Effect of wheat germ and acid whey addition on the chemical and technological properties of pan bread.

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Abstract:

Wheat germ (WG) and whey milk are important functional ingredients for cereal products. In this study, WG (0%, 5%, 10% and 15%) and commercial acid whey milk were used to replace wheat flour and water in pan bread formulation and their effects on the nutritional, physical and sensory properties of pan bread were investigated. WG replacement increased ash, protein, lipid, crude fiber, Ca, Fe, K, Mg and Zn contents of the pan bread. Replacement of water with (100%) whey milk caused a significant increase ($p < 0.05$) in the Ca, K, Mg and Zn contents of the pan bread. The combination of WG and whey milk at high replacement levels adversely affected the specific volume of the samples. WG increased the darkness and yellowness of the crust and crumb of pan bread. WG at 15 % alone or in combination with whey milk caused significantly decreased pore structure, taste, odour and overall acceptability score compared to control pan bread.

Keywords : Pan bread; wheat germ; whey milk; physical properties; sensory evaluation; chemical composition.

1. Introduction:

From economic and environmental points of view, adding value to agricultural and agro-industrial by-products is always desirable. Such residues are usually used for animal feed. They contain potentially valuable compounds and can be used to make high-value food products ***(Nandeesh et al., 2011)*** and ***(Elleuch et al., 2011).*** The annual amount of bio-waste produced by the food industry in the European Union was estimated at 37,000,000 tons, **(Commission of the European Communities, 2008).** Food processing by-products have become an important sanitary problem material to be studied. Such efforts have been made for converting these refused materials into valuable products ***(Tresca, 2012).*** Foods rich in natural antioxidants have been proposed as a tool to prevent and cure liver damage ***(Morisco, et al., 2008).*** At present, functional foods, in principle apart from their basic nutritional functions provide physiological and healthy benefits and are very important ***(Viuda-Martos, 2010***).

Bakery products, specifical cookies are considered the most viable and acceptable carriers of supplements ***(Dhingra et al., 2012).*** Wheat is one of the most important cereal crops not in Egypt only, but all over the world. In Egypt, according to the limited area of cultivated land and the rapid increase in population, about 50% of consumer needs are annually imported to cover the demand for bread consumption ***(Reda, 2006).*** Wheat flour is also called refined flour or white flour. It is the basic structural component of most bakery products such as traditional flatbreads, tandoori roti, fast foods, baked goods such as pastries, bread, and several varieties of sweets.

Wheat flour contains two proteins-gliadin and glutenin which form gluten by the addition of water. No other cereal flour contains gluten. However, the nutritional value of refined wheat flour was 13.00% moisture, 10.0% crude protein, 3.33% crude fat, and 72.00% carbohydrates on a dry weight basis according to the USDA nutrient database

The wheat germ is therefore a unique source of concentrated nutrients, highly valued as a food supplement. The germ contains about 10–15% lipids, 26–35% proteins, 17% sugars, 1.5–4.5% fiber, and 4% minerals. In the germ fraction recovered from the milling process, the carbohydrates represent about 45% of the total chemical composition. However, they come mainly from other contaminating fractions (starch from the endosperm, and most cellulose and hemicelluloses from bran) ***(Brandolini and Hidalgo, 2012).***

The interest in whey and whey preparations has considerably increased in recent years. Whey and whey preparations are the so-called (forgotten treasure) and, because of their unique properties, they have been "rediscovered" and have been increasingly frequently and successfully used by various production plants in the food industry. They have also been eagerly purchased by consumers who are aware of the role of whey preparations inadequate human nutrition. For many years, there has been a tendency in the food processing industry to use substitutes for ingredients in recipes of many products. This situation can be observed in the case of foods with reduced fat and sugar, or products for lacto-ovo-vegetarians ***(Krolczyk et al., 2016).***

Whey contains most of the water-soluble components of milk except casein-bound minerals. It contains all the water-soluble milk protein fragments such as lactoglobulin and lactalbumin, serum albumin, lactoferrin, lactoperoxidase, and immunoglobulins that are present in milk ***(Etzel, 2004).*** Whey also contains milk sugar (lactose), water-soluble milk vitamins, and minerals. Quantitative occurrence of these components, resistance to processing applications, and their physiological functions and bioavailability to the consumer are important factors to consider while discussing the nutritional significance of whey-based ingredients ***(Solak and Nihat, 2012). Hassan et al., (2013)*** reported that whey contained 91.77% moisture, 8.23% T.S, 0.51% protein, 0.103% fat, 1.93% ash and a pH value was 4.15.

The consumption of bakery and confectionery products grows every day and consumers are becoming increasingly demanding. The search for quality makes this sector a very competitive niche market. Among the bakery products, the most consumed is bread, which is prepared with wheat flour, yeast, water, salt, and sugar confectionery products such as cakes and biscuits are also greatly appreciated, ***(Paula et al., 2015).*** Bread is a basic food of Egyptian family meals and its flavor for combined with many other foods. One recent trend is to increase the fiber component in food products to overcome health problems like hypertension, diabetes, and hyperlipidemia. Unfortunately, the use of date pits powder as a food for human beings is very limited in Egypt, ***(Najafi, 2011).***

Wheat germ (WG), which is high in protein, fat, ash, and other phytochemicals, was used successfully in the development of a designer food (pan bread). The pan bread formulations containing varying levels of wheat germ affected the physical texture and objective color of bread crumbs. The addition of raw germ did not adversely affect the sensory quality of these phytochemical enriched bread samples. The overall objective of producing a highly nutritious pan bread with acceptable textural and crumb color qualities than the presently available white bread was achieved in the present work ***(Al-Hooti et al., 2002).*** Besides wheat germ, nutritional added value, low levels (< 5%) enhanced color and taste, with no effect on texture. If improvers are also incorporated in the bread formula, around 10% or 20% wheat germ can be the limit of addition to levitated bread and up to 10% to those unleavened ***(Boukid et al., 2018).*** This trend may be attributed to the interaction between fiber and protein and leads to the weakening of the gluten network of the dough and reduces the gas-holding capacity of the dough ***(Yitayew et al., 2022).***

The functional properties of whey proteins are mainly used in their production; they include solubility, gelling, emulsifying, foaming, and water-binding properties. In the manufacture of bakery products, whey and whey preparations can be used as functional additives or for partial substitution of fat and non-fat constituents. Also, partial replacement of fat by high-protein preparations is uniquely associated with a reduction in the caloric value of the final product. In addition, the improvement of the functional properties of food products, i.e. textural properties ***(Krolczyk et al., 2016)***.

Egyptian Baladi bread using wheat flour (82% extraction) and replacing water dough with Ras cheese sweet whey (RCSW) or Acidic cheese whey (ACW) or Milk Permeate (MP) improved all Physico-Chemical and sensory characteristics of experimental Baladi bread. Compared to control, MP achieved the best product followed by RCSW and then ACW. Statistically, bread characteristics improved with increasing replacement ratio (***Gaber et al 2017).*** Egyptian Baladi bread can be made by adding cheese whey or milk permeate as a water substitute up to 100%. This fortification could enhance the quality attributes, acceptability, and nutritive value of the product ***(El-Batawy et al., 2018).***

The aim of this investigation is providing a nutritious baked product for consumers; the local baking industry would be contributing to the health, productivity and well being of the population. In view of the technological and nutritional significance of WG being used in pan bread formulations could be developed with desirable nutritional and sensory qualities.

2. Material and methods:

2.1 Materials :

Wheat (Triricum aestivum) flour (72% extraction): it was purchased from Middle Egypt Flour Mills Company, Fayoum Governorate. Egypt. Wheat (Triricum aestivum) germ: it was purchased from Middle Egypt Flour Mills Company, Fayoum Governorate. Egypt. Acid milk whey: it was obtained from the dairy manufacture unit, Dairy Science Department, Faculty of Agriculture, Fayoum University, Egypt.

2.2 Methods:

2.2.1 Preparations of the raw materials:

2.2.1.1 Wheat germ flour:

The germ collected was carefully cleaned to remove the foreign matter, milled by Brabender laboratory and sieved through 60 mesh sieves to get wheat germ flour and stored in an airtight container in a freezer (–20 $^\circ$C) until it was further used for different experiments.

2.2.1.2 Milk whey:

Sweet milk whey was stored in a plastic container in a freezer (–20 $^\circ$C) until it was further used for different experiments.

2.2.2 Blends of wheat flour substituted with wheat germ flour:

Blends of wheat flour (72%) (WF), partially substituted with wheat germ flour (WGF) and sweet milk whey (SMW) were used to make pan bread and cake as indicated in Table (1).

Table (1): Blends of wheat flour are substituted with wheat germ flour and whey milk (for kneading).

Samples	Blends composition
1	100% Wheat flour (72%) (WF).
2	100% (WF) + Sweet milk whey (SMW) (for kneading).
3	95.0 % (WF) + 5.0 % wheat germ flour (WGF).
4	95.0 % (WF) + 5.0 % (WGF) + (SMW) (for kneading).
5	90.0 % (WF) + 10.0 % (WGF).
6	90.0 % (WF) + 10.0 % (WGF) + (SMW) (for kneading)
7	85.0 % (WF) + 15 % (WGF).
8	85.0 % (WF) + 15 % (WGF) + (SMW) (for (kneading).

2.2.3. Analytical methods:

2.2.3.1. Chemical composition of raw materials:

Moisture content, crude protein, ether extract, crude fiber and ash were determined according to the methods described in **A.O.A.C (2000).** Total carbohydrates were calculated by difference as follow: Carbohydrates =100 - (protein % +fat % + ash % +fiber %).

2.2.3.2. Determination of Minerals composition.

Calcium (Ca), Potassium (K), Iron (Fe), Zinc (Zn) and magnesium (Mg) were determined according to the method described by **A.O.A.C. (2003)** using the Perkin Elmer 3300 (USA) Atomic Absorption.

2.2.4. Pan bread making techniques:

The straight dough method for pan bread production was carried out according to the method of **Kent and Amos, (1967)** which could be summarized as follow:

One hundred grams of wheat flour or its blends in Table (1) were mixed with 25 ml of freshly prepared yeast suspension (12 g fresh compressed yeast suspended in 100 ml water or sweet milk whey), 25 ml of 3% Sodium chloride solution and an additional amount of water or sweet milk whey as determined by Farinograph test. All ingredients were mixed for a time obtained from Farinograph data; the dough was removed from the bowel and rounded manually. Fermentation was carried out for 3 h, through three consecutive stages at 30 c and 85 % relative humidity. The first punch was after 105 min, the second punch was after 50 min and molding was after 25 min. The fermented was placed in a baking pan (5x9x8) tightly greased to prevent the loaves from sticking for 55 min. The loaves were then proofed for 55 min in a cabinet at 30 c and 85 % relative humidity. After proofing, the pans were placed in the oven at 250 c for 25 min. The producer loaves were removed from the oven and then after cooling at ambient temperature were placed in the tight cabinet until scoring.

2.2.5. Physical and Sensory evaluation of pan bread:

2.2.5.1. Physical properties of pan bread:

Weight: Bread samples were weighted in grams after 2 h of baking.

Volume: The volume in cm3 of each sample was determined by the rape seed displacement method **AACC (2001).**

Specific Volume (S.L.V): It was calculated from the following equation:

$$S.L.V = \frac{\text{Volume (cm 3)}}{\text{Weigh (g)}}$$

2.2.5.2. Color analysis of pan bread:

The crust color of all breads and biscuits products was determined using a spectrophotometer (MOM, 100 D, Hungary) according to the method described in **(Hunter and Harold 1987**)**..** Color coordinates X, Y, and Z were converted to corresponding Hunter L*, a*, and b* color coordinates according to the formula given by the manufacturer. The vertical coordinate ‘‘L’’ is lightness from 0 (total light absorbance and therefore completely black) through gray (50) to 100 (complete light reflectance); the horizontal coordinate ‘‘a’’ is greenness/redness, from - 60 (green) through gray to + 60 (red); orthogonal horizontal coordinate ‘‘b’’ is yellowness from -60 (blue), to + 60 (yellow).

2.2.5.3. Sensory evaluation of pan bread:

This attribute was measured by a panel of ten judges from the staff of Food Technology Res Inst., Agric Res. Cent., Giza, Egypt. The evaluation of pan bread was done by the scoring system according to **Mostafa (1976).** The evaluation of pan bread was done by using the following score in Table (2):

Table (2): Scoring system of pan bread.

Character	Degree
Shape	10
Crust color	10
Crust appearance	10
Crumb color	10
Texture	10
Grain cell structure	10
Taste	20
Odor	20
Overall acceptability	100

2.2.6. Statistical analysis:

`Data analysis for Duncan multiple comparison test at $p > 0.05$ and response optimization were done using Statistical Analysis System, STATISTICA Statsoft software release 8.0 package.

3. Result and discussion:

3.1. Chemical composition of wheat flour, wheat germ flour and acid whey and pan bread substituted with wheat germ and whey milk:

Moisture, protein, lipid, Ash, crude fiber and total carbohydrate content were found as 13.40 ± 0.85 %, 12.53± 0.34%, 1.01 ± 0.24%, 0.53± 0.19%, 0.98 ± 0.20 % and 72.51 ± 0.86 % for wheat flour and 12.76 ± 0.43 %, 29.95± 0.71 %, 12.48 ± 0.30 %, 2.97± 0.20 %, 3.72 ± 0.42 % and 41.83 ± 0.17 % for wheat germ flour, respectively. While crude fiber was not determined in whey milk, Moisture, protein, lipid, ash and carbohydrate content of whey milk were found as 93.65 ± 0.24 %, 0.79 ± 0.04 %, 0.054± 0.005 %, 0.5± 0.03 % and 4.92 ± 0.33 %, respectively.

The chemical composition of pan bread samples is given in Table 3. Wheat germ flour and acid whey milk addition increased ($p < 0.05$) protein, lipid, ash and crude fiber of contents of the samples at all levels of wheat germ. As expected, the rich ash, lipid, crude fiber and protein content of wheat germ improved the final product composition in terms of protein, lipid, ash and crude fiber. Compared to pan bread without wheat germ and whey milk, on the other hand the replacement of wheat flour with wheat germ decreased the total carbohydrate of pan bread samples. The replacement of water with whey milk had a significant ($p < 0.05$) effect on protein and ash content causing its increase at all wheat germ replacement levels. Protein, lipid, ash and crude fiber contents were affected ($p < 0.05$) by wheat germ flour replacement levels, protein content increasing up to 15.13 ± 0.17 %, lipid content increased up to 6.25 ± 0.14 %, ash content increased up to 2.58 ± 0.11 % and crude fiber content increased up to 3.29 ± 0.12 % at 15 % WG replacement level.

Wheat germ had been considered as a functional food supplement in several bakery products 20% wheat germ fortified biscuits proved to be nutritious functional and healthful food. Moreover, it could be recommended for caloric-reduced diets for obese and overweight persons. Likewise, it should be increasing interest as an ingredient in the food industry such as functional and healthy foods formulations such as biscuits, bread, and cakes **(Youssef, 2015).** And also **Bansal and Sudha, 2011** found that biscuits prepared by replacing wheat flour with steamed wheat germ at a 40% level had higher protein and dietary fiber content and also had some amount of vitamin E, indicating that the by-product of the milling industry could be processed into value-added products

Table (3): Chemical composition of Wheat flour (WF), wheat germ flour (WGF), Whey Milk and pan bread substituted with wheat germ and whey milk (WM) (g/100g dry matter).

Samples	Constituents					
	Moisture	Crude protein	Crude Fat	Ash	Crude Fiber	Carbohydrates**
Raw materials						
WF	13.40± 0.85	12.53± 0.34	1.01± 0.24	0.53± 0.19	0.98± 0.20	72.51±0.86
WGF	12.76± 0.43	29.95± 0.71	12.48± 0.30	2.97± 0.20	3.72± 0.42	41.83± 0.17
WM	93.65± 0.24	0.79± 0.04	0.054± 0.005	0.5± 0.03	-	4.92 ± 0.33
Pan bread substituted with wheat germ (WGF) and milk Whey (MW)						
Control WF 100%	33.42± 0.34^{g}	12.26 ± 0.18^{h}	4.65± 0.23^{h}	1.32 ± 0.13^{f}	1.86 ± 0.15^{d}	
WF 100%+ MW	33.96 ± 0.16^{f}	12.63 ± 0.18^{g}	4.83± 0.10^{g}	1.38 ± 0.16^{f}	1.89 ± 0.16^{d}	
WF 95%+5% WGF	35.12± 0.31^{e}	13.14 ± 0.17^{f}	5.14± 0.18^{f}	1.78± 0.12^{e}	2.52± 0.09^{c}	
WF 95%+5% WGF+MW	35.48± 0.20^{d}	13.45 ± 0.24^{e}	5.28± 0.08^{e}	1.92 ± 0.09^{d}	2.56 ± 0.13^{c}	
WF 90%+10%WGF	36.60± 0.36^{c}	14.21 ± 0.20^{d}	5.74± 0.18^{d}	2.24 ± 0.12^{c}	2.86 ± 0.15^{b}	
WF 90%+10%WGF+MW	36.92± 0.12^{b}	14.62 ± 0.11^{c}	5.92± 0.11^{c}	2.33 ± 0.07^{c}	2.89 ± 0.14^{b}	
WF 85%+15%WGF	37.63± 0.21^{a}	15.13 ± 0.17^{b}	6.25± 0.14^{b}	2.58 ± 0.11^{b}	3.29 ± 0.12^{a}	
WF 85%+15%WGF+MW	37.82± 0.24^{a}	15.35 ± 0.19^{a}	6.39± 0.09^{a}	2.73 ± 0.14^{a}	3.30 ± 0.11^{a}	

Means with different letters among treatments in the same column are significantly different ($p \leq 0.05$).Data are presented as means ± SDM (n=3). **/ Carbohydrates by difference.

Mineral contents of the samples are summarized in Tab. 4. Increasing the wheat germ flour level in pan bread formulation also increased ($p < 0.05$) Ca, K, Mg, Fe and Zn contents of the pan bread samples. The replacement of whey milk caused a significant ($p < 0.05$) increase in Ca, K, Mg and Zn contents. Ca contents of the pan breads was between 46.27±058 mg/100g and 98.89±0.35 mg/100g, the highest value being obtained with 15% WG usage (with whey milk) due to a higher Ca content of whey milk and wheat germ (51.73 mg/100g and 42.41 mg/100g) than wheat flour (31.54 mg/100g). Ca is the most abundant mineral in the body, and 99% of Ca is found within the bones and teeth. Ca is very important for biological functions such as cell adhesiveness, mitosis, blood coagulation, structural support, muscle contraction and glandular secretion **(Lanham-New, 2008).**

Mg and K contents of the pan bread increased with wheat germ replacement, and a slight increase was observed with the replacement of whey milk usage in Mg and K content. Higher Mg and K contents of wheat germ (243.38 mg/100g and 1069.40 mg/100g) compared to wheat flour (38.08 mg/100g and 139.74 mg/100g) affected Mg and K contents in the final product. The highest values of Mg and K were obtained with 15% wheat germ and whey milk usage (89.44±0.17mg/100g and 469.55±0.31 mg/100g). A significant ($p < 0.05$) increase was also obtained in the Fe content of pan bread with wheat germ replacement. The increment ratio reached up to 1.6 times at a high wheat germ (15%) replacement level. Fe is another important mineral in human health due to the fact that Fe deficiency is one of the most widespread nutritional disorders in the world. The World Health Organization (WHO) has estimated that nearly 3.7 billion people are iron-deficient, with two billion of these so severely deficient that they can be described as anemic **(Zeng et al 2010**).

Table 4 Minerals content (mg/100 g) of Wheat flour, wheat germ flour, acid Whey Milk and pan bread substituted with wheat germ flour and milk whey (g/100g dry matter)

Samples g/100g dry matter	Minerals (mg/100g sample)				
	Macro- elements			Micro-elements	
	Calcium (Ca)	Magnesim (Mg)	Potassium (K)	Iron (Fe)	Zinc (Zn)
Raw materials					
WF	31.54^{c}	38.08^{b}	139.74^{c}	2.33^{b}	0.82^{b}
WGF	42.41^{b}	243.38^{a}	1069.40^{a}	7.87^{a}	15.^{64a}
WM	51.73^{a}	8.16^{c}	143.54^{b}	0.081c	0.015^{c}
Pan bread supplemented with Wheat germ (WGF) and Milk Whey (MW)					
Control WF (100%)	46.27±058^{h}	45.91±0.53^{h}	176.22± 0.46^{h}	3.61±0.30^{d}	0.98±0.01^{h}
WF 100% + MW	94.23±0.67^{d}	5765± 0.48^{f}	333.32±0.62^{d}	2.50±0.12^{h}	1.31±0.07^{g}
WF 95% +5% WGF	47.56±0.21^{g}	56.68±0.36^{g}	221.33±0.47^{g}	4.03±0.10^{c}	1.79±0.05^{f}
WF 95%+5% WGF + MW	95.93±0.49^{c}	69.58±0.48^{d}	379.22±0.47^{c}	2.91±0.04^{g}	2.22±0.06^{e}
WF 90%+10% WGF	49.33±0.19f	66.17± 0.41^{e}	266.06±0.33^{f}	4.22±0.07^{b}	2.52±0.08^{d}
WF 90%+10% WGF+ MW	97.43± 0.15^{b}	79.80±0.29^{b}	424.22±0.48^{b}	3.12±0.06^{f}	2.98±0.06^{c}
WF 85% +15% WGF	50.48±0.44^{e}	76.55±0.39^{c}	311.64±0.35^{e}	4.48±0.13^{a}	3.26±0.05^{b}
WF 85%+15% WGF+ MW	98.89±0.35^{a}	89.44±0.17^{a}	469.55±0.31^{a}	3.46±0.11^{e}	3.75±0.06^{a}

Means with different letters among treatments in the same column are significantly different ($p \leq 0.05$)**.**Data are presented as means ± SDM ($n=3$).

3.2. Physical properties of Pan bread .

Some physical properties of pan bread samples are given in Tab. 5. Weight of the pan bread samples did not change significantly ($p > 0.05$) with increasing wheat germ or whey milk replacement levels.

Loaf weight is determined by the amount of moisture and carbon dioxide diffuse out of the dough during baking. More loaf weight could be attributed to protein and fiber-rich grain incorporated and carbon dioxide diffused. The loaf weight of standard refined wheat bread was less than the composite flour bread. Also, the presence of more fibrous flour causes a subsequent reduction in loaf volume. Bread with more proportion of refined wheat was present, thus gluten formation was more which might help in the retention of more carbon dioxide gas resulting in higher loaf height. There is a negative influence of the fiber on bread volume, which is related to reducing the ability of the gluten to aggregate and affects the volume and texture of the product. It also reduces crust crispness **(Bhatt and Gupta 2015).** A decrease in the volume and specific volume were observed. Both of these effects were expected, as the amount of gluten, which imparts higher volume in pan bread, was decreased as a result of wheat germ in the pan bread formulation. The specific volume is an indicator of pan bread volume. In the present study, specific volume values varied between 2.90 and 5.09 and the high levels of wheat germ decreased the specific volume values significantly ($p < 0.05$). However, control and control with whey milk samples, gave the highest specific volume values. In the study conducted by. The decrease in the specific volume at high replacement levels of wheat germ could be due to dilution of gluten and deterioration of the gluten network in pan bread dough. The works of (**Mudau et al 2021**) also reported an increase in bread loaf weight and a decrease in bread loaf volume and specific volume by the addition of high fibrous ingredients in the dough.

Table (5): Physical properties of pan bread prepared from WF (72% extraction) with different levels of wheat germ flour (WGF) and acid whey milk:-

Treatments	Loaf Volume (cm3)	Loaf Weight (g)	Specific Volume (cm3/g)
100 % (WF).	685.33	134.49	5.09a
100 % (WF) + (MW)	676.33	137.86	4.90b
95% (WF) + 5% (WGF)	635.67	139.24	4.56c
95% (WF) + 5% (WGF) + (MW)	619.67	139.48	4.44d
90% (WF) + 10% (WGF)	536.67	140.95	3.81e
90% (WF) + 10% (WGF) + (MW)	527.33	141.45	3.73f
85% (WF) + 15% (WGF)	421.00	141.68	2.97g
85% (WF) + 15% (WGF) + (MW)	411.00	141.64	2.90h

Means with different letters among treatments in the same column are significantly different ($p \leq 0.05$).Data are presented as means ± SDM (n=3).

3.3 Crumb and crust Colour values of pan bread.

Crumb and crust colour values of pan bread samples are summarized in Tab. 6. Crumb and crust L* (light/dark) values decreased, a*(green/red) and b* (blue/yellow) values increased with wheat germ addition. The natural colour characteristics of wheat germ had a significant effect on final product colour values. On the other hand, rich amino acid and saccharide contents of wheat germ may promote the Maillard reaction, which may increase the darkness and redness of the product. Up to 10% WG, loaf color was comparable to the control bread, which might be probably attributed to the carotenoids from WG. Brownness (b*) also increased with WG supplementation due to protein and free sugar content increase accelerating the Maillard reaction. The color of the bread surface was reported to become darker with increased addition level (up to 30%) **(Boukid et al., 2018).**

Table (6) Crust and crumb color parameters of wheat flour (WF) substituted with wheat germ flour (WGF) and milk whey (MW) pan bread.

Treatments	Color parameters					
	Crust color parameters			Crumb color parameters		
	L*	a*	b*	L*	a*	b*
100 % WF (control)	63.25 ± 0.07[a]	14.55 ± 0.05[h]	24.36 ± 0.06[h]	78.30± 0.08[a]	-0.54± 0.03[h]	11.69± 0.02[h]
100 % WF+MW	59.70 ± 0.05[b]	14.74 ± 0.06[g]	24.90 ± 0.05[g]	73.91± 0.06[b]	-0.37± 0.04[g]	11.95± 0.02[g]
95% WF+5% WGF	57.35 ± 0.05[c]	14.95 ± 0.07[f]	25.44 ± 0.07[f]	71.00± 0.06[c]	0.77± 0.02[f]	14.75± 0.04[f]
95% WF+5% WGF+MW	56.45 ± 0.07[d]	15.15 ± 0.08[e]	25.95 ± 0.07[e]	69.89± 0.08[d]	0.85± 0.07[e]	15.05± 0.04[e]
90% WF+10% WGF	55.85 ± 0.03[e]	15.75 ± 0.06[d]	26.56 ± 0.06[d]	69.14± 0.03[e]	1.46± 0.04[d]	17.26± 0.03[d]
90% WF+10%WGF+MW	54.16 ± 0.07[f]	15.95 ± 0.06[c]	27.07 ± 0.04[c]	67.04± 0.08[f]	1.86± 0.05[c]	17.59± 0.02[c]
85% WF+15%WGF	52.35 ± 0.05[g]	16.86 ± 0.06[b]	27.63 ± 0.05[b]	64.81± 0.06[g]	2.25± 0.06[b]	19.34± 0.03[b]
85% WF+15%WGF+MW	51.65 ± 0.04[h]	17.06 ± 0.06[a]	28.14 ± 0.05[a]	63.94± 0.04[h]	2.67± 0.04[a]	19.70± 0.03[a]

Means with different letters among treatments in the same column are significantly different ($p \leq 0.05$).Data are presented as means ± SDM (n=3).

3.4 Sensory analysis of pan bread.

The sensory properties of the pan bread samples are given in Table 7. Pan bread samples containing 15% wheat germ were subjected to sensory analysis due to nutritional superiority. Colour values of pan bread containing but high addition levels of wheat germ decreased the colour score. The appearance of the pan bread containing wheat germ was evaluated at a lower score by the panelists, compared to the control. 10–15% addition levels of wheat germ had a negative effect on the pore structure of the bread crumb. Replacement of wheat flour with wheat germ decreased the taste and odour of the pan bread compared to control pan bread due to the unique taste and odour of wheat germ.

Higher replacement levels of wheat germ (10–15%) decreased the overall acceptability score compared to control and other pan bread samples. **Sun et al., 2015** indicated that bread made with a mixed flour of wheat flour and wheat germ flour had acceptable sensory properties and the addition level of wheat germ flour is up to 6% of flour. Therefore, the addition of wheat germ flour could be an effective way to produce functional white flour bread without altering its desirable physical properties.

Table (7) Sensory evaluation of pan bread prepared from WF (72% extraction) different Levels of wheat germ flour and acid whey Milk.

Treatments	Shape 10	Crust Appearance 10	Crust color 10	Crumb color 10	Crumb texture 10	Grain cell structure 10	Taste 20	Odor 20	Overall 100
100 % WF.	9.0[a]	9.2[a]	9.25[a]	9.25[a]	9.35[a]	9.25[a]	18.45[a]	18.35[a]	92.10[a]
100 % WF+ MW	8.70[b]	8.7[b]	8.75[b]	8.85[b]	8.65[b]	8.80[b]	18.30[a]	18.05[ab]	88.80[b]
95% WF+5% WGF	8.0[c]	8.25[c]	8.35[c]	8.40[c]	8.20[c]	8.35[c]	17.90[b]	18.20[a]	85.65[c]
95% WF+5% WGF+MW	7.75[c]	7.8[d]	7.90[d]	8.00[d]	7.85[d]	7.95[d]	17.65[b]	17.75[b]	82.65[d]
90% WF+10% WGF	6.95[d]	7.15[e]	7.05[e]	6.90[e]	6.65[e]	6.85[e]	15.35[c]	15.35[c]	72.25[e]
90% WF+10% WGF+ MW	6.70[d]	6.7[f]	6.71f	6.70[e]	6.70[e]	6.70[e]	14.75[d]	14.80[d]	69.75[f]
85% WF+15% WGF	5.75[e]	5.5[g]	5.35[g]	5.50[f]	5.20[f]	5.40[f]	13.95[e]	14.00[e]	60.65[g]
85% WF+15% WGF+ MW	5.40[f]	5.25[g]	5.20[g]	5.25[f]	5.15[f]	5.25[f]	13.50[f]	13.70[e]	58.70[h]

Means with different letters among treatments in the same column are significantly different ($p \leq 0.05$).Data are presented as means ± SDM (n=3).

Also **Gómez et al., 2012** reported that adequate quality bread could be obtained by adding up to 5 g extruded WG per 100 g of flour. Also **Boukid et al., 2018** conducted that sensory acceptability was improved with the application of a low level of wheat germ flour (3%), while over 9% of taste and texture were hampered. According to sensory analysis, taste, crust color (light golden brown), and flavor were enhanced (up to 15% addition) due to the Maillard reactions products resulting from germ sugars and proteins interaction. **Al-Hooti et al., 2002** concluded that wheat germ enriched pan bread with acceptable physical texture and objective crumb color can be produced using WF, 20% WG, 0.5% SSL, and 30 ppm potassium bromate and 50 ppm ascorbic acid. The overall objective of producing a highly nutritious pan bread with acceptable textural and crumb color qualities than the presently available white bread was achieved in the present work

CONCLUSION

Wheat germ is a rich source of protein, lipids, vitamins, minerals, bioactive components and free saccharides. On the other hand it has certain adverse effects on the sensory properties of food. In the present study, the wheat germ was used in pan bread formulation at levels of up to 15%. Wheat germ replacement increased the ash, protein, lipid, crude fibre and mineral contents of the pan bread. The combination of wheat germ at high replacement levels adversely affected the specific volume and color parameters of the samples. The usage of wheat germ at 10–15% levels decreased the overall acceptability scores of pan bread. On the other hand, pan bread with wheat germ at a level of 5% showed sensory scores getting close to the control pan bread in all parameters with the exception of appearance. It can be concluded that 15 % wheat germ with or without whey milk can be used in pan bread formulation for nutritional and functional enrichment of pan bread without adverse effects on sensory quality except for appearance.

REFERANCES

AACC (2001). International Approved Methods of Analysis, 11th Ed. Method 10–05.01. Guidelines for measurement of volume by rapeseed displacement. First approval October 17, 2001. AACC International: St. Paul, MN.

Al-Hooti, S.N., Sidhu, J.S., Al-Saqer, J.M and Al-Othman, A. (2002). Effect of raw wheat germ addition on the physical texture and objective color of a designer food (pan bread). Nahrung/Food, 46 (2), pp. 68 – 72.

AOAC (2000). Official Methods of Analysis of AOAC International, 17th ed.; AOAC International: Gaithersburg, MD, USA.

AOAC (2003). Official methods of analysis of the Association of Official's Analytical

Chemist, 17th Edn. Association of Official Analytical Chemists, Airlington, Virginia.

Bansal, S and Sudha, M.L (2011). Nutritional, microstructural, rheological and quality characteristics of biscuits using processed wheat germ. Int J Food Sci Nutr, 62(5): 474–479

Bhatt, S. M. and Gupta, R. K. (2015). Bread (composite flour) formulation and study of its nutritive, phytochemical and functional properties. Journal of Pharmacognosy and Phytochemistry, 4 (2), 254–268.

Boukid, F., Folloni, S., Ranierib, R. and Vittadinia E. (2018). A compendium of wheat germ: Separation, stabilization and food applications. Trends in Food Science and Technology, 78, pp.120–133

Brandolini, A. and Hidalgo, A. (2012). Wheat germ: not only a by-product. International Journal of Food Sciences and Nutrition, 63, 71–74.

Commission of the European Communities Green Paper COM, (2008). 811, on the management of bio-waste in the European Union, Brussels. Retrieved from.

Dhingra, D. and Michael, M (2012). Hradesh Rand Patil RT . Dietary fibre in foods: a review J Food Sci Technol.; 49(3): 255–266

El-Assar, M. A., Bekheet, M. A., Hassanein, A. M. and Mayada, M. A. (2017). Effect of replacement of water by acid whey at different levels on quality characteristics of flat bread (balady) and fino bread. Bulletin of the National Nutrition Institute of the Arab Republic of Egypt. 50, 26-47.

El-Batawy, O.I., Mahdy, M.S. and Abo El-Naga, M.Y. (2018). Utilization of cheese whey and uf milk permeate in manufacture of Egyptian Baladi bread. Alex. J. Fd. Sci. and Technol. Vol. 15, No. 1, pp. 1-14,

Elleuch, M.; Bedigian, D.; Roiseux, O.; Besbes, S,; Blecker, C. & Attia, H. (2011). Dietary fiber and fiber-rich by-products of food processing: characterisation technological functionality and commercial applications. Rev.Food Chem., 124, 411-421.

Etzel, M.R. (2004). Manufacture and use of dairy protein fractions. J. Nutr. 134: 996S–1002S.

Gaber, A. M., Abd- El Satar, A.S. and Abdeen, I.M.I. (2017). Utilization of ras cheese sweet whey, acidic cheese whey and permeate to improve of baladi bread properties. J. Food and Dairy Sci., Mansoura Univ., Vol. 8 (11): 449 – 453.

Gómez, M., González, J., and Oliete, B. (2012). Effect of extruded wheat germ on dough rheology and bread quality. Food and Bioprocess Technology, 5(6), 2409–2418.

Hassan, A. A., El-Shazly, H. A. M., Sakr, A. M. and Ragab, W. A. (2013). Influence of substituting water with fermented skim milk, acid cheese whey or buttermilk on dough properties and baking quality of pan bread. World Journal of Dairy and Food Sciences 8 (1): 100-117.

Hunter, R. S. and Harold, R. W. (1987). The Measurement of Appearance, 2nd ed., John Wiley and Sons, Inc. New York, NY USA, 1987.

Kent-Jons, D.W. and Amos, A.J. 1967. Modern Cereal Chemistry, 6th Ed., Food Trade Press Ltd., London.

Królczyk1, J. B., Dawidziuk, T., Janiszewska-Turak, E and Sołowiej, B. (2016). Use of Whey and Whey Preparations in the Food Industry – a Review. Pol. J. Food Nutr. Sci., 66, No. 3, pp. 157–165.

Lanham-New, S. A (2008). Importance of calcium, vitamin D and vitamin K for osteoporosis prevention and treatment. Symposium on “Diet and bone health”. Proceedings of the Nutrition Society, 67, pp. 163–176.

Morisco, F., Vitaglione, P., Amoruso, D., Russo, B., Fogliano, V., and Caporaso, N., (2008). Foods and liver health. Molecular Aspects of Medicine 29, 144–150.

Mostafa, M. K. (1976). Parboiling of wheat enrichment and improvement of wheat flour for bread making. Ph.D. Thesis food Sci., Fac., of agric., Ain Shams University.

Mudau, M., Ramashia, S. E., Mashau, M. E., and Silungwe, H. (2021). Physicochemical characteristics of bread partially substituted with finger millet (Eleusine corocana) flour. Brazilian Journal of Food Technology, 24, e2020123. https://doi.org/10.1590/1981-6723.12320

Najafi, M., (2011). Date Seeds: A Novel and Inexpensive Source of Dietary Fiber. International Conference on Food Engineering and Biotechnology. 323- 326.

Nandeesh, K.; Jyotsna, R. & Venkateswara Rao, G. (2011). Effect of differently treated wheat bran on rheology microstructure and quality characteristics of soft dough biscuit. J. Food Proc. Preserv., 35, 79-200

Paula B.; Simone M.; Jakline E.; Luciana C. and Jonatas E. (2015). Sensory evaluation of bakery and confectionery products prepared through semi-industrial and artisanal processes. American Journal of Food Science and Technology, Vol. 3, No. 4A, 32-36.

Prasad, A. S (2008). Zinc in human health: Effect of zinc on immune cells. Molecular Medicine Cambridge Mass, 14, pp. 353–357

Pyler, E. J (1988). Baking science and technology. Kansas : Sosland Publishing Company, 1988. 1323 pp. ISBN 0-929005-00-7

Reda M.M. (2006). The effect of barley and barley fortified bread on diabetic rats. M.Sc. Thesis, of home Economics. Helwan Univ. Egypt.

Solak, B. B. and Akin, N. (2009). Nutritional value and health benefits of whey proteins. Conference: Food and Function. International scientific conference on nutraceuticals and functional foods 9th -11th June 2009, Zilina , Slovakia.

Sun, R., Zhang, Z., Hu, X., Xing, Q and Zhuo, W. (2015). Effect of wheat germ flour addition on wheat flour, dough and Chinese steamed bread properties. Journal of Cereal Science 64,153e158.

Tresca J. Amber (2012). About.com Guide. About.com Health's DiseaseandCondition. http://ibdcrohns.about.com/od/dietandnutrition/g/fiber.htm

Viuda-Martos M.; Ruiz Navajas Y.; Sánchez Zapata E.; Fernández-López J. and Pérez-Álvarez J.A. (2010) Antioxidant activity of essential oils of five spice plants widely used in a Mediterranean diet. Flavour and Fragrance Journal 25 (1):13-19.

Yitayew , T., Moges , D. and Satheesh, N. (2022). Effect of brewery spent grain level and fermentation time on the quality of bread. International Journal of Food Science, Article ID 8704684, 10 pages.

Youssef, H. M. K.E (2015). Assessment of gross chemical composition, mineral composition, vitamin composition and amino acids composition of wheat biscuits and wheat germ fortified biscuits. Food and Nutrition Sciences, 6, 845-853.

Zeng, Y. Zhang, H. Wang, L. Pu, X. Du, J. Yang, S. Liu, J (2010). Genotypic variation in element concentrations in brown rice from Yunnan Iandraces in China. Environmental Geochemistry and Health, 32, pp. 165–167.

تأثيرأضافة مسحوق جنين القمح و شرش اللبن على الخواص الكيميائية و التكنولوجية لخبز القوالب

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الملخص العربى

أن جنين القمح و شرش اللبن من الخامات الهامة التى تستخدم فى منتجات الحبوب. فى هذة الدراسة تم أستخدام جنين القمح بنسب خلط مختلفة (٠٪, ٥٪, ١٠٪ ,١٥٪) و شرش اللبن الحامضى للأستبدال دقيق القمح و ماء العجن المستخدم فى أنتاج خبز القوالب. كما تم دراسة تأثيرهما على القيمة الغذائية و الخواص الطبيعية و الحسية لخ,/:بز القوالب. أدى أستبدال دقيق القمح بجنين القمح إلى زيادة محتوى خبز القوالب من الرماد و البروتين و الدهن و الألياف الخام و الكالسيوم و الحديد و البوتاسيوم و الماغنسيوم و الزنك. كذلك فأن أستبدال ماء العجن بنسبة ١٠٠٪ بشرش اللبن الحامضى أدى لزيادة معنوية فى محتوى خبز القوالب من الكالسيوم و البوتاسيوم و الماغنسيوم و الزنك . كما أدى أستخدام كلاً من جنين القمح و شرش اللبن الحامضى بتركيز مرتفع١٠٪ و ١٥٪ إلى التاثير سلبياً على الحجم النوعى لخبز القوالب. كذلك فأن أستخدام جنين القمح بتركيز ١٥٪ بمفردة أو فى وجود شرش اللبن أدى إلى أنخفاض معنوى فى مختلف الخواص الحسية لخبز القوالب مثل الشكل الخارجى و الطعم و الرائحة و اللون مقارنةً بالعينة الحاكمة.

الكلمات المفتاحية:- خبز القوالب , جنين القمح , شرش اللبن , التحليل الكيميائى , الخواص الطبيعية , التقييم الحسي.