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SUPPLEMENTATION EFFECTS OF SOME CEREAL PRODUCTS BY DIFFERENT PERCENTAGES OF LUPIN FLOUR ON PHYSICOCHEMICAL PROPERTIES OF THOSE PRODUCTS

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ABSTRACT
The supplementation of protein and dietary fiber rich lupin flour to wheat-flour-based baked products such as bread and biscuits has the potential to enhance the nutritional values however it may adversely affect the physical and sensory characteristics. To establish the effect of lupin flour supplementation on physical and sensory properties of bread for providing information to the potential manufactures. Two lupin species that are commonly cultivated commercially from Jordan and Egypt were used for supplementation. It was found that supplementation up to 8% level had no significant effect on bread volume and all sensory evaluation, but thickness increased at ≥10%. Sensory evaluation revealed an improvement in color, taste, flavor, texture, and overall acceptability up to 8% addition to wheat flour. No significant ($p<0.05$) differences were recorded in bread sensory evaluation between control and supplemented backed-products of both Jordanians and Egyptians lupin sources. So that we could confirm that lupin flour can be successfully incorporation into bread and its products processing by substitution up to 10% of wheat flour to increase protein, fat, and dietary fiber contents to improve human health. Oil contained in lupin flour might perform an important nutritional role regarding to their fatty acid profile especially of its contents and alternate proportions of Saturated and unsaturated fatty acids. The high contents of monounsaturated and polyunsaturated fatty acids are 60.36 and 15.23g/100g respectively that are appeared it's important for both human and animal nutrition.

KEYWORDS: bread, lupin flour, physico-chemical analysis, sensory evaluation, wheat flour.

INTRODUCTION

Breads are defined as a fermented bakery product prepared by baking wheat flour, water, yeast and salt by a consequences process involving mixing, kneading, proofing, shaping and baking (Dewettinck *et al*., 2008). Wheat bread represents the main source of carbohydrate, minerals and vitamins for most of the people. However, white bread is considered to be nutritionally poor, due to its deficient in an essential amino acid such as lysine, tryptophan, and threonine. So that, addition of lupin flour to wheat flour in food formulation, complementary effect is achieved due to the low content of lysine, methionine and cysteine of wheat flour protein (Hacer, L. & Nermin, B. 2012). Lupin is an economically and agriculturally valuable legume plant (Gulewicz *et al*., 2008). Its seeds are valuable for high contents of protein, fat, also rich in dietary fiber and carbohydrates, minerals and vitamins (Zielinska *et al*., 2008), in addition its contain an antioxidants and phytochemical compounds (Martinez *et al*., 2009) which is responsible for the health benefits including oxidative stress such as cancer, cardiovascular disease (Magni *et al*., 2004), neuro-degeneration and diabetes (Campos-Vega *et al*., 2010). Lupin flour can be supplemented into wheat flour to enhance the nutritional value of the final products without detrimental effects on the quality (Pollard *et al*., 2002). In general, the addition of up to 10% lupin flour improves water binding, texture, shelf-life, and aroma (Martinez, et al., 2006). Doxastakis *et al*., 2002 conducted that the mixing time and dough stability decreased as the substitution level increased. Determination of the suitability of high dietary fiber lupin product was carried out in experimental baking, where 10%, 15%, and 20% additions of high fiber lupin product to wheat dough has a potential to be used as a suitable substitute for egg albumin as a foaming agent in food. It was presented that the lupin foam become very similar in texture and microstructure to the uncooked egg-white foams when boiled in water for 5 min., and that foaming stability of lupin protein concentrate and flour strong even after 36 hour (Pollard *et al*., 2002). Lupin-derived protein ingredients have to provide both nutritional and useful technological functionality to the food in which are incorporated in order to meet the need of consumers and the food industry (Zraly *et al*., 2008). In addition of that, the cost of lupin is lower than other legumes (Jayasena and Quail, 2004). Therefore, supplementation of lupin flour would improve the nutritional and sensory values of different backed products at a comparatively lower cost. The objectives of the present study were to investigate the effect of different addition of lupin flour concentrations on bread and biscuit quality, and to determine the effect of lupin addition on sensory evaluation of bakery products.

MATERIALS & METHODS

This study was carried out: First suction, Bread making were done in the food biotechnology's Lab/college of Agric. / Abu-ghraib/ Baghdad/Iraq in 2-5/2014.

Lupin seed

Two different lupin seed imported from the local market in Jordan and Egypt.

De- bittering of lupin seed

The de- bittering process for lupin seeds consisted of cleaning, soaking, and boiling. Extraneous material, stone, immature and damaged seeds were removed. About 800 gram of chosen lupin samples were cleaned, presoaked in hot water about 60-70°C for 12 hours, then repeated this process for another 12 hours, after each 4 hours we change the hot water, then we boiled the soaked seeds for 1-2 hours (1:3, seed: water) to destroy thermo-labile anti-nutritional factors, such as trypsin inhibitors, phytic acid and soften the seed. The hull of the seed were taken off by pressing on the seed with hands finger, then washed with tap- water and soaked with water for at least 6 hours until the bitter taste off and accepted. Then dried, milled with coffee grinder, stored in sealable polythene bags in a refrigerator at approximately 5°C before analysis and making baked food (Erbas *et al*., 2010).

Flour blends

The six blends used in this experiment (Table 1) were prepared by incorporation 2, 4, 6, 8 and 10%, of wheat flour with processed lupin flour, and 5% of lupin bran from both of two sources of lupin (Jordanian JLF and Egyptian ELF). The blends were homogenized with Kenwood mixer (Model A 907 D, Kenwood Ltd, England) for 3 min. Wheat flour (100%) was used as control (C).

TABLE 1: Formulation of different lupin-wheat blends

Blend	Wheat (g/100g) flour	Lupin (g/100g) flour
C (control)	100	-
2% JLF	98	2
4% JLF	96	4
6% JLF	94	6
8% JLF	92	8
10%JLF	90	10
5% JLB	95	5
2% ELF	98	2
4% ELF	96	4
6% ELF	94	6
8% ELF	92	8
10%ELF	90	10
5% ELB	95	5

Farinograph water absorption

The farinograph water absorption (FWA) was determined for different blends to foretell the hydration rate for bread making procedure. FWA is the volume of water, expressed in ml/100 g of flour at 14.0% moisture content, required to produce dough with a maximum consistency of 500 FU (Farinograph Unit) under the operating condition specified by the Iraqi standard NM 08.1.245 (AACC, 1984).

Bread making

Bread was produced using straight dough process. Baking trials was carried out under laboratory conditions to optimize baking conditions prior to the actual runs. Flour and dough weighing was carried out on laboratory-scale (CE-4101, Camry Emperors, China). Dough was mixed to optimum consistency in a Kenwood mixer (Model A 907 D, Kenwood Ltd, England) with low speed of 85 rpm for 1 min. Final dough temperature was 80°C. Dough rested in bulk for 10 min. in a cabinet at 25°C. Afterwards, it was kneaded and left to proof for 15 min. Dough was scaled into 500 g portions, manually rounded, rolled, put in tin baking pans (75 min, 30°C, 80% relative humidity). Then, baked at 230°C in an electric oven (Electric oven SL-9 Infra red Food Oven, Hubert, China) until the golden brown color is formed. Bread samples were allowed to cool at room temperature 37°C for 2 hours before sensory and further analysis were carried out.). The supplemented bread were prepared using the same formula except for wheat flour (72%) which substituted with both Jordanian and Egyptian, sweet lupin flour at 2, 4, 6, 8, and 10%.

TABLE 2: Bread composition

Ingredients	g/100g	Weight (g)
Flour⋆	100	2,000
Water	57	1,140
Yeast	2	40
Salt	2	40
Improver	0.5	10

Wheat flour ⋆

Physical analysis

Measurement of bread volume

Loaves were weighed one hour after removal from the oven (cooling). Volume (ml) was measured by rapeseed displacement method: specific volume (cm3/g) was then calculated by dividing volume by weight: and oven spring (cm) was calculated by the difference between loaf height before and after baking according to (AACC, 2000). Triplicate measurements were taken.

Sensory evaluation of bread

A descriptive characteristics sensory evaluation was done by a trained expert panel using the norm UNE 87-017-092 (UNE, 1992). The attributes is used in the analysis were determined by panel consensus: appearance (crust spot, crumb color and alveolate); bread smell (intense, roasted or torrefied, green vegetable, leguminous and cereal); bread taste (lupin, roasted, bitter, sweet or torrefied) and bread texture (gritty, chewy, soft and dense). Loaves were cooled for 1-2 h at room temperature 25°C in a sealed plastic bag. The bread was then cut into 2×3×5 cm slices using a bread knife. Sensory evaluation was performed using 15 panelists comprising of graduate students and staff member of Food Technology Division in Agriculture College/ Baghdad university/Iraq. Samples were randomized assigned to each panelist. Panelists were asked to evaluate each loaf for appearance, crump texture, taste, odor and overall acceptability. A 9-point hedonic scale was where 1=dislike extremely to 9=like extremely.

Chemical Analysis

The samples were homogenized in an analytic micro-mill, with mesh 0.50, and stored in sealable polythene bags in a refrigerator at approximately 5°C before analysis and making baked food. Moisture and nitrogen of wheat, boiling lupin and the different wheat-lupin flour blends content were according to standard procedures based on the (AOAC methods 2002). Moisture was determined by the gravimetric method with Oven drying at 105°C. Total fat was determined by the Soxhlet extraction method to obtained 200 mg. The extracted fat (80 ml) was transferred to esters, and concentrations of fatty acid s in the form of methyl-esters (FAMEs) were specified by gas chromatography analyzer GC-2010 (Shimadzu, Japan) with flame ionization detector (FID). The method with an addition of internal standard (C15:0) was used. The GC-2010 system was equipped with an auto sampler and auto injector. The injection volume was 1µl. The total split flow was 90 ml/min. Helium was used as the carrier gas. Air and hydrogen gases were used as auxiliary gases. The FAMEs were separated on a column VB-VAX (60 m length; 0.25 mm ID; 0.25µm film thickness). The FID temperature was set at 300^{o}C, initial injector temperature was 280^{o}C and pressure was 299.2 kPa, initial colum temperature was 70^{o}C. The data were processed by a computer using data processor GC solution Post run. The protein content was determined by Kjeldahl total nitrogen method. Ash content was determined by carbonization and incineration of samples in a muffle furnace (Carbolite, CWF 1200. England) at 550°C for 6 hours. The conversion factor for total nitrogen to protein of 5.75 was used to express the protein content. Then the carbohydrate determination was estimated by subtraction of one hundred. All analysis was performed in triplicates.

Statistical Analysis

The Statistical Analysis System- SAS (2012) was used to effect of different factors in study parameters. Least significant difference –LSD test was used to significant compare between means in this study.

RESULTS & DISCUSSION

The chemical composition contents were determined in processing lupin flour sources (Jordanian and Egyptian) and its bran flour as shown in table 3. Lupin flour presents one of the most promising alternative protein sources for the nutritional supplementation and technological improvement of traditional foods (Martinez-Villaluenga *et al.*, 2009). Raw lupin flour moisture of both sources was significantly lower than that of the wheat flour (P<0.05). The present study shows the high content of protein, fat, ash and fiber of both sources of lupin flour compared with control flour (wheat) as shown in table 3. These results were lower than that found by (Ahmed, 2014) due, to cultivar, season of planting and climate of cultivation. The high content of protein in lupin flour could be used in human diet. Also, the temperature of denaturation of these proteins is higher than animal protein, so they are technologically easier to handle (Howard, 1972). Lupin flour had a high content of crude fiber 11.5%, which have many desirable properties, including white color, high water capacity and beneficial effects on human health. Therefore, lupin flour can be supplemented into many foods to make healthier dietary products, such as bakery, dairy and meat products.

TABLE 3: Chemical analysis of different lupin source and Wheat flour used in bread making

Type	Moisture# (g/100g)	Ash# (g/100g)	Fiber%	Protein# (g/100g)	Fat# (g/100g)	CHO By diff.
JLF	7.8 ab	7.4 b	11.5 b	26.13 a	18.5a	36.67 b
ELF	7.2 b	6.9 b	10.5 b	22.60 a	19.1a	40.50 b
WF	12.5 c	1.2c	0.35	12.2c	0.09c	73.66c
LSD value (P≤0.0*)	1.227 NS	1.614 *	2.094 *	4.762 *	2.846 *	9.815 *

# Each No. the average of triplicate samples
JLF=Jordanian lupin flour, ELF=Egyptian lupin flour, LBF=Lupin bran flour
WF=Wheat flour

Table 4 indicates the fat content in raw and boiled of lupin flour expressed in g/kg^{-1} of dry matter. Differences in fat contents between raw and boiled lupin flour was highly significant (P<0.05). Differences in fatty acids contents between raw and boiled lupin flour were not significant (P > 0.05). An important criterion for oil assessment for dietary roles due to their fatty acid profile. It was found also, the differences in fatty acids contents between raw and boiled lupin flour were not significant (P > 0.05). Fatty acids in the oil of raw and boiled lupin flours were in the highest proportions, namely lauric, myristic, palmitic, palmitoic, stearic, oleic, linoleic, linoleinic, behenic (C12, C14, C16:0, C18:0, C18:1, C18:2, C18:3, and C220 respectively) and the fatty acid whose concentrations are monitored due to its negative on animal health is eruicic acid (C22:1). The highest contents of C18:1 was detected in oil of raw lupin flour 60.36 $g/100g^{-1}$, which is very close to the olive oil (range from 60-72$g/100g^{-1}$), then the contents of C18:2 decreased to 15.23 $g/100g^{-1}$, and C18:3 lowered to 8.25 $g/100g^{-1}$. These data was confirmed by Jezierny *et al.,* 2010). Similar results as in our research concering fat and fatty acids concentrations in lupin were showed (Erbas *et al*., 2005, Sujak *et al*., 2006) who considered lupin promising for growing in Europe mentioned *Lupin albus* as the most interesting with regard to human and farm animal nutrition. It was clearly founded that the soaking and boiling heat has no effect on fatty acids content of lupin seed flour but effect significantly on fat content as shown below in the table.

TABLE 4: Concentrations of fatty acids most frequently present in oil of raw and boiled lupin seed flour and fat content in the seed dry matter

Fatty acids $g/100g^{-1}$oil	Oil of raw lupin seed	Oil of boiled lupin seed	T-Test value
C12.0	0.1330	0.1350	0.0197 NS
C14.0	0.0783	0.0881	0.0263 NS
C16.0	9.3699	9.8794	1.536 NS
C16:1	0.5215	0.5179	0.199 NS
C18	2.7383	1.9881	0.438 *
C18:1	60.3625	60.1314	3.422 NS
C18:2	15.2316	16.4021	1.072 *
C18:3	8.2556	7.8910	0.883 NS
C22	0.5697	0.3760	0.103 *
C22:1	2.7396	2.5909	0.409 NS
Fat ($g/100g^{-1}$)	19.1	13.8	3.618 *

Data expressed as T-test * ($P<0.05$), NS: Non-significant. namely C12:0-lauric, C14:0-myristic, C16:0-palmitic, C18:0-stearic, C18:1-oleic, C18:2-linoleic, C18:3- linoleinic, and C22:0-behenic.

Table 5 represents the result of chemical analysis of different blends of wheat flour WF with different concentration of lupin flour LP. The moisture content is very important in bread making. It effect the rate of dough hydration and thus rheological properties (Malomo *et al*., 2011). The maximum limit fixed by the Iraqi Quality Standard regulation is 15%. All flour blends were found to contain below of that limit. The low moisture content noticed for 2% ELF, and the high moisture content 14% for 5% of both JLFB and ELFB is justified because the lupin bran is generally very high solid coated. The ash content represents the quantity of bran (outer layer of the kernel) remaining in the flour after milling process, thus amount of bran affect water absorption of flour during making the dough, nutrition (mineral content), fermentation activity, breakdown of gluten during mixing, color of the dough. The ash content increased significantly as the percent of lupin flour increased as shown in the table 4 for both of sources as compared with control sample. Fat content increased significantly with increased the percent of supplementation as shown in this table. Whereas, the fat content decreased in both of JLFP and ELFB. Protein is an important criterion for bread making, which is used to appreciate the end quality use of wheat. Low protein content gets low quality of bread for each volume and texture. For below blends, the average protein content is 112.8 (% dry matter basis) which is close to control. In contract, there were no significant differences in carbohydrate content for both sources.

TABLE 5: Chemical analysis of the different samples blend flour for making bread

Treatments	Moisture# (g/100g)	Ash# (g/100g)	Fat# (mg/100g)	Protein# (g/100g)	CHO By diff.
2 % JLF	11.5 b	0.5 c	1.8 b	12.4 a	73.70 b
4 % JLF	11.6 b	0.7 c	2.1 ab	12.5 a	73.10 b
6 % JLF	11.5 b	0.8 c	2.1 ab	12.8 a	73.80 b
8 % JLF	11.8 b	0.9 bc	2.2 ab	12.9 a	72.20 b
10 % JLF	12.0 ab	1.2 bc	2.5 a	13.1 a	71.20 b
5% JLFB	14.0 a	2.5 a	1.2 b	4.3 b	78.00 a
2 % ELF	10.9 b	0.9 bc	1.9 b	12.5 a	73.80 ab
4 % ELF	11.0 b	1.1 bc	2.5 a	12.8 a	72.60 b
6% ELF	11.3 b	1.5 b	2.8 a	13.0 a	71.10 b
8% ELF	11.5 b	1.6 b	3.0 a	13.5 a	70.40 b
10% ELF	12.2 ab	2.0 ab	3.5 a	14.1 a	68.20 b
5%ELFB	14.0 a	2.6 a	1.3 b	5.0 b	77.10 a
Control	11.3 b	0.45 c	1.5 b	11.9 a	74.85 ab
LSD value	2.183 *	0.873 *	1.532 *	4.588 *	

#Each No. the average of duplicate samples
* ($P \leq 0.05$), NS: Non-significant.

Influence of different concentration of lupin flour supplementation on bread properties

Physical properties of dough

During the kneading process it was essential to control the temperature and volume of the dough in order to obtain enough fermentation then achieved excellent bread quality. The wheat bread specific volume was 29, while it decrease slight significantly (P<0.05) with high 8 and 10% of lupin flour supplementation as shown in table 6. The dough control (wheat flour only) was easily formed with good absorption of water, resulting smoother dough with good flexibility and tension. While supplemented dough especially with 8 and 10% of lupin flour, were sticky and more flexible but less smooth and irregular in texture. Moisture, weight, volume, specific volume and oven spring of the tested breads are presented in table 3. A gradient increase in moisture and weight were found with increasing the concentration of both sources of lupin flour compared with the control. On the other hand, opposite trends were found in the case of volume and specific volume. A higher volume implies a less compact bread structure, therefore a lower value for bread hardness (pasting). Also, a more intense leavening process should cause an increase in water loss during baking resulting in lower final moisture content.

TABLE 6: Effect of different lupin flour supplementation on physical proprieties of bread

Treatments	Moisture* (g/100g)	Weight (g)	Volume (ml)	Specific volume (cm3)	Oven spring (cm)
2 % JLB	23.8 b	153.2 a	905.0 a	5.91 a	1.62 a
4 % JLB	24.0 b	154.5 a	903.5 a	5.85 a	1.60 a
6 % JLB	24.2 b	155.6 a	901.0 a	5.79 ab	1.52 ab
8 % JLB	25.5 b	158.0 a	898.0 a	5.68 b	1.09 b
10 % JLB	27.1 ab	159.0 a	895.5 a	5.63 b	0.90 b
5% JLFB	23.0 b	152.5 a	904.5 a	5.93 ab	1.53 ab
2 % ELB	23.6 b	153.5 a	903.1 a	5.88 a	1.72 a
4 % ELB	24.5 b	156.4 a	901.5 a	5.76 ab	1.65 ab
6% ELB	26.2 ab	157.3 a	900.0 a	5.72 ab	1.54 ab
8% ELB	27.3 ab	159.0 a	895.8 a	5.63 ab	1.15 b
10% ELB	28.05 a	160.2 a	890.2 a	5.56 b	1.10 b
5%ELFB	23.05 b	153.0 a	905.0 a	5.91 a	1.52 ab
Control	23.2 b	152.6 a	905.2 a	5.93 a	1.65 a
LSD value	3.451 *	16.830 NS	52.194 NS	0.361 *	0.573 *

* (P≤0.05), NS: Non-significant.

The effect of different supplementation of both lupin flour sources on the chemical composition of the bread products.

The chemical compositions of different lupin bread products formula was shown in table 7. The ash and protein content was significantly increased (p≤0.05) and the carbohydrate content was significantly decreased as a result of using LF. While there was a little or no change was occurred in moisture and fat. Therefore, lupin has an excellent interest, worldwide, as a potential of high protein food ingredient suitable for human consumption. So, incorporation bread with lupin flour , are very rich (> 10%) in the amino acid arginine and can be useful for children or athletes, who need it as well as vegetarians, vegans and people with high cholesterol levels (Hall, et al. 2005). Also, essential amino acid (lysine, threonine, isoleucine, phenylalanine and tryptophan) in lupin flour were higher than those in wheat flour except methionine content which was higher in wheat flour 1.7g/kg (Abdelrahman, R. 2014).

TABLE 7: Chemical analysis of the different samples of bread

Treatments	Moisture# (g/100g)	Ash# (g/100g(	Fat# (mg/100g)	Protein# (g/100g)	CHO By diff.
2 % JLF	11.5 b	0.5 c	1.8 b	12.4 a	73.70 b
4 % JLF	11.6 b	0.7 c	2.1 ab	12.5 a	73.10 b
6 % JLF	11.5 b	0.8 c	2.1 ab	12.8 a	73.80 b
8 % JLF	11.8 b	0.9 bc	2.2 ab	12.9 a	72.20 b
10 % JLF	12.0 ab	1.2 bc	2.5 a	13.1 a	71.20 b
5% JLFB	14.0 a	2.5 a	1.2 b	4.3 b	78.00 a
2 % ELF	10.9 b	0.9 bc	1.9 b	12.5 a	73.80 ab
4 % ELF	11.0 b	1.1 bc	2.5 a	12.8 a	72.60 b
6% ELF	11.3 b	1.5 b	2.8 a	13.0 a	71.10 b
8% ELF	11.5 b	1.6 b	3.0 a	13.5 a	70.40 b
10% ELF	12.2 ab	2.0 ab	3.5 a	14.1 a	68.20 b
5%ELFB	14.0 a	2.6 a	1.3 b	5.0 b	77.10 a
Control	11.3 b	0.45 c	1.5 b	11.9 a	74.85 ab
LSD value	2.183 *	0.873 *	1.532 *	4.588 *	

#Each No. the average of duplicate samples, * (P≤0.05), NS: Non-significant.

Rheological properties of the dough

The farinograph data of the adding different concentration of *Lupin albus* to wheat flour that used in Iraqi local markets are summarized in table 8. Protein is an important criterion for bread-making, which is used to appreciate the end use of wheat. The protein content is strongly correlated to the quantity of gluten which is responsible for rheological characteristics and behavior of flour during baking (Aziz, and Mohammed 2013). Protein content of lupin flour ranged from 12.4.1 to 14.1% of different origins which is highly significantly different (P<0.05) compared with control 11.9%. Moisture content also significantly different for all kinds of flours compared with control. Water absorption of both kind of lupin flour dough ranged from 65.3 to 72.8% that was higher than the control 58.2. The development time of the dough that was supplemented with lupin flour significantly increased compared with wheat flour as control as shown in table below. Also, It is increased significantly (P<0.05) by increasing the concentration of supplementation with lupin flour. In addition of that, dough stability increased significantly as the same pattern of dough development by supplementation and increasing the percent of adding lupin flour compared with wheat flour dough. This behavior of the dough may be attributed to decrease the percent of gluten content which is important to make the dough structure and the gluten network.

TABLE 8: Rheological properties of the dough by adding different concentration of both Jordanian and Egyptian Lupin albus to wheat flour

Samples	Protein %	Moisture %	Water absorption %	Dough development time (min)	Dough stability time (min)
JLF 2%	12.4	11.6	70.0	3.4	6.7
JLF 4%	12.5	11.5	69.0	10.0	6.6
JLF 6%	12.8	10.4	68.5	10.0	6.6
JLF 8%	12.9	10.0	67.2	11.8	12.8
JLF !0%	13.1	9.9	65.3	11.9	16.0
ELF 2%	12.5	11.8	70.0	3.4	6.7
ELF 4%	14.8	11.5	68.5	9.8	6.6
ELF 6%	13.0	10.5	68.0	10.0	6.7
ELF 8%	13.5	10.0	67.0	11.5	12.7
ELF 10%	14.1	9.9	66.0	11.8	16.4
WF (Control)	11.9	11.8	58.4	2.3	2.6
LSD value	2.189 **	2.077 NS	5.237 *	4.076 *	4.361 *

* (P<0.05)

Sensory evaluation

The main factors to determine good acceptability of bread supplemented with processed lupin flour were smell and taste like beany, juicy texture and yellow color of the crump. Sensory evaluation results of supplemented bread with different concentration of both sources of lupin flour are presented in table 9. It was found that bread which was supplemented with 2, 4, and 6% of lupin flour had no significant difference in color, taste, odor and overall acceptability as compared to wheat sample bread (control). But there were significant (P<0.05) difference in color, crump, taste, and texture by increasing the percent of lupin flour supplementation to 8 and 10 as shown clearly in the table below.

TABLE 9: Effect of different supplementation concentrations of JL and EJL Flour on sensory evaluation of bread making

	Characters and its degree							
Treatment	Specific Volume (30)	Color of crust (10)	Symmetry of Form (5)	Evenness of Bake (5)	Grain of Crump (10)	Color of Crump (10)	Aroma & Taste (20)	Texture of Crump (10)
2%JLB	28 a	9 ab	4 a	5 a	9 a	9 a	19 a	10 a
4%JLB	29 a	9 a	5 a	5 a	9 a	9 a	18 a	9 a
6%JLB	28 a	10 a	5 a	5 a	8 a	10 a	18 a	9 a
8%JLB	26 a	9 a	4 a	4 a	7 ab	8 ab	18 a	8 a
10%JLB	22 b	7 b	3 a	3 a	5 b	6 b	12 b	6 b
2%ELB	29 a	10 a	5 a	5 a	9 a	10 a	19 a	10 a
4%ELB	28 a	10 a	5 a	5 a	9 a	10 a	19 a	10 a
6%ELB	28 a	8 bc	4 a	5 a	9 a	9 a	18 a	9 a
8%ELB	27 a	8 bc	3 a	4 a	7 ab	9 a	18 a	9 a
10%ELB	26 a	7 c	3 a	4 a	7 ab	8 ab	16 a	8 ab
Control	29 a	10 a	5 a	5 a	9 a	10 a	19 a	10 a
LSD value	3.82 *	1.50 *	2.30 NS	2.45 NS	2.06 *	2.35 *	3.21 *	2.75 *

No. of panelists= 26 person

Evaluation degree* = 1, 2, 3, 4, 5, 6, 7, 8, 9

CONCLUSION & RECOMMENDATION

Lupin is considered as economically and agriculturally valuable plants with rising of human consumption. Lupin has attracted interest as a potential food ingredient suitable for human consumption due to its special composition, mostly consisting of protein, dietary fiber, and limited amount of oil. In the backed-products, lupin derived raw materials will be used for different bakery products processing (Erbas *et al*., 2005; Scarafoni *et al*., 2009). The substitution level that gave the best bread quality for the lupin flour was maintained up to 8%, therefore decreasing in quality attributes. Overall acceptable score for bread made using 2, 4, 6, 8% of both Jordanian and Egyptian lupin flour was the same score of control (bread) sample were insignificant difference. Incorporation of lupin flour rather enhances the sensory characteristic of color making bread more attractive to the consumer. The same pattern was found in all tested attributes (color, texture, taste, flavor and mouth feel) for both Jordanian and Egyptian. So that replacement of lupin flour up to 8% levels may be acceptable to the health conscious consumers who would be willing to compromise with change in taste and beany flavor. As compared with other natural protein, dietary fiber and antioxidants sources, lupin flour is lower in cost. Therefore, the supplementation of lupin flour would enhance the nutritional value and best quality of bread and biscuits at comparatively lower cost.

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