Zagazig J.Agric. Res., Vol. 32 No. (1) 2005 233 - 246

NUTRITIONAL AND BIOCHEMICAL CHANGES IN IRRADIATED LENTIL AND COW PEA

AboEl- Ella, W. M. *; M. Diaa El- Din H. Farag ** ; Madeha, A . Al- Shiwi* ; Hannia, F. G . El-Niely and El-Sayed, M . Bayoumi ***

*** Food Sci. Dept., Fac. of Agric., Zagazeg Univ.**

**** Food Irradiation Department , Radiation Processing Division, National Center for Radiation Research and Tochnology, Atomic Energy Authority, Nasr City, P.o. Box 29, Cairo, Egypt 11371**

Accepted 6 / 12 / 2004

ABSTRACT : Lentil *(lens esculenta)* and cow pea *(Vigna unguiculata)* were irradiated at doses 5 ,10,15 and 20 kGy . The effect of radiation processing was investigated on the chemical composition , soluble protein , phytate content , protein efficient ratio (PER) and short-term rats feeding.

The chemical composition of raw lentil and cow pea did not affect by radiation processing up to 20 kGy . Both of soluble protein and phytate content of irradiated samples reduced significantly (P< 0.05) compared with raw (control) . The (PER) of irradiated samples increased significantly (P< 0.05) at the dose of 20 kGy . Feeding raw and processed samples up to 20 kGy caused a significant increase in body weight gain, and increasing in relative liver weight at raw and processed samples at dose 5 kGy. However, there were no significant changes in relative kidney, spleen, heart, lungs and tests weight of raw and processed samples . Hematological results , indicated that no significant effects could be revealed due to the consumption of irradiated samples .

The results suggested that the radiation processing of lentil and cow pea at dose 20 kGy was successful to reduce the effect antinutritional factors and upgrade the nutritional value.

INTRODUTION

Legumes are a major of dietary protein particularly in countries that have inadequate animal protein (Carpenter, 1970 and El-Niely, 2001). It is used successfully in child feeding programs and food formulations. However, in some foodstuffs the utilization of available protein and carbohydrates are much less than that calculated from the chemical composition because of presence of various antinutritional or anti physiological substances such as trypsin inhibitors, phytates etc (Makkar, *et al.*, 1998 and Siddhuragu, *et al.*, 2000). Lentil and cow pea are the important legumes which contain 25.82% and 26.68% of protein, respectively The treatment of foods with ionizing radiation used to extend the shelf-live, destroy organisms or preventing sprouting, killing insects through the storage period and reduced the incidence of food-borne diseases (Farkas, 1998 and Molins, 2001)

The objective of this work is to study the effect of gamma irradiation on lentil *(Lens esculenta)* and cow pea *(Vigna unguiculata)* on chemical composition and nutritive value.

MATERIAL AND METHODS

Material

Lentil *(Lens esculenta)* and cow pea *(Vigna unguiculata)* samples were obtained from the Agricultural Research Center, Ministry of Agriculture, Giza, Egypt. Samples were free from stones,... etc and were packed in well-sealed polyethylene bags (0.25 mm thickness).

Methods

Radiation Treatment:

Lentil and cow pea seeds were subjected at ambient temperature to gamma irradiation from Co-60 source at National Center for Radiation and Technology at Nasr City, Cairo, Egypt using an Indian gamma Chamber 400A. The applied radiation doses were 5, 10 ,15 and 20 kGy delivered at dose rate of 5.212 kGy h^{-1} as calibrated according to Melaughiin *et al.*, (1985) at the time of experimentation.

In vitro studies

Samples were analyzed for moisture content, ash content, crude fat, crude fiber content and crude protein according to the method described in the A.O.A.C.

(1995). Phytic acid was determined according to Lopez *et al.*, (1983)

In vivo studies :

Protein efficient ratio (PER) bioassay:

Male albino rats with an initial weight of about of 58 g, were housed individually in plastic bags with wire mesh bottoms at room of 25 °C. They were given g/kg casein protein control diet (Table 1) and water *ad libitum* for one week. Groups of 5 rats were then assigned to receive one of the 11 experimental diets.

The diets were prepared with raw and irradiated lintil and cow pea as outlined in Table (1). Food intake and body weight changes were measured regularly over The next 42 days. The amount of spilled food was measured and taken into account in the calculation of food intake of rate.

Calculation

A weekly record of food consumption and body weight is maintained. After 6 weeks the PER of lentil and cow pea was calculated:

$$PER = \frac{[\text{weight gain (g)}]}{\text{protein consumed (g)}}$$

The PER values obtained were corrected by a factor 2.5 times value for the casein standard (Chapman *et al.*, 1959 and A.O.A.C., 1984).

The blood samples were then centrifuged at 5000 rpm for 15 min after which blood plasma could be separated and collected using pasteur pipettes and frozen pending analysis were undertaken of total protein (King and Wootten, 1954) and albumin (Doumas *et al.*, 1971). Hemoglobin (Hb) estimation was carried out according to Van Kampen and Zijlstra, (1961). Packed Cell Volume (PCV) was measured using micro haematocrit centrifuge (Williams *et al.*, 1972). Hematological indices were computed using special calculation (Dacie and Lewis, 1975).

Statistical analysis

The data were subjected to analysis of variance (ANOVA), according the general linear models (GLM) procedure of the Statistical Analysis System Institute, Inc. (SAS, 1987).

Table (1): Composition of the experimental diets (g kg^{-1} diet).

Ingredients	Diet (g kg^{-1})		
	Casein	Lentil	Cow pea
Lentil [a]	-	377.3	-
Cow pea [a]	-	-	365.3
Casein	115.0	-	-
Corn Oil	80.0	74.7	74.2
Cellulose	10.0	3.6	5.3
Sucrose	125.0	120.2	123.7
Corn starch	560.0	360.0	371.0
Water	50.0	14.1	17.1
Vitamin mix[b].	10.0	10.0	10.0
Mineral mix[c].	50.0	39.4	33.2
Total	1000.0	1000.0	1000.0

[a] Raw, irradiation legumes at 5 , 10 , 15 , and 20 KGy were inceroprated at the same level.

[b] The mixture provides the following (mg/kg) : Vit. A, 20000 IU; Menadione, 5.0; Choline, 2000; D-Aminobenzoic acid, 100; Inositol, 100; Niacin, 40; Ca D-pantothenate, 40; Riboflavin, 8.0 Thiamine. HCL, 5.0; Pyridoxine-HCL, 5.0; Folic acid, 2.0; Biotin, 0.4; Vit. B_{12}, 0.03; Glucose, to make 1000 g.

[c] The mixture provides the following: 193.3g NaCl; 0.79g KI; 389.0g kH_2PO_4; 57.3g $MgSO_4$ anhyd.;381.4g $CaCO_3$; 27.0g $FaSO_4$. $7H_2O$, 4.01g $MnSO_4.H_2O$; .548g Zn SO_4.7H2O; 0.477g Cu SO_4.5 H_2O; and 0.023g$CoCl_2$.6 H_2O.

RESULTS AND DISCUSSION

Effect of radiation processing on the chemical composition of raw and irradiated lentil and cow pea :

The results presented in Table(2) and Table(3) showed that the chemical composition of lentil (*Lens esculenta*) and cow pea (*Vigna unguiclata*) have no significant changes by radiation processing at dose levels 5 , 10 ,15 and 20 kGy except some changes in some components that due to the experimental mistake during analysis processing. El-Niely, (2001) reported that the chemical composition of peanut kernels didn't affect by radiation processing at dose levels 5, 7.5 and 10 kGy. This results due to lentil and cow pea contain limited amount of water 4.88% and 8.62% respectively, which could not be easily influenced to be radiolyzed by irradiation to producing enough free radicals that could induced significant changes in chemical

composition of these samples. In addition, crude protein and fat are in a complex matrix of foodstuffs which take them more resistant to radiation processing than those in pure state (Diehl and Scherz,1975 and EL-Niely, 2001) .

Effect of radiation processing on protein solubility of lentil and cow pea:

The results presented in Table (4) reported that the protein solubility of lentil and cow pea decreased significantly by radiation processing at dose levels 5, 10, 15 and 20 kGy. The protein solubility of lentil was reduced by 6.25%, 6.40%, 6.25% and 6.01% respectively. While the protein solubility of cow pea was reduced by 6.67%, 6.32%, 6.54 and 6.65%, respectively compared with raw samples. These results may be due to the fact that the irradiation of globular protein aggregates which decrease solubility of lentil and cow pea proteins (EL-Niely, 1996).

Effect of radiation processing on phytate content of lentil and cow pea:

The results presented in Table (5) showed that phytate content of raw lentil was 0.24 which decreased significantly by radiation processing at doses of 5, 10, 15 and 20 kGy by 6.25%, 6.66%, 8.75 and 10.83, respectively. On the other hand, the phytate content of raw cow pea was 0.697 which decreased significantly by 12.20%, 13.06%, 23.0% and 24.10% respectively compared with raw samples, as treated with 5, 10, 15 and 20 kGy,respectively.

Effect of radiation processing on protein efficient ratio (PER) of lentil and cow pea:

The results presented in Table (6) indicated that the (PER) of raw lentil was 0.660 and increased by radiation processing at doses 5 , 10 , 15 and 20 kGy to 0.683, 0.837, 0.913 and 0.950 respectively. On the other hand, the PER of raw cow pea was 0.587 which increased by radiation processing at the same doses to 0.610, 0.627, 0.690 and 0.770 respectively.

The statistical analysis indicated that the (PER) of rats fed to raw and irradiated (Lentil and cow pea) up to 20 kGy reduced significantly compared with those fed to casein diet (2.017), while the PER of rats fed to irradiated samples were higher than those fed to raw samples.

Effect of feeding raw and irradiated (*Lentil and cow pea*) on albino rats performance:

Body weight gain:

The results presented in Table(7) showed that the total and daily body weight gain of rats fed on raw and irradiated (lentil and cow pea) at doses 5 , 10 ,15 and 20 kGy were lower than those fed to casein diet. While the total and daily body weight gain of rats fed to irradiated lentil and cow pea up to 20 kGy were higher than those fed raw samples. These results explain that the radiation processing improved the total and daily body weight gain as a results improve the PER and the reduction of antinutritional factors present naturally in samples. (EL-Niely, 2001).

Organ weight :

The results presented in Table(8) and Table(9) show that the relative liver weight of rats fed to raw and irradiated (lentil and cow pea) at doses 5 kGy were increased compared with those fed to casein diet. No significant changes in relatives liver weight between rats fed to irradiated lentil and cow pea at doses 10 , 15 and 20 kGy compared with those fed to casein diet. However, there are no significant changes in relative kidney, spleen, heart, lungs and tests weight of rats fed to raw and irradiated (lentil and cow pea) at doses 5 , 10 , 15 and 20 kGy compared with those fed to casein diet.

Hematological Parameters :

Hemoglobin (HB) :

The data presented in Table(10) indicated that (HB) of rats fed to raw and irradiated lentil at doses 5 and 10 kGy decreased insignificantly compared with those fed to casein or irradiated lentil at doses 15 and 20 kGy. While, the (HB) of rats fed to raw and irradiated cow pea at doses up to 20 kGy had no significant changes compared with those fed to casein diet .

Packed Cells Volum, Hematocrite, (PCV) :

The results presented in Table (10) show that the (PCV) of rats fed to raw and irradiated (lentil and cow pea) at doses 5, 10, 15 and 20 kGy had no significant effect ($P<0.05$) compared with those fed to casein diet.

Mean Cell Hemoglobin Concentration, (MCHC):

The results in Table (10) indicated there are no significant changes in (MCHC) values of rats fed to raw and irradiated lentil at doses 5 and 10 kGy compared with those fed to casein diet. While, the rats fed to irradiated lentil at doses 15 and 20 kGy were significantly higher in their (MCHC) values than those fed to casein diet. No significant changes in (MCHC) values of rats fed to raw and irradiated cow pea at doses 5, 10, 15 and 20 kGy compared with those fed to casein diet.

Biochemical Parameters :

The data presented in Table (11) indicate that the total plasma proteins of rats fed to raw and irradiated (lentil and cow pea) at doses 5 , 10 and 15KGy were significantly lower ($P < 0.05$) than those fed to casein diet or irradiated (lentil and cow pea) at doses 20 kGy. The statistical analysis indicated that there were no significant differences ($P < 0.05$) between total plasma proteins values of rats fed to casein diet and those fed to irradiated (lentil and cow pea) at doses level 20 kGy.

The results show also that the total plasma albumin concentration of rats fed to raw and irradiated lentil at doses 5 and 10 kGy were significantly lower ($P<0.05$) than those fed to casein diet. There were no significant differences ($P<0.05$) between plasma protein concentration of rats fed to casein diet and those fed to irradiated lentil at doses 10 , 15 and 20 kGy.

While, the plasma protein concentration values of rats fed to raw and irradiated cow pea at doses levels 5 , 10 , 15 and 20 kGy were significantly lower ($P<0.05$) than those fed to casein diet .

REFERENCES

A. O. A. C. (1984). "Official Methods of Analysis" Association of Official Analytical Chemists. Washington, D. C., U. S. A.

A. O. A. C. "Official Methods of Analysis". (1995): Association of Official Analytical Chemists International 16th ed., Arlington, Virginia, USA.

Carpenter, J. K. (1970). Nutritional consideration in attempts of changing the chemical composition of crops. Proc. Nutr. Soc., 29, p 3.

Chapman, D. G.; R. Castillo and G.A. Campbell (1959). Evaluation of protein in foods: 1- A method for the determination of protein efficency ratio. Can. J. Biochem. Physiol., vol. 37, p 679.

Dacie, J. V. and Lewis, S.M. (1975): Partical Haematology. Churchil, Livivng-stone,Edinbugh, London and NY 5th –Ed.

Diehl, J. F. and H. Scherz (1975). Estimation of radiolytic products as a basis for evaluation the wholesomeness of irradiated foods. Int. J. Appl. Radiat. Isotopes 26, p 499.

Doumas, B. T., Waston, W. R. and Biggs, H. G. (1971). Albumin standards and measurement of serum albumin with bromocresol green. Clin, Chim. Acta, 31, P.87.

El-Niely, H. F. G. (2001). Biochemical and Nutritional studies on radiation processed peanuts Ph. D. Thesis, Women's College, Ain Sahms University.

Farkas, J. (I988). Irradiation of dry food ingredients. Boca Raton, FL: CRC Presa.

Hania, F. G. EL-Niely(1996). Chemical constituent and digestability of broad beans subjected to irradiation treatment. M.Sc.Thesis,Women's College, Ain shams University.

Hania, F. G. EL-Niely (2001). Biochemical and nutritional studies on Radiation processed peanuts Ph. D. Thesis, Women's College, Ain shams University.

King, E. J. and I.D.P. Wootton (1959). Micro-analysis In: Medical Biochemistry. Churchil, London.

Lopez, Y.; Gordon, D.T. and Field, M.L.,(1983). Release of Phosphorus from Phytate by natural lactic acid formation.

Makkar. H. P. S., Aderibige, A. O., & Becker, K. (1998). Comparative evaluation of non-toxic and toxic varieties of *Jatropha curcas* for chemical composition, digestibility, protein degradability and toxic factors. Food Chemistry, 62, 207-215

Melaughlin, W. L.; Wenxiu Chen, H. Jia and J. C. Humphreys (1985). Response of Radiochromic Film Dosimeter to Gamma Rays in Different Atmosp-heres. Radiat. Phys. Chem., 25 p. 793.

Molins, R. A. (2001). Food irradiation: principles and applications. NewYork: John Wiley & Sons.

SAS "Statistical Analysis System", (1987). SAS/STAT User's Guide: Statistics, version 6.03 Edition. SAS Institute Inc., Cary, N.C., USA.

Siddhuraju. P., Becker, K., & Makkar. H. P. S. (2000). Studies on the nutritional composition and antinutritional factors in three different germplasm seed materials of an under-utilised tropical legume, *Mucuna pruriens* var. *Utilis*. Journal of Agricultural and Food Chemistry, 48, 6048-6060.

Van Kampen, E. J.,W. G. Zijlstra, (1961). Standarization of Hemoglobinmetery. II-The hemoglobin cyanide method. Cliniva Chimica Acta,6, p. 538.

Williams,R.R.; Beutler, E.A. and Rundless, R. W., (1972): Haematology. NewYork, Mc Graw-Hill Book Company.

Table (2): Effect of radiation dose on chemical composition of lentil (*Lens esculenta*).

Treatment	MO%	AS%	EE%	CP%	CF%	CA%
Raw (control)	9.88^{ab} ±0.035	2.34^{a} ±0.018	1.44^{a} ±0.012	25.82^{c} ±0.254	5.68^{a} ±0.012	54.84^{a-b} ±0.251
5 kGY	9.91^{a} ±0.058	2.34^{a} ±0.000	1.38^{c} ±0.000	25.38^{c} ±0.000	5.70^{a} ±0.016	55.29^{a} ±0.046
10 kGy	9.54^{a} ±0.121	2.25^{a} ±0.066	1.38^{a} ±0.012	25.82^{c} ±0.251	5.62^{b} ±0.012	55.39^{a} ±0.284
15 kGy	9.17^{b} ±0.020	2.29^{a} ±0.061	1.41^{b} ±0.006	26.68^{b} ±0.251	5.58^{c} ±0.000	54.59^{a-b} ±0.216
20 kGy	9.17^{c} ±0.107	2.20^{a} ±0.012	1.37^{c} ±0.006	27.56^{a} ±0.254	5.61^{b} ±0.006	54.09^{b} ±0.372

(Mo), moisture; (AS), ash; (EE), ether extract; (CP), crude protein; (CF), crude fiber; (CA), carbohydrate.

Means within a column, with no common superscript differ significantly (P<0.05).

Table (3): Effect of radiation dose on chemical composition of cow Pea (*Vigna unguiculata*).

Treatment	MO%	AS%	EE%	CP%	CF%	CA%
Raw (control)	8.62a ±0.261	8.48a ±0.129	1.62a ±0.012	26.68b ±0.251	6.42a ±0.011	52.17a ±0.203
5 kGY	8.91a ±0.029	4.48a ±0.066	1.58a ±0.012	27.56a ±0.254	6.25b ±0.024	51.21b ±0.303
10 kGy	8.76a ±0.026	4.67a ±0.228	1.64a ±0.000	26.68b ±0.251	6.24b ±0.011	52.00a ±0.378
15 kGy	9.01a ±0.006	4.79a ±0.032	1.56a ±0.058	27.56a ±0.254	6.64a ±0.048	50.59a-b ±0.127
20 kGy	8.96a ±0.035	4.87a ±0.075	1.55a ±0.009	27.93a ±0.040	6.44a ±0.000	50.05c ±0.174

(Mo), moisture; (AS), ash; (EE), ether extract; (CP), crude protein; (CF), crude fiber; (CA), carbohydrate.

Means within a column, with no common superscript differ significantly (P<0.05).

Table (4): Effect of radiation dose on soluble and insoluble protein of lentil (*Lens esculenta*) and cow pea (*Vigna unguiculata*).

Treatment	Lentil		Cow Pea	
	Soluble protein%	Insoluble protein%	Soluble protein%	Insoluble protein%
Raw (control)	6.853^{a} ±0.029	18.967^{c} ±0.244	6.860^{a} ±0.023	19.82^{c} ±0.240
5 kGY	6.249^{c} ±0.029	19.13^{c} ±0.029	6.673^{b} ±0.006	20.88^{ab} ±0.254
10 kGy	6.398^{b} ±0.009	19.41^{c} ±0.242	6.322^{c} ±0.007	20.36^{bc} ±0.244
15 kGy	6.249^{c} ±0.029	20.43^{b} ±0.266	6.537^{d} ±0.041	21.39^{a} ±0.059
20 kGy	6.014^{d} ±0.072	21.54^{a} ±0.190	6.647^{b} ±0.038	21.28^{a} ±0.0593

Means within a column, with no common superscript differ significantly (P<0.05).

Table (5): Effect of radiation dose on phytate content of lentil (*Lens esculenta*) and cow pea (*Vigna ungiculata*).

Treatment	Lentil	Cow pea
Raw	0.240^{a} ±0.001	0.697^{a} ±0.000
5 kGy	0.225^{b} ±0.000	0.612^{b} ±0.001
10 kGy	0.224^{c} ±0.001	0.606^{c} ±0.000
15 kGy	0.219^{d} ±0.000	0.537^{d} ±0.001
20 kGy	0.214^{e} ±0.000	0.529^{d} ±0.001

Means within a column, with no common superscript differ significant (P<0.05).

Table (6) : Effect of radiation dose on (PER) of lentil (*Lens esculenta*) and cow pea(*Vigna ungiculata*).

Treatment	PER	
	Lentil	Cow pea
Casein	$2.017^{a} \pm 0.042$	$2.017^{a} \pm 0.042$
Raw	$0.660^{c} \pm 0.021$	$0.587^{c} \pm 0.037$
5 KGy	$0.683^{c} \pm 0.032$	$0.610^{c} \pm 0.035$
10 KGy	$0.837^{b} \pm 0.430$	$0.627^{c} \pm 0.015$
15 KGy	$0.913^{b} \pm 0.860$	$0.690^{bc} \pm 0.035$
20 KGy	$0.950^{b} \pm 0.042$	$0.770^{b} \pm 0.020$

Means within a column, with no common superscript differ significantly (P<0.05).

Table (7): Performance of rats fed on casein (reference) and containing row and irradiated lentil (*Lens* esculenta) and cow pea (*Vigna unguiculata*).

Treatment	lentil		cow pea	
	Total Gain (g)	Daily Gain (g)	Total Gain (g)	Daily Gain (g)
Casein	$104.82^{a} \pm 20.236$	$2.50^{a} \pm 0.482$	$94.77^{a} \pm 16.387$	$2.26^{a} \pm 0.390$
Raw	$52.42^{b} \pm 1.836$	$1.25^{b} \pm 0.044$	$69.98^{ab} \pm 2.322$	$1.67^{ab} \pm 0.055$
5 kGy	$61.02^{b} \pm 3.827$	$1.45^{b} \pm 0.044$	$59.44^{b} \pm 5.819$	$1.42^{b} \pm 0.138$
10 kGy	$58.42^{b} \pm 2.155$	$1.45^{b} \pm 0.091$	$79.64^{ab} \pm 6.872$	$1.90^{ab} \pm 0.164$
15 kGy	$65.70^{b} \pm 2.628$	$1.39^{b} \pm 0.051$	$82.90^{ab} \pm 14.005$	$1.97^{ab} \pm 0.335$
20 kGy	$73.0^{b} \pm 12.707$	$1.56^{b} \pm 0.062$	$84.66^{ab} \pm 4.472$	$2.02^{ab} \pm 0.106$

Means within a column,with no common superscript differ significantly (P<0.05).

Table (8): Average relative organ weight for rats fed on casein (reference) and diets containing raw and irradiated lentil (*Lens esculenta*).

Diets orgines	Liver	Kidney	Spleen	Heart	Lungs	Tests
Casein	3.875^{b} ±0.196	0.8525^{a} ±0.043	0.205^{a} ±0.022	0.360^{a} ±0.015	0.410^{a} ±0.027	1.075^{a} ±0.074
Raw	4.662^{a} ±0.152	0.892^{a} ±0.022	0.212^{a} ±0.011	0.354^{a} ±0.017	0.418^{a} ±0.027	1.008^{a} ±0.058
5 kGY	4.526^{a} ±0.036	0.858^{a} ±0.040	0.206^{a} ±0.015	0.358^{a} ±0.018	0.412^{a} ±0.012	0.934^{a} ±0.028
10 kGy	3.918^{b} ±0.091	0.856^{a} ±0.053	0.196^{a} ±0.005	0.386^{a} ±0.011	0.466^{a} ±0.015	1.034^{a} ±0.058
15 kGy	4.058^{b} ±0.072	0.824^{a} ±0.027	0.198^{a} ±0.006	0.348^{a} ±0.009	0.440^{a} ±0.008	0.930^{a} ±0.018
20 kGy	4.005^{b} ±0.119	0.852^{a} ±0.030	0.188^{a} ±0.006	0.365^{a} ±0.013	0.438^{a} ±0.008	0.968^{a} ±0.051

Means within a column, with no common superscript differ significantly (P<0.05).

Table (9): Average relative organ weight for rats fed on casein and diets containing raw and irradiated cow pea (*Vigna unguiculata*).

Diets orgines	Liver	Kidney	Spleen	Heart	Lungs	Tests
Casein	3.875^{b} ±0.196	0.852^{b} ±0.043	0.205^{a} ±0.022	0.310^{a} ±0.015	0.375^{a} ±0.013	0.660^{b} ±0.073
Raw	4.504^{a} ±0.103	1.074^{a} ±0.066	0.168^{a} ±0.010	0.316^{a} ±0.015	0.478^{a} ±0.087	1.075^{a} ±0.074
5 KGY	4.430^{a} ±0.152	1.004^{ab} ±0.037	0.182^{a} ±0.014	0.354^{a} ±0.004	0.462^{a} ±0.032	0.766^{ab} ±0.134
10 KGy	3.924^{b} ±0.158	0.902^{b} ±0.063	0.192^{a} ±0.015	0.334^{a} ±0.010	0.420^{a} ±0.011	0.776^{ab} ±0.080
15 KGy	3.760^{b} ±0.081	0.888^{a} ±0.038	0.175^{a} ±0.013	0.340^{a} ±0.004	0.428^{a} ±0.014	0.922^{ab} ±0.162
20 KGy	3.762^{b} ±0.148	0.936^{ab} ±0.033	0.186^{a} ±0.010	0.342^{a} ±0.026	0.390^{a} ±0.023	0.866^{a} ±0.142

Means within a column, with no common superscript differ significantly (P<0.05).

Table (10): Effect of radiation processing on raw and irradiated lentil (*Lens esculenta*) and cow pea (*Vigna unguiculata*) fed to albino rats on some hematological parameters.

Diet degines	Lentil			Cow pea		
	HB gdl^{-1}	PCV %	MCHC $g\ dl^{-1}$	HB gdl^{-1}	PCV %	MCHC $g\ dl^{-1}$
Casein	12.22^{ab} ±0.413	46.38^{a} ±1.344	26.42^{b} ±1.111	12.22^{ab} ±0.414	44.12^{a} ±0.515	29.52^{a} ±0.674
Raw	9.88^{b} ±1.107	44.10^{a} ±0.187	20.80^{b} ±1.947	12.20^{a} ±0.336	42.90^{a} ±0.714	27.68^{a} ±0.888
5 kGY	11.54^{b} ±0.927	45.50^{a} ±2.000	75.63^{b} ±7.562	13.29^{a} ±0.494	43.40^{a} ±0.400	30.60^{a} ±0.966
10 kGy	10.44^{b} ±0.399	44.50^{a} ±0.387	23.44^{b} ±1.818	13.19^{a} ±0.459	43.40^{a} ±0.400	30.39^{a} ±0.986
15 kGy	14.30^{a} ±0.399	47.50^{a} ±2.356	32.43^{a} ±0.956	12.67^{a} ±0.407	43.88^{a} ±0.625	27.80^{a} ±0.510
20 kGy	14.34^{a} ±0.833	44.88^{a} ±0.718	32.07^{a} ±2.293	13.02^{a} ±0.588	43.50^{a} ±0.806	29.90^{a} ±0.957

Means within a column, with no common superscript differ significantly (P<0.05).

Table (11): Effect of radiation processing on plasma protein of rats fed row and irradiated lentil (*Lens esculenta*) cow pea (*Vigna unguiculata*).

Treatment	lentil		cow pea	
	Total protein $g\ dl^{-1}$	Abumin $g\ dl^{-1}$	Total protein	Abumin
Casein	4.710^{a} ±0.122	3.813^{a} ±0.128	4.410^{a} ±0.122	3.813^{a} ±2.983
Raw	3.400^{c} ±0.006	2.330^{c} ±0.190	3.547^{c} ±0.074	2.983^{c} ±0.034
5 kGY	4.323^{b} ±0.037	2.910^{b} ±0.070	4.080^{b} ±0.095	3.200^{bc} ±0.155
10 kGy	4.227^{b} ±0.013	3.287^{ab} ±0.352	4.183^{b} ±0.029	3.250^{bc} ±0.067
15 kGy	4.313^{b} ±0.038	3.463^{ab} ±0.058	4.240^{b} ±0.203	3.157^{bc} ±0.019
20 kGy	4.580^{a} ±0.105	3.477^{ab} ±0.142	4.330^{a} ±0.080	3.333^{b} ±0.039

Means within a column, with no common superscript differ significantly (P<0.05).

التغيرات الغذائية والبيوكيميائية فى العدس واللوبيا المعاملين بالإشعاع

واصل محمد أبو العلا* ــ محمد ضياء الدين حامد فرج** ــ
مديحة عبد الجواد الشيوى* ــ هنية فتحى غريب** ــ السيد محمد بيومى*

* قسم علوم الأغذية ــ كلية الزراعة ــ جامعة الزقازيق .
** قسم تشعيع الأغذية ــ شعبة التصنيع الصناعى ــ المركز القومى لبحوث وتكنولوجيا الإشعاع ــ هيئة الطاقة الذرية.

يعتبر العدس واللوبيا من أهم مصادر البروتينات الغذائية فى مصر . ونتيجة الإصابة بالحشرات التى تفقدهما كميات كبيرة بعد الحصاد تعتبر المعاملة الإشعاعية من أهم الوسائل البديلة لخفض تلك الخسائر.

تم تشعيع كل من حبوب العدس واللوبيا الجافة بجرعات ٥ ، ١٠ ، ١٥ و ٢٠ كيلو جراى لدراسة التأثير الإشعاعى على التركيب الكيميائى والمحتوى من الفيتات والبروتين الذائب وكفاءة البروتين (PER) وتأثير التغذية على البذور الجافة على معدل نمو الفئران ووزن الأعضاء الداخلية وتركيب الدم ومحتوى البلازما من البروتين الكلى والالبيومين .

دلت النتائج على أن التركيب الكيميائى لكل من العدس واللوبيا المعاملين بالجرعات السابقة لم يتأثرا تأثيراً معنوياً (مستوى معنوية ٠,٠٥). كما أدت المعاملة الإشعاعية إلى خفض محتواهما من الفيتات والبروتين الذائب وإلى زيادة كفاءة البروتين (PER) . كما دلت نتائج التغذية على عدم حدوث تغير معنوى (مستوى معنوية ٠,٠٥) فى وزن الفئران المغذاة على العينات المعاملة بجرعات ١٠ ، ١٥ ، ٢٠ كيلو جراى بينما انخفض وزن الفئران المغذاة على العينات غير المعاملة والمعاملة بجرعات ٥ كيلو جراى بالمقارنة بتلك المغذاة على علائق الكازين.

ودلت النتائج إلى زيادة الوزن النسبى للكبد للفئران المغذاة على العدس الخام والمعامل بجرعات ٥ كيلو جراى مقارنة بتلك المغذاة على علائق الكازين . ولم يحدث تغير معنوى لباقى الجرعات. كما لم يلاحظ أى تغير معنوى فى وزن الكلى والقلب والطحال والرئة والخصيتين للفئران المغذاة على العدس واللوبيا الغير معاملين والمعاملين بجرعات حتى ٢٠ كيلو جراى مقارنة بتلك المغذاة على علائق الكازين.

وأوضحت نتائج اختبارات الدم على عدم وجود تغيرات معنوية يمكن إرجاعها إلى المعاملة الإشعاعية، كما انخفض مستوى بروتين وألبيومين بلازما الفئران المغذاة على العدس واللوبيا غير المعاملين والمعاملين بجرعات ٥، ١٠ كيلو جراى انخفاضاً معنوياً عن مستوياهما فى الفئران المغذاة على علائق الكازين .

وتدل النتائج المتحصل عليها أن المعاملة الإشعاعية لعينات العدس واللوبيا حتى ٢٠ كيلو جراى كانت ناجحة فى خفض محتواها من معيقات التغذية ورفع قيمتها الغذائية.