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EFFECT OF ADDING DIFFERENT PROPORTIONS OF LUPIN FLOUR TO WHEAT FLOUR ON PHYSICOCHEMICAL AND SENSORY PROPERTIES IN BISCUIT PRODUCTION

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ABSTRACT
Adding flour rich in proteins and dietary fibers to wheat flour to produce bread and its products such as bread and biscuits has the potential to promote nutritional values, but may adversely affect physical and sensory properties and to determine the effect of adding lupin flour on the physical and sensory properties of biscuits to provide vital information for manufactured products. Two types of lupin, usually grown locally in Jordan and Egypt, were used to add it to wheat flour. The addition of 10% was found to have no significant effect on biscuit diameter and all sensory assessments, but fish increased by 10%. The results of the sensory evaluation showed an improvement in the characteristics of color, taste, flavor, texture, and acceptance generally to add 10% of the thermos flour to wheat flour. There were no significant differences (P <0.05) in the sensory evaluation of the biscuits between the control treatment supported by both the Jordanian and Egyptian lupine flour. It is also possible to add lupin flour to wheat flour for baked goods such as biscuits by replacing up to 10% to increase the content of protein, fat, and dietary fiber to improve human health. In addition, the oil in the thermos flour plays an important nutritional role because it contains fatty acids, especially saturated and unsaturated fatty acids. The high content of monounsaturated and unsaturated monounsaturated fatty acids is 60.36 and 15.23 g.

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

INTRODUCTION

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[12]. Biscuits are the most famous bakery product prepared by battering flour, fat, water, and sugar. The high constituent of biscuits also, is wheat flour which is low in protein, essential amino acid such as lysine and dietary fiber contents. There for, the incorporation of lupin flour, which is rich in protein (40%) and dietary fiber (28%), to wheat flour-based products, such as biscuits, has the potential to increase protein and dietary fiber contents to improve consumers health [24] and achievement of satisfactory sensory and physical properties of dough and biscuits. Fat is needed in biscuit making because they have plasticity properties, allowing the air to be incorporated during dough formation and enabling the dough to withstand the high temperatures during baking and hold its shape for longer[20]. Few trials in biscuits were presented to replace butter or wheat flour by lupin oil or flour [3]. Lupin oil and flour were succeeded to supplement 30% fat and 20% wheat flour, in biscuits [28]. Lupin is an economically and agriculturally valuable legume plant [10]. Its seeds are valuable for high contents of protein, fat, also rich in dietary fiber and carbohydrates, minerals and vitamins [36], in addition its contain an antioxidants and phytochemical compounds [26] which is responsible for the health benefits including oxidative stress such as cancer, cardiovascular disease [22], neuro-degeneration and diabetes[5]. 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. Also, lupin flour can be supplemented into wheat flour to enhance the nutritional value of the final products without detrimental effects on the quality [27]. In general, the addition of up to 10% lupin flour improves water binding, texture, shelf-life, and aroma [25]. [6] Doxastakis *et al.* Conducted that the mixing time and dough stability decreased as the substitution level increased. In addition, 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. 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[37]. In addition of that, the cost of lupin is lower than other legumes[17]. Therefore, supplementation of lupin flour would improve the nutritional and sensory values of different backed products at a comparatively lower cost. The aim of the present study was to investigate the effect of different addition of lupin flour concentrations on the physic-chemical and sensory characteristic of bakery products (biscuit).

MATERIALS & METHODS

This study was carried out for biscuit making were done in Al-Khaseiqi plants where the whole apparatuses available there, in order to get a good products.

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 [8].

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

Sweet Biscuit (plain) making

Ingredient used for making control biscuit sample were included 100 g of wheat flour with baking powder 1.6g, margarine butter 15g, salt 0.3g, milk 2.6 and sugar 40g according to the method described by[21]. The supplemented biscuit 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%. All different biscuits formula were baked at 23°C for 10-15min then cooled and packaged in zip-locked poly ethylene bags and storage at room temperature 25°C for chemical analysis after sensory (organoleptic) evaluation.

Sensory evaluation of biscuits

Organoleptic evaluation of biscuits color, texture, taste, flavor, and total acceptance of crispness, thickness, shrinkage and odor as the method described by using 9-points hedonic scale method [33].

Biscuits samples were evaluated organoleptic ally by a panel of 15 panelists. On the day of evaluation, biscuits were placed in small plates and labeled with three-digital random codes. Panelists were provided with distilled water and unsalted crackers to clean their palates between samples. The biscuit samples were presented in random order and panelists were asked to rate their assessment of color, texture, taste, flavor, and total acceptance of crispness, thickness, shrinkage and odor on a nine-point hedonic scale (1=dislike extremely, 2=dislike very much, 3= dislike moderately, 4= dislike slightly, 5=neither like or dislike, 6= like slightly, 7=like moderately, 8=like very much and 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[34]. 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 acids 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 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°C, initial injector temperature was 280°C and pressure was 299.2 kPa, initial colum temperature was 70°C. The data were processed by a computer using data processor GC solution Post run [14]. 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.

Biscuits weight

Biscuits weight was determined using a precision scale (HF-2000G, A&D Company Ltd., Tokyo, Japan). Biscuits dimensions were evaluated according to AACC method 10-50D [1]. The diameter (D) was measured by placing six biscuits edge-to-edge horizontally and rotating at 90° angle for a duplicate reading. Thickness (T) of biscuits was measured using a digital venire caliper (Kincrome Australia Pty. Ltd., Scoresby, Australia) by placing six biscuits on top of each other, followed by a duplicate reading recorded by shuffling biscuits. The spread ratio and spread factor were determined by using the following equations:

Spread ratio= Width/ Thickness

Spread factor= Spread ratio of sample/ Spread ratio of control sample

All the measurements were done in three duplicates.

Statistical Analysis

The Statistical Analysis System- [29] 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 2. Lupin flour presents one of the most promising alternative protein sources for the nutritional supplementation and technological improvement of traditional foods[29]. 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 [2] 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[13]. 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 2: Chemical analysis of different lupin source and Wheat flour used in bread and Biscuit 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
L Bran	8.6 a	9.8 a	14.2 a	2.50 b	3.5 b	61.40 a
WF	12.5 c	1.2c	0.35	12.2c	0.09c	73.66c
LSD value	1.227 NS	1.614 *	2.094 *	4.762 *	2.846 *	9.815 *

* ($P\leq0.05$).

Each No. the average of triplicate samples

JLF=Jordanian lupin flour, ELF=Egyptian lupin flour, LBF=Lupin bran flour WF=Wheat flour

Table 3 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 [18]. Similar results as in our research concerning fat and fatty acids concentrations in lupin were showed [9], [32] 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 3: 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 4 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 effects the rate of dough hydration and thus rheological properties [23]. 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 4: 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≤0.05), NS: Non-significant.

Influence of different concentration of lupin flour supplementation on biscuits properties

Baking of bakery products generally causes a substantial increase in both diameter and thickness of biscuits due to CO_2 gas production by baking powder, which should be retained in order to guarantee good biscuit height, and in respect flour quality has an important role to play. Another factor is the low gelatinization temperature of the starch would prevent the correct expansion of dough, as [13] pointed. Biscuits expand both in diameter and thickness in early stage but collapse at the later stage of the baking process. This collapse is due to structural properties of gluten in cookie flour for the two-dimensional collapsible film formation rather than three-dimensional elastic network formation as presented by [31]. It was noticed that the supplement of soft wheat with lupin flour up to 10% level had no significant effect on the biscuit diameter thickness as shown in table 5. The results are in agreement to those of other researcher showing an increase in biscuit thickness when high protein lupin flour was added into the formulation[36]. Decrease in the biscuit thickness resulted in a corresponding decrease in spread ratio for both sources of lupin flour which is comparable to the control sample.

TABLE 5: Effect of different lupin flour supplementation on physical proprieties of biscuits

Treatments	Moisture* (g/100g)	Dry weight (gU)	Diameter (mm)	Height (mm)	Spread ratio (Diameter/height)
2 % JLB	2.5 ab	16.5 ab	60.2 a	8.5 a	6.8 a
4 % JLB	2.6 ab	16.2 ab	58.5 a	8.9 a	6.8 a
6 % JLB	2.8 ab	16.0 ab	58.6 a	8.9 a	6.7 ab
8 % JLB	2.9 a	15.8 ab	56.5 a	9.0 a	6.7 ab
10 % JLB	2.9 a	15.2 ab	56.5 a	9.2 a	6.5 ab
5% JLFB	2.2 ab	14.8 b	55.5 a	8.5 a	7.0 a
2 % ELB	2.5 ab	16.3 ab	61.5 a	9.0 a	6.9 a
4 % ELB	2.7 ab	16.5 ab	61.0 a	9.0 a	6.8 a
6% ELB	2.8 ab	16.5 ab	59.0 a	8.6 a	6.5 ab
8% ELB	3.1 a	16.6 ab	58.5 a	8.6 a	6.4 ab
10% ELB	3.0 aa	16.9 ab	58.0 a	8.5 a	5.9 b
5%ELFB	2.0 ab	15.5 ab	56.0 a	8.6 a	6.9 a
Control	1.5 b	17.2 a	62.0 a	9.0 a	7.0 a
LSD value	1.277 *	2.338 *	8.924 NS	1.027 NS	0.872 *

* ($P \leq 0.05$), NS: Non-significant.

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

In general, there were slightly significant differences between Jordanian and Egyptian lupin flour in their chemical composition due to location and season or climatic conditions [35] as shown in table 6. The results shows that the content of ash and fibers for both sources of lupin flour which is indicate to its beneficial effects on stool bulking[19], reduced blood glucose in non-insulin diabetics [11], and blood pressure. Protein content resulted high for both different sources, but with no difference between them. Lupin seed flour is also a potentially useful source of high quality oil and carbohydrate compared with other cereal crops [32].

TABLE 6: Chemical analysis of the different samples of Biscuits

Treatments	Moisture* (g/100g)	Ash* (g/100g)	Fat* (mg/100g)	Protein* (g/100g)	CHO By diff.
2 % JLB	3.9 a	1.9 b	18.0 a	12.0 a	64.2 a
4 % JLB	4.0 a	1.9 b	18.2 a	12.3 a	63.9 a
6 % JLB	4.0 a	2.0 b	18.3 a	12.3 a	63.4 a
8 % JLB	4.0 a	2.0 b	18.5 a	12.4 a	63.1 a
10 % JLB	4.1 a	2.1 b	18.9 a	12.5 a	62.4 a
5% JLFB	3.8 a	2.5 a	18.4 a	12.0 a	62.8 a
2 % ELB	3.8 a	1.8 b	18.1 a	12.5 a	63.8 a
4 % ELB	3.9 a	1.9 b	18.3 a	12.5 a	63.4 a
6% ELB	4.0 a	1.9 b	18.3 a	12.8 a	63.0 a
8% ELB	4.0 a	1.9 b	18.8 a	13.0 a	62.3 a
10% ELB	4.1 a	2.0 b	18.9 a	13.0 a	62.0 a
5%ELFB	3.8 a	2.5 a	18.4 a	12.2 a	63.1 a
Control	4.0 a	2.2 ab	18.0 a	12.0 a	63.8 a
LSD value	0.634 NS	0.309 †	1.024 NS	1.16 NS	4.93 NS

Each No. the average of duplicate samples

† ($P<0.05$).*

Sensory evaluation of biscuits

The sensory evaluation testes were carried out to confirm and determine the degree of supplementation in the physical properties of the tested biscuit as a result of wheat flour substitution by lupin flour, JLF or ELF. Thus, data presented in table 7 show the sensory evaluation scores of the biscuit samples panel testing. The tested lupin biscuits were submitted to a series of qualitative measures (including elements such as color, texture, taste, flavor and overall acceptability. All biscuit sensory exhibited the high

acceptable scores for all the sensory attributes of taste, appearance, texture and aroma with an observable improvement in the color of lupin fiber -wheat biscuits which they comparable to the control 2, 4 and 6% for both sources JLF and ELF. The sensory score for color of biscuits were improved by the increasing the percent of addition of lupin flour up to 10%, due to the natural yellow pigments present in lupin flour which was attractive to the panelists as compared with the pale color of the control sample. These observations were in agreed with that found by[28],[15]. Similarly, up to 10% supplementation of lupin flour enhanced the texture taste and flavor of biscuits positively table 2. These results are concurrent and confirmed by [7]. It was observed that lupin bran supplemented to wheat flour for biscuit product caused slight decreases in all sensory properties, instead of that it gives more crispness and acceptable by all panelist as in the table below.

TABLE 7: Sensory evaluation of the Biscuit products

	Evaluation´s Degree *				
Treatments	Color	Texture	Taste	Flavor	Total acceptance
2 % JLB	8 a	8 a	9 a	8 a	9 a
4 % JLB	8 a	9 a	8 a	8 a	9 a
6 % JLB	8 a	9 a	8 a	8 a	9 a
8 % JLB	10 a	9 a	9 a	10 a	10 a
10 % JLB	10 a	10 a	10 a	10 a	10 a
5% JLFB	10 a	9 a	9 a	10 a	10 a
2 % ELB	8 a	9 a	8 a	9 a	9 a
4 % ELB	8 a	9 a	8 a	10 a	9 a
6% ELB	8 a	9 a	9 a	9 a	9 a
8% ELB	9 a	10 a	10 a	9 a	10 a
10% ELB	10 a	10 a	10 a	9 a	10 a
5%ELFB	10 a	9 a	10 a	10 a	10 a
Control	9 a	9 a	10 a	10 a	10 a
LSD value	2.28 NS	2.40 NS	2.36 NS	2.39 NS	2.2. 7 NS

NS: Non-significant

CONCLUSION & RECOMMENDATION

Lupins are 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 [9],[30]. The substitution level that gave the best biscuit quality for the lupin flour was maintained up to 10. Overall acceptable score for bread and biscuits made using 2, 4, 6, 8, 10% of both Jordanian and Egyptian lupin flour was the same score of control biscuit sample were insignificant difference. Incorporation of lupin flour rather enhances the sensory characteristic of color making biscuits 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. Also, 5% lupin fiber flour addition was insignificant difference on sensory properties and resulting in very good quality biscuit, with interesting sensory characteristics and good behavior during the baking process. So that replacement of lupin flour up to 10% 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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