Technological Properties of some Egyptian New Wheat Varieties

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Abstract: Whole meal and flour (72%) of Gemmeiza 7, Giza 168, Sohage 3 and Sakha 93 wheat varieties were evaluated to produce pan bread, pasta and biscuits. Pan bread of whole meal wheat varieties had higher contents of moisture, protein, fat, ash and fiber than wheat flour 72% of the same varieties. Pan bread of Sakha 93 was characterized by its higher baking quality (weight, volume and specific volume) than pan breads of other varieties. Crust color of pan bread was slightly affected with whole-meal wheat varieties, where its color score was maximized in case of Sakha 93 (7.7) and Sohage 3 (6.7). This result agreed with the obtained color parameter of Hunter, where lightness (L) was maximized to 55.95 and 49.79 in pan bread crust of Sohage 3 and Sakha 93, respectively. Pasta was characterized by its higher protein (13.12%), fat (2.59%) and crude fiber (2.82%) in case of using whole meal of Sohage 3, Giza 168 and Gemmeiza 7 varieties, respectively. Pasta cooking quality ranked first in case of using Sohage 3 whole meal, where its weight increase, volume increase and cooking loss reached to 265%, 305.3% and 8.3%, respectively. Pasta color parameter showed that, wheat flour 72% and whole meal of Sakha 93 were characterized by their higher lightness (L). Sensory evaluation showed that, pasta of wheat flour (72%) accepted slightly more in appearance and color if compared with whole meal pasta of the same variety. In addition, there were no significant differences between pasta of wheat flour (72%) and whole meal in flavor, tenderness and stickiness. Biscuit of whole meaal was characterized by its higher content of protein, fat, ash and crude fiber than wheat flour (72%). Whole meal biscuit of Sohage 3 was characterized with its higher protein (12.13%), fat (31.0%) and ash (2.51%) contents; and lowest carbohydrate content (52.18%). Biscuit of Sakha 93 variety (whole meal or flour 72%) was higher in baking quality. Hunter color parameter and sensory evaluation showed that, biscuit of whole meal varieties was slightly darker than biscuit of wheat flour 72%. In addition, biscuits flavor, taste, texture, appearance and overall acceptability of wheat flour (72%) was not affected significantly in case of using whole meal flour of the same variety.
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1. Introduction:

In Egypt, there is a gap between wheat production and consumption. Therefore, National Program for Wheat Research developed new wheat varieties characterized with its higher yield and persist pests, such as Gemmiza 7, Giza 168, Sohag 3 and Sakha 93 (Anon., 2005). The importance of wheat is mainly due to its nutritive value and the fact that its seed can be ground into flour, semolina, etc., which form the basic ingredients of bread and other bakery products, as well as pastas.

Milling of wheat has two important purposes, one is to remove the bran and the other is to reduce the endosperm to small and fine particles. Such process decrease the nutritive value of wheat. Consequently, several researchers (Collins *et al.*, 1983; Finney *et al.*, 1985; Jenkins *et al*, 1988; Lai *et al.*, 1989a; Mugford, 1993; Shouk, 1996 and Czerny and Schieberle, 2002) studied the possibility of using whole meal grains (100%) in several products to make use of its bran and germ that contain several healthy and nutrient components, and to maximize the yield of flour and reduce the gape between wheat production and consumption.

The differences that usually occur in the wheat flour products depend on the wheat variety (hard or soft wheat), rate of flour milling and particle size. On the other hand, whole meal flour contains the whole product obtained from the milling of cleaned wheat. Bread can only legally be described as whole meal bread if the flour used in its manufacture is whole meal flour, and no other flour is added. Production of whole meal bread, which is produced from whole meal grains (100%), should reduce bread making cost.

This study aimed to evaluate processing quality of some new Egyptian wheat varieties (whole meal and flour 72%), through some important products that depend on hard wheat varieties (bread and pasta) and soft wheat varieties (biscuit).

2. Materials and methods

Materials

Wheat grains varieties of Gemmeza 7, Giza 168, Sohage 3and Sakha 93 were obtained from Field Crops Department, Agricultural Research Centre, Ministry of Agriculture, Giza, Egypt. Shortening, sugar, salt and sodium bicarbonate were obtained from Egyptian local market.

1. Analytical methods

Moisture, ash, crude protein, fat and crude fiber contents of wheat products were determined according to the methods outlined in AOAC (2000), while carbohydrates were calculated by difference as mentioned by Tadrus (1989).

2. Statistical analysis

All results were evaluated statistically using analysis of variance as reported by McClave and Benson (1991).

3. Methods of Processing:

Wheat grains varieties were manually cleaned, tempered to 14% moisture content, then milled using Quadrumat Junior flour mill. The obtained flour represent whole flour mill (100% extraction), then sieved to obtain flours of 72% extraction.

3.1 Preparation of Pan Bread

Pan bread baking carried out as described by Lazaridou *et al*. (2007) as follows: Firstly, yeast dissolved in warm water (35°C), then mixed and kneaded with flour, salt (1.5%) and sugar (1%). Then dough fermented at 30°C/30 min in a fermentation cabinet under 80-85% relative humidity. Dough was then placed in the pan (150 g/piece) and kept under the same fermentation condition for 45 min. Bread dough loaves were baked at 240 °C for 20–25 min in an electric oven (Mondial Formi, 4T 40/60, Italy), then subjected to steam for 10 sec to enhance the browning process of bread. The obtained pan bread was packed in polyethylene bags and stored at room temperature for evaluation and analysis.

3.2 Preparation of Biscuits

Two types of biscuits were prepared, biscuit of whole meal flour (100%) and traditional biscuit of wheat flour 72% extraction. Biscuits were prepared according to the method of AACC (2000) by using the following formula: wheat flour 100% or 72% extraction (100 g), sugar (50 g), shortening (28 g), salt (0.93 g), sodium bicarbonate (1.11g), 14.66 ml of dextrose solution (5.93%).

3.3 Preparation of Pasta:

Pasta samples were prepared in the Food Technology Department, National Research Centre, Cairo, Egypt, according to the method of AACC (2000) by using Pasta Matic 1000 Simac Machine Corporation, Milano, Italy. Pasta hydrated for 15 min under atmospheric air, dried in a cabinet dryer at 40ºC for 14 hrs, then cooled at room temperature, packed in polyethylene bags and kept at room temperature for analysis.

4. Baking quality of Pan Bread and Biscuit:

Weight, volume and specific volume of manufactured pan bread were determined as described by AACC (1983).

Biscuits Diameter, volume and thickness were determined according to the standard method of AACC (2000). The spread ratio (Diameter/thickness) was calculated according to standard methods of AACC (2000).

5. Cooking quality of pasta

Cooking quality of pasta were carried out by measuring the increases in weight, volume and cooking loss after cooking according the methods of AACC (2000).

6. Color quality of Processed Products:

The color of pan bread (crust and crumb), biscuit and pasta samples were evaluated using Hunter, Lab Scan XE, Reston VA., calibrated with a white standard tile of Hunter Lab color standard (LX No. 16379) x = 77.26, y = 81.94 and z = 88.14 (L^* = 92.43, a^* = -0.88, b^* = 0.21).

7. Freshness of pan Bread

Pan bread was packed in polyethylene bags and stored at room temperature. Loaves freshness of pan bread was tested at interval time (1, 3 and 5 days) using alkaline water retention capacity (AWRC) as described by Kitterman and Rubenthaler (1971).

8. Sensory Evaluation of Processed Products:

Sensory evaluation of pan bread was performed by 10 trained panelists as described by Kulp *et al*. (1985) for symmetry of shape (5), crust color (10), break & shred (10), crumb texture (15), crumb color (10), aroma (20), taste (20) and mouth feel (10). Cooked pasta were organoleptically evaluated by ten panelists for its appearance (10), color (10), flavor (10), tenderness (10) and stickiness (10) as described by Hallabo *et al.* (1985).

Sensory characteristics of biscuits were evaluated by ten trained panelist for its color (10), flavor (10), taste (10), texture (10), appearance (10)

and overall acceptability (10) as mentioned by Zabic and Hoojjat (1984).

3. Results and Discussion:

Technological properties of wheat varieties:
1 Pan Bread
1.1 Chemical composition:

Pan bread of whole meal or wheat flour 72% varieties were evaluated chemically and presented in Table (1). The obtained results showed that, pan bread of whole meal was characterized by its higher moisture content, compared with wheat flour 72% of all the studied varieties. In addition, moisture content of whole meal pan bread increased significantly to the highest level (37.02%) in Sohage 3 variety and decreased to the lowest level (33.09%) in gemmiza 7. Sohage 3 was characterized by its higher protein content; it reached 12.43% and 12.22% in pan bread of whole meal and wheat flour 72%, respectively. Fat content of whole meal ban bread decreased slightly in Giza 168, Sohage 3, Gemmiza 7 and Sakha 93 to reach 3.73, 3.42, 3.43 and 3.22%, respectively. The same trend was also observed in ash content of pan bread for the same varieties. Crude fibre of whole meal pan bread reached to the highest level in Sakha 93 (3.07%) and lowest level in Sohage 3 (1.39%). Table (1) showed also that, all pan bread of wheat flour 72% varieties are characterized by its higher content of carbohydrate than whole meal, while whole meal had higher contents of moisture, protein, fat, ash and fiber. These results could be explained with the fact that, whole meal had all outer layers and germ of the wheat grains.

1.2 Baking quality:

Since quality of pan bread depends on flour type, so baking quality of whole meal flour and wheat flour 72% of the studied wheat varieties were evaluated. Data presented in Table (2) showed that, pan bread of whole meal varieties is characterized by its higher weight (133.3-143 g) compared with its wheat flour 72% varieties (131.0-134.8 g). In addition, the volume of pan bread whole meal was more and ranged between 265-312.5 cm^3, while its wheat flour 72% less, ranged between 255-290 cm^3. On other hand, pan bread of wheat flour 72% varieties is characterized by its higher specific volume (1.91-2.16), compared with its whole meal (1.94-2.25). The obtained results agree with those found by He and Hoseny (1992) and shouk (1996). Also, Pommeranz et al (1977), stated that, as the fiber content increase, loaf volume and weight increase. Chen et al (1988) stated that, the effect could result from the interaction between gluten and fiber.

It can be concluded from Table (2) that, whole wheat meal and its flour 72% of Sakha 93 is characterized with higher baking quality (weight, volume and specific volume) for pan bread than Gemmeiza 7, Giza 168 and Sohage 3 varieties.

Table 1: Effect of wheat varieties and extraction rate on chemical composition of pan bread.

Sample	Moisture	Protein	Fat	Ash	Crude fiber	Total Carb.
Gemmeiza 7:						
Whole meal	33.09^{c} ± 0.56	11.26^{bc} ± 0.25	3.43^{b} ± 0.07	1.94^{b} ± 0.09	2.86^{b} ± 0.03	80.48^{de} ± 0.16
Wheat flour 72%	29.37^{e} ± 1.35	10.88^{c} ± 0.08	2.50^{e} ±0.06	1.06^{c} ± 0.13	0.69^{b} ± 0.14	84.91^{ab} ± 0.28
Giza 168:						
Whole meal	35.50^{b} ± 0.62	11.25^{bc} ± 0.25	3.73^{a} ± 0.15	2.18^{a} ± 2.89	3.00^{ab} ± 0.05	79.72^{e} ± 0.34
Extraction: 72%	31.26^{d} ± 0.91	10.95^{c} ± 0.05	2.57^{de} ± 0.06	1.07^{c} ± 0.06	0.88^{d} ± 0.04	84.61^{b} ± 0.18
Sohage 3:						
Whole meal	37.02^{a} ± 0.58	12.43^{a} ± 0.69	3.48^{b} ± 0.03	1.94^{b} ± 0.09	1.39^{c} ± 0.03	80.82^{d} ± 0.59
Wheat flour: 72%	30.15^{de} ± 0.45	12.22^{a} ± 0.26	2.64^{d} ± 4.20	0.93^{cd} ± 0.07	0.70^{d} ± 0.09	83.51^{c} ± 0.26
Sakha 93:						
Whole meal	35.29^{b} ± 0.49	11.53^{b} ± 0.30	3.22^{c} ± 0.08	1.82^{b} ± 0.12	3.07^{a} ± 0.16	80.35^{de} ± 0.43
Wheat flour 72%	31.19^{d} ± 0.42	10.95^{c} ± 0.13	2.32^{f} ± 0.03	0.85^{d} ± 0.10	0.77^{d} ± 0.12	85.24^{a} ± 0.07
LSD at 0.05	1.27	0.54	0.13	0.16	0.17	0.57

Total Carb. = Total carbohydrate.

Table (2): Effect of wheat varieties and extraction rate on baking quality of pan bread.

Sample	Weight (g)	Volume (cc)	Specific volume (cc/g)
Gemmeiza 7:			
Whole meal	133.30^{c} ± 1.50	274^{c} ± 8.4	2.06^{bc} ± 5.51
Wheat flour 72%	131.00^{d} ± 0.50	255^{e} ± 5.0	1.95^{d} ± 6.81
Giza 168:			
Whole meal	135.30^{bc} ± 1.52	305.0^{a} ± 5.0	2.25^{a} ± 4.93
Wheat flour 72%	133.80^{c} ± 1.75	267.5^{cd} ± 2.5	1.99^{cd} ±4.43
Sohage 3:			
Whole meal	136.30^{b} ± 0.763	265.0^{cde} ± 5.0	1.94^{d} ± 0.025
Wheat flour 72%	134.80^{bc}±0.289	257.5^{de} ± 7.5	1.91^{d} ± 0.049
Sakha 93:			
Whole meal	140.00^{a} ± 1.50	312.5^{a} ± 10.5	2.23^{a} ± 0.115
Wheat flour 72%	134.20^{bc} ± 1.52	290.0^{b} ± 5.0	2.16^{ab} ± 0.065
LSD at .05	2.227	11.983	0.111

1.3 Color quality:

Data presented in Table (3) represent color attributes of pan bread as affected by wheat varieties and its extraction rate (72%). The obtained results indicated that, the lightness color (L) of crust whole-wheat meal is affected by wheat varieties, where it was maximized in Sohage 3 to reach 55.95 and minimized to 44.18 in Giza 168. In addition, extraction rate (72%) and wheat variety affected lightness. The values obtained were 60.06, 57.01, 56.96 and 50.98 in Sohage, Giza 168, Gemmiza 7 and Sakha93, respectively. The obtained results showed also that, the color parameter (a & b) of crust pan bread were affected with wheat varieties, except in case of crumb.

As expected, crumb color layer was characterized with its higher whiteness than crust layer where lightness (L) score increased, and both redness and yellowness scores decreased. This result could be explained as stated by Kordonowy &Young (1985), Kim *et al.*(1997) and Ramy *et al*. (2002) that darkness increased in whole-meal pan bread as a result of bran and germ present in whole-meal.

Table (3): Color quality of pan bread as affected by wheat varieties and extraction rate.

Sample	Lightness "L"		Redness "a"		Yellowness "b"	
	Crust	Crumb	Crust	Crumb	Crust	Crumb
Gemmeiza 7:						
Whole meal	51.32^{c} ± 0.50	53.80^{c} ± 3.31	9.48^{f} ± 0.11	6.48^{a} ± 0.16	27.50^{d} ± 0.50	25.46^{a} ± 2.02
Wheat flour (72%)	56.96^{b} ± 0.72	64.46^{a} ± 3.41	6.44^{f} ± 0.23	3.41^{c} ± 1.19	26.94^{d} ± 0.31	25.73^{e} ± 3.35
Giza 168:						
Whole meal	44.18^{d} ± 0.55	60.03^{ab} ± 2.92	14.21^{b} ± 0.18	5.93^{ab} ± 0.83	24.80^{e} ± 1.79	25.79^{a} ± 1.34
Wheat flour (72%)	57.01^{b} ± 2.92	63.35^{a} ± 3.28	10.05^{a} ± 0.46	4.04^{c} ± 0.64	30.79^{bc} ± 0.80	25.26^{a} ± 1.26
Sohage 3:						
Whole meal	55.95^{b} ± 0.78	59.12^{abc} ± 3.22	11.72^{d} ± 1.01	6.09^{ab} ± 0.60	31.11^{b} ± 0.56	25.28^{a} ± 0.97
Wheat flour (72%)	60.06^{a} ± 1.25	64.96^{a} ± 4.16	12.71^{c} ± 0.38	4.83^{bc} ± 0.61	33.91^{a} ± 0.23	26.01^{a} ± 0.91
Sakha 93:						
Whole meal	49.79^{c} ± 0.34	56.19^{bc} ± 3.49	14.88^{ab} ± 0.30	6.45^{a} ± 0.95	29.35^{c} ± 0.39	23.98^{a} ± 1.42
Wheat flour (72%)	50.98^{c} ± 1.59	63.63^{a} ± 4.49	15.37^{a} ± 0.53	3.92^{c} ± 0.71	32.03^{b} ± 1.61	23.55^{a} ± 1.62
LSD at 0.05	2.33	6.15	0.83	1.32	1.66	2.70

1.4 Sensory Properties:

Effect of wheat varieties on sensory properties of pan bread was evaluated and the results are presented in Table (4). The obtained results showed that, the symmetric shape of whole meal pan bread or its 72% extraction was not affected significantly in case of using any one of the studied wheat varieties, where it ranged between 3.35 – 4.05. Crust color was slightly affected in case of whole-meal wheat varieties, where its color score was highest in Sakha 93 (7.7) and Sohage 3 (6.7). These results agree with that measured by Hunter lab Scan (Table 6), where lightness (L) maximized to 55.95 and 49.79 in pan bread crust of Sohage 3 and Sakha 93, respectively. In addition, sensory property and Hunter color parameter not affected significantly with wheat varieties flour (72%) of pan-bread crumb.

Comparing crust color pan bread of wheat flour (72%) with whole meal, it could state that, the crust color quality is related to maillard reaction that is affected by sugars content of flour. Therefore, wheat flour 72% had higher content of total and reducing sugars than whole meal, consequently crust color of wheat flour pan-bread was better than that of whole meal pan bread. This effect was observed in all samples of the prepared pan-bread regardless of wheat variety. These findings are in agreement with those obtained by Lai et al (1989b) and Shouk (1996). They proposed that, bran binds relativity large amount of water, changes the appearance and the handling properties of the dough. Therefore, the gluten is not properly hydrated and developed at normal absorption levels.

Concerning break and shred, it's clear that pan bread of wheat flour 72% had better break and shred than that of whole meal pan bread. These findings were observed in all tested samples regardless of wheat variety.

The same table showed that, crumb-texture, aroma, taste and mouse feel of pan bread wheat flour (72%) were better than whole meal pan bread regardless of wheat variety.

Table 4: Effect of wheat varieties and extraction rate on sensory properties of pan bread.

Characterisctics	Gemmeiza 7		Giza168		Sohage 3		Sakha 93		L.S.D 5%
	Whole meal	Flour 72 %	Whole meal	Flour 72 %	Whole meal	Flour 72 %	Whole meal	Flour 72 %	
Symmetrical Shape (5)	3.45 ± 2.90	3.50 ± 1.01	3.35 ± 5.27	3.95 ± 0.79	3.50 ± 0.726	3.6 ± 0.768	4.00 ± 0.707	4.05 ± 0.726	---
Crust color (10)	7.6^{abc} ± 1.5	8.20^{ab} ± 1.48	7.65^{ab} ± 1.43	8.60^{a} ± 1.0	6.70^{c} ± 0.66	7.2^{bc} ± 1.50	7.7^{abc} ± 0.66	7.8^{abc} ± 1.51	1.222
Break & shred (10)	7.6^{a} ± 1.11	8.00^{a} ± 1.73	7.11^{a} ± 1.16	7.88^{a} ± 0.78	6.88^{a} ± 1.17	7.7^{a} 1.30	7.33^{a} ± 1.16	7.8^{a} ± 0.86	1.48
Crumb texture (15)	11.3^{a} ± 2.1	12.13^{a} ± 2.28	11.60^{a} ± 2.65	12.10^{a} ± 2.65	10.80^{a} ± 2.04	11.1^{a} ± 2.00	11.50^{a} ± 2.69	11.8^{a} ± 2.06	2.268
Crumb color (10	7.2^{a} ± 1.64	8.00^{a} ± 1.11	7.30^{a} ± 1.36	8.20^{a} ± 1.2	7.50^{a} ± 0.88	7.9^{a} ± 1.41	7.40 ± 1.73	7.8^{a} ± 1.26	1.302
Aroma (20)	16.0^{ab} ± 2.39	17.55^{a} ± 1.66	16.33^{ab} ± 1.66	16.66^{ab} ± 2.73	15.22^{b} ± 2.73	15.66^{ab} ± 2.70	16.33^{ab} ± 2.29	16.5^{ab} ± 2.60	2.295
Taste (20)	17.0^{ab} ± 2.12	17.33^{a} ± 1.80	16.22^{ab} ± 1.20	17.33^{a} ± 2.12	15.44^{b} ± 1.66	16.33^{ab} ± 2.29	16.55^{ab} ± 1.24	16.0^{ab} ± 1.66	1.735
Mouth feel (10)	8.0^{a} ± 1.32	8.1^{a} ± 1.52	7.33^{a} ± 1.22	7.7^{a} ± 0.08	7.44^{a} ± 93	7.52^{a} ± 53	7.77^{a} ± 1.09	7.8^{a} ± 0.87	1.056

- Significant at 0.05 probability level.
- There is no significant difference between two means (within the same property) designed by the same letter. *NS=Not Significant

1.5 Freshness:

Data in Table (5) show and compare the effect of whole meal, wheat flour (72%) and wheat varieties on the pan bread freshness that was stored at room temperature for 1, 3 and 5 days. The obtained results showed that, pan bread wheat flour 72% had

the lowest values of alkaline water retention capacity (AWRC) than that of whole meal pan-bread. Furthermore, all tested samples showed a noticeable decrease in AWRC values at 1, 3 and 5 days storage. This could be related to whole meal pan-bread that contained more fiber and protein than wheat flour 72% bread consequently could retain more water. Mohamed *et al.* (2006) reported that bread samples with higher wheat flour (higher amylase) and lower protein content showed higher firmness values. In addition, Parker and Ring (2001) stated that, bread staling is caused by amylose and to a lesser extent, amylopectin retrogradation. The high protein content altered the macromolecular content of the bread and thus the overall glass transition of the system. The change in the glass transition directly related to the molecular relaxation of the bread, which in turn affected the staling process as explained.

Table 5: Effect of wheat varieties and extraction rate on Freshness properties of stored pan bread.

Sample	Storage period (days)					
	1		3		5	
	Moisture	Freshness	Moisture	Freshness	Moisture	Freshness
Gemmeiza 7 :						
Whole meal	33.09^{c} ± 0.56	303.70^{d} ± 5.98	31.27^{c} ± 0.48	293.50^{a} ± 3.04	27.45^{c} ± 0.57	268.90^{a} ± 3.12
Extraction: (72%)	29.37^{e} ± 1.35	252.47^{e} ± 7.29	27.31^{e} ± 0.79	231.96^{d} ± 0.83	25.60^{e} ± 0.79	215.50^{e} ± .5.20
Giza 168:						
Whole meal	35.50^{b} ± 0.62	305.33^{b} ± 8.38	32.95^{d} ± 0.43	286.20^{a} ± 8.43	30.03^{b} ± 0.39	262.10^{b} ± 3.05
Extraction: (72%)	31.26^{d} ± 0.92	275.00^{d} ± 5.00	29.23^{d} ± 1.03	255.27^{c} ± 5.20	26.71^{cd} ± 0.61	235.46^{d} ± 4.70
Sohage 3:						
Whole meal	37.02^{a} ± 0.58	315.37^{a} ± 4.95	34.99^{a} ± 0.54	292.90^{a} ± 2.56	31.97^{a} ± 0.79	271.27^{a} ± 1.16
Extraction: (72%)	30.15^{de} ± 0.45	278.33^{cd} ± 2.88	28.18^{de} ± 0.49	258.33^{bc} ± 2.88	25.75^{de} ± 0.32	238.60^{cd} ± 3.13
Sakha 93:						
Whole meal	35.29^{d} ± 0.48	285.60^{c} ± 4.76	32.89^{b} ± 0.56	265.40^{b} ± 5.00	29.84^{b} ± 0.67	244.70^{c} ± 4.09
Extraction: (72%)	31.23^{d} ± 0.42	251.83^{e} ± 2.75	29.09^{d} ± 0.81	232.13^{d} ± 2.92	26.36^{de} ± 0.66	212.27^{e} ± 2.97
LSD at 5%	1.27	9.63	1.16	7.66	1.07	6.27

2. Pasta:

Gemmeiza 7, Giza 168, Sohage 3 and Sakha 93 wheat varieties were evaluated also to produce pasta from its whole meal and flour 72%.

2.1 Chemical composition of pasta:

Data presented in Table (6) showed that, moisture content of whole meal pasta was higher than pasta of wheat flour 72% in all studied varieties. This could be attributed to higher content of crude fiber (ranged between 1.65 to 2.82) in pasta of whole meal than pasta of wheat flour 72% (ranged between 0.5-0.78). In addition, whole meal pasta of all wheat varieties were characterized by its higher protein, fat and ash contents than wheat flour 72% pasta. In contrast, whole meal pasta was lower in carbohydrate than flour 72% pasta. These results agreed with those found by Kent-Jones and Amos (1967) and Shouk (1996) where they stated that, whole meal wheat bread was higher than wheat flour 72% bread in protein, fat, ash and fiber content. Furthermore, whole meal pasta of Sohage 3, Giza 168 and Gemmeiza 7 were characterized by their higher protein (13.12%), fat (2.59%) and crude fiber (2.82%) contents than other studied varieties. 2.2 Cooking quality:

Table (7) showed that, cooked pasta of whole meal is characterized with its higher increase in weight (ranged between 219.%-265%) and volume (ranged between 247.4-305.3%), while weight and volume of wheat flour (72%) cooked pasta ranged between (175.8-230%) and (183.3-188%), respectively. Cooking loss (solids loss into cooking water) of wheat flour (72%) pasta was characterized by its lower loss (ranged between 6-8.8%), the values for whole meal pasta ranged between 8.3-12.8%. Regarding pasta cooking quality of studied varieties, Sohage 3 ranked first in both whole meal and wheat

flour (72%) pasta, followed by Giza 168, Sakha 93, and Gemmeiza 7. The increased weight of whole meal pasta could due to its high fiber content (table 6), where fiber have a lower bulk density, more surface area, polar groups, and uronic acid groups leading to surrounding water, and increase in its swelling volume (Lo et al, 1991 and Bao & Chang, 1991).

The undesirable effect on cooking loss may be due to dilution of gluten, or the interaction between gluten and fiber that allows high starch to leach out from the pasta, consequently, resulting in an increase in cooking losses.

Table 6: Effect of wheat varieties and extraction rate on chemical composition of pasta.

Sample	Moisture	Protein	Fat	Ash	Crude fiber	Total Carb.
Gemmeiza 7 :						
Whole meal	8.07^{a} ± 0.03	11.05^{de} ± 0.06	2.19^{d} ± 0.10	2.52^{a} ± 0.03	2.82^{a} ± 0.03	81.42^{ab} ± 0.06
Wheat flour 72%	7.71^{c} ± 0.11	10.69^{f} ± 0.45	1.52^{g} ± 0.03	0.99^{e} ± 0.03	0.5^{d} ± 0.05	86.3^{a} ± 0.9
Giza168:						
Whole meal	7.82^{b} ± 0.03	11.09^{d} ± 0.03	2.59^{a} ± 0.04	2.03^{b} ± 0.03	2.17^{b} ± 0.17	82.12^{ab} ± 0.03
Wheat flour 72%	7.23^{e} ± 0.06	10.87^{ef} ± 0.03	1.64^{f} ± 0.04	0.98^{e} ± 0.03	0.78^{d} ± 0.05	85.73^{a} ± 0.04
Sohage 3:						
Whole meal	8.03^{a} ± 0.02	13.12^{a} ± 0.11	2.42^{c} ± 0.05	1.91^{c} ± 0.10	1.65^{d} ± 0.06	80.90^{ab} ± 0.26
Wheat flour 72%	7.52^{d} ± 0.03	12.05^{b} ± 0.06	1.66^{f} ± 0.03	0.97^{e} ± 0.08	0.64^{d} ± 0.05	84.58^{a} ± 0.12
Sakha 93:						
Whole meal	7.70^{c} ± 0.09	11.45^{c} ± 0.29	2.52^{b} ± 0.05	1.70^{d} ± 0.02	2.45^{b} ± 0.40	81.88^{ab} ± 0.46
Wheat flour 72%	7.18^{e} ± 0.03	10.82^{f} ± 0.06	1.74^{e} ± 0.04	0.84^{f} ± 0.09	0.73^{d} ± 0.12	85.87^{a} ± 0.19
LSD at .05	0.9	0.6	0.21	0.10	0.29	18.79

Total Carb. = Total carbohydrate.

Table 7: Effect of wheat varieties and extraction rate on cooking quality of pasta.

Sample	Weight increase (%)	Volume increase (%)	Cooking loss (%)
Gemmeiza 7:			
Whole meal	219.6^{c} ±1.65	247.4^{d} ±1.72	11.9^{b}±0.09
Wheat flour 72%	177.2^{d} ±1.1	184.4^{e}±1.25	8.8^{c}±0.25
Giza 168:			
Whole meal	247.6^{b} ±2.51	285.0^{b} ±5.00	11.63^{c}±0.15
Wheat flour 72%	175.8^{b} ±1.40	183.3^{e} ±1.71	8.6^{c}±0.09
Sohage 3:			
Whole meal	265^{a} ±5.0	305.3^{a} ±4.50	8.3^{d}±0.25
Wheat flour 72%	230.0^{c} ±5.0	265.7^{c}±4.51	6.0^{e}±0.21
Sakha 93:			
Whole meal	248.3^{b}±7.63	263.8^{c} ±8.14	12.8^{a}±0.25
Wheat flour 72%	178.0^{de} ±1.0	188.0^{e} ±2.00	8.5^{c}±0.25
LSD at .05	16.51	7.33	0.30

*Average of three determinations

2.3 Color quality:

Data presented in Table (8) showed the effect of wheat variety and extraction rate (whole meal and flour 72%) on the color quality of pasta. Regarding to pasta color parameter of the four wheat varieties, Sakha 93 ranked first in lightness (L) in its flour (72%) and whole meal, where L reached to 63.37 and

54.39, respectively. While, L value of pasta of other varieties ranged between 57.76-59.05 and 49.90-52.12 in flour (72%) and whole meal, respectively. Pasta of whole meal Gemmeiza 7 is characterized by higher redness (a = 5.46) and yellowness (b = 20.62). Comparing pasta color of whole meal with that of flour (72%), pasta whole meal of studied varieties were darker, where its color parameter were lower in lightness (L) and higher in redness (a) and yellowness (b). These results could be due to the fact that pasta of whole meal contains higher level of fiber if compared with pasta of wheat flour (72%).

Table (8): Effect of wheat varieties and extraction rate on color quality of pasta.

Sample	Lightness "L"	Redness "a"	Yellowness "b"
Gemmeiza 7			
Wheat flour 72%	59.05^{b}±2.64	3.03^{d}±0.27	18.85^{c}±1.21
Whole meal	49.98^{d}±0.71	5.46^{a}±0.05	20.62^{a}±0.17
Giza 168:			
Wheat flour 72%	58.86^{b}±1.03	3.60^{c}±0.21	17.17^{ab}±0.25
Whole meal	49.90^{d}±1.87	5.32^{a}±0.24	20.1^{ab}±0.52
Sohage 3			
Wheat flour 72%	57.76^{b}±2.64	3.02^{d}±0.12	18.49^{c}±0.36
Whole meal	52.12^{cd}±0.98	4.19^{b}±0.30	19.49^{bc}±0.67
Sakha 93			
Wheat flour 72%	63.37^{a}±2.58	2.17^{e}±0.02	14.52^{e}±0.74
Whole meal	54.39^{b}±1.69	3.83^{c}±0.18	16.64^{d}±0.45
LSD at .05	2.97	0.34	1.08

2.4 Sensory evaluation:

Pasta of studied wheat varieties (whole meal and wheat flour 72%) evaluated sensorially and the results are presented in Table (9). The obtained results showed that, pasta of wheat flour (72%) had better appearance and color, compared to whole meal pasta of the same variety. The obtained color score of sensory evaluation was agreed with the obtained measured color of Hunter lab Scan (Table 8). Kordonowy & Young (1985) reported that flavor, texture and color of no bran spaghetti were rated significantly higher than those of other samples containing bran. Table (9) indicated also that, there were no significant difference between wheat flour 72% and whole meal regarding flavor, tenderness and stickiness.

Table 9: Effect of wheat varieties and extraction rate on sensory properties of pasta.

Sample	Appearance (10)	Color (10)	Flavor (10)	Tenderness (10)	Stickiness (10)
Gemmeiza 7:					
Wheat flour 72%	7.8^{a} ± 1.03	7.2^{ab} ± 1.2	7.4 ± 1.6	7.2 ± 1.39	7.2^{ab} ± 0.78
Whole meal	6.4^{b} ± 1.64	6.5^{ab} ± 1.4	7.4 ± 1.4	7.0 ± 1.33	7.7^{a} ± 0.91
Giza 168:					
Wheat flour 72%	6.8^{ab} ± 1.62	7.3^{a} ± 1.4	6.5 ± 1.7	6.5 ± 1.27	6.8^{ab} ± 1.13
Whole meal	6.9^{ab} ± 1.85	6.7^{ab} ± 1.3	6.6 ± 1.3	6.7 ± 1.34	7.0^{ab} ± 1.33
Sohage 3:					
Wheat flour 72%	6.4^{ab} ± 1.43	6.0^{b} ± 1.8	6.7 ± 1.2	6.5 ± 1.35	6.8^{ab} ± 0.92
Whole meal	5.8^{b} ± 1.37	6.1^{ab} ± 1.5	6.5 ± 1.1	7.3 ± 1.30	6.3^{b} ± 1.15
Sakha 93:					
Wheat flour 72%	6.7^{ab} ± 1.34	6.7^{ab} ± 1.5	6.7 ± 1.2	7.3 ± 1.05	6.4^{b} ± 1.07
Whole meal	6.3^{b} ± 1.25	6.4^{ab} ± 1.1	7.1 ± 1.3	7.4 ± 1.05	6.7^{b} ± 1.33
LSD at 0.05	1.34	1.29	---	---	1.00

3 Biscuit

3.1 Chemical composition of biscuit samples:

The effect of using some Egyptian new wheat variety (whole meal, flour 72%) on gross chemical composition of biscuit was studied. Table (10) Showed that, whole meal biscuit is characterized by its higher content of protein, fat, ash and crude fiber than wheat flour (72%). While wheat flour (72%) biscuit was higher than whole meal in total carbohydrate (TC). This result agreed with those

found by Kent-Jones and Amos (1967) and Shouk (1996), they stated that, whole meal wheat bread was higher than wheat flour 72% bread in protein, fat, ash and fiber. In addition, whole meal biscuit of Sohage 3 was characterized with its higher protein (12.13%), fat (31.0%) and ash (2.51%) contents; and lower carbohydrate content (52.18%), while whole meal biscuit of Sakha 93 was characterized by its higher moisture (4.5%) and crude fiber contents (3.0%).

Table 10: Effect of wheat varieties and extraction rate on chemical composition of biscuit.

Sample	Moisture	Protein	Fat	Ash	Crude fiber	Total Carb.
Gemmeiza 7:						
Wheat flour 72%	3.60^{ef} ± .005	9.50^{f} ± 0.06	29.08^{f} ± 0.10	1.65^{d} ± 0.05	1.10^{e} ± 0.09	58.61^{a} ± 0.23
Whole meal	4.20^{c} ± 0.02	10.34^{d} ± 0.14	30.35c ± 0.15	2.12^{b} ± 0.10	2.28^{b} ± 0.26	54.91^{d} ± 0.62
Giza 168:						
Wheat flour 72%	3.64^{de} ± 0.04	9.75^{e} ± 0.05	2929^{e} ± 0.04	1.83^{c} ± 005	1.48^{de} ± 0.08	57.65^{b} ± 0.09
Whole meal	4.31^{b} ± 0.08	10.76^{c} ± 0.21	30.51b ± 0.04	2.40^{a} ± 0.10	2.24^{bc} ± 0.06	54.18^{e} ± 0.11
Sohage 3:						
Wheat flour 72%	3.72^{d} ± 0.03	11.34^{b} ± 0.14	29.36^{e} ± 0.04	1.75^{cd} ± 0.03	1.85^{cd} ± 0.61	56.37^{c} ± 0.20
Whole meal	4.55^{a} ± 0.05	12.13^{a} ± 0.08	31.00^{a} ± 0.06	2.51^{a} ± 0.1e	1.22^{e} ± 0.61	52.18^{f} ± 0.15
Sakha 93:						
Wheat flour 72%	3.54^{f} ± 0.03	9.86^{e} ± 0.05	29.16^{f} ± 0.05	1.42^{e} ± 0.09	1.66^{d} ± 0.14	57.89^{b} ± 0.29
Whole meal	4.55^{a} ± 0.05	10.86^{c} ± 0.05	30.22^{d} ± 0.03	2.21^{b} ± 0.04	3.00^{a} ± 0.15	53.71^{e} ± 0.16
LSD at 0.05	0.078	0.196	0.128	0.133	0.432	0.485

Total Carb. = Total carbohydrate.

2.3.2 Baking quality:

Table (11) showed that, whole-meal biscuits were higher in weight and volume than biscuit of wheat flour 72%, where biscuit weight of whole meal and wheat flour 72% varieties ranged between (81.49-87.47g) and (74.38-81.51g), respectively. Biscuit volume of whole meal and wheat flour (72%) varieties ranged between (135.0-160.0cc) and (123.3-143.30cc) respectively. Whole meal biscuits were also higher in height than wheat flour (72%) biscuits, where biscuits height of whole meal varieties ranged between (0.95-1.15cm). It decreased to a range between (0.87-1.01cm) in wheat flour (72%) varieties. This effect could be due to the increased level of crude fiber in biscuit of whole meal (Table 10). In contrast, biscuits diameter and spread ratio of whole meal varieties were lower than biscuit of wheat flour (72%) varieties, the diameter and spread ratio of biscuit of whole meal varieties ranged between (6.78-7.28cm) and (6.38-6.86diam/ht), and the values increased to (7.13-7.62cm) and (7.088.73diam/ht) in wheat flour (72%) varieties, respectively.

It could be concluded from Table (11) that, the higher baking quality (specific volume and spread ratio) of whole meal biscuits or wheat flour (72%) was obtained in case of using Gemmeiza 7 or Giza 168 varieties.

2.3.3 Color quality:

Biscuits color quality of whole meal and flour (72%) for Gemmeiza 7, Giza 168, Sohage 3 and Sakha 93 varieties were studied and presented in Table (12). As expected biscuits face or back of flour (72%) varieties was characterized by its higher lightness (L) than whole meal varieties. Where, (L) value of biscuits face and back of flour (72%) varieties ranged between (68.58-75.16) and (45.12-63.46), respectively. The whole meal ranged between (64.28-72.69) and (41.28-51.56), respectively. In addition, biscuits face or back of flour (72%) varieties are characterized by its higher redness (a) than whole meal varieties. In contrast, yellowness (b) of biscuits face or back of flour (72%) varieties was decreased, compared with biscuit of whole meal varieties. From the obtained results of Hunter color parameter (Table 12), it was found that biscuit of whole meal varieties was slightly darker than biscuit of wheat flour (72%) varieties, where whole meal

contain higher level of dietary fiber. These results agreed with those found by Kim *et al* (1997) who stated that adding dietary fiber to bread dough increase darkness.

Table 11: Effect of wheat varieties and extraction rate on biscuits baking quality.

Samples	Weight (g)	Volume (cc)	Specific volume (cc/g)	Diameter (cm)	Height (cm)	Spread ratio (diam./ht.)
Gemmeiza 7:						
Wheat flour (72%)	81.51^{bc} ± 2.19	135.0^{c} ± 5.00	1.63^{b} ± 0.03	7.62 ^{a}± 0.16	0.87^{d} ±0.01	8.73^{a} ±0.02
Whole meal	87.47^{a} ±3.40	135.0^{c} ± 5.00	1.54^{d} ± 0.02	6.92 ^{e} ±0.34	0.95 ^{bc} ±0.09	6.86^{e} ±0.08
Giza 168:						
Wheat flour (72%)	74.38^{d} ± 1.73	123.3^{d} ± 5.77	1.81^{a} ± 0.02	7.6 ^{ab} ±0.18	0.93^{cd} ±0.09	8.49 ^{b} ±0.13
Whole meal	83.95^{abc} ± 1.59	138.5^{c} ± 2.89	1.82^{a} ± 0.02	6.78^{e} ±0.09	1.01 ^{b} ±0.04	6.73^{f} ±0.02
Sohage 3:						
Wheat flour (72%)	79.28^{c} ± 2.67	143.00^{bc} ± 5.77	1.52^{c} ± 0.02	7.46 ^{b} ±0.13	0.99 ^{bc} ±0.08	7.55 ^{c} ±0.04
Whole meal	81.49^{ab} ± 1.61	152.33^{ab} ± 2.51	1.62^{b} ± 0.03	7.1 ^{d} ±0.12	1.1 ^{a} ±0.05	6.63 ^{g} ±0.09
Sakha 93:						
Wheat flour (72%)	79.28^{c} ± 2.81	143.30^{bc} ± 5.70	1.83^{a} ± 0.03	7.13 ^{cd} ±0.12	1.01 ^{b} ±0.09	7.08^{d} ±0.07
Whole meal	85.33^{ab} ± 0.84	160.00^{a} ± 10.00	1.85^{a} ± 0.03	7.28^{c} ±0.08	1.15 ^{b} ±0.09	6.38^{h} ±0.05
LSD at .05	4.85	6.96	0.07	0.16	0.08	0.07

Table 12: Effect of wheat varieties and extraction rate on biscuits color quality.

Sample	Lightness "L"		Redness "a"		Yellowness "b"	
	Face	Back	Face	Back	Face	Back
Gemmeiza 7:						
Wheat flour (72%)	68.58^{de} ± 0.51	63.46^{a} ± 1.20	6.44^{a} ± 0.52	15.61^{c} ± 0.29	27.79^{b} ± 0.50	34.71^{abc} ± 0.83
Whole meal	64.28^{f} ± 0.46	51.56^{b} ± 1.24	3.89^{c} ± 0.53	12.08^{d} ± 1.0	29.72^{a} ± 0.75	36.62^{a} ± 0.57
Giza 168:						
Wheat flour (72%)	68.72^{d} ± 0.59	45.12^{bcd} ± 6.22	6.75^{a} ± 0.50	17.34^{ab} ± 0.47	29.67^{a} ± 0.68	32.1^{cd} ± 3.02
Whole meal	68.09^{de} ± 0.37	41.28^{d} ± 3.13	6.7^{a} ± 0.48	16.76^{b} ± 0.43	29.27^{a} ± 0.67	33.80^{abcd} ± 3.99
Sohage 3:						
Wheat flour (72%)	75.16^{a} ± 0.46	48.81^{bc} ± 7.01	3.59^{c} ± 0.34	17.92^{a} ± 0.60	29.27 ^{a} ± $^{0..66}$	36.25^{ab} ± 3.36
Whole meal	72.69^{b} ± 0.73	45.64^{bcd} ± 3.71	5.34^{b} ± 0.06	17.50^{ab} ± 0.26	30.11^{a} ± 1.14	35.46^{abc} ± 1.25
Sakha 93:						
Wheat flour (72%)	70.37^{c} ± 1.31	46.12^{bc} ± 1.52	7.26^{a} ± 0.89	17.71^{a} ± 0.12	29.43^{a} ± 0.9	32.66^{bcd} ± 0.77
Whole meal	67.55^{e} ± 0.29	42.40^{cd} ± 1.75	6.73^{a} ± 0.21	16.72^{b} ± 0.06	26.28^{c} ± 0.57	30.25^{d} ± 0.85
LSD at 0.05	1.15	6.69	0.86	0.81	1.66	2.70

3.4 Sensory properties:

Biscuits quality of whole meal and flour (72%) of studied wheat varieties evaluated sensorially and presented in Table (13). Biscuit color of wheat flour (72%) varieties ranged between (7.7-8.17). Whole meal varieties showed non-significant decrease (range between 6.66-8.16). These results agreed with the obtained Hunter color parameter (Table 12), where biscuit of whole meal varieties was slightly darker than biscuit of wheat flour (72%) varieties. In addition, biscuits flavor, taste, texture, appearance and overall acceptability of wheat flour (72%) showed non-significant improvement compared with whole meal of the same variety.

Table 13: Effect of wheat varieties and extraction rate on sensory properties of biscuits.

Samples	Color (10)	Flavor (10)	Taste (10)	Texture (10)	Appearance (10)	Overall acceptability (10)
Gemmeiza 7:						
Wheat flour (72%)	8.17 ^{a} ±1.64	8.75 ^{a} ±1.08	8.5 ^{a} ±1.17	8.25 ^{a} ±1.3	8.25 ^{a} ±1.14	5.8 ^{a} ±1.08
Whole meal	7.9 ^{a} ±1.08	7.75 ^{ab} ±1.35	7.5 ^{ab} ±1.83	7.66 ^{ab} ±1.1	7.58 ^{ab} ±1.73	7.83 ^{ab} ±1.61
Giza 168:						
Wheat flour (72%)	7.7 ^{a} ±1.16	7.75 ^{ab} ±1.46	7.3 ^{ab} ±2.03	7.5 ^{ab} ±1.83	7.58 ^{ab} ±1.73	7.58 ^{ab} ±1.86
Whole meal	8.16 ^{a} ±0.75	7.08 ^{bc} ±1.24	7.2 ^{b} ±1.69	7.2 ^{ab} ±1.4	7.75 ^{ab} ±0.96	7.42 ^{ab} ±1.16
Sohage 3:						
Wheat flour (72%)	8.0 ^{a} ±1.21	7.5 ^{bc} ±1.0	7.6 ^{ab} ±1.55	7.7 ^{ab} ±1.32	7.92 ^{ab} ±0.9	7.58 ^{bc} ±1.62
Whole meal	7.92 ^{a} ±0.99	6.83 ^{bc} ±0.86	7.1 ^{b} ±1.24	7.6 ^{ab} ±1.08	7.58 ^{ab} ±1.16	7.17 ^{bc} ±.40
Sakha 93:						
Wheat flour (72%)	7.7 ^{a} ±0.98	7.08 ^{bc} ±1.38	7.5 ^{ab} ±0.80	7.0 ^{b} ±1.52	7.08 ^{bc} ±0.79	7.33 ^{bc} ±0.51
Whole meal	6.66 ^{b} ± 0.96	6.58 ^{c} ±1.24	6.5 ^{b} ±2.02	6.6 ^{b} ±1.24	6.25 ^{c} ±0.62	6.29 ^{c} ±1.32
LSD at 0.05	0.99	1.01	1.33	1.15	0.88	1.12

It could be concluded from the present work that, whole meal of the studied wheat varieties were able to produce high quality products (pan bread, biscuit and pasta) characterized with higher nutritional contents, therefore, we recommend to use Giza 168 and Sakha 93 for producing pan bread, Sohag 3 for pasta and Gemmiza 7 for biscuits as found in the obtained technological and sensorial evaluation.

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