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EFFECT OF ADDITION OF WHOLE CEREALS FLOUR ON RHEOLOGICAL AND CHEMICAL PROPERTIES OF PAN BREAD

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ABSTRACT

The present study was designed to estimate the effects of addition of whole cereals flour on rheological and chemical properties of pan bread processed from whole cereals flour. Whole corn and barley malt flour were added in rates of (10%, 20% and 30% replacement), and defatted soybean and skim milk were added by substitution of 5%, in compare with whole wheat pan bread (100% whole wheat flour) to determine the effect of each on chemical composition and rheological properties of pan bread. Results of farinograph and extinsograph showed the addition of whole corn flour (10, 20, 30%) led to decreased in the rate of water absorption and extensibility up to (67%) and (80 - 35mm) respectively, on the other hand it showed increase in the arrival time, dough stability, dough development time and the proportional number up to (6.0 min),(20 BU), (8.0 min) and (12.9) respectively whereas addition of barley malt flour with (10, 20, 30%) increased the rate of water absorption, mixing tolerance index up to (71.2%) and (80.0 BU), and decreasing for the proportional number up to (6.9 BU). While addition of (5%) skim milk powder or defatted soybean to whole corn flour as a partial substitute for whole wheat flour decreased the rate of water absorption, mixing tolerance index up to (63.0%) and (10.0 BU), and increasing in arrival time, dough development time, dough stability, resistance to extension and the proportional number up to (6.5min), (8.0min), (20.0min), (580 BU) and (12.9), while addition of skim milk powder or defatted soybean (5%) to barley samples has increased the water absorption, mixing tolerance, up to (71.0%) and (20 BU), and decreased arrival time, extensibility and resistance to extension up to (4.5min), (55mm) and (500 BU). Chemical composition showed that protein, fat, total dietary fiber ash and minerals have been increased in all processed formulas, and decreased in carbohydrate content.

Generally, it could be recommended that addition of whole cereals flour, defatted-soybean and skimmed milk enhances rheological, sensory and chemical composition of processed pan bread.

Keywords: Whole meal, whole cereals, rheological parameters, barley malt.

INTRODUCTION

Whole cereals became part of the human diet about 10,000 years ago. Cereals are an important source of energy and protein in human diet. Wheat is the second most produced food among the cereal crops after rice (Spiller *et al*. 2002 and USDA, 2003).

Cereals main dietary contribution is carbohydrates beside these they also provide protein and a smaller amount of lipids, fiber and vitamins. It is commonly known that the main nutritional drawback of cereal is their low protein contents and limited biological quality of their protein (highly deficient in lysine and tryptophan) when compared with animal protein (Waliszewski *et al*., 2000), Wheat is one of the most common cereals used for bread making. However, bread prepared from wheat flour dough is considered to be nutritionally poor (Sabanis and Tzia, 2009). Partial replacement of wheat flour with non-wheat flours improves the nutritional quality of bakery products and satisfies consumers' demands for healthy food and variety in food products (Alvarez-Jubete *et al*., 2010). Wheat can be used for preparation of many products; bread is one of the least expensive most important staples in the world. Because of their high popularity and large consuming, bakery products (including bread) could ab a vehicle to improve the quality and nutritive value (Abreu et al., 1994).

Hegazy (2002) and Seleem (2000) had used corn flour as wheat flour substitute before to produce bakery products and they found that the rheological properties of dough was affected by addition of corn flour.

On the other hand addition of malt to bread produces low mol. Wt. dextrin from starch by hydrolysis. Its effect on starch reteogradation is considered anti-staling agents for retardation of bread staling (Duran et al., 2001). In bread only one type of enzyme is add either after milling the flour or adds at bakery to help in fermentation. This is called alpha-amylase. Also α –amylase is used for bread making because sound wheat flour contains less α –amylase than *β*-amylase (Mathewson, 1998). Barley malt can be used as enzymes supplements because malt is rich in α –amylase and *β*-amylase (Mc. Gregor and Morgan, 1986).

Defatted soybeans have high protein contents; these have great potential in overcoming protein-calorie malnutrition. Supplementation of soybean, in a suitable form, to cereal foods would not only increase their protein content but also improve the availability of lysine (Rastogi and Singh, 1989; Rao and Rao, 1997; Riaz, 1999; Sharma et al., 1999a). Also, the use of cereal grains in combination with skim milk has been shown to improve overall protein quality (El Tinay, El Mahadi and El Soubki, 1985; Graham *et al*., 1986).

The aim of study is to compare the effects of addition whole grains cereal mixtures on rheological and chemical composition of pan bread.

MATERIALS AND METHODS

Materials:

Grains:

Whole wheat (*triticum spp*.) gemmeiza (10), Whole corn (Zea mays) Giza (10) Barley (*Hordeum desticum*) Giza (127) were obtained from Field Crops Institute, Agricultural Research Center, Giza, Egypt.

Other ingredients:

Defatted soybean flour was obtained from Food Technology Research Institute, Agricultural Research Center, Giza, Egypt.

Skim milk powder was obtained from Misr Company for Dairy and Food El-Mansoura City, Egypt.

Methods:

Wheat and corn grains were milled using a laboratory mill (MLW, Type: sk1, WaTT:/100, West Germany), while malting of barley was carried out according to the method described by (Arif *et al.,* 2011). The rheological measurements were carried out for each of above mentioned flour portions under investigation using farinograph and extensograph tests at rheological Lab., department of Bread and Dough Food Technology Research Institute, Giza, Egypt. As described by AACC, (2000). Moisture, ash, fat, crude fiber and protein were determined according to AACC, (2000). Carbohydrate was calculated by difference. Total phenolic compounds (TPC) extracts were determined according to the method described by Lim *et al*, (2007).Total dietary fiber was determined according to the method described by Prosky *et al*. (1984), while soluble, and insoluble dietary fiber contents were estimated according to ASP *et al*.,(1983). Minerals namely (Ca, Fe, Mg, P, Zn and Se) were determined as described by AOAC, (2000).

The caloric values were estimated according to the method described by (Dougherty *et al.,* 1988) as follows:

E= 4(protein% + digestible carbohydrates %) +9 (fat %)

Where E = energy as calories per 100 g of product.

Flour mixtures;

The mixtures were prepared according to the ratio outlined in Table (1).

Table (1): the mixtures used for the production of pan bread.

No	WWF	WCF	BMF	DFSB	SMP
1	100 %	-	-	-	-
2	90 %	10 %	-	-	-
3	90 %	-	10 %	-	-
4	80 %	20 %	-	-	-
5	80 %	-	20 %	-	-
6	70 %	30 %	-	-	-
7	70 %	-	30 %	-	-
8	65 %	30 %	-	5 %	-
9	65 %	30 %	-	-	5 %
10	65 %	-	30 %	5 %	-
11	65 %	-	30 %	-	5 %

WWF= whole wheat flour, WCF= whole corn flour, BMF= barley malt flour, SMP= skimmed milk powder, DFSB= defatted soybean

Baking procedures:

Pan bread baking carried out as described by Lazaridou *et al*., (2007) as follows: Firstly, dry yeast dissolved in (75–80) ml of warm water (35°C), then mixed and kneaded with flour (100g), salt (1.5%) and sugar (1%) for about 6 min to form the dough. The dough was left to ferment at 30°C/30 min and 80-85% relative humidity. The dough was then divided into (150g/unit) and booted in metal pans that had been left to ferment for about 45 min at the same temperature and relative humidity. Bread dough were baked at 240°C for 20–25 min in an electric oven (Mondial Formi, 4T 40/60, Italy), the resulted pan bread was allowed to cool at room temperature for 2 h before being packed in polyethylene bags and stored at room temperature for further analysis.

Statistical analysis:

Data analysis was performed using SPSS Inc v.17.00, software. All data were expressed as mean ± standard deviation. Analysis of variance (ANOVA) was used to test differences between the groups. Least Significant Differences (LSD) test was used to determine significant differences ranking among the mean values at $P< 0.05$.

RESULTS AND DISCUSSION

Chemical composition of raw materials:

Data tabulated in Table (2) indicated that the moisture content of different materials was ranged from 4.32 to 12.90 %. The whole wheat flour showed the highest content of moisture (12.90%), while the skim milk powder shows the lowest content moisture (4.32%). These data were in agreement with those found by (Abd El-Megeed, 1995). Crude protein contents of whole wheat flour and different substitutes were 11.80% in whole wheat flour, 45.6% in defatted soybean, 10.15% in barley malt flour, 8.63% in whole corn flour and 36.51% in skim milk powder. These results are in accordance to result of Domah *et al*. (1992); (Ahmed *et al*, 2010) and (U.S.D.A, 2012).

Crude fat content was higher in whole corn flour (4.59%); in compare with the other ingredients. These data agree with those found by (Abd El-Hak *et al*, 2008) and (U.S.D.A, 2012). Results of crude fiber could be arranged asendingly as follows corn flour, whole wheat flour, defatted soy bean and barley malt flour were 2.94%, 3.30%, 3.93% and 6.50% respectively. Skim milk powder showed the highest content of ash (7.66%) compared with the other ingredients. The second largest ash content was in defatted soy bean (5.95%) while whole corn, barley malt flour and whole wheat flour are 1.51%, 1.62% and 1.75% respectively. These results agree with those reported by (Lasztity, 1996) and (U.S.D.A, 2012). At the same table we noted that the whole wheat flour and whole corn flour, have recorded the highest content of carbohydrate 80.60% and 79.09% respectively, followed by barley malt flour and defatted soy bean 77.07% and 71.20% respectively, and then come up in last skim milk powder 53.64%. All above results are found to be closely near that obtained by (Ahmed *et al*, 2010).

Table (2): Chemical composition of raw materials (calculated as mg/100g dry sample).

Samples	Moisture %	Crude protein %	Crude fiber %	Fat %	Ash %	T.C* %
WWF	12.90^{d} ± 0.12	11.80^{c} ± 0.21	3.30^{b} ± 0.11	2.60^{c} ± 0.10	1.75^{a} ± 0.10	80.70^{e} ± 0.36
BMF	8.51^{b} ± 0.40	10.15^{b} ± 0.35	6.50^{c} ± 0.41	2.31^{c} ± 0.22	1.62^{a} ± 0.18	77.07^{c} ± 0.90
WCF	10.51^{c} ± 0.43	8.63^{a} ± 0.22	2.94^{b} ± 0.30	4.59^{d} ± 0.50	1.51^{a} ± 0.11	79.07^{d} ± 0.62
DFSB	8.35^{b} ± 0.33	45.06^{e} ± 0.16	3.93^{c} ± 0.22	1.25^{b} ± 0.23	5.95^{b} ± 0.20	71.20^{b} ± 0.12
SMP	4.32^{a} ± 0.11	36.30^{d} ± 0.21	0.00	0.68^{a} ± 0.14	7.66^{c} ± 0.15	53.64^{a} ± 0.32

WWF= whole wheat flour, WCF= whole corn flour, BMF= barley malt flour, SMP= skimmed milk powder, DFSB= defatted soybean
T.C*= Total carbohydrates calculated by difference
(a,b,c,d,..) Mean values in each column, having different superscript are significantly different at <0.05.
(±) Each value (an average of three replicates) is followed by the standard deviation.

Minerals content of raw materials:

Data in Table (3) represent the minerals content of the raw materials. From the data, it could be observed that whole wheat flour was superior in magnesium and selenium these results were in agreement with those reported by Rizwan (2006), who found that the content of magnesium and selenium were (15.90 and 0.618 PPM) respectively, while defatted soybean was superior in iron and zinc. These data agree with those found by Hamza, (1997) and USDA (2012) who reported that iron and zinc content in defatted soybean were (56.20 and 2.46 mg/100g). The skim milk powder showed the highest content of calcium and phosphorus.

Table (3): Minerals content of raw materials used in pan bread processing (calculated as P.P.M sample on dry weight basis).

Samples	P	Ca	Mg	Fe	Zn	Se
WWF	85.5^{d} ± 1.24	3.59^{a} ± 0.19	11.2^{b} ± 0.92	0.71^{a} ± 0.09	0.435^{b} ± 0.098	0.74^{d} ± 0.043
BMF	36.7^{a} ± 1.31	6.51^{b} ± 0.32	9.1^{a} ± 0.85	0.271^{a} ± 0.033	0.175^{a} ± 0.038	0.162^{b} ± 0.031
WCF	43.8^{b} ± 1.22	3.9^{a} ± 0.45	8.7^{a} ± 0.66	0.395^{a} ± 0.061	0.21^{a} ± 0.032	0.41^{c} ± 0.030
DFSB	69.5^{c} ± 1.32	24.7^{c} ± 0.91	9.88^{a} ± 0.75	4.96^{b} ± 0.98	0.69^{c} ± 0.091	0.21^{b} ± 0.012
SMP	99.3^{e} ± 1.34	121.98^{d} ± 1.65	9.8^{a} ± 0.89	0.071^{a} ± 0.01	0.408^{b} ± 0.036	0.019^{a} ± 0.002

WWF= whole wheat flour, WCF= whole corn flour, BMF= barley malt flour, SMP= skimmed milk powder, DFSB= defatted soybean
(a,b,c,d,..) Mean values in each column, having different superscript are significantly different at <0.05.
(±) Each value (an average of three replicates) is followed by the standard deviation.

Also, results in Table (3) showed that there was a difference between whole corn flour and barley malt flour in each of calcium, phosphorus, magnesium and selenium while whole corn flour showed the highest content of calcium and magnesium followed by barley malt flour, but barley malt flour showed the highest phosphorus content. These data agree with those found by Bowes and Church (1983) and USDA (2012), who found that phosphorus content, was (189.2 and 272.0 mg/100g).

Dietary fiber content of raw materials:

The dietary fiber content was determined in whole wheat flour, whole corn flour and barley malt flour; Results were tabulated in Table (4). Results showed that the content of dietary fiber in barley malt flour was the highest where the content of dietary fiber as follows (Insoluble (IDF) 14.99%, Soluble (SDF) 3.89% and total dietary fiber (TDF) 18.88%), followed by whole wheat flour was (IDF) 12.41%, (SDF) 1.38% and (TDF) 13.78%) and finally whole corn flour was (IDF), (SDF) and (TDF) were 8.78%, 0.50% and 9.29%. These results agree with those reported by (Abd El-Hak *et al,* 2008) and (A.A.C.C 2000).

Table (4): Dietary fiber content of raw materials used in pan bread processing (mg/100g sample on dry weight basis):

Sample	Dietary fiber %		
	Insoluble (IDF)	Soluble(SDF)	Total (TDF)
Whole wheat flour	$12.41^{b} \pm 0.24$	$1.38^{b} \pm 0.04$	$13.78^{b} \pm 0.27$
Barley malt flour	$14.99^{c} \pm 0.12$	$3.89^{c} \pm 0.12$	$18.88^{c} \pm 0.08$
Whole corn flour	$8.78^{a} \pm 0.28$	$0.50^{a} \pm 0.11$	$9.29^{a} \pm 0.18$

***Mean values in each column, having different superscript (a,b,c,d,..) are significantly different at <0.05.**
±* Each value (an average of three replicates) is followed by the standard deviation.

Rheological properties of whole wheat flour and its mixtures:
Farinograph test:

Farinograph was used to evaluate the rheological properties of different samples, with different quantities of whole wheat flour and whole wheat flour with (whole corn flour, barley malt flour, and defatted soybean). Data in Table (5) and Figures (1, 2, 3, 4, 5, 6, 7, 8, 9, 10and 11) showed that water absorption, arrival time, dough development time, dough stability and dough weakening for all samples. The range of water absorption was increased from (63.0 to 71.5%). this increase due to increase in protein and dietary fiber content in the sample; Results showed also that the highest values were found in sample7 (70 %whole wheat flour +30% barley malt flour), sample5 (80 %whole wheat flour +20% barley malt flour), sample10 (65 %whole wheat flour +30% barley malt flour +5% defatted soybean), sample11 (65 % whole wheat flour +30% barley malt flour 5% skim milk powder) and sample3 (90 %whole wheat flour +10% barley malt flour) being(71.5%, 71.2%, 71.0%, 71.0% and 70.0%), respectively; This results could be due to the presence of some dietary fiber of grain outer layer (bran).This result was agreement with (Indrani *et al*, 1985, Shouk *et al*, 1996 and Azizi *et al*, 2006). Results showed that the Arrival time of whole wheat flour was 3.0min, while in other blends were ranged from 2.0 to 6.5min. The lowest arrival time (2.0min) detected in sample3 contained 90% whole wheat flour + 10%barley malt flour. While the highest value of arrival time (6.5min) detected in sample9 contained 65%whole wheat flour +30%whole corn flour +5% skim milk powders. Other samples showed a variation in arrival time due to the different in components of the mixtures, while barley malt flour and whole corn flour samples (3, 5, 7 and 11) showed lowest arrival time owing to the high content of dietary fiber in each sample. The same trend was also observed in case of dough development time required for all samples studied. These results were in agreement with (Indrani *et al*, 1985 and shouk, 1996). Increasing of dietary fiber contents lead to the decreasing in both of dough stabilities (DS) and mixing tolerance indices (MTI) which ranged from (7.0 to 20.0 BU), whereas (MTI) were found in the range of (10.0 to 80 BU). So, it could be conclude that the variations in the farinographic characteristics might be due to difference in endosperm portion and dietary fiber from outer layer (bran) among the different samples (Rao *et al*, 1985 and shouck, 1996).

Extensograph test:

Extensograph analysis gives information about the viscoelastic behavior of a dough and measures dough extensibility and resistance to extension. A combination of good resistance and good extensibility results in desirable dough properties (Rosell *et al*., 2001). Data presented in table (6) showed that there was a difference in the results could be attributed to the differences in their components especially in whole corn flour or barley malt flour. The sample consisting of whole wheat flour showed an extensibility (E) by (90 mm) and resistance to extension (R) by (420 BU) as shown in (Fig 12: tab 6). While samples contained whole corn flour with whole wheat flour recorded a slow rise in the dough resistance to extension which ranged from (360 to 420 BU), also these samples showed a decrease in the dough extensibility ranged between (80 to 35mm),(Fig13, 15 and 17). Similarly, samples which contained barley malt flour with whole wheat flour showed an increase in the dough resistance to extension, accompanied by a decrease in the extensibility of the dough as presented in (Fig 14, 16 and 18). The highest values of the dough resistance to extension were (580and 500 BU) in samples (8 and 10) respectively while dough extensibility for last samples were (45 and 55 mm). These samples which contain defatted soybean flour as shown in (Fig 19 and 21). Similar results were obtained by (Ribotta *et al*., 2009) and (Olu *et al*., 2011). Moreover, Table (6) showed that, dough energy of the studied blends decreased and ranged from (15- 49 cm^2), these results could due to the higher content of fiber or other word, by dilution of gluten with fiber as stated by (Chen *et al*., 1988b).

Table (5): Effect of whole wheat flour and its mixtures on farinograph parameters:

Samples	Water absorption %	Arrival time (min)	Dough development time (min)	Dough stability (BU)	Mixing tolerance index (BU)	Dough weakling (BU)
1	68.5	3.0	5.5	10.0	40.0	40.0
2	67.5	4.5	6.0	12.5	30.0	20.0
3	70.0	2.0	4.5	8.0	60.0	80.0
4	67.0	5.0	6.0	8.0	20.0	20.0
5	71.2	2.5	5.0	7.0	60.0	100.0
6	65.0	6.0	7.0	10.0	20.0	10.0
7	71.5	2.5	5.0	8.0	80.0	80.0
8	63.0	4.5	7.5	20.0	10.0	-----
9	63.0	6.5	8.0	17.5	10.0	-----
10	71.0	4.5	6.5	12.0	20.0	20.0
11	71.0	2.0	3.5	8.5	10.0	100.0

Table (6): Effect of whole wheat flour and its mixtures on extensograph parameters:

Samples	Extensibility (E) (mm)	Resistance to extension (R) (BU)	Proportional number (R/E)	Dough energy (cm^2)
1	90	420	4.7	49
2	80	360	4.5	39
3	65	370	5.7	32
4	65	420	6.5	34
5	70	370	5.3	27
6	35	400	11.4	15
7	55	380	6.9	22
8	45	580	12.9	26
9	70	500	7.1	40
10	55	500	9.1	27
11	55	430	7.8	28

Figs (1-11): Effect of whole wheat flour and its mixtures on farinograph parameters.

Figs (12-22): Effect of whole wheat flour and its mixtures on extensograph parameters.

fig

Sensory evaluation of manufactured pan bread:

The mixtures of whole wheat flour with whole corn flour, barley malt flour, defatted soybean and skim milk powder at different levels altered the organoleptic properties of different blended breads. Data on symmetrical shape, crust color, break and shred, crumb texture, crumb color, aroma, taste and overall acceptability were presented in Fig (23). The symmetric shape of whole meal pan bread decreased significantly and showed the lowest values in treatments (T5, T6 and T7) compared with control (whole meal wheat).

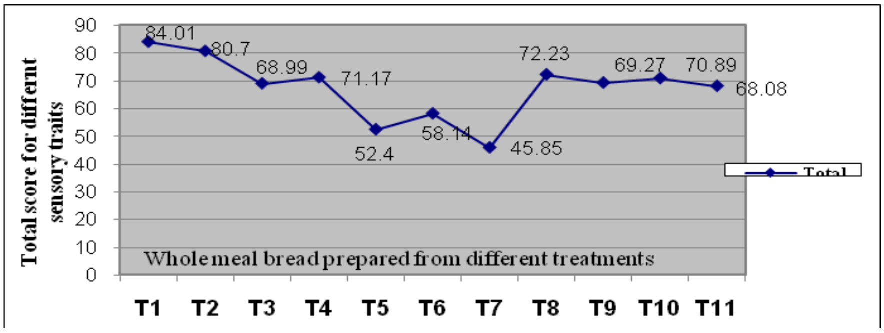
Crust color quality is related to maillard reaction which is affected by sugars and protein content of flour (Raidi and Klein, 1983). Crust color of the breads were changed from creamy white to dull brown and showed a significant increase at the level of (30%) for barley malt and whole corn with (5%) defatted soybean followed by this treatments with replacement (5%) defatted soy by 5% skim milk powder. These results were in agreement with that found by Lai *et al*, (1989.b).

In regard to break and shred, it´s clear that whole meal wheat bread had better break and shred than that other samples and the lowest values was found in T5, T6 and T7. The same table showed that crumb texture, crumb color showed a significant increase ($P<0.05$) in control compared with other treatments which showed an increase at the level of (10-20%) for corn (T2 and T4) and 10% for barley malt (T3). On the hand the increase of barley malt or whole corn at level 30% showed the worst values. However, addition of whole meal bread with defatted soy or skim milk at the level of 5% showed a significant increase comparing with other samples.

Results for aroma of the bread formulas revealed that aroma score increased slightly with the increasing the level of barley malt flour up to 10% or whole corn at (10-20%) and thereafter it decreased. supplemented whole meal at the decrements level of corn and barley malt with defatted soy or skim milk at level 5% showed significant improve of aroma.

Taste and mouse feel evaluation showed that control and various processed breads had most satisfactory taste scores at the (10%) level for barley malt and (20%) whole corn. However, whole meal bread supplemented with defatted soy or skim milk had a satisfactory taste score up to 5% level of substitution.

Fig (23): sensory evaluation of manufactured pan bread:



Chemical composition and Caloric values of the processed pan bread:

Data presented in Table (7) showed the chemical composition and caloric values of processed pan bread. Results indicated that there were significant differences ($p < 0.05$) between control (whole wheat bread) and other processed bread formula. Protein content ranged from (7.64 to 11.78%). In supplemented whole meal bread with barley malt flour and defatted soybean showed a highly significant increase in compare with the other samples and followed by control. The increment in protein could be due to defatted soybean. These results agree with those found by Olaoye *et al*., (2006) who reported that the addition of defatted soybean to whole wheat flour improved the nutritional quality of the protein in diets. Results showed that protein content ranged between (8.51-8.96%) in whole meal bread supplemented with skim milk powder. El Tinay, El Mahadi and El Soubki, 1985; Graham *et al*., 1986 found that usage of cereal grains with skim milk improves overall protein quality.

Data in the same table showed that the crude fiber content ranged from (2.10 to 4.52%) and the highest values showed in whole meal bread with barley malt flour (4.01- 4.52%) followed by bread supplemented with whole corn flour (3.32-3.48%). Jan *et al*., (2000) indicated that supplementation with defatted soybean flour significantly affected the crude fiber content of composite flours, The crude fiber content of composite flours increased by increasing the level of defatted soybean. Results of crude fat showed a significant increase in whole meal bread supplemented with whole corn flour (5.67%). followed by other formula contained barley malt and finally whole meal wheat (3.21%).This can be attributed to the high fat content of corn compared to the other ingredients used in preparation. Results showed a significant increase in ash content in all processed bread compared with control sample. The average values of ash content ranged from (1.28 to 1.92%) and the highest value was found in whole meal bread supplemented with barley malt and skim milk or defatted soybean (1.92 and 1.84%) respectively. This increase could be due to skim milk and defatted soybean. These results are agree with those reported by Singh, (1978) and Kayani, (1987) who reported that the variation in ash content in bread is due to the increase in skim milk powder while Anjum *et al*. (2006) found that an increase in ash content with the increase in defatted soybean flour supplementation in the whole wheat flour. Similar results were reported by Mishra *et al*., (1991) and Dhingra and Jood., (2002), they found that breads incorporated with defatted soy flour at 2-10% level had higher content of protein, crude fiber and total ash. On the other hand results of carbohydrates showed a significant decrement compared with control. The average values ranged from (67.65 to 79.87%) and the highest value was found in control sample. Whole meal bread supplemented with (5%) defatted soybean showed a significant decrement compared with control and this may be explained by the decrease in carbohydrates during baking through chemical reaction with amino acids (El-Zalaki and Lunch, 1981). This result agreed with that found by Maqbool *et al.,* (1987) who reported that the carbohydrates contents showed a significant decrease with the incorporation of defatted soybean flour. Yanez *et al*., (1982) reported that enrichment of bread with defatted soybean the carbohydrate content was reduced markedly and the nutritional quality was improved with an increase in protein content. The same trend were also observed in the results of caloric values were and this could be due to the previously mentioned reasons.

Table (7): Chemical composition and Caloric values of the manufactured pan bread:

Samples \ Chemical	Moisture	Protein	Crude fiber	Crud fat	Ash	T.C*	Energy Kcal/100gm
Control 100% WWF	33.30[a] ± 0.56	11.51[d] ± 0.25	3.06[d] ± 0.03	3.21[a] ± 0.07	1.82[b] ± 0.09	79.87[e] ± 0.16	394.41 ± 2.27
90% WWF+10% WCF	35.62[b] ± 0.62	7.94[ab] ± 0.25	2.10[a] ± 0.05	3.67[bc] ± 0.15	1.28[a] ± 0.10	74.39[d] ± 0.34	362.35 ± 3.71
90% WWF+10% BMF	35.74[b] ± 0.82	8.81[c] ± 0.69	2.42[b] ± 0.03	3.46[b] ± 0.30	1.40[a] ± 0.09	72.84[c] ± 0.59	357.74 ± 7.82
80% WWF+20% WCF	36.23[bc] ± 0.49	7.64[a] ± 0.18	2.71[c] ± 0.16	4.14[d] ± 0.08	1.43[a] ± 0.12	72.76[c] ± 0.43	359.193 ± 3.64
65% WWF+30% WCF+5% DFSB	37.65[de] ± 0.56	8.49[bc] ±0.25	3.48[f] ± 0.03	5.67[f] ± 0.07	1.52[a] ± 0.09	68.19[a] ± 0.16	357.75 ± 2.27
65% WWF+30% WCF+5% SMP	37.02[cd] ± 0.62	8.51[bc] ± 0.25	3.32[e] ±0.05	4.53[e] ± 0.15	1.78[b] ± 0.10	69.84[b] ± 0.34	354.17 ± 3.71
65% WWF+30% BMF+5% DFSB	38.26[e] ± 0.58	11.78[d] ± 0.69	4. 52[g] ± 0.03	3.69[c] ± 0.03	1.84[b] ± 0.09	69.18[b] ± 0.59	357.05 ± 5.39
65% WWF+30% BMFr+5% SMP	38.49[e] ± 0.49	8.96[c] ± 0.30	4.01[h] ± 0.16	3.72[c] ± 0.08	1.92[b] ± 0.32	67.65[a] ± 0.43	339.92 ± 3.66

WWF= whole wheat flour, WCF= whole corn flour, BMF= barley malt flour, SMP= skimmed milk powder, DFSB= defatted soybean

T.C*= Total carbohydrates calculated by difference

(a,b,c,d,..) Mean values in each column, having different superscript are significantly different at <0.05.

(±) Each value (an average of three replicates) is followed by the standard deviation.

Minerals content of the manufactured pan bread:

Results presented in Table (8) showed that the minerals contents (phosphorus (P), calcium (Ca), magnesium (Mg), iron (Fe), zinc (Zn) and selenium (Se)) in processed pan bread. Present data showed that the highest values of (P) and (Ca) were (104 and 5.30 ppm) in whole meal bread contain skim milk powder. These results showed that defatted soybean also increases the (P) and (Ca) as follows (85.8-96.1 PPM) and (3.67-3.32 PPM) respectively. These results agreed with those found by (Flynn and Cashman, 1997) who reported that skim milk has been recognized for a long time as an excellent source of minerals, especially calcium and phosphorus. Control sample showed a highly significant increase in (Mg) content compared with other bread samples. The average value of (Mg) content was ranged from (10.97 to 6.92 ppm) and the highest value was in control sample followed by whole meal bread supplemented with 10% whole corn flour. These findings were concurrent with those found by Adam *et al*., (2003). Data in the same table showed that (Fe), (Zn) and (Se) content in different whole meal bread samples ranged from (0.67 to1.97 PPM) iron, (0.40 to 0.86 PPM) zinc and (0.25 to 0.58 PPM) selenium. The highest values of iron, zinc and selenium were found in bread supplemented with barley malt flour and defatted soybean followed by whole meal bread supplemented with whole corn flour and defatted soybean. Rawat *et al*., (1994) found that defatted soy blending with whole meal bread increases the iron, zinc and selenium contents in bread.

Table (8): Minerals content of the processing pan bread (P.P.M sample on dry weight basis).

Minerals / Samples	P (PPM)	Ca (PPM)	Mg (PPM)	Fe (PPM)	Zn (PPM)	Se (PPM)
Control 100% WWF	$83.5^{a} \pm 0.43$	$3.44^{cd} \pm 0.23$	$10.97^{d} \pm 0.36$	$0.68^{a} \pm 0.09$	$0.42^{a} \pm 0.01$	$0.53^{ef} \pm 0.02$
90% WWF+10% WCF	$85.8^{b} \pm 0.65$	$2.59^{b} \pm 0.13$	$8.26^{c} \pm 0.37$	$0.78^{a} \pm 0.08$	$0.43^{a} \pm 0.05$	$0.49^{de} \pm 0.03$
90% WWF+10% BMF	$91.7^{d} \pm 0.67$	$1.29^{a} \pm 0.09$	$7.93^{bc} \pm 0.41$	$0.67^{a} \pm 0.07$	$0.40^{a} \pm 0.06$	$0.31^{b} \pm 0.03$
80% WWF+20% WCF	$89.1^{c} \pm 0.45$	$3.72^{d} \pm 0.15$	$7.31^{ab} \pm 0.26$	$0.78^{a} \pm 0.10$	$0.43^{a} \pm 0.04$	$0.35^{b} \pm 0.04$
65% WWF+30% WCF+5% DFSB	$85.8^{b} \pm 0.60$	$3.67^{d} \pm 0.11$	$7.39^{ab} \pm 0.22$	$1.92^{b} \pm 0.11$	$0.85^{b} \pm 0.08$	$0.46^{cd} \pm 0.02$
65% WWF+30% WCF+5% SMP	$93.0^{e} \pm 0.84$	$5.30^{f} \pm 0.23$	$6.92^{a} \pm 0.63$	$0.80^{a} \pm 0.07$	$0.43^{a} \pm 0.02$	$0.25^{a} \pm 0.06$
65% WWF+30% BMF+5% DFSB	$96.1^{f} \pm 0.76$	$3.32^{c} \pm 0.12$	$7.89^{bc} \pm 0.28$	$1.97^{a} \pm 0.12$	$0.86^{b} \pm 0.05$	$0.58^{f} \pm 0.02$
65% WWF+30% BMFr+5% SMP	$104^{g} \pm 0.99$	$4.87^{e} \pm 0.25$	$7.24^{ab} \pm 0.35$	$0.83^{a} \pm 0.05$	$0.46^{a} \pm 0.07$	$0.42^{c} \pm 0.03$

WWF= whole wheat flour, WCF= whole corn flour, BMF= barley malt flour, SMP= skimmed milk powder, DFSB= defatted soybean

(a,b,c,d,..) Mean values in each column, having different superscript are significantly different at <0.05.

(±) Each value (an average of three replicates) is followed by the standard deviation.

Dietary fiber content of the processing pan bread:

Processed whole meal breads were analyzed for their total dietary fiber (TDF) contents and their soluble (SDF) and insoluble (IDF) fractions, the results are given in Table (9).

Results in Table (9) showed the average values of (TDF) ranged from (7.23 to 11.56%) and (IDF) showed a highly significant increase in all samples of bread contained barley malt flour and whole corn flour in compare with control as the following (9.88, 9.49, 8.34 and 7.87%) respectively. The highest values of (SDF) were found in samples of whole meal bread supplemented with barley malt flour at (30%) and followed by control as the following (1.68, 1.46 and 1.0%) respectively, these results could be due to the highly values of total dietary fiber and major fractions in barley malt flour and whole wheat flour. These results agreed with those obtained by Frolich and Asp (1981) and Trogh, (2004.d) they found that bread contain barley malt, content markedly increased of soluble dietary fiber.

Table (9): Dietary fiber content of the processed pan bread:

Samples	Dietary fiber %		
	Insoluble (IDF)	Soluble (SDF)	Total dietary fiber (TDF)
100% WWF (Control)	$6.25^{a} \pm 0.15$	$1.00^{b} \pm 0.01$	$7.251^{a} \pm 0.16$
90% WWF+10% WCF	$6.29^{a} \pm 0.21$	$0.94^{ab} \pm 0.08$	$7.230^{a} \pm 0.29$
90% WWF+10% BMF	$6.81^{b} \pm 0.21$	$1.20^{c} \pm 0.10$	$8.013^{b} \pm 0.31$
80% WWF+20% WCF	$7.04^{b} \pm 0.07$	$0.87^{ab} \pm 0.07$	$7.911^{b} \pm 0.14$
65% WWF+30% WCF+5% DFSB	$8.34^{d} \pm 0.25$	$0.89^{ab} \pm 0.06$	$9.232^{d} \pm 0.31$
65% WWF+30% WCF+5% SMP	$7.87^{c} \pm 0.39$	$0.76^{a} \pm 0.05$	$8.632^{c} \pm 0.45$
65% WWF+30% BMF+5% DFSB	$9.88^{e} \pm 0.25$	$1.68^{e} \pm 0.01$	$11.560^{f} \pm 0.27$
65% WWF+30% BMFr+5% SMP	$9.49^{e} \pm 0.21$	$1.46^{d} \pm 0.25$	$10.950^{e} \pm 0.46$

WWF= whole wheat flour, WCF= whole corn flour, BMF= barley malt flour, SMP= skimmed milk powder, DFSB= defatted soybean.

(a,b,c,d,..) Mean values in each column, having different superscript are significantly different at <0.05.

(±) Each value (an average of three replicates) is followed by the standard deviation.

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تأثير إضافة دقيق الحبوب الكاملة على الخواص الريولوجية والكيماوية لخبز القوالب.

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تم إعداد الدراسة الحالية من أجل تقييم تأثيرإضافة دقيق الحبوب الكاملة على الخصائص الريولوجية والكيماوية لخبز القوالب المجهز من دقيق الحبوب الكاملة. ولذا تم إضافة كلا من دقيق الذرة الكاملة ودقيق مولت الشعير بمعدلات إستبدال (١٠- ٢٠و٣٠ %) من دقيق القمح الكامل، وتم إستبدال جزء من دقيق القمح الكامل بالصويا منزوعة الدهن أو مسحوق اللبن الفرز بنسبة (٥%) ثم مقارنة هذه الخلطات بخبز القمح الكامل وتم دراسة تأثير كل منها على الخصائص الريولوجية والكيماوية للخبز الناتج . وأظهرت نتائج الفارينوجراف والإكستنسوجراف أن إضافة دقيق الذرة الكاملة للقمح بنسب (١٠- ٢٠و ٣٠ %) أدى إلى إنخفاض فى معدل إمتصاص الماء (٦٧%) والتمدد للعجينة (٨٠ - ٣٥) من ناحية أخرى أدى إلى زيادة زمن الوصول (٦,٥ دقيقة) وثبات العجينة (٢٠) وكذلك الوقت اللازم لتطور العجينة (٨,٠ دقيقة) والرقم النسبي (١٢,٩)، في حين أن إضافة دقيق الشعير المنبت بمعدلات إستبدال (١٠-٢٠و٣٠ %) من دقيق القمح الكامل أدى إلى زيادة فى معدل إمتصاص الماء (٧١%) وخفض الرقم النسبى (٦,٩). كما أظهرت النتائج أن إضافة دقيق الصويا منزوع الدهن وكذلك مسحوق اللبن الفرز إلى دقيق الذرة الكاملة (٣٠%) وبنسب إستبدال (٥%) من دقيق القمح الكامل أدى إلى إنخفاض فى معدل إمتصاص الماء (٦٣%) وزيادة فى زمن الوصول (٦,٥ دقيقة) وزمن تكون العجينة (٨,٠ دقيقة) وثباتها (٢٠) وكذلك المقاومة للشد (٥٨٠) والرقم النسبى (١٢,٩). وفى حالة إضافة كلا من دقيق الصويا منزوع الدهن و مسحوق اللبن الفرز إلى دقيق الشعير المنبت (٣٠%) وبنسب إستبدال(٥%) من دقيق القمح الكامل أدى إلى زيادة فى معدل إمتصاص الماء (٧١%) وإنخفاض زمن الوصول (٤,٥ دقيقة) والمطاطية (٥٥) والمقاومة للشد (٥٠٠). وأظهرت نتائج الإختبارات الكيماوية لجميع عينات خبز القوالب إرتفاع فى محتوها من البروتين والدهون والألياف الغذائية الكلية والمعادن فى حين أظهرت إنخفاض فى محتوها من الكربوهيدرات.

قام بتحكيم البحث

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