.00±0.00^{a}	8.75±0.42^{a}
		Color parameters	
L*	76.69±0.05^{a}	73.47±0.01^{c}	75.90±0.02^{b}
a*	3.23±0.01^{b}	3.43±0.01^{a}	3.21±0.01^{b}
b*	24.42±0.01^{b}	24.54±0.02^{a}	24.40±0.06^{b}
		Cooking Quality	
Optimum cooking time (min)	9.66±0.28^{a}	9.83±0.28^{a}	9.66±0.28^{a}
(Weight increase) (%)	228.01±0.02^{c}	230.10±0.37^{a}	228.90±0.03^{b}
Cooking losses (%)	8.67±0.01^{a}	8.32±0±.01^{b}	8.32±0.00^{b}
		Texture characteristics	
Firmness (N)	4.43±0.01^{b}	4.45±0.01^{a}	4.45±0.01^{a}
Gumminess (N)	3.60±0.02^{b}	3.70±0.03^{a}	3.65±0.04^{ab}
Chewiness (N)	2.98±0.03^{b}	3.12±0.04^{a}	3.07±0.02^{a}
Cohesiveness	0.81±0.01^{b}	0.83±0.01^{a}	0.82±0.01^{ab}
Springiness (mm)	0.82±0.01^{b}	0.84±0.01^{a}	0.84±0.01^{a}

**Chemical composition was calculated as (%) on dry weight basis except for moisture. L* (lightness with L = 100 for lightness, and L = zero for darkness), a* [(chromaticity on a greenness (-) to redness (+)], b* [(chromaticity on a blueness (-) to yellowness (+)]. Means followed by different letters in the same row are significantly different at $p < 0.05$.

Benisweif 7 Benisweif 8 Sohag 4

Figure 3. Photograph of pasta produced from semolina durum wheat variety Benisweif 7, 8 and Sohag 4.

4. Conclusion

In our present study, Misr 4 and Benisweif 8 varieties recorded the highest yields and constituents. The most favorable field trial design and favorable, nutritional and technological properties had a grain of the new wheat varieties Misr 4 and Benisweif 8. This study has clearly indicated that grain yield, physic-chemical, rheological, and technological characteristics of wheat varieties showed significant ($p < 0.05$) variability. The flour and semolina obtained from wheat varieties Misr 4 and Benisweif 8 demonstrated an increasing tendency in protein content for dry and wet gluten. Misr 4 and Benisweif 8 showed the most appealing physical properties among all cultivars. Based on rheological and technological parameters, dough made from wheat flour 82% ext. (Misr 4) and semolina from Benisweif 8 showed better performance, longer development times, stability periods, dough constancy, and a lower degree of softening. Misr 4 was found to be the most suitable variety for the production of balady bread, and Benisweif 8 was found to be the most suitable variety for the production of pasta. Hence, these findings may provide insight for bakers and millers to select the best-suited variety for high-quality products and intended applications. Evaluation of genetic variation concerning nutritional and quality characteristics is essential for the success of breeding studies aimed at developing new wheat genotypes that can be used as crops or as grains for growing new common wheat varieties with high nutritional content. Finally, it can be classified as Misr 4 to be used for bread and Benisweif 8 for pasta production.

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