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Evaluation of Pan Bread Fortified with Sunflower Seeds Powder

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ABSTRACT

The main goal of such work was to study the effect of adding sunflower seeds powder in different ratios (5, 10, 15 and 20%) on chemical composition, amino acids contents, fatty acids composition, rheological properties, physical features, bioactive compounds and sensory evaluation of pan bread samples. The obtained results indicated that sunflower seeds powder contained 12.79% crude protein, 24.98% oil, 35.98% crude fibers and 3.53% ash contents. Also, sunflower seeds powder were rich in Ca (191.16 mg/100g), P (103.21 mg/100g) and K (181.74 mg/100g). While, sunflower seeds powder contained cysteine (7.50 mg/g), lysine (19.91 mg/g), methionine (33.62 mg/g), aspartic acid (75.73 mg/g) and proline (154.59 mg/g). There were no significant differences between control pan bread sample and pan bread sample fortified with 10% sunflower seeds powder in appearance, taste, odor, color and overall acceptability. Studied pan bread samples contained high amounts of crude protein, oil, crude fibers, ash and a good source of minerals, total phenolic and total flavonoids compounds. So, it could be advisable to add sunflower seeds powder up to (10%) for producing high quality pan bread and excellent acceptance.

Keywords: Sunflower seeds, pan bread, chemical analysis, nutritional value and sensory acceptability.

INTRODUCTION

Sunflower is an important crop that is planted worldwide. A sunflower sprout is rich in protein, vitamin A, D, and E, minerals, amino acids, and lecithin. It is also a good source of antioxidants (Guo *et al*., 2017 and Sirimuangmoon, 2018).

Sunflower, *Helianthus annuus*, is from the *Asteraceae* family and is the largest family of flowering plant. Sunflower is an important oilseed and food crop, and it produces 10% of oil in the world (De Oliveira Filho and Egea, 2021).

Sunflower seeds contains (15) g protein, (58) g lipids, (3) g ash, and (24) g carbohydrate with (675) kcal total energy per 100 g seeds (De Oliveira Filho and Egea, 2021).

Bread is a significant part of the daily diet in several regions of the world, where it accounts for about 20% of the calories consumed by people (Saccotelli *et al.*, 2017).

Khalil, *et al*., (2021) reported that bread is one of the oldest foodstuffs that man relied on and is the main food in many countries around the world, where all segments of society, rich and poor, depend on it. Its types may vary according to the financial situation of each of these groups, but everyone depends on it mainly.

Pan bread referred to loaf bread or sliced bread, in which the dough is baked in a loaf pan to give its characteristic format (Ishida and Steel, 2014).

Wheat flour (*Triticum aestivum*) is the most widely used around the world to produce bread as it gives an ideal product with excellent sensory properties and acceptable to the consumer (Lockyer and Spiro, 2020). Because of his uniqueness with these qualities, the demand for it increased, which created a gap between what is produced of wheat in some countries and what is consumed, and this gap widened with the increase in the population of these countries (White, 2021).

Skrbic and Filipcev, (2008) reported that sunflower seeds could be added to bread up to levels of 16% (flour basis) without significant adverse effects regarding the crust color, crumb grain structure and uniformity. Adding sunflower seeds significantly decreases crumb elasticity compared to the control samples but not to the level that would disqualify the product and the addition of sunflower seed improved the flavour of bread samples.

Zorzi *et al.,* (2020) demonstrated that the acceptance index reached 70% for bread with 5% and 10% of sunflower protein concentrate (SPC), almost reaching 20% (69.89%). Bread formulated with 10% was the only one with 70% AI in all parameters, following 5% SPC bread, which only the residual flavor was lower than 70%. The bread with the fewer parameters reaching the minimal AI was 20% SPC bread, where only texture, odor, color, and appearance parameters were higher than 70%, probably due to SPC's higher content.

So, the main goal of such manuscript is to study the effect of adding sunflower seeds powder at levels of 5, 10, 15 and 20 % on chemical composition, rheological properties, physical features and sensory evaluation of pan bread samples.

MATERIALS AND METHODS

Materials:

Raw materials:

Wheat flour (*Triticum aestivum*, 72% extr), sunflower seeds (*Helianthus annuus*) were purchased from Mansoura city local market, El-Dakahlia governorate, Egypt.

Other ingredients:

Sugar, instant active dry yeast, skim milk powder, salt and commercial fat were bought from Mansoura city local market, El-Dakahlia governorate, Egypt.

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Chemicals:

All chemicals used in this study were of analytic grade and obtained from El-Gomhouria pharmaceutical company, El-Mansoura city, El-Dakahlia Governorate, Egypt.

Methods:

Technological Methods:

Preparation of sunflower seeds:

Sunflower seeds were manually cleaned and foreign matters, such as stones, dirt and broken seeds were removed. Afterwards, the seeds were grinded into powder using an electrical grinder to pass through sieved 120 mesh and stored at refrigeration (3-5°C) in hermetic plastic vessels until used A.A.C.C, (2010).

Baking process of pan bread:

Samples of pan bread were prepared as indicated by the technique described in A.A.C.C, (2010) at Food Technology Research Institute, Agricultural Research Center, El-Giza, Egypt. The resulted dough were let to rest for 20 min at 30±2°C (first proofing), and then the dough were partitioned into 400 g for pieces, hand stacked, and put into metal pans at 30±2°C and 80-85% relative humidity in fermentation cabinet for 60 min. then, dough was baked in electrically heated oven (National MFG Co.) (with steam added during baking) at 210-220°C for 15-20 min. Acquired portions were separated from the metal dish, cooled to ordinary room temperature, then were ground into powder using electrical grinder (made in Egypt) to pass through sieved 120 mesh and stored at (3-5◦C) in sealed polyethylene bags until analysis showen in (Table A).

Table A. Pan bread formula preparation:

Components Treatments		Wheat flour (72%) (g)	Sunflower seeds (powder) (g)	Active Dry yeast (g)	Sugar (g)	Fat (g)	Skin milk powder (g)	Salt (g)
Control Sample		100	-	2	4	4	2	1.5
Blends	(1)	100	5	2	4	4	2	1.5
	(2)	100	10	2	4	4	2	1.5
	(3)	100	15	2	4	4	2	1.5
	(4)	100	20	2	4	4	2	1.5

Treatments: Blend (1) Control +5% sunflower seeds powder, Blend (2) Control +10% sunflower seeds powder, Blend (3) Control +15% sunflower seeds powder and Blend (4) Control +20% sunflower seeds powder.

Analytical Methods:

Proximate chemical analysis:

Moisture, ash, crude fat, crude protein and crude fibers content were determined according to the method described by A.O.A.C, (2019) at Agricultural Seeds Laboratory, Mansoura University, Dakahlia. While total carbohydrates content was calculated by difference from the following equation: Carbohydrates content % =100- [% protein + % ash + % lipids + % fibers].

Determination of minerals content:

Minerals content was determined as indicated by Chapman and Pratt (1979) at Agricultural Research Center, Mansoura, Dakahlia. The total quantities of Fe, Zn, Na, K and Ca were determined using atomic absorption spectrophotometry as indicated to the methods of A.A.C.C, (2005). Whereas, P content was determined by spectrophotometer as indicated by the method of Astem, (1975).

Determination of amino acids pattern:

Amino acids composition of experimental samples was determined using HPLC-Pico-Tag method as described by Heinrikson and Meredith, (1984), White *et al.* (1986) and Cohen *et al.* (1989) at National Research Center, Giza.

Predicted protein efficiency ratio (PER)

Predicted protein efficiency ratio (PER) was calculated using one of the equations of Alsmeyer *et al.*, (1974) as adapted by Adeyeye, (2009).

PER = -0.468 + 0.454(Leu) - 0.105(Tyr)

Biological value (BV)

Biological value (BV) was estimated using the equation suggested by Oser, (1959) BV = 49.9+10.53 PER

Determination of fatty acids composition:

Fatty acids methyl esters preparation :

Fatty acids composition were determined according to the modified method of Zahran and Tawfeuk, (2019) at National Research Center, Giza.

Determination of Vitamin A:

Vitamin A content in raw materials and studied pan bread samples was described by Plozza *et al.*, (2012) at National Research Center, Giza.

Determination of tocopherols:

Samples were saponified according to Lee *et al.*, (2012) at National Research Center, Giza.

Determination of bio-active compounds:

Total Phenolic compounds content:

Total Phenolic compounds content were measured with some modification at Seeds and Tissues Pathology Laboratory, Faculty of Agriculture, Mansoura University, Egypt according to the method of Singleton and Rossi, (1965).

Total flavonoid compounds content:

Total flavonoid compounds were assayed in the methanolic extract with some modifications at Seeds and Tissues Pathology Laboratory, Faculty of Agriculture, Mansoura University, Egypt according to the method adopted by Zhuang, (1992).

Determination of radical Scavenging activity DPPH%:

(1,1-diphenyl -2-picythydrazyl, the free radical capacity was carried out as reported by **Siger *et al.*, (2008)** at Seeds and Tissues Pathology Laboratory, Faculty of Agriculture, Mansoura University, Egypt.

Rheological measurements of dough:

Farinograph test:

Farinograph instrument (Brabender Duis Bur G. type 810105001 No. 941026 made in West Germany) was used to determine the water absorption and mixing characteristics of dough prepared from the various blends under investigation according to A.A.C.C, (2012) method at food Technology Research Institute, Agricultural Research Center, El-Giza. Egypt. All the parameters were obtained from the Farinograph instrument.

Extensograph test:

Extensograph test was carried out according to the method described by A.A.C.C, (2012) using Extensograph test (Brabender Duis Bur G. type 86001 No. 9416003 made in West Germany) at food Technology Research Institute, Agricultural Research Center, El-Giza. Egypt.

Physical properties of pan bread:

The weight of bread loaves were determined after cooling for one hour. Volumes were measured by rape seed displacement method as described by A.A.C.C, (2012). Specific volumes were calculated by dividing the volume (Cm^3) by their weights (g) at food Technology Research Institute, Agricultural Research Center, El-Giza. Egypt.

Sensory evaluation of pan bread samples:

Samples of fresh pan bread that were baked and left for cool at room temperature (25±2°C) for an hour, then were applied to sensory test and evaluated according to A.A.C.C, (2005), by ten panelists at Food Industries Department Faculty of Agriculture, Mansoura University. The quality score of pan bread included crust color (10), crumb color (10), texture (20), taste (20), flavor (20), general appearance (20) and all over acceptability (100degrees).

Statistical analysis:

The obtained sensory evaluation results were statistically analyzed by (ANOVA) with the producer of the Statistical Package of Social Sciences (SPSS) software program version 17 (2008). Significant differences among treatments means were determined by Duncan's Multiple Comparisons at $P \leq 0.05$, according to Gomez and Gomez, (1984).

RESULTS AND DISCUSSION

Sensory evaluation of studied pan bread samples:

Sensory evaluation plays a significant part in order to evaluate the product characteristics and to access what differences of the product would collect better sensory evaluation for various mixtures of pan brad samples (Bryhni *et al.,* 2002).

Sensory properties of studied pan bread prepared by adding different percentages of sunflower seeds powder were evaluated to choose the best addition percentage to produce high quality pan bread. Samples of pan bread were evaluated by ten members for their internal and external properties as shown in Table (1).

Data in Table (1) showed that there were significant differences ($p \leq 0.05$) in all sensory attributes between control pan bread and pan bread using 5, 10, 15 and 20% sunflower seeds powder. However, pan bread sample fortified with 5% and 10% of sunflower seeds powder samples were the best addition and pan bread sample fortified with 10% was the nearest treatment to control sample. Pan bread samples fortified with 5,10,15 and 20% sunflower seeds powder had no significant difference ($p \leq 0.05$) between them in crust color, crumb color, texture, flavor, odor and total acceptability.

Table 1. Sensory evaluation of pan bread with sunflower seeds:

Sensory attributes Treatments	Crust color (15)	Shape (10)	Crumb color (15)	Grain cell structure (15)	Texture (15)	Flavor (15)	Odor (15)	Total (100)
Control	14.80^{a}	9.80^{a}	14.72^{a}	14.68^{a}	14.68^{a}	14.60^{a}	14.64^{a}	97.92^{a}
Blend (1)	13.40^{b}	9.12^{bc}	13.84^{b}	13.80^{b}	13.92^{b}	13.76^{b}	13.76^{b}	91.60^{b}
Blend (2)	13.92^{b}	9.40^{ab}	13.96^{b}	13.96^{ab}	13.96^{b}	13.84^{b}	13.76^{b}	92.80^{b}
Blend (3)	13.68^{b}	8.92^{bc}	13.56^{b}	13.40^{b}	13.32^{b}	13.12^{b}	13.40^{b}	89.40^{b}
Blend (4)	13.56^{b}	8.72^{c}	13.72^{b}	13.56^{b}	13.40^{b}	13.12^{b}	13.24^{b}	89.32^{b}

***The values followed by the same letter in the same coulmn are not significantly different at $p \leq 0.05$.**

Treatments: Blend (1) Control +5% sunflower seeds powder, Blend (2) Control +10% sunflower seeds powder, Blend (3) Control +15% sunflower seeds powder and Blend (4) Control +20% sunflower seeds powder.

Sensory evaluation led to choice the preferred samples by panalists to complete the experement which were the addition of 5% Blend (1) and 10% Blend (2) sunflower seeds powder. Pan bread using 10% sunflower seeds powder Blend (2) was as good as control pan bread.

Chemical composition of raw materials and pan bread samples:

Chemical composition of the raw materials used in this investigation is presented in Table (2). With regard to moisture content in sunflower seeds powder results showed that values (5.85%). As was expected, the seeds powder showed a high amount of fat (24.98%).

Data listed in Table (2) revealed that sunflower seeds powder had the high percentages of protein and fibers, which were 12.79 and 35.98%, respectively.

On the other hand, the obtained results of sunflower seeds powder were near from those reported by De Oliveira Filho and Egea, (2021), who found that sunflower seed powder contains 15 g protein, 58 g lipids, 3 g ash and 24 g carbohydrates with 675 kcal total energy per 100 g.

From the same table, the used wheat flour 72% extr contained 11.97, 11.69, 2.03, 0.56, ND and 85.72 % for moisture, protein, lipids, ash, crude fibers and carbohydrates, respectively.

Abo Raya *et al.,* (2022) reported that wheat flour 72% extr had moisture (10.85%), crude protein (11.28%), ash (1.24%), crude fibers (1.93%), fat (1.60%) and carbohydrates (83.95%).

Results in Table (2) showed that chemical composition of prepared pan bread. Content of moisture in pan bread samples ranged from 4.00% to 8.02%. Protein, ash and fibers in pan bread increased mostly with increasing the level of sunflower seeds powder in bread. Addition of sunflower seeds powder to pan bread characterized higher results of fibers content, than the control sample.

Dietary fibers presence in the human diet helps to accelerate intestinal peristalsis, reduces the absorption of cholesterol and triglycerides, decreases glucose levels in the blood, and reduces the feeling of hunger (Costantini *et al.,* 2014 and Coelho and Salas-Mellado, 2015).

Fat of pan bread samples essentially increased (9.41%) with increasing of sunflower seeds powder level (12.47 and 15.69 %) blend (1) and (2) respectively. Thus, the addition of sunflower seed to pan bread had appositive effect on nutritional value of the product.

Table 2. Chemical composition of raw materials and studied pan bread samples (g/100 g in dry matter):

Components Samples	Moisture %	Crude protein %	Ash %	Crude fiber %	Fat %	Total carbohydrates %
Wheat flour (72%) extr	11.97	11.69	0.56	ND	2.03	85.72
Sunflower seeds powder	5.85	12.79	3.53	35.98	24.98	22.72
Control	4.00	9.30	1.22	25.21	9.41	54.86
Blend (1)	6.35	9.01	1.19	25.98	12.47	51.35
Blend (2)	8.02	9.80	1.34	34.23	15.69	38.94

Blend (1) Control +5% sunflower seeds powder and Blend (2) Control +10% sunflower seeds powder

Minerals content of raw materials and pan bread samples:

Data in Table (3) gives the contents of four macro elements: calcium (Ca), potassium (K), Sodium (Na) and phosphorus (P) as well as two of micro elements: iron (Fe) zinc (Zn) in sunflower seeds powder, wheat flour and studied pan bread samples blend (1) and (2).

Data listed in Table (3) revealed that sunflower seeds powder appear to be poor in macro elements: sodium (Na) (94.11 mg/100g), but very rich in calcium (Ca) (191.16 mg/100g), potassium (K) recorded 181.74 mg/100g and phosphorus (P) was 103.21mg/100g. The World Health Organization recommends that adults reduce salt intake to less than 5 grams per person per day (2 grams per day of sodium). For children, the recommended maximum level of 2 grams per day of sodium. Calcium is important for building and maintaining bone strength (WHO).

As for trace elements content, iron and zinc were estimated in sunflower seeds powder, wheat flour and pan bread samples with or without adding sunflower seeds powder, and the results are listed in Table (3). Obtained data revealed that, sunflower seeds powder contained higher amounts of iron and zinc (17.13,1.03 mg/100g) compared with wheat flour (72% extr) (0.65 and 0.29 mg/100g) respectively.

The obtained results were in agreement with El-Refai *et al*., (2021) they reported that wheat flour 72% had K (176.33 mg / l00g), Ca (30.68 mg / l00g), Na (25.11 mg / l00g), P (148.41 mg / l00g), Zn (0.81 mg / l00g) and Fe (2.64 mg / l00g.).

Tabulated data listed in Table (3) illustrated that pan bread samples baked using sunflower seeds powder were recorded (56.78-mg/100g) calcium (Ca) in control sample, but in pan bread sample fortified with 10% sunflower seeds powder (Blend 2) were very rich in Sodium (Na) (259.18 mg/100g), potassium (K) (120.18 mg/100g) and phosphorus (P) (191.05 mg/100g). Also, the same tabulated results revealed that pan bread samples baked using +10%sunflower seeds powder (Blend 2) contained higher amounts of zinc (1.33 mg/100g), iron (5.11 mg/100g), compared with control (1.26 and 3.71 mg/100g), respectively.

Table 3. Minerals contents of raw materials and pan bread samples (mg/100 g) on dry weight basis:

Raw materials and	Minerals (mg/100g)					
pan bread samples	Ca	Zn	Fe	Na	K	P
Wheat flour (72%) extr	41.12	0.29	0.65	27.18	122.76	135.36
Sunflower seeds powder	191.16	1.03	17.13	94.11	181.74	103.21
Control	56.78	1.26	3.71	221.18	109.78	181.47
Blend (1)	61.17	1.29	4.81	243.11	113.76	189.16
Blend (2)	67.81	1.33	5.11	259.18	120.18	191.05

Blend (1) Control +5% sunflower seeds powder and Blend (2) Control +10% sunflower seeds powder

The obtained results were in agreement with El-Refai *et al.*, (2021) reported that control pan bread had K (114.76mg/100g), Ca (64.44 mg/100g), Na (218.11 mg/100g), P (183.16 mg/100g), Zn (1.18 mg/100g) and Fe (3.83 mg/100g).

From the obtained results the levels of either macro or micro elements in Table (3) may be explained from the nutritional point of view on a nutritional basis, the needs of elements and their role in the human body should be pointed out. Therefore, sunflower seeds powder are considered as a good source for these minerals.

Bioactive compounds and antioxidant activity (DPPH) of raw materials and pan bread samples:

Bioactive compounds and antioxidant activity (DPPH) of studied raw materials and pan bread samples Blend (1) and (2) were presented in Table (4). From obtained results, it could be noted that total phenolic content of used raw material ranged from 74.200 mg/g in wheat flour (72%) extr to 728.337mg/g in sunflower seeds powder. As for total flavonoids content, sunflower seeds powder contained the highest amount recording 21.467 mg/g, while wheat flour (72%) extr contained the least value of 0.267 mg/g.

Antioxidant activity is an important parameter to establish the food product healthy functionality. Antioxidant scavenging activity content recorded the highest value of 90.345% in sunflower seeds powder and 2.651% in wheat flour (72%) extr. This high value of sunflower seeds powder was due to the high content of total phenolic (728.337%).

From the same table, it could be seen that sunflower seeds powder had the highest content of total flavonoids content and antioxidant scavenging activity, while wheat flour (72%) extr had the least value of total phenolic content, total flavonoids content and antioxidant scavenging Table (4).

Bioactive compounds and antioxidant activity (DPPH) of studied pan bread samples using sunflower seeds powder Blend (1) and (2) were presented in Table (4). From obtained results, it could be noticed that total phenolic compounds content of pan bread samples ranged from143.400 mg/g in control sample to 866.671 mg/g in pan bread samples fortified with 5% sunflower seeds (Blend 1). As for total flavonoids compounds content pan bread samples prepared using sunflower seeds powder contained the highest amount recording 8.133 mg/gin pan bread sample fortified with 10% sunflower seeds powder (Blend 2), while control sample contained the least value of 0.667 mg/g flavonoids compounds.

Table 4. Bioactive compounds and antioxidant activity (DPPH%) of raw materials and pan bread samples:

Raw materials and pan bread samples	Bioactive compounds		Antioxidant scavenging activity (%)
	Total phenolic compounds content (mg/g dry weight)	Total flavonoids compounds content (mg/g dry weight)	
Wheat flour (72%) extr	74.200	0.267	2.651
Sunflower seeds	728.337	21.467	90.345
Control	143.400	0.667	13.178
Blend (1)	501.869	3.600	27.134
Blend (2)	866.671	8.133	55.634

Blend (1) Control +5% sunflower seeds powder and Blend (2) Control +10% sunflower seeds powder

Antioxidant scavenging activity recorded a value of 55.634% in pan bread samples fortified with 10% sunflower seeds powder (Blend 2) and 13.178% in control sample. This observation may be attributed to the highest value of total phenolic compounds content (866.671%) in pan bread samples fortified with 10% sunflower seeds powder. From the same table, it could be concluded that pan bread samples fortified with 10% sunflower seeds pan bread samples (Blend 2) had the highest content of total flavonoids compounds content and antioxidant scavenging activity, while control sample had the least value of total phenolic content, total flavonoids content and antioxidant scavenging activity Table (4).

Amino acids composition of raw materials and pan bread samples (mg aminoacid per g protein):

Amino acids composition of wheat flour, sunflower seeds powder and studied pan bread samples were shown in Table (5). Tabulated results cleared that sunflower seeds powder protein was considered a poor source of cysteine 7.50 mg/g, Lysine19.91mg/g, while, Isoleucine, Histidine and Threonine were recorded 38.36mg/g, 42.07mg/g and 43.58mg/g respectively Table (5).

Table 5. Amino acids composition of raw materials and pan bread samples (mg amino acid per g protein)

Samples Amino acids (mg/g)	Wheat flour (72%) extr	Sunflower seeds powder	Control	Blend (1)	Blend (2)
Lysine	24.55	19.91	10.82	11.16	32.39
Leucine	48.65	60.36	47.72	59.64	76.04
Isoleucine	36.76	38.36	52.81	41.24	41.33
Phenylalanine	91.28	62.44	47.47	59.47	46.38
Tyrosine	24.99	50.43	68.95	53.19	31.12
Histidine	41.54	42.07	41.32	50.31	37.71
Valine	54.94	55.37	45.77	63.05	46.73
Threonine	71.77	43.58	40.05	70.82	51.04
Methionine	24.13	33.62	54.09	27.02	15.63
Cysteine	11.11	7.50	9.30	16.53	8.73
Total essential amino acids	429.72	413.64	418.3	452.43	387.1
Aspartic acid	58.36	75.73	59.75	61.08	107.80
Glutamic acid	128.36	133.09	176.96	133.27	141.34
Serine	52.51	22.96	26.35	34.96	33.61
Proline	134.49	154.59	165.21	115.21	120.74
Glycine	48.92	29.09	21.89	34.80	30.48
Alanine	41.99	30.66	15.59	30.67	38.65
Arginine	46.72	95.05	69.12	80.75	82.73
Total Non-Essential amino acids	511.35	541.17	534.87	490.74	555.35
P.PER	1.48	1.75	0.97	1.69	2.66
BV	65.49	68.33	60.12	67.70	77.91

Blend (1) Control +5% sunflower seeds powder and Blend (2) Control +10% sunflower seeds powder
Protein efficiency ratio (PER) and Biological value (B.V)

On the other hand, sunflower seeds powder contained tyrosine, valine, leucine and phenylalanine were the predominant essential amino acids represented 50.43, 55.38, 60.36 and 62.44 mg/g respectively Table (5). Non-essential amino acids included proline and glutamic acids were the basic of amino acids, which were 154.59 and 133.09 mg/g respectively, followed by arginine, aspartic acid and alanine 95.05, 75.73, and 30.66 mg/g respectively. Also, sunflower seeds powder had high value of P.PER content (1.75) compared with wheat flour (72%) while, wheat flour (72%) had lower value of BV content (65.49%) than sunflower seeds powder.

Total essential amino acids ranged from 387.1% in pan bread sample fortified with 10% sunflower seeds powder (Blend 2) to 452.43% in pan bread sample fortified with 5% sunflower seeds powder (Blend 1), it could be observed that leucine (76.04 mg/g) is the predominant essential amino acids in pan bread sample fortified with 10% sunflower seeds powder (Blend 2), while threonine (70.82 mg/g) is the predominant essential amino acids in pan bread sample fortified with 5% sunflower seeds powder (Blend 1), while tyrosine (68.95 mg/g)is the predominant essential amino acids in control sample.

Total non-essential amino acids ranged from 490.74% in pan bread sample fortified with 5% sunflower seeds powder (Blend 1) to 555.35% in pan bread sample fortified with 10% sunflower seeds powder (Blend 2), it could be observed that glutamic acid is the predominant essential amino acids, it ranged from 133.27 mg/g in pan bread sample fortified with 5% sunflower seeds powder (Blend 1) to 176.96 mg/g in control sample.

Protein efficiency ratio (PER) ranged from 0.97 in control sample to 2.66 in pan bread sample fortified with 10% sunflower seeds powder (Blend 2). While, Biological value (B.V) ranged from 60.12% in control sample to 77.91% in pan bread sample fortified with 10% sunflower seeds powder (Blend 2).

Abo Raya *et al.,* (2019) showed amino acids composition of wheat flour (72%) extr were cleared that protein was considered poor source of cysteine 1.59%, tyrosine 2.53%, histidine 3.11%, isoleucine3.89% and threonine 5.18% as essential amino acids. On other hand, valine was predominant essential amino acids represented 5.63%. Nonessential amino acids included glutamic is basic of amino acids that was 11.67%, followed by arginine 6.92 %.

Fatty acids composition of raw materials and studied pan bread samples:

The results in Table (6) showed that the composition of fatty acids in raw materials and studied pan bread samples. Total saturated fatty acids in sunflower seeds recorded 56.77%, It could be observed that stearic acid

(C18:0) (50.47%) is the predominant saturated fatty acid in sunflower seeds powder oil. The oil of sunflower seeds contains high amounts of palmitic acid (C16:0) being5.80%. Meanwhile, total unsaturated fatty acids in sunflower were 43.22%, It could be observed that oleic acid (C18:1n9c) (40.83%) is the most predominant unsaturated fatty acid in sunflower seeds oil.

Jaski *et al.,* (2022) illustrated those sunflower seeds powder oil had saturated fatty acids12.8%, monounsaturated 49.1%, polyunsaturated 38.3%, and Linoleic 38.3%.

Table 6. Fatty acids composition of raw materials and pan bread samples:

samples Fatty acids (%)	Wheat flour (72%)	Sunflower seeds powder	Control	Blend (1)	Blend (2)
Caproic acid (C6:0)	-	-	-	0.48	0.76
Caprylic acid (C8:0)	-	-	-	0.12	-
Capric acid (C10:0)	-	-	-	0.55	0.75
Lauric acid (C12:0)	-	-	-	1.33	1.64
Myristic acid (C14:0)	-	-	-	3.33	4.19
Pentadecanoic acid (C15:0)	-	-	-	0.34	0.42
Palmitic acid (C16:0)	19.42	5.80	12.92	14.35	17.13
Heptadecanoic acid (C17:0)	-	-	-	0.36	0.42
Stearic acid (C18:0)	22.34	50.47	28.92	43.14	38.72
Arachidic acid (C20:0)	0.08	-	0.18	0.37	0.42
Behenic Linolenic acid (C22:0)	0.18	0.50	0.29	0.46	-
Total Saturated fatty acids	42.02	56.77	42.31	64.83	64.45
Myristoleic acid (14:1)	-	-	-	-	-
Palmitoleic acid (C16:1)	0.40	-	0.28	0.11	0.28
Cis-11- Eicosenoic acid (C20:1)	0.31	0.81	0.39	0.50	0.42
Cis -11,14- Eicosadienoic acid (C 20:2)	-	-	0.13	0.32	-
Oleic acid (C18:1n9c)	51.18	40.83	48.87	30.57	27.00
Elaidic acid (C18:1n9t)	-	-	-	-	-
Linoleic acid (C18:2n6c)	2.99	-	5.20	1.52	5.10
Linoleic acid (C18:2n6t)	-	-	1.02	-	-
γ- Linolenic acid (C18:3n6)	0.20	0.45	0.37	0.19	0.37
Linolenic acid (C18:3n3)	0.54	0.26	0.24	0.41	0.87
Cis-8,11,14-eicosetrienoic acid (C20:3n6)	0.24	0.43	0.26	0.46	0.77
Erusic acid (C22:1n9)	-	-	-	-	-
Cis-11,14,17-Eicosetrienoic acid (C20:3n3)	0.29	0.33	0.14	0.41	-
Arachidonic acid (C20:4n6)	-	0.11	-	0.16	-
Total Unsaturated fatty acids	56.15	43.22	56.9	34.65	34.81
Total	98.17	99.99	99.21	99.48	99.26

Blend (1) Control +5% sunflower seeds powder and Blend (2) Control +10% sunflower seeds powder

Total saturated fatty acids ranged from 42.31% in control sample to 64.83% in pan bread sample fortified with 5% sunflower seeds powder (Blend 1), it could be observed that stearic acid (C18:0) is the predominant saturated fatty acid, it ranged from 28.92% in control sample to 43.14% in pan bread sample fortified with 5% sunflower seeds powder (Blend 1).

Total unsaturated fatty acids ranged from 34.65% in pan bread sample fortified with 5% sunflower seeds powder (Blend 1), to 56.9% in control sample, it could be observed that oleic acid (C18:1n9c) is the predominant unsaturated fatty acid, it ranged from27% in pan bread sample fortified with 10% sunflower seeds powder (Blend 2), to 48.87%in control sample.

Vitamin A and E content of raw materials and pan bread samples:

Vitamin A and E contents of raw materials and pan bread samples were presented in Table (7). From obtained results, it could be noted that delta E contents of raw materials ranged from 0.76 µg/g in wheat flour 72%to 3.73 µg/g in sunflower seeds powder.

sunflower seeds powder contained high amount of Gamma E recording 13.45 µg/g, while wheat flour (72%) contained the least value of 2.99 µg/g. Alpha E content recorded a value of 236.96µg/g in sunflower seeds powder and 5.05µg/g in wheat flour (72%) extr. Also, vitamin A was not detected in wheat flour (72%) extr and sunflower seeds powder.

It could be noted that Delta E contents of pan bread samples using sunflower seeds powder ranged from 1.77 mg/g in pan bread sample fortified with 5% sunflower seeds powder (Blend1) to 11.57µg/g in control sample. As for control contained the highest amount of Gamma E recording 34.76µg/g, while in pan bread sample fortified with 5% sunflower seeds powder (Blend1) contained 5.70µg/g. Alpha E content recorded a value of 30.03 µg/g in pan bread sample fortified with 5% sunflower seeds powder (Blend1) and 8.59 µg/g in control sample. Also, Vitamin A was not detected in control and pan bread samples Fortified with sunflower seeds powder.

Table 7. Vitamin A and E content of studied raw materials and pan bread samples:

Raw materials and pan bread samples	Vitamin content (µg/g)			
	Vitamin A	Vitamin E		
		Delta E	Gamma E	Alpha E
Wheat flour (72%) extr	ND	0.76	2.99	5.05
Sunflower seeds powder	ND	3.73	13.45	236.96
Control	ND	11.57	34.76	8.59
Blend (1)	ND	1.77	5.70	30.03
Blend (2)	ND	1.98	6.44	18.17

ND = not detected

Blend (1) Control +5% sunflower seeds powder and Blend (2) Control +10% sunflower seeds powder

From the same table, it could be concluded that control pan bread sample had the highest content of delta E and Gamma E, while, pan bread sample fortified with 5% sunflower seeds powder (Blend1) had the least values (1.77 and 5.70 µg/g) respectively.

Sunflower seeds contains an appreciable amount of vitamin E being 37.8 mg/100g (Food Standards Agency Institute of Food Research, 2002).

Farinograph parameters of studied pan bread dough:

The farinograph is an apparatus designed to measure and record the resistance of dough evaluates water absorption; determine the stability and other characteristics of dough during mixing (A.A.C.C, 2012). The farinograph parameters of wheat flour dough (72% ext.) and wheat flour partially added with different levels 5and 10% of sunflower seeds powder of were given in Table (8).

Water absorption (%) is the measure of water amount, which be added to the flour in order to form good dough at 500 (B.U.) line. Data of the present study revealed that the water absorption (%) decreases with increased levels of sunflower seeds powder addition. The water absorption decreased from 61.5% for wheat flour to 59 and 58% for levels of sunflower seeds powder addition with 5and 10% Blend (1) and (2) respectively. This decrease in water absorption might be explained that wheat flour contained damaged starch granules higher than that of sunflower seeds powder.

Results also showed that the dough development time (Mixing time) clearly reduced with increased addition of sunflower seeds powder. Dough development time was 3 min for wheat dough and decreased to 0.5 min for levels of sunflower seeds powder addition with 5 and 10% Blend (1) and (2).

The dough stability times increased by increasing the addition levels of sunflower seeds powder in dough as well as the dough strength become stronger. The stability time increased from 3 min for wheat flour dough to10 and 6.5 min for blends (1 and 2) with 5and 10% levels of sunflower seeds power addition, respectively.

The mixing tolerance index (B.U.) decreased with the increase of the addition of sunflower seeds powder levels in the mixture by 5% (Blend 1). The mixing tolerance index is 50 (B.U.) for wheat dough and decreased to 30 (B.U.) in the mixing ratio of 5% (Blend 1), while in the mixing ratio of 10% (Blend 2) it increased to 100 (B.U.).

Table 8. Farinograph parameters of studied pan bread dough.

Farinograph parameters Treatments	Water absorption (%)	Degree of weakening (B.U.)	Dough development Time (min)	Stability time (min)	tolerance index (B.U.)
Control	61.5	60	3	3	50
Blend (1)	59	150	0.5	10	30
Blend (2)	58	200	0.5	6.5	100

Blend (1) Control +5% sunflower seeds powder and Blend (2) Control +10% sunflower seeds powder

The dough weakening (B.U.) increased with increasing the addition of sunflower seeds powder levels in the blend. The dough weakening increased from 60 BU for wheat dough to 150 and 200 BU for blends (1 and 2) with 5 and 10% addition of sunflower seeds powder levels respectively.

El-Gammal *et al*., (2014) mentioned that control dough (100g wheat flour 72% extr only) had water absorption 63.5%, dough development time 5.0 min and dough stability 6.0 min.

Abo Raya *et al*, (2022) illustrated that control dough (100 g wheat flour 72% extr only) had water absorption 55.60%, dough weakening 60 B.U, dough development time 4.50 min and dough stability 8.0 min.

Extensograph parameters of studied pan bread dough:

Extensograph analysis gives data about the viscoelastic conducts of a dough resistance to extension and measures dough extensibility. A combination of both good extensibility and resistance results is desirable dough properties (Zalatica *et al*., 2012).

Data in Table (9) showed that wheat dough characteristics were affected by the addition of sunflower seeds powder at all levels used in this study. The dough strength (energy) as indicated with the area under extension curve increased from 99.5 $Cm^2$for wheat dough control to 102 and 115Cm^2 with sunflower seeds powder addition levels of 5 and 10% (Blend1 and 2), respectively. Also, elasticity increased from 400 BU for wheat dough control to 420 BU for pan bread sample fortified with 5% sunflower seeds powder (Blend1). Maximum elasticity also dropped from 605 BU for wheat dough control to 545 BU for pan bread sample fortified with 5% sunflower seeds powder (Blend1), while, it increased to 646 BU for pan bread sample fortified with10% sunflower seeds powder (Blend 2).

Table 9. Extensograph parameters studied pan bread dough behavior.

Extensograph parameters Treatments	Elasticity (B.U.)	Maximum Elasticity (B.U.)	Extensibility (min)	Proportional Number	Energy (Cm^2)
Control	400	605	165	2.42	99.5
Blend (1)	420	545	160	2.62	102
Blend (2)	400	646	160	2.5	115

Blend (1) Control +5% sunflower seeds powder and Blend (2) Control +10% sunflower seeds powder

Extensibility decreased from 165(min) for wheat dough to 160(min) for pan bread sample fortified with5% and 10% sunflower seeds. Proportional Number ranged from 2.42in wheat dough to 2.62in pan bread sample fortified with5 %sunflower seeds.

El-Gammal *et al*., (2014) resulted that control dough (100g wheat flour 72% extr only) had elasticity (EC) 320, extensibility(E) 175 mm, proportional number (R/E) 1.83 and dough energy 44.6 Cm^2.

Abo Raya *et al*., (2022) resulted that control dough (100g wheat flour 72% extr only) had extensibility (E) 90.0 mm, proportional No. (R/E)8.22 and energy (72.0 Cm^2).

Physical properties of studied pan bread samples:

Physical properties of studied pan bread control samples were presented in Table (10). From obtained results, it could be noted that loaf weight(g) of samples ranged from 172.15g in pan bread sample fortified with 10% sunflower seeds powder sample (Blend 2) to 172.61 gin pan bread sample fortified with 5% sunflower seeds sample.

As for loaf volume (Cm^3)**,** it could be noticed that pan bread sample fortified with 5% sunflower seeds powder sample (Blend1) recorded the highest value being 564Cm^3, while pan bread sample fortified with10% sunflower seeds powder (Blend 2) recorded the least value of 520 Cm^3. Specific volume recorded a value of 3.27 Cm^3/g in pan

bread sample fortified with 5% sunflower seeds powder sample (Blend1) and 3.02(Cm^3/g) in pan bread sample fortified with 10% sunflower seeds powder sample (Blend2).

From the same table, it could be concluded that pan bread sample fortified with 5% sunflower seeds powder had the highest content of loaf weight, loaf volume and specific volume.

El-Gammal *et al*. (2014) resulted that control pan bread had loaf volume (635Cm^3).

Abo Raya *et al.* (2022) resulted that control pan bread had loaf weight (162.50g), loaf volume (365Cm^3) and specific loaf volume (2.25 Cm^3/g).

Table 10. Physical properties of studied pan bread samples.

Physical properties Treatments	Loaf Weight (g)	Loaf Volume (Cm^3)	Specific Volume (Cm^3/g)
Control	172.24	523	3.04
Blend (1)	172.61	564	3.27
Blend (2)	172.15	520	3.02

Blend (1) Control +5% sunflower seeds powder and Blend (2) Control +10% sunflower seeds powder

CONCLUSION

From all previous results, it could be concluded that addition of sunflower seeds powder in pan bread production will increase nutritive value and bioactive components. This addition also, increased the amount of some essential amino acids, unsaturated fatty acids and vitamin E. As for rheological and physical properties, addition of sunflower seeds powder did not show notable changes in the most features. Finally, according to sensory evaluation, there was no clear negative effect of sunflower seeds powder addition especially at +5% (Blend 1) and +10% samples (Blend 2). So, it could be recommended to use sunflower seeds powder in pan bread production even in small commercial scale.

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تقييم خبز القوالب المدعم ببذور عباد الشمس

فاطمة مجدي البهلول ، مني محمود خليل، جيهان علي غنيم و الحسيني احمد ابوالنجا

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الملخص

الهدف الرئيسي من هذا العمل هو دراسة تأثير إضافة مسحوق بذور عباد الشمس بنسب مختلفة (5، 10، 15 و20٪) على التركيب الكيميائي، ومحتوى الأحماض الأمينية، وتركيب الأحماض الدهنية، والخصائص الريولوجية، والخصائص الفيزيائية، والمركبات النشطة بيولوجيا والتقييم الحسي لعينات الخبز. أشارت النتائج المتحصل عليها إلى أن مسحوق بذور دوار الشمس يحتوي على 12.79٪ بروتين خام، 24.98٪ زيت، 35.98٪ ألياف خام و3.53٪ رماد. أيضا، مسحوق بذور عباد الشمس كان غنيا بالكالسيوم 191.16 مجم / 100 جم، الفسفور 103.21مجم / 100 جم والبوتاسيوم 181.74مجم / 100 جم. بينما احتوى مسحوق بذور عباد الشمس على السيستين 7.50 مجم / جم واللايثين 19.91 مجم / جم والميثيونين 33.62 مجم / جم وحمض الأسبارتيك 75.73 مجم / جم والبرولين 154.59 مجم / جم. لا توجد فروق ذات دلالة إحصائية بين عينة خبز الكنترول وعينة الخبز المدعمة بمسحوق بذور عباد الشمس بنسبة 10٪ في المظهر والطعم والرائحة واللون والمقبولية الكلية. احتوت عينات الخبز المدعمة بمسحوق بذور عباد الشمس المدروسة على كميات عالية من البروتين الخام والزيت والألياف الخام والرماد ومصدر جيد للمعادن ومركبات الفينول الكلية ومركبات الفلافونويد الكلية. لذلك، قد يكون من المستحسن إضافة مسحوق بذور عباد الشمس حتى (10٪) لإنتاج خبز عالي الجودة وقبول ممتاز.

الكلمات الداله: بذور عباد الشمس، خبز القوالب، التحليل الكيمائي، القيمة الغذائية والقبول الحسي.