PRODUCTION OF HIGH NUTRITIONAL VALUE COOKIES FROM BROKEN RICE SUPPLEMENTED WITH SWEET LUPIN FLOUR

AMERA T. MOHAMMED

Crop Tech. Res., Food Tech. Res. Inst., ARC, Giza, Egypt.

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Abstract

The objective of the current study was to produce high nutritional value gluten-free cookies from broken rice and sweet lupin flour. Rice flour was replaced with 20%, 40 %, 60 % and 80 % sweet lupin flour. Sensory evaluation, physical properties and chemical composition were determined to assess the quality of produced cookies. The results indicated that the incorporation up to 40% sweet lupin flour into cookies had the highest score in taste and overall acceptability. Physical properties of cookies replaced with 40 % sweet lupin showed increased thickness with a reduction in diameter and spread ratio. Protein, Fe, Ca, Zn, In-vitro protein digestibility (IVPD), total essential amino acids, chemical score and biological value were increased in sweet lupin cookies meanwhile, total carbohydrate content was lower compared to control. Therefore, it could be recommended the use of sweet lupin flour for enhancement the nutritional value of bakery products.

Key words: sweet Lupin flour, rice flour, free- gluten cookies, Chemical composition, Sensory evaluation, Physical properties.

INTRODUCTION

Sweet lupin seeds are good sours of protein, especially lysine but its poor in the sulfur–containing amino acids–methionine, cystein and theronine Abdelrahman, (2014). Lupin flour (LF) is widely considered an excellent raw material for supplementing different food products owing to its high protein content (Kohajdova *et al.* 2011) .Other naturally components of lupin seeds are oligosaccharides, especially raffinose, stachyose, and verbascose, which are contributory factors to flatulence, (diarrhea, nausea) to many consumers Ramadan, (2012).

Broken rice is a by-product produced during rice milling and polishing. Rice flour is used in many gluten-free formulas. It is available in several different textures, from regular to fine grinds. Broken rice flour had 7.95% protein, 0.30% fat, 0.42% crude fiber, 0.80% ash, and 90.53% carbohydrate Ola *et al*, (2015).

Cookies are baked products, which are considered the most desirable products for all ages due to their low manufacturing cost, convenience, long shelf life and good eating quality. Moreover, cookies could be used as a vehicle to deliver essential nutrients to people Maghaydah *et al* , (2013).

Gluten-Free foods have attracted much research interest especially, with rising number of patients with gluten sensitivity and celiac disease. In addition to, the rapid change in consumer life style, where gluten-free diet is also associated with weight management and overall health . Rice, corn, amaranth, cassava, soybean and peanut, gums and hydrocolloids, enzymes, soybean proteins, egg white have been used to mimic viscoelastic properties of gluten in gluten-free cereal products in order to improve quality, structure, mouthfeel, acceptability and shelf life (Korus *etal.*2006). Lupin flour does not contain gluten thus it is sometimes used as functional ingredient in gluten- free foods with improved nutritional quality at a comparatively lower cost (Kohajdova *et al.* 2011). A balance of nutrients may be obtained by including cereals and pulses in our diets. Such these diets supply a large proportion of our energy needed, carbohydrate, protein, dietary fiber, amino acids and minerals.

Therefore, the present research work aimed to determine and evaluate the effect of the partial replacement of rice flour with varying levels of sweet lupin flour on the physical properties, quality and consumer acceptability of cookies for finding maximum incorporation of lupine flour to improve the nutritional quality of gluten-free cookies

MATERIALS AND METHODS

Materials

Broken rice was obtained from Sakha Research Station Agricultural Research Center, Kafrel-Shiekh, Egypt**.** Broken rice was grounded into flour to obtain particles around 0.45mm. Sweet lupin was purchased from local market, Giza, Egypt, and milled into flour after soaking to obtain particles around 0.45 mm , then kept in polyethylene bags at refrigerator till using. Powdered sugar, shortening, baking powder, salt, vanilla and milk were purchased from local market, Giza, Egypt. Standard, sucrose, stachyose and raffinose were obtained from Sigma Co. Sanit Louis, Missori, U.S.A.

preparation of Lupin flour

Sweet lupin seeds were cleaned from impurities then washed with tape water and soaked in water for 24 h then firmly dehulled manually and finally dried in oven at 60ºC. The dried lupin seeds were ground into flour to get particles around 0.45 mm.

Determination of raffinose family and sucrose

Raffinose family and sucrose of cookies was evaluated according to the method described by Zielinski *et al*, (2014). Sample (1g) was diluted 1:10 (v/v) with ultra purified water and then filtered through 0.22µm filter membrane. 1.5ml of these solutions was placed in vials for injection into HPLC Agilant packared (series 1100) equipped with auto sampling injector, IR detector. The column temperature was

maintained at 35cº. The column was used Aminex- carbohydrate HPX-87C, 300 mm ×7.8 mm.

Production of cookies

Cookies formula and Ingredients

The cookies dough was prepared according to the formula presented in Table 1., which described by Obeidat *etal*. (2012)**.** Rice cookies supplemented with lupin flour at different levels of 20 %, 40, 60 and 80%. Control cookies was produced from (100% Rice flour).

Table 1. Formula of Rice cookies supplemented with lupin flour

Ingredients / Treatment	Rice flour	Lupin flour	powdered Sugar	shortening	Baking powder	milk	salt	Vanillia
R	100	-	35	36	3	10	1	1
RL_1	80	20	35	36	3	10	1	1
RL_2	60	40	35	36	3	10	1	1
RL_3	40	60	35	36	3	10	1	1
RL_4	20	80	35	36	3	10	1	1

R =control rice flour $RL_{1, 2, .3, 4}$ = Rice flour supplemented with 20, 40, 60 and 80 % Lupin flour respectively.

Dough preparation

Powdered sugar and shortening were mixed for 2 min at speed four using a mixer. The dry ingredients were weighed and mixed with milk for 3 min at speed 3 to get cookies dough. Then, it was sheeted to a thickness of about 5 mm , the sheeted dough was cut into round shape using a 35 mm diameter. The cookies dough was baked at 180 c^o for 12-15 min. Cookies were kept at room temperature for 8-10 minutes after baking until sensory evaluation, Obeidat *et al*. (2012). The reset of cookies were kept in polyethylene bags at refrigerator until physical and chemical analyses.

Analytical methods

Crude protein, crude fat, ash, crude fiber and moisture contents were analyzed in rice, lupin flours and cookies according to the procedures described in AOAC, (2005**).** Total carbohydrates was calculated by difference. Minerals content were determined according to AOAC,(2005) using Perkin Elmer atomic absorption spectrophotometer model 3300 (USA).

Sensory Evaluation of cookies

Sensory characteristics of cookies were evaluated according to the method described by Chinma *et al*, (2012) which carried out by panel of ten experienced guides from the staff of the Food Tech. Res. Institute, Agric., Res. Center, Giza,

Egypt. Assigning scores for various qualities attributes such as: color, taste, texture, aroma and overall acceptability on a nine- point hedonic scale (1= disliked extremely, to 9 = like extremely).

Physical characteristics of cookies

Cookies diameter, thickness, spread ratio were measured according to AACC (2000). The diameter (D) was measured by placing six cookies edge to edge to get an average diameter in millimeters. The Thickness (T) was measured by stacking six cookies on top of one another and measuring them to get the average in millimeters. The Spread ratio was determined by dividing the diameter out thickness.

Caloric value of the cookies

Calories of the cookies were calculated by James,(1995) as follows:

$$caloric\ value\ (Kca/100g) = 4\ (protein\ ) + 4(carbohydrate\ ) + 9(fate)$$

Determination of In vitro Protein Digestibility (IVPD)

The IVPD of the cookies was determined according to the method of Akeson and Stahmann (1964). After enzymatic digestion of samples with pepsin (37°C/3h) and pancreatin (37°C/24h), the protein in the resultant supernatant was estimated using the Kjeldahl method according to AOAC, (2005) . The percentage of protein digestibility was calculated by the ratio of protein in supernatant to protein in sample as the following equation:

$$protein\ digestabilty\ \% =\ N\ in\ supernatant - N\ in\ Blank\ /\ \ N\ in\ sample \times 100$$

N = Nitrogen

Determination of Amino acids Profile of cookies

Amino acids content was determined using amino acids analyzer Biochrom 30 using the instruction manual according to AOAC, (2005).

Biological value of Cookies

Biological value of the cookies were calculated according to Eggam *et.al*, (1979) as follows:

$$Bilogical\ value\ \% = 39.55\ + 8.89 \times lysin\ \ (\ g/100g\ protein)$$

Chemical score of cookies

Chemical score were calculated according to FAO/WHO (2007) as follows:

$$Chemical\ score\ \% = \frac{Essential\ amino\ acid\ of\ crude\ protein}{Essential\ amino\ acid\ of\ FAO/WHO} \times 100$$

Statistical Analysis

The obtained data were exposed to analysis of variance (ANOVA). Duncan is multiple range tests at ($P \leq 0.05$) level was used to compare between means values. Waller and Duncan, (1969).

RESULTS AND DISCUSSION

The rafinose family and sucrose of lupin flour

Raffinose , stachyose and sucrose percentage were analyzed in Lupin flour before and after soaking and the results are shown in Table 2 .Results indicated that the Raffinose reduced by 37.5 %, Stachyose by 7.08 % and sucrose by 30.62 % after soaking and dehhulling . In yellow lupin seeds the content of raffinose 1.23 g/100g, stachyose 5.14 g/100g, sucrose 1.54g/100g and verbascose 2.90g/100g Sobotk *etal.,*(2013) .Stachyose (5.87g/100g) was the most abundant oligosaccharide in lupin, followed by sucrose (3.23g/100g), verbascose (1.37g/100g) and raffinose (1.33g/100g) Bhardwaj and Hamama , (2013).

Table 2. The raffinose family and sucrose of lupin flour (%)

Analysis / Treatment	Raffinose	Stachyose	Sucrose
LBS	1.12	5.22	1.60
LAS	0.70	4.85	1.11
Reduction %	37.5	7.08	30.62

LBS= Lupin before soaking LAS=Lupin after soaking and dehulling

Chemical Composition of lupin and rice flour

Data in Table 3.showed that the lupin flour contained higher level of crude protein, crude fat, crude fiber and lower level of total carbohydrates compared to rice flour that distinguished by the highest value of total carbohydrates. Our present findings are in accordance with those of Abdelrahman (2014) who indicated that % protein, fat and ash contents of lupin flour were (38.6 ; 9.49 and 3.41), respectively. The moisture content of Lupin flour was (8.7g/100g) Yorgancilar and Bilgicli (2014).Total carbohydrate of lupin flour was 36.76% Maghaydah *et al,(* 2013). Rice flour had high amount of total carbohydrate 90.14%, protein 7.72% (Abdel-Haleem, and Hafez, (2015). From the same Table, lupin flour was a rich source of Mg and Ca; while Fe and Zn were found in lowest values. Meanwhile the broken rice flour contained 28.02

Mg, 10.55 Ca, 0.91 Fe and 0.29 Zn mg/100g , respectively. These result are in accordance with those reported by Yorgancilar and Bilgicli,(2014) .

Table 3. Chemical Composition (g/100g) and Minerals Content (mg /100g) of lupin and broken Rice flour on dry wieght

Analysis / Treatment	Moisture	Ash	Protein	Crude fat	Crude fiber	T.C**	Mg	Ca	Fe	Zn
Lupine flour	8.76^{b} ±0.03	3.21^{a} ±0.03	39.19^{a} ±0.01	9.98^{a} ±0.05	5.64^{a} ±0.04	41.98^{b} ±0.05	110.33^{a} ±3.21	290^{a} ±3.0	5.43^{a} ±0.04	4.95^{a} ±0.05
Broken Rice flour	9.01^{a} ±0.01	0.39^{b} ±0.04	8.15^{b} ±0.03	0.32^{b} ±0.02	0.28^{b} ±0.05	90.86^{a} ±0.04	28.02^{b} ±0.03	10.55^{b} ±0.05	0.91^{b} ±0.04	0.29^{b} ±0.02

T.C** = Total carbohydrate calculated by deference values are means (n=3) ±SD & Means with different letters are significantly different at *P≤ 0.05*.

Sensory evaluation of cookies

Sensory evaluation of the studied cookies are outlined in Table 4. It could noticed that addition of lupin flour exhibited a substantial effect on the sensory properties of rice cookies;the sensory scores for color of cookies were improved by the incorporation of lupin flour. The color score of cookies was increased with the increase in lupin flour substitution similar improvements in color of different foods by lupin incorporation have been reported in other studies. Cookies containing lupin flour up to 30% improved the color score of the cookies Bilgicli and Levent , (2014)

Table 4. Sensory characteristics of cookies

characteristics / Treatment	Color (9)	Taste (9)	Aroma (9)	Texture (9)	Overall Acceptability (9)
R	8.24^{d} ± 0.24	8.40^{a} ± 0.84	8.50^{a} ± 0.70	8.30^{a} ± 1.05	8.42^{a} ± 0.76
RL_1	8.52^{c}± 0.10	7.40 ^{ab}± 0.87	8.15^{ab} ± 1.0	7.45^{ab}±0.95	7.80^{ab} ± 0.72
RL_2	8.71^{b} ± 0.12	7.10^{ab}± 1.42	8.05^{ab} ± 0.95	7.20^{b} ± 1.00	7.83^{ab} ± 0.73
RL_3	8.87^{a} ± 0.07	6.90 ^{bc}± 1.59	7.70^{ab} ± 1.15	6.17^{c} ±1.06	7.39^{bc} ± 0.66
RL_4	8.97^{a} ± 0.03	6.0 ^{c} ± 1.49	7.20^{b} ±1.61	5.5^{c} ±1.10	6.90^{c} ± 0.61

R =control rice flour $RL_{1, 2, .3, 4}$ = Rice flour supplemented with 20, 40, 60 and 80 % Lupin flour respectively. values are means (n=10) ±SD & Means with different letters are significantly different at *P≤ 0.05* .

Regarding to taste score, results showed that substitution with lupin up to 40% did not affect significantly taste score. However, significant decrease in taste score was observed at 60 and 80% substitution levels. It might be due to flavor associated with lupin flour. The texture decreased significantly with increase percentage of lupin except 20% substitution level. This may be due to texture hardness caused by high

protein and dietary fiber contents of lupin flour when added at higher levels. Fibers sourced from apple, lemon, when added at ≥15% levels caused a reduction in sensory scores for texture of cookies (Jayasena and Nasar, 2011).

Overall acceptability scores provide a general acceptability of the product based on all of the sensory parameters. Cookies made from substituted rice flour with 20 and 40% lupin showed no significant differences in all over all acceptability relative to control.

Physical Characteristics of Cookies

Physical Characteristics are presented in Table 5. Results showed that the highest diameter, spread ratio and the smallest thickness was observed in Control . Cookies supplemented with 40% lupin flour showed increased in thickness with a reduction in diameter and spread ratio. The data are in good agreement with Maghaydah *et al*, (2013), Chinma *et al*, (2012) found that the addition of high protein flours sources causes negative correlation on the cookies diameter and spread.

Table 5. Physical characteristics of cookies

Characteristics / Treatment	Diameter(mm)	Thickness (mm)	Spread ratio (D/T)
R	34.48 ^{a}± 0.05	6.12 ^{b}± 0.01	5.63 ^{a}± 0.04
RL_2	34.21 ^{b}± 0.03	6.34 ^{a}± 0.01	5.39 ^{b}± 0.03

R =control rice flour RL_2 = Rice flour supplemented with 40% Lupin flour values are means (n=6) ±SD & Means with different letters are significantly different at $P \leq 0.05$

Chemical Composition and minerals content of Cookies

The data in Table 6. revealed that the supplementation with 40% lupin flour in rice cookies (RL_2) decreased significantly in the total carbohydrates while increased ash, crude fiber, crude protein, crude fat, Mg , Zn, Ca, and Fe compared to control (R). The increase in ash, crude fiber, crude protein and crude fat in RL_2 may be attributed to addition effect by lupin flour to the complementation of rice flour with lupin flour that contain higher amount of crude protein, ash and crude fiber. Lupin flour at 30% in cookies formulation caused an increment in protein content up two times and improved minerals (Mg, Zn, Ca and Fe) compared to control cookies Bilgicli and Levent, (2014). Considering to the method of processing, before prepare lupin flour (soaking and dehulling), these processing methods increase the protein content. Increment in protein content after soaking was also observed by Hassan *et al*., (2005).

Table 6. Chemical Composition (g/100g) and Mineral Contents (mg/100g) of Cookies on dry weight.

Analysis / Treatment	Moisture	Ash	Crude fiber	Crude Protein	Crude fat	TC**	Mg	Zn	Ca	Fe
R	6.49^{b} ±0.03	0.50^{b} ±0.05	0.48^{b} ±0.01	8.85^{b} ±0.03	26.31^{b} ±0.01	63.86^{a} ±0.08	40.0^{b} ±0.01	0.375^{b} ±0.03	10.73^{b} ±0.02	0.231^{b} ±0.04
RL_2	6.65^{a} ±0.02	1.30^{a} ±0.03	2.26^{a} ±0.04	16.20^{a} ±0.04	30.01^{a} ±0.05	50.23^{b} ±0.09	62.50^{a} ±0.06	1.860^{a} ±0.07	119.0^{a} ±4.01	1.690^{a} ±0.01

R =control rice flour RL_2 = Rice flour supplemented with 40% Lupin T.C**= Total carbohydrate calculated by deference values are means (n=3) ±SD & Means with different letters are significantly different at *P≤ 0.05*

Nutritional Quality of Cookies

Table 7. Represents the nutritional quality of cookies. From calculated data, it could be noticed that the highest accepted cookies (RL_2) had higher value of total calories than control (R). RL_2, R will provide 26%, 25% respectively, from the DRI of energy for female aged 9-13 year (calculated as 2071 Kcal/day). Moreover, 24 %, 23% respectively, from the DRI of energy (calculated as 2279 Kcal /day) for male aged 9-13 year. Each 100 g (R and RL2) cookies will provide 3 %, 21% for Fe ; 5 % , 23% for Zn and 0.8 %, 9 % Ca , respectively based on (8 mg /day for Fe, Zn and 1300 mg /day for Ca) from the DRI for male and female aged 9 - 13 y. From the above-mentioned data about the nutritional quality, it could be demonstrated that the RL_2 cookies had reasonable amounts of the required nutrients particularly energy, Fe, Ca and Zn. In vitro Protein digestibility (IVPD) is an important factor for evaluation of protein quality as well as an indicator for protein bioavailability in food Chinma *et al.*,(2011).

Table 7. Nutritional Quality of Cookies

Analysis / Treatment	Crude potein kcal	TC** kcal	Crude fat kcal	Caloric value Kca/100g	Fe mg/100g	Zn mg/100g	Ca mg/100g	IVPD %
R	35.4^{b} ±0.14	255.44^{a} ±0.33	236.79^{b} ±0.09	527.63^{b} ±0.27	0.231^{b} ±0.04	0.375^{b} ±0.03	10.73^{b} ±0.02	60.11^{b} ±0.09
RL_2	64.80^{a} ±0.18	200.92^{b} ±0.36	270.09^{a} ±0.05	535.81^{a} ±0.31	1.690^{a} ±0.01	1.860^{a} ±0.07	119.0^{a} ±4.01	72.83^{a} ±0.27

R = control rice flour RL_2 = Rice flour supplemented with 40% Lupine flour

(IVPD)= In vitro Protein digestibility T.C**= Total carbohydrate calculated by deference values are means (n=3) ±SD & Means with different letters are significantly different at *P≤ 0.05*

Data from Table7. showed that supplementation with 40% lupin flour increased IVPD compared to control . IVPD were 72.83 % and 60.11% for RL_2 and R, respectively. Guemes-Vera *etal.*(2012) who reviewed that in vitro protein digestibility of lupin flour ranged from (78.58-82.72%). Protein digestibility of rice was 89% Emara, (2015). Hassan *et al*. (2005) estimated the in vitro protein digestibility of lupin seed ranged 72-74% and Processing methods (soaking, cooking, dehulling) of lupin seeds improved protein digestibility. Considering the method of processing, before prepare lupin flour (soaking and dehulling), these processing methods increased the IVPD.

Amino acids profile of cookies

Table 8. Amino acids, chemical score and Biological value

	Amino acids %						
	R			RL_2			
EAA	amino acid g/100 sample	amino acid g/100 proteine	Chemical score %	amino acid g/100 sample	amino acid g/100 proteine	Chemical score %	*FAO/WHO
Leucine	0.55	6.21	94.10	1.04	6.42	97.27	6.6
Valine	0.42	4.74	135.43	0.67	4.14	118.29	3.5
Lysine	0.29	3.27	64.13	1.01	6.23	107.41	5.8
Isolucine	0.27	3.05	108.92	0.66	4.07	145.36	2.8
Phenylalanin	0.41	4.63	73.49	0.64	3.95	62.70	6.3
Theronine	0.27	3.05	89.71	0.51	3.15	92.65	3.4
Methonine	0.25	2.82	112.8	0.19	1.17	46.8	2.5
Total E.A.A	2.46	27.77	678.58	4.72	29.13	670.48	30.9
Non –E.A.A							
Histidine	0.18	2.03		0.35	2.16		
Argnine	0.58	6.55	-	1.26	7.80	-	-
Serine	0.38	4.30	-	0.66	4.07	-	
Tyrosine	0.38	4.30	-	0.68	4.20	-	-
Aspartic	0.61	6.89		1.34	8.30		
Glutamic	1.32	14.92		2.67	16.48		
proline	0.41	4.63		0.64	3.95		
Glycine	0.31	3.50		0.53	3.27		
Alanin	0.39	4.41		0.57	3.52		
Cysteine	0.18	2.03	-	0.30	1.85	-	-
Total Non –E.A.A	4.74	53.56		9	55.6	-	-
Limiting aminoacids			Lysine			Methonine	
Biological value	-	68.62		-	94.93	-	

R =control rice flour RL_2 =Rice flour supplemented with 40% Lupine flour

EAA= essential amino acid *FAO/WHO (2007)

The amino acids of food product is an important of protein quality. The essential amino acids are necessary for tissue maintenance and required for growth of children. Table 8. Showed that the Essential amino acids (EAA) of accepted sample (RL_2) contained higher amount of leucine, lysine, Isolucine and theronine than those in (R) which contained high amount of valine, phenyl alanine and methonin. Our present findings are in line with Abdelrahman, (2014) who stated that lupin flour was higher in (lysine ,theronine and isolucine). Yorgancilar and Bilgicili , (2014) stated that all essential amino acids were increased except methonine in sweet lupin seeds. Rice protein contains 5.87 % valine, 2.54% histidine and 2.25% methonine (USDA, 2011). It could be noticed that, the total EAA and total non-EAA were highest amount in RL_2 than R. From the same table showed that the Limiting amino acids were lysine for (R) and Methonine for RL_2. lupin protein content high amount of lysine and low amount of sulfur amino acids (methonine and cystein Abdelrahman, (2014).On other hand the biological value increased in RL_2 than R (94.93 and 68.62 %), respectively. Chemical score of RL_2 were highest value concerning, Isolucine , lysine, leucine and theronine mean while R were highest value for Valine, and methonine (Table 8). This may be due to the effect of lupins flour addition. Higher lysine content was associated with increasing in biological value (Kohajdova *et al.*2011).

CONCLUSION

This study demonstrated the possibility of incorporating lupin flour into cookies processing up to 40%. This product could be used by celiac patient due to it contain high amount of fiber and provides fewer calories and good source of protein, amino acids, Zn, Fe, Ca. Therefore, substitution of sweet lupin flour into cookies improved sensory characteristic, nutritional value and could be utilized from locally product lupin at small scale industry.

REFERENCES

1. AACC. 2000. *In Approved Methods of American Association of Cereal Chemists*, 10th Ed., American Association of Cereal Chemists, St. Paul, M.N.
2. Abdelrahman , R.A. 2014. Influence of chemical properties of wheat – lupine flour Blend on cake quality. American Journal of food science and technology. 2:2, 67-75.
3. Akeson, W.R. and, A. Stahmann. 1964. A Pepsin Pancreatin Digest Index of Protein Quality. *Journal of Nutrition*, 83, 257-261.

4. Abdel-Haleem, A.MH. and HH. Hafez. 2015. Production of gluten–free and casein free(GFCF) cupcakes for autistic children. J. of Food and nutritional disorders,4:3,1-9.
5. AOAC.2005. Official Methods of AOAC 18th Ed., 2005 current through revision I, Basic sensory methods for food Evaluation. IDRC, Ottawa Ontario, Canada.
6. Bhardwaj, H. L. and Hamama A. A. 2013. Cultivar and Growing Location Effects on Fatty Acids, Minerals, and Sugars in Green Seeds of White Lupin (*Lupinus albus* L.). *The Open Horticulture Journal. 6,* 1-8.
7. Bilgicli, N. and H. Levent. 2014. Utilization of lupin (Lupinus albusl.) flour and bran with xylanase enzyme in cookies production .Legume research , 37 (3):264-271.
8. Chinma ,C. E.; S. James; H. Imam ; O. B. Ocheme and J. C. Anuonye. 2011. Biscuit making potential of tigernut (Cyperus esculentus) and pigeon pea (Cajnus Cajan) flour blends . Nigerian J. Nutr.Sci. ,32:55-62.
9. Chinma,C.E.; B.D. Igbabul and O.O. Omotayo. 2012. Quality Characteristics of cookies prepared from unripe plantain and defatted sesame flour blends. American Journal of food Technology. 7:7, 398–408.
10. DRI. 2005. Dietary Reference Intakes for Energy, Carbohydrate. Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids (Macronutrients). The National Academies Press, Washington DC. www.nap.edu.
11. Eggam, B.O.; E. M. Villegas and S. K. Vasal. 1979. Progress in protein quality of maize . J. Sci., Food Agric., 30:1148-1153.
12. Emara, M. A. H. 2015. Utilization of extrusion technique to produce high nutrition snacks based on cereals and legumes .M.SC. Thesis , Damanhour University, Faculty of Agric. 113pp.
13. FAO/ WHO. 2007. Energy and protein requirement. In Geneva, nutrition report series No.935,
14. Guemes-Vera, N.; J. Martinez-Herrera; J. Hernandez-Chavez; J. Yanez-Fernandez and A. Totosaus. 2012. Comparison of Chemical Composition and Protein Digestibility, Carotenoids, Tanins and Alkaloids Content of Wild Lupinus Varieties Flour. Pakistan Journal of Nutrition 11 (8): 774-780, ISSN 1680-5194.
15. Hassan, A. B.; G. A. Osman and E. E. Babiker. 2005. Effect of domestic processing on anti nutrients and availability of proteins and minerals of lupin (*Lupinus termis*) seeds. J. Food Technol., 3(2): 255- 262.
16. James, C. S. 1995. General Food Studies. In: *Analytical Chemistry of Foods*, Blachie Academic and Professional, London, New York, Tokyo, Chapter 6, 135.

17. Jayasena, V. and S. M. Nasar-Abbas. 2011. Effect of lupin flour incorporation on the physical characteristics of dough and biscuits. Quality Assurance and Safety of Crops and Foods 3:140–147
18. Kohajdova, Z.; J. Karovičova and Štefan Schmidt. 2011. Lupin Composition and Possible Use in Bakery– A Review. Czech J. Food Sci. Vol. 29, No. 3: 203–211
19. Korus, J.; K. Grzelak; K. Achremowicz and R. Sabat. 2006. Influence of prebiotic additions on the quality of gluten-free bread and on the content of inulin and fructooligosaccharides, Food Sci. Technol. Int. 12:489-495.
20. Maghaydah, S.; S. Abdul-hussain ; R. Ajo ; Y. Tawalbeh and N. Elsahory. 2013. Effect of Lupin Flour on Baking Characteristics of Gluten Free Cookies. Advance Journal of Food Science and Technology. 5(5): 600-605.
21. Obeidat , B. A.; S. S. Abdul-Hussain and D. Z.. Al-Omari. 2012. Effect of addition of germinated lupine flour on the physiochemical and organoleptic properties of cookies. J. Food Proc. Preservation, DOI: 10.1111/j.1745-4549.2012.00688.x.
22. Ola, S. I ; Amera ,T. M. and Hayat, H. A, (2015). Quality Characteristics of Rice Biscuits Sweetened with Carob Powder. Middle East J. Appl. Sci., 5(4): 1082-1090, ISSN 2077-4613
23. Ramadan, E. A. 2012. Effect of Processing and Cooking Methods on the Chemical Composition, Sugars and Phytic acid of Soybeans Food and Public Health. 2(1):11-15
24. Sobotka,W.; S. Maria; B. Jacek and M. Paulius. 2013. The effect of oligosaccharides and alkaloids contained in yellow and blue lupine seeds on feed intake,body weight and fermentation processes in the cecum of rats. Vet. Med. Zoot. T. 63 (85). ISSN 1392-2130 .
25. USDA. 2011. United States Department of Agriculture. National Nutrient Database for standard reference release 24.http://www.ars.usda.gov/services/ doc.htm.docid=8964.
26. Waller, W. M. and D. B. Duncan. 1969. A bayes rule for symmetric multiple composition problem. Am. State. Assoc. J. 64:1487-1503.
27. Yorgancilar, M. and N. Bilgicli. 2014. Chemical and nutritional changes in bitter and sweet lupine seeds (*lupinus alpus L.*) during bulgur production . J. Food Sci. Technol. 51(7): 1384-1389.
28. Zielinski, AA. F. ; CM.Braga ; IM . Demiate ; FL. Beltrame; A. Nogueira and G. Wosiacki. 2014. Development and optimization of a HLPC-RI method for the determination of major sugars in apple juice and evaluation of the effect of the ripening stage. Food sci. technol. Campinas, 34(1): 38-43.

انتاج كوكيز مرتفع القيمة الغذائية من دقيق كسرالارز المدعم بدقيق الترمس الحلو

أميرة طه محمد محمد

معهد بحوث تكنولوجيا الاغذية – مركز البحوث الزراعية – جيزة

تهدف الدراسة لانتاج كوكيزمرتفع القيمة الغذائية خالى من الجلوتين وذلك باستبدال دقيق كسر الارز بنسب٢٠٪ ، ٤٠٪ ، ٦٠٪ و ٨٠٪ من دقيق الترمس وتم اجراء التقييم الحسي والخصائص الفيزيائية والكيميائية للكوكيز واوضحت النتائج ان تدعيم الكوكيز بنسبة ٤٠٪ من دقيق الترمس الحلو سجلت اعلى النتائج من حيث الطعم و القبول العام والخصائص الفيزيائية حيث اوضحت النتائج زيادة فى السمك مع انخفاض القطر كما حدث ارتفاع فى محتوى البروتين والحديد والزنك والكالسيوم ومعامل هضم البروتين والاحماض الامينية الاساسية الكلية والقيمة الحيوية بينما حدث انخفاض فى محتوى الكربوهيدرات الكلية بالمقارنة مع العينة الضابطة . وبالتالى يمكن التوصية باستخدام دقيق الترمس الحلو لتحسين القيمة الغذائية فى منتجات المخابز .