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EFFECT OF PROTEIN FRACTION ON QUALITY CHRACTERIESTICS OF WHEAT FLOUR OBTAINED FROM DIFFERENT WHEAT KERNELS.

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ABSTRACT

Different wheat kernels (Australian, Argentine, Russian, American and French), and Egyptian wheat (Gimaza 9, Misr 1 and 2) local wheat cultivars were subjected to physico-chemical properties according to their different performance in baked products. The Total protein fraction for the all flour samples were studied and related to the of rheological and dough properties. Water addition required for dough development was positively correlated with gluten protein content so the properties of flour dough strongly depended on high gluten index. On the other hand at low protein and gluten index were related to weak dough with the low glutenin and gliadin content. Thus, the behaviours of flour and dough respect to total protein fraction.
Keywords: Wheat, Flour, Physical, chemical, properties, milling, baking and bread.

INTRODUCTION

Wheat flour is the major ingredient in many products and consequently it exerts a major effect on their quality. It is also a complex biological entity and, as such, varies significantly with the source of the wheat. As a complex system, and because it is obtained from a plant, wheat flour contains a multitude of compounds found in any living tissue. These include: moisture 14%, proteins 7-15% (albumins, globulins, gliadin and glutenin), starch 63-72% (amylopectin, amylose), non starchy polysaccharides 4.5-5.0% (pentosans and beta glucans), lipids 1%, as well as vitamins (thiamin, riboflavin, niacin) and minerals (iron, sodium, potassium, calcium, magnesium, copper and zinc). The most of these components play an important role in the way of how the flour-based and other product constituens will behave during processing or how the final product meets the consumer's requirements (Katarina and Dušanka, 2008). Bread-making quality of a variety usually reacts like other quantitative characteristics to favourable or unfavourable environmental conditions and varies its performance. It is unrealistic to expect the same level of performance in all environments (Grausgruber *et al*., 2000). For the milling and baking industry, it is desirable that quality traits should be maintained as stable as possible through all environments. There exit different concepts of stability definition.

Flour is a product made from grain that has been ground into a powdery consistency. It is flour that provides the primary structure to the final baked bread. Commonly available flours are made from rye, barley, maize, and other grains, but wheat flour is most commonly used for bread. Each of these grains provides the starch and protein necessary for the production of bread. The quantity of the proteins contained in the flour serve as the best indicator of the quality of the bread dough and the finished bread. While bread can be made from all-purpose wheat flour, for quality bread a specialty bread flour, containing more protein, is recommended. If one uses a flour with a lower (9-11%) protein content to produce bread, a longer mixing time will be required to develop gluten strength properly. This extended mixing time leads to oxidization of the dough which gives the finished product a whiter crumb, instead of the cream color preferred by most artisan bakers. Wheat flour in addition to its starch contains three water-soluble protein groups, albumin, globulin, proteoses, and two non-water soluble protein groups, glutenin and gliadin. When flour is mixed with water the water-soluble proteins dissolve, leaving the glutenin and gliadin to form the structure of the resulting dough. When worked by kneading, the glutenin forms strands of long thin chainlike molecules while the shorter gliadin forms bridges between the strands of glutenin. The resulting networks of strands produced by these two proteins are known as gluten. Gluten development improves if the dough is allowed to autolyse (Peter, 2001).

The variation in dough rheology and bread making performance between wheat cultivars is largely determined by differences in protein quantity and composition (Pomeranz, 1988) and (MacRitchie, 1992). Classically, the proteins of wheat are subdivided into: water-soluble (albumins), salt soluble (globulins), 70% ethanol-soluble (gliadins), and acidor alkali-soluble (glutenins); all protein fractions being heterogeneous (Eliasson *et al.,*1990). Gliadins and glutenins together make up the storage or gluten proteins. Glutenins are present as large complexes formed by subunits linked together by disulphide bonds. Several reports were published on the relation between dough rheological properties and gluten protein composition. wheat flours exhibiting long mixing times and strong doughs contain relatively large amounts of glutenin of large size. A strong correlation was found between dough strength and the total amount of glutenin, but an even stronger correlation was found between glutenin fraction of largest size, i.e. the insoluble fraction plus the fraction eluting in the void volume. Similarly, a very strong correlation was observed by (Cornec *et al.,* 1994) between the shear modules of hydrated gluten and the proportion of the largest glutenin. The glutenin to gliadin ratio clearly affects the mechanical properties of gluten dough in uniaxial extension tests (Kim *et al.,* 1988). With increasing gliadin content the resistance to extension decreased and the extensibility increased. From measurements on glutens reconstituted at various glutenin/gliadin ratios, (Janssen *et al.*, 1996), found that at a constant protein content the main factor determining the rheological behavior of hydrated gluten is the glutenin to gliadin ratio. The gluten of cultivars giving good bread flour had a higher modules and a lower loss tangent in dynamic measurements and higher values for the stress and for strain hardening in biaxial extension tests. By interchanging the gliadin and glutenin fractions from the two glutens, it was shown that the source the fractions, particularly that of the glutenin fraction, was also important.

The objective of this paper is to relate differences in gluten composition to the mechanical properties of wheat flour dough. To evaluate the most common imported wheats (Australian, Argentine, Russian, American and

French), as well as a local wheat cultivars Egyptian wheat (Gimaza9) for bread making. The physical, chemical, rheological as well as the manufactured bread quality characteristics were examined. To obtain information of protein fraction (albumin, globulin, glutenin and gliadin).

MATERIALS AND METHODS

Wheat samples.

Five imported wheat grains *(Triticum aestivum*) different cultivars were obtained from Argentine, France, Russia, Australia and U.S.A which were obtained from five Goverment (Alexandria, Domiata, El-Suez, El-Skhna and Cairo) and Egyptian wheat grains (Gimaza 9, Misr 1 and 2) were obtained from El-Ghrbia and El-bahara. They were taken from eight different Companies since 2013.

Preparation of wheat flours

A twenty kg of each wheat sample used in this investigation was stored 90 days at temperature 25°c and relative humidity less than 62% and taken samples from stored wheat at different time (0, 7, 14, 21, 30, 36, 42, 49, 60, 66, 72, 84 and 90 days) According to the methods described in USDA, (1995). At the end of stored wheat sample was cleaned mechanically to remove dirt, dockage, imparters and other strange grains by Carter Dockage Tester According to the methods described in USDA, (2002). the wheat samples were tempered to 16.5 % moisture and allowed to conditioning for 24 hours, than milled by Laboratory mill CD1 auto Chopin According to the methods described in AACC method (2000).the extraction rate of any flour sample was adjusted to recurred rate (72% extraction).

Bread processing

Different samples of flours were used to produce standard Toast breads according to the formula showed in Table (1).

Table (1):

Type of bread	Flour	Active Dry Yeast	Salt	Sugar
Stander Toast	1000gm	20gm	NaCl 10gm	Sucrose 10gm

Standard Toast

Standard Toast was prepared According to the methods described in AACC method (2000 A). All ingredient of Stander Toast (shown in Table (1)) were mixed with water to Farinograph Chopin test. The dough was mixed for 5-10 min. until the correct consistency was obtained. Dough fermentation and branding of the dough for 7 min. dough were divided to 300 gm and put in pan no. 17 which fermentation for 2 hours at 30°c and relative humidity 80%. All samples were baked at 230°c for 20 min. at electric oven (Futurci oven 220 Perten) in Regional Center for Food and Feed, Agri. Res. Center, Cairo, Egypt.

Analytical methods

Physical properties

Cleanliness, dockage, shrunken and broken, foreign materials, total damaged kernels and total defects were separated and determined manually (hand picking). Test weight pound per bushel, Test weight P/B = (Kg ⁄ Hectoliter) ÷1.278 according to USDA, (2006). A thousand kernel weight was determined by counting the kernels in a 10 g wheat sample AACC method, (2000). Wet and dry gluten, Extraction of wheat flour, Loaf volume= weight/volume after baking and falling number were determined according to A.O.A.C., (2005)

Chemical properties

Moisture, crude protein, Total protein fraction, ash, crude fiber, protein sediment and fat were determined according to A.O.A.C., (2005) and Grains Moisture according to USDA, (1999). The nitrogen free extract(NFE) was calculated by difference.

Rheological properties

All samples were tested by macro Farinograph and Extensograph. (in Regional Center for Food and Feed, Agri. Res. Center, Cairo, Egypt.) to determine the rheological properties of the different types of flour according to the methods described by AACC,(2000).

Economic Evaluation

A mill management, economic model was developed and consists of seventeen major components or steps according to Bunn, (1998) :

(1) wheat price L.E/Tons.
(2) Secondary production price L.E/ Tons.
(3) Moisture Content of wheat %.
(4) Moisture Content of flour%.
(5) Flour yield %.
(6) Reduction of flour extraction %= 0.6.
(7) Quantity of wheat to produce one ton flour Tons = 100 / Flour yield % .
(8) Increase in mill feed% = (Moisture Content of flour% - Moisture Content of wheat %) x100 / (100 - Moisture Content of flour%) - Reduction of flour extraction %.
(9) Total production of flour Tons= Quantity of wheat to produce one ton flour Tons x (100+ Increase in mill feed%) /100.
(10) Quantity of Secondary production Tons= Total production of flour Tons - 1.
(11) Wheat cost to produce one ton flour L.E/Tons= Total production of flour Tons x wheat price L.E/Tons.
(12) Secondary production cost to produce one ton flour L.E/Tons= Quantity of Secondary production Tons x Secondary production price L.E/ Tons.
(13) Total flour cost L.E/Tons= Wheat cost to produce one ton flour L.E/Tons + Secondary production cost to produce one ton flour L.E/Tons.
(14) High quality %= ((100 – (Bread loaf volume gm/cm3 / total addition of Bread loaf volume gm/cm3 x 100)).
(15) Low cost %= ((100 – (Total flour cost L.E/Tons / total addition of Total flour cost L.E/Tons x 100)).
(16) Storage effect on grading %= ((100 – (grade / total grade x 100)).

(17) Average of quality, cost and storage %.

Not : total addition of Bread loaf volume gm/cm3**=** 3.13

total addition of Total flour cost L.E/Tons= 42992.254

total grade= 1+2+3+ 0= 6

sample grade = 0

Linear relationships were explored between the High quality %, the variation in flour sale price, wheat transportation cost and the Storage effect on grading %.

Statistical analysis

Data of three replicates were computed for the analysis of standard division (S.D) among the means were determined by Duncan's multiple range test using SAS programs SAS, (1999).

RESULTS AND DISCUSSION

Physical and chemical properties of wheat kernel and flours

Mean value of physical properties of different wheat kernel cultivars are presented in Table (2). Moisture content among all samples which was ranged from 8.6 to 9.8%. the highest moisture content noticed for Australian stander white wheat, while the lowest moisture content noticed for Egyptian soft white wheat (Gimaza 9). It can be concluded that the test weight for all samples which ranged from 58.03 to 63.6 pound per bushel. The same trend were observed in test weight where Argentine soft red winter wheat the highest and followed by Australian stander white wheat, French soft white wheat, Egyptian soft white wheat (Gimaza 9), Egyptian hard red wheat (Misr1), American soft red winter wheat, Egyptian hard red wheat (Misr2) and Russian hard red wheat. More ever the foreign material among all samples ranged from 0.05 to 0.19%, either Argentine soft red winter wheat have highest percentage of shrunken and broken kernels followed by Australian stander white wheat. For damage kernels which contest of heat damage and total damage, specially Argentine soft red winter wheat and Russian hard red wheat which have highest total damage kernels percentage (2.0%), while Egyptian soft white wheat (Gimaza9) have lowest percentage of total damage kernels (0.93%). It can be noticed that the American soft red winter wheat, Australian stander white wheat and Egyptian soft white wheat haven't heat damage. More over from the same table noticed that all sample are free from insect and od odor. After 3 months all wheat cultivars had infested and had been sample grade even Argentine soft red winter wheat and Australian stander white wheat. The Egyptian stander no. 1601/1986 and it's modification on 23/4/2002 (ES, 1986) has obligation that the dockage % (first separated from sample) not exceed 1%, foreign material % not exceed 1%, total damage kernels % (heat damage ,sprout damage, insect damage and mould damage kernels) not exceed than 4%. However that difference between wheat samples, all wheat samples had grade one according to USDA, (2006).

Table 2: Grading of different wheat kernel cultivars.

Wheat		AmW	ArW	AuW	FrW	RuW	EgyW		
							Gimaza 9	Misr1	Misr2
M.C%		9.60 ±0.1	9.0 ±0.5	9.80 ±0.07	8.70 ±0.1	9.40 ±0.1	8.60 ±0.1	9.7 ±0.1	9.6 ±0.1
T.W p/b		60.30 ±0.1	63.14 ±0.01	62.6 ±0.07	61.95± 0.01	58.03 ±0.01	61.55 ±0.01	61.65 ±0.01	59.7 ±0.01
F.M%		0.13 ±0.01	0.05 ±0.01	0.08 ±0.01	0.16 ±0.01	0.19 ±0.01	0.10 ±0.01	0.14 ±0.01	0.12 ±0.01
Sh.& B.N%		0.52 ±0.01	1.76 ±0.01	0.75 ±0.07	0.72 ±0.01	0.36 ±0.01	0.48 ±0.01	0.39 ±0.01	0.72 ±0.07
D.K%	H.D	Zero	Zero	0.10 ±0.1	0.20 ±0.2	Zero	Zero	Zero	0.10 ±0.7
	T.D	1.60 ±0.1	1.30 ±0.1	2.0 ±1.0	1.50 ±0.1	0.93 ±0.01	1.0 ±0.01	1.1 ±0.1	2.0 ±1.0
Odor		Ok	Ok	Ok	Ok	Ok	Ok	Ok	Ok
Insect		Free	Free	Free	Free	Free	Free	Free	Free
Grade		1	1	1	1	1	1	1	1
Grade after 3 mouth		G.S	3	3	G.S	G.S	G.S	G.S	G.S

T.W = Test weight, p/b= Pound per Bushel (American unit), M.C = Moisture Content, F.M = Foreign Material, Sh. & B.N = Shrunken &Broken kernels, D.K = Damage Kernels, H.D = Heat Damage, T.D = Total Damage, ArW =Argentine Soft Red winter Wheat, FrW =French Soft white Wheat, RuW =Russian Hard Red Wheat, AmW =American Soft Red Winter Wheat, AuW =Australian Stander White Wheat, EgyW=Egyptian Wheat (Gimaza 9, Misr1 and Misr2), G.S= Sample Grade

Results of Table (3) that the flour yield was different slightly among test samples and ranged from 64.3 to 69.8 %. So data present that Argentine soft red winter wheat had highest flour yield (69.8), while American soft red winter wheat and Russian hard red wheat had lowest flour yield (64.82%) and (64.3%) receptivity. On the other hand Russian hard red wheat had the highest coarse bran (18.26%), while American soft red winter wheat, Egyptian soft white wheat(Gimaza 9) had lowest coarse bran (16.25%). However American soft red winter wheat and Russian hard red wheat had highest fin bran (15.52%) and (15.54%) receptivity, while Egyptian soft white wheat (Gimaza 9) had the lowest fin bran (7.84%) and highest semolina (7.9%). However, these differences may be partialy attributed due to different growing and environmental conditions prevailed during growing periods (Randhawa *et al.,* 2002).

Table 3: Extraction of different wheat flour obtained from different wheat kernels

Wheat Flour	AmW	ArW	AuW	FrW	RuW	EgyW		
						Gimaza 9	Misr1	Misr2
Coarse Bran%	16.25	16.68	17.24	17.18	18.26	16.25	17.1	16.2
Fin Bran %	15.52	14.81	12.33	11.82	15.54	7.84	15.2	15.3
Semolina %	3.40	1.29	2.03	2.70	2.0	7.91	4.0	2.60
Flour yield %	64.83	69.80	68.40	68.30	64.20	68.0	63.7	65.9

ArW =Argentine Soft Red winter Wheat, FrW =French Soft white Wheat, RuW =Russian Hard Red Wheat, AmW =American Soft Red Winter Wheat, AuW =Australian Stander White Wheat, EgyW=Egyptian Wheat (Gimaza 9, Misr1 and Misr2)

D,Appolonia and Emeritus, (1996) Reported that milling separates the bran and germ fractions from the endosperm, which is used to make flour, and reduces endosperm particles to the correct size. Results of Table (4) that B1 are ranged from 2.03 to 6.14%, B2 are ranged from 2.87 to 8.21%, B3 are ranged from 1.90 to 5.18%, B4 are ranged from 1.06 to 3.45% and B5 are ranged from 1.24 to 2.67%. So data present that French soft white wheat had highest value of breaks flour yield followed by Australian stander white wheat, while American soft red winter wheat had lowest value of breaks flour yield even in break 5 (B5) had the highest value of breaks flour yield (12.63%) and French soft white wheat had lowest value of breaks flour yield (1.24%), but in the total of breaks flour yield French soft white wheat had highest value of breaks flour yield (24.22%) followed by Australian stander white wheat (22.35%), while American soft red winter wheat had lowest value of breaks flour yield (10.53%). On the other hand C1 are ranged from 10.13 to 12.56%, C2 are ranged from 10.68 to 12.63%, C3 are ranged from 5.63 to 10.45%. So data present that American soft red winter wheat had highest value of carry-over flour yield followed by Russian hard red wheat, while French soft white wheat had lowest value of carry-over flour yield even in carry-over 3 (C3). Argentine soft red winter wheat had the highest value of breaks flour yield (10.45%) and Russian hard red wheat had lowest value of breaks flour yield (5.63%), but in the total of carry-over flour yield American soft red winter wheat had highest value of breaks flour yield (32.36%) followed by Argentine soft red winter wheat (31.75%), while Russian hard red wheat had lowest value of breaks flour yield (28.62%). However F1 are ranged from 1.21 to 2.7%, F2 are ranged from 1.27 to 2.25%, F3 are ranged from 2.25 to 3.51%, F4 are ranged from 3.15 to 6.2%, F5 are ranged from 1.85 to 12.53% and F6 are ranged from 1.05 to 3.1%.

So data present that French soft white wheat had highest value of reduction flour yield followed by Australian stander white wheat, while American soft red winter wheat had lowest value of reduction flour yield even in reduction F4, F6 (Egyptian soft white wheat(Gimaza 9)) and F5 (American soft red winter wheat) had the highest value of reduction flour yield (6.2%, 3.1% and 12.53%) and French soft white wheat had lowest value of reduction flour yield (3.15%, 1.85% and 1.05%), but in the total of reduction flour yield American soft red winter wheat had highest value of reduction flour yield (21.94%) followed by Egyptian soft white wheat(Gimaza 9) (20.62%), while French soft white wheat had lowest value of reduction flour yield (14.51%). At the end we can concluded that the wheat which had low hardness give more flour yield in the steps of breaking than the wheat which had high hardness but in the steps of carry-over and reduction the wheat which had high hardness give more flour yield than the wheat which had low hardness.
(Randhawa *et al.,* 2002).

Table 4: Breaking, Carry over and Reduction of different wheat flour obtained from different wheat kernels

Wheat Flour		AmW	ArW	AuW	FrW	RuW	EgyW		
							Gimaza 9	Misr1	Misr2
Breaking %	B1	2.03	4.98	5.56	6.14	3.83	4.11	4.31	4.08
	B2	2.87	6.26	7.23	8.21	4.31	5.52	5.73	5.54
	B3	1.90	4.04	4.61	5.18	2.91	1.91	4.92	3.54
	B4	1.06	3.31	3.38	3.45	3.17	3.41	3.31	2.25
	B5	2.67	1.90	1.57	1.24	2.57	2.30	2.40	1.95
	Total	10.53	20.49	22.35	24.22	16.79	17.25	20.67	17.36
Carry - Over %	C1	12.56	10.48	10.3	10.13	10.83	10.44	10.32	11.34
	C2	12.63	10.82	10.75	10.68	10.96	10.71	11.09	11.65
	C3	7.17	10.45	8.98	8.76	8.89	8.29	8.60	5.63
	Total	32.36	31.75	30.03	29.57	30.59	29.44	30.01	28.62
Reduction %	F1	1.21	2.26	2.48	2.70	1.83	2.01	2.10	1.95
	F2	1.27	2.13	2.19	2.25	2.01	2.12	1.92	1.76
	F3	2.25	3.18	3.34	3.51	2.85	3.23	3.03	2.88
	F4	3.48	4.74	4.16	3.15	6.20	3.84	4.11	3.33
	F5	12.53	3.24	2.54	1.85	4.63	3.90	2.71	7.19
	F6	1.20	2.01	1.31	1.05	3.10	1.91	1.35	1.11
	Total	21.94	16.56	16.02	14.51	20.62	17.01	15.22	18.22
Total Yield %		64.83	69.80	68.40	68.30	64.20	68.0	63.7	65.9
Hardness		65	60	57	57	61	63	58	63

ArW =Argentine Soft Red winter Wheat, FrW =French Soft white Wheat, RuW =Russian Hard Red Wheat, AmW =American Soft Red Winter Wheat, AuW =Australian Stander White Wheat, EgyW=Egyptian Wheat (Gimaza 9, Misr1 and Misr2), B 1, 2, 3, 4 ,5 = Break 1, 2, 3, 4, 5, C 1, 2, 3 = Carry-Over 1, 2, 3, F 1, 2, 3, 4, 5, 6 = Reduction 1, 2, 3, 4, 5, 6

Chemical composition of wheat flour prepared from different wheat kernels are showing from Table (5). Result indicted that chemical composition of flour are different in all investigated samples. Moisture content are ranged from 13.5% (American soft red winter wheat flour) to 13.85% (Argentine soft red winter wheat flour), while Argentine soft red winter wheat flour contain highest protein (11.5%) and lower nitrogen free extract (72.47%) than other samples, however Australian stander white wheat flour showed that have highest fat content compared with other studied samples. On other hand the American soft red winter wheat flour have a lower sample in ash.

Table 5: proximate analysis of different wheat flour obtained from different wheat kernels

Wheat Flour	AmW	ArW	AuW	EgyW			FrW	RuW
				Gimaza 9	Misr1	Misr2		
M.C	13.50 ±0.1	13.85 ±0.1	13.80 ±0.1	13.65 ±0.1	13.75 ±0.1	13.66 ±0.1	13.60 ±0.1	13.70 ±0.1
Protein%	10.0 ±1.0	11.50 ±0.1	9.60 ±0.1	10.30 ±0.1	10.20 ±0.1	10.60 ±0.1	10.20 ±0.1	9.80 ±0.1
Fat %	1.0 ±1.0	1.20 ±0.1	1.22 ±0.01	1.10 ±0.1	1.10 ±0.1	1.13 ±0.01	1.0 ±0.5	1.15 ±0.01
Ash%	0.48 ±0.01	0.85 ±0.01	0.59 ±0.1	0.90 ±0.1	0.65 ±0.01	0.63 ±0.01	0.50 ±0.1	0.51 ±0.01
Fiber%	0.11 ±0.01	0.13 ±0.01	0.16 ±0.01	0.20 ±0.1	0.19 ±0.01	0.17 ±0.01	0.15 ±0.01	0.12 ±0.01
NFE%	74.91 ±0.01	72.47 ±0.3	74.63 ±0.16	73.85 ±0.1	74.11 ±0.1	74.81 ±0.01	74.55 ±0.1	74.72 ±0.01
Total caloric values%	346.64 ±0.01	346.08 ±0.01	347.1 ±0.01	345.1 ±0.01	347.14 ±0.01	347.81 ±0.01	346.4 ±0.01	347.23 ±0.01

ArW =Argentine Soft Red winter Wheat, FrW =French Soft white Wheat, RuW =Russian Hard Red Wheat, AmW =American Soft Red Winter Wheat, AuW =Australian Stander White Wheat, EgyW=Egyptian Wheat (Gimaza 9, Misr1 and Misr2)

The data in Table (6) showed that the highest starch damage was in American soft red winter wheat flour (4.59%), while French soft white wheat was lowest (5.6%). Also, the results shown wet and dry gluten and hydration ratio of different flour samples are given in Table (6). Results from Tables (5) and (6) indicated the increases in protein content wasn't accompanied by an increase in wet and dry gluten contents .The Australian stander white wheat flour showed protein content of 9.60% have higher wet , dry gluten and hydration ratio than other samples 30, 9.60 and 213 % respectively, while it had the lower protein content 9.6 than other samples. Additionally, all samples investigated have a good characteristics for the production of bread except the Australian stander white wheat flour and Egyptian soft white wheat flour(Gimaza 9), while Australian stander white wheat flour it can be used for produce pasta and bread ,but the Egyptian soft white wheat flour(Gimaza 9) it can be used for biscuits and breakfast food . The same table reviewed that the falling number values were ranged from 154 to 442 sec. Argentine soft red winter wheat flour had the highest value (442sec.) and the Egyptian soft white wheat flour(Gimaza 9) had lower values (154sec.). Economic European community recommended that the falling number of flour should exceed than 230sec (Milatovie and Mondelli, 1991). Egyptian stander no. 1419/2006 of white flour for production of bread (ES, 2006) has the following requirement: protein content not less than 10.2% Ash content not exceed than 0.9% And the falling number showed exceed than 200 Sec. Also, Egyptian stander no.

1649/2004 for durum wheat (ES,2004) has obligation that protein content of durum wheat not less than 10.5% and ash content not exceed than 1.3%. From the same Table (5) it can be concluded that the percentage of sediment ranged from 15 to 40%. Australian stander white wheat flour was highest sediment ratio which had good characteristics to produce bread. At the end of the Table (6) it showed that Starch damaged are ranged from 4.59 to 5.6%. French soft white wheat flour had the highest value, while American Soft Red Winter Wheat flour had the lowest value.

Table 6: physicochemical properties of different wheat flour obtained from different wheat kernels

Wheat Flour		**AmW**	**ArW**	**AuW**	**FrW**	**RuW**	**EgyW**		
							Gimaza 9	**Misr1**	**Misr2**
Starch damage %		4.59	5.34	5.16	5.60	5.23	5.10	5.21	5.32
Gluten quantity	Wet%	20.0	25.30	30.0	25.0	20.40	24.10	23.20	24.30
	Dry%	6.40	8.10	9.60	8.0	6.52	9.50	8.10	7.77
	Hydration ratio	2.13	2.12	2.13	2.13	2.12	2.10	1.86	2.08
	Index%	83.50	93.40	93.30	92.60	80.10	91.40	90.80	90.70
Protein sediment %		15	27	40	33	30	16	35	25
Falling Number Sec.		383 ±1.0	442 ±1.0	430 ±1.0	360 ±1.0	436 ±1.0	154 ±1.0	399 ±1.0	435 ±1.0

ArW =Argentine Soft Red winter Wheat, FrW =French Soft white Wheat, RuW =Russian Hard Red Wheat, AmW =American Soft Red Winter Wheat, AuW =Australian Stander White Wheat, EgyW=Egyptian Wheat (Gimaza 9, Misr1 and Misr2)

Using a modified Osborne sequential extraction method for Total Protein fraction of different wheat flour obtained from different wheat cultivars were separated into four fractions: albumins, globulins, gliadins and glutenins. Table (7) shows the total extracted protein and the protein content of fraction soluble in 70% ethanol (gliadin) and in the alkaline solvent (glutenin). It is important to realise that the amounts and the types of protein extracted differ with the extraction procedure and that the gliadin and glutenin fraction, here defined as a solubility fraction, are not pure gliadin or glutenin fraction as defined on protein composition (Byers *et al.,* 1983) and (Eliasson *et al.,*1990). The distinction between proteins that are soluble in pure water and water containing also some NaCl is not discussed further. The protein content of the flours varied from 9.60 to 11.50%. The American Soft Red Winter Wheat flour were lowest, while the Argentine soft red winter wheat flour was the highest protein contents were found. For most cultivars gluten index comprised from 80.10 to 93.40% of the total protein. A high gluten index was found for Argentine soft red winter wheat flour. On other hand the American soft red winter wheat flour the glutenin content was exceptionally low (2.33%) and is expressed in a low gliadin content (1.54%), (Roels *et al.,* 1993). Other cultivars the gliadin content was higher and amounted to an average of 16% of total protein. Percentages of glutenin on total protein for Argentine soft red winter wheat flour were significantly highest (2.79%) than the other cultivars and the gliadin was highest (1.84) too.

Table 7: Total Protein fraction of different wheat flour obtained from different wheat kernels

Wheat Flour		AmW	ArW	AuW	FrW	RuW	EgyW		
							Gimaza 9	Misr1	Misr2
Protein fraction	Albumin	3.05	3.54	2.97	3.13	3.20	3.17	3.19	3.03
	Globulin	1.80	2.09	1.70	1.83	1.86	1.84	1.91	1.75
	gliadin	1.60	1.84	1.54	1.63	1.65	1.63	1.67	1.57
	Glutenin	2.43	2.79	2.33	2.48	2.50	2.48	2.57	2.38
	residue	1.12	1.24	1.06	1.13	1.09	1.08	1.16	1.07

ArW =Argentine Soft Red winter Wheat, FrW =French Soft white Wheat, RuW =Russian Hard Red Wheat, AmW =American Soft Red Winter Wheat, AuW =Australian Stander White Wheat, EgyW=Egyptian Wheat (Gimaza 9, Misr1 and Misr2)

Rheological properties of different wheat flour samples

Farinograph studies were conducted to determine the rheological properties of wheat flour for different wheat varieties (Table 8) and Fig (1). Highest water absorption (57.50%), was observed in Egyptian soft white wheat flour(Gimaza 9) followed by Argentine soft red winter wheat flour and Egyptian hard red wheat (Misr1) (57.0%) while American soft red winter wheat flour had the lowest water absorption (49.5%). Water absorption is considered to be an important characteristic of flour. Stronger wheat flours have the ability to absorb and retain more water as compared to weak flours. Higher water absorption is required for good bread characteristics which remain soft for a longer time. In considering the Farinograph mixing properties for the samples, it was found that arrivel time ranged from 1.0 to 1.25 min. French soft white wheat flour, Egyptian hard red wheat (Misr2) and Australian stander white wheat flour had the highest arrival time among all samples, but Argentine soft red winter wheat flour, Russian hard red wheat flour, American soft red winter wheat flour, Egyptian hard red wheat (Misr1) and Egyptian soft white wheat flour (Gimaza 9) had lowest . As regards the Dough Development Time (mixing time), the time in minutes need to mix flour and water to form dough of suitable consistency was ranged from 1.5 to 3.0 min. The Australian stander white wheat flour had the highest value of Dough Development Time and Egyptian soft white wheat flour(Gimaza 9) had lowest value. Higher Dough Development Time reflects strong flour while its lower value is an indication of weak flour. Usually the decrease of Dough Development Time is associated with weaker gluten. Regarding dough stability which indicates dough strength and it’s resistance for mechanical action and degree of weakening , it was found that Australian stander white wheat flour showed long period of dough stability was 18.0 min with low value of dough weakening 50.0 BU, on the other hand the Egyptian soft white wheat flour(Gimaza 9) had lowest period of dough stability 2.5min and the highest value of dough weakening 240 BU. In case of Mixing Tolerance Index (TI), highest value (140 BU) was observed in Egyptian soft white wheat flour(Gimaza 9) followed by American soft red winter wheat flour (110 BU). Australian stander white wheat flour had the lowest mixing tolerance index value(30BU.) Generally, higher mixing tolerance index value, weaker is the flour. For softening of dough (SD), Australian stander white wheat flour had the lowest value (20 BU), which indicates strong flour since flours that have lower softening of dough SD are stronger and the ones having higher softening of dough SD values are weaker. Differences in farinographic characteristics among different wheat flour varieties may be due to variations in protein quantity and quality. Results in (Table 6) for different wheat flour varieties were comparable to the earlier findings of (Rehman *et al*., 2001), (Huma (2004) and (Raman et al.,2000).

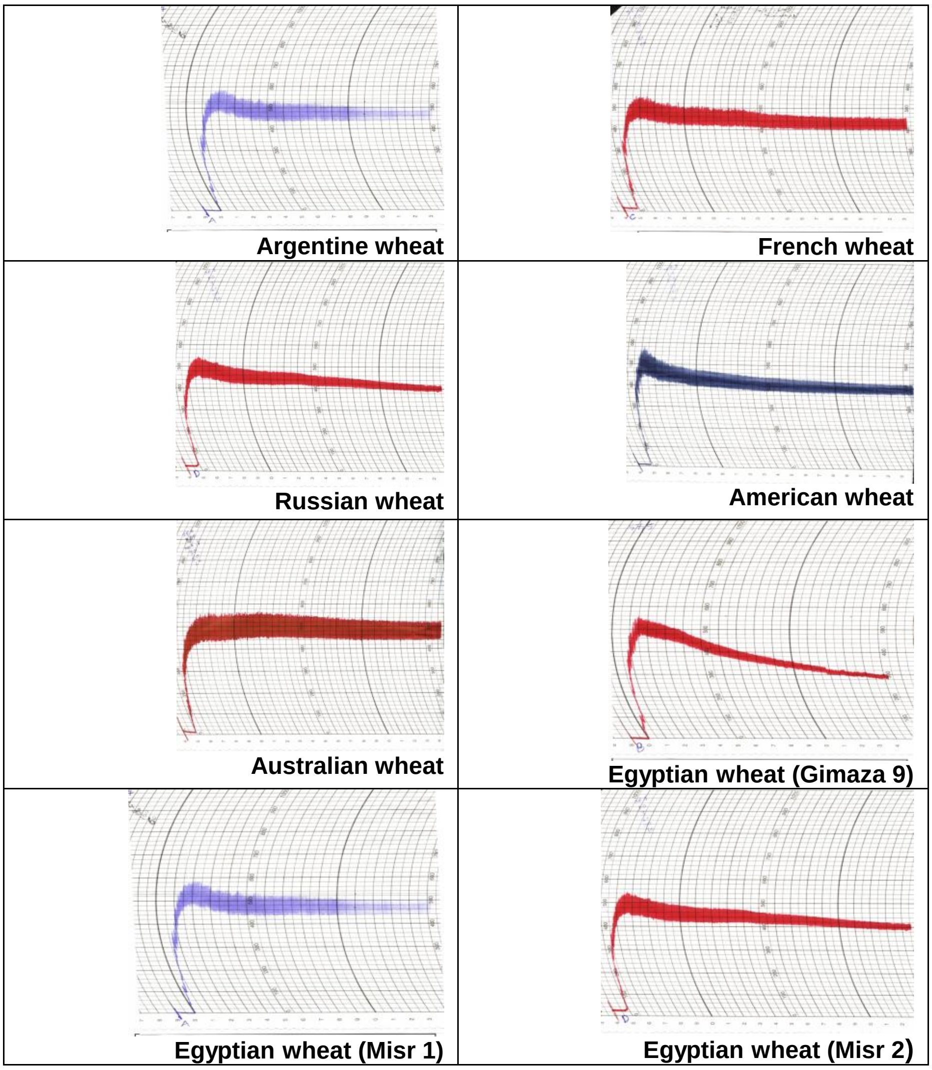

Figure 1: Farinograph Test

Extensograph gives information about the viscoelastic behaviour of a dough (Walker and Hazelton, 1996). This equipment measures dough extensibility and resistance to extension. A combination of good resistance and good extensibility results in desirable dough properties. Data in Table (8) and Fig(2) shown that resistance of extensibility (elasticity) of Russian hard red wheat flour had lowest value (210 mm), while Argentine soft red winter wheat flour had the highest value (700 mm) which was baking quality of a flour is defined by the elasticity (strength) of the gluten, the volume and crust of the loaf, and the quantity of water absorbed. The volume of the loaf and the strength of the gluten may be considered together, as loaf volume depends on the elasticity of the wet gluten in the dough. But extensibility decreased with Egyptian soft white wheat flour(Gimaza 9) (85 BU) and increased with American soft red winter wheat flour (145 BU) which is showing the behaviour of yeast acts on the starch and produces carbon dioxide (CO2) and alcohol. The dough mass fills with CO2, the volume of the dough increases, and the dough rises. If the dough is not subjected to the baking temperature, the elasticity of the walls around the gas-filled spaces reaches its limit, the walls break, the gases are released, and the dough contracts and returns to its original volume. During the bread-making process, however, the dough is placed into an oven before it reaches its greatest volume. However, proportional No. ratio is showing the baking behaviour of dough, so Argentine soft red winter wheat flour and American soft red winter wheat flour are short and stiff dough while Australian stander white wheat flour, French soft white wheat flour and Egyptian soft white wheat flour(Gamaza 9) are plastic short dough. On the other hand Russian hard red wheat flour is flowy dough. The energy or work input is necessary to refer to the bread crumb volume, so Australian stander white wheat flour had the highest value (150 cm2), while Egyptian soft white wheat flour(Gimaza 9) had lowest value (35 cm2).

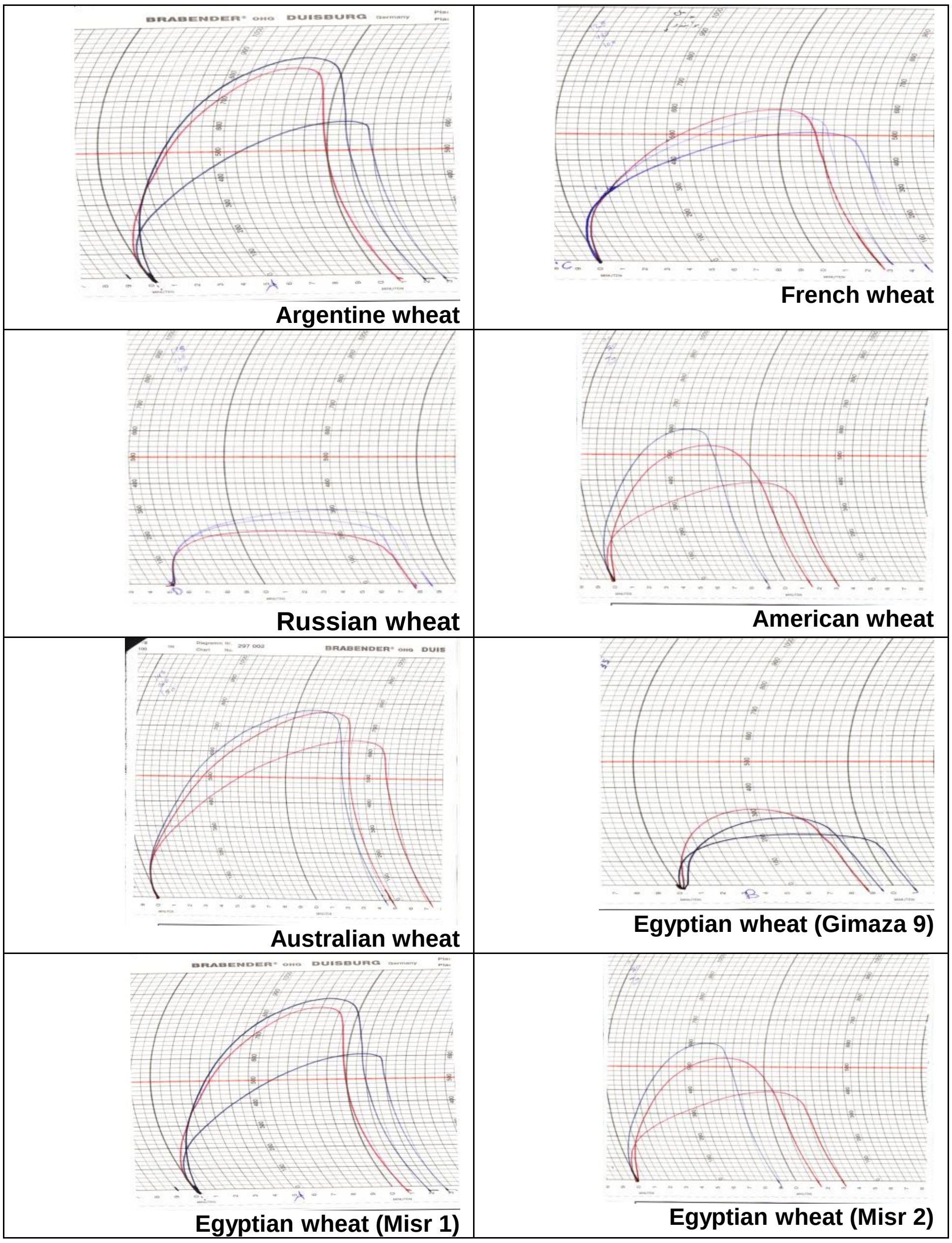

Figure 2: Extensograph Test

Table 8: Rheological properties of different wheat flour obtained from different wheat kernels

Wheat Flour		AmW	ArW	AuW	FrW	RuW	EgyW		
							Gimaza 9	Misr1	Misr2
Farinograph Test	Water absorption(%)	49.5	57.0	55.6	57.5	57.5	57.0	56.6	56.5
	Arrival Time (min)	1.0	1.0	1.25	1.25	1.0	1.0	1.25	1.0
	Dough stability (min)	2.50	4.0	18	5.50	2.50	4.0	3.50	3.0
	Development time (min)	2.0	2.50	3.0	2.0	1.50	2.50	2.0	1.50
	Mixing tolerance index (B.U.)	110	80	30	50	140	70	60	60
	Dough weaking Brabender	150	100	50	90	240	90	100	100
	Softening (B.U.)	90	60	20	60	170	50	60	70
Extensograph Test	Extensibility (mm)	91	115	145	125	85	110	115	125
	Elasticity (B.U.)	580	700	560	480	320	600	610	210
	Proportional No. ratio Elasticity/ Extensibility	6.37	6.09	3.86	3.84	3.76	5.45	5.30	1.68
	Energy (Cm2)	75	115	150	100	35	105	100	45

ArW =Argentine Soft Red winter Wheat, FrW =French Soft white Wheat, RuW =Russian Hard Red Wheat, AmW =American Soft Red Winter Wheat, AuW =Australian Stander White Wheat, EgyW=Egyptian Wheat (Gimaza 9, Misr1 and Misr2)

Physical properties of Toast made from different wheat flour(72% extraction).

The obtained results showed that the different values were observed on all physical properties of toast making such as weight after baking, volume, specific volume and loaf volume. Additionally Table (9) presented that the weight after baking for among of toast were ranged from 255 to 275 gm. Argentine toast had heaviest weight 275gm, while Egyptian(Gimaza 9), Egyptian (Misr2) and American toast had lightest weight 255gm. In the other side the volume after baking is different, the Australian Toast had the highest volume 1050cm3 followed by Argentine toast 1000cm3, while Egyptian(Gimaza 9) toast had the lowest volume 569cm3. So the specific volume is related to the volume, the Australian toast had highest volume 4.1 cm3/g followed by Argentine toast 3.63 cm3/g, while Egyptian(Gimaza 9) toast had lowest volume 2.23cm3/g, however loaf volume for Australian toast had lowest loaf volume 0.24g/cm3 and more cells of air followed by Argentine toast 0.28g/cm3, while Egyptian(Gimaza 9) toast had highest loaf volume 0.94g/cm3 and less cells of air.

Table 9: Physical properties of Toast made from different wheat flour (72% extraction).

wheat Flour		Weight after baking gm	Volume after baking cm3	Specific volume cm3/g	Loaf volume g/cm3
AmW		255	600	2.35	0.43
ArW		275	1000	3.63	0.28
AuW		256	1050	4.10	0.24
FrW		260	850	3.27	0.30
RuW		256	840	3.28	0.31
EgyW	Gimaza 9	255	569	2.23	0.94
	Misr 1	256	830	3.24	0.31
	Misr 2	255	800	3.13	0.32

DISCUSSION

From obtained results in Tables (5, 6, 8 and 9), it can be noticed that baking quality of a flour is defined by the elasticity (strength) of the gluten, the volume and crust of the loaf, and the quantity of water absorbed. The volume of the loaf and the strength of the gluten may be considered together, as loaf volume depends on the elasticity of the wet gluten in the dough. The yeast acts on the starch and produces carbon dioxide (CO_2) and alcohol. The dough mass fills with CO_2, the volume of the dough increases, and the dough rises. If the dough is not subjected to the baking temperature, the elasticity of the walls around the gas-filled spaces reaches its limit, the walls break, the gases are released, and the dough contracts and returns to its original volume. During the bread-making process, however, the dough is placed into an oven before it reaches its greatest volume. At this point the walls of the gas-filled spaces begin to harden as the gluten stiffens, the yeast organisms die and gas production releases. The gluten in the flour gives the walls of the spaces their elasticity, which keeps the accumulated gases from escaping. Obviously, the capacity of the membrane depends on the elasticity of the gluten. This capacity is usually determined by means of a baking test, which allows the membrane to expand while retaining its form, and by the uniformity of the membrane. The size of the baked loaf is a very important assessment factor: its quality is more difficult to define than its volume, however, because the important features here are the distribution of the spaces and the thickness of their walls. During the mixing of the dough for baking, water is added to the flour until the dough becomes fully formed. The amount of water absorbed by the dough ball depends on the quality of the flour. The water-absorbing capacity is a very important factor for the baker because the greater the capacity to absorb water, the more bread can be baked from a barrel of flour. The weight of a loaf after baking is also very important to the baker: it defines the water-holding capacity of the flour, which defines the productivity of the bread. This results are parallel with the results obtained by Stephan, (1999) and (Gwirtz *et al.,* 2002).

Table 10: Economic evaluation of different wheat flour milling operations obtained from six different wheat kernels

Performance	AmW	ArW	AuW	FrW	RuW	EgyW		
						Gimaza 9	Misr1	Misr2
Wheat price L.E/Tons	2216	4216	4240	2696	2000	3040	3040	3040
Secondary production price L.E/ Tons	779.37	1273.23	1339.84	854.63	716	972.8	1103.52	1057.92
M,c of wheat %	9.6	9.0	9.8	8.7	9.4	8.6	9.7	9.6
M,c of flour %	13.5	13.85	13.8	13.6	13.7	13.65	13.75	13.66
Flour yield %	64.83	69.8	68.4	68.3	64.2	68.0	63.7	65.9
Reduction of flour extraction %	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Quantity of wheat to produce one ton flour Tons	1.542	1.433	1.462	1.464	1.558	1.471	1.570	1.520
Increase in mill feed %	3.91	5.03	4.04	5.07	4.38	5.25	4.73	4.74
Total production of flour Tons	1.481	1.505	1.521	1.538	1.490	1.548	1.644	1.592
Quantity of Secondary production Tons	0.481	0.505	0.521	0.538	0.490	0.548	0.644	0.592
Wheat cost to produce one ton flour L.E/Tons	3417.072	6041.528	6198.88	3946.944	3116	4471.84	4997.76	4839.68
Secondary production cost to produce one ton flour L.E/Tons	374.87	642.98	698.1	459.79	350.84	533.1	710.67	626.29
Total flour cost L.E/Tons	3791.942	6684.508	6896.93	4467.34	3466.84	5004.94	5708.43	4896.97
High quality %	86.3	91.1	92.3	90.4	90.1	70.0	90.1	89.8
Low cost %	90.4	84.24	83.8	89.0	91.1	87.75	86.2	86.7
Storage effect on grading %	0.0	50.0	50.0	0.0	0.0	0.0	0.0	0.0
Average of quality, cost and storage %	58.9	75.11	75.37	59.8	60.40	52.58	58.87	58.83

ArW =Argentine Soft Red winter Wheat, FrW =French Soft white Wheat, RuW =Russian Hard Red Wheat, AmW =American Soft Red Winter Wheat, AuW =Australian Stander White Wheat, EgyW=Egyptian Wheat (Gimaza 9, Misr1 and Misr2), M.c = Moisture Content.

Economic evaluation

The data in Table (10) showed that the lowest price of wheat was the Russian Hard Red Wheat (2000 L.E/Tons), while Australian Stander White Wheat was the highest price (4240 L.E/Tons). However the lowest quantity of wheat to produce one ton flour was the Argentine Soft Red winter Wheat (1.433 Tons), while the Russian Hard Red Wheat was the highest quantity of wheat (1.558 Tons). On the other hand the Egyptian soft White Wheat (Gimaza 9) had the highest value of increasing in mill feed percentage, total production of flour and quantity of Secondary production (5.25%), (1.548 Tons) and (0.548Tons) respectively which performance high cost of secondary production (794.6 L.E/Tons), while American Soft Red Winter Wheat had the lowest value of increasing in mill feed percentage, total production of flour and quantity of Secondary production (3.91%), (1.481 Tons) and (0.481Tons) respectively which performance high cost of secondary production (697.45 L.E/Tons). From the result in Table (10) it can be noticed that the highest Wheat cost to produce one ton flour was Australian Stander White Wheat (6198.88 L.E/Tons) which performance highest Total flour cost (6954.33 L.E/Tons), while Russian Hard Red Wheat was the lowest value (3116 L.E/Tons) and (3896.5 L.E/Tons) respectively. At the end we can concluded that the high quality, low cost and storage effect on grading present the most suitable wheat for us which was Argentine Soft Red winter Wheat (75.37%). These results are parallel with the results obtained by Bunn, (1998) and Wingfield, (1985).

CONCLUSION

Data indicated that Argentine flours had more suitable properties for bread-making, low cost and storage effect on grading percent which is more suitable wheat and flour to us than the others. From the different tested wheat flours indicated that high protein must be high gluten index, so high gliadin and glutenin fraction

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تـأثير المركبـات الجزئيـة للبـروتين علـي جـودة خصـائص الـدقيق النـاتج مـن أنـواع مختلفة من الاقماح

تامر توفيق السيسي و طارق محمد العفيفى
المركز الاقليمى للأغذية و الأعلاف، مركز البحوث الزراعية

تـم فـي هـذا البحـث دراسـة الخصـائص الطبيعيـة والكيماويـة لخمسـة أنـواع مـن الأقمـاح المسـتوردة (الاسترالي ، الارجنتينى ، الفرنسي، الأمريكي ، الروسي) وثلاثـة انـوع مـن الأقمـاح المصـرية المحليـة (جميـزة ٩ ومصـر١ و٢) و دراسـة الاختـلافِ فـي صـفات المُنتَجـاتِ المَخْبُـوزةِ. تـم دراسـة المركبـات الجزئيـة للبـروتين لجميع عينات الدقيق وربطها بالخواص الريولوجية للعجين. إضـافة المـاء إلـى العجين يسـاعد علـى الـربط الجيد لغرويات البروتين، لذلك يتضح أن خواص العجين الجيد يعتمد على ارتفاع الجلوتين اندكس. كمـا يتضـح أيضـا أن انخفاض البروتين والجلوتين اندكس يوادى الى عجين ضعيف منخفض فى الجلوتينين والجليادين. وهذا يـدل على العلاقة السلوكية بين الدقيق والعجين من خلال المركبات الجزئية للبروتين.