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Effect of pumpkin and psyllium husk seed powder on dough rheology, sensory and quality of pan bread

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ABSTRACT

The present work was conducted to study the effect of pumpkin and psyllium husk seed powders as a source of dietary fiber on dough rheology and pan bread quality. Dietary fiber promoted several beneficial metabolic and physiological effects in human. Therefore, the present study was carried out to use plant sources rich in dietary fiber from pumpkin (P_k), and psyllium husks (P_s) in bread making. The physicochemical and functional properties of these plant sources rich in dietary fiber were also determined. Crude fiber of these plants ranged between 66.7% (P_s) as a maximum ratio to 16.1% (P_k) as minimum. On the other hand, the same samples had either very low levels of fat being 0.01 P_s, or relatively higher fat level being 2.03 in P_k on dry matter basis (DMB). As regard to the three dietary fiber fractions celluloses, hemicelluloses and lignin, they constitute about 66.4, 0.49 and 14.5% from total dietary fiber (TDF) in P_k and 7.3, 54.7 and 0.5 % in P_s, respectively. All plants used in the present investigation as a source of dietary fibers contained relatively large amounts of both K (246.83 : 605.94), Fe (106.04 : 79.06) and Ca (99.60 :121.63 mg/100 g DMB) in (P_s and P_k), respectively. Differential Scanning Calorimetry (DSC) and Thermogravimetric Analysis (TGA) of the P_k, and P_s samples were carried out. Pan bread was baked from tested wheat flour supplemented with P_k and P_s powders at 2.5, 5, 7.5 and 10% and both dough and bread properties as well as the sensory attributes were tested.

In conclusion, psyllium husk powder were the most successful additions because one can add as much as 10% dietary fiber source with slight less overall acceptability of ban bread which may be compensated when one can obtain the main benefits from eating functional food in a form of bread rich in dietary fibers.

Key words: Dietary fibers; Pumpkin; Psyllium Husk Seed; Particle Size; Thermogravimetric Analysis (DSC and TGA); Bread quality; Sensory evaluation.

INTRODUCTION

Pumpkin, from the genus *Cucurbita* of family Cucurbitaceae, is green in colour when unripe, and turns yellow on ripening (Caili *et al*., 2007). In 2007, 10224 metric tons of pumpkin was produced in Malaysia mainly for local consumption. Emadi *et al.* (2007) reported that there was a high demand for pumpkin by people living in Asia and the Pacific countries. Pumpkin has been receiving an increasing attention due to its nutritional value, polysaccharides content of the fruit, and the oil content of the seeds (Murkovic *et al.*, 2004). Jun *et al.* (2006) reported that pumpkin is processed into various food products as it is a good source of carotene, pectin, mineral salts, vitamins, and other bioactive substances, such as phenolic compounds and terpenoids (Crozier, 2003). According to Li *et al.* (2005), protein-bound polysaccharides from the pumpkin pulp could help to regulate the serum insulin levels, reduce blood glucose levels and improve glucose tolerance.

According to a study by See *et al.*, (2007), protein content of pumpkin powder was reported to be 9%, while, other studies reported it to be 9.65%. While protein content in wheat flour was

7% to 15% (Atwell, 2001), reflecting the potential application of pumpkin flour to be used as substitution for wheat flour or as wheat–pumpkin composite flour blend. Cauvain and Young, (2000), reported that fibrous material from sources other than wheat could be supplemented into bakery products to confer particular nutritional or sensory properties. According to Noor and Komathi (2009) pumpkin powder contains 40% cellulose, 4.3% hemi cellulose, and 4.3% lignin, which are the main components of insoluble dietary fiber. Consumption of high-fiber diet has been reported to be protective against various health disorders such as diabetes mellitus, cardiovascular diseases, constipation, appendicitis, hemorrhoids, and colon cancer. Studies have researched about the application of pumpkin powder to enhance the loaf volume and organoleptic acceptability of wheat bread (Ptitchkina *et al.*, 1998).

Plantago ovata (psyllium) is an annual herb mainly cultured in North Gujarat in India. The plant is normally 12 to 18 inch in height, with numerous small white flowers. The seeds are enclosed in capsules. Generally, psyllium is cultured for its mucilage content, which is a white fibrous material with hydrophilic property. The mucilage can be obtained by mechanical milling/grinding, and is usually referred to as husk. Interest in psyllium arose due to a variety of health benefits. In world market, India is the primary country that produces and exports psyllium, while the United States is the largest importer of psyllium, and over 60% of imported psyllium husk is used in pharmaceutical products (Cheng *et al*., 2004).

Psyllium, prepared from the seed husk of *Plantago* genus including *P. ovata* and P. psyllium, contains about 78% soluble fibres and 13% insoluble fibres and is an excellent dietary source of both soluble and insoluble fibres**.** Psyllium intake has been shown to reduce total plasma and LDL cholesterol, the risk of colon cancer, and hyperglycemia, and may have potential in body weight control and treatment of irritable bowel syndrome and constipation (Yu *et al.,* 2008). However, incorporation of psyllium in food formula at the levels required for health claim on the label is a great challenge because of its extremely strong water uptake and gelling capacities (Miyuki *et al.,* 2017).

Psyllium has also been incorporated into ready-to-eat cereal bars. Ringe and Stoll (1991) developed a type of psyllium-fortified ready-to-eat cereal bar which contained about 2% to 37% psyllium with the minimum content of soluble fibers of 3g/oz. Compared to former ready-to-eat cereal products, fortified with dietary fiber contained a higher proportion of soluble fibers, which provide more health benefits. Furthermore, they claimed that this type of product offered a more pleasing organoleptical effect.

Methods were established to add psyllium into aqueous food products, filed a patent on developing a psyllium hydrophilic mucilloid with increased mixablility as well as dispensability (Samira, *et al.,* 2016).

MATERIALS AND METHODS

Materials:

Pumpkin (*Cucurbita moschata*).

Mature pumpkin vegetables each weighing 5-7 kg were obtained from AL Oboor market. After cleaning , peeling and trimming they were sliced by special tools to slices of 1.5-2 mm thickness and blanched in hot water at 95°C for 5 min, then washed in cold water, dried in an air oven at 65 ºC over night and milled into a powder form by the hammer mill.

Psyllium seed husks (Genus: *Plantago*)**:**

These were obtained from Al-Azher district (it is called red katona or lesan El-hamal). They were additionally air dried for 1 h., ground to a powder form with hammer mill.

Methods:

Chemical analysis:

Moisture, protein, fat, crude fiber and ash content of the investigated samples were carried out according to the (AOAC, 2007). Total carbohydrates are given by difference.

Dietary fiber content

Dietary fiber (DF) content was determined by an enzyme method according to AOAC (2007). The method gives the sum of insoluble (IDF) and soluble dietary fiber (SDF) contents, determination of insoluble dietary fiber compounds cellulose; hemicellulose and lignin were carried out according to (Perez *et al.*, 1997).

Minerals analysis

Minerals (K, Na, Mg, Fe, Ca, Cu, Mn and Zn) contents were estimated using Atomic Absorption (GBC 932/933-England) according to procedure outlined by AOAC (2007).

Physical properties

Particle size distribution

Sample weight of 100 g was pleased at the top surface of graded sieves formed of six units of 500, 400, 355, 200, 160 µm and <160 µm. The stack of the six sieves was mechanically shaked by a vibrator (Veb Mlw Labortechinik Il Menau Car), at speed (8) until the weight of the material on the smallest sieve had reached equilibrium (Sangnark and Noomhorm, 2003) .

Thermal Analysis

Differential scanning calorimetry (DSC)

DSC measurements were carried out on DSC-60 (Shimadzu Co.; Kyoto, Japan) calorimeter at temperatures within 50-200 ºC in an inert gas stream (nitrogen). The measurements of the tested samples were performed using around 10 mg of each sample that were put into an aluminum pan. A sample pans were heated at rate 10ºC/min from 50–200ºC. Onset temperature (T_o) ; peak temperature (T_p) ; conclusion temperature (T_c) and enthalpy of gelatinization (ΔH_{gel}) were calculated automatically (Kaur *et al.*, 2002) . The gelatinization temperature range (R_t) was computed as (T_c-T_o) as described by Vasanthan and Bhatty, (1996). Enthalpies were calculated on a flour dry basis. The peak height index (PHI) was calculated by the ratio $\Delta H/ (T_p-T_o)$ as described by Mousia *et al.* (2004).

Thermogravimetric analysis (TGA)

TGA was carried out by a Shimadzu TGA-50H (Japan) apparatus, the measurements of the tested sample were performed using about 10 - 20 mg of each flour sample. Samples were heated from 20 to 600ºC with heating rate of 10ºC/min. Analyses were carried out under a nitrogen atmosphere with a 20 ml/min flow rate using alumina cell. Degradation temperatures were determined from the DTG scans, as the peak maximum (Averousa and Boquillon, 2004).

Rhelogical properties of dough

Alveograph tests

Alveograph characteristics were determined according to the approved method No. 54–30 (AACC, 2000) by using an Alvéograph NG, (Chopin France) and the dough properties were determined in five replications. The Alveograph provides valuable information on dough visco-elasticity and is mainly characterised by using the standard procedure for the alveographic measurements, tenacity (P in mm H_2O) and extensibility (L in mm) as described by the AFNOR method V03-710, baking strength (W in 10^{-4} J), configuration ratio of the curve (P/L) and elasticity index **(**Ie in percentage) were assessed.

Mixolab tests

The Mixolab system, recently launched by Chopin Technologies

(France), measures and plots in real time the torque (expressed in Nm) produced by passage of the dough between the two kneading arms, thus allowing the study of mixing and pasting behaviour of the wheat flour dough (Rosell *et al.* , 2007). For the assays, 50 g of wheat flour supplemented with tested sample were placed into the Mixolab bowl and mixed with the rest of the ingredients following the factorial design. The amount of water (water absorption) to be added was previously determined in the Brabender farinograph. For analysis of the mixing and pasting behaviour, the standard ‘‘Chopin+’’ protocol as seen in Figure (1) was followed: initial equilibrium at 30ºC for 8 min, heating to 90ºC over 15 min (at a rate of 4ºC/min), holding at 90ºC for 7 min, cooling to 50ºC over 5 min (at a rate of 4ºC/ min) and holding at 50ºC for 5 min. The mixing speed was kept constant at 80 rpm.

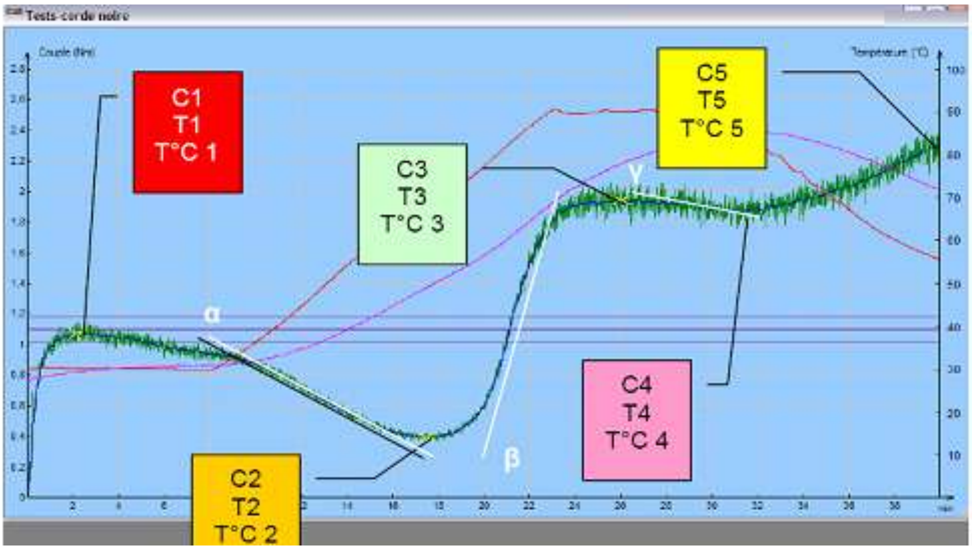

Fig. (1): Main changes that occur during Mixolab test (after Dubat *et al.*, 2013). Numbers indicate the different areas detected in the curve according to the wheat bread dough changes . (1) Dough development. (2) Protein reduction during heating. (3) Starch gelatinization . (4) Amylase activity . (5) Starch gelling due to cooling .

Baking properties

Process of pan bread

The conventional straight dough procedure of pan bread processing was done using the following ingredients : wheat flour 100g: sugar 0.5g ; yeast 2 g: salt 2g: and a specific amount of water according to the water absorption revealed by Brabender Farinograph, wheat flour was supplemented with tested samples rich in fiber at different percentage of 2.5 , 5, 7.5 and 10 % . Dough was mixed for 10 min, fermented at 30-32 ºC and 72% RH. , for 60 min , scaled at 300 g each , mechanically molded , proofed to height at 35°C and 95% R.H , and the dough was then baked at 210°C for 20 min. The bread quality attributes were evaluated after cooling for 1 h. at room temperature (Wang *et al.*, 2002).

Measurements of pan bread

Weight (g) and volume (cm^3) of resulted pan bread were measured by scale and rapeseed displacement method according to AACC (2000). Specific volume (cm^3/g) was calculated by dividing bread volume by its weight. Moisture content of bread crumb was estimated according to the method of Peressini and Alessandro (2009).

Sensory evaluation

Toasts were organoleptically evaluated for their external and internal properties by ten stuff members of Food Technology research institute, agricultural research center, according to the method of Ranhotra *et al.* (1995). To score toasts, a maximum number of points were assigned to each bread characteristic identified as follows:

Sensory attribute	Score	Sensory attribute	Score
Volume	15	Texture	20
Symmetry	7	Crumb color	10
Break & shred	7	flavor	15
Crust color	6	Overall acceptability	100
Grain	20		

Statistical analysis

The obtained data were exposed to analysis of variance. Duncan's multiple range tests at ($P \leq 0.05$) level was used to compare between means. The analysis was carried out using the PRO ANOVA procedure of Statistical Analysis System (SAS, 1996).

RESULTS AND DISCUSSION

Chemical composition and fiber analysis of pumpkin and psyllium husks powders:

The obtained results of pumpkin and psyllium husks powders were seen in Table (1). Psyllium husks and pumpkin powders contained high levels of carbohydrate being 94.94 and 81.18%, respectively. Crude fiber of these plants ranged between 66.7 (psyllium husks) to 16.1% (pumpkin). On the other hand, the same samples had very low levels of fat being 0.01 and 2.03 % for psyllium husks and pumpkin powders, respectively. Pumpkin is worthy of consideration as an important vegetable source of protein being 7.92% in dry matter. These results agree with those reported by Souci *et al.* (2000).

On the other hand, the moisture content was 6.59 and 7.0% in pumpkin and psyllium husks powders, respectively. Ash varied between 3.66% in psyllium and 8.86% in pumpkin powders. These data agree with Raymundo *et al.* (2014) who demonstrated that an increase of ash is caused by the considerable content of minerals in the psyllium sample (2.67% w/w). They also mentioned that these plants can be utilized in novel dietary fiber functional foods that can target special needs of populations.

Table (1): chemical composition of tested samples (% dry matter)

Constituents (%)	Mean ±SDM of Samples	
	pumpkin	**Psyllium husks**
Moisture	6.59±0.34 ^{b}	7.00±0.12 ^{a}
Ash	8.86±0.04 ^{a}	3.66±0.07 ^{b}
Protein	7.92±0.56 ^{a}	1.40± 0.14 ^{b}
Fat	2.03±0.07 ^{a}	0.01±0.01 ^{b}
Carbohydrate	81.18±0.18 ^{b}	94.94±0.32 ^{a}
Crude fiber	16.10±0.14 ^{b}	66.70± 0.14 ^{a}
Total dietary fiber	24.62 ±0.03 ^{b}	80.95±0.24 ^{a}
Insoluble dietary fiber	4.14 ± 0.31 ^{a}	1.15 ±0.64 ^{b}
Soluble dietary fiber	20.48 ± 0.77 ^{b}	79.80 ±0.53 ^{a}
Fiber fractionation		
Celluloses	16.34±0. 14 ^{a}	5.93±0.18 ^{b}
hemicelluloses	0.12±0.53 ^{b}	44.28±0.31 ^{a}
Lignin	3.57±0.043 ^{a}	0.44±0.08 ^{b}

Data are presented as means ± SDM (*n=3*.

Means within a row with different letters are significantly different at P≤ 0.05.

Dietary fiber (DF) is one of the major phytochemicals present in the selected sources (pumpkin and psyllium husks). It can be divided into two categories insoluble dietary fibers (IDF) and soluble dietary fibers (SDF) according to their water solubility. Water soluble fraction consists mainly of non-starchy polysaccharides such as beta-glucans and pentosans (arabinoxylan). The total dietary fiber (TDF) of the studied samples were significantly different, varied between 24.62% (pumpkin) and 80.95% (psyllium husks) (Table 1) .The highest ratio of soluble fraction from TDF in the investigated plants was about 98.6% in psyllium husks and about 83.2% in pumpkin powder. Samira *et al.* (2016) found that the total fibre was positively affected by increasing the levels of psyllium husk. The most numerous type of soluble fibre in the psyllium husk seed consists of a polymer of arabinose, galactose, galacturonic acid, and rhamnose.

It is well accepted that a high intake of soluble fiber is associated with favorable affects on human health (Anderson *et al.,* 2000). Psyllium husk has been reported as a medicinally active natural polysaccharide. It has been used for the treatment of constipation (Ramkumar and Rao, 2005; Nidhi *et al.,* 2016), diarrhea, inflammation bowel diseases-ulcerative colitis, obesity in children and adolescents (Pittler and Ernst, 2004). Soluble Fiber reducing high LDL-cholesterol reducing hyperglycaemia (Moreyra *et al.,* 2005) and diabetes as well as colon cancer (Singh, 2007).

The UK recommending an average intake of 18 g non starch polysaccharides (NSP). Recommendations for dietary fibers intake in children have recently been reviewed and a new recommendation of age (years)+5 g to age (years)+10 g as an indication for fiber intake at ages between 2 and 20 years has become widely accepted. Whereas intake of 5 g/day is recommended in the weaning period (Lee and Prosky (1994). As regard to the three dietary fiber fractions celluloses, hemicelluloses and lignin, they constitute about 66.4, 0.49 and 14.5% from TDF in pumpkin powder; 7.3, 54.7 and 0.5 % in Psyllium husk, respectively.

Minerals composition

Eight minerals in pumpkin and psyllium husks powder were determined. These minerals were Ca, K, Mg, Na, Mn, Fe, Cu and Zn (Fig. 2) .The three principal minerals in pumpkin and psyllium husks were K, Ca and Fe. The investigated pumpkin and psyllium husks powder contained relatively large amounts of both K (605.94 and 246.83 mg/100 g dry matter) and Fe (79.06 and 106.04 mg/100 g dry matter), respectively. However, Ca (in pumpkin and psyllium husks powder) was also found in relatively large quantities.

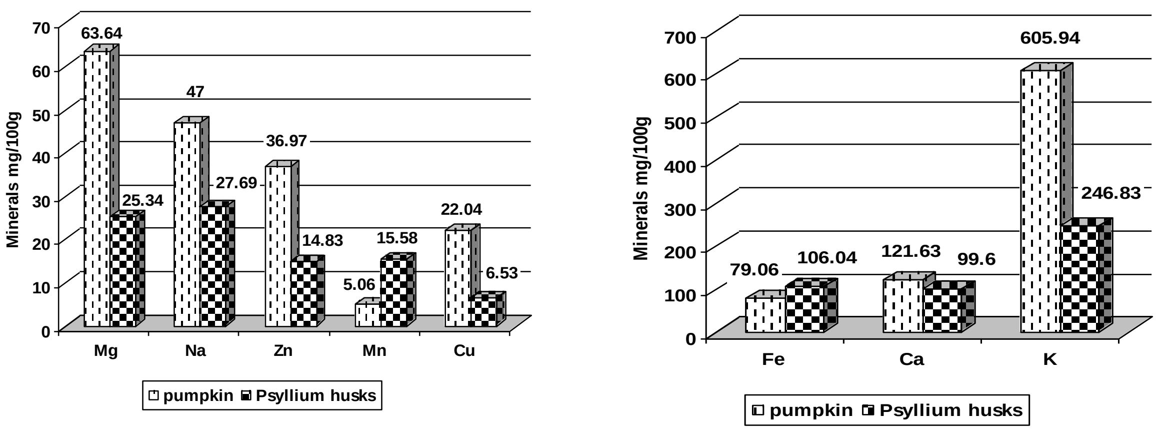

Fig. (2): Minerals (mg/100g dry matter) of pumpkin and psyllium husk seed powder

The positive effects of consuming a high-fiber diet far out weight the probable adverse effects of decreased mineral adsorption. It is virtually impossible to predict the bioavailability of some minerals in diet rich in dietary fibers because chelating components varied significantly (*P*≤ 0.05) in different dietary fibers sources. Pumpkin are fairly good dietary sources of zinc. For adult consumers of both sexes about 25-30 g of both plants can alone or in combination supply the RDA of 11 mg Zn/day (Whitney *et al.*, 2002). It is likely that a high percentage of Egyptian population suffered bitterly from the micronutrient deficiencies related to iron and zinc metabolism and they are in great need to subsist their eating products with plants rich not only in dietary fibers but also in micronutrients.

Physical properties

Particle Size of pumpkin and psyllium husks powder

Regarding the particle size distribution of the tested pumpkin and psyllium husks as a function of grinding, data of Table (2) indicated that, the highest particle size fraction was collected from the powder of pumpkin, it was found over a sieve of 160 µm with a value of 29.9%. On the other hand, the corresponding highest particle fraction of psyllium husks powder was 38.40g (38.61%) on sieves 400 µm. In the contrary, data showed that little meshing values in psyllium husks powder and pumpkin were 5.43% and 6.29% on the sieve >500µm, respectively. While particle size distribution on sieve <160 µm of pumpkin was 22% except psyllium husks powder, it was 6.49% at the same sieve. These results are in agreement with Mattern (1991) who proved that during milling and reduction of particles almost all the embryo and most of the scutellum that localized in coarse stocks was flattened.

Table (2): Particle size distribution in (g) of pumpkin and psyllium husks powder samples.

Particle size (µm)	Pumpkin		Psyllium husks	
	Mean	%	Mean	%
>500	6.29	6.29± 0.40[e*]	5.4	5.43± 0.45[f]
400	24.25	24.26± 0.18[b]	38.4	38.61± 0.06[a]
355	6.245	6.26± 0.08[e]	10.73	10.79± 0.49[d]
200	10.13	10.14± 0.22[d]	13.2	13.27± 0.25[c]
160	29.89	29.90± 0.91[a]	25.27	25.41± 0.78[b]
<160	23.13	23.15± 0.60[c]	6.46	6.49± 1.22[e]
Sum	99.94	100	99.46	100
Milling loss	0.06 g		0.64 g	

Data are presented as means ± SDM (*n=3*)
Means within a row with different letters are significantly different at P≤ 0.05.

From Table (2) it was obvious that the highest milling loss was for psyllium husks powder 0.64% followed by pumpkin samples being 0.06%. Such results could be referring to the adhering properties of the tested samples**.**

Thermal properties

Differential Scanning Calorimetry (DSC)

Typical DSC thermographs of the endothermic gelatinization profiles of the tested samples are shown in Figure (3).

The results of the DSC analysis of tested samples are summarized in Table (3). The transition temperatures (T_o, T_p and T_c), (R_t) the gelatinization temperature (T_c-T_o), enthalpies of gelatinization (*ΔH*) and peak height indices (PHI) (ΔH/ T_p-T_o), PHI provides a numerical value that is descriptive of the relative shape of the endotherm, *e.g.*, a tall narrow endotherm has a higher PHI than does a short broad one, even if the enthalpy of transition involved in the process was the same; were varied among examined powder samples.

Onset temperature (T_0) of all the tested samples ranged from 21 to 280 ºC, the peak gelatinization temperature (T_p) was the highest one (309 ºC) in pumpkin powder sample followed by psyllium husks powder (304 ºC), in contrast, the peak gelatinization temperature which was only 67 ºC was observed in the peak 1 in psyllium husks, compared to the other tested sample. The conclusion temperature (T_c) of tested samples ranged between 115 to 340ºC and exhibited little variation between two samples (Table 3).

Table (3): Differential scanning calorimetry (DSC) of pumpkin and psyllium husks powder samples

Peak	**T_o (°C)**	**Transition temperature**		***ΔH* (mcal/mg)**	PHI	**R_t**
		T_p(°C)	T_c (°C)			
Pumpkin powder						
1	25	59.03	117	64.56	1.898	92
2	130	151	170	10.47	0.498	40
3	197	210	230	21.50	0.693	51
4	280	309	340	27.94	0.963	60
Psyllium husks powder						
1	21	67	115	116.58	2.534	94
2	240	252	273	5.45	0.454	33
3	273	304	315	228.75	7.37	42

T_o = onset temperature, T_p = peak temperature, Tc = conclusion temperature, R_t = gelatinization range (T_c - T_o); ΔH_{gel}= enthalpy of gelatinization (dwb, based on dry weight basis of flour), PHI = peak height index ΔH_{gel}/ (T_p - T_o).

The gelatinization temperature (R_t) of the two investigated samples ranged from 33 to 94ºC. Furthermore , R_t were broadest (94 and 92ºC) for peak 1 in psyllium husks and pumpkin powder samples, respectively, which could be attributed to the irregularly shaped and cuboidal starch granules. This finding was in agreement with the scientific view of Athawale and Lele (2000) who found that the main decomposition peak of starch was around 300ºC in thermal studies on granular maize starch. The lowest values of *R* were recorded as 33 and 40ºC for peak 2 in both psyllium husks and pumpkin samples, respectively. The highest value of *ΔH* of gelatinization of tested sample was 228.75 mcal/mg and the lowest was 5.45 mcal/mg in the peak 3 and peak 2 in psyllium husks, compared to pumpkin samples.

Several factors could be taken in consideration to explain the higher *ΔH* value for prime starch which include: size of the starch granule, total starch content, amylose- amylopectin ratio, and interactions between starch and other components. Addition of gluten to prime starch fraction (gluten / prime starch), caused a slight increase in both T_o and T_p of gelatinization, and vice versa due to a reduction in *ΔH* which could be attributed to a competition for water attraction between gluten and the starch molecules (Addo *et al*., 2001).

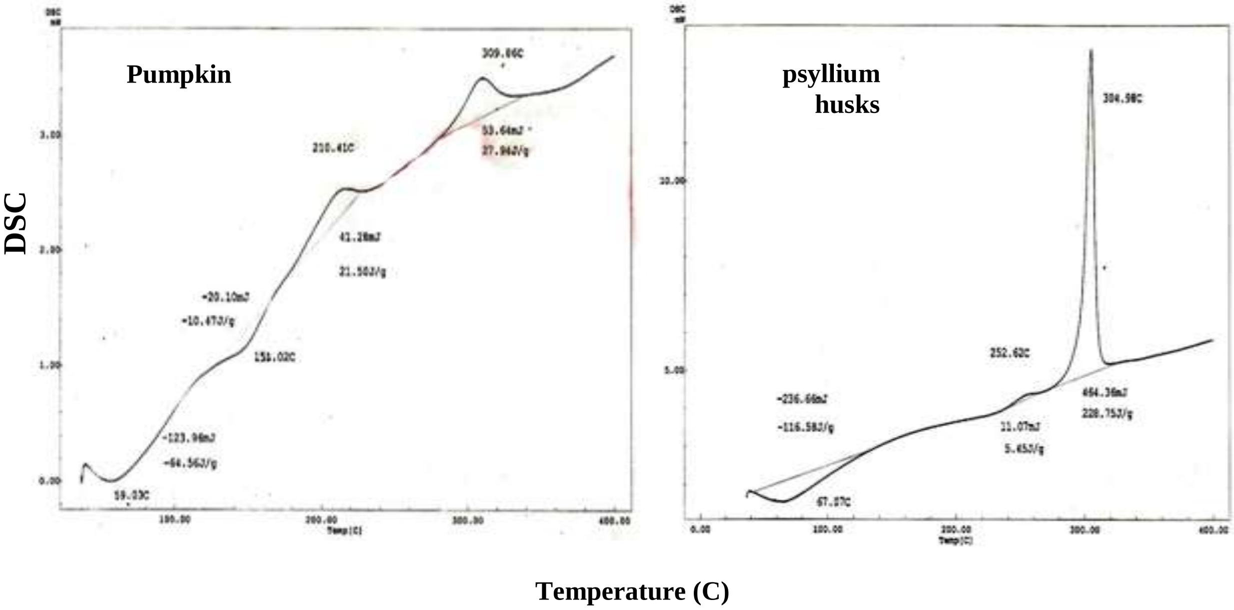

Fig.(3): The DSC thermograph of thermal properties of pumpkin and psyllium husks powders.

Thermogravimetric Analysis (TGA)

The profile of the thermal decomposition of the samples characteristics with three or four events of thermal decomposition is illustrated in Table (4) and Figure (4). The thermogravimetric curves of pumpkin sample presented the first event of the thermal decomposition at temperature intervals of 49.05°C, while the psyllium husks powder presented high temperature as much as 234.50 °C. The percent weight loss in the first stage in the tested samples, ranged from 6.279 to 6.958 %. The pumpkin powder sample recorded two stages at 207 and 429 °C with loss of 30%, while psyllium husks powder recorded high weight loss being 50.104 % at 301.72°C followed by 39.590 % at 481.07°C with residue of about 3.01%**.**

Table (4): Thermogravimetric (TGA) data of pumpkin and psyllium husks powder samples.

Stage	**Temperature (°C) Peak (Tp)**	**Weight %**	
		Loss during decomposition stages	Residue at 600 °C
Pumpkin powder			
1	49.05	6.279	
2	207.19	30.028	9.27
3	292.57	22.932	
4	429.75	30.843	
Psyllium husks powder			
1	234.50	6.958	
2	301.72	50.104	3.01
3	481.07	39.590	

These results suggest that it is likely, in the case of different investigated starch samples, that it is the degree of crystallization, rather than granule size that has the more important impact on thermal properties (Fujita *et al.,* 1998).

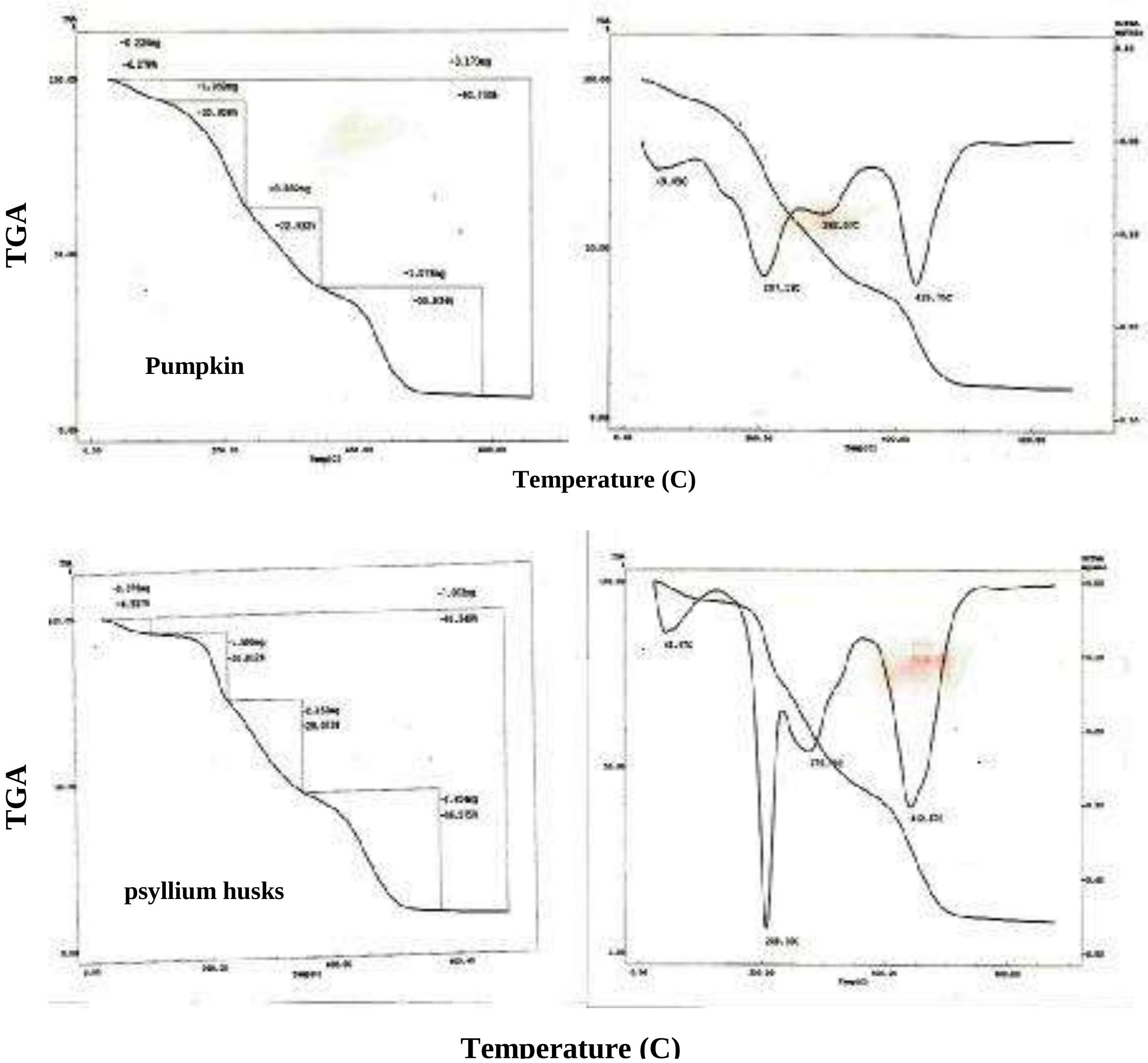

Fig.(4):Thermogravimetry analysis properties of pumpkin and psyllium husks powders.

Bread making quality of the tested wheat flour supplemented with pumpkin and psyllium husks powders at different levels:

Dough properties

Dough rheological properties are important for both product quality and process efficiency. Dough properties were determined by two instruments; Alveograph and Mixolab.

Alveograph characteristics

Alveograph has been used to evaluate bread making quality of wheat flours (control). The alveograph characteristics of the two samples are shown in Table (5). It was obvious from this Table that the maximum over pressure (P), a measure of dough elasticity, varied from 98 to 200 (mmH_2O). The average of abscissa at rupture (L), which is a measure of dough extensibility, ranged from 11 to 72 mm. Indrani *et al.* (2007) reported that higher value for (P) indicates that the dough resists deformation and is elastic in nature.

Table (5): Alveograph characteristics of the tested wheat flour samples supplemented with Pumpkin and Psyllium husks powders.

Parameters	Control	Samples added levels %			
		2.5	5	7.5	10
		Pumpkin powder			
P (mm H_2O)	107	98	121	110	103
L(mm)	57	72	47	40	32
W (10E-4J)	246	247	219	202	171
P/L	1.88	1.36	2.57	2.75	3.2
		Psyllium husks powder			
P (mm H_2O)	107	173	200	200	198
L(mm)	57	49	12	11	11
W (10E-4J)	246	338	108	112	102
P/L	1.88	3.53	16.67	18.2	18

P = Dough elasticity **L** = dough extensibility **W** = deformation energy **P/L**= Curve configuration ratio

On the other hand, "L" gives information about dough extensibility, longer "L" values indicating weak dough. A high P and a short L values would denote very elastic dough. The alveograph parameters showed that flour dough sample which had a higher P/L value (18.2) was that supplemented with 7.5 % psyllium husks powder dietary fibers, while flour sample supplemented with 2.5 % pumpkin powder had lower P/ value (1.36).

These results are very close with those obtained by Wang *et al.,* (2002) who found effects of added plants powders on the alveograph characteristics of wheat flour's dough. The P value (dough resistance to deformation or tenacity) is an indicator of the dough's ability to retain gas. P values increased with the addition of the four different levels of milled investigated powders. This is likely due to the interactions between their fiber structure and that of wheat proteins. It is clearly noticed from Table (5) that the value of deformation energy (W) of flour sample supplemented by 2.5% psyllium husks powder was $338x10^{-4}$, this value decreased with increasing supplementation ratio. Data also show that flour supplemented with pumpkin powder was $247\ x10^{-4}$. This finding was coincides with those obtained by Indrani *et al.,* (2007) who proved that higher (W) values resulted in bigger dough bubble owing to balanced elastic and extensibility properties .

Mixolab

Mixolab is a new instrument developed by Chopin Technologies Company and the information related to its utilization on different aspects of wheat flour quality. It has the capabilities to measure physical properties of dough like dough strength and stability, and also to assay the pasting properties of starch on actual dough. Furthermore, it is used to characterize the rheological behavior of dough subjected to a dual effects, mixing and temperature. It measures in real time the torque (Nm) produced by mixing of the dough between the two kneading arms (Rosell *et al*., 2007).

The results of Mixolab parameters are summarized in Table (6). Mixolab curve is separated to five different stages. At the first development stage (C1) which it measures the characteristics of the dough during mixing at constant temperature, 30^oC; the dough mixing characteristics such as stability, elasticity and water absorption can be determined. In this stage, the dough development values of the tested wheat flour samples supplemented by different ratios of plant powders were ranged from 1.08 to 1.16 Nm and the maximum torque reached during mixing in this stage at 30^{o}C was appeared in dough flour sample supplemented by 10 % pumpkin powder followed by 5 , 7.5 % of the same sample. The dough stability during heating of the control sample was 10.82 min, while sample supplemented by 10% psyllium husks powder time stability of 11.45 min followed by 11.23 min supplemented dough for the same sample, while the lowest value of 9.21 min was found in pumpkin powder sample at 10% . During this stage an increase in the torque was observed until reached its maximum value and the dough can resist the deformation for some time.

However, in the second stage (C2), at protein reduction: when dough temperature increases, consistency decreases, and the intensity of this decrease depend on protein quality. On the other hand, the consistency of the dough decreased with excessive mixing which was an indication of protein weakening, the values of maximum torque produced by dough passage subjected to mechanical and thermal constraint of the protein reduction in this stage (C2) was 0.79 Nm in psyllium husk at a supplemented level of 10 % compared to control sample (0.51Nm) followed by psyllium husk at 7.5% (0.76 Nm), as seen in Table (6). However, the protein breakdown of all tested wheat flour samples in this stage was performed at 51.50 to 55.30 ^{o}C. The minimum torque of protein reduction in this stage depending on the quality of the wheat flour (Hayta and Schofield 2004) and the greater decrease in consistency indicated the lower the protein quality (Kahraman *et al.*, 2008).

Third stage (C3), starch granules swell and absorb water and amylose molecules leach out resulting in an increased viscosity. The peak torque produced during heating stage that required for starch gelatinization was observed in this stage. The highest value (1.87 Nm) was found in sample supplemented by 5% pumpkin powder and the lowest value (1.33 Nm) was observed in psyllium at 10%. The temperatures associated to the starch gelatinization as pasting temperature range in this stage was 74.40- 86.2 ^{o}C for all tested samples.

At the fourth stage (C4), the consistency of dough decreases as a result of amylolytic activity, the intensity of the decrease depends on the degree of amylase activity, the greater consistency due to the greater amylasic activity, the minimum torque reached during cooling to 50^{o}C was 0.69 Nm of wheat flour sample supplemented by10 % psyllium and the highest value (1.86 Nm) was observed at the same ratio in sample supplemented with pumpkin.

During the fifth stage (C5), the decrease in the temperature causes an increase in the consistency as a result of gel formation. This stage is also related to retrogradation of starch. The starch gelling or the torque after cooling had the highest value of torque produced after cooling at 50^{o}C of starch gelling reached 2.55 Nm in pumpkin dough at 10 % supplementation and the least value (1.02 Nm) was found in psyllium sample at the same ratio

A decrease of the temperature resulted in an increase of the torque due to the augmentation in the dough resistance. This increase is referred to as set back and corresponds to the gelation process of the starch, in which the amylose chains which leached outside the starch granules during the heating are prompted to recrystalize. The reassociation between the starch molecules, especially amylose, results in the formation of a gel structure. This stage is related to the retrogradation and reordering of the starch molecules. In the cereal slurries, low values of setback indicates low rate of starch retrogradation and low syneresis (Rojas *et al*., 1999).

Table (6): Mixolab parameters of wheat flour supplemented with fiber sources from pumpkin and psyllium husks powders at different ratios.

Parameters	Control	Samples ratios							
		Pumpkin powder				Psyllium husks powder			
		2.5	5	7.5	10	2.5	5	7.5	10
Development (Nm)	1.09	1.14	1.15	1.15	1.16	1.14	1.08	1.10	1.09
Stability (min)	10.82	10.55	10.07	9.58	9.21	10.95	10.63	11.23	11.45
Protein reduction (Nm)	0.51	0.53	0.53	0.49	0.4	0.56	0.62	0.76	0.79
Protein breakdown (C)	51.50	51.50	53.30	55.00	54.40	55.30	54.70	54.50	53.20
Starch gelat. (Nm)	1.80	1.81	1.87	1.86	1.84	1.54	1.42	1.4	1.33
Pasting temp. range (C)	76.5	82.7	83.2	84.5	96.2	76.70	74.4	75.7	75.9
Amylase activity (Nm)	1.63	1.77	1.82	1.82	1.86	1.30	0.95	0.76	0.69
Starch gelling (Nm)	2.24	2.24	2.5	2.52	2.55	1.78	1.28	1.13	1.02

Nm = Nuten meter

Baking properties

Bakery products have a short shelf-life and their quality is highly dependent on the time between baking and consumption. Their quality is also highly correlated to the functionality of the flour constituents: starch, which is the major constituent of wheat flour, and other substances such as gluten, non-starch polysaccharides and lipids etc., all these influence the quality of the final product (Shewry *et al.,* 1995).

Dough of the tested flour samples were fermented for 60 min at 30°C and after baking at 203ºC for 30 min. Bread quality was evaluated 1 h after baking, the bread, the loaves were allowed to cool at room temperature, then bread volume was measured by the rapeseed displacement method. The loaf volume gives an indication of the gas retention capacity of the dough during the fermentation process and indicates also oven spring of bread. The specific bread volume was calculated by dividing the bread volume by its dough weight. Physical measurement of pan bread for investigated flour samples are presented in Table (7).

The bread loaf volume was much better for all tested samples after 60 min fermentation time. However, loaf sample with 2.5% pumpkin and the control one appeared to have practically the same volume being 920 and 900, respectively, compared to other samples understudy. Weight of loaves from tested flour samples was almost constant and ranged from 240 to 246 g for all the tested samples. Additionally, bread baked from flour contained 2.5% pumpkin was of higher specific volume (4.1 ml/g) than other samples.

During baking, alpha-amylase breaks down a portion of the starch granules as they begin to gelatinize and before the enzyme itself is inactivated. This increases loaf volume by delaying crumb setting and allowing more expansion of the dough. The level of alpha-amylase affects the breakdown of starch during baking and so has an effect on loaf volume even when it does not affect yeast fermentation (Bloksma, 1990).

As shown in Table (7), loaves sample baked from flour supplemented with 2.5% pumpkin recorded the lowest value (0.24 g/ml). All the other tested loaves, their density ranged between (0.27-0.35 g/ml). In the same Table, it was noticed that the moisture content of pan bread samples ranged from 27.0 to 39.6 %. The psyllium samples recorded the high percent of moisture content as it was 37.7, 36.7, 34.9 and 39.56 at ratios 7.5, 5, 2.5 and 10 %, respectively. Fig. (5) showed that there were proportional relationship between moisture content % and fiber ratio in bread. For instance moisture content was 29.2% in control sample and it was 39.6% in bread supplemented by 10% psyllium. Also data proved that loaf sample with psyllium was higher than loaves baked with pumpkin fiber in the moisture content. These results could be explained by **Jinshui *et al.*, (2002)** who reported that fiber rich bread has higher moisture contents.

Table (7): Physical measurements and moisture content of pan bread supplemented by different ratios of the tested samples.

Parameters	Control	Pan bread supplementation by ratios of							
		Pumpkin powder				Psyllium husks powder			
		2.5	5	7.5	10	2.5	5	7.5	10
volume (ml)	900	920	740	720	680	780	760	790	750
Weight(g)	240	225	240	235	241	246	247	240	245
Specific volume(ml/g)	3.8	4.1	3.1	3.1	2.8	3.2	3.1	3.3	3.2
Density (g/ml)	0.27	0.24	0.32	0.33	0.35	0.32	0.33	0.30	0.31
Moisture content (%)	29.2	27.0	28.8	29.3	30.5	34.9	36.7	37.7	39.6

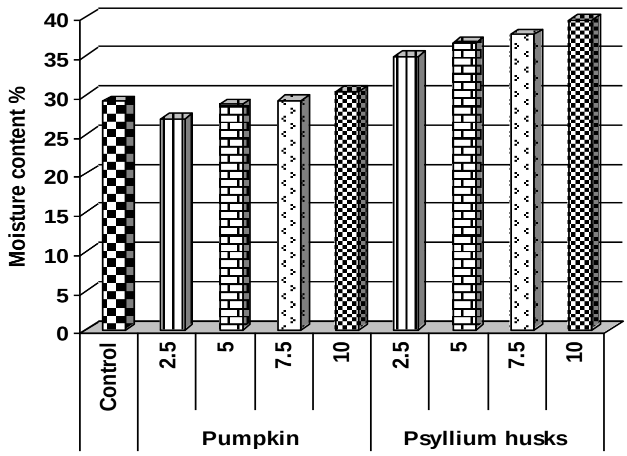

Fig. (5): Comparison between pan bread supplemented by different ratios of pumpkin and psyllium husks powders in the moisture content %

Sensory evaluation

The organoleptic evaluation of pan bread baked from wheat flour supplemented with (pumpkin and psyllium husk powders) at ratios 2.5, 5, 7.5 and 10 % are shown in Table (8) and Figure (6). Mean sensory scores of volume showed significant differences ($P \leq 0.05$) between the tested samples. Whereas psyllium sample at 7.5 % had the highest score (13.3) followed by pumpkin at 2.5% (13.2), while control sample was (12.70) and the lowest volume score (8.3) for the pan bread with 10 % pumpkin sample.

The crust color of pan loaves changed from light brown to dull brown. Therefore, a significant difference ($P \leq 0.05$) in crust color was observed in all tested samples. The best crust color which was for pan bread bright to golden brown was observed in pan bread supplemented by psyllium and pumpkin at 2.5 % compared to other tested samples they received mean scores values of 4.8 and 4.7, respectively, while the color of control bread scored was (4.2) . On the other hand, crust color of pan bread supplemented with pumpkin at 10% level recorded the least score of (3.0). The darker crust color might be due to the formation of Millard reaction products formed between reducing sugars and amino acids as well as proteins (Nikouzadeh *et al.*, 2008).

The desired textural quality characteristics in ban bread with added psyllium husk powder at 7.5 % were greater in pliability and of soft texture; maximum scores were observed (17.9) then 17.6 at 10%, followed by control17.5, then pumpkin at level of 2.5%. The minimum score (10.0) was recorded at 10% pumpkin. Extensible doughs are able to hold the gas produced during fermentation within evenly distributed discrete cells within their structure. These results expressing loaf crumb in which the gas cells are of regular size and even distribution.

The color score of crumb was higher for bread supplemented with psyllium at 2.5% (white creamy) which received sores of 8.1, while addition of pumpkin at 2.5 % and control leaves were almost of similar color having scores of 7.8 and 7.2, respectively. The minimum score value (5.1) was observed for pumpkin bread at 10 %. Such a crumb structure appears light in color, fine and silky in structure, both highly desirable characteristics of bread. Weak gluten will make the gas cells expand excessively during fermentation, causing their walls to collapse and the cells to coalesce. The resulting bread had very open texture with a coarse wall structure (Raymundo *et al.*, (2014).

Control bread had an acceptable and good flavor (13.6) of crumb compared to other tested samples, followed by pumpkin and psyllium husk powders at 2.5% (between 13 and 13.1). Control and psyllium husk at 2.5 % was (15.6) and pumpkin powder at 2.5 % (15.4). Symmetry attribute was differed significantly *($P \leq 0.05$)* between the tested samples. The maximum score (5.7) was observed for psyllium husk at 7.5 % bread compared to other tested samples, followed by (5.5) in the same sample 2.5%, while pumpkin powder at 2.5% recorded 5.3. The minimum score (2.9) of break& shred was observed in pan bread supplementation with 10 % pumpkin powder. Control and ban bread with added psyllium husk powder at 7.5% (5.8 and 5.6), respectively record the highest values. The overall acceptability of tested bread was ranged from 49.8 to 83.4%. The maximum score of the overall acceptability was observed in the control; bread and those supplemented by 2.5% added powders in all tested samples, for example, pumpkin (81.9) and psyllium husk powder (80.9). When pumpkin was added at 10 % level to wheat flour it showed overall acceptability score (49.8).

Control | **2.5** | **5** | **7.5** | **10** | **2.5** | **5** | **7.5** | **10**

Pumpkin powder ratios | **Psyllium husks powder ratios**

Fig. (6): Photograph of pan bread and their slides produced from experimental wheat flour supplemented with pumpkin and psyllium husks powders at different ratios.

Table (8): Mean values of sensory attributes of pan bread samples with pumpkin and psyllium husks powders at different ratio.

Parameters	Control	Pan bread supplementation by ratios of			
		Pumpkin powder (%)			
		2.5	**5**	**7.5**	**10**
Volume (15)	12.7±0.27[b]	13.2±0.25[a]	9.9±0.30[e]	8.8±0.35[g]	8.3±0.27[h]
Crust Color (6)	4.2±0.40[b]	4.7±0.24[a]	3.4±0.32[c]	3.2±0.41[d]	3.0±0.34[d]
Symmetry (7)	5.8±0.25[a]	5.3±0.25[b]	4.2±0.27[c]	3.6±0.32[d]	3.3±0.22[e]
Break& shred (7)	5.8±0.12[a]	5.2±0.26[b]	3.3±0.25[f]	3.3±0.26[f]	2.9±0.18[g]
Texture (20)	17.5±0.26[b]	17.4±0.39[b]	12.9±0.38[f]	11.8±0.22[g]	10.0±0.17[h]
Crumb Color (10)	7.2±0.18[b]	7.8±0.22[a]	6.7±0.23[c]	5.6±0.37[d]	5.1±0.27[de]
Grain (20)	16.6±0.27[a]	15.4±0.32[b]	11.4±0.22[d]	10.0±0.39[e]	10.0±0.2[e]
Flavor (15)	13.6±0.26[a]	13.0±0.21[ab]	11.2±0.36[c]	10.6±0.27[d]	7.2±0.22[f]
Over all acceptability (100)	83.4±2.3[a]	81.9±2.4[b]	63.0±3.4[e]	56.9±4.2[f]	49.8±3.6[g]
	Control	**Psyllium husks powder** (%)			
Volume (15)	12.7±0.27[b]	11.8±0.25[c]	11.8±0.25[c]	13.3±0.31[a]	11.1±0.13[d]
Crust Color (6)	4.2±0.40[b]	4.8±0.16[a]	4.2±0.30[b]	4.1±0.26[b]	4.0±0.16[b]
Symmetry (7)	5.8±0.25[a]	5.5±0.26[ab]	5.4±0.24[ab]	5.7±0.28[a]	5.0±0.20[b]
Break& shred (7)	5.8±0.12[a]	4.7±0.12[bc]	4.4±0.13[d]	5.6±0.13[a]	5.2±0.24[b]
Texture (20)	17.5±0.26[b]	17.3±0.25[b]	16.4±0.32[e]	17.9±0.44[a]	17.6±0.30±b
Crumb Color (10)	7.2±0.18[b]	8.1±0.29[a]	7.3±0.49[b]	7.1±0.36[b]	7.1±0.21[b]
Grain (20)	16.6±0.27[a]	15.6±0.18[b]	13.8±0.29[c]	14.8±0.46[bc]	13.9±0.33[c]
Flavor (15)	13.6±0.26[a]	13.1±0.35[ab]	12.5±0.50[b]	12.4±0.49[b]	11.9±0.28[bc]
Over all acceptability (100)	83.4±2.3[a]	80.9±2.18[b]	75.8±3.12[c]	80.9±2.9[b]	75.8±3.5[c]

Data are presented as means ±SDM (*n*= 10)
Means within a column with different letters are significantly different at(P≤ 0.05)

Conclusion

In conclusion, psyllium husk powder were the most successful additions because one can add as much as 10% dietary fiber source with slight less overall acceptability of ban bread which may be compensated when one can calculate the main benefits come from eating functional food in a form of bread rich in dietary fiber .

REFERENCES

A.O.A.C. (2007). Official Methods of Analysis of the Association of Official Analytical Chemists. 18th Ed. Published by Association of Official Analytical Chemists, Gaithersburg, MD, USA.

AACC. (2000). Approved methods of the AACC. American Association of Cereal Chemists, (10th ed). The Association St. Paul MN.USA

Addo, K.; Xiong,Y., and Blanchard, S. (2001). Thermal and dynamic rheological properties of wheat flower fraction. Food Res. Inter., 34:329-335.

Anderson, J.; Allgood, L.; Laurence, A.; Altringer, L.; Jerdack, G.; Hengehold, D. and Morel, J. (2000). Cholesterol-lowering effects of psyllium intake adjunctive to diet therapy in men and women with hypercholesterolemia: metaanalysisof 8 controlled trials. Amer. J. Clini Nutr., 71: 472-479.

Athawale, V. and Lele, V. (2000). Thermal studies on granular maize starch and its copolymers with vinyl monomers. Starch /Stärke,52:205-213.

Atwell, W. (2001). Wheat flour-practical guides for the food industry. Minn.: Eagen Press.

Averousa, L. and N. Boquillon (2004). Biocomposites based on plasticized starch: thermal and mechanical behaviours. Carbohydrate Polymers, 56: 111–122.

Bloksma, A. (1990). Dough structure, dough rheology and baking quality. Cereal Foods World, 35: 237–244.

Caili, F.; Haijun, T.; Tongyi, C.; Yi, L. and Quanhong, L. (2007). Some properties of an acidic protein-bound polysaccharide from the fruit of pumpkin. Food Chem., 100(3):944–947.

Cauvain, S. and Young, L. (2000). Baked products science, technology and practice. Gloucester, Mass.: Blackwell Science.

Cheng, Y.; Ohlsson, L. and Duan, R. (2004). Psyllium and fat in diets differentially affect the activities and expressions of colonic sphingomyelinases and caspase in mice. British J. Nutr., 91: 715-723.

Crozier, A. (2003). Classification and biosynthesis of secondary plant products: an overview. In: Goldberg G, editor. Plants: diet and health. Oxford, U.K.: Blackwell Science. p 27–48.

Dubat, A.; Rosell, C.R. and Gallagher, E. (2013). Mixolab. A new approach to Rheology, published by AACC International, Inc.

Emadi, B.; Kosse, V. and Yarlagadda, P. (2007). Abrasive peeling of pumpkin. J. Food Engr.,79(2):647–56.

Fujita, S.; Yamamoto, H.; Sugimoto,Y.; Morita, N. and Yamamori, M.(1998). Thermal and Crystalline Properties of Waxy Wheat (*Triticum aestivum* L.) Starch. J. Cereal Sci., 27: 1–5

Hayta, M. and Schofield, J. (2004). Heat and additive induced biochemical transitions in gluten from good and poor bread making quality wheat. J. Cereal Sci., 40:245–256.

Indrani, D.; Manohar, R.; Rajiv, J. and Rao, G. (2007). Alveograph as a tool to assess the quality characteristics of wheat flour for parotta making. J. Food Eng., 78: 1202–1206.

Jinshui, W.; Rosell, C. and De Barber, C. (2002). Effect of the addition of different fibres on wheat dough performance and bread quality. Food Chem., 79: 221–226.

Jun, H.; Lee, C.; Song, G. and Kim, Y. (2006). Characterization of pectic polysaccharides from pumpkin peel. Lebensm Wiss Technol., 39:554–61.

Kahraman, K.; Sakıyan, O.; Ozturk, S.; Koksel, H.; Sumnu, G. and Dubat, A. (2008). Utilization of Mixolab1 to predict the suitability of flours in terms of cake quality. Eur. Food Res. Technol., 227: 565–570

Kaur, L.; Singh, N. and Sodhi, N. (2002). Some properties of potato and their starches. Morphological, thermal and rheological properties of starches. Food Chem., 79: 177–181.

Kaur, M. and Singh, N. (2005). Studies on functional, thermal and pasting properties of flours from different chickpea *(Cicer arietinum L.)* cultivars. Food Chem., 91: 403–411

Lee, S. and Prosky, L. (1994). Perspectives on new dietary fiber definition. Cereal Foods World, 39:767-768

Mattern, P. (1991).Wheat In: Lorenz, K.J. & Kulp, K. (eds), Hand Book of Cereal Science & Technology PP.112-126. New York: MarCel Dekker.

Miyuki, O.; Tran Van Hung; Hiroyuki, T.; Teruaki, A. and Takuya, S. (2017). Dietary psyllium fiber increases intestinal heat shock protein 25 expression in mice. Nutr. Res., 39: 25-33.

Moreyra, A.; Wilson, A. and Koraym, A. (2005). Effect of combining psyllium fiber with simvastatin in lowering cholesterol. Arch. Int. Med., 165:1161–1166.

Mousia, Z.; Edherly, S.; Pandiella, S. and Webb, C. (2004). Effect of wheat pearling on flour quality. Food Res. Inter., 37: 449–459

Murkovic, M.; Piironen, V.; Lampi. A.; Kraushofer, T. and Sontag, G. (2004). Changes in chemical composition of pumpkin seeds during the roasting process for production of pumpkin seed oil. Part I: non-volatile compounds. Food Chem., 84(3):359–65.

Nidhi, Y.; Vivek, S.; Suman, K.; Ravinder, K.M. and Sumit, A. (2016). Hypo-cholesterolaemic and prebiotic effect of partially hydrolysed psyllium husk supplemented yoghurt. J. Functional Foods; 24: 351-358.

Nikouzadeh, H.; Taslimy, A. and Azizi, M.H. (2008). Effects of the addition of psyllium husk on the rheological characteristics of dough and quality of sangak bread. In: Proceedings 18th National Congress on Food Technol. Mashhad. Iran [in Persian].

Noor, A. and Komathi, C. (2009). Physicochemical and Functional Properties of Peeled and Unpeeled Pumpkin Flour. J. Food Sci.,74(7):S328-S333

Peressini, D. and Alessandro, S. (2009). Effect of soluble dietary fiber addition on rheological and bread making properties of wheat dough’s . J. Cereal Sci., 49: 190–201.

Perez, H.; Guerra-Hernández, E. and García-Villanova, B. (1997). Determination of insoluble dietary fiber compounds: cellulose, hemicellulose and lignin in Legumes. Ars. Pharm., 38(4): 357-364

Pittler, M. and Ernst, E. (2004). Dietary supplements for body-weight reduction: a systematic review. Am. J. Clin. Nutr., 79: 529–536.

Ptitchkina, N.; Novokreschonova, L.; Piskunova, G. and Morris, E. (1998). Large enhancements in loaf volume and organoleptic acceptability of wheat bread by small additions of pumpkin powder: Possible role of acetylated pectin in stabilising gas-cell structure. Food Hydro., 12: 333–337.

Ramkumar, D. and Rao, S. (2005). Efficacy and safety of traditional medical therapies for chronic constipation: systematic review. Am. J. Gastroenterol., 100: 936–971.

Ranhotra, G.; Gelroth, J.; Glaser, B. and Lorenz, K. (1995). Baking and Nutritional Qualities of a Spelt Wheat Sample. Lebensm-Wiss Technol., (28): 118-122.

Raymundo A.; Fradinho P. and Nunes, M.C. (2014). Effect of psyllium fibre content on the textural and rheological characteristics of biscuit and biscuit dough. Bioactive Carbohydrate and Dietary Fibre, 3: 96–105.

Ringe, M. and Stoll, J. (1991). R-T-E cereal with psyllium. US Patent 5, 026, 689.

Rojas, J.; Rosell C. and Benedito C. (1999). Pasting properties of different wheat flour-hydrocolloid systems. Food Hydro., 13: 27–33.

Rosell, C.; Collar, C. and Haros, M. (2007). Assessment of hydrocolloid effects on the thermo-mechanical properties of wheat using the Mixolab. Food Hydro., 21: 452–462

Samira, B.; Seyed, H.P.; Mehdi, B.; Mohammad, A.J. and Aziz, H.R., (2016). Effect of Psyllium Husk on Physical, Nutritional, Sensory, and Staling Properties of Dietary Prebiotic Sponge Cake. Czech J. Food Sci., 34, (6): 534–540

Sangnark, A. and Noomhorm, A. (2003). Effect of particle sizes on functional properties of dietary fibre prepared from sugarcane bagasse. Food Chem., 80 : 221–229.

SAS Program (1996). SAS/STAT User's Guide Release 6.12 ed. Cary, NC, USA: SAS Inst. Inc.

See, E.; Wan Nadiah,W. and Noor, A. (2007). Physico-chemical and sensory evaluation of breads supplemented with pumpkin flour. Asean. Food J., 14(2):123–30.

Shewry, P.; Tatham, A.; Barro, F.; Barcelo, P. and Lazzeri, P. (1995). Biotechnology of breadmaking: unraveling and manipulating the multi-protein gluten complex. Bio. Tech., 13: 1185–1190.

Singh, B. (2007). Psyllium as therapeutic and drug delivery agent. Inter. J. Pharm., 334 :1–14

Souci, S.; Fachmann, W. and Kraut, H. (2000). Food Composition and Nutrition Tables. Medpharm. Stuttgart, Germany: Scientific Publishers.

Vasanthan, T. and Bhatty, R. (1996). Physicochemical properties of small and large granule starches of waxy, regular, and high amylase barleys. Cereal Chem., 73: 199–207

Wang, J.; Rosell, C. and Barber, C. (2002). Effect of the addition of different fibers on wheat dough performance and bread quality, Food Chem., 79:221–226

Whitney, E.; Cataldo, C. and Rolfes, S. (2002). Understanding Normal and Clinical Nutrition, 6th Edition. Wadsworth/Thomson Learning, Belmont, California: 177-178, Appendix 1, D1-D3.

Yu, L.; Lutterodt, H. and Cheng, Z. (2008). Beneficial health properties of psyllium and approaches to improve its functionality. In: S. Taylor (Ed.). Advances in food and nutrition research, 55: 193–220. San Diego: Elsevier Inc.

تأثير مسحوق القرع العسلى وقشور بذور لسان الحمل على الخواص الريولوجية للعجائن والتقييم الحسى وجودة خبز القوالب

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قسم الإقتصاد المنزلى - كلية التربية النوعية - جامعة عين شمس – القاهرة- مصر

المستخلص

تهدف هذه الدراسة إلى معرفة تأثير كل من مسحوق القرع العسلى ومسحوق قشور بذور لسان الحمل كمصدر للألياف الغذائية على الخواص الريولوجية وجودة خبز القوالب. حيث أن الألياف الغذائية لها منافع عديدة من حيث التمثيل الغذائى والتأثيرات الفسيولوجية للإنسان. لذلك تشير الدراسة إلى استخدام مصادر نباتية غنية بالألياف الغذائية مثل القرع العسلى وقشور بذور لسان الحمل فى عمل خبز القوالب. ولقد تم دراسة الخواص الوظيفية والفسيولوجية لهذه النباتات الغنية بالألياف الغذائية.

أظهرت نتائج الألياف الخام تراوحها بين 66,7% فى قشور بذور لسان الحمل (أعلى نسبة) و 16,1% كأقل حد فى القرع العسلى. على جانب اخر, سجل قشور بذور لسان الحمل نسبة ضئيلة فى الدهون 0,01 فى حين وصلت إلى 2,03 فى القرع العسلى على اساس الوزن الجاف. وفيما يتعلق بمشتقات الألياف الغذائية الثلاثة (السيليلوز والهيموسيليلوز واللجنين) فقد سجلت نتائج القرع العسلى احتوائه على 66,4 , 0,49 , 14,5% من مجموع الألياف الغذائية فى حين سجلت نتائج قشور بذور لسان الحمل 7,3 , 54,7 , 0,5% على التوالى. ويتم استخدام مشتقات الألياف الغذائية فى تشخيص النباتات كمصدر للألياف الغذائية والتى تحتوى على نسبة كبيرة من البوتاسيوم 246,83 : 605.94 وفى الحديد 106,04 : 79.06 وفى الكالسيوم 99,60 : 121,63 مليجرام/100 جرام على اساس الوزن الجاف فى كل من قشور بذور لسان الحمل والقرع العسلى على التوالى. كما تم استخدام كل من المسح الحرارى التفاضلى و الفقد الوزنى بالحرارة لتدعيم النتائج, تم عمل عينات من خبز القوالب من الدقيق المدعم بمسحوق القرع العسلى ومسحوق قشور بذور لسان الحمل باستخدام نسب مختلفة 2,5 و 5 و 7,5 و 10% .كما أنه تم اختبار خواص خبز القوالب والخواص الحسية لتقدير جودة الخبز. مما سبق يمكن تلخيص اهم النتائج بأن مسحوق قشور بذور لسان الحمل تعتبر أفضل إضافة حيث أنه يمكن اضافته بنسبة 10% كمصدر للألياف الغذائية مع تغير ضعيف فى درجة القبول العام لخبز القوالب والذى يعوضه الفائدة التى تعود من التغذى على غذاء وظيفى على هيئة خبز غنى بالألياف الغذائية.