



Biological Studies on Producing Samoli Bread Supplement with Irradiated Sunflower Flour by Gamma Rays

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Smoli bread was made by supplementation sunflower flour which was prepared from sunflower (Dahr-EL-Haea) gray after hilling and milling. The flour was irradiated by two doses (5 and 10 KGy). After that, the ratios of irradiated sunflower flour were 5 and 10%. All samples of Samoli bread were examined for organoleptic and biological evaluation. Biological assay (PER, NPU, FE, DC and BV.) was carried out on rats fed 5 and 10% irradiated and non-irradiated sunflower Samoli bread. Results obtained showed that total lipids, cholesterol and triglycerides were reduced compared to those of casein. Also, figures of the biological evaluations were higher than those of the control Samoli bread and improved its nutritive values.

Keywords: Gamma rays, Sunflower, Samoli bread, cholesterol, lipids, Triglycerides Irradiation, Edible coating paraffin oil or glycerol, Fungal mold, Anna apples, treatment, shelf- life, Marketability

Introduction

Sunflower is considered the second major source of vegetable oil in the world and it provides protein of food nutritional quality. More recently, sunflower became a stable crop in KSA. Sunflower contains 34.7% of total essential amino acids which is somewhat less than that of milk or egg protein 50.53%.

Some researchers [1-2] found that the lysine content of wheat flour was increased by adding sunflower protein isolates and that the digestibility of fortified short bread samples was also improved. Gharib et al. and Diaz et al. [3-4] reported that sunflower flour supplementation affected true digestibility TD. The ratio of TD ranged from 85 to 60.6% compared with 99% in casein. Supplementation of semi-fat sunflower flour (5%) and full fat sunflower flour (10%) scored the highest ratio of TD, i.e. 90.1 and 90.6 defatted sunflower flour supplementation 85.8.

Gamma radiation has long been known as a method of food preservation. Radiation treatment at moderate doses has been recommended for disinfection. Some investigators [5-7], studied the effects of different doses of gamma irradiation (0, 100, 150 and 200 KGy) on digestible energy and gross energy. The results, indicated that gamma irradiation caused a significant increase the digestible energy values ($P < 0.05$). Whereas, there was no significant effect of irradiation on the gross energy.

The objective of the present study is to investigate and evaluate the addition of irradiated sunflower flour to Samoli bread to improve the nutritive value through measuring some parameters such as protein efficiency ratio (PER), weight gain, feed intake, total cholesterol and total lipid.

Material And Methods

Raw material

Irradiated sunflower

Sunflower (Dahr El-Haea) was obtained from local market, seeds of sunflower were cleaned from impurities and foreign grains, and then the seeds were blended for half a minute in a blender, then dehulled by hand to obtain a kernel. The kernel was milled using a laboratory dis C mill, then sieved using 8xx sieve to obtain the sunflower flour. The sunflower flour was divided into 3 portions and treated with gamma radiation at 0.0, 5.0, and 10 KGy at Gamma cell220, (Cobalt-60) radiation source was KGy/h at the time radiation at king Abdul Aziz City for Science and Technology (KACST) Saudi Arabia.

Wheat flour 72% extraction

It was obtained from local market. The formula of Samoli bread was found in Table (1).

Table (1): Blends preparation: were as follows, in grams

Wheat flour (72% ext)	Irradiated with 5 KGy	10 KGy	Unirradiated
100	-	-	-
95	5	5	5
90	10	10	10

Methods

A-Samoli bread

The straight dough method for Samoli bread production was carried out according to the method of Kent et al.[8],At Nutrition and Food Sciences Department, Princess Nourah Bint Abdulrahman University, Riyadh, Saudi Arabia.

B-Organolepticevaluation

Sunflower Samoli bread samples were tested by 10 panelists of appearance, volume, color of crust, color of crumb texture, softness, flavor and taste according to EL-Gepaly et al.[9].

C-Biological assay

Biological examinations were carried out on seven samples of pan bread that contain 5and 10% sunflower flour unirradiated, 5 and 10% sunflower flour irradiated with (5 and 10 KGy) beside the control.

Rats which used in this assay were obtained and housed in the animal house of College of Science, King Saud University in Riyadh, Saudi Arabia.

Table (2): Composition of test diets (g/100g)

Diets	Free protein	Control diet	Experimental diets						
			1	2	3	4	5	6	7
Casein	-	11.26	-	-	-	-	-	-	-
1			86.79						
2				90.2					
3					88.67				
4						91.58			
5							84.88		
6								91.37	
7									85.67
Corn oil	5	5	2.6	2.8	2.1	1.9	2.3	2.2	2.0
Salt mix	4	4	4	4	4	4	4	4	4
Vitamin mix	1	1	1	1	1	1	1	1	1
Cellulose	1	1	1	1	1	1	1	1	1
Starch	89.00	77.74	04.61	1.00	3.23	0.52	6.62	0.43	6.53
	100	100	100	100	100	100	100	100	100

- 1- Samoli bread produced from 100% wheat flour 72% (control).
- 2- Samoli bread produced from 95% wheat flour +5% sunflower flour
- 3- Samoli bread produced from 90% wheat flour +10% sunflower flour
- 4- Samoli bread produced from 95% wheat flour +5% irradiated sunflower flour (5 KGy)
- 5- Samoli bread produced from 90% wheat flour +10% irradiated sunflower flour (5 KGy)
- 6- Samoli bread produced from 95% wheat flour +5% irradiated sunflower flour (10 KGy)
- 7- Samoli bread produced from 90% wheat flour 10% irradiated sunflower flour (10 KGy)

D- Test diets

Compositions of various test diets are shown in Table (2). Seven diets were formed to be equal in the test samples, protein level at 10% by adding casein fat content to 5% by adding corn oil, vitamins mixture, minerals mixture and cellulose were added according to A.O.A.C. [10]. Corn starch were added to total 100%.

Test animals

A total of 102 weanling male rats of 23 days old were used in the experiment. The rats were obtained and housed in animal house of the College of Science, King Saud University, Riyadh, Saudi Arabia. They were housed individually in wire cages under standard conditions for one week before the beginning of the experiments. Animals were allowed to tap water and were fed on uniformly basal diet.

The rats were divided into 2 stages

1- The first stage = evaluation of protein efficiency ratio

This stage contained 8 groups to evaluate the protein efficiency ratio. It was determined according to the method described by Bender et al. [11]. Rats were divided randomly into 8 groups 6 rats each. One group was fed casein as a control and the other groups were fed by tested diets of Samoli bread present in Table (2) for 4 weeks. The experimental diets were designed according to the method of A.O.A.C [10]. Diets were weighed daily and in weighing out the daily food intake care was taken. The food given should not exceed greatly the average food consumption, thus avoiding large spillage. Food residue remaining uneaten was carefully dried and the weights of the residual food were subtracted from the weight of daily given food to the rats. By this means, food intake was obtained. Also, rats were weighed weekly to calculate weight gain (gm).

Determination of the protein efficiency ratio (PER)

PER was calculated from the grams of weight gain per grams of protein consumed by the growing rats.

$PER = \text{Gain in body weight (gm)} \div \text{protein intake (gm)}$

2- The Second stage = evaluation of net protein parameters such as (NPU) feed efficiency (FE), Digestibility coefficient DC, and Biological value (BV) were utilized.

This stage contained 9 groups of 6 rats each. The control group was fed on casein diet and the negative control group was fed on protein free diet. The rest groups were fed on the experimental diets for 10 days. The diets and tap water were supplied a *ad libitum*. The animals were weighed, scattered diets and faces were collected and their body weights as well as their feed consumption were recorded daily. At the end of the experiment, rats were scarified using chloroform. The carcasses were dried in an oven at 105°C for 48hr until reaching a constant weight. The dried carcasses were ground and used for estimation of total nitrogen using the marco-kjeldahl method. From the total feed consumption during the assay period, the protein eaten by each rat was calculated according to the methods of A.O.A.C [10].

Feed efficiency (FE)

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

$\text{Feed efficiency} = \text{Gain in body weight (gm)} \div \text{Feed intake (gm)}$

Net protein utilization (NPU)

The NPU was determined according to the method described using the following equation:

$NPU = [(B_n - B_i) \div N] \times 100$

B_n = Body nitrogen of the group fed the tested protein (gm)

B_f = Body nitrogen of the group fed free protein (gm)

N = Nitrogen intake (gm)

Digestibility coefficient (DC)

The determination of digestibility of each tested diet was as follows: protein tested the faces were collected daily, dried weighed and ground. Their nitrogen content was determined on a

representative sample kjeldahl method. The digestibility coefficient was determined according to method described in the report by FAO/WHO [12], and was calculated as follows:

$$DC = [1 - (F - FK \times 100)] \div 1$$

1 = The nitrogen intake during the experimental period

F = The Fecal nitrogen value of the animal fed on the protein diet

FK = The fecal nitrogen value of the animal fed on the protein free diet

Biological value (BV)

Biological value of proteins means the retained nitrogen in body tissues from the observed nitrogen of protein intake. The biological value was estimated indirectly, using the relationship between NPU, DC and BV [13], and was calculated according to the following equation:

$$BV = (NPU \div DC) \times 100$$

Determination of cholesterol, total lipids and triglycerides in serum

About 48 male albino rats were divided into 8 groups. Seven groups were fed for 6 weeks on the experimental diets and the eighth group was fed on

the basal diet. At the beginning and at the end of the experimental period, blood samples were collected from the rats.

Determination of total cholesterol

Total cholesterol was determined, according to the method of Allain et al.[14].

Determination of total lipids

Total lipids in the serum were determined according to the method of Knight et al.[15].

Determination of triglycerides

Triglycerides in serum was determined according to the method of Lowell et al. [16].

Result And Discussion

Results of acceptability recorded in Table (3) indicated that the addition of untreated and treated sunflower flour had acceptable effect on the quality of Samoli bread and such addition produced a good Samoli bread, very similar to those of 100% wheat flour.

Table (3): Effect of untreated and treated sunflower flour on the organoleptic test of Samoli bread

Samoli bread samples	Appearance (20)	Volume (10)	Crust color (5)	Crumb color (5)	Crumb texture (10)	Softness (10)	Flavor (10)	Taste (30)	Overall acceptability
1	20	10	5	5	10	10	10	30	100
2	19	9	4	5	10	10	10	29	96
3	18	8	4	5	9	9	9	27	89
4	17	8	4	4	9	9	9	27	87
5	16	8	4	4	8	8	8	26	80
6	17	8	4	4	8	8	9	26	82
7	15	8	4	4	8	8	8	25	78

- Samoli bread from 100 wheat flour 72% extraction
- Samoli bread from 5% untreated sunflower flour +95% wheat flour 72%
- Samoli bread from 10% untreated sunflower flour +90% wheat flour 72%
- Samoli bread from 5% treated sunflower flour with 5 KGy +95% wheat flour 72%
- Samoli bread from 10% treated sunflower flour with 5 KGy +90% wheat flour 72%
- Samoli bread from 5% treated sunflower flour with 10 KGy +95% wheat flour 72%
- Samoli bread from 10% treated sunflower flour with 10 KGy +90% wheat flour 72%

Biological evaluation of tested Samoli bread

It is well known that the protein quality depends mainly on its essential amino acids pattern. Moreover, this quality depends also on its digestibility amino acids bio-availability and conditions under which it could be eaten to cover the Basel requirements [12-17-1].

Growing Albino rats were fed on various diets contained 10% protein. The diets were casein, Samoli bread produced from 100% wheat flour 72%, Samoli bread supplemented with 5%, 10% non-irradiated sunflower flour and 5%, 10% irradiated sunflower flour (5 KGy) and 5%, irradiated sunflower flour (10 KGy) for 10 days. Also, several biological parameters as Feed Efficiency (FE) and Net Protein Utilization (NPU) were determined to evaluate the nutritional quality of protein.

Feed efficiency (FE) of Samoli bread experimental diets

Growing Albino rats were fed on various diets i.e. casing Samoli bread containing 5%, 10% non-

irradiated sunflower flour, 5%, 10% irradiated sunflower flour at a dose of 10 KGy for 10 days. The body weight gain and feed intake were measured. The (FE) was calculated and the data are listed in Table (4).

From the results presented in Table (4), it could be noticed that the (FE) of casein was 0.21. Other investigators [18-1] found that the (FE) of casein was about 0.22, these results are also shown Table (4) which indicated that the highest value of (FE) was observed for Samoli bread produced from 90% wheat flour 72%+10% sunflower flour irradiated at a dose of 5 KGy (0.33) followed by 90% wheat flour 72%+10% irradiated sunflower flour at a dose of 10 KGy (0.32), while (FE) of Samoli bread produced from 95% wheat flour +5% sunflower flour irradiated at 5 and 10 KGy were of the same value (0.31). This may be due to the fact that sunflower contained most of the essential amino acids [19-20-21].

Table (4): The Effect of Samoli bread experimental diets on weight gain, feed intake and feed efficiency after 10 days

Experimental	Initial weight (g)	Final weight (g)	Gain in weight (g)	Feed intake (g)	Feed Efficiency CIF
1	52.78	62.5	9.73	37.99	0.25
2	45.83	64.85	19.03	65.38	0.29
3	47.55	66.15	18.6	63.25	0.29
4	43.23	72.03	23.83	77.35	0.31
5	51.53	78.60	27.08	80.48	0.33
6	51.78	71.78	22.28	72.36	0.31
7	44.85	69.98	25.13	78.66	0.32
8	49.25	56.05	26.8	82.91	0.21

- (1): Control (wheat flour 72%)
 (2): 5% untreated sunflower flour
 (3): 10% untreated sunflower flour
 (4): 5% treated sunflower flour with 5 KGy
 (5): 10% treated sunflower flour with 5 KGy
 (6): 5% treated sunflower flour with 10 KGy
 (7): 10% treated sunflower flour with 10 KGy
 (8): Casein

Net protein utilization (NPU) of the Samoli bread experimental diets

The (NPU) of rats fed on different diets containing 10% protein were shown in Table (5). The data indicated that the (NPU) of casein diet was 85.12%. Some authors [21-22-1] found that the (NPU) of casein was 18%. From the result in Table

(5), it could be noticed that the highest value of (NPU) (83.12%) was for Samoli bread supplemented with 10% sunflower flour non-irradiated followed by 5% non-irradiated sunflower flour (79.96%). While 5% irradiated sunflower flour at 5 and 10 KGy were equal in (NPU) (78.89%).

Table (5): Net protein utilization (NPU) of rats fed on Samoli bread of experimental diets 10 days

Experimental Diets	Body Nitrogen of rat (g)	Nitrogen intake (g)	Net protein (NPU)
1	2.22	4.68	71.14
2	2.84	4.29	79.96
3	3.89	4.54	83.12
4	2.67	4.71	74.54
5	3.31	4.71	78.89
6	2.46	4.75	74.11
7	2.86	4.62	78.73
8	2.12	3.27	85.12

(1): Samoli bread produced from 100% wheat flour 72%

(2): Samoli bread produced from 95% wheat flour +5% unirradiated sunflower flour

(3): Samoli bread produced from 90% wheat flour +10% unirradiated sunflower flour

(4): Samoli bread produced from 95% wheat flour +5% irradiated sunflower flour with 5KGy

(5): Samoli bread produced from 90% wheat flour +10% irradiated sunflower flour with 5KGy

(6): Samoli bread produced from 95% wheat flour +5% irradiated sunflower flour with 10 KGy

(7): Samoli bread produced from 90% wheat flour +10% irradiated sunflower flour with 10 KGy

(8): Casein

Protein efficiency ratio (PER) of different Samoli bread experimental diets

Table (6): Protein efficiency ratio of Samoli bread experimental diets

Experimental diets	Initial B.W	Final B.W	Gain B.W	Daily B.W* increase	Food intake		PER**
					Total food consumed	Consumed protein	
1	55.75	85.85	30.1	1.08	293.05	29.31	1.03
2	55.70	108.48	53.73	1.90	268.23	29.82	1.77
3	58.25	109.55	51.30	1.83	283.80	28.38	1.81
4	29.25	100.52	41.28	1.47	293.35	29.34	1.41
5	56.25	106.23	49.98	1.78	294.45	29.45	1.70
6	56.50	87.33	30.83	1.10	296.98	29.70	1.04
7	53.75	99.13	45.38	1.62	288.53	28.85	1.57
8	45.00	99.43	45.43	0.55	204.68	20.47	2.23

B.W.* : Body weight

PER** : Calculated in grams as: weight gain / protein consumed

Protein efficiency ratio (PER) explains the relationship between the rate of growth and the protein intake after 4 weeks. The results presented in Table (6) indicated that the highest value of (PER) could be seen in the experimental diet no.8 which recorded a value of 2.23. Control bread had the lowest (PER) value (1.03). While Samoli bread supplemented with 5, 10% and non-irradiated sunflower flour was found to have a high value of (PER) compared to that of the control sample (1.77 and 1.81) respectively. In addition, the (PER) of Samoli bread with 5 and 10% irradiated sunflower flour at 5 and 10 KGy were (1.41, 1.70, 1.04 and 1.57) respectively. These results were higher than the control Samoli bread.

From the above-mentioned results of the biological evaluation for the different diets of Samoli bread supplemented with 5 and 10% non-irradiated sunflower flour and 5 and 10% irradiated sunflower flour at 5 and 10 KGy had high NPU, FE and PER compared to the control Samoli bread. These results agree with those found by other researchers [23-24-25].

Effect of Samoli bread of experimental diets on total cholesterol, triglycerides and total lipids in rats blood serum

The effect of feeding rats with Samoli bread made from 100% wheat flour 72% ext., 95% wheat flour 72% +5% non-irradiated sunflower flour, 90% wheat flour 72% +10% non-irradiated sunflower flour, 5% and 10% irradiated sunflower flour at 10 KGy for 6 weeks on total cholesterol triglycerides and total lipids are reported in Table (7).

The total cholesterol for all rats decreased at the end of the experiment (6 weeks), the lowest level of total cholesterol (77.36 mg/100ml) was shown for rats fed on Samoli bread which was produced from 95% wheat flour 72% +5% irradiated sunflower flour at 5 kGy, followed by 95% wheat flour 72% +5% irradiated sunflower flour at 10 KGy. This decrease in the cholesterol level may be due to the decrease of the intestinal absorption in rats. Also, the undigested materials of sunflower flour may interfere with the enter hepatic circulation bile acids and enhance the elimination of steroids into feces which may result in the lower level of serum cholesterol.

As for the triglycerides level, Table (7) indicated that the increase at the end of the experiment (6 weeks) was great, the highest level of triglycerides was shown in rats fed on Samoli bread diet which contains 95% wheat flour +5% sunflower flour at 5 KGy (242.76 and 233.71 mg/ml).

Table (7): The Effect of Samoli bread experimental diets on total cholesterol, triglycerides and total lipids in rats blood serum

Experimental Diets	T.G mg/100 ml		T. cholesterol mg/dL		T. Lipid mg/dL	
	Zero time	End of experiment	Zero time	End of experiment	Zero time	End of experiment
1	70.25	165.83	62.74	68.40	643	694
2	63.97	242.76	72.64	74.11	611	824
3	61.99	194.18	150.00	125.00	663	865
4	104.40	233.71	106.132	55.19	615	647
5	112.67	202.02	109.43	110.38	816	950
6	90.27	176.92	94.81	77.36	626	646
7	70.06	192.53	75.94	88.68	701	727
8	161.60	224.21	111.32	91.04	606	770

- (1): Control (wheat flour 72%)
 (2): 5% non-irradiated sunflower flour
 (3): 10% non-irradiated sunflower flour
 (4): 5% irradiated sunflower flour with 5KGy
 (5): 10% irradiated sunflower flour with 5KGy
 (6): 5% irradiated sunflower flour with 10KGy
 (7): 10% irradiated sunflower flour with 10KGy
 (8): Casein

As regards the total lipids, it could be noticed that the increase was low compared to the casein diet. The lower values (646 and 647 mg/100ml) of total lipids were shown for rats fed on Samoli bread contains 95% wheat flour +5% irradiated sunflower flour at 5 KGy and 95% wheat flour +5% irradiated sunflower flour at 10 KGy respectively. These results agree with those found in earlier studies [1-26-4].

It could be concluded that the groups which were fed on Samoli bread with 95% wheat flour +5% irradiated sunflower flour at 10 KGy, caused a decrease in total cholesterol. These results agree with those mentioned previous studies [1-20-26-4].

Finally, it can be concluded that using 5% irradiated sunflower flour at 5 KGy or 10 KGy caused an improving effect on the quality of Samoli bread and improved its nutritive value.

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