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Research Article

Nutritional Evaluation of Cookies Supplemented with Sweet Lupine Seeds and Proso Millet Seed Powders

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Abstract:

This study was conducted to evaluate the sweet lupine seed powder (SLSP) and Proso millet seed powder (PMSP), as replacements for wheat flour (extra 72%) at different levels (5.0, 10.0, 15.0, 20.0, and 25.0%), a mixture of 10% SLSP and 10% PMSP, and a mixture of 15% SLSP and 15% PMSP to prepare cookies rich in protein and minerals. The results revealed that SLSP and PMSP, are very rich in protein, Ash, and fiber compared with wheat flour (72%). Adding PMSP and SLSP at different levels to wheat flour (extra 72%) led to increased Moisture, crude protein, ash, and crude fiber contents in cookie products. In contrast, carbohydrates value decreased gradually with increasing MSP and SLSP substitution levels. Results also showed that Hunter color parameters (L*, a*, and b*) of cookies decreased in lightness as the mixing level of PMSP and SLSP. Results also showed that Hunter color parameters (L*, a*, and b*) of cookies decreased in lightness in cookies substituted with (5,10,15,20 and 25%) of PMSP, SLSP, and the mixing level of PMSP and SLSP. While the (a*) value demonstrated a significant increase ($p < 0.05$) in PMSP and SLSP. From the results of the sensory evaluation, it should be noted that the replacement of PMSP and SLSP until 25% is acceptable for the sensory evaluation of cookies, the new product of cookies containing PMSP and SLSP can meet the covered protein and mineral nutritional needs of schoolchildren in developing countries.

1. Introduction

In most parts of the world, lupine and millet have traditionally been used primarily as foodstuffs, and interest in the nutritional values of lupine and millet as food ingredients have increased as people have become more aware of their health benefits (Thambiraj et al., 2015). In addition, lupine (*Lupinusalbus L.*) contains a variety of carbohydrates, proteins, fats, vitamins, minerals, and other essential nutrients, as well as abundant phytochemicals, which are associated with antioxidant properties and inhibit the action of malignant cell proliferation Devi et al. (2014) and Elkadousy et al. (2020)**.** Proso millet contributes to the human diet due to its high levels of calcium, iron, zinc, lipids, and high-quality proteins. Besides, it is also a rich source of dietary fiber and micronutrients. Starch is the major constituent of pearl millet. The minerals of pearl millet, especially calcium, iron, and phosphorus, are similar to those of cereals (Kulthe et al., 2018 and Mansour et al., 2021).

Millet proteins are good sources of all essential amino acids except lysine and threonine but are relatively high in methionine. Millets are also rich sources of phytochemicals and micronutrients, rich in resistant starch, soluble and insoluble dietary fibers, minerals, and antioxidants, and contain about 92.5% dry matter, 2.1% ash, 2.8% crude fiber, 7.8% crude fat, 13.6% crude protein, and 63.2% starch (Sharma et al., 2021). Lupines are distinguished by their high protein and dietary fiber content. In addition, lupine seeds are characterized by high levels of total unsaturated fatty acids (over 80%), and they contain, carbohydrates (3.27%), protein (35.8%), oil (9.4%), and crude fiber (10.6%) (Saleh et al., 2013)

Lupine and millet powder can be used in baking and in the production of pasta and a variety of other food products to increase their nutritional value and improve aroma and texture (Abd El-Maasoud and Ghaly, 2018). Also, lupine can be a good choice for vegetarians as regards protein abundance (Lampart-Szczapa et al., 2006 and Martinez-Villaluenga et al., 2006). Biscuit consumption is among the top ten daily consumed foods, as they are easily available and convenient to enjoy as a snack (Jauharah et al., 2014). Cookies are high in carbohydrates, fat, and calories but low in fiber, vitamins, and minerals, which make them unhealthy for daily use (Serrem et al., 2011). There is a growing interest in improving the nutritional qualities of cookies to produce more healthy, natural, and functional products. Biscuits require a balanced nutritional value, which can be enhanced by fortification and supplementation with a wide variety of protein-rich cereals and pulses (Ahmad and Ahmed, 2014). The study aims to evaluate the impact of lupine and millet as innovative functional food ingredients in cookies and study the effect of lupine and millet powders and their chemical constituents on the final product's baking quality and sensory properties.

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2. Materials and Methods

2.1. Material used

- Sweet lupine seeds (*Lupinus albus*) were obtained from the Agric. Rese. Center, Giza, Egypt., during (the 2021) harvest season and stored in a deep freeze at -20°C until use.
- Proso millet, or baragu (Kannada) (*Panicummiliaceum*) was obtained from the Field Crops Dep., Agric. Res., Centre Giza, Egypt, during the 2021 harvest season and stored in a deep freeze at -20°C until use.
- Wheat flours (72% extraction) were purchased from Delta Middle and West Milling Company, Tanta, Egypt.
- Salt, bakery yeast, Sugar, shortening, baking powder, and a whole egg were purchased from the local market of Tanta City in El-Gharbia Governorate, Egypt.
- All chemicals used in the current study were obtained from El-Gomhoria Company for Chemicals and Drugs and Merk Company for Chemicals and Biodiagnostica, Egypt.

2.2. Preparation of samples

Sweet lupine seed powder (SLSP) and Proso millet seed powder (PMSP) were ground using a willy mill (IKA, model A11 BS000, Germany) to pass through a 60-mesh sieve, packed in polyethylene bags, and stored at -18 ºC. (Abdelrahman, 2014**)**.

2.3. Chemical analysis of samples

2.3.1. Gross chemical composition and caloric value of samples

Moisture, ash, ether extract, crude protein, and crude fiber content were determined according to the methods of A.O.A.C. (2005)**.** Total and Available carbohydrates were calculated by difference according to the methods of A.O.A.C. (2005)**.** The energy value was calculated according to James (1995)**.**

Energy value (kcal/100 g-1) = (g of protein × 4) + (g of lipids × 9) + (g of carbohydrates × 4).*2.3.2.*

2.3.2. Determination of amino acids:

Fifty milligrams of the samples were mixed with 10 ml of 6 N hydrochloric acid containing 50µl of mercapto ethanol in a heat-resistant tube. The tubes were sealed, heated in an oven at 110oC for 24 hours, cooled to room temperature and filtered through Whatman No. 1 filter paper. Both the tube and the precipitate were washed with distilled water. The washed water was added to the previous filtrate, which was then reduced to 25 ml in a volumetric flask. Five ml of the filtrate was transformed into a 25 ml beaker and placed in a vacuum desiccator until dryness potassium hydroxide. The dried residue was dissolved in one ml of sodium citrate buffer (PH 2.2) and analyzed by (Beckman amino acid analyzer, Model 119 CL, as described by Sadasivam and Manickam (1992) method.

2.3.3. Determination of Tryptophan

The tryptophan content of samples was determined calorimetrically after subjecting them to alkaline hydrolysis, as outlined by Blauth et al. (1963).

2.3.4. Determination of total phenolic compounds

The total phenolic compounds of the extracts were determined spectrophotometrically using the Folin-Ciocalteau reagent according to the method described by Salem et al. (2018) and used to estimate the phenolic-acid content using a standard curve prepared using gallic acid.

2.3.5. Determination of total flavonoids

Total flavonoid content was determined by the method of Ordonez et al. (2006).and used to estimate the flavonoid content using a standard curve prepared using quercetin acid.

2.3.6. Determination of antioxidant activity by using DPPH (radical scavenging method):

The antioxidant activity was determined based on the radical scavenging ability of a stable DPPH free radical, according to the method of Lee et al. (2003).

2.3.7. Determination of minerals

Samples were prepared for mineral determination according to the method of the A.O.A.C. (2005).

a) Phosphorus (mg/100 g) was determined using the colorimetric method described by Murphy and Riley (1962).
b) Potassium and sodium (mg/100 g contents were estimated using a flame photometer as given by Pearson (1976).
c) Iron, Magnesium, Manganese, Copper, Zinc, and Calcium contents of samples were conducted using the atomic absorption spectrophotometer Perken Elmer Model 2180 and following the methods of Pearson (1976).

2.4. Preparation of cookies

The method of Alobo (2001) was used to prepare the cookies samples. Blends containing 5, 10,15, 20, and 25% of (SLSP) or (PMSP); a mixture with (10% SLSP or PMSP) and (15% SLSP or PMSP) were used as a replacement for wheat flour (72% extraction). The basic ingredients were 455g of flour blends, 200g shortening, 200g sugar, 50g of whole egg, 5g of baking powder, and water variable. The cookies were baked in an electric oven at 175 °C for 30 minutes. Cookies were allowed to cool at room temperature for 30 minutes after removal from the oven and were then divided into two lots. One lot was initially used for sensory evaluation measurements, and the second lot was used for chemical analysis.

2.5. Physical measurements of cookies

The specific volume (g/cm^3) was calculated by dividing the volume by the weight, spread factor, Diameter, and thickness of cookies according to the method described in A.A.C.C. (2002). The spread ratio was calculated by dividing the Diameter (D) by the thickness (T).

2.6. Color measurements

The color of cookies was measured according to the method outlined by McGurie (1992) using a handheld Chromameter (model CR-400, Konica Minolta, Japan). The results were expressed in terms of L (lightness), a (redness-greenness), and b (yellowness-blueness).

2.7. Sensory evaluation of cookies

Sensory evaluation of cookie was carried out by ten trained panelists in the Food Technology Research Institute according to the method of Sudha *et al*. (2007). The panelists were asked to use the control to determined acceptance by first assigning a score (1 to 10) for appearance, odor, texture, taste, and overall acceptability.

2.8. Statistical analysis:

Data were analyzed statistically using the analysis of variance, and the means were further tested using the DMRT test (Duncan's multiple range test, DMRT). Outlined by Steel and Torrie (1980)

3. Results and discussion

3.1. Nutritional composition and bioactive compounds of raw materials

The results in Table (1) Show significant differences between SLSP, PMSP, and WF 72%with regard to their content of moisture, crude protein, crude ether extract, crude fiber, total carbohydrates, available carbohydrate, Total phenolic, total flavonoid content, and Antioxidant activity%. The results in table (1) revealed that the moisture content of SLSP, PMSP, and WF72% was 8.00, 8.97, and 10.11% respectively. This helps keep the quality of seeds during storage in proper condition. At this level of moisture, the microorganism's growth and biochemical reactions are usually inhibited.

Data in the same table proved that SLSP was relatively higher on crude protein, ether extract, and crude fiber and was 35.08, 11.37, and 12.70%, respectively, followed by PMSP, which contained 10.67; 4.19, and 8.70 %, followed by WF72%, which contained 9.33, 1.28, and 0.55% of the same contents, respectively. While the content of Ash was slightly lower in SLSP than in PMSP and WF. Furthermore, the caloric values of SLSP, PMSP, and WF were 443.97, 405.15, and 404.36 (kcal/100 g). The obtained results are in agreement with those reported by AbdEl-Kader (2016), Himanshu et al. (2018), Hassan et al. (2020), and Mansour et al. (2021).

Finally, through the data tabulated in Table (1), it could be clearly concluded that the total phenolics, flavonoids, and antioxidant activity of PMSP are significantly ($p \leq 0.05$) higher than those of SLSP. Furthermore, SLSP and PMSP are significantly ($p \leq 0.05$) higher than those of WF 72%. Similar data was previously reported by Abdel-Gawad et al. (2020) and Hassan et al. (2020). The results revealed that SLSP and PMSP are considered good sources of crude protein, ether extract, ash, and crude fiber total phenolics, flavonoids, and antioxidant activity compared with these compounds in WF 72%. This means adding SLSP and PMSP to bakery products would improve their nutritional composition

Table (1): Nutritional composition and bioactive compounds of raw materials (dry weight basis).

Samples Compound	SLSP	PMSP	WF (72%)
Moisture%	8.00±0.075c	8.97±0.055b	10.11±0.055a
Dry matter	92.00±0.095a	91.03±0.065b	89.89±0.14bc
Crude Protein%	35.08±0.195a	10.67±0.125b	9.33±0.055c
Ether extract%	11.37±0.085a	4.19±0.12b	1.28±0.055c
Ash%	3.22±0.055b	4.00±0.05a	0.51±0.05c
Crude fiber%	12.70±0.095a	8.70±0.085b	0.55±0.055c
Totalcarbohydrates%	50.33±0.16c	81.14±0.205b	88.88±0.16a
Available carbohydrates%	37.63±0.185c	72.44 ±0.24b	88.33±0.19a
Caloric value (K. cal./100g)	443.97±1.555a	405.15±0.54b	404.36±0.19bc
TPC (mg GAE/g)	18.00±0.04b	130.0 ±1.04a	0.56±0.025c
TFC (mg of QE/g)	21.00±0.0045b	33.00±0.02a	0.08±0.0005c
Antioxidant activity (%)	70.00 ± 0.085b	78.00±0.11a	45.33±0.145c

Each value is an average of three determinations ± standard division.
Values followed by the same letter in rows are not significantly different at P<0.05.,
SLSP: Sweet Lupines seed powders; PMSP: Pross Millet seed powders;
WF72%:, Wheat flour (72% extra); TPC: Total phenolic content; TFC: Total flavonoid content

3.2. Mineral contents

Among the functional food ingredients, minerals have a fundamental function in their indispensable role in a healthy life. Minerals, including trace minerals, are important for helping body metabolism, water balance, bone health, helping heart function, preventing fatigue and muscle spasms, and helping transport oxygen throughout the body. It is very important to include the right amount of minerals in the body **(**National Academy of Sciences, 2001).

The minerals content of SLSP, PMSP, and WF72%on a dry weight basis is demonstrated in Table (2). It is apparent from these Tables that, the SLSP had high levels of potassium (1098 mg/100g), magnesium (190.00 mg/100g), calcium (170 mg/100g), iron (4.3 mg/100 g), zinc (4.55 mg/100 g), and manganese (2.52 mg/100g) compared with PMSPandWF72%. While PMSP had higher values of phosphorus (721. 26 mg/100 g), followed by iron (6.90 mg/100 g) and copper (1.10 mg/100g g) compared with SLSP and WF72%. These results are supported by Fayed et al. (2016), Hamad et al. (2020), and Mansour et al. (2021).

Table (2): Mineral contents (mg/100g) of raw material.

Minerals	SLSP	PMSP	WF72%
Potassium(K)	1098.00±3.6[a]	90.90±4.9[c]	140.0±2.1[b]
Sodium(Na)	15.50±0.25[b]	9.20±0.08[c]	25.89±0.27[a]
Calcium(Ca)	170.00±4.2[a]	24.00±2.7[c]	37.0±0.34[b]
Phosphorus(P)	6.5.00±0.5[c]	721.40±4.7[a]	316.0±3.2[b]
Copper(Cu)	0.30±0.04[b]	1.10±0.06[a]	0.004±0.001[c]
Zinc(Zn)	4.55±0.09[a]	0.67±0.07[c]	2.12±0.05[b]
Manganese(Mn)	2.52±0.02[a]	1.77±0.009[b]	0.03±0.001[c]
Magnesium(Mg)	190.00±2.8[a]	81.00±2.7[c]	132.0±2.03[b]
Iron(Fe)	4.30±0.09[b]	6.90±0.06[a]	1.60±0.008[c]

Each value is an average of three determinations ± standard division. Values followed by the same letter in rows are not significantly different at P<0.05.
SLSP: Sweet Lupines seed powders; PMSP: Pross Millet seed powders; WF72%: Wheat flour (72% extra).

3.3. Amino acid composition of SLSP and PMSP

The nutritive value of food, especially protein, would mostly depend not only on its amino acid profile in general but also on the quantities of the essential amino acid content in particular (Afify et al., 2012**).**

The amino acid compositions of SLSP and PMSP are given in table (3). The results show that PMSP is richer in essential and non-essential amino acids than SLSP. The total amino acids of SLSP and PMSP were 56.97 and 79.13 %, respectively. As for essential amino acids, it could be observed that Isoleucine was the dominant acid in SLSP recorded (2.01 %), followed by Cysteine (1.89%) and leucine (1.77%). In addition, Leucine was the dominant acid in PMSP recorded (4.63%), followed by phenylalanine (4.31%). Meanwhile, tryptophan was the lowest amino acid in SLSP and PMSP (0.42 and 0.10%, respectively). These results agree with Mohammed (2017) and Bourekoua *et al.* (2018)**,** who reported that Leucine was the dominant acid in SLSP while isoleucine was the dominant acid in PMSP. Among non-essential amino acids, glutamic acid was the highest among all of the other acids in SLSP and PMSP (11.56% and 16.46%, respectively). Arginine was the second level recorded in both SLSP and PMSP (6.76 and 11.78%, respectively), followed by aspartic acid and alanine in both SLSP and PMSP. This result is in agreement with Dias-Martins et al. (2018), Othman et al. (2020), and Mahfooz (2023)**,** who reported that the proteins of SLSP and PMSP had the highest levels of glutamic acid. Furthermore, Glutamic acid is a non-essential amino acid. According to Han et al. (2015), foods rich in glutamic acid may benefit health**.**

The quality of proteins as a source of amino acids can usually be adequately assessed by comparison with the recommended pattern of essential amino acids. SLSP and PMSP had lower total essential amino acids than the FAO/WHO (1973) reference pattern. Meanwhile, Methionine + Cysteine were higher amino acids in SLSP and PMSP compared with the FAO/WHO (1973) recommended pattern. Furthermore, recommended pattern. Furthermore, PMSP reported higher phenylalanine +tyrosine content than the FAO/WHO (1973) reference pattern. These results showed SLSP and PMSP could be used to complement cereal proteins (Shimray et al., 2012 and Abd El-Maasoud and Ghaly, 2018).

Table (3): Amino acids profile (g/100g protein) of SLSP and PMSP.

Amino acids	SLSP	PMSP	FAO/WHO** (1973)
A-Essential amino acid			
Valine	0.93	3.49	5.0
Leucine	1.77	4.63	7.0
Isoleucine	2.01	2.28	4.0
Metheonine	0.80	1.92	
Cycteine	1.89	2.89	
Metheonine+ Cycteine	3.75	4.81	3.5
Phenylalanine	1.39	4.31	
Tyrosine	0.61	1.93	
Phenylalanine+Tyrosine	5.0	6.24	6.0
Therionine	1.13	2.83	4.0
Lysine	1.60	2.25	5.50
Tryptophan*	0.42	0.10	1.0
Total Essential amino acid	22.61	26.63	36
B-Non-essential amino acid			
Glycine	2.34	4.13	
Alanine	2.68	4.32	
Serine	2.24	3.96	
Aspartic acid	4.89	4.86	
Glutamic acid	11.56	16.46	
Proline	2.13	4.67	
Arginine	6.76	11.78	
Histidine	2.11	2.32	
Total Non-essential amino acid	34.36	52.5	
Total amino acid	56.97	79.13	

SLSP: Sweet Lupines seed powders;
PMSP: Pross Millet seed powders.
* Tryptophan was determined calorimetrically;* * FAO/WHO (1973)

3.4. Chemical composition of cookies

The results of the chemical composition of cookies made of different levels of PMSP and SLSP were recorded in table (4). The obtained results demonstrated that there is an incremental relationship between Moisture, crude protein, ether extract, ash, and crude fiber contents of cookies with substitution levels of PMSP and SLSP. While there is an inverse relationship between carbohydrates value and the substitution levels of PMSP and SLSP. These results are in harmony with the findings of Awolu et al. (2017) and Abd El-Maasoud and Ghaly (2018) They mention that substituting PMSP and SLSP for wheat flour resulted in cookies with higher levels of protein, fat, crude fiber, and ash, but lower levels of carbohydrate content. From the same table, the moisture contents ranged from 4.90% in control to 6.67 and 6.37% in substitution cookies, with 25% PMSP and SLSP. The increased moisture content can be explained by the higher content of protein and fiber, which also increases the water-binding capacity of dough with higher levels of PMSP and SLSP. (Farahat et al., 2020).

As shown in the same table, the substitution of PMSP and SLSP to wheat flour led to a significant increase in protein content from 6.82% in control to 7.42 and 13.22% in cookies with 25%PMSP and SLSP, respectively. The protein content of the substitution cookies was increased by increasing the concentrations of PMSP and SLSP. This increment may be due to PMSP and SLSP's high protein content as compared to wheat flour. The data of the present study are in agreement with Singh et al., (2012) and Abdelrahman, (2014). Therefore, PMSP and SLSP had a tendency to improve the protein contents of cookies. The consumption of about 100g of the sample containing 25% SLSP would provide about 50% of the recommended daily requirement protein (25-30g/day) as recommended by (FAO/WHO, 1973) for children aged between 5 and 19 years. This fact suggests cookies supplemented with SLSP may be useful as food supplements for the alleviation or prevention of protein malnutrition in developing countries.

Table (4): Chemical composition (% on dry weight base) of cookies made of different substitution levels of PMSP and SLSP.

Component%	**Moisture**	**Protein**	**ether extract**	**Ash**	**Crude fiber**	***T. C**
cookies control	4.90±0.09 e	6.82±0.13 h	24.95±0.25d	0.54±0.04h	0.85±0.05 f	67.69±0.35a
5% PMSP	5.29±0.18 d	6.94±0.20 h	25.14±0.35c	0.81±0.06f	0.97±0.04ef	67.11±0.61ab
10% PMSP	5.71±0.12 c	7.10±0.15g	25.29±0.11c	0.99±0.09e	1.08±0.08 e	66.62±0.31b
15% PMSP	5.97±0.11bc	7.19±0.08g	25.42±0.23c	1.24±0.06c	1.22±0.03 d	66.15±0.35bc
20% PMSP	6.15±0.15 b	7.30±0.31g	25.57±0.30c	1.42±0.08 b	1.35±0.05 d	65.71±0.53c
25% PMSP	6.38±0.10ab	7.42±0.22g	25.70±0.23c	1.69±0.09 a	1.51±0.08 c	65.19±0.53 cd
5% SLSP	5.40±0.10d	8.66±0.16f	25.53±0.23c	0.73±0.05g	1.07±0.08 e	65.08±0.43 cd
10% SLSP	5.86±0.10bc	9.53±0.13e	26.00±0.50bc	0.88±0.08f	1.32±0.12 d	63.59±0.43d
15% SLSP	6.26±0.17ab	10.32±0.26d	26.48±0.35b	1.04±0.05de	1.58±0.07 c	62.16±0.65e
20% SLSP	6.48±0.11 ab	11.27±0.15c	26.89±0.17b	1.16±0.15d	1.9±0.10 b	60.68±0.14 f
25% SLSP	6.67±0.10 a	13.22±0.20a	27.27±0.58a	1.35±0.05b	2.16±0.15 a	58.16±0.63 g
10% SLSP -10 PMSP	6.22±0.16 b	9.75±0.24e	25.66±0.35c	1.10±0.10 de	1.17±0.00 e	63.19±0.69 d
15% SLSP -15PMSP	6.33±0.19 ab	12.63±0.13b	25.95±0.25bc	1.22±0.10 c	2.10±0.10 a	59.62±0.46 fg

Each value is an average of three determinations ± standard division.
Values followed by the same letter in the column are not significantly different at P<0.05.
SLSP: Sweet Lupines seed powders; PMSP: Pross Millet seed powders. T.C : Total carbohydrates

3.5. Physical characteristics of cookies

Physical characteristics of cookies, such as Specific volume, thickness, diameter, and spread ratio, were low affected by the substitution increment of the level of PMSP, SLSP, mixture at level (10% SLSP and 10% PMSP), mixture at level (15% SLSP and15% PMSP), and control, as recorded in Table (5). The same Table showed that significant differences were noticed in Specific volumes among the control sample and substituted cookies with PMSP and SLSP. The values of Specific volume of cookies ranged from 30.85 g/cm^3 in control cookies to 32.90 and 33.00 g/cm^3 in cookies substituted with 25% PMSP and SLSP. These results are in agreement with Abd El-Maasoud and Ghaly (2018).

The changes in diameter and thickness reflected the spread ratio which showed asignificant ($p \leq 0.05$) decrease from 10.07 in control samples to 7.88 and 7.69 at 25.0 % levels of PMSP and SLSP substitution. The values of diameter cookies were decreased from 6.45cm in control cookies to 5.91 and 5.85 cm in cookies substituted with 25% PMSP, and SLSP respectively. The results are in conformity with Abdelrahman (2014) and Awolu et al. (2017). A linear decrease was noted in both diameters of the cookies with increasing levels of substitution. This decrease in the diameter was due to the dilution of gluten (Aslam et al., 2014**).** Moreover, Chia and Chong (2015) reported that the decrease in the diameter and spread ratio of the cookies may be due to the high-water absorption capacity of the wheat flour. The diameter decreases as the thickness increases with the increase of the level of PMSP, and SLSP with wheat flour According to Chinma et al. (2012), who found that the addition of high protein flour sources causes a negative correlation between the diameter and spread of the cookie. Similar results had been reported by Mostafa et al. (2022**).** who reported that increased the thickness and decreased the diameter and spread ratio in lupine flour incorporated cookies**.**

Table (5). Physical properties of produced cookies partially substituted wheat flour with PMSP and SLSP.

Sample	Specific volume (v\w)	Diameter (cm)	Thickness (cm)	Spread ratio
cookies control	30.85±0.35b	6.45±0.11a	0.64±0.07b	10.07±0.23a
5% PMSP	33.40±0.23a	6.45±0.14a	0.66±0.11b	9.77±0.25a
10% PMSP	33.95±0.20a	6.25±0.13ab	0.67±0.06b	9.33±0.19ab
15% PMSP	33.05±0.28a	6.11±0.10ab	0.68±0.03b	8.99±0.43ab
20% PMSP	33.00±0.19a	6.00±0.09b	0.72±0.05ab	8.33±0.20b
25% PMSP	32.90±0.22a	5.91±0.07bc	0.75±0.04a	7.88±0.28c
5% SLSP	33.35±0.13a	6.40±0.08a	0.67±0. 11b	9.55±0.20a
10% SLSP	33.24±0.29a	6.19±0.11b	0.67±0.07b	9.23±0.33ab
15% SLSP	33.15±0.20a	6.08±0.09b	0.69±0.10b	8.81±0.11ab
20% SLSP	33.06±0.43a	5.90±0.10bc	0.71±0.13ab	8.30±0.16b
25% SLSP	33.00±0.18a	5.85±0.13bc	0.76±0.03a	7.69±0.17c
10% SLSP -10 PMSP	33.11±0.11a	6.24±0.14ab	0.70±0.05ab	8.91±0.20ab
15% SLSP -15PMSP	33.20±0.25a	6.09±0.11b	0.72±0.04ab	8.46±0.23b

Each value is an average of three determinations ± standard division. Values followed by the same letter in columns are not significant different at P<0.05.
SLSP: Sweet Lupines seed powders; PMSP: Pross Millet seed powders

Reduced spread ratios of prepared cookies samples contained (5, 10,15,20, and 25%) of PMSP, SLSP, mixture at level (10% SLSP -10 PMSP),and mixture at level (15% SLSP -15% PMSP) may be due to the fact that composite flours apparently form aggregates with the increased number of hydrophilic sites available for competing of limited free water in biscuit dough's, these hydrophilic sites occur during dough mixing led to the increase of dough viscosity, thereby limiting cookie spread and top grain formation during baking (Rababah et al., 2006). These results are in accordance with those found by Abdelrahman, (2014)

Baljeet et al., (2010), reported that these two parameters are still devolving in reverse. The spread ratio is the ratio between the diameter and the thickness and this parameter is important to assess the quality of the cookies (Bose and Shams Ul-Din, 2010**)**. Cookies with high spread ratio values are better. in addition, The quality of cookies is also evaluated by their specific volume which is a technological parameter that can adequately inform on the textural properties of the dry cookies **(**Eissa et al., 2007**)**.

3.6. Color attributes of cookies

Color is one of the most important sensory attributes directly affect any product's consumer preference. Special attention should be given to bakery products to attract consumer attention. The color parameters (L*, a*, and b*) of coo samples were evaluated and presented in table (6).

The results showed that the (L) value significantly decrease ($p < 0.05$) in cookies substituted with (5,10,15,20 and 25%) of PMSP, SLSP, mixture at level (10% SLSP -10 PMSP), mixture at level (15% SLSP -15% PMSP). The lowest value was observed at level replacement 25% PMSP and SLSP (56.21 and 70.63) relative to the control sample (79.82). While the (a*) value demonstrated a significant increase ($p < 0.05$) in PMSP and SLSP. The highest value was observed at level replacement 25% PMSP and SLSP were (16.12 and 12.71) relative to the control sample (11.21).

As well as the (a*) and (b*) values significantly increase ($p < 0.05$) in cookies substituted in SLSP. On the contrary, (b*) values significantly decrease ($p < 0.05$) in cookies substituted in PMSP. The highest b* value observed at level replacement 25% SLSP was (18.12) while the lowest b*value observed at level replacement 25% PMSP was (8.71) relative to the control sample (11.21). These results are in agreement with those obtained by Jayasena and Nasar-Abbas (2011), Kulthe et al. (2018) and Mota et al. (2020) who found that lightness L values decreased, generally, for the cookies supplemented with PMSP and SLSP. They attributed these changes to the Maillard reaction, as proteins and sugars initiate a complex cascade of reactions during heating (higher than 100 ºC), producing a darker color.

Table (6). color evaluation of produced cookies partially substituted wheat flour with PMSP and SLSP.

Component%	L*	a*	b*
Cookies control	79.82±1.02a	11.21±0.51e	11.21±0.52d
5% PMSP	67.51±**0**.21d	12.03±3.06d	12.03±0.36cd
10% PMSP	66.34±1.30d	13.92±0.38c	12.92±0.38c
15% PMSP	63.06±0.67e	15.69±0.61ab	14.69±0.61b
20% PMSP	62.89±0.93e	15.84±0.72ab	17.54±0.72ab
25% PMSP	56.21±0.73c	16.12±0.89a	18.12±0.89a
5% SLSP	75.07±0.20b	11.07±0.35e	10.57±0.35d
10% SLSP	72.28±1.18c	11.35±.56e	10.1**5**±0.56d
15% SLSP	72.15±1.18c	11.56±.37d	9.5**6**±0.37de
20% SLSP	71.96±0.28c	11.98±.53d	9.00±0.53e
25% SLSP	70.63±0.95c	12.71±.47cd	8.71±0.47e
10% SLSP -10 PMSP	71.79±1.46c	11.13±1.39e	10.83±0.39d
15% SLSP -15PMSP	65.99±2.41d	12.87±0.63cd	12.87±0.63d

Each value is an average of three determinations ± standard division. Values followed by the same letter in columns are not significantly different at P<0.05. SLSP: Sweet Lupines seed powders; PMSP: Pross Millet seed powders.

3.7. Sensory properties of cookies

The results Sensory properties of cookies contained (5, 10,15,20, and 25%) of PMSP, SLSP, mixture at level (10% SLSP and10 PMSP), mixture at level (15% SLSP and15% PMSP) compared with control sample for appearance, color, odor, taste, texture, and overall acceptability were recorded in Table (7).

The data in table (7) revealed that the sensory score of cookies significantly decreased with increasing levels of PMSP and SLSP. The scores for all sensory parameters were higher in the control sample. Furthermore, cookies with substitution levels up to 25% PMSP and SLSP were found to be acceptable for their sensory characteristics. Increasing the PMSP and SLSP levels caused grittiness in cookies.

From the same table , it could be noticed that there was no significant variation ($P \leq 0.05$) between samples containing 5 % of PMSP and SLSP for all organoleptic properties appearance, color, odor, taste, texture, and overall acceptability which were (8.95 and8.81),(8.36 and8.29),(8.79and 8.58),(8.20 and 8.00), (8.19 and8.12) and (8.99 and 8.95), respectively, compared to the control sample (9.18, 8.5, 9.0, 8.36, 8.25and 9.23, respectively). On the other hand, the level replacement of 25% of PMSP and SLSP showed a significant decrease ($P \leq 0.05$) for all organoleptic properties as compared with the control sample or produced cookies containing 5,10,15 and 20 % PMSP, SLSP**,** mixture at level (10% SLSP -10 PMSP) and mixture at level (15% SLSP -15% PMSP). The mentioned data was in accordance withOluwamukomi et al. (2011); Florence et al. (2014); Abdelrahman, (2014); Kulthe et al. (2018), and Abd El-Maasoud and Ghaly (2018).

Conclusions

From this study, it could be concluded that incorporated of wheat flour with PMSP and SLSP raising nutritional values, minerals and amino acid content of cookies, and recommended to replace PMSP and SLSP up to 25%. Newly prepared cookies could be recommended as a food aid in institutional feeding programs for pupils in different school stages and adults as well. Also, it is easy to prepare by mothers for home to their family as healthy diet.

Table (7). Sensory evaluation of produced cookies partially substituted wheat flour with PMSP and SLSP.

Component	Appearance	color	Odor	Taste	texture	overall acceptability
cookies control	9.18±0.75a	8.50±0.89a	9.0±0.86 a	8.36±1.02 a	8.25±0.82 a	9.23±0.75 a
5% PMSP	8.95±0.72 a	8.36±0.74 a	8.79±0.73 a	8.20±0.77 a	8.19±1.04 a	8.99±0.72 a
10% PMSP	8.55±0.82 bc	8.05±1.15 ab	8.23±0.98 ab	8.09±0.70 ab	8.09±0.83 ab	8.58±0.82 abc
15% PMSP	8.5±0.59 bc	7.91±0.70 ab	8.15±0.93 ab	7.68±0.71 ab	7.86±0.89 ab	8.53±0.59 abc
20% PMSP	8.14±1.09 bcd	7.80±0.64 ab	8.08±0.75 ab	7.73±0.64 ab	7.80±0.72 ab	8.18±1.09 bc
25% PMSP	8.05±0.85 cd	7.70±0.70 ab	8.00±1.01 b	7.32±0.71 b	7.77±0.68 ab	8.09±0.85 bc
5% SLSP	8.81±0.83 a	8.29±0.87 a	8.58±0.71 a	8.00±0.80 ab	8.12±0.75 a	8.95±0.83a
10% SLSP	8.0±1.09 cd	7.55±0.93 ab	7.93±0.90 b	7.59±0.97 ab	7.95±1.03 ab	8.05±1.09 bc
15% SLSP	8.14±0.95 bcd	7.45±0.96 b	7.88±0.84 b	7.52±0.97 ab	7.68±0.95 ab	8.19±0.95 bc
20% SLSP	7.36±1.00 e	7.41±1.15 b	7.82±0.84 b	7.41±0.86 ab	7.55±0.96 ab	7.68±1.00 c
25% SLSP	7.64±1.00 de	7.28±1.23 b	7.77±1.12 b	7.35±1.06 ab	7.41±1.06 b	7.59±1.00 c
10% SLSP -10 PMSP	8.05±1.01 cd	7.82±1.16 ab	8.09±1.04 b	7.78±1.25 ab	7.95±1.2 ab	8.16±1.01 bc
15% SLSP -15PMSP	8.36±0.89 bc	7.82±1.10 ab	8.05±0.90 b	7.70±1.12 ab	7.75±1.23 ab	8.08±0.75 bc

Each value is an average of three determinations ± standard division. Values followed by the same letter in columns are not significantly different at P<0.05. SLSP: Sweet Lupines seed powders; PMSP: Pross Millet seed powders

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