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BIOLOGICAL EVALUATION OF BALADY BREAD PRODUCED FROM WHEAT FLOUR AND SWEET LUPINUS (TERMIS) TREATED WITH GAMMA RADIATION

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ABSTRACT: *This study was carried out to produce high protein balady bread. In this study, the sweet lupines (terms) are used as a new source of protein. Sweet lupines were irradiated in two doses (5 and 10 kGy) for preservation. Balady bread was made with supplementation of 5, 10% non-irradiated and irradiated lupines. All samples of balady bread were examined for chemical composition and biological evaluation. Beside determining PER (protein efficiency ratio), FE (feed efficiency), cholesterol, triglycerides and lipids. The obtained results showed that 5% of irradiated with (5 kGy) had high value for (PER) than control, while total cholesterol; triglycerides and total lipids were reduced than control values.*

Key words: *kGy : Kilo Gray, Sweet lupines (Termis), Irradiated : (5, 10 kGy) PER, IE, Cholesterol, Triglycerides and Lipids.*

INTRODUCTION

Lupine (Lupinus albus L.) could be used as a source of protein or fiber and for supplementation in existing or new products. Lupine can also be used in breadmaking, biscuits, pasta products and a variety of other food products (Hill, 1986 and Mohamed and Rayas, 1995). Also, Lampart Szczapa et al. (1997) reported that, lupine seed flour may be used as an ingredient for bread, cakes, noodles products for manufacturing of protein products and for incorporation in dietetic foods.

New markets in Australia for lupines being considered for human foods as well as animal feed (Hough and Jacobs, 1994). Sobihah (1998) reported that, the total protein, ash, fat, total carbohydrates and crude fiber of lupine seed flours were 42.42, 3.99, 11.14, 38.0 and 4.45%, respectively.

Hegazy and Faheid (1991) found that, the biological value of some types of flour can be raised by partial addition of lupines. Also, they concluded that 5% lupine seed flour could be replaced by wheat flour up to 15% in cookies formula without affecting baking performance or organoleptic properties.

Gamma irradiation had long been known as a method of food preservation. Radiation treatment at moderate doses has been recommended for disinfections of food (Aurangzeb et al., 1988).

The aim of this study is to produce balady bread containing sweet lupine as a source of protein in different levels. The present study investigates the chemical composition. Also, biological study on rats fed balady bread

containing 5, 10% irradiated and non-irradiated sweet lupines was carried out to inquires the effect of sweet lupine on PER, FE and blood serum cholesterol, triglycerides and lipids.

MATERIAL AND METHODS

Materials:

1. Sweet (Lupines albus L.) were obtained from field crop research Institute, agricultural Research Center, Giza, Egypt. Lupine seeds were crushed using household mill (Braun, Germany) and ground to pass through a 60-mesh sieve. The flour was kept in the refrigerator until used.
2. Wheat flour, 82% extraction, was obtained from Food Technology Research Institute, Giza, Egypt. The flour of lupines used to replace wheat flour at 5 and 10% levels, which treated with irradiation at (5 and 10 kGy) at Gamma-Cell-220 in King Abul Aziz City For Science and Technology (KACST).

Preparation of Balady Bread

Balady bread was prepared according to the method described by Afaf (1986). One hundred grams of wheat flour 82% or its blends were mixed with 0.5 gm dry yeast or 1 gm bakery yeast, 1 gm sodium chloride and 80-85 ml water at 30 ^{0}C and 85% relative humidity. After that the dough was divided into 140 gm piece. Each piece was arranged on wooden board previously sprinkled with a fine layer of bran and left to ferment for about 45 min. at the same temperature and relative humidity. The fermented dough pieces were flattened to about 20 cm diameter. The flattened dough were proofed at 30-35 ^{0}C and 85% relative humidity for 30 min., then baked at 450-500 ^{0}C for 1-2 min. Bread loaves were allowed to cool on racks for about 1 hr. Some of the loaves were allowed to cool for one hour and cut into pieces and air dried at about 50 ^{0}C in an electric oven. Then they were finely ground in a hammer mill.

Methods

Chemical analysis:

Protein, fat, moisture, ash and crude fiber were determined according to the method described in the A.O.A.C. (1995). Total carbohydrate was calculated by differences.

Biological assay

Biological examinations were carried out on balady bread that contains 5 and 10% lupines and also 5, 10% irradiated lupines treated of (5, 10 kGy) beside the control.

Male albino rats average weight ranged between 60-80 grams were divided into 8 groups (each group contain 5 rats) seven groups were feed for 6 weeks on the experimental diet and the last was feed on the basal diet.

Rats, which were used in this assay were obtained and housed in the animal house of the Research Institute of ophthalmology, Giza, Egypt.

Test diets:

Composition of various test diets are shown in Table (1). Seven diets were formed to be equal in the test samples, protein level at 15% by adding casein. Fat content 5% by adding corn oil, vitamins mixture, salt mixture and cellulose were added according to A.O.A.C. (1990). All diets complete to 100% with corn starch.

Table (1): Composition of test diets (g/100 g).

Ingredients	Free protein diet	Control diet %	Experimental diets						
			1	2	3	4	5	6	7
Casein	-	11.26	-	-	-	-	-	-	-
(1)	-		86.26	-	-	-	-	-	-
(2)	-		-	86.09	-	-	-	-	-
(3)	-		-	-	89.0	-	-	-	-
(4)	-		-	-	-	87.8	-	-	-
(5)	-		-	-	-	-	89.46	-	-
(6)	-		-	-	-	-	-	8.70	-
(7)	-		-	-	-	-	-	-	89.19
Corn oil	5	5	3.85	3.35	2.60	3.2	2.35	2.74	2.03
Vitamine mix	1	1	1	1	1	1	1	1	1
Salt mix	4	4	4	4	4	4	4	4	4
Cellulose	1	1	1	1	1	1	1	1	1
Corn starch	89	77.7	3.89	4.56	1.60	3.00	2.19	4.26	2.78
Total	100	100	100	100	100	100	100	100	100

All diets contained 15% total protein and 5% total lipids Casein containing 88.8% protein

(1) Balady bread produced from flour 82% extraction
(2) Balady bread produced from 95% flour 82% extraction + 5% sweet lupines
(3) Balady bread produced from 90% flour 82% extraction + 10% sweet lupines.
(4) Balady bread produced from 95% flour 82% extraction + 5% irradiated sweet lupines (5 kGy).
(5) Balady bread produced from 95% flour 82% extraction +5% irradiated sweet lupines (10 kGy).
(6) Balady bread produced from 90% flour 82% extraction + 10% irradiated sweet lupines (5 kGy).
(7) Balady bread produced from 90% flour 82% extraction + 10% irradiated sweet lupines (10 kGy).

Animals:

This stage contained 8 groups of male weaning rats (each group was 5 rats). The control group was on casein diet and the negative control group feed on protein free diet. The rest of group was feed on the experimental diet for 10 days. Rats were housed individuality in plastic mash top stainless steel cages in controlled environment. Each rat was fed the same amount of diet, which was adequate and gradually increased during the test period. Rats were weighed at the beginning and at weekly intervals. At the end of experiment, rats were sacrificed with chloroform. The carcasses were dried in a oven at 105 ^{0}C for 48 hours, until reaching a constant weight. The dried

carcasses were ground and used for estimating total nitrogen using the micro-kgeldahl method.

Evaluation of Protein Efficiency Ratio (PER)

The protein efficiency ratio was determined according to the method described by Bender and Doehi (1975). PER was calculated from the grains of weight gain per grams of protein consumed by the growing rats.

PER = Gain in body weight (gm) / protein intake (gm)

Evaluation of Feed Efficiency (FE)

The feed efficiency was calculated from the data of each rat using the following equation

Feed Efficiency = Gain in body weight (gm)/ Feed intake (gm)

At the end of 6 weeks test period, all animals were fasted for 16 hours. Blood was drawn by cardiac puncture and centrifuged to obtain the serum, which was frozen at $-20^{0}C$ until analysis. Serum samples were analyzed for total cholesterol, total lipids and triglycerides.

Determination of total cholesterol, total lipids and triglycerides in serum

About male albino rats average weight ranged between 60-80 grams were divided into 8 groups, 7 groups were feed for 6 weeks on the experimental diet and the last was feed on the basal diet. At the beginning and the end of the experimental period samples were collected from the rats in tub and centrifuged to obtain the serum, which was kept frozen at $-20\ ^{0}C$. All serum samples were analyzed for total cholesterol, total lipids and triglycerides.

Determination of total cholesterol

Total cholesterol was determined according to the method of Allain et al. (1974) by kits obtained from Alkan Company, Cairo, Egypt.

Determination of total lipids

Total lipids in the serum were determined according to the method of Knight et al. (1972) by kits obtained from Alkan Company, Cairo, Egypt.

Determination of triglycerides

Triglycerides in serum were determined according to the method of Lowell et al. (1973) by kits obtained from Alkan Company, Cairo, Egypt.

RESULTS AND DISCUSSIONS

Chemical Composition

From the results presented in Table (2), it could be noticed that the protein content increased in the produced balady bread by increasing the levels of sweet lupines non-irradiated. Also, protein increased in bread contains sweet lupines irradiated (5 and 10%kGy) than the control and sweet lupines non-irradiated. This may be due to presence the higher content of essential amino acids Youssef (1999). In the same table, it is noticed that ether extract ash

and fiber increase by increasing the level of sweet lupines non-irradiated and irradiated, while the total carbohydrates were decreased.

Protein Efficiency Ratio (PER)

The results present in Table (3) indicate that the highest value of (PER) could be seen for the casein, which recorded (2.45). Control Balady bread had the lowest PER value (1.09). The highest value of (PER) was noticed for Balady bread produced from 10% sweet lupines un-irradiated (1.71). Also, (PER) for balady bread produced from 5% sweet lupines irradiated was high than control sample (1.34).

From the results of Table (3) the supplementation of wheat flour 82% with sweet lupines non-irradiated and irradiated were found to have high values of (PER) than those of the control sample. This may be due to sweet lupines had high content from essential amino acids. These results agreed with those reported by Youssef (1999) for lupines terms.

Feed Efficiency (FE):

From the results, presented in Table (4), it could be noticed that the (FE) of casein was (0.28). Mohamed (1998) found that (FE) value for casein was (0.27). The highest value of (FE) was observed for Balady bread produced from 10% sweet lupines irradiated with (5 kGy) 0.418. The lowest (FE) value was recorded for control Balady bread (0.256). Also, (FE) for balady bread produced from 5% sweet lupines irradiated with (5 kGy) was high than control Balady bread (0.347)

Serum Cholesterol

The results of total cholesterol reported in Table (5) diets contained different levels of non-irradiated and irradiated sweet lupines were low in cholesterol of rats than those of casein and control. Cholesterol level was low on diet contained 5% sweet lupines irradiated (5 kGy) followed by 10% sweet lupines irradiated (5 kGy). Also, these diets were high in fiber contents, which has likely hypocholesterolemic effect (Krichevesky, 1985; Rahottra et al., 1987 and Kahlon et al., 1990).

Serum Triglycerides

In addition to elevated cholesterol, serum triglycerides levels have also been implicated as metabolic contributors to atherosclerosis (Krichevesky, 1985). From the same Table (5) it can be noticed that triglycerides level were high in casein and control 82% (220.77, 212.01 mg/100 ml) respectively. While the least value 122.17 mg/100 ml of triglycerides was shown in rats fed on balady bread produced from 95% wheat flour 82% + 5% irradiated sweet lupines (5 kGy).

Serum Lipids:

Regarding the total lipids, Table (5) indicated that, the total lipids decrease in all diets compared with casein diet and control. While, the lower value (174.62 mg/100 ml) for rats fed on balady bread produced from 95% wheat flour 82% + 5% irradiated sweet lupines (5 kGy) followed by 5% sweet lupines irradiated (10 kGy), 174.62 and 190.23 mg/100 ml, respectively. This may be

due to when sweet lupines are added to the animal diet, it decreases the intestinal absorption of lipids.

It could be concluded that, the groups of animals, which fed on balady bread with 5% sweet lupines irradiated (5 kGy) caused a decrease in total cholesterol, triglyceride and total lipids in serum compared to other diets and control one (balady bread).

Also, usage of irradiation in 5 kGy dose could be recommended as a food preservation technology.

Table (2): Chemical composition of balady bread produced from wheat flour 82% extraction supplemented with sweet lupines non-irradiated and irradiated at different levels (on dry basis)

Balady bread	Moisture %	Protein %	Ether extract %	Ash %	Fiber %	Total Carbohydrates %
*Control	13.05	8.46	1.15	1.63	9.88	87.88
(1)	13.10	10.20	1.65	1.76	1.60	84.79
(2)	12.90	11.90	2.40	1.89	2.24	81.57
(3)	13.06	10.33	1.80	1.79	1.82	84.26
(4)	12.46	12.35	2.65	1.99	2.50	80.51
(5)	12.42	10.57	2.26	1.90	2.26	83.01
(6)	12.51	12.49	2.97	2.10	2.97	79.47

(1) Balady bread produced from sweet lupines non-irradiated 5% +95% wheat flour 82%
(2) Balady bread produced from sweet lupines non-irradiated 10% +90% wheat flour 82%
(3) Balady bread produced from sweet lupines irradiated (5 kGy) 5% + 95% wheat flour 82%
(4) Balady bread produced from sweet lupines irradiated (10 kGy) 5% + 95% wheat flour 82%
(5) Balady bread produced from sweet lupines irradiated (5 kGy) 10% + 90% wheat flour 82%
(6) Balady bread produced from sweet lupines irradiated (10 kGy) 10% + 90% wheat flour 82%
* Control: Balady bread produced from 100% wheat flour 82% extraction

Table (3): Protein Efficiency Ratio (PER) of Balady bread experimental diets

Experimental diets	Intial B.W.* (g)	Final B.W. (g)	Gain B.W. (g)	Daily B.W. increase (g)	Food intake (g)		PER**
					Food consumed	Protein consumed	
Casien	48.12	118.19	70.07	2.50	286.00	28.60	2.45
Control	55.75	85.85	30.10	1.07	293.05	27.42	1.09
(1)	55.25	108.47	53.22	1.90	268.00	32.26	1.64
(2)	58.25	109.55	51.30	1.83	283.80	29.85	1.71
(3)	59.25	100.52	41.27	1.47	293.35	30.86	1.34
(4)	56.25	106.22	49.97	1.78	294.45	34.68	1.44
(5)	56.50	87.32	30.82	1.10	296.90	30.73	1.00
(6)	53.75	99.12	45.37	1.62	288.52	43.27	1.04

* B.W. : body weight
** PER : Calculated in grams as : weight gain / protein
*** Control : Balady bread produced from 100% wheat flour 82% extraction
(1) Balady bread produced from sweet lupines non-irradiated 5% +95% wheat flour 82%
(2) Balady bread produced from sweet lupines non-irradiated 10% +90% wheat flour 82%
(3) Balady bread produced from sweet lupines irradiated (5 kGy) 5% + 95% wheat flour 82%
(4) Balady bread produced from sweet lupines irradiated (10 kGy) 5% + 95% wheat flour 82%
(5) Balady bread produced from sweet lupines irradiated (5 kGy) 10% + 90% wheat flour 82%
(6) Balady bread produced from sweet lupines irradiated (10 kGy) 10% + 90% wheat flour 82%

Table (4): The effect of Balady bread experimental diets on weight gain, feed intake and Feed Efficiency (FE) after 10 days.

Experimental diets	Initial weight (g)	Final weight (g)	Gain weight (g)	Feed (F) intake (g)	* FE (G/F)
Casein	43.60	72.56	29.52	105	0.280
**Control	52.77	62.50	9.73	37.99	0.256
(1)	47.55	66.15	18.6	63.25	0.294
(2)	48.22	72.02	23.80	77.35	0.307
(3)	51.52	78.60	27.08	77.97	0.347
(4)	51.77	72.02	20.25	72.35	0.279
(5)	44.95	69.97	35.02	83.65	0.418
(6)	45.82	64.85	19.03	65.38	0.291

* FE : Feed Efficiency

**Control: Balady bread produced from 100% wheat flour 82% extraction

(1) Balady bread produced from sweet lupines non-irradiated 5% +95% wheat flour 82%
(2) Balady bread produced from sweet lupines non-irradiated 10% +90% wheat flour 82%
(3) Balady bread produced from sweet lupines irradiated (5 kGy) 5% + 95% wheat flour 82%
(4) Balady bread produced from sweet lupines irradiated (10 kGy) 5% + 95% wheat flour 82%
(5) Balady bread produced from sweet lupines irradiated (5 kGy) 10% + 90% wheat flour 82%
(6) Balady bread produced from sweet lupines irradiated (10 kGy) 10% + 90% wheat flour 82%

Table (5): The effect of Balady bread experimental diets on total cholesterol, triglycerides and total lipids in rats blood serum

Experimental diets	Total cholesterol mg/100 ml		Triglycerides mg/100 ml		Total lipids mg/100 ml	
	Zero time	End of experimental	Zero time	End of experimental	Zero time	End of experimental
Casein	57.17	69.81	114.93	220.77	170.74	287.12
*Control	62.73	68.49	112.66	212.01	170.42	212.77
(1)	72.65	62.11	111.31	142.99	170.10	199.24
(2)	75.02	63.74	111.44	132.35	170.37	186.65
(3)	67.49	61.50	109.77	122.17	170.45	174.62
(4)	73.59	64.23	110.91	125.01	177.01	190.23
(5)	66.60	64.38	113.93	141.02	170.91	193.28
(6)	69.44	67.83	115.86	146.17	170.12	195.25

* Control : Balady bread produced from 100% wheat flour 82% extraction

(1) Balady bread produced from sweet lupines non-irradiated 5% +95% wheat flour 82%
(2) Balady bread produced from sweet lupines non-irradiated 10% +90% wheat flour 82%
(3) Balady bread produced from sweet lupines irradiated (5 kGy) 5% + 95% wheat flour 82%
(4) Balady bread produced from sweet lupines irradiated (10 kGy) 5% + 95% wheat flour 82%
(5) Balady bread produced from sweet lupines irradiated (5 kGy) 10% + 90% wheat flour 82%
(6) Balady bread produced from sweet lupines irradiated (10 kGy) 10% + 90% wheat flour 82%

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التقييم البيولوجي للخبز البلدي المضاف إليه الترمس الحلو المعامل بأشعة جاما

أشجا العدوى ناصف

المركز القومي لبحوث وتكنولوجيا الإشعاع – هيئة الطاقة الذرية – القاهرة

الملخص العربي

يهدف هذا البحث إلى إنتاج خبز بلدي عالي البروتين. في هذه الدراسة استخدم الترمس الحلو كمصدر جديد للبروتين. تم تشعيع الترمس الحلو بجرعتان من الإشعاع (٥ ، ١٠ كيلو جراى) وذلك للحفظ والخبز البلدي تم تدعيمه بـــ ٥، ١٠% من الترمس الحلو الغير مشعع والمشعع. جميع عينات الخبز البلدي تم تقدير التركيب الكيماوي لها وكذلك التقييم البيولوجي وتم تقدير معدل كفـــاءة البروتين (PER). وكفاءة الغذاء (FE) وكذلك تأثير التغذية بالخبز المختبر على نسبة الكولستيرول والجلسريدات الثلاثية والدهون الكلية في سيرم دم الفئران وأظهرت النتائج أن الخبز المدعم بالبروتين بـــ٥% والمشعع بـــ٥ كيلو جراى أعطى أعلى قيمة لمعدل كفاءة البروتين (PER) في العينة عن الكونترول وكذلك كفاءة الغذاء أعطت أعلى قيمة عن الكونترول وأظهرت النتائج أن الخبز المدعم أعطى أقل نسبة لكل من الكولستيرول والدهون الكلية والجلسريدات الثلاثية عن الكونترول.