RESULTS AND DISCUSSION

1) Physical properties of kernels and hulls of sunflower seed varieties:

It is clear from Table (1) that Miak seeds have higher flour content than Balady seeds 75.67 and 60.20%, respectively. This is attributed to the lower percentage of hull in Miak seeds than Balady ones, 24.33 and 39.80% respectively.

The same trends were reported by **Youssef and Abdel-Rahman, (1976),** who determined the percentage of kernels in Giza and Miak sunflower seeds to be 65 and 72% respectively, and hull percentages to be 35 and 28%, respectively.

Balady variety exhibited-larger seeds, higher hull weight (39.73% and 24.09%) and higher volume than Miak for whole seed (182 and 161 ml.), kernel (46 and 38 ml.) and hull (23 and 21 ml.) respectively

2) Chemical composition of kernels and hulls of sunflower seeds varieties:

Data in Table (2) represent the chemical composition of whole seeds and its constituents, kernel and hulls, in the two studied varieties, Miak and Balady.

It is clear that ether extract is higher in Miak whole seeds than in Balady 41.49, 32.82% respectively. This is an agreement with findings of **(Farag, 1966)** who indicated that the oil content of the whole sunflower seeds were found in the range of 34.51 to 36.77% and 54.39 to 57.41% for white and dark Egyptian sunflower seeds, respectively. Also, this is in agreement with the findings of **Wan *et al.*, (1979)** who

Table (1): Physical properties of kernels and hulls of sunflower seed varieties.

Physical properties	Varieties					
	Miak			Balady "Dahr-El-haea"		
	Whole seed	Kernel flour	Hull	Whole seed	Kernel flour	Hull
%	100	75.67	24.33	100	60.20	39.8
Weight (g) per 1000 seeds	102.40	78.13	24.09	92.42	52.72	39.73
Volume (ml) per 1000 seeds	161.00	38.00	21.00	182.0	46.00	23.00
Specific gravity (g/ml)	0.64	2.06	1.15	0.51	1.15	1.73

Table (2): Chemical composition of kernels and hulls of sunflower seed varieties.

Chemical composition	Sunflower varieties used					
	Miak			Balady "Dahr-El-haea"		
	Whole seed	Kernel flour	Hull	Whole seed	Kernel flour	Hull
Moisture	5.90	5.23	6.41	6.10	6.32	6.71
Protein	19.30	26.75	2.84	22.70	31.88	3.05
Ether extract	41.49	51.61	2.43	32.82	43.22	1.87
Carbohydrates	5.09	3.22	21.94	5.99	4.13	17.59
Ash	7.23	4.15	2.37	8.64	4.53	2.96
Fiber	20.99	9.04	64.01	23.75	9.92	67.82
Energy "K.cal."	470.97	584.37	120.99	410.14	533.02	99.39

estimated oil content of high oil varieties to be ranging from 37.9 to 49.10% while that of confectionery varieties to be ranging from 31.7 to 34.3%.

Referring to kernel constituents, kernel flour has the highest percent of the protein and ether extract in both varieties. On the other hand, hulls of both varieties contained the highest percent of carbohydrates and fibers as shown in Table (2). Fibers were 64.01% in the hull of Miak, while it were 67.82% in Balady variety. This agreed with **Wan *et al.*, (1979)** who found that fiber content in the hull of the high oil variety was 62.2-62.9, while confectionery varieties gave 64.7-69.0 in the hull.

From the above representation it should be observed that the decortication operation is important for supplementation of wheat flour with high quality sunflower proteins for producing good quality baked products, because the hull consists of high percent of fibers 64.01% in Miak and 67.82% in Balady (Table 2).

3) <u>Chemical composition of wheat and sunflower flours</u>:

Chemical composition of wheat flour 72% extract, full fat and defatted sunflower flours is recorded in Table (3).

The defatted sunflower flour contained the highest percentage in protein, while the full-fat had the highest ether extract. Protein percentage was higher in Balady full fat flour than Miak, 31.88 and 26.75% respectively, while the ether extract was higher in Miak than Balady 51.61 and 43.22% respectively.

Data of **Wan *et al.*, (1979)** stated the following ranges for seeds of oil types 49.0 - 55.0% oil, and 26.7 - 22.6% protein, while that of confectionery types was 52.6 - 56.2% oil, and 28.6 - 34.2% protein.

The defatting process of sunflower flours caused the apparent increase in protein content of the flour from 26.75 and 31.88% in full-fat flours of Miak and Balady to 53.85 and 57.71% in defatted flours, respectively. The same trend was observed concerning carbohydrates and ash contents.

Ibrahim *et al.*, (1992) obtained similar results in defatted sunflower meal which contained 51.43% protein.

4) Protein and protein digestibility of wheat flour and sunflower flour:

Table (4) indicates the protein content and protein digestibility of wheat flour (72% ext.) and sunflower flour full fat as well as defatted flours of both varieties of sunflower under study.

It is clear from these data that the lowest digestibility of different proteins was that of wheat flour (79.84%). This behaviour of wheat flour proteins is logic since glutenin component of gluten represents about 60% . This protein has s-s disulfide bonds which resist to some desgree proteolysis with proteolitic enzymes.

It is obvious that sunflower flour proteins digestibility is generally higher than that of wheat flour proteins. The full-fat flour proteins were less digestible than the defatted flour (92.61 and 96.5% respectively). This may be due to the hindering effect of the fatty contents of the full-fat flour against proteolysis.

Concerning the adaptation of the enzyme active center to the active groups in the protein substrate through the mechanism of formation of enzyme-substrate complex before the step of producing hydrolytic products of proteins.

Table (3): Chemical composition of wheat and sunflower flours.

Chemical composition	Wheat flour (72% ext.)	Sunflower flour			
		Full fat (F.S.F.)		Defatted (D.S.F.)	
		Miak	Balady	Miak	Balady
Moisture	12.02	5.23	6.32	6.49	6.84
Protein	11.03	26.75	31.88	53.85	57.71
Ether extract	1.13	51.61	43.22	1.78	1.14
Carbohydrates	74.81	3.22	4.13	24.47	19.63
Ash	0.52	4.15	4.53	8.19	8.78
Fiber	0.49	9.04	9.92	5.22	5.93
Energy "K.cal."	353.53	584.37	533.02	329.30	319.62

Table (4): Protein and protein digestability of wheat flour and sunflower flours.

Properties	Wheat flour (72% ext.)	Sunflower flour			
		Full fat (F.S.F.)		Defatted (D.S.F.)	
		Miak	Balady	Miak	Balady
Protein digestability (g/100 gm protein)	79.84	92.61	93.40	96.50	97.90

The two varieties of Miak and Balady behaved in a similar manner except that the digestibility of Balady proteins were little higher in both cases of flour full-fat and defatted Table (4).

5) Chemical composition of wheat-sunflower flours blends:

It should be observed that in wheat sunflower flours blends the protein, ether extract, ash and fibers contents increased gradually as sunflower addition was increased from 5 to 20% because of the higher content of these constituents in sunflower flour than in wheat flour. (protein in case of defatted blends of Miak and Balady gaves 19.61 and 20.39% while full-fat gaves 14.18 and 15.21% for 20% level of supplementation, respectively, but in wheat flour only protein content was 11.03%). Oil in case of full-fat blends of Miak and Balady gaves 11.22 and 9.56% while in defatted 1.27 and 1.25% for 20% level of supplemantation, respectively.

On the other hand, carbohydrate contents of the blends behaved in a reverse manner due to its lower content in sunflower than in wheat flour Table (5), (in full-fat blends of Miak gave 60.04% carbohydrate, while that of Balady gave 59.93% for 20% level of supplementation).

In case of defatted blends of Miak gave 64.63%, and Balady gave 63.57% carbohydrates for 20% level of supplementation. But in wheat flour only gave 74.81% carbohydrate.

Burns *et al.*, (1972) found that when wheat flour of 8.6% protein was used in bread making and fortified with dehulled sunflower defatted meal having 46.8% proteins in levels of 0, 3, 17, and 30%, the enriched bread formulation had 11.6, 13.4, 19.0 and 23.6% proteins, respectively.

Table (5): Chemical composition of wheat-sunflower blends

Chemical composition	Control 100% Wheat flour	Wheat - sunflower blends							
		Full-fat sunflower flour							
		Miak				Balady			
		5%	10%	15%	20%	5%	10%	15%	20%
Moisture	12.02	11.68	11.34	11.01	10.67	11.74	11.45	11.18	10.89
Protein	11.03	11.82	12.63	13.38	14.18	12.06	13.11	14.15	15.21
Ether extract	1.13	3.65	6.18	8.71	11.22	3.34	5.34	7.45	9.56
Carbohydrates	74.81	70.34	66.88	63.47	60.04	70.21	66.91	63.46	59.93
Ash	0.52	0.70	0.90	1.08	1.26	0.76	0.93	1.13	1.35
Fiber	0.49	1.81	2.07	2.35	2.63	1.89	2.26	2.63	3.06
Energy (K.cal.)	353.53	361.49	373.66	385.79	397.86	359.14	368.14	377.49	386.60
Defatted sunflower flour									
Moisture	12.02	11.75	11.44	11.20	10.92	11.77	11.46	11.31	10.99
Protein	11.03	13.18	15.33	17.46	19.61	13.39	15.72	17.12	20.39
Ether extract	1.13	1.16	1.21	1.25	1.27	1.13	1.19	1.23	1.25
Carbohydrates	74.81	72.24	69.73	67.19	64.63	71.98	69.22	67.24	63.57
Ash	0.52	0.91	1.30	1.67	2.10	0.94	1.35	1.77	2.19
Fiber	0.49	0.76	0.99	1.23	1.47	0.79	1.06	1.33	1.61
Energy (K.cal.)	353.53	352.12	351.13	349.85	348.39	351.65	350.47	348.51	347.09

In the same time **Timmes *et al.*, (1981)** reported that baking tests indicated that bread making quality of the flours increased as protein content increased. The gluten drived from high protein flour gave a lower loaf volume, and texture score.

The afore mentioned results behaved parallel in both cases of full-fat and defatted blends. The obtained data are in agreement with those of **Burns *et al.*, (1972), Khan *et al.*, (1980),** and **Gharib (1995).**

6) Effect of adding sunflower flour to wheat flour (72% ext.) on the farinograph data:

Data shown in Tables (6 & 7), gave farinograph data of the blends under investigation. In the blends of full-fat sunflower flour with wheat flour, it was found that water absorption decreased than that of the control. This decrease was essentially stable in spite of the increased addition of sunflower flour in the added blends. This may be due to the lower polarity of the sunflower protein than wheat proteins. Therefore the water retention capacity of the mixed proteins had less water retention capacity. Moreover, the addition of sunflower flour decreased the total starch content of the dough hence reduced water absorption (55.5 % in control; 53.7, 53.6, 53.5 and 53.3% in 5, 10, 15 and 20% sunflower flour blends with wheat flour, respectively).

When wheat flour was blended with 5 and 10% full-fat sunflower flour, developing time of dough was longer (4.45 min.) than that of control (2.00 min.), but 15 and 20% levels of addition gave longer developing time than the control but still lower than 5 and 10% levels (3.45 and 3.30 min.), respectively.

It is clear that the dough strength was affected by protein and fat constituents of the sunflower flour which interfere with the mechanism

Table (6): Effect of addition of full-fat and defatted sunflower flours (Miak), to wheat flour (72% ext.) on the Farinograms.

Dough mexture	Water absorption	Dough development time (min)	Dough stability (min)	Weakening of dough (B.U.)
100% W.F. "Control"	55.5	2.00	1.30	40
Miak full-fat sunflower flour:				
95% W.F. + 5% M.F.F.S.	53.7	4.45	4.00	100
90% W.F. + 10% M.F.F.S.	53.6	4.45	3.00	110
85% W.F. + 15% M.F.F.S.	53.5	3.45	2.30	110
80% W.F. + 20% M.F.F.S.	53.3	3.30	2.30	120
Miak defatted sunflower flour				
95% W.F. + 5% M.D.F.S.	57.8	6.00	2.00	120
90% W.F. + 10% M.D.F.S.	58.0	5.45	1.45	120
85% W.F. + 15% M.D.F.S.	58.4	4.45	1.30	130
80% W.F. + 20% M.D.F.S.	58.6	4.30	1.30	140

W.F. = Wheat flour
M.F.F.S. = Miak full-fat sunflower flour
M.D.F.S. = Miak defatted sunflower flour

Table (7): Effect of addition of full-fat and defatted sunflower flour (Balady), to wheat flour (72% ext.) on the Farinograms.

Dough mexture	Water absorption	Dough development time (min)	Dough stability (min)	Weakening of dough (B.U.)
100% W.F. "Control"	55.5	2.00	1.30	40
"Balady" full-fat sunflower flour:				
95% W.F. + 5% B.F.F.S.	55.0	5.30	3.00	130
90% W.F. + 10% B.F.F.S.	53.0	4.30	2.30	150
85% W.F. + 15% B.F.F.S.	52.0	4.30	2.15	160
80% W.F. + 20% B.F.F.S.	51.5	4.00	1.45	170
"Balady" defatted sunflower flour				
95% W.F. + 5% B.D.F.S.	57.2	5.00	2.30	120
90% W.F. + 10% B.D.F.S.	57.6	5.00	2.00	120
85% W.F. + 15% B.D.F.S.	57.8	4.45	2.00	140
80% W.F. + 20% B.D.F.S.	58.2	4.00	1.30	140

W.F. = Wheat flour
B.F.F.S. = "Balady" full-fat sunflower flour
B.D.F.S. = "Balady" defatted sunflower flour

of hydrogen bond formation hence increasing the time of dough development due to the lower polarity of sunflower proteins.

The ability of the gluten network of dough to resist mechanical mixing effects is measured by dough stability parameter. The more stable the dough is, the more preferred would be the flour for bread making.

From data in Table (6) and Figs. (1 and 2) the dough of wheat flour blend with 5% Miak sunflower flour showed higher stability than the control (1.30 min. for the control, 4.00 min. for the 5% level of addition. As the level of blending increased to 10, 15 and 20%, the stability decreased to 3.00, 2.30, and 2.30 min., respectively).

This means that as the quantity of absorbed water was decreased by increased levels of blends, proteins and fats of these blends mask the polarity of polypeptide chains and starch granules of the dough, then it takes more time for the dough to develop. On the other hand, the presence of organic phosphates and phosphorus which have negative electric charges, thus stimulating hydrogen bond formation and increasing dough stability. (phosphorus in wheat control is lower than in sunflower flour.).

Therefore it may be concluded that the decreasing or slowing rate of arrangement of water molecules with polypeptide chains of mixed proteins results in the increase of the time of gluten network formation.

The weakening of blended doughs was higher than that of the control (40 B.U. in control, 100, 110, 110 and 120 B.U. in 5, 10, 15 and 20% Miak full-fat sunflower blends) and (120, 120, 130 and 140 B.U. in 5, 10, 15 and 20% levels of Miak defatted sunflower blends respectively). While in case of Balady full-fat sunflower blends it were

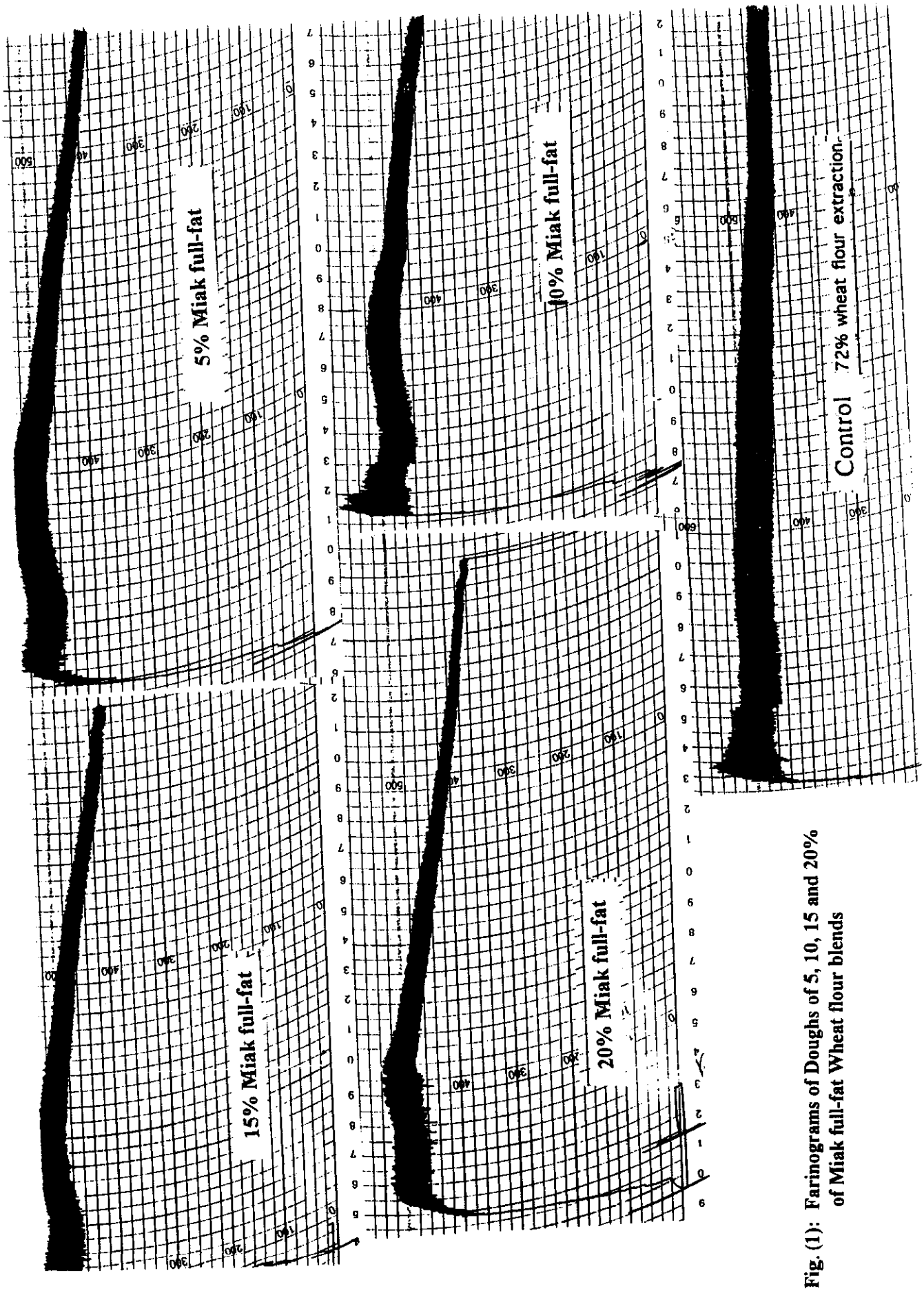

Fig. (1): Farinograms of Doughs of 5, 10, 15 and 20% of Miak full-fat Wheat flour blends

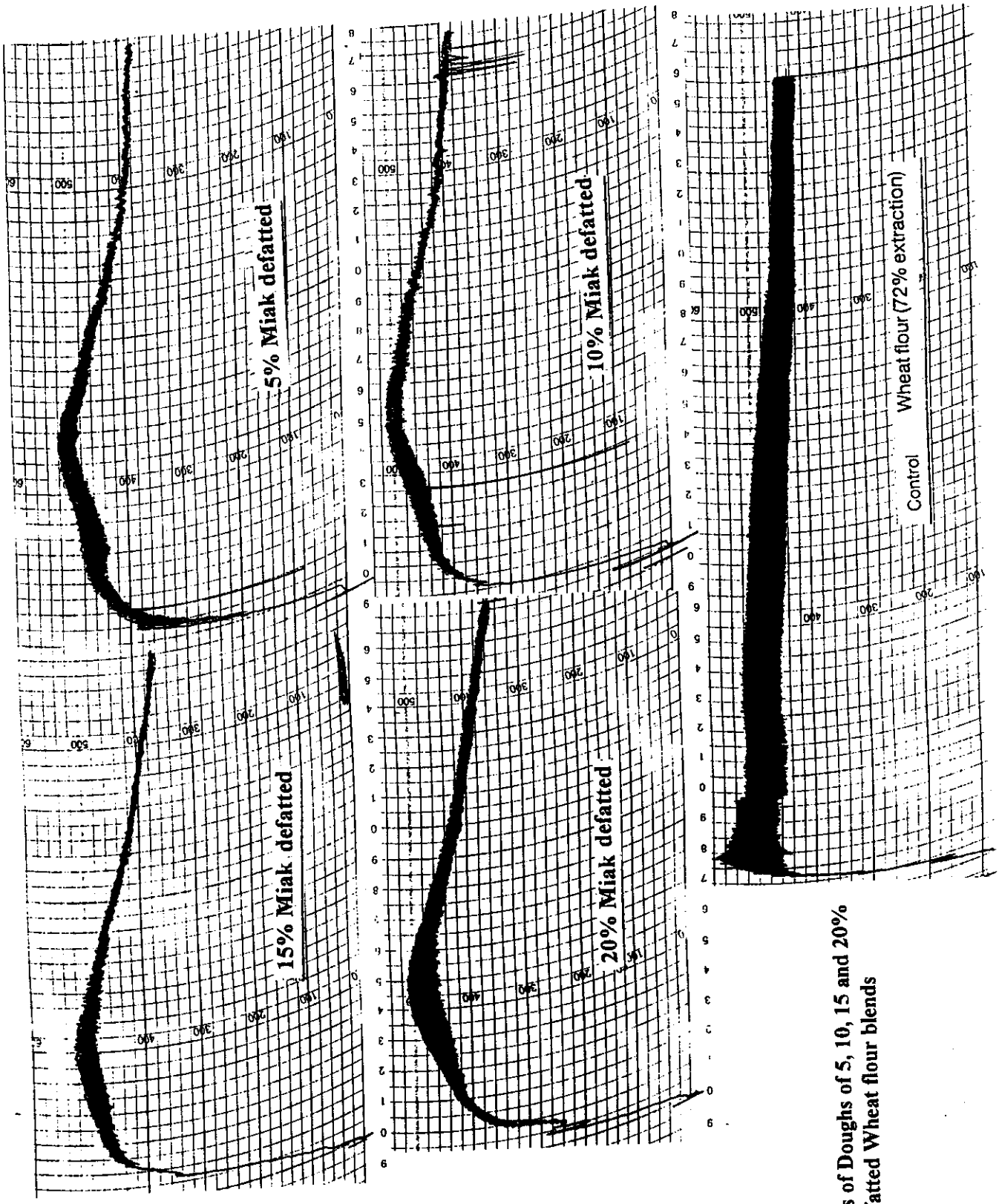

Fig. (2): Farinograms of Doughs of 5, 10, 15 and 20% of Miak Defatted Wheat flour blends

(130, 150, 160 and 170 B.U. for 5, 10, 15 and 20%) but in Balady defatted blends it were (120, 120, 140 and 140 B.U. respectively).

This weakening value of the blends may be due to the interference of sunflower proteins and fats through the gluten network thus increasing its weakening.

In case of defatted sunflower flour blends with wheat flour, water absorption increased than the control because of the absence of fat (55.5% in control, 57.8, 58.0, 58.4 and 58.6%) of 5, 10, 15 and 20% levels of addition of Miak defatted sunflower blends with wheat flour, respectively. While in Balady defatted sunflower blends were (57.2, 57.6, 57.8 and 85.2%) at levels 5, 10, 15 and 20% respectively.

In spite of the absence of fat content of the blends the time of dough development increased than the counterparts of the full-fat ones. (Miak full-fat wheat blends gave 4.45, 4.45, 3.45 and 3.30 min. , while Miak defatted-wheat blends gave 6.00, 5.45, 4.45 and 4.30 min.) for 5, 10, 15 and 20% respectively).

This may be due to doublefold percentage of proteins and carbohydrates of the defatted counter parts (for protein 26.75 and 53.85% in full-fat and defatted flours respectively) and 11.82 and 26.76% for carbohydrates respectively Table (3).

On the other hand, Balady full-fat and defatted sunflower wheat blends behaved in the same trend (5.30, 4.30, 4.30 and 4.00 min.) and (5.00, 5.00, 4.45 and 4.00 min) for 5, 10, 15 and 20% level of addition, respectively.

Dough stability of defatted blends decreased than a full-fat counterparts this may be due to the absence of additive forces arriving in the presence of fat from hydrophobic bonds among the nonpolar groups in fat which adds stability to dough.

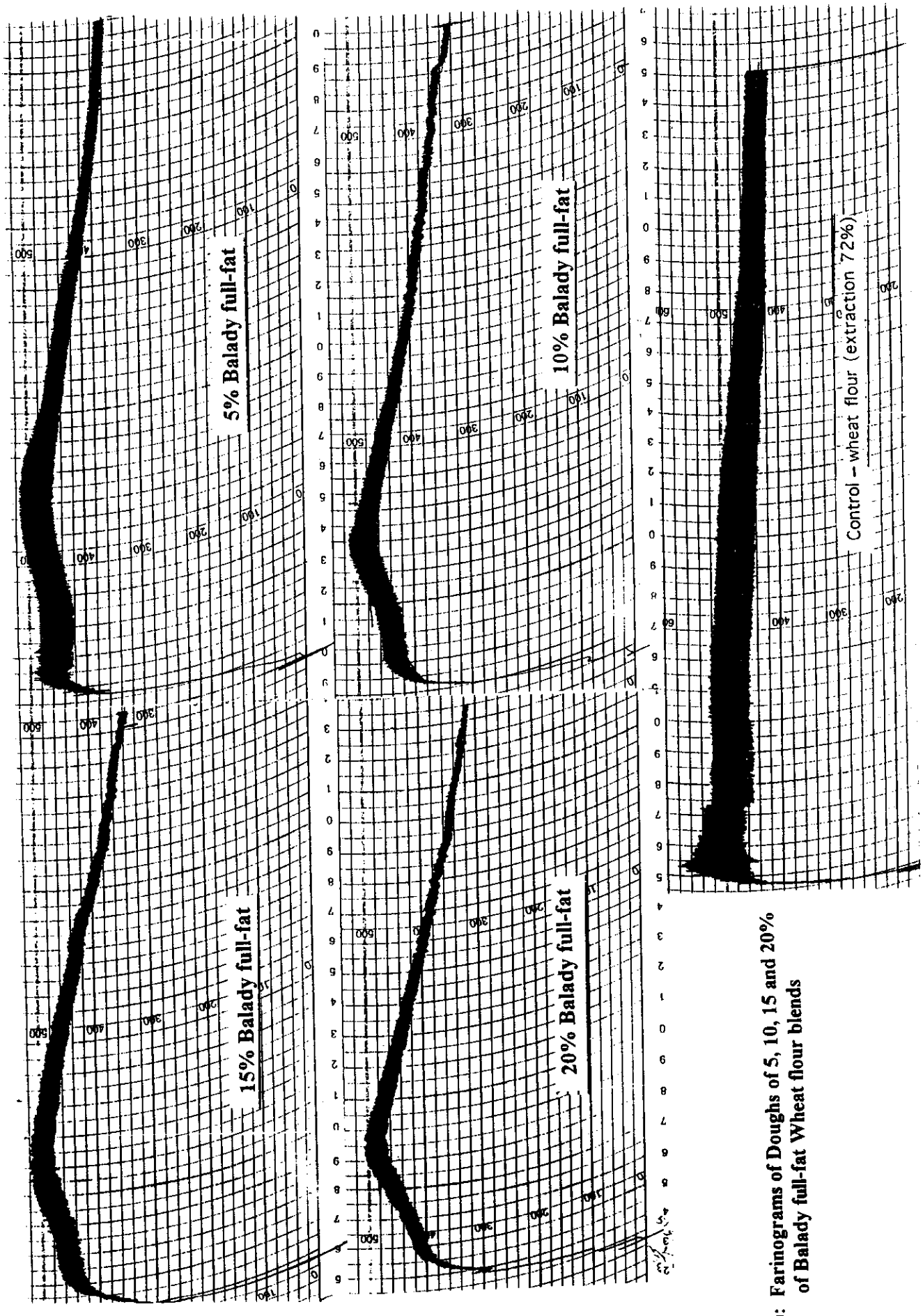

Fig. (3): Farinograms of Doughs of 5, 10, 15 and 20% of Balady full-fat Wheat flour blends

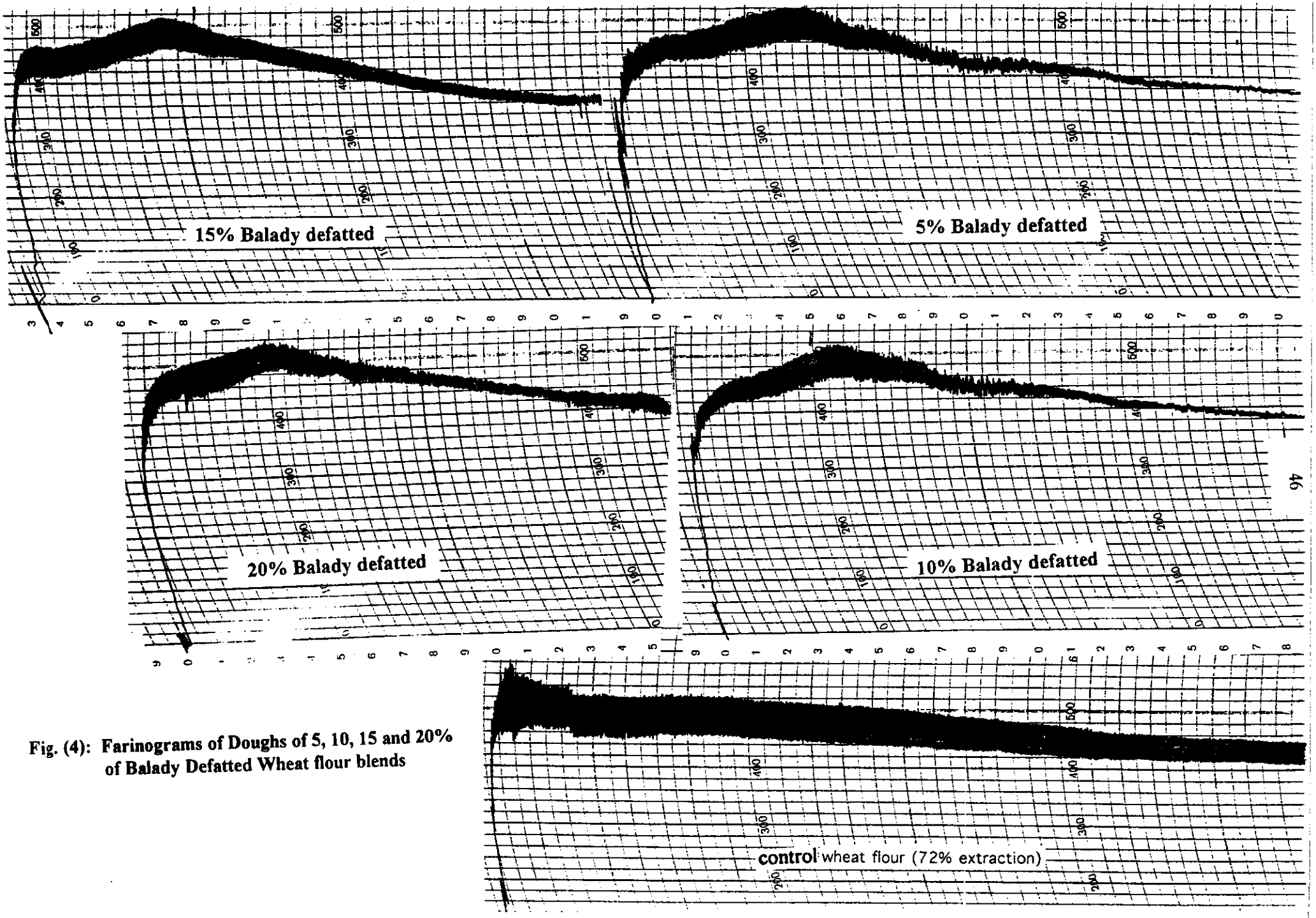

Fig. (4): Farinograms of Doughs of 5, 10, 15 and 20% of Balady Defatted Wheat flour blends

The absence of reinforcing effect of hydrophobic bonds in defatted blends was also reflected in the more weakening of dough in defatted blends of Miak variety.

Farinograph data of Balady sunflower flour blends with wheat flours behaved in the same trend as in Miak variety with small differences in water absorption, dough development, and dough stability and its weakening.

These small variations are logic since the two varieties differ in their chemical composition and physical properties. **Khan and Lawhon (1980)** used some oil seed flours as a potential bread ingredient by replacing 7.5% of wheat flour with each of sunflower, commercial soy and peanut flours. They reported that the high level of sunflower flour addition weakened dough structure. Also, **El-Talawy *et al.*, (1988)** reported about supplementation of bread in Egypt with proteins. They studied the effect of sunflower, cottonseed and peanut flours as means of protein fortification of bread on the dough properties and baking quality of bread. They found that at high levels of addition the dough was weakened but low levels of addition improved bread texture and crust color.

7) Effect of adding sunflower flour to wheat flour (72% ext.) on the extensograph data:

Extensograph data are presented in Tables (8 & 9) and Figs. (5 & 6). These results gave an identical image for the effect of formation and deformation of chemical and nonchemical bonds in the mechanism of dough formation.

The extensibility of the control showed a lower value (150mm) than other treatments of Miak full-fat sunflower flour blends with

Table (8): Effect of addition of full-fat and defatted sunflower flours (Miak), to wheat flour (72% ext.) on the Extensograms.

Dough mexture	Extensibility (mm)	Resistance to extension (B.U.)	Proportion Number (R/E)	Energy (cm^2)
100% W.F. "Control"	150	470	3.1	76.0
Miak full-fat sunflower flour:				
95% W.F. + 5% M.F.F.S.	142	460	3.24	71.4
90% W.F. + 10% M.F.F.S.	150	350	2.32	58.8
85% W.F. + 15% M.F.F.S.	160	215	1.34	45.4
80% W.F. + 20% M.F.F.S.	154	160	1.19	34.4
Miak defatted sunflower flour				
95% W.F. + 5% M.D.F.S.	134	340	2.54	47.3
90% W.F. + 10% M.D.F.S.	127	265	2.09	39.2
85% W.F. + 15% M.D.F.S.	161	180	1.12	37.2
80% W.F. + 20% M.D.F.S.	155	170	1.09	28.8

W.F. = Wheat flour
M.F.F.S. = Miak full-fat sunflower flour
M.D.F.S. = Miak defatted sunflower flour

Table (9): Effect of addition of full-fat and defatted sunflower flours (Balady), to wheat flour (72% ext.) on the extensograms.

Dough mexture	Extensibility (mm)	Resistance to extension (B.U.)	Proportion Number (R/E)	Energy (cm^2)
100% W.F. "Control"	150	470	3.10	76.0
"Balady" full-fat sunflower flour:				
95% W.F. + 5% B.F.F.S.	140	420	3.00	67.5
90% W.F. + 10% B.F.F.S.	153	280	1.83	47.2
85% W.F. + 15% B.F.F.S.	139	260	1.87	39.4
80% W.F. + 20% B.F.F.S.	145	210	1.45	39.1
"Balady" defatted sunflower flour:				
95% W.F. + 5% B.D.F.S.	131	415	3.17	58.5
90% W.F. + 10% B.D.F.S.	126	315	2.50	43.0
85% W.F. + 15% B.D.F.S.	127	285	2.24	40.7
80% W.F. + 20% B.D.F.S.	137	170	1.24	35.5

W.F. = Wheat flour
B.F.F.S. = Balady full-fat sunflower flour
B.D.F.S. = Balady defatted sunflower flour

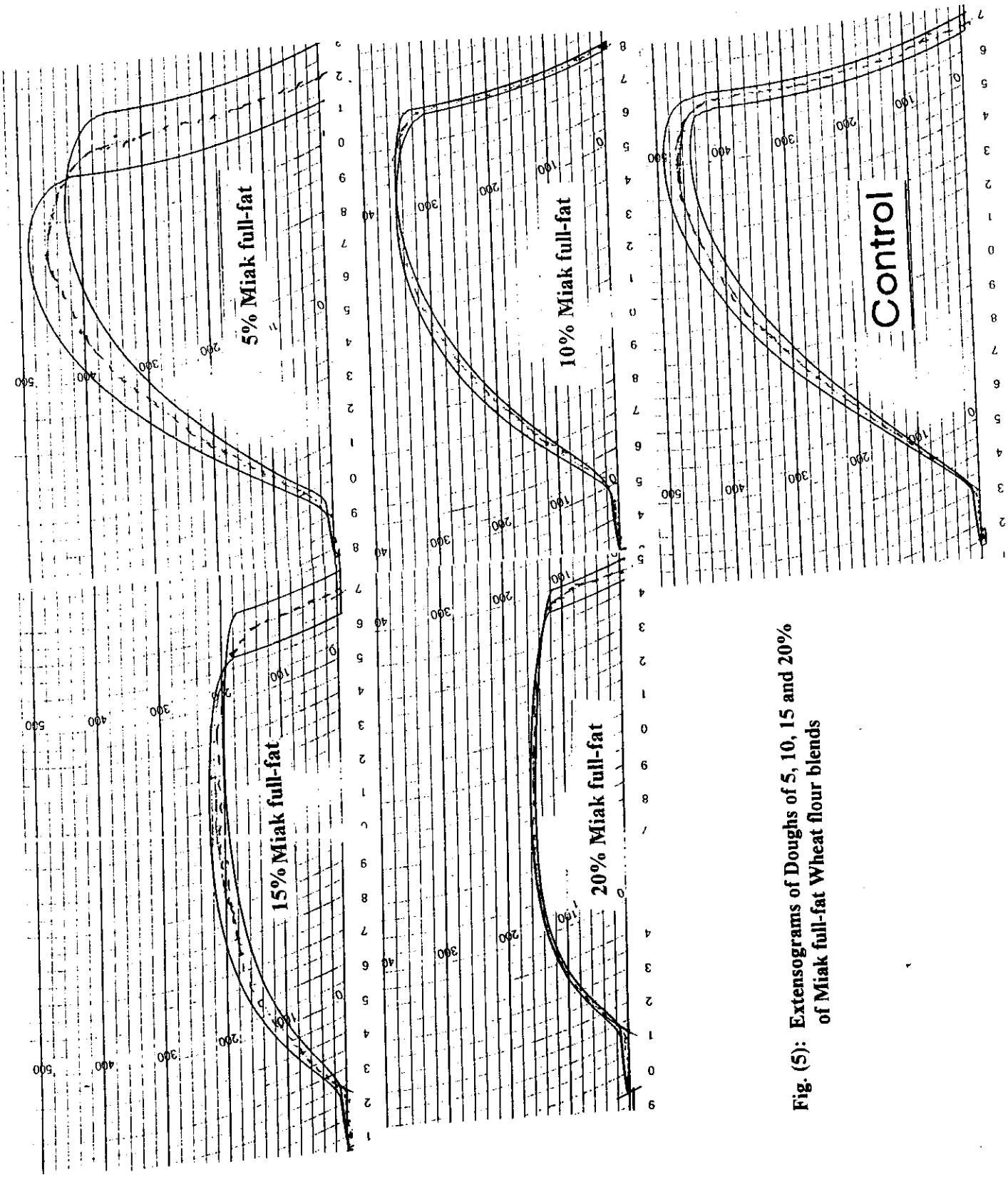

Fig. (5): Extensograms of Doughs of 5, 10, 15 and 20% of Miak full-fat Wheat flour blends

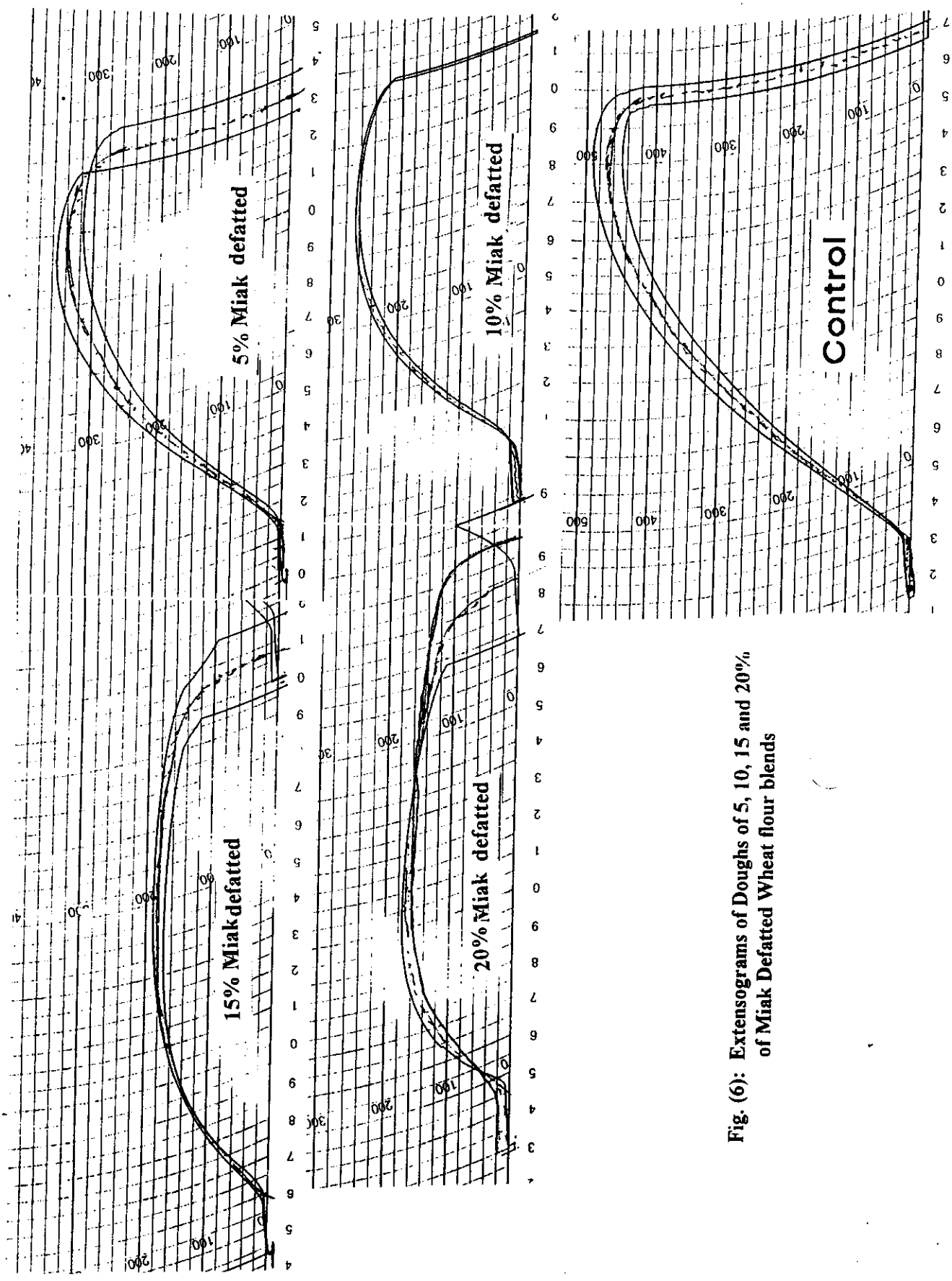

Fig. (6): Extensograms of Doughs of 5, 10, 15 and 20% of Miak Defatted Wheat flour blends

wheat flour except in the 5% level of blend which showed lower extensibility than the control (142mm).

On the other hand, the addition of 15 and 20% levels showed higher extensibility than that of the control. Which means higher ability to extend or to stretch than other levels (5 and 10% levels).

From the above results it is clear that blending full-fat sunflower flour increased extensibility of dough due to the function of phospholipids of the oil which adds to the function of gliadin fraction of the dough. But in 5% level of addition extensibility decreased than control (142mm). This behavior may be interpelled by the increased polarity of gliadin due to the polar fraction of fats, phospholipids and negative charge of phosphates in the added blends (10, 15 and 20% levels) while it decreased in 5% level.

Concerning resistance to extension (B.U.), which is usually defined as the ability of the dough to regain its chape after extension, lower resistance to extension values were obtained in all additions than that of the control.

Resistance to extension was decreased in the presence of high oil content in blended doughs (215 and 470 B.U.) for Miak full-fat blended dough at 15% level and unblended.

Also, resistance to extension for 15% level of Miak defatted blends gave (180 B.U.) but in control was (470 B.U.).

It is clear that the hydrophobic bonds on the fat fraction of blended doughs could not resist extension of dough because of its relative weakness which could not withstand the mechanical forces of extension.

The proportional number is the ratio of resistance to extension/extensibility. Data in Table (8) showed that the control

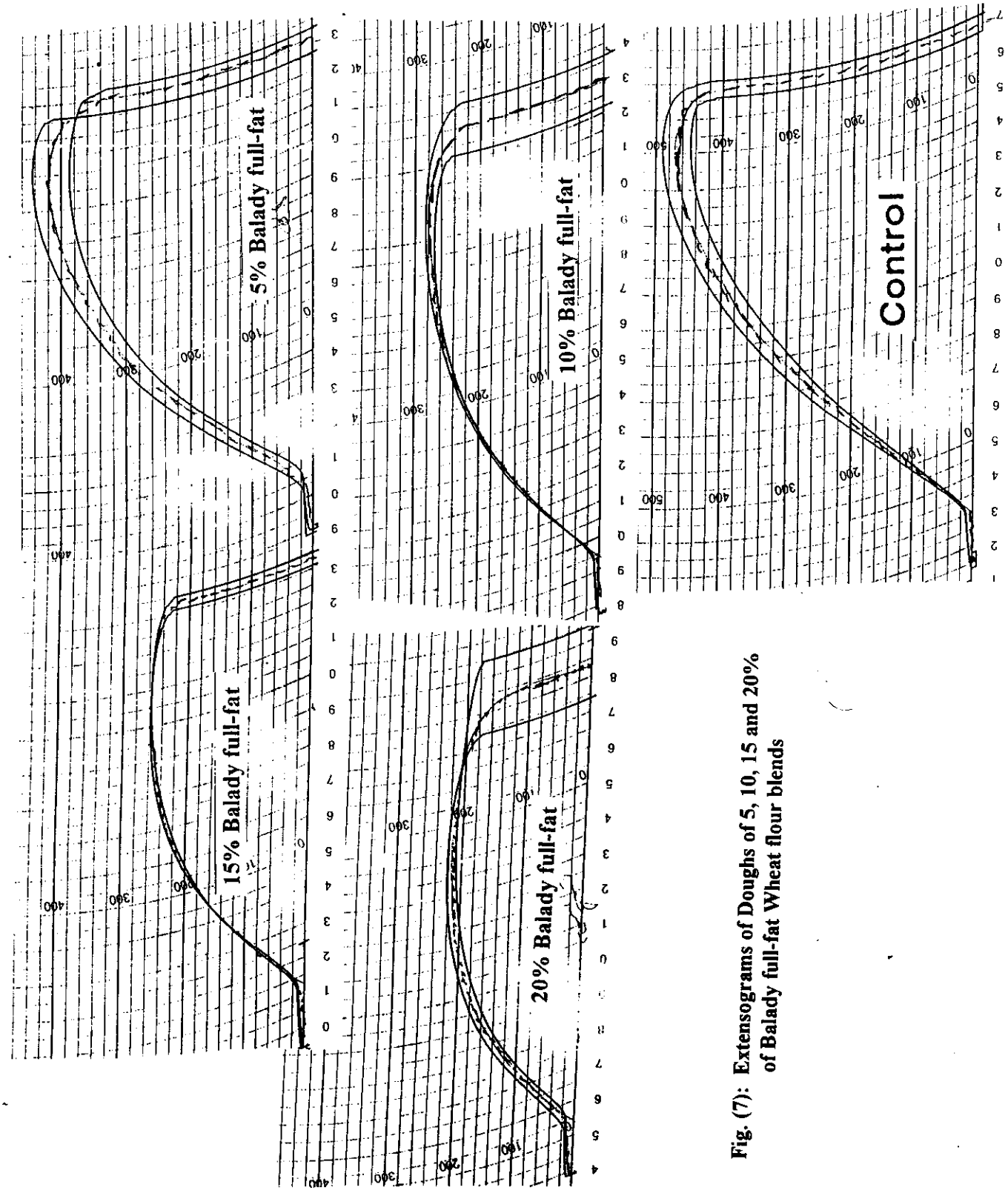

Fig. (7): Extensograms of Doughs of 5, 10, 15 and 20% of Balady full-fat Wheat flour blends

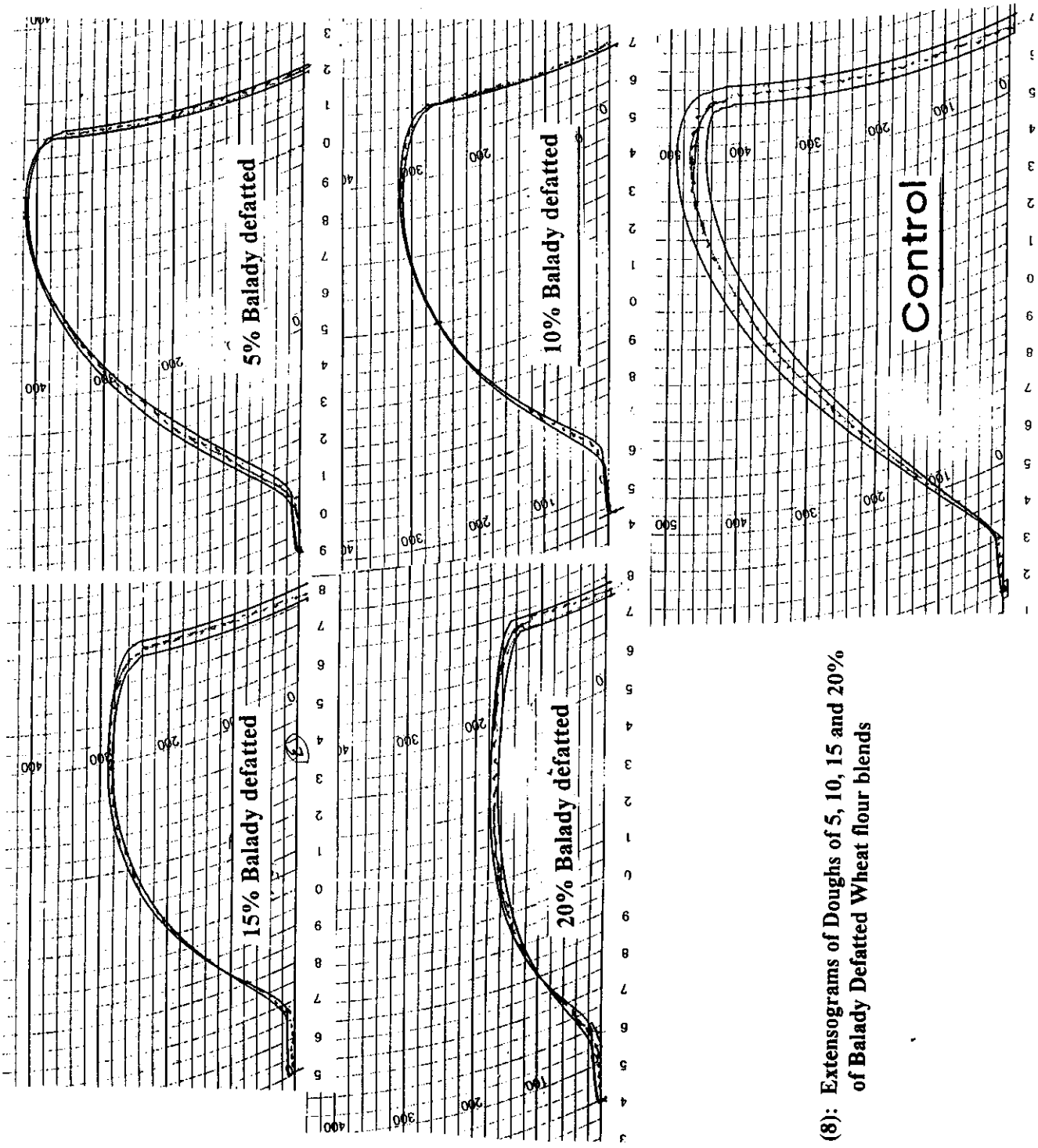

Fig. (8): Extensograms of Doughs of 5, 10, 15 and 20% of Balady Defatted Wheat flour blends

sample gave the highest value of proportional number followed by 5% level of blends (3.1 in control, 3.24, 3.32, 1.43 and 1.19) and 2.54, 2.09, 1.12 and 1.09) for 5, 10, 15 and 20% levels of Miak full-fat and defatted blends respectively. It could be concluded that a dough having balance between the two factors, extensibility and resistance to extension, may help in having a good and highly accepted baked bread. This conclusion agrees with that mentioned by **Mohye (1985).**

Considering energy it is clear that the area under the extinsorgram decreased gradually as the level of blending increased indicating the decrease of both extensibility and resistance to extension. The defatted blends behaved in the same trend with some differences. (76.0 cm^2 in the control), (71.4, 58.8, 54.4 and 34.4 cm^2) and (47.3, 39.2, and 28.8 cm^2) for 5, 10, 15 and 20% levels of Miak full-fat and defatted blends respectively. The most important of which the more pronounced effect of decreasing R/E as the blend level increased which is reflected on the energy parameter. This may be due to the complete absence of hydrophobic bonds existing in the fat fraction of blends which was removed from defatted blends.

Balady sunflower gave the same behaviour nearly in both of their blends full-fat and defatted with some small variations due to the differences in chemical and physical constitution.

8) <u>Effect of adding sunflower flour to wheat flour (72% ext.) on physical properties of pan bread</u>:

Results of the effect of enriching bread formula with full-fat and defatted sunflower flour blends on the physical properties of pan bread were represented in Table (10).

Table (10): Effect of adding full-fat and defatted sunflower flours (Miak and Balady) to wheat flour (72% ext.) on physical properties of pan bread.

Additives	Weight (gm)	Volume (cm^3)	Specific volume (cm^3/gm)
100% W.F. "Control"	152.41	525	3.44
Miak full-fat sunflower flour:			
95% W.F. + 5% M.F.F.S.	158.54	555	3.50
90% W.F. + 10% M.F.F.S.	162.43	640	3.94
85% W.F. + 15% M.F.F.S.	168.31	510	3.03
80% W.F. + 20% M.F.F.S.	171.65	495	2.88
"Balady" full-fat sunflower flour:			
95% W.F. + 5% B.F.F.S.	156.23	540	3.47
90% W.F. + 10% B.F.F.S.	159.82	535	3.35
85% W.F. + 15% B.F.F.S.	162.63	440	2.71
80% W.F. + 20% B.F.F.S.	166.43	425	2.55
100% W.F. "Control"	149.1	507	3.40
Miak defatted sunflower flour			
95% W.F. + 5% M.D.F.S.	153.69	520	3.38
90% W.F. + 10% M.D.F.S.	155.03	505	3.26
85% W.F. + 15% M.D.F.S.	157.40	465	2.95
80% W.F. + 20% M.D.F.S.	160.90	355	2.21
"Balady" defatted sunflower flour:			
95% W.F. + 5% B.D.F.S.	150.17	510	3.39
90% W.F. + 10% B.D.F.S.	152.46	485	3.18
85% W.F. + 15% B.D.F.S.	153.41	425	2.77
80% W.F. + 20% B.D.F.S.	157.19	335	2.13

W.F. = Wheat flour
M.F.F.S. = Miak full-fat sunflower flour
B.F.F.S. = Balady full-fat sunflower flour
M.D.F.S. = Miak defatted sunflower flour
B.D.F.S. = Balady defatted sunflower flour

From data in Table (3) it is clear that the protein content of full-fat flour of Miak and Balady varieties were 26.75 and 31.88% respectively, while that of defatted flours were 53.85 and 57.71% respectively. In the same time protein content of wheat flour (72% ext.) was 11.03%.

Considering data in Table (10) it is clear that when wheat flour was enriched with 5, 10, 15 and 20% full-fat sunflower flours the weight of pan bread baked from it increased while its volume decreased as addition of blends increased. The weight were (152.41 g) in control, (158.54, 162.43, 168.31 and 171.65 g) and (156.23, 159.82, 162.63 and 166/43g.) for 5, 10, 15 and 20% level of Miak full-fat and defatted sunflower blends, respectively.

The volume gave (525 cm^3) in control, (555, 640, 510 and 495 cm^3) and (540, 535, 440 and 425 cm^3) for 5, 10, 15 and 20% level of Miak full-fat and defatted blends respectively.

This increase in pan bread weight is due to the high percentage of protein existing in sunflower flour which is of high molecular weight.

It is also clear that in spite of the higher protein content in Balady than in Miak variety blends, the Miak blends gave higher weight in loaves of pan bread. **El-Talawy *et al.*, (1988)** reported that supplementation of bread in Egypt with sunflower, as a source of protein, affected at high levels of addition the dough which was weakened, but at low levels of addition the bread texture and crust color were improved. They found also significant increase in protein quality of the supplemented bread.

The presence of fat fractions improved dough formation and decreased dough development time {Miak full-fat and defatted of 15% level of addition gave 3.45 and 4.45 mins. Table (6)}.

On the other hand, the decrease of bread volume as the addition was increased may be due to the increase of extensibility (5 and 15%) addition levels of Miak full-fat flour gave 142 mm and 160 mm extensibility, respectively.

Bacigalupo *et al.*, (1967) reported similar findings when 5-10% non-wheat flour (high protein) replaced wheat flour, while at high levels of replacement levels they found that loaf volume severely decreased along with deterioration of crumb color and texture.

Timmes *et al.*, (1981) mentioned that gluten derived from high protein flour gave a lower loaf volume and texture scores.

Referring to Table (10) it is obvious that the defatted blends gave less increase in weight of loaf and less decrease in its volume than their counterparts of the full-fat blends. This may be interpreted by the decrease in extensibility in defatted blends (Miak full-fat and defatted blends of 10% level of addition gave 150 and 127mm extensibility, respectively Table (8).

9) Effect of adding sunflower flour to wheat flour on physical properties of cake:

Concerning the effect of adding full-fat and defatted sunflower flour to wheat flour on the physical properties of sponge cake it behaved nearly in the same trend as in pan bread with small variations due to the additives in the case of sponge cake preparation such as eggs (Table 11).

Generally, the weight of pan bread and cake backed from enriched wheat flour with 5, 10, 15 and 20% of full-fat and defatted sunflower blends increased, while, its volume decreased as addition of blends increased from 5% to 20%.

Table (11): Effect of adding full-fat and defatted sunflower flours (Miak and Balady) to wheat flour (72% ext.) on physical properties of sponge cake.

Additives	Weight (gm)	Volume (cm^3)	Specific volume (cm^3/gm)
100% W.F. "Control"	137.1	520	3.57
Miak full-fat sunflower flour:			
95% W.F. + 5% M.F.F.S.	138.52	505	3.65
90% W.F. + 10% M.F.F.S.	140.20	490	3.50
85% W.F. + 15% M.F.F.S.	143.27	480	3.35
80% W.F. + 20% M.F.F.S.	146.60	485	3.31
"Balady" full-fat sunflower flour:			
95% W.F. + 5% B.F.F.S.	135.71	495	3.68
90% W.F. + 10% B.F.F.S.	137.23	485	3.54
85% W.F. + 15% B.F.F.S.	139.40	470	3.37
80% W.F. + 20% B.F.F.S.	142.62	472	3.31
100% W.F. "Control"	131.23	480	3.66
Miak defatted sunflower flour			
95% W.F. + 5% M.D.F.S.	134.14	450	3.35
90% W.F. + 10% M.D.F.S.	136.72	430	3.15
85% W.F. + 15% M.D.F.S.	139.31	400	2.87
80% W.F. + 20% M.D.F.S.	141.12	390	2.76
"Balady" defatted sunflower flour:			
95% W.F. + 5% B.D.F.S.	132.66	425	3.20
90% W.F. + 10% B.D.F.S.	134.74	410	3.04
85% W.F. + 15% B.D.F.S.	137.68	405	2.94
80% W.F. + 20% B.D.F.S.	140.76	395	2.81

W.F. = Wheat flour
M.F.F.S. = Miak full-fat sunflower flour
B.F.F.S. = Balady full-fat sunflower flour
M.D.F.S. = Miak defatted sunflower flour
B.D.F.S. = Balady defatted sunflower flour

In case defatted blends gave less increase in weight of loaf and less decrease in its volume than their counterparts of the full-fat blends.

10) Chemical composition of pan bread supplemented with sunflower flours:

Chemical composition of pan bread baked from wheat flour supplemented with sunflower flour at different percentages is presented in Table (12). From these data it is obvious that proteins, ether extract, ash and fibers increased as the supplementation percentage increased, while carbohydrate content decreased in both varieties studied in case full-fat flour. **Gharib (1995)** mentioned that adding sunflower flour to wheat flour proved that raising ratio of supplementation of defatted sunflower flour increased the amount of protein more than full fat sunflower, while carbohydrates decreased according to the increased of sunflower supplementation.

It is worthy to observe that in all supplementation ratios, the ether extract content was highly increased than the control of pan bread made from wheat flour 72% only. This increase of fat content in the bread would be subjecting for rancidity and auto oxidation (ether extract was 1.23 in wheat bread then 2.96, 3.94, 5.82, and 7.90% in 5, 10, 15 and 20% supplementation of Miak full-fat flour).

In supplementation of defatted sunflower flour proteins, carbohydrates, ash and fibers behaved in the same trend as in the full-fat flours. Protein content increased in the different blending ratios than in the full-fat counterparts (protein content in pan bread made of full-fat and defatted blends of Balady variety at 5, 10, 15 and 20% respectively were 10.51, 11.72, 12.93 and 13.33% - 12.49, 14.79, 16.12 and 18.29%).

Table (12): Chemical composition of pan bread supplemented with sunflower flours (g/100g).

Chemical composition	Control 100% Wheat flour	Full-fat sunflower flour							
		Miak				Balady			
		5%	10%	15%	20%	5%	10%	15%	20%
Moisture	13.56	13.70	13.68	12.97	12.86	13.10	13.00	12.80	12.90
Protein	10.34	10.51	11.72	12.83	13.33	10.96	11.81	12.93	13.71
Ether extract	1.23	2.96	3.94	5.82	7.90	2.10	2.86	3.97	5.62
Carbohydrates	72.58	70.15	67.65	64.84	61.89	70.93	68.92	66.43	63.34
Ash	1.47	1.72	1.99	2.24	2.49	1.81	2.09	2.33	2.61
Fiber	0.82	0.96	1.02	1.30	1.53	1.10	1.32	1.54	1.82
Energy (K.cal.)	342.75	349.28	352.94	363.06	367.98	346.46	348.66	353.17	358,78
Defatted sunflower flour									
Moisture	13.56	12.70	12.80	12.30	12.10	12.60	12.70	12.90	12.00
Protein	10.34	12.27	14.13	15.97	17.14	12.49	14.79	16.21	18.29
Ether extract	1.23	1.72	1.86	2.27	2.94	1.65	1.79	2.03	2.67
Carbohydrates	72.58	70.34	67.72	65.61	63.58	70.12	67.15	64.75	62.32
Ash	1.47	1.74	2.10	2.39	2.62	1.86	2.15	2.44	2.74
Fiber	0.82	1.23	1.39	1.46	1.62	1.28	1.42	1.67	1.98
Energy (K.cal.)	342.75	345.92	344.14	346.75	349.34	345.29	343.87	342.11	346.47

The lower fat contents of the bread made from supplemented defatted blends made it superior than that made of full-fat counterparts when we take shelf life of bread into consideration. The same findings were obtained by **Gharib (1995)** who found that full-fat sunflower flour in Balady bread raised protein in a narrow range at 5, 10, and 15% levels giving 11.0, 11.5 and 11.95%, while in defatted meal protein was highly increased to 12.1, 13.6, and 15.1%, respectively.

11) Chemical composition of sponge cake supplemented with sunflower flour:

The discussion of pan bread chemical composition may be extended to the chemical composition of sponge cake because, these products behaved nearly in the same trend.

Generally, protein, ether extract, ash and fibers increased as the supplementation percent is increased, while carbohydrate content decreased in both varieties studied in case of full-fat and defatted flour blends. In case of defatted supplementation, protein content increased at higher level in the different blending ratios than in the full-fat counterparts.

12) Protein and protein digestibility of pan bread supplemented with sunflower:

Data presented in Tables (14 & 15) indicate protein content of pan bread baked from wheat flour only as a control and pan bread baked from blends of wheat and sunflower flours full-fat and defatted, together with their protein digestibility percents.

From Tables (14 & 15) it should be observed that the protein digestibility of pan bread of the control was decreased than that of the

Table (13): Chemical composition of cake supplemented with sunflower flours (g/100g).

Chemical composition	Control 100% Wheat flour	Full-fat sunflower flour							
		Miak				Balady			
		5%	10%	15%	20%	5%	10%	15%	20%
Moisture	18.10	18.8	19.40	20.20	21.20	18.60	19.20	19.70	20.90
Protein	9.50	10.1	10.65	11.15	11.75	10.30	10.71	11.32	11.82
Ether extract	2.63	3.55	4.43	5.30	6.90	3.30	3.98	4.67	5.80
Carbohydrates	68.08	65.68	63.30	60.92	57.51	65.77	63.68	61.44	58.30
Ash	1.06	1.14	1.36	1.49	1.76	1.28	1.49	1.78	1.98
Fiber	0.63	0.73	0.86	0.94	1.06	0.75	0.94	1.09	1.20
Energy (K.cal.)	333.99	335.07	335.67	335.98	338.48	333.98	333.38	333.07	332.68
Defatted sunflower flour									
Moisture	18.10	18.30	18.80	19.20	19.40	18.60	18.80	19.20	19.3
Protein	9.50	10.72	11.55	12.43	13.87	10.96	12.00	13.89	14.92
Ether extract	2.63	2.96	3.44	4.32	5.10	2.70	3.12	3.87	4.16
Carbohydrates	68.08	66.00	63.86	61.29	58.51	65.59	63.45	60.13	58.20
Ash	1.06	1.32	1.54	1.87	2.10	1.43	1.78	1.93	2.36
Fiber	0.63	0.70	0.81	0.89	1.02	0.72	0.85	0.98	1.06
Energy (K.cal.)	333.99	333.52	332.60	333.76	335.42	330.50	329.88	330.91	329.92

Table (14): Protein and protein digestability of pan bread supplemented with full-fat and defatted sunflower flours (Miak).

Properties	100% W.F	Miak full-fat				Miak defatted			
		5%	10%	15%	20%	5%	10%	15%	20%
Protein	10.34	10.51	11.72	12.83	13.33	12.27	14.13	15.97	17.14
Protein digestability (g/100 gm)	77.60	81.40	82.30	83.50	84.92	82.70	83.93	85.30	87.60

W.F. = Wheat flour (72% ext.). Casein = 97.8

Table (15): Protein and protein digestability of pan bread supplemented with full-fat and defatted sunflower flours (Balady "Dhar-El-haea).

Properties	100% W.F	Balady full-fat				Balady defatted			
		5%	10%	15%	20%	5%	10%	15%	20%
Protein	10.34	10.96	11.81	12.93	13.71	12.49	14.79	16.21	18.29
Protein digestibility (gm/100g)	77.60	81.86	82.60	83.83	85.20	83.00	84.40	86.08	88.84

W.F. = Wheat flour (72% ext.). Casein = 97.8

wheat flour considerably (77.60 and 79.84%, respectively). This decrease in digestibility may be due to the physical modification of wheat proteins of flour through the formation of the dough before baking. This modification includes the formation of gluten network from flour proteins through water and gelatinization of starch granules in the oven. The gelatinized starch granules were distributed through out the net, thus hindering the complete proteolytic action of proteases on pan bread proteins.

Considering protein content of pan bread baked from flour containing increased amounts of sunflower flours 5, 10, 15 and 20%. The protein content increased as the addition of sunflower flour, was increased because of the higher content in proteins of sunflower (26.75 and 31.88% in full-fat Miak and Balady flours respectively, Table 3). In the same time, digestibility of proteins of pan bread increased as the blend content was increased due to the masking effect of sunflower proteins on glutenin fraction of gluten, therefore increasing the susceptibility of mixed proteins of the blends.

This increase in susceptibility was more pronounced in the defatted blends because of the absence of the hindering effect of sunflower fats on digestibility of proteins.

The Balady variety behaved in the same trend as Miak with a very small increase in the digestibility (Tables 14 & 15).

13) Protein and protein digestibility of cake supplemented with sunflower flour:

Tables (16 & 17) represent data of protein contents and protein digestibility of cake supplemented with full-fat and defatted sunflower flour. Considering these data, it is clear that the protein digestibility of

Table (16): Protein and protein digestability of cake supplemented with full-fat and defatted sunflower flours (Miak).

Properties	100% W.F	Miak full-fat				Miak defatted			
		5%	10%	15%	20%	5%	10%	15%	20%
Protein	9.50	10.10	10.65	11.15	11.75	10.72	11.55	12.43	13.96
Protein digestability (g/100 gm)	81.40	86.07	87.26	88.10	88.78	88.23	89.10	90.30	91.20

W.F. = Wheat flour (72% ext.). Casein = 97.8

Table (17): Protein and protein digestability of cake supplemented with full-fat and defatted sunflower flours (Balady "Dhar-El-haea").

Properties	100% W.F	Balady full-fat				Balady defatted			
		5%	10%	15%	20%	5%	10%	15%	20%
Protein	9.50	10.31	10.71	11.32	11.82	10.86	12.00	13.89	14.92
Protein digestibility (gm/100g)	81.40	86.30	87.95	88.66	89.50	88.40	89.30	92.70	93.09

W.F. = Wheat flour (72% ext.). Casein = 97.8.

sponge cake produced from wheat flour (72% ext.) was higher than the protein digestibility of pan bread which was baked from the same wheat flour. This increase may be due to the animal protein addition (egg protein) which has about 96.5%. Protein digestibility (81.40 and 77.60% for cake and pan bread products, respectively Tables (14, 15, 16 & 17).

It is clear from Tables (16 & 17) that the digestibility of proteins in cakes made of wheat sunflower blends increased as the supplementation increased. The increase was more pronounced in the blends of defatted sunflower flour.

Both varieties under study behaved in the same manner as well as in the case of pan bread except that the protein digestibility of cakes was higher.

14) Sensory evaluation of pan bread made from wheat flour (72% ext.) blends with full-fat and defatted sunflower flours (Miak and Balady):

Sensory evaluation data of pan bread baked from wheat and full-fat sunflower blends of flour are recorded in Table (18) for both Miak and Balady varieties.

The addition of 5% level full-fat blends gave pan bread superior than pan bread of wheat flour only in both varieties (88 and 91 scores) for pan bread of wheat and full-fat blends, respectively.

The addition of 10% level of full-fat blends gave pan bread superior than the control in Miak variety (88 and 91 scores) for wheat and full-fat blends, respectively).

In case of Balady variety the score of pan bread made of 10% level addition decreased a little than the control (88 and 83)

Table (18): Sensory evaluation of pan bread made from blends of wheat flour (72% ext.) with full-fat sunflower flours (Miak and Balady).

Properties / Additives	General appearance (20)	Crust color (10)	Crumb color (10)	Distribution of crumb (10)	Sponge (15)	Odor (15)	Taste (20)	Overall acceptability (100)	Descriptive category
100% W.F. "Control"	17.10 bc	8.45 b	8.90 ab	8.85 ab	13.35 a	13.65 a	18.00 ab	88 b	G
Miak full-fat sunflower flour									
95% W.F. + 5% M.F.F.S.	18.05 a	8.20 b	8.80 abc	9.15 a	13.75 a	13.75 a	18.85 a	91 b	V.G
90% W.F. + 10% M.F.F.S.	17.20 b	9.10 a	9.25 a	9.05 ab	13.80 a	13.75 a	18.40 ab	91 b	V.G
85% W.F. + 15% M.F.F.S.	16.00 cd	6.90 c	8.50 bc	8.40 bc	13.25 a	12.80 bc	16.50 cd	82 c	G
80% W.F. + 20% M.F.F.S.	14.95 d	6.50 c	7.85 de	7.80 ce	13.15 a	12.40 cb	16.10 cd	79 d	S
"Balady" full-fat sunflower flour:									
95% W.F. + 5% B.F.F.S.	17.65 b	9.35 a	9.10 ab	9.00 ab	13.80 a	13.75 a	18.85 a	92 a	V.G
90% W.F. + 10% B.F.F.S.	14.90 d	7.85 b	8.25 cd	7.80 cd	13.20 a	13.15 ab	17.35 bc	83 c	G
85% W.F. + 15% B.F.F.S.	12.45 e	6.90 c	6.95 e	7.15 de	12.15 bc	12.50 bcd	16.20 cd	74 e	S
80% W.F. + 20% B.F.F.S.	11.40 e	6.30 c	6.70 e	6.80 e	11.50 c	12.10 d	15.40 d	70 f	S
L.S.D. 0.05	1.15	0.64	0.61	0.71	0.75	0.68	1.39	3.22	

W.F. = Wheat flour (72% ext.)
M.F.F.S. = Miak full-fat sunflower flour
B.F.F.S. = Balady full-fat sunflower flour
L.S.D. = Least significant difference

V.G. = Very good (90 - 100 scores)
G = Good (80 - 89 scores)
S = Satisfactory (70 - 79 scores)
Q = Questionable (less than 70 scores).

Table (19): Sensory evaluation of pan bread made from blends of wheat flour (72% ext.) with Defatted sunflower flours (Miak and Balady).

Properties / Scores	General appearance (20)	Crust color (10)	Crumb color (10)	Distribution of crumb (10)	Sponge (15)	Odor (15)	Taste (20)	Overall acceptability (100)	Descriptive category
Additives									
100% W.F. "Control"	19.65 a	9.65 a	9.50b a	9.55 a	14.55 a	14.45 a	19.15 a	97 a	V.G
Miak defatted sunflower flour									
95% W.F. + 5% M.D.F.S.	19.00 a	9.20 ab	9.20 a	9.20 ab	14.00 c	13.00 cd	18.20 ab	92 b	V.G
90% W.F. + 10% M.D.F.S.	17.70 bc	8.60 bc	8.70 b	8.50 cd	13.25 d	12.30 d	17.10 bc	86 c	G
85% W.F. + 15% M.D.F.S.	16.75 cd	8.00 cd	7.95 c	8.05 de	12.70 ef	11.50 e	14.90 de	78 d	S
80% W.F. + 20% M.D.F.S.	14.95 ef	7.00 ef	6.80 ef	7.00 fg	11.25 gh	10.30 f	13.90 e	71 e	S
"Balady" defatted sunflower flour:									
95% W.F. + 5% B.D.F.S.	18.50 ab	9.15 ab	9.20 a	8.95 bc	14.05 bc	14.00 ab	18.75 a	93 b	V.G
90% W.F. + 10% B.D.F.S.	16.85 c	8.40 c	8.30 bc	8.20 d	13.25 d	13.30 bc	17.85 ab	86 c	G
85% W.F. + 15% B.D.F.S.	15.85 de	7.40 de	7.45 d	7.60 e	12.60 f	12.60 cd	16.40 c	80 d	G
80% W.F. + 20% B.D.F.S.	14.00 f	6.70 f	6.65 f	6.80 g	11.10 h	11.30 e	14.50 de	71 e	S
L.S.D. 0.05	0.99	0.62	0.44	0.48	0.22	0.71	1.31	2.4	

W.F. = Wheat flour (72% ext.)
M.D.F.S. = Miak defatted sunflower flour
B.D.F.S. = Balady defatted sunflower flour
L.S.D. = Least significant difference

V.G. = Very good (90 - 100 scores)
G = Good (80 - 89 scores)
S = Satisfactory (70 - 79 scores)
Q = Questionable (less than 70 scores).

Fig. (9): Pan Bread Baked From Miak Full-Fat-Wheat flour Blends

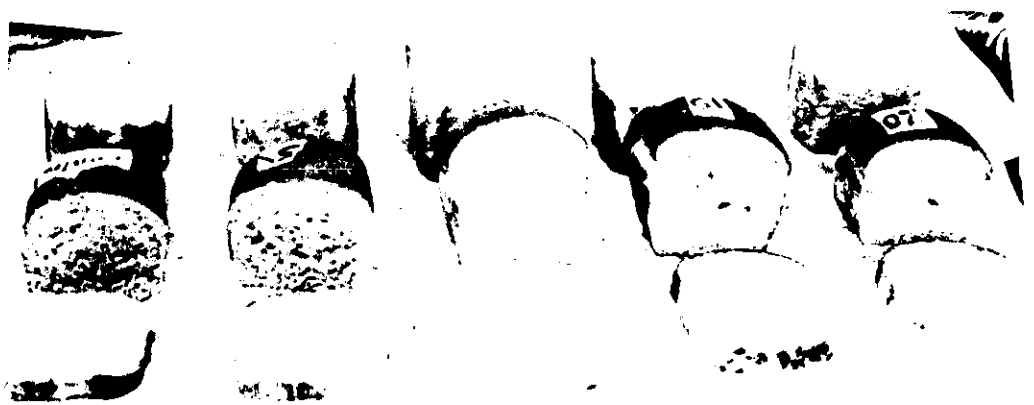

Fig. (10): Pan Bread Baked From Miak Full-Fat-Wheat flour Blends

Fig. (11): Pan Bread Baked From Balady Full-Fat-Wheat Flour Blends

Fig. (12): Pan Bread Baked From Balady Full-Fat- Wheat flour Blends

Fig (13):Pan Bread Baked From Miak Defatted Wheat flour Blends

Fig. (15): Pan Bread Baked From Balady Defatted-Wheat Flour Blends

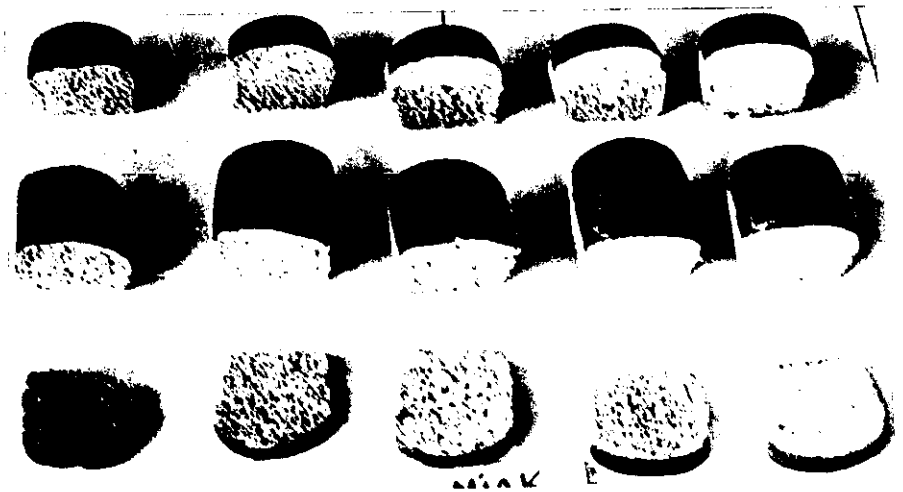

Fig. (14): Pan Bread Baked From Miak Defatted Wheat flour Blends

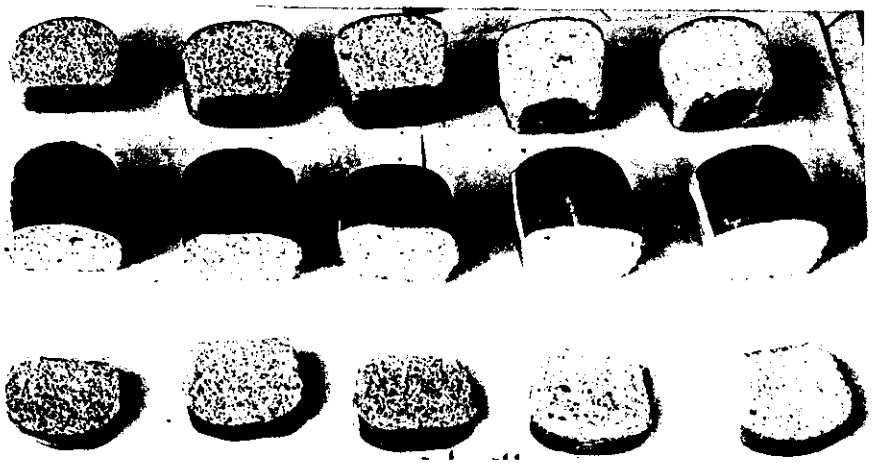

Fig.(16): Pan Bread Baked From Balady Defatted Wheat flour Blends

respectively. This difference between the two varieties of sunflower may be due to the differences in the composition of their fat and protein fractions. Addition of 15 and 20% levels of full-fat blend decreased the scores of pan bread made from the blends of the two varieties but the decreases were more pronounced in Balady variety. However, in all decreased scores it was not decreased below the satisfactory score (70 - 79) Table (18).

Concerning the blends of defatted sunflower flours of Miak and Balady varieties the pan bread baked from these blends decreased also in its scores but the most decreased scores in 20% level of blend was still within the satisfactory score in both varieties.

Referring to Miak and Balady varieties it was found that there is significant differences among the blends of full-fat and their counterparts of the defatted blends. The full-fat blends of 15 and 20% levels in Miak gave higher scores, while in Balady variety 10, 15 and 20% of defatted blends behaved in a reversed manner giving higher scores than in their counterparts of full-fat blends.

These differences in the behavior of the blends of the two varieties under study may be mainly attributed to the variations in chemical composition of the fat fraction and mineral contents of the flour in both varieties.

The most suitable additive level in baking good quality pan bread was up to 15% in Miak full-fat blends, while it was up to 10% in Balady full-fat blends. But in defatted flour blends it was found to be 10% for both Miak and Balady.

Table (20): Sensory evaluation of sponge cake made from blends of wheat flour (72% ext.) with full-fat sunflower flours (Miak and Balady).

Properties / Additives	General appearance (15)	Volume (10)	Crust color (5)	Crumb color (5)	Grain texture (10)	Softeness (15)	Aroma (10)	Taste (30)	Overall acceptability (100)	Descriptive category
100% W.F. "Control"	14.20 a	8.95 a	4.45 a	4.80 a	8.95 a	13.85 a	9.15 a	28.00 a	92 a	VG
Miak full-fat sunflower flour										
95% W.F. + 5% M.F.F.S.	13.50ab	8.70 ab	4.05abc	3.90 bc	8.55 a	13.30ab	8.75 a	26.85 b	88 b	G
90% W.F. + 10% M.F.F.S.	12.85bc	8.35bc	3.90bc	3.60 cd	7.75 b	12.75bc	8.00 bc	25.10 c	82 c	G
85% W.F. + 15% M.F.F.S.	11.50de	7.45de	3.10 f	2.80 e	7.40 cd	12.20cd	7.85bcd	23.40 d	76 d	S
80% W.F. + 20% M.F.F.S.	11.80de	7.55de	3.40def	2.65 e	7.15 cd	11.70de	7.60bcd	23.10 d	75 d	S
"Balady" full-fat sunflower flour:										
95% W.F. + 5% B.F.F.S.	13.85 a	8.45ab	4.20ab	3.90 bc	8.50 a	13.70ab	9.10 a	27.55ab	89 b	G
90% W.F. + 10% B.F.F.S.	12.25cd	7.90cd	3.65cde	3.50 d	7.60 bc	12.20cd	8.10 b	24.85 c	80 c	G
85% W.F. + 15% B.F.F.S.	11.30 e	7.05 e	3.20 ef	2.70 e	7.00 d	11.10 e	7.50 cd	23.60 d	74 de	S
80% W.F. + 20% B.F.F.S.	11.30 e	7.10 e	3.65cde	2.65 e	7.00 d	11.00 e	7.30 d	22.70 d	73 a	S
L.S.D. 0.05	0.79	0.51	0.45	0.38	0.58	0.99	0.56	1.14	2.87	

W.F. = Wheat flour (72% ext.)
M.F.F.S. = Miak full-fat sunflower flour
B.F.F.S. = Balady full-fat sunflower flour
L.S.D. = Least significant difference

V.G. = Very good (90 - 100 scores)
G = Good (80 - 89 scores)
S = Satisfactory (70 - 79 scores)
Q = Questionable (less than 70 scores).

Table (21): Sensory evaluation of sponge cake made from blends of wheat flour (72% ext.) with defatted sunflower flours (Miak and Balady).

Properties / Additives	General appearance (15)	Volume (10)	Crust color (5)	Crumb color (5)	Grain texture (10)	Softeness (15)	Aroma (10)	Taste (30)	Overall acceptability (100)	Descriptive category
100% W.F. "Control"	14.55 a	9.90 a	4.75 a	4.90 a	9.35 a	14.30 a	9.40 a	28.75 a	96 a	VG
Miak defatted sunflower flour										
95% W.F. + 5% M.D.F.S.	13.70 b	9.35 ab	4.30 b	3.65 b	8.50 b	13.55ab	8.70 bc	26.25 b	88 b	G
90% W.F. + 10% M.D.F.S.	13.00 b	9.00 b	4.05 bc	3.15 c	7.75 c	12.95bed	8.05 de	25.60bc	84 c	G
85% W.F. + 15% M.D.F.S.	11.10 c	6.70 de	3.10 fg	2.65 de	7.00 de	12.20cde	7.60 ef	23.20de	74 e	S
80% W.F. + 20% M.D.F.S.	9.70 d	6.10 e	2.90 g	2.25 f	6.50 ef	10.80 g	6.90 g	22.30ef	68 f	Q
"Balady" defatted sunflower flour:										
95% W.F. + 5% B.D.F.S.	13.40 b	8.80 b	3.90 cd	3.80 b	8.55 b	13.60 ab	9.10 ab	26.90 b	88 b	G
90% W.F. + 10% B.D.F.S.	11.30 c	7.90 c	3.60 de	3.15 c	7.15 d	12.00def	8.40 cd	24.30cd	78 d	S
85% W.F. + 15% B.D.F.S.	11.20 c	7.25 d	3.30 ef	2.80 cd	7.00 de	11.60efg	7.80 e	23.10de	74 e	S
80% W.F. + 20% B.D.F.S.	10.30 d	6.60 e	2.85 g	2.40 ef	6.20 f	11.10 fg	7.10 fg	21.30 f	68 f	Q
L.S.D. 0.05	0.78	0.60	0.35	0.38	0.58	1.01	0.51	1.43	2.89	

W.F. = Wheat flour (72% ext.)
M.D.F.S. = Miak defatted sunflower flour
B.D.F.S. = Balady defatted sunflower flour
L.S.D. = Least significant difference

V.G. = Very good (90 - 100 scores)
G = Good (80 - 89 scores)
S = Satisfactory (70 - 79 scores)
Q = Questionable (less than 70 scores).

20% 15% 10% 5% Control

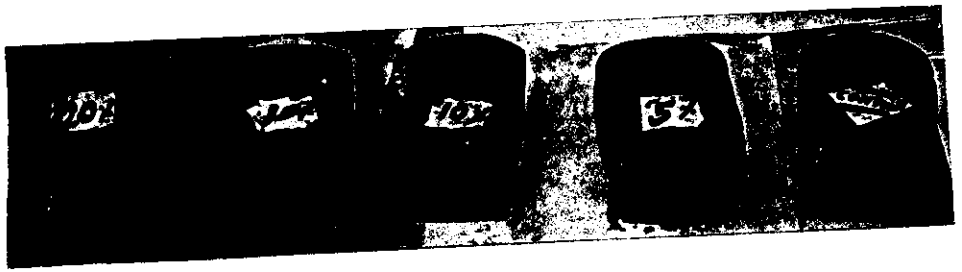

Fig. (17): Sponge Cake Baked From Miak full-fat Wheat Flour Blends

Fig. (18): Sponge Cake Baked From Miak Full-fat Wheat Flour Blends

20% 15% 10% 5% Control

Fig. (19): Sponge Cake Baked From Balady Full-fat Wheat Flour Blends

Fig. (20): Sponge Cake Baked From Balady Full-fat Wheat Flour Blends

20% 15% 10% 5% Control

Fig. (21): Sponge Cake Baked From Miak Defatted-Wheat Flour Blends

Fig. (22): Sponge Cake Baked From Miak Defatted-Wheat Flour Blends

20% 15% 10% 5% Control

Fig. (23): Sponge Cake Baked From Balady Defatted-Wheat Flour Blends

Fig. (24): Sponge Cake Baked From Balady Defatted-Wheat Flour Blends

15) Sensory evaluation of cake made from wheat flour (72% ext.) blends with full-fat and defatted sunflower flours (Miak and Balady):

Sensory evaluation of cakes made from wheat flour, full-fat and defatted flour blends of sunflower flour behaved in a similar manner as in pan bread with some small differences due to the additives of eggs,....etc. in case of making cakes out of the blends.

In case cake production the 5% level of addition gave the most superior product in both full-fat and defatted sunflower flour for both varieties, under investigation (88 and 89 score) for 5% level of Miak and Balady full-fat blends, while defatted blends gave (88 score and 88 score) for 5% level of Miak and Balady blends respectively. But in the control gave (92 score).

16) Effect of adding full-fat and defatted sunflower flour to wheat flour on Alkaline Water Retention Capacity (A.W.R.C.) of pan bread:

Data in Table (22) represent the effect of sunflower flour blends with wheat flour on the retardation of staling property in pan bread made of these blends.

The addition of 10% full-fat flour on wheat flour preserved freshness for six hours in pan bread made from blends of both varieties Miak and Balady. Addition of 15% full-fat flour to wheat flour extended the freshness period up to 12 hrs., in bread made from both varieties under study. Increasing the blending ratio to 20% extended the preservation period up to 48 hrs.

On the other hand, addition of defatted flour of sunflower of both varieties to wheat flour had no effect on retardation staling in pan

Table (22): Effect of adding full-fat sunflower flours to wheat flour (72% ext.) on Alkalinee water Retention Capacity (A.W.R.C.) of pan bread during the different storage periods at roomtemperature.

Storage periods (hrs)	S.P. Fresh after baking	S.P. after (6 hrs)	R.D. to fresh %	S.P. after (12 hrs)	R.D. to fresh %	S.P. after (24 hrs)	R.D. to fresh %	S.P. after (48 hrs)	R.D. to fresh %
Control 0%	499.70	410.50	17.85	373.20	25.06	340.10	31.94	320.90	35.78
Miak 5%	504.75	443.00	12.23	400.60	20.75	372.80	26.14	348.30	30.99
R.D. to control %	- 1.01	- 7.92		- 7.34		- 9.61		- 8.54	
Miak 10%	545.50	501.25	8.40	461.80	15.34	426.70	21.78	397.50	27.13
R.D. to control %	- 9.17	- 22.11		- 23.74		- 25.46		- 23.87	
Miak 15%	566.25	527.25	6.88	511.80	9.61	472.50	16.55	432.10	23.60
R.D. to control %	- 13.32	- 28.44		- 37.13		- 38.93		- 34.65	
Miak 20%	584.50	551.75	5.60	544.40	6.96	512.30	12.35	481.40	17.64
R.D. to control %	- 16.97	- 34.41		- 45.87		- 50.63		- 50.01	
Balady 5%	504.50	441.75	12.44	398.10	21.09	371.30	26.40	345.90	31.43
R.D. to control %	- 0.96	- 7.61		- 6.67		- 9.17		- 7.79	
Balady 10%	543.25	497.00	8.51	459.50	15.41	424.10	21.93	394.80	27.32
R.D. to control %	- 8.72	- 21.07		- 23.12		- 24.69		- 23.03	
Balady 15%	566.00	526.90	6.97	510.30	9.84	471.90	16.62	430.00	24.00
R.D. to control %	- 13.26	- 28.35		- 36.74		- 38.75		- 33.99	
Balady 20%	583.25	549.90	5.72	541.10	7.20	509.60	12.62	479.80	17.70
R.D. to control %	- 16.72	- 33.96		- 44.99		- 49.84		- 49.52	

S.P. = Swelling power **R.D. = Rate of decrease.**

Table (23): Effect of adding defatted sunflower flours to wheat flour (72% ext.) on Alkalinee water Retention Capacity (A.W.R.C.) of pan bread during the different storage periods at roomtemperature.

Storage periods (hrs)	S.P. Fresh after baking	S.P. after (6 hrs)	R.D. to fresh %	S.P. after (12 hrs)	R.D. to fresh %	S.P. after (24 hrs)	R.D. to fresh %	S.P. after (48 hrs)	R.D. to fresh %
Control 0%	502.10	408.20	18.70	374.50	25.41	342.20	31.85	322.60	35.74
Miak 5%	510.40	417.50	18.20	386.50	24.28	354.20	30.16	335.80	34.22
R.D. to control %	- 1.65	- 2.28		- 3.20		- 3.51		- 4.09	
Miak 10%	520.50	430.25	17.33	409.50	21.30	397.18	27.34	351.20	32.53
R.D. to control %	- 3.66	- 5.40		- 9.35		- 16.06		- 8.86	
Miak 15%	528.80	470.25	11.06	444.50	15.39	391.74	25.91	360.60	31.80
R.D. to control %	- 5.32	- 15.20		- 18.69		- 14.48		- 11.78	
Miak 20%	572.10	518.90	9.29	487.50	14.78	429.29	24.96	394.07	31.12
R.D. to control %	- 13.94	- 27.12		- 30.17		- 25.45		- 22.15	
Balady 5%	512.00	420.50	18.87	385.75	24.66	356.20	30.46	330.52	35.44
R.D. to control %	- 1.97	- 3.01		- 3.00		- 4.09		- 2.46	
Balady 10%	521.25	431.25	17.30	406.15	22.08	375.88	27.89	340.25	34.72
R.D. to control %	- 3.81	- 5.65		- 8.45		- 9.84		- 5.47	
Balady 15%	533.00	461.75	13.36	435.00	18.38	390.15	26.80	358.17	32.80
R.D. to control %	- 6.15	- 13.12		- 16.15		- 14.01		- 11.03	
Balady 20%	570.25	516.75	9.37	483.25	15.26	426.82	25.15	390.30	31.56
R.D. to control %	- 13.57	- 26.59		- 29.04		- 24.73		- 20.99	

S.P. = Swelling power **R.D. = Rate of decrease.**

bread at any rate of addition from 5 to 15% of defatted addition. Addition of 20% of defatted sunflower flour to wheat flour only preserved freshness for six hours in the bread of both varieties (Table 23).

The oil of sunflower may be the essential factor in retardation of staling and preservation of freshness up to 24 or 48 hours. This may be due to the adsorption of polar fats on the surface of starch granules of the dough, and hence of the bread during baking, this coating of starch granules with polar fats prevented the possibility of the attachment of starch molecules on the surfaces of granules through hydrogen bonding thus, causing the loss of development of staling in bread.

17) <u>Effect of adding full-fat and defatted sunflower flour to wheat flour (72% ext.) on Alkaline Water Retention Capacity (A.W.R.C.) of cake</u> :

Concerning the effect of sunflower flour blends with wheat flour on the retardation of staling property in cake made of these blends should be detected from (Tables 24 & 25).

From Table (24) it is clear that full-fat blends had no effect in retardation of cake staling in both varieties Miak and Balady up to 10% level. At 15% level the staling was retarded to 12 hrs. in both varieties, while the addition of 20% sunflower full-fat flour to wheat flour retarded staling to 48 hrs. This changed manner in behavior in comparison with pan bread may be due to the additives to the blends such as eggs. Which contain phospholipids molecules having the capability of attaching both polar and nonpolar components of cake since loss and distribution of moisture between components are the principle components of cake staling, therefore as water migrates from

Table (24): Effect of adding full-fat sunflower flours to wheat flour (72% ext.) on Alkaline Water Retention Capacity (A.W.R.C.) of cake during the different storage periods at roomtemperature.

Storage periods (hrs)	S.P. Fresh after baking	S.P. after (6 hrs)	R.D. to fresh %	S.P. after (12 hrs)	R.D. to fresh %	S.P. after (24 hrs)	R.D. to fresh %	S.P. after (48 hrs)	R.D. to fresh %
Control 0%	537.40	444.20	17.34	430.90	19.82	419.60	21.92	381.5	29.01
Miak 5%	548.60	471.50	14.05	456.30	16.82	443.10	19.23	421.10	23.24
R.D. to control %	- 2.08	- 6.14		- 5.89		-5.60		-10.38	
Miak 10%	576.30	516.60	10.36	500.20	13.20	487.60	15.39	466.20	19.10
R.D. to control %	- 7.23	- 16.29		- 16.08		-16.20		-22.20	
Miak 15%	609.40	559.80	8.14	543.10	10.88	528.40	13.29	509.80	16.34
R.D. to control %	- 13.39	- 26.02		- 26.04		-25.93		-33.63	
Miak 20%	629.90	588.50	6.57	576.40	8.49	559.80	11.13	538.10	14.57
R.D. to control %	- 17.21	- 32.48		- 33.76		-33.41		-41.04	
Balady 5%	546.30	469.20	14.11	450.90	17.46	435.30	20.32	410.90	24.78
R.D. to control %	- 1.66	- 5.63		- 4.64		-3.74		-7.71	
Balady 10%	573.10	510.30	10.96	495.60	13.52	479.10	16.40	454.30	20.73
R.D. to control %	- 6.64	- 14.88		- 15.01		-14.18		-19.08	
Balady 15%	604.30	553.00	8.49	536.70	11.19	519.90	13.97	498.90	17.44
R.D. to control %	- 12.44	- 24.49		- 24.55		-23.90		-30.77	
Balady 20%	620.80	581.90	7.49	565.90	8.84	549.80	11.44	527.10	15.09
R.D. to control %	- 15.52	- 30.99		- 31.33		-31.03		-38.17	

S.P. = Swelling power **R.D. = Rate of decrease.**

Table (25): Effect of adding defatted sunflower flours to wheat flour (72% ext.) on Alkaline Water Retention Capacity (A.W.R.C.) of cake during the different storage periods at roomtemperature.

Storage periods (hrs)	S.P. Fresh after baking	S.P. after (6 hrs)	R.D. to fresh %	S.P. after (12 hrs)	R.D. to fresh %	S.P. after (24 hrs)	R.D. to fresh %	S.P. after (48 hrs)	R.D. to fresh %
Control 0%	538.60	442.00	17.93	433.80	19.46	421.20	21.80	385.80	28.36
Miak 5%	545.25	465.30	14.67	453.70	16.79	439.30	19.43	403.10	26.07
R.D. to control %	-1.23	-5.27		-4.58		-4.30		-4.48	
Miak 10%	563.25	486.20	13.68	480.10	14.76	463.50	17.71	421.40	25.18
R.D. to control %	-4.58	-10.0		-10.65		-10.04		-9.23	
Miak 15%	604.75	536.75	11.24	521.80	13.72	503.70	16.70	453.60	24.99
R.D. to control %	-12.28	-21.44		-20.29		-19.59		-17.57	
Miak 20%	623.75	563.75	9.61	543.75	12.83	529.40	15.13	471.80	24.36
R.D. to control %	-15.81	-27.55		-25.34		-25.69		-22.29	
Balady 5%	546.90	461.10	15.68	449.20	17.96	435.70	20.33	400.00	26.86
R.D. to control %	-1.54	-4.32		-3.55		-3.44		-3.68	
Balady 10%	565.30	482.90	14.57	475.30	15.92	459.20	18.77	417.60	26.12
R.D. to control %	-4.96	-9.25		-9.57		-9.02		-8.24	
Balady 15%	606.40	533.90	11.96	517.50	14.66	498.90	17.72	449.30	25.90
R.D. to control %	-12.59	-20.79		-19.29		-18.45		-16.46	
Balady 20%	626.10	559.80	10.59	539.80	13.78	524.30	16.26	467.60	25.31
R.D. to control %	-16.25	-26.65		-24.44		-24.47		-21.20	

S.P. = Swelling power **R.D. = Rate of decrease.**

proteins to the other components, cake texture becomes drier. The presence of phospholipids hinder this migration and loss of moisture from cakes, rendering it more fresh.

It is clear from Table (25) that both 5 and 10% levels of defatted blends addition had no effect of staling retardation, while 15 and 20% levels retarded staling for 6 hrs. and 12 hrs. respectively in the two studied varieties Miak and Balady sunflower flours.