



# Preparation and Evaluation of Pan Bread Made with Wheat Flour and Psyllium Seeds for Obese Patients

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## **Author's contribution**

*The sole author designed, analyzed and interpreted and prepared the manuscript.*

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## **ABSTRACT**

In this covenant of functional foods, the world seeks for new healthier food products with appropriate proportions of bioactive constituents such as fiber, mineral elements, amino acids and phenols. The psyllium seed has good nutritional and pharmaceutical properties; therefore, its incorporation in pan bread could be beneficial in improving human health. In the current study, partial substitution of wheat flour (WF) with psyllium seed flour (PSF) at levels of 5%, 10% and 15% were carried out to investigate the rheology properties of dough, baking performance, proximate compositions and physical properties of the pan bread. Partial substitution of WF with PSF increased the water absorption, arrival time and developing time of dough ( $P \leq 0.05$ ), while, the dough extensibility was reduced. Also, elasticity and energy were increased by addition of PSF. Pan bread supplemented with PSF resulted in a reduction in quality in terms of specific loaf volume, while, weight was increased. PSF up to 15% could partially replace WF in pan bread; increase its nutritional value in terms of fiber, amino acids content and minerals, with only a small depreciation in the bread quality. Sensory evaluation showed that pan bread supplemented up to 15% PSF were acceptable to the panelists and there was significant difference in terms of appearance, crumb texture, crumb grain, crust color, taste, odor and overall acceptability compared to the control. The incorporation of PSF increased the minerals contents, amino acids contents and nutritional properties compared to the control (for pan bread).

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## 1. INTRODUCTION

Obesity causes several complications as well as dyslipidemia, diabetes, hypertension, and heart illness. In recent times, obesity has also been associated with the increased incidence of several cancers [1]. Dyslipidemia is a pathological disorder, and current evidence has highlighted not only total cholesterol but also triacylglycerol (TAG) as lipid risk factors in metabolic syndrome. Recently, community awareness in nutrition as a cornerstone for healthy life style has increased. Functional food is a concept of nutrition, based on the role of reducing the risk of illness. A food will be considered as a functional food if it gives one or more advantages or positive influences to the body beyond adequate nutritional influences in a way that is relevant to either enhance the stage of health and wellbeing and/or reduce the risk of illness [2]. Wheat (*Triticum aestivum*) is a main of the important palatable grains around the world [3]. It is used in several formulas comprises flat or pan forms leavened bread. WF is that it is depression in indispensable amino acids, such as lysine and methionine, which minimizes its nutritious value when use in foods produces [4].

*Plantago ovata*, the common name of the psyllium that described as a short-stemmed annual herb, which grows between (30- 40 cm), several of flowering shoots arise from the base of the herb [5]. Psyllium has been recorded in several countries around the world since ancient times, and its use in India until 1500 BC as medicine, as the Chinese used it as traditional medicine thousands of years ago.

Both Chinese and Indians used herb seeds to remediate of diarrhea, bladder problems constipation, high blood pressure and hemorrhoids, in North Americans and Europeans started using it as cholesterol and hyperglycemia treatment [6]. Psyllium used in instant juices, ice cream, breakfast cereals and in bakery products similar cakes, biscuits, breads and muffins with varying functional and health aspects [7].

*Plantago ovata* mucilage has an extended history as a nutritious addition due to its considerable extent of insoluble and soluble fiber being described as a pharmaceutically active gel forming natural polysaccharide, effectively used for the treatment of diabetes, high cholesterol, obesity in kids, remediation of diarrhea, constipation, ulcerative colitis and inflammation bowel diseases [8]. While, it's functional benefits, there are few reports about the combination of Psyllium in manufacturing foodstuffs [9] in developed countries Psyllium seed consumption essentially results from the intake of capsules and other dietary preparations. Psyllium is world-famous as a laxative, is a potential source of nutritious enhancement and has important biological antioxidant and anti-inflammatory properties [10,11]. *Plantago ovata* seeds comprise in 65% insoluble polysaccharides (lignin, cellulose and hemicellulose) and 35% of soluble fibers. The seeds comprise xylose, arabinose, rhamnose and galactose. Also, they verified that the polysaccharide of *Plantago ovata* husks can be used as a disintegrating agent in the improvement of fast-dissolving tablets [12]. The presence of mucilage's is on the level of 20–25% [13]. *Plantago ovata* psyllium is a source of natural and concentrated soluble fiber derived



**Plate 1. Psyllium plant (*Plantago ovata*)**



**Plate 2. Psyllium seed**

from psyllium husks. The husk is the represents the epidermal layer of the seeds, which is removed in a mechanical method. The total recovery of the husk is about 25–26% of the seeds. The husk comprises 4.07% ash, 6.83% fiber, 0.94% protein and 84.98% of total carbohydrates [14]. It was verified [15] that the psyllium hydrocolloid has a great potential to be used in the production of edible films with stimulating characterizes, that is, low water vapor permeability and high elasticity, elongation and a hydrophobic surface and solubility in water.

Bread is a staple food that closely related to people’s daily life. It consists of flour, leavening agents and water. It is popular around the world and one of the oldest foods. Bread is usually known as important source of carbohydrates in the food pyramid to ensure that a person can get enough nutrition that needed by the body [16]. To prepare healthy bread, bakers often reduce calories, fat and sugar, while increase fiber or water. Similarly, natural components are seeking to substitute chemically produced ones.

Rheology properties of numerous fluids are appropriate technologically to recognize the most proper dough system project as well as enhance operating circumstances [17]. Brabender farinograph parameters has been successfully used as a sensitive tool for the examine of characterization of bread dough properties; especially for the modifications caused by fiber at the period of mixing and developing of bread dough. Whereas, Brabender extensograph parameters permits indirect examination of the extension behavior of the dough at furthermore stages of bread making [18]. The aim of the present study was to investigate the effect of partial substitution of wheat flour with psyllium seeds flour on the dough properties and pan bread making, and estimation of its proximate composition, bread quality, sensorial and physical properties.

## 2. MATERIALS AND METHODS

### 2.1 Materials

Materials psyllium seed, wheat flour and other materials that used to produce pan bread such as fresh egg, instant active dry yeast, salt (sodium chloride) and shortening were purchased from the local market, Kafrelsheikh city, Egypt. All chemicals and solvents were used in this study were analytical grade and Sigma Company.

### 2.2 Methods

#### 2.2.1 Pan bread processing

The straight dough process was performed in pan bread preparation according to the method described by [19]. The control of pan bread was (300 g of WF and other materials), also three formulas 1, 2 and 3 contain (285 g WF+ 15 g PSF), (270 g + 30 PSF) and (255 g WF +45 g PSF), respectively.

Pan bread formulation is shown in Table 1.

### 2.3 Chemical Analysis

Psyllium seed flour and pan bread blends were analyzed for crude protein, ash, crude ether extract and crude fiber according to the methods of AOAC [20]. Available carbohydrates were calculated by difference.

$\% \text{Available carbohydrates} = 100 - (\text{protein} + \text{ash} + \text{ether extract} + \text{crude fiber})$   
Calorie value were calculated agreeing to the Atwater system FAO, [21].

$\text{Calorie value (kcal/100 g)} = (\% \text{carbohydrate} \times 4.1) + (\% \text{protein} \times 4.1) + (\% \text{fat} \times 9.1)$ .

### 2.4 Determination of Minerals

Minerals were analyzed according to the methods of AOAC [20].

**Table 1. Pan bread formulation**

Constituents	Control	Formula(1)	Formula(2)	Formula(3)
WF (72%)	100	95	90	85
PSF (%)	0	5	10	15
Salt (g)	2	2	2	2
Yeast (g)	1.5	1.5	1.5	1.5
Sugar (g)	2	2	2	2
shortening (g)	3	3	3	3

PSF = Psyllium seeds flour WF = wheat flour 72% extraction

## 2.5 Determination of Soluble and Insoluble Dietary Fiber

Soluble and insoluble fiber was determined according to the method described by Asp et al. [22].

## 2.6 Determination of Amino Acids

Amino acids were calculated according to the method described in AOAC [20].

## 2.7 Computed Protein Efficiency Ratio (C-PER)

C-PER was calculated as described by [23] following the equation: C-PER = 0.684+0.456 (Leucine)-0.047 (proline).

## 2.8 Computed Biological Value (BV)

Biological value was calculated as described by [24] according following equation: Computed Biological Value (BV) =49.9+10.53C-PER.

## 2.9 Rheological Properties

Rheological properties of the different mixtures were estimated by Brabender Farinograph and Extensograph apparatus according to AACC [25].

## 2.10 Sensory Evaluation of Pan Bread

Ten panelists from the staff of Sakha food Technology Research Laboratory., Agric. Res. Center. Egypt. were asked for sensory evaluation of pan bread appearance, volume, crumb texture, crumb grain, crust color, taste, odor and overall acceptability according to the method described by [26]. Panelists evaluated pan bread formulas on a 10 point hedonic scale.

## 2.11 Pan Bread Physical Parameters

The average weight of loaves was recorded after cooling the loaves for 3 hrs. The loaf volume was measured by rapeseed displacement method as described by AACC [27]. Specific volume (cm<sup>3</sup>/g) was calculated by dividing volume of the loaf by its weight.

## 2.12 Statistical Analysis

Statistical analysis was done using SPSS software (version 15) and Duncan's multiple range tests was used for mean comparison.

## 3. RESULTS AND DISCUSSION

### 3.1 Proximate Composition of WF and PSF Composite (g / 100 g on Dry Weight Basis)

Table 2 studied the chemical composition of WF 72% extraction and PSF on dry weight basis. WF 72% extraction and PSF were found to contain 11.81 and 16.40% for protein and 0.75 and 5.40% for crude ether extract and 0.45 and 3.70% for ash and 86.97 and 74.50% for total carbohydrates and 0.84 and 26.50% for crude fiber and 0.35 and 0.49% for soluble fiber and 0.49 and 20.50% for insoluble fiber and 398.5 and 306.20 Kcal / 100 g for caloric value, respectively. These results are nearly in agreement with [28] who found that PSF contained 17.4% protein and 24.6% crude fiber. Ziemichód, et al. [29] revealed that *Plantago ovata* contain 15.45 crude protein, 3.55 fat. Khalil et al. [30] reported that WF 72% extraction comprised 11.38% crude protein, 0.82% fat, 0.45% ash and 86.79% total carbohydrates. Hafez, [31] illustrated that WF 72% extraction contain 0.74% ether extract and 0.83% crude fiber.

**Table 2. Chemical composition of raw materials (g/ 100 g on dry weight basis)**

Raw materials	WF 72% extraction	PSF
Crude protein (%)	11.81 ±0.11	16.40 ±0.22
Crude ether extract (%)	0.75 ±0.06	5.40 ±0.20
Ash (%)	0.45 ±0.05	3.70 ±0.15
Total carbohydrates (%)	86.97 ±0.39	74.50 ±0.55
Available carbohydrates (%)	86.13±0.40	48.00±0.33
Crude fiber (%)	0.84 ±0.06	26.50 ±0.66
Soluble fiber (%)	0.35 ±0.03	6.00 ±0.06
Insoluble fiber(%)	0.49 ±0.05	20.50 ±0.25
Caloric value (kcal/100g )	398.51±0.88	306.20±0.78

- Each value was an average of three determinations ± standard deviation. - WF= wheat flour -PSF=psyllium seed flour

**Table 3. The chemical composition of pan bread (g/ 100 g on dry weight basis)**

Blends	Crude protein (%)	Ether extract (%)	Ash (%)	Crude fiber (%)	Available carbohydrates (%)	Caloric value (kcal/100 g)
Control	12.75 <sup>d</sup> ±0.05	3.80 <sup>d</sup> ±0.02	0.55 <sup>d</sup> ±0.01	0.80 <sup>d</sup> ±0.02	82.10 <sup>a</sup> ±0.11	413.60 <sup>a</sup> ±0.10
5% PSF	13.65 <sup>c</sup> ±0.02	3.95 <sup>c</sup> ±0.03	0.65 <sup>c</sup> ±0.02	2.11 <sup>c</sup> ±0.01	79.64 <sup>b</sup> ±0.12	408.71 <sup>b</sup> ±0.10
10% PSF	14.45 <sup>b</sup> ±0.03	4.20 <sup>b</sup> ±0.05	0.80 <sup>b</sup> ±0.02	3.38 <sup>b</sup> ±0.03	77.17 <sup>c</sup> ±0.14	404.28 <sup>c</sup> ±0.12
15% PSF	15.27 <sup>a</sup> ±0.04	4.45 <sup>a</sup> ±0.01	0.95 <sup>a</sup> ±0.01	4.65 <sup>a</sup> ±0.05	74.68 <sup>d</sup> ±0.15	399.85 <sup>d</sup> ±0.13

- Means with different letter in the same column are significantly different at LSD at ( $p \leq 0.05$ ). - Each value was an average of three determinations  $\pm$  standard deviation. - PSF\* psyllium seed flour

**Table 4. Mineral contents of PSF, WF pan bread and WF-PSF composite pan bread (mg / 100 g on dry weight basis)**

Mineral	Ca (mg/ 100 g)	Na (mg/ 100 g)	P (mg/ 100 g)	K (mg/ 100 g)	Mg (mg/ 100 g)	Fe (mg/ 100 g)	Mn (mg/ 100 g)	Zn (mg/ 100 g)
PSF	160.05 ±0.34	33.54 ±1.50	650.33 ±1.22	750.11 ±1.80	99.22 ±2.50	16.30 ±0.04	2.50±0.01	3.50 ±0.02
Control	17.03 ±0.45	4.95 ±0.05	132.50 ±1.24	150.00 ±0.65	107.55 ±0.44	1.90 ±0.03	0.82 ±0.02	4.30 ±0.07
05% PSF	23.58 ±0.23	6.40 ±0.30	156.80 ±1.33	176.40 ±0.88	107.15 ±0.55	2.45 ±0.02	0.89 ±0.03	4.17 ±0.11
10% PSF	30.77 ±0.24	7.82 ±0.40	182.77 ±1.60	206.60 ±1.70	106.75 ±0.65	3.18 ±0.03	0.97 ±0.01	4.13 ±0.02
15% PSF	38.20 ±0.23	9.25 ±0.66	208.75 ±1.55	236.80 ±1.90	106.32 ±1.33	3.92 ±0.06	1.05 ±0.01	4.09 ±0.05

- Each value was an average of three determinations  $\pm$  standard deviation. -PSF\* psyllium seed flour

### 3.2 Chemical Composition of Pan Bread (g/ 100 g on Dry Weight Basis)

Table 3 showed the comprise of the mean value of the chemical composition and caloric value of the produced pan bread substituted with 5%, 10% and 15% of PSF. The results explain crude protein, total fat, crude fiber and ash increased significant in pan bread substituted with PSF compared with control with out of PSF. This may be due to increased amount of crude fiber, total fat, crude fiber and ash in PSF. This clearly indicates that PSF can be an alternative source of dietary fiber in pan bread processing. This study is consistent with hose obtained by [32] found that biscuit prepared from psyllium seeds flour at different extent (0, 5,10 and 20% of PSF) increased of crude ether extract, crude fiber and ash. Whereas, available carbohydrates and caloric value reduced.

### 3.3 Mineral Contents of PSF, WF Pan Bread and WF- PSF Composite Pan Bread (mg / 100 g on Dry Weight Basis)

The data in Table 4 indicated that content of macro and micro mineral elements of control pan bread without PSF and pan bread enriched with PSF. It is clear from the table that pan bread enriched with PSF was increased the content of calcium (Ca), sodium (Na), phosphorus (P), potassium (K), manganese(Mn) and iron compare with control of pan bread prepared from WF. The data show a decrease in element of magnesium (Mg) and zinc (Zn) for pan bread enriched with PSF compared with control of pan bread. It is clear from the results that the pan bread content of mineral elements depends content of PSF. The PSF are comparatively source of indispensable minerals.

### 3.4 Na/k Ratio of PSF, WF and WF-PSF Pan Bread

Fig. 1 clear Na/K ratio and pan bread without of PSF or pan bread made from different extent of PSF. Na/K ratio of PSF was high in comparative with pan bread without of PSF or pan bread made from different level of PSF.

Na/K ratio less than one with increasing the levels of substitution (5%, 10% and 15%) of PSF pan bread. Aremu et al. [33] illustrated that Na/K ratio less than one have a great importance in the body for the control of high blood pressure.

### 3.5 Amino Acids Profile of PSF and Pan Bread Made from WF-PSF (g/100 g of Protein)

Data given in Table 5 presented the amino acid composition (g amino acid / 100 g protein.) of PSF, pan bread preparation of WF 72% extraction and different levels of WF-PSF of pan bread. The obtained results indicated that, the amount of total indispensable amino acids of pan bread formulas contained (5% PSF, 10% PSF and 15%PSF) were relatively higher compared to pan bread prepared from wheat flour (72% extraction). On the other hand, total non-essential amino acids contents were lower in formulas prepared with WF-PSF pan bread compared to control prepared from wheat flour 72% extraction. Computed protein efficiency ratio C- PER and biological value BV of PSF, pan bread made from WF and pan bread made from WF- PSF were presented in Table 5. The results in this Table showed that the (C-PER and BV) were higher in formulas prepared with (5% ,10% and 15% SPF) than those of control WF.

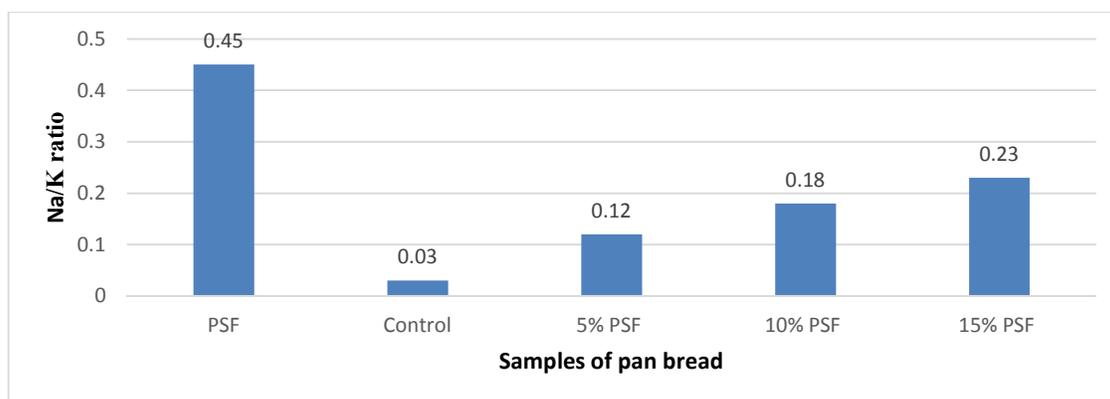


Fig. 1. Na/k ratio of PSF, WF and WF-PSF pan bread

**Table 5. Amino acids profile of PSF and pan bread made from WF-PSF (g/100 g of protein)**

Amino acids	PSF	Control	5% PSF	10% PSF	15% PSF
<b>Essential amino acids</b>					
Lysine	6.33	2.60	2.76	2.95	3.15
Isoleucine	5.02	4.03	4.15	4.20	4.25
Leucine	8.10	4.25	4.45	4.63	4.83
Phenyl alanine	4.18	5.26	5.20	5.15	5.10
Tyrosine	6.20	1.90	2.05	2.30	2.50
Histidine	3.50	4.00	3.98	3.95	3.93
Valine	5.80	4.40	4.45	4.55	4.60
Theronine	4.90	2.00	2.10	2.25	2.45
Methionine	2.21	1.20	1.30	1.35	1.40
Total (EAA)	46.24	29.64	30.44	31.33	31.21
<b>Non-essential amino acids</b>					
Aspartic	7.55	5.50	5.55	5.65	5.75
Glutamic	13.00	32.55	31.10	31.10	30.09
Proline	7.60	12.80	12.50	12.20	11.90
Serine	5.10	6.80	6.70	6.60	6.45
Glycine	5.55	3.60	3.85	4.00	4.15
Alanine	6.12	3.80	3.75	3.88	4.00
Arginine	8.20	2.33	2.70	3.10	3.42
Total (NEAA)	53.12	67.38	66.15	66.53	65.76
C-PER	4.04	2.03	2.13	2.22	2.33
BV	92.23	71.27	72.28	73.30	74.41

EAA: Essential amino acids. NEAA: Nonessential amino acids C-PER = Computed protein efficiency ratio. BV = Biological value

**Table 6. Some amino acids ratio of PSF, control, 5% PSF, 10% PSF and 15% PSF of pan bread as compared with casein**

Ratio	PSF	Control	5%PSF	10%PSF	15%PSF	Casein
Methionine : Glycine	0.40	0.33	0.34	0.34	0.34	1.72
Lysine: Arginine	0.77	1.12	1.02	0.95	0.92	1.78
Leucine: Isoleucine	1.61	1.05	1.07	1.10	1.14	1.04

**Table 7. Farinograph parameters WF and WF-PSF dough**

Samples	Water absorption (%)	Arrival time (min)	development Dough (min)	Stability (min)	Degree of softening (B.U)
Control	59.2±0.50	0.5±0.05	1.0±0.03	10±0.22	40±0.40
5 % PSF	62.7±0.55	1.0±0.03	2.5±0.04	12.50±0.20	30±0.30
10 % PSF	65.3±0.60	1.5±0.02	3.5±0.05	16.00±0.15	20±0.25
15 % PSF	68.6±0.45	2.0±0.01	4.5±0.06	18.50±0.25	20±0.32

- Each value was an average of three determinations ± standard deviation .-PSF\* psyllium seed flour.

**3.6 Some Amino Acids Ratio of PSF, Control, 5% PSF, 10% PSF and 15% Psf of Pan Bread as Compared with Casein**

Table 6 show some amino acids ratio of PSF, control, 5, 10 and 15% of PSF pan bread as compared with casein. Methionine: glycine ratios were 0.40, 0.33, 0.34, 0.34, 0.34 and 1.72 for PSF, control ,5, 10 and 15% of PSF pan bread and casein, respectively. Also, lysine: arginine

ratios were 0.77, 0.1.12, 1.02, 0.95, 0.92 and 1.78 for f PSF, control, 5, 10 and 15% of PSF pan bread and casein. On the other hand, leucine: isoleucine ratios were 1.61, 1.05, 1.07, 1.10, 1.14 and 1.04 for PSF, control 5, 10 and 15% of PSF pan bread and casein, respectively.

Methionine: glycine ratios and lysine: arginine ratios of casein was high in comparative with raw materials amino acids, led to hypocholesterolemic ratio in serum of blood. On

the contrary, leucine: isoleucine ratio of raw materials was high compare with casein. Also, a significant strong positive correlation with serum cholesterol concentration was observed [34].

### 3.7 Farinograph Test

Results in Table 7 explain the rheological characterize estimated by farinograph apparatus for four formulas using wheat flour without or with PSF. From these results it could be noticed that addition of PSF to WF lead to increase the water absorption (%), arrival time (min), development dough (min), stability (min). On the other hand, degree of softening (B. U) was decreased with added of PSF. The high capacity of water absorption of psyllium husk is due to the molecular structure of Psyllium Seed, 75% xylose, 23% arabinose, traces of other sugar, and almost 35% of non-reducing terminal remains [35]. The influences of oat bran and wheat bran as sources high concentrations of soluble and insoluble fiber in the formulation of instant vermicelli, in addition to its influence on the rheological properties and product quality. The addition of oat bran and wheat bran from (0 to 20 %) in the blends raised the water absorption significantly from 58.3 to 64.1 % [36].

### 3.8 Extensograph Test

The results presented in Table 8 clarify the effect of adding 5, 10 and 15 % of PSF to WF on the

extensograph parameters. From these results it could be noticed that addition of PSF to WF lead to increase the elasticity (B.U), proportional number and energy (cm<sup>2</sup>) compare with control dough. On the contrary, extensibility (min) was reduced. Energy was increased by addition PSF at levels of 5 and 10% of PSF were (62 and 76 cm<sup>2</sup>), respectively. Also, proportional number increased in all formulas enriched with PSF.

### 3.9 Sensory Evaluation of Pan Bread

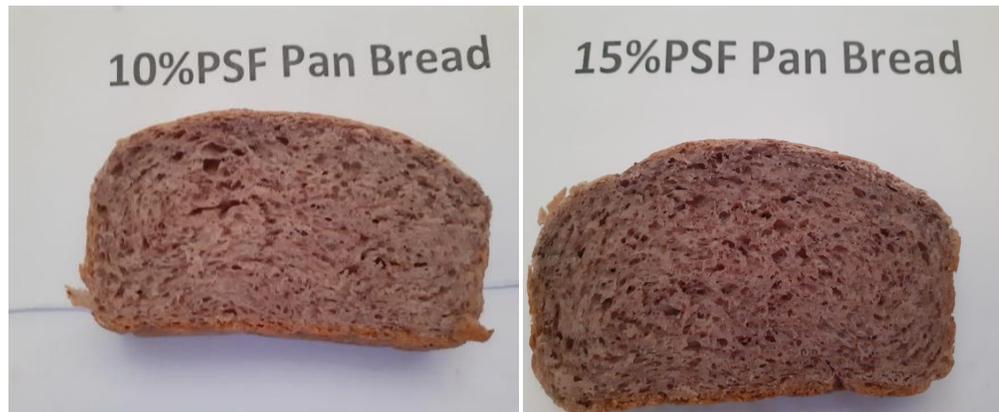
Results of sensory parameters such as appearance, volume, crumb texture, crumb grain, crust color, taste, odor and overall acceptability are presented in Table 9 and Fig. 2. It could be observed that all the formulas were significant decrease in appearance, volume, crumb texture, crumb grain, crust color, taste, odor and overall acceptability. pan bread produced by partial substitution of wheat flour with PSF at extent 5,10 and 15% characterized with good sensorial properties. It seems, that the decrease in pan bread volume resulting from increased level of the PSF or fiber addition is most likely due to the combined effects of gluten dilution and mechanical disruption of the gluten network structure by the SPF particles.

**Table 8. Extensograph parameters of WF and WF-PSF dough**

Dough properties	Elasticity (B.U)	Extensibility (min)	Proportional number	Energy (cm <sup>2</sup> )
Control	220±2.33	130±0.35	1.69±0.03	47±0.65
5% PSF	440±3.50	80±0.80	5.50±0.02	62±0.65
10% PSF	600±4.70	75±0.65	8.00±0.04	76±0.70
15% PSF	720±3.50	50±0.65	14.40±0.08	51±0.80

- Each value was an average of three determinations ± standard deviation.-PSF\* psyllium seed flour.





**Fig. 2. Pan bread formulas enriched with PSF**

The differences in the color of pan bread enriched with PSF resulted from two reasons. The first and dominant was the color of the PSF, which was characterized by a greyish shade and strongly affected the overall color of the dough and breads. This was also noticed by the panelists. On the contrary, when comparing the chemical composition of WF and PSF it was indicated that the WF was characterized by a higher protein content, which had a significant influence on the Maillard reaction during baking.

### 3.10 Physical Properties of Fortified Pan Bread

The impact of pan bread fortification with PSF on weight (g), volume (cm<sup>3</sup>) and specific volume (cm<sup>3</sup>/g) are presented in Table 10. From the results, it is revealed that pan bread enriched with PSF had lower values in volume and specific volume compare control pan bread. On the contrary, weight increased with increasing PSF ratio. These results are in agreement with [37] who explained that the volume of the bread reduced as the extent of PSF increased, the volume due to interactions among dietary fiber components, gluten and water. The increased amount of mucilage of PSF reduced swelling of gluten in the WF-PSF biscuits and due to limited of volume according to [32].

### 3.11 Discussion

*Plantago psyllium* mucilage or *Plantago psyllium ovata* is a food grade polysaccharide. It has soluble fiber component. Psyllium has wide use in various health problems. Several investigators have studied amazing health benefits of psyllium mucilage particularly cholesterol control, preparation for colonoscopy procedure,

enhancing absorption of water during ingestion subsequent to relaxed stools and reduced pain associated with hemorrhoids, colon cancer prevention, high sugar levels in blood, obesity and weight loss, inflammatory bowel disease, and widely used as laxative [38]. Ziemichód, et al. [29] demonstrated that psyllium seeds contain Na, Ca, K, Fe, Mn and Zn were 331, 1440, 7380, 183, 12.2 and 27.4 mg / kg, respectively. Romero-Baranzini et al. [28] found that PSF surpassed the requirement of indispensable amino acids and seems to be a good source of lysine and methionine (6.82 and 2.61 g/100 g of protein, respectively). These values are higher than that reported for a *Plantago ovata* cultivar from India with 4.14 and 1.7 g/100 g of protein for lysine and methionine, respectively [39]. Genotypic and environmental variances could reason for the observed variances. The variances in water absorption is principally caused by numerous hydroxyl groups existing in the fibers and let more water interaction throughout hydrogen bonding [40].

The comparatively stable water activity in pan bread crumb, in spite of the increase in water content from incorporating hydrate PSF, due to enhance pan bread softness without significantly increasing the hazard microbial deteriorate [41]. The increased quantity of mucilage of PSF reduced swelling of gluten in the WF-PSF biscuits and due to limited of volume according to [32]. The results showed that sensorial parameters, at 5, 10 and 15% of the PSF addition to the pan bread the quality parameters of the pan bread significantly deteriorated at 15% portion of wheat flour, the color deteriorated (was too greyish in panelists opinion), it seems that 5, 10 and 15 % PSF fortification of pan bread is suitable to obese patients.

**Table 9. Sensory evaluation of pan bread fortified with PSF**

<b>Blends</b>	<b>Appearance (10)</b>	<b>Volume (10)</b>	<b>Crumb texture (10)</b>	<b>Crumb grain (10)</b>	<b>Crust color (10)</b>	<b>Taste (10)</b>	<b>Odor (10)</b>	<b>Overall Acceptability (10)</b>
Control	9.70 <sup>a</sup> ±0.52	9.75 <sup>a</sup> ±0.22	9.50 <sup>a</sup> ±0.32	9.30 <sup>a</sup> ±0.46	9.40 <sup>a</sup> ±0.22	9.20 <sup>a</sup> ±0.22	9.20 <sup>a</sup> ±0.32	9.20 <sup>a</sup> ±0.44
5% PSF	8.80 <sup>b</sup> ±0.48	8.50 <sup>b</sup> ±0.50	9.00 <sup>ab</sup> ±0.59	8.80 <sup>b</sup> ±0.74	8.30 <sup>b</sup> ±0.50	8.50 <sup>b</sup> ±1.70	8.80 <sup>ab</sup> ±1.11	8.00 <sup>b</sup> ±0.40
10% PSF	8.20 <sup>bc</sup> ±0.41	7.80 <sup>c</sup> ±0.28	8.80 <sup>b</sup> ±0.86	8.50 <sup>b</sup> ±1.70	8.10 <sup>b</sup> ±0.59	8.00 <sup>d</sup> ±0.48	8.30 <sup>bc</sup> ±1.77	7.50 <sup>b</sup> ±0.36
15%PSF	7.50 <sup>c</sup> ±0.42	7.30 <sup>d</sup> ±1.69	8.50 <sup>b</sup> ±1.70	7.60 <sup>c</sup> ±1.11	6.70 <sup>c</sup> ±1.70	7.20 <sup>d</sup> ±1.77	7.80 <sup>c</sup> ±1.60	6.70 <sup>c</sup> ±1.77

*-Means with different letter in the same column are significantly different at LSD at (p ≤ 0.05). - Each value was an average of ten panelists ± standard deviation. -PSF\* psyllium seed flour*

**Table 10. Influence of enriched wheat flour with PSF on the physical parameters of pan bread**

Samples	Volume (cm <sup>3</sup> )	Weight(g)	Specific volume (cm <sup>3</sup> /g)
Control	1375±4.45	460±02.40	2.98±0.02
5 % PSF	1325±6.33	510±2.20	2.60±0.42
10 % PSF	1164±5.20	535±2.70	2.18±0.03
15% PSF	1011±7.30	560±2.55	1.81±0.05

- Each value was an average of three determinations ± standard deviation. -PSF\* psyllium seed flour

#### 4. CONCLUSION

From the overall results, it could be concluded that the partial substitution of wheat flour with psyllium seeds flour was modified the rheological properties of the dough to different extent. Inclusion of PSF in pan bread formula; increase its nutritional value, with only a small depreciation in pan bread quality. Organoleptic properties shown that the loaf supplemented up to 15% PSF was acceptable and has significant difference with control in terms of appearance, crumb texture, crumb grain, crust color, taste, odor and overall acceptability. Regardless to this, it could prepare some bakery products using PSF and WF flours with high quality that are suitable for obese patients.

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#### COMPETING INTERESTS

Author has declared that no competing interests exist.

#### REFERENCES

- Huang XF, Chen JZ. Obesity, the PI3K/Akt signal pathway and colon cancer, *Obesity Reviews*. 2009;10(6):610–61.
- Roberfroid MB. A European consensus of scientific concepts of functional foods. *Nutrition*. 2000;16(7-8):689–691.
- Alu'datt MT, Ereifej K, Alli I, Alrababah M, Almajwal A, Masadeh N, Alhamad M. Effects of barley flour and barley protein isolate on chemical, functional, nutritional and biological properties of pita bread. *Food Hydrocolloids*. 2012;26:135-143.
- Newman CW, Newman RK. A brief history of barley foods. *Cereal Foods World*. 2006; 51:4-7.
- Jat RS, Reddy RN, Bansal R, Manivel P. Good agriculture practices, for Isabgol. ICAR Directorated of Medicinal and Aromatic Plants Research. Gujarat –India; 2015.
- Ashwini RM, Monica RP, Deepa W. Characterization of Psyllium (*Plantago ovata*) polysaccharide and its uses. Springer International Publishing Switzerland. 2014;1-17.
- Ziai SA, Larijani B, Akhoondzadeh S, Fakhrzadeh H, Fakhrzadeh Dastpak A, Bandarian F, Rezai A, Badi HN, Emami T. Psyllium decreased serum glucose and glycosylated hemoglobin significantly in diabetic outpatients. *J. Ethnopharmacol*. 2015;102:202-207.
- Singh B. Psyllium as therapeutic and drug delivery agent. *Int J Pharm*. 2007;334(1–2):1–14.
- Bedard AM, Lai GH, Wullschleger RD, Kincaid JG. Psyllium enriched pasta products and methods for making same. US Patent 5384144; 1995.
- Samuelsen AB. The traditional uses, chemical constituents and biological activities of *Plantago major* L. A review. *J. Ethno Pharmacol*. 2000;71:1–21. DOI: 10.1016/S0378-8741(00)00212-9.
- Beara IN, Lesjak MM, Jovin ED, Balog KJ, Anačkov GT, Orčici, DZ. Plantain (*Plantago L.*) species as novel sources of flavonoid antioxidants. *J. Agri. Food Chem*. 2009;57:9268–9273. DOI: 10.1021/jf902205m
- Pawar H, Varkhade C. Isolation, characterization and investigation of *Plantago ovata* husk polysaccharide as super disinter grant. *International Journal of Biological Macromolecules*. 2014;69: 52–58.
- Olivier SD. The long-term safety and tolerability of ispaghula husk. *The Journal of the Royal Society for the Promotion of Health*. 2000;120:107–111.
- Guo Q, Cui SW, Wang Q, Young JC. Fractionation and physicochemical characterization of gum. *Carbohydr. Polym*. 2008;73:35-43.
- Sukhija S, Singh S, Riar CS. Analyzing the effect of whey protein concentrate and

- psyllium husk on various characteristics of biodegradable film from lotus (*Nelumbo nucifera*) rhizome starch. Food Hydrocolloids. 2016;60:128–137.
16. Sivam AS, Sun-Waterhouse D, Siew YQ, Perera CO. Properties of bread dough with added fiber polysaccharides and phenolic antioxidants: A review,” Journal of Food Science. 2010;75(8):163-174.
  17. El Sheikh, Dalia M. Rheological characteristics of Arabic gum suspension and *Plantago* seeds mucilage, Journal of American Science, 2014;10(11):18-24.
  18. Koletta P, Irakli M, Papageorgiou M, Skendi A. Physicochemical and technological properties of highly enriched wheat breads with wholegrain non wheat flours. J Cereal Sci. 2014; 60(3):561–568.
  19. Curie D, Dugum J, Bauman I. The influence of fungal amylase supplementation on amylolytic activity and baking quality of flour. International J. Food Sci. and Technology. 2002;37:673–680.
  20. AOAC. Official Methods of Analysis of the Association of Official Analytical Chemists. 18th edition, Washington DC; 2005.
  21. FAO. Food energy. Methods of analysis and conversion factors. Food and Nutrition Paper 77. Report of a technical workshop, Rome; 3-6 December, 2002. ISSN: 0254-4725.
  22. ASP NG, Johansson GG, Haller H, Siljestrom M. Rapid enzymatic assay of insoluble and dietary fiber. Journal of Agricultural and Food Chemistry. 1983;31: 476-482.
  23. Alsmeyer RH, Cuningham AE, Happich, M. L. Equations predict PER from amino acid analysis. Food Techno. 1974;28(7): 34-40.
  24. Farag SA, El-Shirbeeney A, Nassef A. Physicochemical studies for preparing quick-cooking rice by using gamma irradiation. Annals of Agric Sci., Moshtohor. 1996;34:641-652.
  25. AACC. International Methods approved of the American Association of Cereal Chemists, 11th ed., American Association of Cereal Chemists, INC., St. Paul, Minnesota, USA; 2012.
  26. Matz SA. Bakery Technology and Engineering. The AVI Pub. Co., Westport, Connecticut; 1972.
  27. AACC Approved method of the American Association of Cereal Chemists Published by American Association of Cereal Chemists Inc. St. Paul, Minnesota, U.S.A; 1983.
  28. Romero-Baranzini AL, Rodriguez OG, Yanez-Farías GA, Barron-Hoyos JM, Rayas-Duarte P. Chemical, Physicochemical, and Nutritional go (*plantago ovata* Forsk). J Cereal Chem. 2006;83(4):358-362.
  29. Ziemichód A, Wójcik M, Rózyło R. Seeds of *Plantago psyllium* and *Plantago ovata*: Mineral composition, grinding, and use for gluten-free bread as substitutes for hydrocolloids. J Food Process Eng. 2018; 1-9.
  30. Khalil Mona M, Hussein MA, Salaby MT, Ghonim JA. Nutritional and biological evaluation of high nutritive biscuits processed for primary school children. Proceeding of the First Arab Mansoura Conf. of Dairy Sci and Technol., J. Agric. Sci. 2002;131-142.
  31. Hafez Hoda HA. Production and evaluation of some bakery products supplemented with soybean products. MSc. Thesis Food Sci and Technol., Dept., Faculty of Agric., Cairo Univ., Egypt; 2004.
  32. Krystyjan M, Gumul D, Korus A, Korus J, Sikora M. Physicochemical properties and sensory acceptance of biscuits fortified with *Plantago psyllium* flour. Emirates Journal of Food and Agriculture. 2018; 30(9):758-763.
  33. Aremu MO, Olaofe O, Akintayo TE. Comparative Study on the Chemical and Amino Acid Composition of Some Nigerian Under-Utilized Legume Flours. Pakistan Journal of Nutrition. 2006;5:34-38.
  34. El Hadidy GS. Chemical, technological and biological studies on mulberry leaves and purslane in Egypt. Ph.D. Thesis, Fac. Agric. Food Technology Dep., Mansoura Univ., Egypt; 2014.
  35. Fischer H, Yu N, Gray GR, Ralph J, Anderson L, Marletta JA. The gel forming polysaccharide of psyllium husk (*Plantago ovata* Forsk). Carbohydrate Research. 2004;339:2009–2017.
  36. Sudha ML, Rajeswari G, Venkateswara Rao G. Effect of wheat and oat brans on the dough rheological and quality characteristics of instant vermicelli. Journal of Texture Studies; 2011. DOI: 10.1111/j.1745-4603.2011.00329.x,1-8.

37. Man S, Paucean A, Muste S, Anamaria POP, Muresan EA. Influence of Bulletin UASVM Food Science and Technology. 2017;74(1):33-34.
38. Kumar D, Pandey J, Kumar P, Raj V. Psyllium Mucilage and Its Use in Pharmaceutical Field: An Overview, J. Curr Synthetic Sys Biol. 2017;5(1):1-7.
39. Chakraborty MK, Patel KV. Chemical composition of isabgol (*Plantago ovata* Forsk) seed. J. Food Sci. Technol. 1992; 29:389-390.
40. Rosell CM, Rojas JA, Benedito de Barber, C. Influence of hydrocolloids on dough rheology and bread quality. Food Hydrocolloids. 2001;15:75-81.
41. Czuchajowska A, Paszczynska B, Pomeranz Y. Functional properties of psyllium in Wheat-Based products. J. Cereal Chemistry. 1992;69(5):516-520.

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