RESULTS & DISCUSSION

4. RESULTS AND DISCUSSION

4.1. Chemical composition:

Chemical composition of wheat grains, wheat flour (82%extraction), hull-less barley grains, hull-less barley flour (70% extraction) and partially defatted soybean flour is presented in Table (2).

4.1.1. Moisture content:

Moisture contents was 11.6% in wheat grains, 14.3% in wheat flour, 11.1% in hull-less barley grains 13.3% in hull-less barley flour and 5.5% in partially defatted soybean flour. These values were slightly higher than those reported by **Bhatty (1993), Sozan and ElAzab (2000) and Abdel-Motaleb (2001).** High wheat flour and hull-less barley flour moisture content could be due to its high water absorption during conditioning process.

4.1.2. Ash content:

Ash content was 1.99% in wheat grains, 0.8% in wheat flour, 1.95% in hull-less barley grain, 1.23% in hull-less barley flour and 7.13% partially defatted soybean flour. These results are in agreement with those reported by **Bhatty (1993), Sozan and El-Azab (2000) and Abdel-Motaleb (2001).**

Table (2): Chemical composition of wheat grains, wheat flour (82% extraction), hull-less barely grains, hull-less barely flour (70% extraction) and partially defatted soybean flour.

Components	Wheat grains	Wheat flour	Hull-less barely grains	Hull-less barely flour	Partially defatted soybean flour
	N x 5.7				N x 6.25
Moisture%	11.6	14.3	11.1	13.3	5.5
Ash%*	1.99	0.8	1.95	1.23	7.13
Crude protein %*	11.5	10.5	9.92	9.53	51.3
Lipids% *	2.17	2.11	3.66	2.66	6.00
Crude fiber %*	2.50	0.10	1.27	0.63	3.20
Carbohydrate %**	81.84	86.49	83.20	85.95	32.37
Reducing sugar %	0.51	0.46	0.71	0.60	1.61
Non reducing sugar %	1.00	0.76	1.23	1.19	0.48
Total sugars%	1.51	1.22	1.94	1.79	2.09
Gluten (of total protein) %	--	26.7	--	0.00	0.00
Pigments as carotenes (ppm)	2.64	1.83	3.07	2.40	13.66
Phytate %	0.70	0.18	1.30	0.20	2.25
Falling number "sec"	395	380	444	470	-

* These values were calculated on dry weight basis.

** Carbohydrate by difference.

4.1.3. Crude protein content:

Crude protein content was 11.5%, 10.5%, 9.92%, 9.53% and 51.3% on dry weight basis for raw materials wheat grains, wheat flour, hull-less barley grains, hull-less barley flour and partially defatted soybean flour, respectively. These results are in agreement with those obtained by **Mc Cleary and Codd (1991) and Abdel-Motaleb (2001).**

Partially defatted soybean flour protein is characterized by it's high protein content (51.3%) consequently, its addition to different flour mixtures improved the protein content **(Lorenz and Maga, 1972).**

4.1.4. Lipids content:

Lipid contents were 2.17% in wheat grains, 2.11% in wheat flour, 3.66% in hull-less barley grains, 2.66% in hull-less barley flour and 6% in partially defatted soybean flour. These results are in agreement with those obtained by **Khalil (1998).**

4.1.5. Crude fiber content:

Crude fiber contents were 2.5% in wheat grains, 0.1% in wheat flour, 1.27% in hull-less barley grains, 0.63% in hull-less barley flour and 3.2% in partially defatted soybean flour. These results are coincidence with those of **Vose and Youngs (1978) and Abdel-Motaleb (2001).**

4.1.6. Carbohydrate content:

Carbohydrate content of wheat grains, wheat flour, hull-less barley grains, hull-less barley flour and partially defatted soybean flour was 81.84, 86.49, 83.20, 85.95 and 32.37%, respectively. From the obtained results it could be observed that the partially defatted soybean flour had the lowest compared with other carbohydrate contents under investigation. So raising partially defatted soybean flours level in the suggested mixtures may decrease the content of the carbohydrate content of the flour mixtures and different bread samples **(Foda *et al.*, 1987)**. These results are in agreement with those obtained by **Bothayna (1995), Khalil (1998), Sozan and El-Azab (2000) and Abdel-Motaleb (2001).**

4.1.7. Sugar content:

Reducing sugar, non reducing sugar and total sugars contents were 0.51, 1.00 and 1.51% in wheat grains; 0.46, 0.76 and 1.22% in wheat flour ; 0.71, 1.23 and 1.94% in hull-less barley grains; 0.60, 1.19 and 1.79% in hull-less barley flour and 1.61, 0.48 and 2.09% in partially defatted soybean flour. These results are in agreement with those obtained by **Mc Cleary and Codd (1991) and Basyony *et al.* (1993).**

4.1.8. Gluten content (of total protein):

Gluten content in wheat flour was 26.7% while it was zero in hull-less barley flour and partially defatted soybean flour.

4.1.9. Pigments content:

Pigments as β-carotene content was 2.64 ppm in wheat grains; 1.83 ppm in wheat flour ; 3.07 ppm in hull-less barley grains; 2.4 ppm in hull-less barley flour and 13.66 ppm in partially defatted soybean flour. It is noticed that the pigments as β-carotene was higher in partially defatted soybean flour. Pigments as β-carotene acts as precursor of Vit. A and carotenoids includes pigments as β-carotenes have antioxidant activity **(Lillian Langseth, 1995)**.

4.1.10. Phytate content:

Data in Table (2) show phytate content of wheat grains, wheat flour, hull-less barley grains, hull-less barley flour and partially defatted soybean flour (0.7, 0.18, 1.3, 0.2 and 2.25%, respectively). Wheat and hull-less barley grains had higher phytate content (0.7 and 1.3%) than the extracted flours (0.18 and 0.2%). Partially defatted soybean flour had the highest phytate content 2.25%. There are a complicated relationship between dietary minerals, protein and phytate content on mineral availability. In humans, retention of calcium, iron and zinc could be decreased significantly by diets high in phytate **(Lolas and Markakis, 1975; Harland and Harland, 1980 and Kent, 1983)**. Therefore partially defatted soybean flour is an excellent source of high fiber bread. Phytic acid has been categorized as an anti-nutritional component in cereals and legumes **(Oatway *et al.*, 2001)**. Also, the same authors have been reported to impair the absorption of minerals and trace elements such as calcium, zinc and iron in humans **(Bohn *et al.*, 2004)**.

4.1.11. Falling number (Alpha-amylase activity):

Alpha amylase activity was 395, 380 444 and 470 sec for wheat grains, wheat flour, hull-less barley grains and hull-less barley flour, respectively. While, non determined falling number for partially defatted soybean flour.

4.2. Rheological characteristics of dough:

4.2.1. Farinograph properties:

4.2.1.1. Effect of mixing wheat flour (82% extraction) with hull-less barley flour (70% extraction) on farinograph properties:

Table (3) and Figs. (1a, b, c, d & e) show the farinograph parameters of wheat flour as affected by different levels (5%, 10%, 15% and 20%) of hull-less barley flour .

The results show that addition of hull-less barley flour under the abovementioned concentrations led to an increase in water absorption (61.4, 63.0, 65.3 and 65.0% compared with control 61.2%). The increment of water absorption may be due to the strong water binding ability of fiber as mentioned by **Chen *et al.* (1988)**.

Arrival time increased at the levels of 5 and 10% hull-less barley flour (3.0 and 4.0 min) compared with control (2.0 min) while, at 15 and 20% arrival time decreased (3.0 and 2.5 min).

Dough development time increased at all hull-less barley flour addition levels (4.5, 5.0, 5.5 and 4.5 min) compared with control (3.5 min). Longer dough development time could be as a

Table (3): Effect of mixing wheat flour (82% extraction) with hull-less barley flour (70% extraction) on the farinograph parameters.

Recipe mixtures		Water absorption	Arrival time	Dough development time	Dough stability	Dough weakening (after 12 min)
Wheat flour	Hull-less barley flour	(%)	(min)	(min)	(min)	(Bu)
100%	-	61.2	2.0	3.5	4.0	45
95%	5%	61.4	3.0	4.5	4.0	50
90%	10%	63.0	4.0	5.0	3.5	50
85%	15%	65.3	3.0	5.5	5.5	55
80%	20%	65.0	2.5	4.5	4.0	70

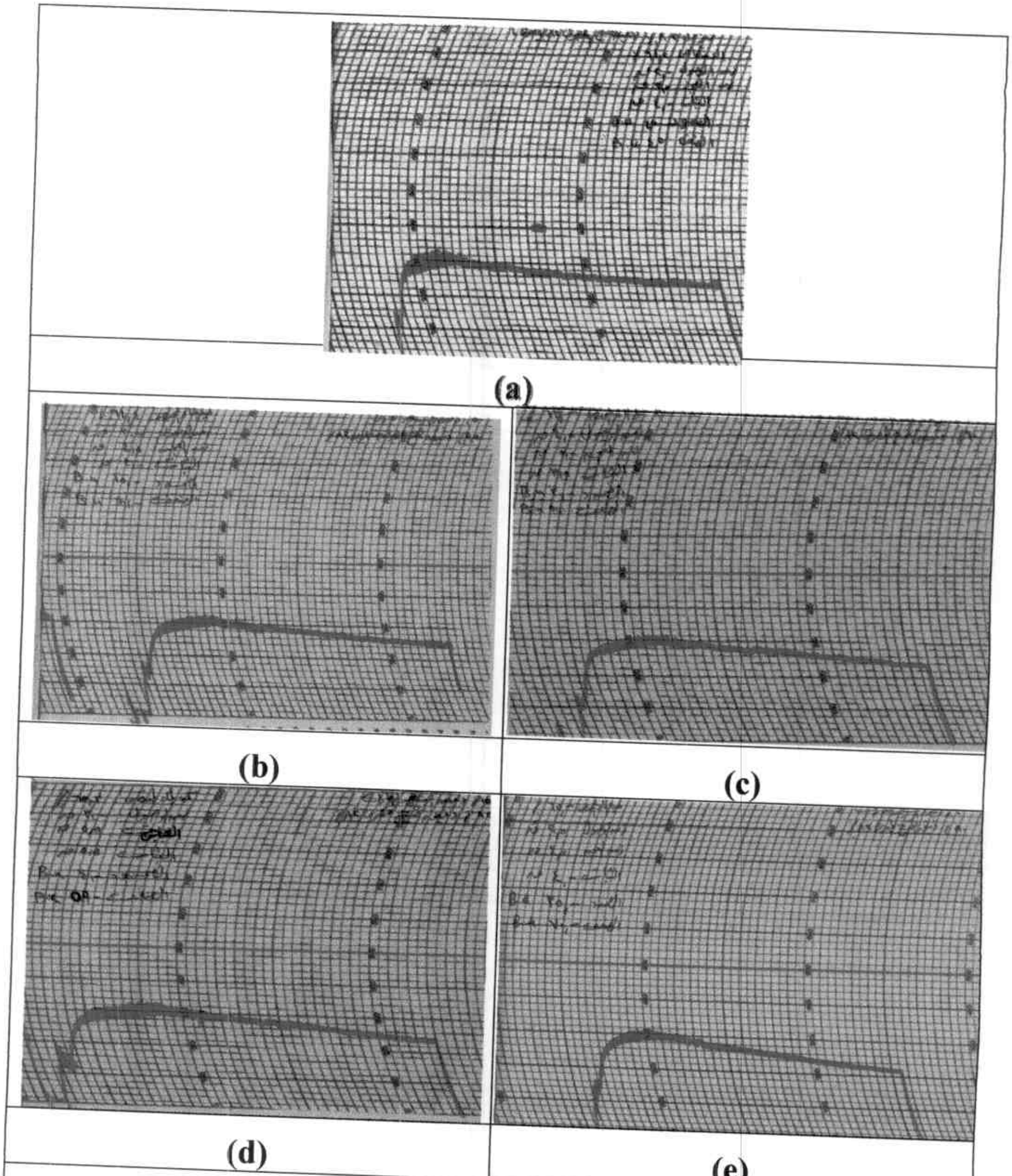


Fig. (1): Farinograph characteristic of wheat flour (82% ext.) mixed with hull-less barley flour (70% ext.) at different ratios.

- **(a) Wheat flour (82% ext.).**
- **(b) 95% wheat flour (82% ext.) + 5% hull–less barley flour (70% ext.).**
- **(c) 90% wheat flour (82% ext.) + 10% hull–less barley flour (70% ext.).**
- **(d) 85% wheat flour (82% ext.) + 15% hull–less barley flour (70% ext.).**
- **(e) 80% wheat flour (82% ext.) + 20% hull–less barley flour (70% ext.).**

result **(Chen *et al.*, 1988)** which contain of hull-less barley flour high fiber content.

Dough stability values were found to be as control at levels 5 and 20% hull-less barley flour (4.0 min). Stability decreased at 10% hull-less barley flour addition (3.5 min) and reached it maximum at 15% hull-less barley flour addition (5.5 min).

Dough stability weakness had been attributed to protein poor in sulhydryl groups which normally cause softening or degradation action of the dough **(El-Farra *et al.*, 1981)**.

Similar results were obtained by **Anjum *et al.* (1991)** who reported that blending up to 10% barley flour with wheat flour gave farinograph characteristics comparable to those of wheat flour but, increasing the proportion of barley decreased dough mixing time and stability.

From the obtained results it could be observed that the addition of hull-less barley flour at different concentrations with wheat flour led to an increase in dough weakening (50, 50, 55 and 70 Bu) comparing with control (45 Bu).

The increment of dough weakening could be attributed to gluten dilution beside the slow formation of gluten net work as cited by **Chen *et al.* (1988)**. Similar conclusions were obtained by **Anjum *et al.* (1991) and Basman *et al.* (2003).**

Addition of 15% hull-less barley flour to wheat flour was the suitable ratio for obtaining descrable rheological properties of the dough.

4.2.1.2. Effect of mixing wheat flour (82% extraction) with partially defatted soybean flour on farinograph properties:

Farinograph parameters as affected by mixing of wheat flour with partially defatted soybean flour at different levels (5, 10, 15 and 20%) are shown in Table (4) and Figs. (2a, b, c, d &e).

The results show that addition of partially defatted soybean flour to wheat flour under the above mentioned concentrations led to increase water absorption which recorded 65.0, 67.3, 71.0 and 75.8% compared with control (61.2%). The increment of water absorption is attributed to the strong water binding ability of partially defatted soybean flour fiber and protein. Partially defatted soybean flour is characterized by it's higher protein content (51.3%). Consequently, its addition to different flour mixtures improved its protein content **(Lorenz and Maga, 1972)**.

The physico-chemical properties of dough were improved as a result of increasing S-S bonds and decreasing SH groups **(Zakharova and Kazakov, 1970)**.

From these results it could be concluded that arrival time, dough development time and dough stability were increased comparing with control. This may be due to the high water absorption of partially defatted soybean flour as mentioned by **Mizrahi *et al.* (1967)**.

Similar results were reported by **Hafez (1996) and Abdel-Motelb (2001)**. But **Amudha *et al.* (2002)** cited that as the proportion of partially defatted soybean flour increased there

Table (4): Effect of mixing wheat flour (82% extraction) with partially defatted soybean flour on the farinograph parameters:

Recipe mixtures		Water absorption	Arrival time	Dough development time	Dough stability	Dough weakening (after 12 min)
Wheat flour	Partially defatted soybean flour	(%)	(min)	(min)	(min)	(Bu)
100%	-	61.2	2.0	3.5	4.0	45
95%	5%	65.0	4.5	6.0	4.5	30
90%	10%	67.3	4.0	6.0	8.0	25
85%	15%	71.0	5.0	6.0	8.0	20
80%	20%	75.8	5.5	7.0	8.0	20

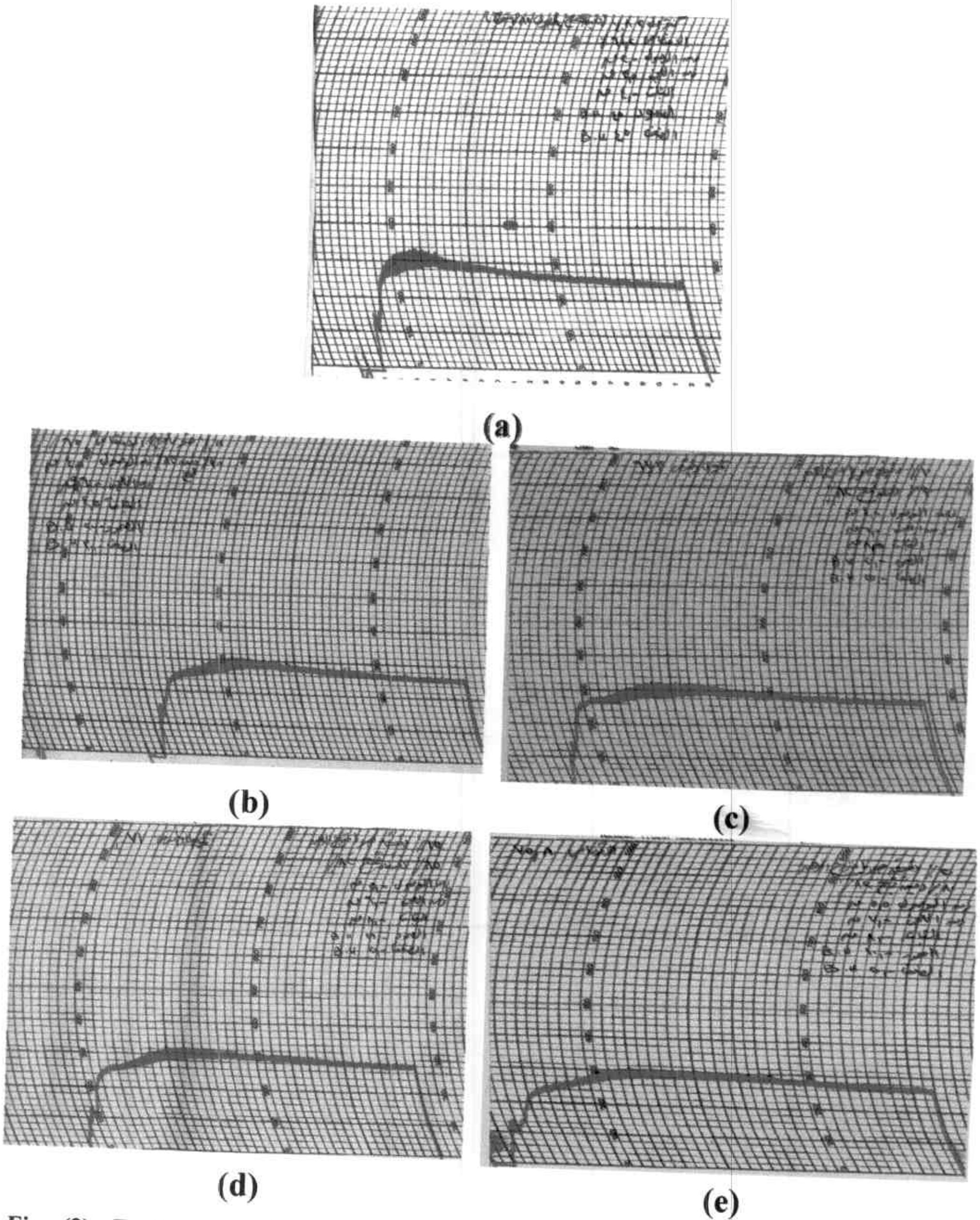


Fig. (2): Farinograph characteristic of wheat flour (82% ext.) mixed with partially defatted soybean flour at different ratio.

(a) **Wheat flour (82% ext.)**
(b) **95% wheat flour (82% ext.) + 5% partially defatted soybean flour.**
(c) **90% wheat flour (82% ext.) + 10% partially defatted soybean flour.**
(d) **85% wheat flour (82% ext.) + 15% partially defatted soybean flour.**
(e) **80% wheat flour (82% ext.) + 20% partially defatted soybean flour.**

was a slight increase in water absorption and decrease in dough stability.

Also results indicate that addition of partially defatted soybean flour to wheat flour led to decrease in dough weakening recording 30, 25, 20 and 20 (Bu) compared with control (45 Bu). The low dough weakening could be attributed to a false increment in strength and stability with reduction in dough weakening. Weakening of the dough may be as a result of the breakdown of gluten network after elapsing an appropriate mixing time. The protein in the applied mixtures are of low quality because of their deficiency of gluten. These results are in harmony with those reported by **Hafez (1996) and Abdel-Motaleb (2001) and Basman *et al.* (2003).**

From the above results, it was found that addition of 20% partially defatted soybean flour to wheat flour was the most suitable ratio for obtaining desirable rheological properties of the dough.

In general, it could be concluded that fiber source addition increase water absorption, dough development time and stability while, it lower dough weakening. These dough characteristics may be attributed to:

1- High ability of dietary fiber components to swell and absorb more water.
2- The gluten dilution beside the slow formation of gluten network, which is the parameter of dough development time. Also dough stability is an important index for the ability of the dough to capture sufficient amounts of gas during fermentation period, but here it had different trend that could

be attributed to the fiber addition since fiber has the ability to absorb more water and dough become tough.

4.2.1.3. Effect of mixing wheat flour (82% extraction) with hull-less barley flour (70% extraction) and partially defatted soybean flour on farinograph properties:

Table (5) and Figs. (3a, b, c, d & e) show farinograph parameters after the addition of hull-less barley flour and partially defatted soybean flours at different concentrations (5, 10, 15 and 20%) with wheat flour .

The results show that addition of barley flour + partially defatted soybean flour to wheat flour under the above-mentioned concentrations led to an increase in water absorption (65.9, 70.4, 75.5 and 78.8%) compared with control (61.2%).

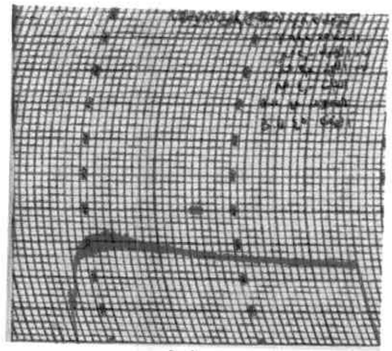
But, the arrival time was the same at 5% of hull-less barley flour and partially defatted soybean flour and increased to 3.0, 4.0, and 3.5 min when compared with control (2.0 min).

The dough development time increased at the ratios 5, 10, 15 and 20% recording 4.5, 5.5, 6.5 and 6.0 min compared with 100% wheat flour . Also, dough stability was increased and recorded 5.5, 6.0, 6.0 and 10.5 min compared with control (4.0 min).

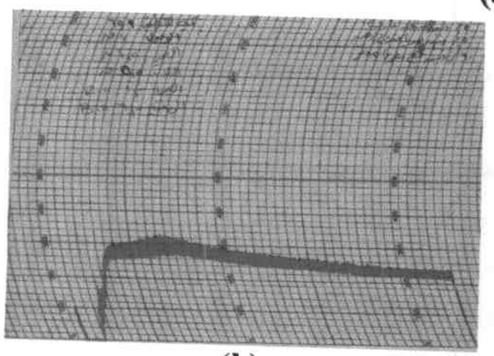
Addition of hull-less barley flour + partially defatted soybean flour to wheat flour led to an increase in dough weakening at ratio 5% (60 Bu) compared with control (45 Bu) while, at levels of 10% and 15% dough weakening was same

Table (5): Effect of mixing wheat flour (82% extraction) with hull-less barley flour (70% extraction) + partially defatted soybean flour on the farinograph parameters.

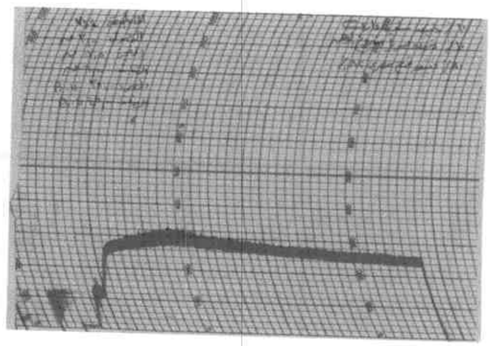
Recipe mixtures			Water absorption	Arrival time	Dough development time	Dough stability	Dough weakening (after 12 min)
Wheat flour	Hull-less barley flour	Partially defatted soybean flour	(%)	(min)	(min)	(min)	(Bu)
100%	-	-	61.2	2.0	3.5	4.0	45
90%	5%	5%	65.9	2.0	4.5	5.5	60
80%	10%	10%	70.4	3.0	5.5	6.0	45
70%	15%	15%	75.5	4.0	6.5	6.0	45
60%	20%	20%	78.8	3.5	6.0	10.5	20



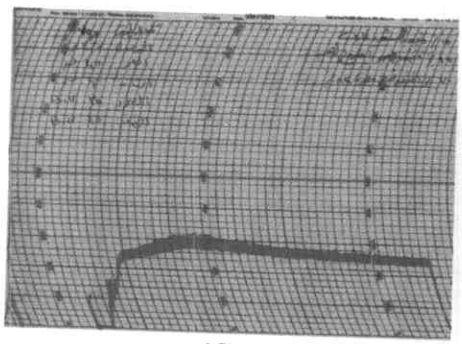
(a)



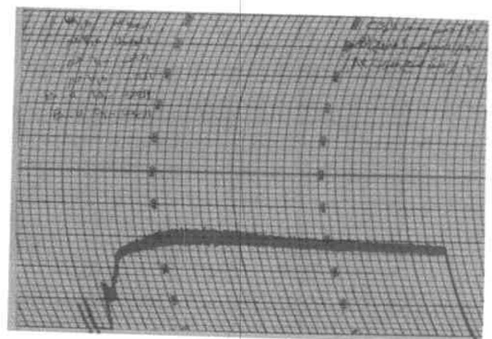
(b)



(c)



(d)



(e)

Fig. (3): Farinograph characteristic of wheat flour (82% ext.) mixed with hull-less barley flour (70% ext.) plus partially defatted soybean flour at different ratios.

(a) **Wheat flour (82% ext.).**

(b) **90% wheat flour (82% ext.) + 5% hull-less barley flour (70% ext.) + 5% partially defatted soybean flour.**

(c) **80% wheat flour (82% ext.) + 10% hull-less barley flour (70% ext.) + 10% partially defatted soybean flour.**

(d) **70% wheat flour (82% ext.) + 15% hull-less barley flour (70% ext.) + 15% partially defatted soybean flour.**

(e) **60% wheat flour (82% ext.) + 20% hull-less barley flour (70% ext.) + 20% partially defatted soybean flour.**

with control, and decreased at 20%. These results are similar to those obtained by **Hafez (1996) and Abdel-Motaleb (2001) and Basman *et al.* (2003).**

4.2.2. Extensograph properties:

4.2.2.1. Effect of mixing wheat flour (82% extraction) with hull-less barley flour (70% extraction) on extensograph properties:

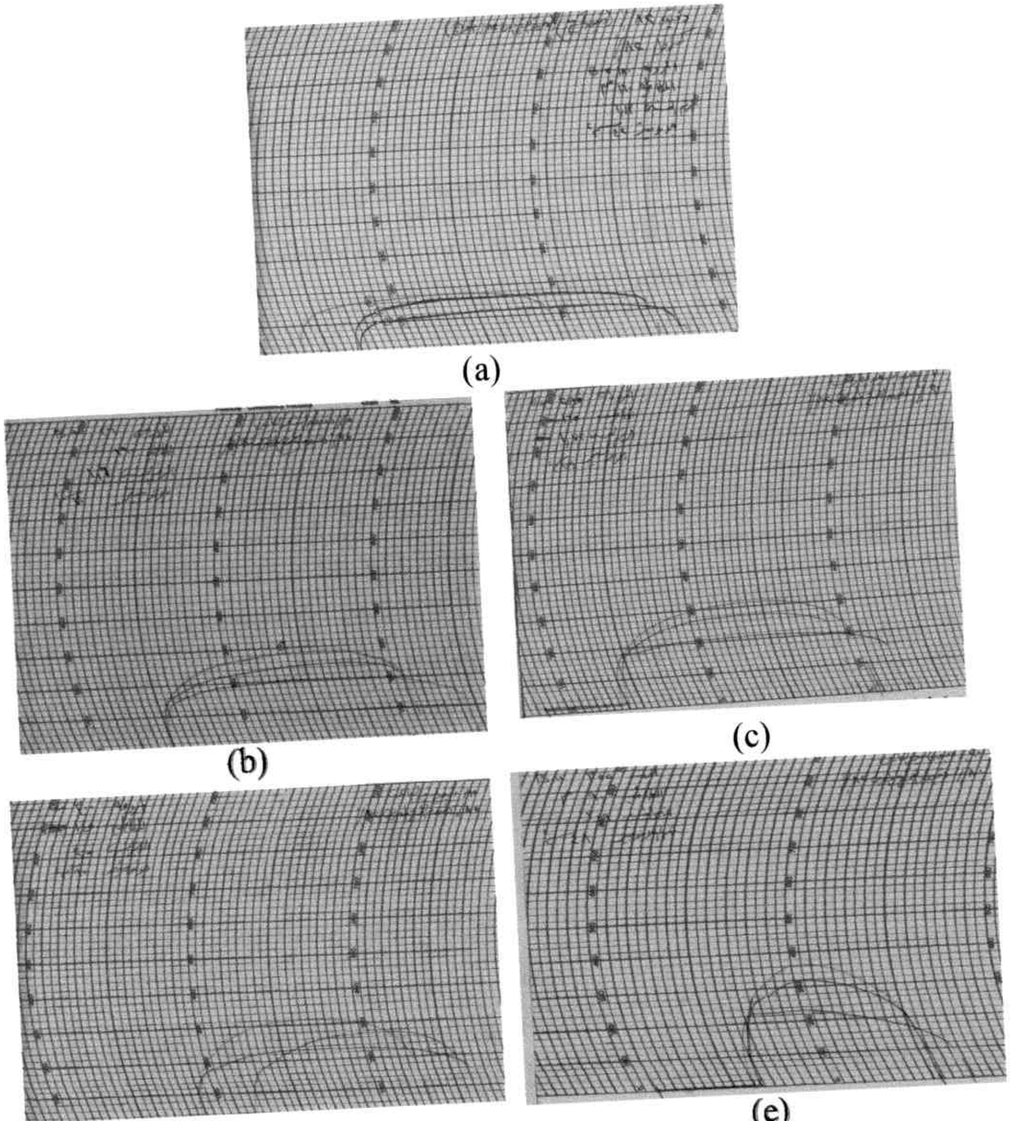
Table (6) and Figs. (4 a, b, c, d, e) show the extensograph parameters of wheat flour as affected by different levels of hull-less barley flour (5, 10, 15 and 20%). Results show that addition of 10% hull-less barley flour to wheat flour increased dough extensibility (E), while addition of 15 and 20% hull-less barley flour decreased dough extensibility (E) (145 and 90 mm). The decrease in dough extensibility may be due to the absence of gluten in hull-less barley flour which weakening dough structure **El-Farra *et al.* (1985)**.

On the other hand, the increase in resistance to extension is believed to be due to the deficiency of hull-less barley flour protein in gluten which recorded 260, 280, 300 and 355 (Bu) compared with control (180 Bu). However, proportional number had the higher values (1.6, 1.72, 2.0 and 3.9) than control (1.13). While dough energy increase to 70, 74, 67 and 48 compared with control (42) cm^2.

The results could be attributed to its low gluten content and characteristics since there are a balance between the extensibility and resistance to extension **(El-Sayed, 1998)**. These

Table (6): Effect of mixing wheat flour (82% extraction) with hull-less barley flour (70% extraction) on extensograph parameters.

Recipe mixtures		Dough extensibility (E) mm	Resistance to extension (R) Bu	Proportional number (R/E)	Dough energy cm^2
Wheat flour	Hull-less barley flour				
100%	-	160	180	1.13	42
95%	5%	160	260	1.6	70
90%	10%	165	280	1.72	74
85%	15%	145	300	2	67
80%	20%	90	355	3.9	48



(a)

(b)

(c)

(d)

(e)

Fig. (4): Extensograph of wheat flour (82% ext.) and hull-less barley flour (70% ext.) mixtures at different ratios.

(a) Wheat flour (82% ext.).
(b) 95% wheat flour (82% ext.) + 5% hull-less barley flour (70% ext.).
(c) 90% wheat flour (82% ext.) + 10% hull-less barley flour (70% ext.).
(d) 85% wheat flour (82% ext.) + 15% hull-less barley flour (70% ext.).
(e) 80% wheat flour (82% ext.) + 20% hull-less barley flour (70% ext.).

results are similar that obtained by **Anjum** *et al.* **(1991) and Basman** *et al.* **(2003).**

4.2.2.2. Effect of mixing wheat flour (82% extraction) with partially defatted soybean flour on its extensograph properties:

Table (7) and Figs. (5 a, b, c, d, e) show the extensograph parameter of wheat flour by partially defatted soybean flour at different levels 5, 10, 15 and 20%.

The results show that dough extensibility increased by the addition of ratio 5% while decreased at ratio 10%, 15% and 20% which recorded 165, 130, 130, 135 (mm) compared with control (160 mm). This may be due to the blends contain low gluten content as a result of the addition of partially defatted soybean flour. However mixing partially defatted soybean flour at different levels improved protein content.

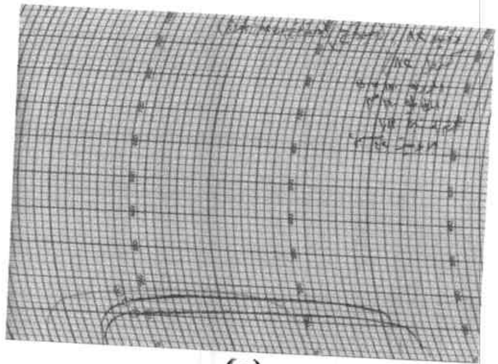
Resistance to extension and proportional number were improved by supplementing wheat flour with partially defatted soybean flour.

Resistance to extension increased and recorded 230, 260, 248 and 300 (Bu) compared with control (180 Bu). However, proportional number had higher values (1.39, 2.0, 1.9 and 2.2) than control (1.13). The dough energy of the mixture were increased by increasing the ratios of partially defatted soybean flour in the blend.

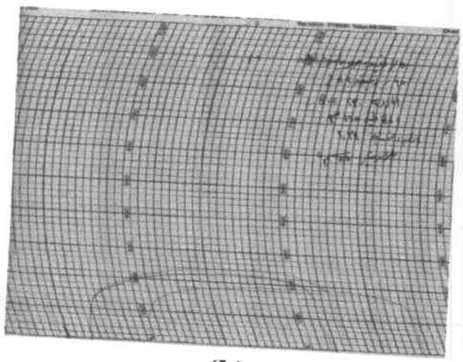
From the previous results, it could be concluded that supplementation of wheat flour with 20% partially defatted

Table (7): Effect of mixing wheat flour (82% extraction) with partially defatted soybean flour on extensograph parameters.

Recipe mixtures		Dough extensibility (E) mm	Resistance to extension (R) Bu	Proportional number (R/E)	Dough energy cm²
Wheat flour	Partially defatted soybean flour				
100%	-	160	180	1.13	42
95%	5%	165	230	1.39	55
90%	10%	130	260	2.00	52
85%	15%	130	248	1.90	49
80%	20%	135	300	2.20	63



(a)



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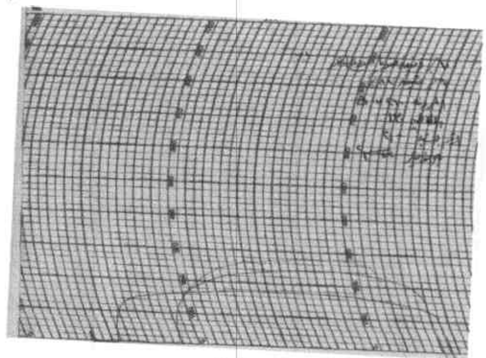

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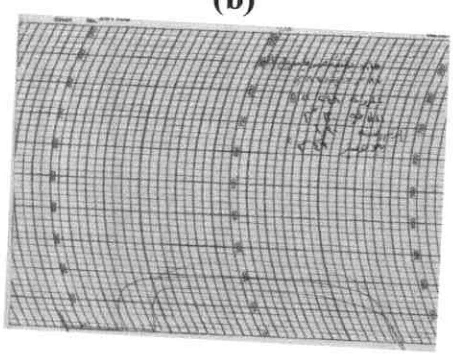
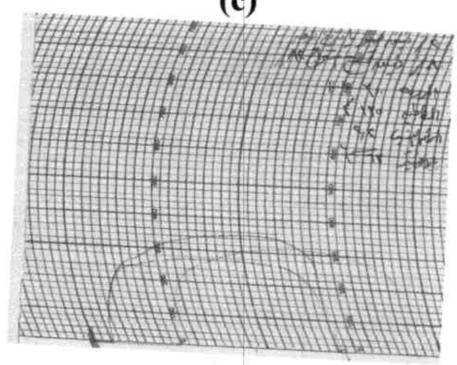


(d)



(e)

Fig. (5): Extensograph of wheat flour (82% ext.) and partially defatted soybean flour mixtures at different ratios.

(a) Wheat flour (82% ext.).
(b) 95% wheat flour (82% ext.) + 5% partially defatted soybean flour.
(c) 90% wheat flour (82% ext.) + 10% partially defatted soybean flour.
(d) 85% wheat flour (82% ext.) + 15% partially defatted soybean flour.
(e) 80% wheat flour (82% ext.) + 20% partially defatted soybean flour.

soybean flour gave good results when compared with dough produced from 100% wheat flour.

Partially defatted soybean is characterized by its high protein content (51.3%) consequently its addition to different flour mixtures improved the protein content **(Lornez and and Maga, 1972)**

These results are similar that obtained by **Hafez (1996), Abdel-Motaleb (2001) and Basman *et al.* (2003).**

4.2.2.3. Effect of mixing wheat flour (82% extraction) with hull-less barley flour (70% extraction) and partially defatted soybean flour on extensograph properties:

Table (8) and Figs. (6 a, b, c, d, e) show the extensograph parameters of wheat flour as affected by adding different levels of hull-less barley flour and partially defatted soybean flour.

The results show that dough extensibility was gradually decreased by adding hull-less barley flour and partially defatted soybean flours in the different ratios. This may be due to the reduction in gluten content by the addition of hull-less barley flour and partially defatted soybean flour.

Also, resistance to extension showed an increment (220, 260, 325 and 330 Bu) compared with control (180 Bu). However, proportional number had higher values (1.43, 2.47, 3.42 and 5.5) than control (1.13).

The dough energy of the mixture was increased at ratio of 5% hull-less barley flour + 5% partially defatted soybean flour

Table (8): Effect of mixing wheat flour (82% extraction) with hull-less barley flour (70% extraction) + partially defatted soybean flour on extensograph parameters.

Recipe mixtures			Dough extensibility (E) mm	Resistance to extension (R) Bu	Proportional number (R/E)	Dough energy cm^2
Wheat flour	Hull-less barley flour	Partially defatted soybean flour				
100%	-	-	160	180	1.13	42
90%	5%	5%	150	220	1.43	47
80%	10%	10%	105	260	2.47	38
70%	15%	15%	95	325	3.42	45
60%	20%	20%	60	330	5.50	31

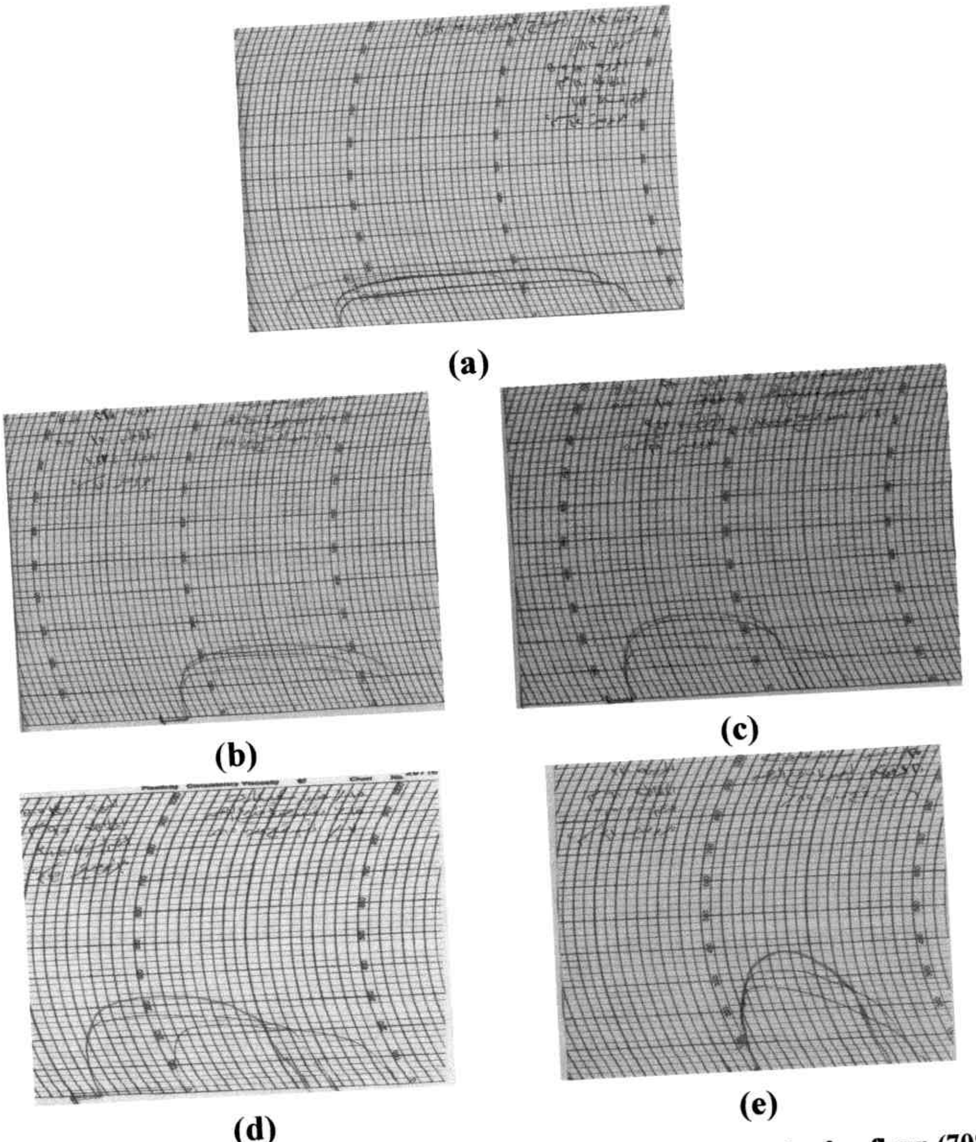


Fig. (6): Extensograph of wheat flour (82% ext.) and hull-less barley flour (70% ext.) + partially defatted soybean flour mixtures at different ratios.

(a) Wheat flour (82% ext.).
(b) 90% wheat flour (82% ext.) + 5% hull-less barley flour (70% ext.) + 5% partially defatted soybean flour.
(c) 80% wheat flour (82% ext.) + 10% hull-less barley flour (70% ext.) + 10% partially defatted soybean flour.
(d) 70% wheat flour (82% ext.) + 15% hull-less barley flour (70% ext.) + 15% partially defatted soybean flour.
(e) 60% 60% wheat flour (82% ext.) + 20% hull-less barley flour (70% ext.) + 20% partially defatted soybean flour.

and ratio 15% hull-less barley flour + 15% partially defatted soybean flour while, decreased at ratio of 10% hull-less barley flour + 10% partially defatted soybean flour and ratio of 20% hull-less barley flour + 20% partially defatted soybean flour because of its low content of gluten in the mixtures. Similar conclusions were obtained by **Hafez (1996), Abdel-Motaleb (2001) and Basman *et al.* (2003).**

4.3. Organoleptic evaluation:

4.3.1. Organoleptic evaluation of balady breads produced from wheat flour (82% extration) mixed with hull-less barley flour (70% extraction):

Table (9) and Figs. (7 a, b, c, d, e) show the organoleptic evaluation of balday breads made from replacing wheat flour by hull-less barley flour at different concentrations i.e. 5, 10, 15 and 20%.

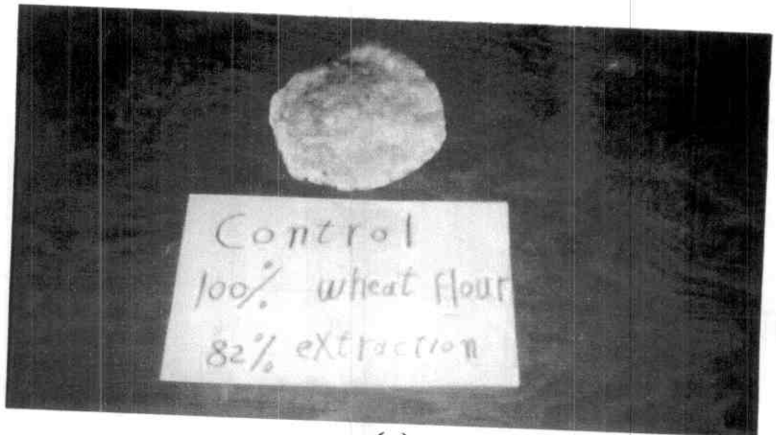
Loaf weight of balady bread 100% wheat flour was 133.58 g increased to 137.00 g in the recipe mixture containing 20% hull-less barley flour .

The sensory evaluation showed no difference in crust colour, aroma, taste, texture and overall acceptability at 5% hull-less barley flour addition compared with control and other blends. These results are similar to those obtained by **Anjum *et al.* (1991) and Basman *et al.* (2003).**

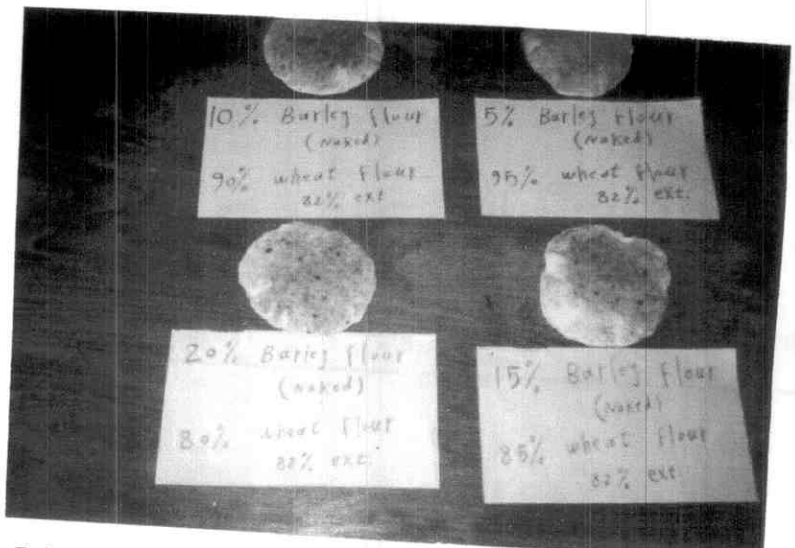
Loaf weight showed increament trend as a result of increasing hull-less barley flour replacement level which could be attributed to it's high fiber content.

Table (9): Baking properties of balady bread blends made by mixing wheat flour (82% extraction) with hull-less barley flour (70% extraction).

Recipe mixtures		Weight	Crust colour	Aroma	Taste	Texture	Total score
Wheat flour	Hull-less barley flour	G	10	10	10	10	40
100%	-	133.58	9	10	10	9	38
95%	5%	133.44	8	8	8	5	29
90%	10%	135.50	6	7	7	5	25
85%	15%	136.85	6	6	6	4	22
80%	20%	137.00	5	5	5	4	19



(a)



(c) (b)

(e) (d)

Fig. (7): Balady bread made from wheat flour (82% extraction) and hull-less barley flour (70% extraction) with different ratios.

- **(a) Wheat flour .**
- **(b) 95% wheat flour + 5% hull-less barley flour .**
- **(c) 90% wheat flour + 10% hull-less barley flour .**
- **(d) 85% wheat flour + 15% hull-less barley flour .**
- **(e) 80% wheat flour + 20% hull-less barley flour .**

Gradual reduction was noticed in all the parameters as the ratio of hull-less barley flour increased. These may attributed to their high values of dough development time, stability and energy. These results are in accordance with those obtained by **Soliman (1997) and El-Sayed (1998)**.

It has been in the produced balady bread with 20% hull-less barley flour showed hardeness, cohesiveness springiness and lower protein barley bread was more gummy than control.

4.3.2. Organoleptic evaluation of balady breads produced from wheat flour (82% extraction) mixed with partially defatted soybean flour:

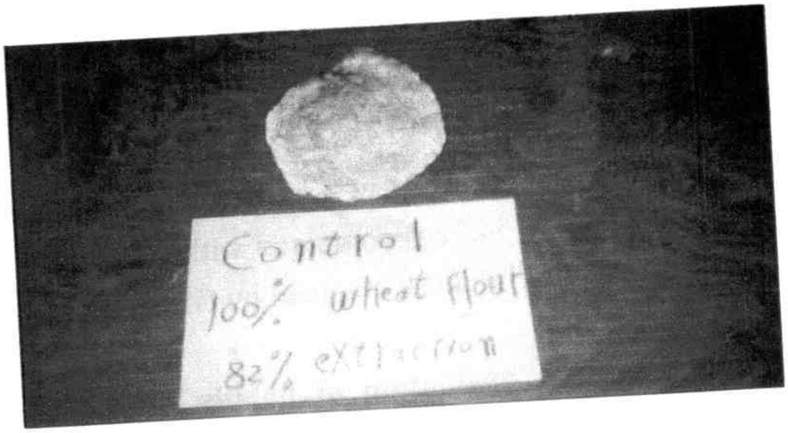
The data in Table (10) and Figs. (8 a, b, c, d, e) show the organoleptic evaluation balady breads supplemented with 5, 10, 15 and 20% partially defatted soybean flour.

Partially defatted soybean flour improved loaf weight for all the addition ratios (136.69, 141.50, 151.60 and 154.72 g) comparing with 100% wheat flour (133.58 g). At high levels supplementation i.e. more than 10% partially defatted soybean flour, the manufactured bread samples were found to have score lower grades. So the level of the added protein is often limited by residual flavour characteristics of raw partially defatted soybean flour.

Partially defatted soybean flour contains a low value of carbohydrate (32.37%), so its addition to wheat flour (5, 10, 15 and 20%) may decrease the carbohydrate content at different ratios. However, the higher reducing sugars may be due to the

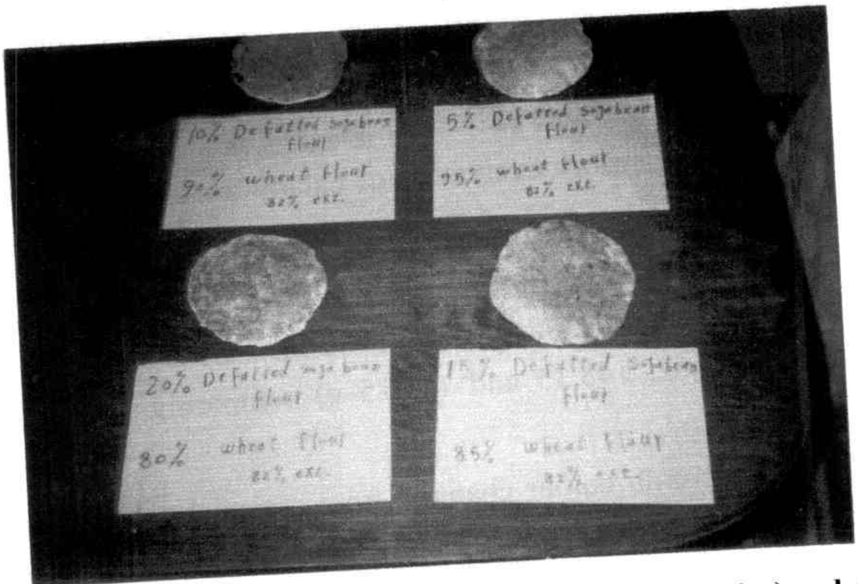
Table (10): Baking properties of balady bread blends made by mixing wheat flour (82% extraction) with partially defatted soybean flour:

Recipe mixtures		Weight	Crust colour	Aroma	Taste	Texture	Total score
Wheat flour	Partially defatted soybean flour	G	10	10	10	10	40
100%	-	133.58	9	10	10	9	38
95%	5%	136.69	7	4	8	6	25
90%	10%	141.50	7	3	6	4	20
85%	15%	151.60	5	2	4	3	14
80%	20%	154.72	3	1	2	2	8



(a)

(c) **(b)**



(e) **(d)**

Fig. (8): Balady bread made from wheat flour (82% extraction) and partially defatted soybean flour with different ratios.

(a) Wheat flour .
(b) 95% wheat flour + 5% partially defatted soybean flour.
(c) 90% wheat flour + 10% partially defatted soybean flour.
(d) 85% wheat flour + 15% partially defatted soybean flour.
(e) 80% wheat flour + 20% partially defatted soybean flour.

residual maltose which was formed by the action of alpha amylase on flour carbohydrate during fermentation period **(Hussein and Mahmoud, 1972)**.

Also, results indicate that loaf weight increased (136.69, 141.50, 151.60 and 154.72g) compared with control (133.58 g). These results are similar those obtained by **Ghaliy *et al.* (1999).**

4.3.3. Organoleptic evaluation of balady breads produced from wheat flour (82% extraction) mixed with hull-less barley flour (70% extraction) + partially defatted soybean flour:

Results in Table (11) and Figs. (9 a, b, c, d, e) presents the results of the sensory evaluation of balady bread produced from mixing wheat flour with different ratio 5%, 10%, 15% and 20% for both hull-less barley flour and partially defatted soybean flour.

The sensory evaluation showed increment in loaf weight 140.44, 143.62, 145.15 and 147.25 g) comparing with control (133.58 g).

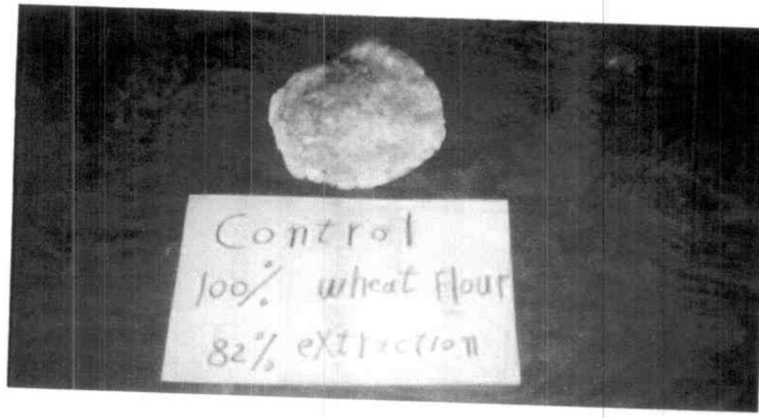
The crumb colour changed from creamish wheat flour to dull brown and gradual hardening or crumb texture was observed as the addition of hull-less barley flour and partially defatted soybean flour increased. At higher levels, the acceptability declined because of the compact texture of the crumb and the strong flavour of the product **(Shfali and Jood, 2004)**.

The overall quality of the produced balady bread has lower score than that of control [100% wheat flour].

These results are similar that obtained by **Basman *et al.* (2003).**

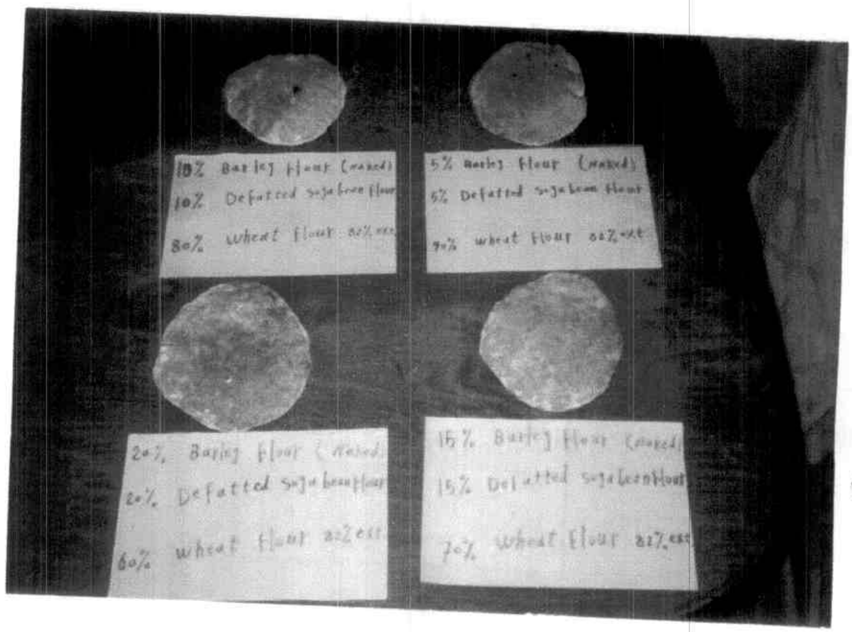
Table (11): **Baking properties of balady bread blends made by mixing wheat flour (82% extraction) with hull-less barley flour (70% extraction) + partially defatted soybean flour:**

Recipe mixtures			Weight	Crust colour	Aroma	Taste	Texture	Total score
Wheat flour	Hull-less barley flour	Partially defatted soybean flour	G	10	10	10	10	40
100%	-	-	133.58	9	10	10	9	38
90%	5%	5%	140.44	8	8	8	8	32
80%	10%	10%	143.62	8	7	8	7	30
70%	15%	15%	145.15	8	6	8	7	29
60%	20%	20%	147.25	7	5	7	5	24



(a)

(c) (b)



(e) (d)

Fig. (9): Balady bread made from wheat flour (82% extraction) and hull-less barley flour (70% extraction) + partially defatted soybean flour with different ratios.

(a) Wheat flour .
(b) 90% wheat flour + 5% Hull-less barley flour + 5% partially defatted soybean flour.
(c) 80% wheat flour + 10% Hull-less barley flour + 10% partially defatted soybean flour.
(d) 70% wheat flour + 15% Hull-less barley flour + 15% partially defatted soybean flour.
(e) 60% wheat flour + 20% Hull-less barley flour + 20% partially defatted soybean flour.

4.4. Biological evaluation:

Lipid fraction are metabolized and absorbed as lipoproteins. Liver play an important role in regulation of lipid metabolism. Increased of lipid fraction in serum is mainly related to partial impairment of liver cells. Since these reactions are controlled by the liver through the absorption of lipoproteins from the intestine, so, these evaluation may due to the increase absorption of lipoproteins from the intestine **(Ingram, 1993)**.

Induction of hyperlipaemia causes liver dysfunction which proved by increase in ALT and AST.

Cholesterol one of the main risk factor. In hypercholesterolemia, the cholesterol content of erythrocytes, platelets, polymorphonuclear leukocytes and endothelial cells increases.

4.4.1. Effect of hypercholesterolemic diet mixed with wheat flour (82% extraction), hull-less barley flour (70% extraction) and partially defatted soybean flour on body weight, food intake and feed conversion ratio in rats after the end of experimental period (8 week):

The effect of dietary hyperlipic diet (1% cholesterol and 10% hydrogenated fat) on body weight gain, food intake and feed conversion ratio are shown in Table (12). The results showed that body weight gain very highly significant decreased for animals receiving the high hyperlipaemic diet (50.48 g) compared with the control group (80.21 g). The same trend was noticed for the food efficiency, also, this decrease in body weight

Table (12): Effect of wheat flour (82% extraction) supplemented with hull-less barley flour (70% extraction) and partially defatted soybean flour diets at different levels on body weight gain, food intake and feed conversion in hypercholesterolemic rats after experimental period (8 weeks).

Groups	Initial weight (g)	Final weight (g)	Body weight gain (g) [A]	Food intake (g) [B]	Feed conversion ratio [A/B]
Basal diet	69.91±3.49	150.12±2.53	80.21±3.21	1001.00±10.26	0.080
High-Cholesterol diet	60.88±2.10	111.35±6.23	50.48±3.16	746.20±9.89	0.068
W.F. (100%)	60.64±1.87	121.78±1.76	61.14±2.34	1044.54±11.23	0.059
85% W.F. + 15% H.B.F.	60.58±0.97	128.25±1.71	67.67±1.94	1122.66±10.64	0.060
80% W.F. + 20% P.D.S.F.	60.75±4.91	237.25±2.06	176.50±2.06	1303.26±8.75	0.135
60% W.F. + 20% H.B.F. + 20% P.D.S.F.	62.56±4.23	217.00±1.83	154.44±4.03	1184.40±9.56	0.130
L.S.D. at 0.05	1.59	3.74	2.88	36.45	

SE: Standard error. W.F.: Wheat flour H.B.F.: Hull-less barley flour. P.D.S.F.: Partially defatted soybean flour.

gain due to the decrease of food intake. It is clear that decrease in food efficiency of the diet led to decrement in the body weight.

The average of the body weight gain of rats maintained the different experimental diets for eight weeks were 61.14, 67.67, 176.50 and 154.44, respectively.

The results clearly indicated that wheat flour, hull-less barley flour and partially defatted soybean flour caused a significant increase in the body weight.

The effect of substitution of wheat flour by partially defatted soybean flour or hull-less barley flour plus partially defatted soybean flour had a higher body weight gain 176.50 and 154.44 than that of rats fed the high cholesterol diet (50.48 g) and more than the basal diet (80.21 g). While 15% hull-less barley flour in diet and 100% wheat flour diet increase the body weight gain (67.67 and 61.14 g) more than the high cholesterol diet, but it did not reach the control group.

It is clear that increase in food efficiency of diet led to an increment in the body weight.

Such evaluation of body weight may be due to the increase of the efficiency of food utilization, "especially the protein utilization" as reported by **Martinez *et al.* (1992)** who found that all chicks fed wheat grow faster and had greater food efficiency than those fed barley.

4.4.2. Effect of different experimental diets on serum triglycerides, total cholesterol, LDL- cholesterol, HDL-cholesterol and risk ratio in hypercholesterolemic rats after the end of experimental period (8 weeks):

The changes in blood lipids after feeding rats with hyperlypaemic diet (high cholesterol diet) is shown in Table (13).

These results showed that high cholesterol diet had a very highly significant increase on serum triglycerides levels compared with the basal diet.

The same effect was noticed on total cholesterol and LDL-cholesterol, whereas the serum HDL-cholesterol showed a significant decrease.

The results showed that wheat flour, hull-less barley flour and partially defatted soybean flour have a hypolypaemic effect. Since the level of serum triglycerides decreased as a result of administration of the previous flours.

Data clearly indicated that the level of serum triglyceride in rats by 100% wheat flour diet or by substitution of wheat flour by 15% hull-less barley flour, 20% partially defatted soybean flour and 20% of both in the diet exhibited significant depression of triglycerides than the high cholesterol diet. It was 85.75, 128.75, 118.50 and 121.25 mg/100 ml, respectively, compared with the high cholesterol diet 294.11 mg/100 ml. Moreover, all diets exhibited significant depression compared with control group, 143.83 mg/100 ml.

Table (13): Effect of different experimental diets on serum triglycerides, total cholesterol, LDL- cholesterol, HDL-cholesterol and risk ratio in hypercholesterolemic rats after experimental period (8 weeks).

Groups	Triglycerides mg/100 ml	Total cholesterol mg/100 ml	LDL-cholesterol mg/100 ml	HDL-cholesterol mg/100 ml	Risk ratio TC/HDL
Basal diet	143.83±1.33	120.09±3.28	57.96±3.09	33.36±1.25	3.60
Relatively	100.00	100.00	100.00	100.00	
High-Cholesterol diet	294.11±1.82	250.04±1.41	160.43±0.92	30.57±0.27	8.18
Relatively	204.48	208.21	276.79	91.63	
W.F. (100%)	85.75±1.80	172.25±2.06	103.35±1.62	52.00±0.71	3.31
Relatively	59.61	143.43	178.31	155.87	
85% W.F. + 15% H.B.F.	128.75±0.25	158.50±1.85	86.25±2.09	47.50±1.29	3.34
Relatively	75.61	131.98	148.80	142.38	
80% W.F. + 20% P.D.S.F.	118.50±2.72	174.75±1.65	84.55±2.25	66.50±2.87	2.63
Relatively	82.38	145.51	145.87	199.34	
60% W.F. + 20% H.B.F. + 20% P.D.S.F.	121.25±0.48	176.00±0.41	97.00±0.80	54.75±0.48	3.21
Relatively	84.30	146.55	167.35	164.11	
L.S.D. at 0.05	1.59	1.92	1.91	1.3	

SE: Standard error. W.F.: Wheat flour H.B.F.: Hull-less barley flour. P.D.S.F.: Partially defatted soybean flour.

The results showed that the wheat flour was significantly more effective in the reduction of serum triglyceride concentration.

Data in Table (13) show the effect of wheat flour, hull-less barley flour, partially defatted soybean flour on the total cholesterol level in rats fed high cholesterol diet. The results showed that these flours had the ability to reduce serum total cholesterol in hypercholesterolemic rats. Diet containing 85% wheat flour plus 15% hull-less barley flour was significantly more effective in the reduction of serum total cholesterol.

These results are in agreement with **Mclntoch *et al.* (1991)** who reported that barley dietary is more effective than wheat dietary fiber at lowering blood cholesterol in hypercholesterolemic men because barley contains β-glucan as a source of soluble dietary fiber whereas wheat contains largely insoluble cellulose and hemicellulose fiber.

The results showed that there were a little differences between cholesterol level of rats fed with 100% wheat flour, 80% wheat flour plus 20% partially defatted soybean flour and 60% wheat flour plus 20% of both hull-less barley flour and partially defatted soybean flour where the levels of serum cholesterol were 172.25, 174.75 and 176.00 mg/100 ml, respectively.

In all diets the level of serum cholesterol was still higher than that of control rats.

The decrease in serum cholesterol and LDL-cholesterol level by the prvious flours may be due to the capacity of wheat, barley and soybean flour to suppress hepatic enzyme (3 hydroxy

3-methyl glutaryl Co-enzyme A) reductase activity as reported by **Chaudhary and Kandweber (1990)**.

Hyperchoesterolemic effects of barley appear may be due to its content of soluble β-glucans, tochotrienols. Possible mechanism for cholesterol-lowering by barley are increased fecal fat and acid exceretion, and inhibition of HMG-CoA reductase and bile acid synthesis **(Kahlon, 2003)**.

Barley fibers contribute significantly to reduce total plasma cholesterol in a variety of animal species and in hypercholesterolemic human subjects **(Kahlon and Chow, 1997)**.

At the same line **Jsuji and Nakagwa (1984)** showed that rats fed high cholesterol diet supplemented with 4% cellulose led to decrease in plasma cholesterol.

Newman *et al.* (1989) reported that β-glucan rich fraction of barley has the ability to lower serum cholesterol. Also, **Beter and Fulcher (2005)** reported that barley have a bioactive compounds that have demonstrated biological activities, such as reducing total and LDL-cholesterol.

The effect of soybean on serum cholesterol may be related to the amino acid structure as shown by **Beynen *et al.* (1985)** who studied the hypercholesterolemic effect of dietary casein and dietary soybean and reported that soybean protein isolate produced a shift in serum blood cholesterol from low-density lipoproteins.

Also, **Aljawad *et al.* (1991)** observed that cholesterol was greater for rats given casein or wheat than there given soybean.

Also, they added that (VLDL-C) was lower for rats given soybean protein than for those given casein.

It has been reported by **Abdel-Motaleb (2001)** that partially defatted soybean and soybean isolate gave a lowest value of total cholesterol, total lipids, triglycerides than that of control.

It was found that the rats fed on diets containing 15% hull-less barley flour and 20% partially defatted soybean flour had the lowest significant decrease in LDL-cholesterol 86.25, 84.55 mg/100 ml when compared with the hypercholesterolemic diet (160.43 mg/100 ml) while in rats fed with 100% wheat flour or with the mixture of wheat flour, hull-less barley flour and partially defatted soybean flour induced a higher level of LDL-cholesterol, 103.35 and 97.00 mg/100 ml.

On the other hand, the obtained results clearly showed that all diets caused a highly significant elevation in serum HDL-cholesterol.

Feeding with a mixture of 80% wheat flour and 20% partially defatted soybean flour had more twice fold on the level of HDL-cholesterol (66.50 mg/100 ml) compared with the high cholesterol diet (30.57 mg/100 ml). While feeding with 100% wheat flour and mixture of wheat flour, hull-less barley flour and partially defatted soybean flour had nearly similar effect. Since the level of HDL-cholesterol were 52.00 and 54.75 mg/100 ml, while the 85% wheat flour plus 15% hull-less barley flour diet led to a less elevation than the previous diets 47.50 mg/100 ml.

Risk ratio is the ratio between LDL- : HDL-cholesterol. The risk ratio is predictive relationship highly correlate to coronary heart disease. Table (13) represented the effect of high-cholesterol diet, wheat four, hull-less barley flour and partially defatted soybean flour on the LDL- : HDL-cholesterol ratio.

The results show that treatment with high cholesterol diet significantly increased the LDL- : HDL- ratio since the risk ratio found to be 8.18 compared with the control diet, 3.60.

The data also, show that all experimental diets except 80% wheat flour plus 20% partially defatted soybean flour have nearly the same effect on the risk ratio. Since the risk ratio was found to be 3.31, 3.34 and 3.21 by fed with 100% wheat flour, 80% wheat flour plus 15% hull-less barley flour and 60% wheat flour plus 20% of both hull-less barley flour and partially defatted soybean flour, respectively. While 80% wheat flour plus 20% hull-less barley flour diet exhibited a lower risk ratio, 2.63.

All the abovementioned result of the effect of wheat flour, hull-less barley flour and partially defatted soybean flour on the serum lipid profile concluded that high cholesterol diet exhibited a disturbance in lipid metabolism including hypertriglycridemia, hypercholesterolemic and alteration in serum cholesterol lipoproteins (HDL- and LDL-cholesterol). These results is in agreement with. The results obtained by **Beynen *et al.* (1985), Aljawad *et al.* (1991) and Abdel-Motaleb (2001).**

The abovementioned results demonstrated that what flour, hull-less barley flour and partially defatted soybean flour improve serum lipid profile of rats fed high cholesterol diet. The effect of these flours could be attributed to the ability of fibers to increased excretion of bile acids and bile salts **(Kritchevsky, 1978)**.

The decrease in serum total lipids may be due to one or more of the following factors.

Inhibition of cholesterol absorption and/or synthesis. Inhibition of bile acid reabsorption and the increase of cholesterol catabolism **(Kritchevsky, 1971)**. In the same line **Kritchevsky *et al.* (1974)** found that facel excretion of cholesterol was found to be high in animals which was fed high fiber diets containing cholesterol. These authors suggested also that the mechanism of fiber action involved the inhibition of cholesterol absorption and bile acid conjugates.

4.4.3. Effect of different experimental diets on liver functions in hypercholesterolemic rats:

Serum enzymatic transamination activity is an indicator of liver status. During diseases it has been shown that its activity widely changes, then the changes in activity of enzymes can be used in the diagnosis of liver function **(Miller, 1960)**.

Plasma enzyme activity represents steady state in which the rate of release from cells into plasma and the rate of removal from plasma by catabolism are equal.

Hyperlipemia normally affects on the activity of enzymes related to protein metabolism. Hence the measurement of serum ALT and AST activities has provided a useful tool for hepatic recovery after administration of high cholesterol wheat, barley and soybean flours.

Effect of high cholesterol diet on serum ALT and AST activity is shown in Table (14). The cholesterol diet had a very

Table (14): Effect of wheat flour (82% extraction0 supplemented with hull-less barley flour (70% extraction) and partially defatted soybean flour diets at different levels on serum aminotransferase enzymes (ALT and AST) in hypercholesterolemic rats after experimental period (8 weeks).

Groups	Transaminase enzyme activities	
	ALT (U/L)	AST (U/L)
Basal diet	32.75±2.63	37.50±1.66
High-Cholesterol diet	74.00±4.88	43.25±3.07
W.F. (100%)	26.00±1.78	35.00±0.71
85% W.F. + 15% H.B.F.	31.25±0.48	29.25±0.48
80% W.F. + 20% P.D.S.F.	30.75±0.48	30.50±0.65
60% W.F. + 20% H.B.F. + 20% P.D.S.F.	31.00±0.41	30.25±0.48
L.S.D. at 0.05	2.29	1.46

SE: Standard error. W.F.: Wheat flour H.B.F.: Hull-less barley flour. P.D.S.F.: Partially defatted soybean flour.

highly significant increase on serum ALT level (74.00 U/L) compared with the basal diet rats 32.75 U/L. The increase attained about 2.2 fold that on normal rats.

Also, high cholesterol diet increase the serum AST activity 43.25 U/L compared with the basal diet 37.50 U/L.

The elevation of serum ALT and AST activity in a blood biological marker of liver cell damage. Which liver damage causes the increase of released amount of many enzymes into the blood stream.

It has been concluded that feeding on high cholesterol diet might effect the function of liver or heart as the activities of these enzymes might originate from either liver or heart **(Hawcraft, 1987)**.

Data obtained showed that wheat flour, hull-less barley flour (70 ext.) and partially defatted soybean flour decreased the serum ALT activity in serum of rats fed high cholesterol diet. Also, data showed that 100% wheat flour diet was found to be more effective, while the effect of diets containing hull-less barley flour, partially defatted soybean flour or both together with wheat flour on serum ALT activity was found to be significantly similar (31.25, 30.75 and 31.00 U/L, respectively).

On the other hand, the results showed that the reductive effect on serum AST was higher when the mixture of wheat flour and hull-less barley flour or partially defatted soybean flour was received compared to that happened when wheat flour received alone. Since the serum AST activity in rats received with the mixture of 85% wheat flour plus 15% hull-less barley flour, 80% wheat flour plus 20% partially defatted soybean flour and 60%

wheat flour plus 20% of hull-less barley flour and partially defatted soybean flour was 29.25, 30.50 and 30.25 U/L, respectively, compared with 100% wheat flour diet 35.00 U/L.

The decrease in the serum ALT and AST activity of rats fed by wheat flour, hull-less barley flour and partially defatted soybean flour raised the possibility that they might be normally excreted in the urine which indicated that there is no any disease in the animal feeding the experimental diets.

The results are in agreement with **Akiba and Matsumote (1980)**, who reported that activities of ALT and AST were reduced by feeding on the cellulose.

It is worthily to note that feeding rats on diets containing wheat, barley and soybean flours eliminate ALT activity largely to the extent of that for normal rats fed only the basal diet.

We can concluded that the observed reduction on ALT and AST activities after feeding wheat, barley and soybean flours reflects the improvement of liver function and heart function by these natural products.

4.4.4. Effect of replacing wheat flour (82% extraction) with hull-less barley flour (70% extraction) and partially defatted soybean flour at different levels on kidneys functions in hypercholesterolemic rats after 8 weeks:

Data in Table (15) indicated the effect of the previous diets on the level of serum creatinine in rats. The obtained results showed that the serum creatinine content significantly increased after administration of high level cholesterol diet. The level of creatinine was found to be more than five fold (2.55 mg/100 ml) than the control group (0.48 mg/100 ml).

The results indicated that wheat flour and the mixture of wheat flour and hull-less barley flour exhibited a higher serum creatinine 0.64 and 0.80 than the exhibited by the mixture of wheat flour and partially defatted soybean flour or the mixture of wheat flour, hull-less barley flour and partially defatted soybean flours (1.65 and 1.23).

The observed high level of serum creatinine indicated that the high cholesterol diet caused a remarkable kidney damage.

Data showed that wheat flour was more effective than hull-less barley flour and also showed that hull-less barley flour more effective than partially defatted soybean flour.

Data in Table (15) show the effect of wheat flour, hull-less barley flour and partially defatted soybean flour on the blood urea level in rats. In comparison to the control group, the addition of cholesterol in diet of rats induced a high significant increase in serum urea level (99.00 mg/100 ml) compared with the control diet (26.81), urea level was elevated in patients with kidney failture, **Champe and Harvey (1994)**. Also, **USEPA (2005)** indicated that the elevation of blood urea level may due to increased of protein catabolism and decreased urinary excretion of urea.

Feeding on 100% wheat flour diet, or diet containing each of hull-less barley flour and partially defatted soybean flour or mixture of both diminished the effect of high cholesterol diet on serum urea level. The results showed that administration of these flours resulted in a highly significant decrease in serum urea

Table (15): Effect of experimental diets at different levels on creatinine and urea in hypercholesterolemic rats after experimental period (8 weeks).

Groups	Creatinine (mg/100 ml)	Urea (mg/100 ml)
Basal diet	0.48±0.01	26.81±0.34
High-cholesterol diet	2.55±0.19	99.00±1.87
W.F. (100%)	0.64±0.07	29.80±1.10
85% W.F. + 15% H.B.F.	0.80±0.05	41.90±1.39
80% W.F. + 20% P.D.S.F.	1.65±0.04	70.43±0.44
60% W.F. + 20% H.B.F. + 20% P.D.S.F.	1.23±0.02	64.25±0.85
L.S.D. at 0.05	0.09	1.10

SE: Standard error. W.F.: Wheat flour H.B.F.: Hull-less barley flour. P.D.S.F.: Partially defatted soybean flour.

level. Although these diets reduce the hyperurea effect of high cholesterol diet, the levels of serum urea are still higher than that in control group.

Data indicated that the ability of these diets to reduce serum urea level in high cholesterol diet seems to be in the following order. Wheat flour is more effective than hull-less barley flour which is greater than partially defatted soybean flour.

4.4.5. Effect of replacing wheat flour (82% extraction) with hull-less barley four (70% extraction) and partially defatted soybean flour at different levels on hemoglobin in hypercholesterolemic rats after 8 weeks:

As shown in Table (16), the blood hemoglobin level was reduced after administration of 100% wheat flour, 85% wheat flour plus 15% hull-less barley flour, 80% wheat flour plus 20% partially defatted soybean flour and 60% wheat flour plus 20% hull-less barley flour and 20% partially defatted soybean flour.

The level of blood hemoglobin decreased from 13.87 at high cholesterol diet to 7.30, 9.55, 7.83 and 8.35 mg/100 ml, respectively. On the other hand, there is no change in blood hemoglobin content in high cholesterol diet compared with the basal diet.

The data showed that the effect of 60% wheat flour plus 20% of hull-less both barley flour and partially defatted soybean flour was higher than that of 85% wheat flour plus 15% hull-less barley flour diets. However the 100% wheat flour and 80%

wheat flour plus 20% partially defatted soybean flour has higher effect on hemoglobin level that that of the previous diets.

The decrease in the blood hemoglobin illustrated that the previous diets inhibit the body's ability to synthesis hemoglobin or elevate the rate of hemoglobin degradation.

The decrease of hemoglobin of rats maintained the previous experimental diets could be attributed to the ability of phytic acid to chelate the iron which reduce heme biosynthesis and hence the decrement in the blood hemoglobin may be ocurred **(Oatway *et al.*, 2001 and Bohn *et al.*, 2004)**.

In addition the decrease in the blood hemoglobin may be due to the presence of proteases enzymes in wheat flour, barley and soybean flour which stimulate the breakdown process of hemoglobin **(Pomeranz *et al.*, 1987)**.

Table (16): Effect of experimental diets at different levels on hemoglobin in hypercholesterolemic rats after experimental period (8 weeks).

Groups	Hemoglobin (mg/100 ml)
Basal diet	13.77±0.11
High-Cholesterol diet	13.87±0.03
W.F. (100%)	7.30±0.12
85% W.F. + 15% H.B.F.	9.55±0.09
80% W.F. + 20% P.D.S.F.	7.83±0.23
60% W.F. + 20% H.B.F. + 20% P.D.S.F.	8.35±0.06
L.S.D. at 0.05	0.12

SE: Standard error. W.F.: Wheat flour H.B.F.: Hull-less barley flour. P.D.S.F.: Partially defatted soybean flour.