

### Poultry Science Journal

ISSN: 2345-6604 (Print), 2345-6566 (Online) http://psj.gau.ac.ir DOI: 10.22069/psj.2017.13717.1271



# Effects of Irradiated Flaxseed on Performance, Carcass Characteristics, Blood Parameters, and Nutrient Digestibility in Broiler Chickens

Beheshti Moghadam MH1, Rezaei M1, Behgar M2 & Kermanshahi H3

<sup>1</sup>Department of Animal Science, College of Animal Science and Fisheries, Sari Agricultural Sciences and Natural Resources University, Sari, Iran

<sup>2</sup>Nuclear Science & Technology Research Institute, Karaj, Iran

<sup>3</sup>Department of Animal Science, College of Agriculture, Ferdowsi University of Mashhad, Mashhad, Iran

Poultry Science Journal 2017, 5 (2): 153-163

Keywords Broiler Flaxseed Performance Electron irradiation Nutrient digestibility

**Corresponding author** Mansour Rezaei

mrezaei2000@yahoo.com

#### Article history

Received: July 26, 2017 Revised: September 16, 2017 Accepted: September 28, 2017



#### Abstract

The objective of this study was to investigate the effects of feeding electron irradiated flaxseed (FS) on performance, carcass characteristics, blood parameters, digesta viscosity, and nutrient digestibility in broiler chickens. In a 2 × 2 factorial arrangement, 320 day-old broiler chicks were randomly assigned to one of five experimental diets, each with four replicates containing 16 chicks each. Dietary treatments included a corn-soybean meal-based diet (control), and diets containing 10% or 20% raw flaxseed (FS10, FS20), or 10% or 20% flaxseed irradiated at 20 kGy (RFS10, RFS20). Feeding irradiated flaxseed improved body weight gain in grower and finisher periods of the experiment (P < 0.05). Birds fed FS20 had a lower (P < 0.05) body weight gain in finisher period as well as lower breast muscle percentage in comparison to chicks fed FS10. Thigh percentage was greater in chicks fed FS20 compared to chicks fed FS10 (P < 0.05). Liver percentage decreased (P < 0.05) in birds fed RFS20 compared other treatments. Birds fed FS20 and RFS20 had significantly lower aspartate aminotransferase activity compared to birds fed FS10 and RFS10 (P < 0.05). Dry matter, organic matter, and ether extract digestibility decreased (P < 0.05) as the levels of FS increased. Apparent digestibility of dry matter, organic matter, and ether extract in irradiated FS increased in birds fed raw flaxseed. Irradiation of flaxseed significantly decreased digesta viscosity compared to diets containing raw irradiated flaxseed (P < 0.05). Results of this study demonstrated that irradiation increases the inclusion level of flaxseed in broiler diets without any negative impacts on broiler performance.

#### Introduction

Flaxseed contains high amounts of  $\alpha$ -linolenic acid (52% of the total fatty acids), an essential fatty acid, making flaxseed a unique oilseed crop for oil production as well as for incorporation in foods (Chung *et al.*, 2005). Flaxseed is a good source of protein, oil, and  $\alpha$ -linolenic acid, so it can be used for enrichments of poultry meat and eggs (Leeson and Summers, 2005). Due to anti-

nutritional factors (ANF) present in flaxseed [non-starch poly saccharides (NSPs), cyanogenic glycosides, trypsin inhibitors, mucilages, linatine dipeptide (a vitamin B6 antagonist), and phytic acid], flaxseed has been shown to adversely affect broiler performance (Ajuyah *et al.*, 1993; Bhatty, 1995; Ortiz *et al.*, 2001; Alzueta *et al.*, 2003; Hernandez, 2013). These ANF and NSPs

Please cite this article as: Beheshti Moghadam MH, Rezaei M, Behgar M & Kermanshahi H. 2017. Effects of Irradiated Flaxseed on Performance, Carcass Characteristics, Blood Parameters, and Nutrient Digestibility in Broiler Chickens. Poult. Sci. J. 5 (2): 153-163.

© 2017 PSJ. All Rights Reserved

Irradiated Flaxseed in Broiler Diet

are associated with increasing intestinal viscosity, reducing litter quality, and poor growth performance in broiler birds (Hall *et al.*, 2006).

Gamma and electron radiation can denature proteins and decrease starch crystallinity (Chamani *et al.*, 2009; Shawrang *et al.*, 2013). Nayefi *et al.* (2015) showed an increase in feed intake and body weight gain in broiler chicks fed diets containing 12% irradiated (30 kGy) cotton seed meal compared to those fed control diet. Previous studies using gamma or electron irradiation show a reduction in anti-nutrient content of canola meal, barley, and cottonseed meal and an improvement in their utilization in broilers (Gharaghani *et al.*, 2008; Chamani *et al.*, 2009; Shawrang *et al.*, 2013; Nayefi *et al.*, 2015., Bahraini *et al.*, 2017).

There is limited information on the use of irradiated flaxseed in broiler nutrition. Therefore, the present study was conducted to investigate the effects of FS diets irradiated by electron beam on performance, carcass blood parameters, characteristics, nutrient digestibility and digesta viscosity of broiler chickens.

#### Materials and methods

All experimental methods were in accordance with Sari Agricultural Sciences and Natural Resources University Research Policy on Animal Ethics and Welfare (Sari, Iran).

#### Preparing of irradiated flaxseed

One hundred ten kg of raw Canadian flaxseed (Linum usitatissimum) was purchased from Zarbal Company (Amol, Mazandaran, Iran). The flaxseed sample was packed in  $35 \times 25 \text{ cm}^2$ polyethylene bags and exposed to electron beam irradiation (Yazd radiation processing center, AEOI, Yazd center, Iran) at a dose of 20 kGy (fixed beam energy of 10 MeV) at room temperature by a Rhodotron accelerator model TT200 (Ion Beam Applications Company, Ottignies-Louvain-la-Neuve, Belgium). A dose rate of 180 kGy min-1 was used for irradiation as determined by cellulose triacetate film (ISO/ASTM 51650, 2015). Uncertainty for electron radiation was 5% and measured dose uniformity ratio (Dmax/Dmin) was 1.10.

#### Chemical analysis of flaxseed

We assessed the chemical composition of three samples of raw (RFS) and irradiated flaxseed

(IFS) to determine content of organic matter (OM), crude protein (CP), ether extract (EE), crude fiber (CF), calcium, and phosphorus according to AOAC (2005) analytical methods in Sari Agricultural and Natural Resources University, Sari, Mazandaran, Iran.

Total cyanogenic glycosides (TCG, or cyanide) were measured using the Picrate method (Egan et al., 1998; Bradbury et al., 1999) using a Cyanide kit (courtesy of Howard Bradbury, The Australian National University, Canberra, Australia). About 25-100 mg ground flaxseed was mixed with phosphate buffer (0.5 mL, 0.1 M at pH=4-10) and cyanoglucoside enzyme. A picrate paper attached to a plastic backing strip (Bradbury et al., 1999) was inserted into the sample and after about 16 hrs at 30°C, the picrate paper was removed and immersed in 5.0 mL water for ~30 min. The absorbance of picrate solution was measured at 510 nm. The total cyanide content (ppm) determined as follows:

Total cyanide content (ppm) =  $396 \times absorbance \times 100/z$ ,

where z = sample weight (mg)

All the fatty acid (FA) analysis were done at the lipid laboratory (Oregon State University, Corvallis, USA). Total lipid was extracted from ~2 g of flaxseed using chloroform: methanol (2:1) following methods described by Folch et al. (1957). Fatty acid methyl esters were prepared from total lipid extract using boron trifluoride methanol (Beheshti Moghadam et al., 2017). Fatty acid analysis was performed with an HP 6890 gas chromatograph (Hewlett-Packard Co., Wilmington, DE) equipped with an autosampler, flame ionization detector, and SP-2360 fused silica capillary column. Samples in hexane (1 µL) were injected with helium as a carrier gas into the column programmed for ramped oven temperatures. Initial oven temperature was set at 150°C and held for 1.5 min, then ramped at 15°C /min to 190°C and held for 20 min, then ramped again at 30°C /min to 230°C and held for 3 min. Inlet and detector temperatures were both 250°C. Fatty acid methyl esters were identified by comparison with retention times of authentic internal or external standards (Nuchek Prep, Elysian, MN). Peak areas and percentages were calculated using Hewlett-Packard ChemStation software (Agilent Technologies Inc., Wilmington, DE). Fatty acid values are reported as percentage of methyl esters.

#### Birds and dietary treatments

A total of 320 day-old male broiler chicks (Ross 308 strain) were individually weighed and randomly distributed to five treatments, with four replicates of 16 chicks each (placed in 20 floor pens bedded with wood shavings). Light was continuous for the first three days post-hatch, after which a 23L:1D was applied. At one day of age, the room temperature was set at 33°C and subsequently reduced by 2 °C/week. Birds had free access to water and feed throughout the experiment.

Dietary treatments consisted of a cornsoybean meal based diet (control), and diets containing 10% raw FS (RFS10), 10% irradiated FS (IFS10), 20% raw FS (20RFS), or 20% irradiated FS (20IFS). Experimental diets were fed during the 3-phase feeding schedule: starter (0 to 10 d), grower (11-22 d), and finisher (23-42 d). All diets were mash and formulated to meet or exceed the minimum requirements for broiler chickens according to Ross 308 catalogue (2014). The composition of experimental diets is given in Table 1.

<b>Table 1.</b> Composition and nutrient content of starter, grower and finisher experimental diets (g/kg)
--

	Sta	rter (0-10	d)	Gro	wer (11-2-	4 d)	Fini	sher (25-42	2 d)
Ingredients	Control	FS10,	FS20,	Control	FS10,	FS20,	Control	FS10,	FS20,
	Control	RFS10	RFS20	Control	RFS10	RFS20	Control	RFS10	RFS20
Corn	533.60	490.30	426.10	568.60	524.20	466.60	615.90	572.60	517.6
Soybean Meal	405.00	368.00	335.00	364.50	328.00	294.00	323.00	286.00	251.00
FS/RFS <sup>1</sup>	0.000	100	200	0.000	100	200	0.000	100	200
Vegetable oil	20.0	2.00	0.000	25.0	7.00	0.000	28.0	10.00	0.000
Salt	2.50	2.30	2.50	2.50	2.30	2.50	2.50	2.30	2.50
Bicarbonate sodium	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Vitamin premix <sup>2</sup>	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Mineral premix <sup>3</sup>	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Dicalcium phosphate	16.0	16.0	16.0	14.0	14.0	14.0	12.0	12.0	12.0
Limestone	9.00	8.00	7.00	8.00	7.00	6.00	7.00	6.00	6.00
L-Lysine. HCl	2.00	2.00	2.20	1.50	1.50	1.70	1.20	1.30	1.30
DL-Methionine	3.70	3.40	3.20	3.20	3.00	2.70	2.90	2.50	2.30
Choline chloride (60%)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
L-Threonine	1.20	1.00	1.00	0.700	1.00	0.500	0.500	0.300	0.300
Titanium dioxide	0.000	0.000	0.000	5.00	5.00	5.00	0.000	0.000	0.000
Nutrient values									
ME (Kcal/kg)	2900	2900	2900	2980	2980	2980	3050	3050	3050
Crud protein	220	220	220	205	205	205	190	190	190
Calcium	9.60	9.60	9.60	8.70	8.70	8.70	7.90	7.90	7.90
Available phosphorus	4.80	4.80	4.80	4.40	4.40	4.40	4.00	4.00	4.00
Lysine	11.8	11.8	11.8	10.5	10.5	10.5	9.50	9.50	9.50
Methionine	4.50	4.50	4.50	4.20	4.20	4.20	3.90	3.90	3.90
Methionine + Cystine	9.5	9.5	9.5	8.7	8.7	8.7	8.0	8.0	8.0

<sup>1</sup>Flaxseed/ Irradiated flaxseed.

Vitamin premix; Supplied per Kg feed: Vitamin A, 8000 UI; vitamin D3, 2000 UI; vitamin E, 30 UI; vitamin K3, 2 mg; thiamine, 2 mg; riboflavin, 6 mg; pyridoxine, 2.5 mg; cyanocobalamin, 0.012 mg, pantothenic acid, 15 mg; niacin, 35 mg; folic acid, 1 mg; biotin, 0.08 mg.

<sup>3</sup>Mineral premix supplied per Kg feed; iron, 40 mg; zinc, 80 mg; manganese, 80 mg; copper, 10 mg; iodine, 0.7 mg; selenium, 0.3 mg.

## Broiler chicken performance, carcass characteristics and blood sample collection

During the experiment, body weight and feed intake (FI) were measured for each pen in three phases of the experiment (starter, grower and finisher), and then body weight gain (BWG) and feed conversion ratio (FCR) were calculated. At the end of the experiment (42 days), 12 birds per treatment (three birds/pen) were randomly selected, weighed, and then sacrificed by cervical dislocation. Tissue samples from each chicken including liver, breast and thigh muscle (pectoralis major and biceps femoris, without skin), and abdominal fat pad (including fat surrounding the gizzard, bursa of fabricius, and cloaca) were collected and weighed.

At days 21 and 42 of the experiment, eight birds from each treatment (two birds/replicate) were selected for blood analysis. Samples were collected from wing vein, collected in heparinized tubes and centrifuged for 10 min at  $2000 \times g$ . Plasma was collected, and stored at - $20^{\circ}$ C until analysis. Plasma was measured for triglycerides, cholesterol concentrations and aspartate aminotransferase (AST) activity using an auto-analyzer (HITACHI 902 automatic autoanalyzer) from specific commercial kits (Pars Azmoon, Tehran, Iran).

#### Nutrients digestibility and viscosity

Titanium dioxide (Ti $O_2$ ) was added to the feed of all birds at a rate of 5 g/kg as a dietary marker from day 14 to 20. On day 21, two birds were randomly selected from each pen and euthanized by cervical dislocation. The content of the ileum (from Meckel's diverticulum to 1 cm above the ileocecal junction) was collected and pooled for two birds to yield four replicate samples per each treatment. The ileal digesta samples were frozen, freeze-dried, ground, and analyzed for Ti $O_2$  using a UV spectrophotometer (Short *et al.*, 1996), and for DM, EE and OM as per AOAC (2005).

At day 42, ileal digesta (1.5 g) of two sacrificed birds in each replicate were collected and centrifuged at  $12000 \times g$  for 4 min. Viscosity of the supernatant was determined at 40°C using the Brookfield digital viscometer (model DVII+LV, Brookfield Engineering Laboratories, Mashhad, Iran). The ileal digesta samples were frozen, freeze-dried, ground, and analyzed TiO<sub>2</sub> using a UV spectrophotometer (Short *et al.*, 1996), and for DM, EE and OM as per AOAC (2005). Apparent ileal digestibility coefficients of

OM, DM, and EE were calculated using  $TiO_2$  in the diets and digesta by using the following equation: Apparent ileal digestibility coefficient = 1 – [diet  $TiO_2$  / ileal  $TiO_2$ ] × [ileal nutrient / diet nutrient].

#### Statistical analysis

The data were analyzed using Mixed procedure of SAS software version 9.4 (SAS, 2013) as a Control plus a 2 × 2 factorial with completely randomized design. The main factors were flaxseed and irradiation. Studentized residuals were calculated for both fixed and random effects and normality of studentized residuals was checked using Shapiro-Wilk test (Zar, 2009). Tukey and Dunnett comparison procedures used to compare means when F-test was significant. All statements of significance are based on P < 0.05.

#### Results

The effects of electron radiation on chemical composition, TCG, and FA of flaxseed are shown in Table 2. There were no significant differences among treatments, except for crude fiber content which was statistically lower in irritated flaxseed (P < 0.05).

Table 2. Analy	vzed chemical	composition of	f raw and	l irradiated flaxseed	l (g/kg)
	Jeen erternettiett	composition of	L L CL I I CL I CL	111000000000000000000000000000000000000	· (8/ · · 8/

Composition	Raw flaxseed	Electron beam (20 kGy)*	SEM	<i>P</i> -value
Organic matter	965	965	0.142	0.1125
Crude protein	191	189	0.067	0.1248
Ether extract	342	362	0.056	0.5333
Crude fiber	210ª	164 <sup>b</sup>	0.086	0.04850
TCG <sup>1</sup> (ppm)	230	197.6	0.600	0.2074
C16:0	63.3	67.0	0.024	0.8728
C18:0	56.5	61.6	0.027	0.7664
C18:1 n-9	209	209	0.046	0.3862
C18:2 n-6	122	123	0.018	0.4694
C18:3 n-3	548	537	0.040	0.2556
Total SFA	119	128	0.033	0.9678
Total MUFA	209	209	0.046	0.3862
Total n-6 FA	122	123	0.018	0.4694
Total n-3 FA	548	537	0.040	0.2556

<sup>1</sup>Total cyanogenic glycosides

\* Flaxseed ground after irradiation.

Total SFA = Total saturated fatty acids (14:0 + 16:0 + 17:0 + 18:0 + 20.0); Total MUFA = Total monounsaturated fatty acids (16:1 + 18:1 + 20:1 + 22:1); Total n-6 polyunsaturated fatty acids (18:2 n-6 + 20:2 n-6 + 20:3 n-6 + 20:4 n-6 + 22:4 n-6 + 22:5 n-6); Total n-3 polyunsaturated fatty acids (18:3 n-3 + 20:5 n-3 + 22:5 n-3). Total LC n-6 FA = Total long chain n-6 fatty acids (20:2 n-6 + 20:3 n-6 + 20:4 n-6 + 22:4 n-6 + 22:5 n-6). Total LC n-3 FA = Total long chain n-3 fatty acids (20:5 n-3 + 22:6 n-3). Values within a row with different superscripts differ significantly P < 0.05.

$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$				0100									•	<b>NULU</b>	
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	This there         Term	Barter (p.10d) Bir (g) Bir (	Starter (0-10d) FI <sup>5</sup> (g) BWG <sup>6</sup> (g) FCR <sup>7</sup> Grower (11-22d) FI (g) BWG (g) FCR	0 1 1		RFS10	FS20	RFS20	Yes	No	10%	20%	SEM <sup>2</sup>	0		FS×R
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	FI <sup>5</sup> (g) BWG <sup>6</sup> (g) FCR <sup>7</sup> Grower (11-22d) FI (g) BWG (g) FCR													
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	BWG <sup>6</sup> (g) FCR7 Grower (11-22d) FI (g) BWG (g) FCR	10	94.72	186.25	188.75	188.99	187.12	191.74	190.49	188.37	5.90	0.726	0.449	0.526
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	FCK         0.920         0.880         0.970         0.870         0.920         0.920         0.030         0.433         0.005         0.163           Stower (11-2d)         1328.32         1314.79         1059.88         138.827         1336.33         119.10         1321.55         109.00         0.030         0.035         0.00	FCK         0.920         0.880         0.970         0.870         0.920         0.920         0.030         0.403         0.005         0.165           Grower         11-2d1         1323.32         1314.79         1059.88         138.27         133.633         1194.10         1321.55         10908         155.23         0.482         0.035         0.005         0.006         0.005         0.006         0.005	FCR7 Grower (11-22d) F1 (g) BWG (g) FCR	J	62.85	163.82	146.39	168.61	166.22	154.62	163.33	157.50	5.70	0.326	0.064	0.087
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	Dirower (11-2d)         Dirower (1	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	Grower (11-22d) FI (g) BWG (g) FCR		0.920	0.880	0.970	0.870	0.870 b	0.950 a	0.900	0.920	0.020	0.403	0.005	0.165
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	H (g) BWG (g) FCR													
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	BWG (g)         642.92         671.08         585.18         674.51         672.79         614.05         657.00         629.84         14.5         0.030         0.005         0.001         0.057           FICR         1.35P         1.49P         1.74         1.52P         1.52P         1.63P         0.63         0.031         0.035         0.001         0.035         0.001         0.035           Finler(72-42d)         2.793.22         2.725.72         2894.86         2.803.32         2769.47         2849.09         50.7         0.102         0.011         0.005         0.001         0.005           FCR         1.12P         1.13P         1.49P         1.25P         1.25P         1.25P         1.25P         1.25P         0.022         0.001         0.005         0.001         0.005           BWG (g)         172.57         188.75         188.75         1382.26         1.25P         1.38P         0.022         0.001         0.005         0.005         0.005         0.005         0.005         0.005         0.005         0.005         0.005         0.005         0.005         0.005         0.005         0.005         0.005         0.005         0.005         0.005         0.005         0.00	BWG (g) 642.92 671.08 585.18 674.51 672.79a 614.05b 657.00 629.84 14.5 0.086 0.001 0.077 FCR 1.57b 1.49b 1.74b 1.32b 1.50b 1.66b 1.52b 1.53b 0.030 0.005 0.009 0.036 Finisher(23-424) 2793.22 275.72 2894.86 2803.22 2769.47 2844.09 2759.47 2849.09 50.7 0.102 0.142 0.815 BWG (g) 1344.06 1419.66 1419.66 1166°.73 1344.83a 1382.26 1325.40b 1381.88 12.225 217 0.001 0.001 0.006 FCR 1.27b 1.18b 1.49b 1.25b 1.25b 1.32b 1.328 1.322.78b 2.17 0.001 0.001 0.006 FCR 1.27b 1.28b 16.85b 16.85b 1.465.94 1.459 1.259 1.329 1.328 1.222 1.349 FCR 1.32b 1.328 1.552.78 2.17 0.001 0.001 0.006 FCR 0.800 0.920 0.880 0.970 0.870 FCR 1.41 1.55 1.49 1.38 1.52 FCR 1.41 1.55 1.49 1.38 2.51 FCR 1.41 1.55 2.134.70 109.98 1358.27 FCR 1.41 1.55 1.49 1.38 2.51 FCR 1.41 1.55 1.49 1.38 2.51 FCR 1.41 1.55 1.49 1.38 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.5	BWG (g) FCR	13	328.32	1314.79	1059.89	1358.27	1336.53	1194.10	1321.55	1209.08	155.23	0.482	0.376	0.334
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	FCR         1.55 <sup>b</sup> 1.49 <sup>b</sup> 1.74 <sup>b</sup> 1.53 <sup>b</sup> 1.49 <sup>b</sup> 1.74 <sup>b</sup> 1.53 <sup>b</sup> 1.43 <sup>b</sup> 0.030         0.005         0.009         0.036           fill(g)         2.793.22         2.725.72         2894.86         2803.22         2769.47         2844.09         2759.47         0.030         0.005         0.001         0.001         0.005           BWG (g)         1.347.06         1.196 <sup>b</sup> 1.160 <sup>b</sup> /73         1344.83 <sup>b</sup> 1382.26 <sup>b</sup> 1.22 <sup>b</sup> 1.38 <sup>b</sup> 1.22 <sup>b</sup> 1.38 <sup>b</sup> 0.022         0.001         0.001         0.005           Dumett test         1.27 <sup>b</sup> 1.18 <sup>b</sup> 1.49 <sup>b</sup> 1.25 <sup>b</sup> 1.22 <sup>b</sup> 1.38 <sup>b</sup> 1.22 <sup>b</sup> 1.38 <sup>b</sup> 0.022         0.001         0.001         0.005           Dumett test         5.34         160.25 <sup>b</sup> 16.85 <sup>d</sup> 1.22 <sup>b</sup> 1.38 <sup>b</sup> 1.22 <sup>b</sup> 1.38 <sup>b</sup> 1.23 <sup>b</sup> 1.23 <sup>b</sup> 1.23 <sup>b</sup> 1.23 <sup>b</sup> 1.23 <sup>b</sup> 1.23 <sup>b</sup> 1.0001         0.001         0.001         0.001         0.001         0.001         0.001         0.001         0.001         0.001         0.001         0.001         0.001	FCR1.551.491.741.521.501.651.521.630.0000.0050.0090.035finiler(23-42d)2793.222753.722894.862803.222769.472849.0950.70.1120.1120.1120.112BWG (g)11.27011.18911.49611.60%.731344.8391352.2661352.78921.70.0010.0010.003FCR11.27011.18911.25911.25911.22911.22911.22921.70.0010.001Dumett testStarterFCR190.26194.72186.25187.79187.99186.61a275.9405.340.690.005FCR0.8600.92050.880a0.97090.870a0.870a0.870a0.0050.005Grower11.111.72.57a12.2382131.0211310.211328.221140.040.754FCR1.411.551.491.381.320.0700.0050.005Grower1.411.551.491.381.320.0300.055FCR1.411.551.491.381.320.334.350.0320.032Grower1.411.551.491.381.320.0300.055FCR1.411.551.491.381.320.0320.032FCR1.411.551.491.381.320.0320.033FCR1.411.551.49 </td <td>FCR</td> <td>Ģ</td> <td>42.92</td> <td>671.08</td> <td>585.18</td> <td>674.51</td> <td>672.79 a</td> <td>614.05 b</td> <td>657.00</td> <td>629.84</td> <td>14.5</td> <td>0.086</td> <td>0.001</td> <td>0.057</td>	FCR	Ģ	42.92	671.08	585.18	674.51	672.79 a	614.05 b	657.00	629.84	14.5	0.086	0.001	0.057
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	Finisher(23-42d)Fini		1	1.55b	$1.49^{b}$	1.74a	$1.52^{b}$	$1.50^{\mathrm{b}}$	$1.65^{a}$	$1.52^{b}$	$1.63^{a}$	0.030	0.005	0.009	0.036
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	H (g)         2793.22         2775.72         2894.86         2803.22         2769.47         2844.09         50.7         0.102         0.142         0.815           RWG (g)         1.27°         1.18°         1.49°         1.25°         1.382.26°         1232.40°         1381.88°         1237°         0.001         0.012         0.0	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	Finisher(23-42d)													
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	BWG (g) 1344.06 1419.69 11600.73 1344.83 1382.26 1252.40 1381.88 1252.78 21.7 0.001 0.001 0.005 FCR 1128 1.229 1.189 1.499 1.229 1.229 1.389 0.025 0.001 0.001 0.000 Statter F1 (g) 190.26 194.72 186.25 188.75 187.99 5.34 0.693 BWG (g0 172.57 16.285 16.822 146.39 168.61a FCR 0.860 0.920 0.880 0.970 0.870 0.870 0.070 0.005 FCR 1310.21 1328.32 1314.79 1059.89 1358.27 BWG (g) 1310.21 1328.32 1314.79 1059.89 1358.27 FCR 1.41 1.55 1.49 1.38 1.52 FCR 1.41 1.55 1.49 1.38 1.52 FCR 1.41 1.55 1.49 1.38 1.52 FCR 1.41 1.55 1.49 1.38 1.52 FFCR 1.44 1.60 1.400.78 1.348.79 1.58 6.74.51a FFCR 1.44 1.55 1.49 1.38 1.52 FFCR 1.45 1.520 and FFCR 1.44 0.67 1.49 1.50 FCR 1.45 1.520 and FFCR 1.44 0.67 1.49 1.53 1.43 1.52 FFCR 1.45 1.50 FFCR 1.44 0.67 1.49 1.53 1.44 0.67 1.49 1.53 1.44 0.67 1.54 1.54 1.54 1.54 1.54 1.54 1.54 1.54	BWG (g) 1344.06 1419.69 1160°.73 1344.83 1382.26 1252.40 1381.88 1252.78 21.7 0.001 0.001 0.006 FCR 1.27 1.38 1.49 1.25 114.9 1.25 1.38 1.22 1.38 1.22 1.38 0.002 0.001 0.001 0.006 Statet Statet F(g) 190.5 194.72 186.25 188.75 187.99 5.53 0.005 5.34 0.693 BWG (g0 172.57 16.285 138.75 187.99 0.870 0.070 BWG (g1 132.257 16.285 163.82 144.59 0.870 0.0870 0.070 FCR 1.41 1.55 1.49 1.38 1.52 FCR 1.41 1.55 1.49 1.27 1.40 1.50 FCR 1.40 FCR 1.4	FI (g)	27		2725.72	2894.86	2803.22	2769.47	2844.09	2759.47	2849.09	50.7	0.102	0.142	0.815
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	FCR         1.27b         1.18b         1.49a         1.25b         1.22b         1.38a         0.022         0.001         0.001         0.001           Dumettest         Starter         Starter         1.22b         1.23b         1.22b         1.38a         0.022         0.001         0.001         0.001         0.001           Starter         Starter         Starter         Starter         1.22b         1.33b         1.22b         1.38a         0.022         0.001         0.001         0.001           Starter         Starter         1.22b         1.32b         1.86.51         188.61         0.970b         0.870b         0.870b         0.020         0.005	FCR         1.27b         1.18b         1.49a         1.25b         1.22b         1.38a         0.022         0.001         0.001         0.001           Dumett test         2.447         1.86.25         188.75         187.99         1.22b         1.38a         0.022         0.001         0.001         0.001           Dumett test         1.026         194.72         186.25         188.75         187.99         168.61a         0.022         0.001         0.001         0.005           BWG (g0         172.57a         162.85a         163.82a         146.39b         168.61a         0.070         0.870a           RCR         0.860a         0.920a         0.880a         0.970b         0.870a         0.022         0.001         0.001           Grower         1310.21         1328.32         1314.79         1059.89         1358.27         144.04         0.736           BWG (g)         704.92a         641.018         533.22         171.19         0.732         171.19         0.734           FCR         1.41         1.55         1.499         1.38         1.52         0.180         0.734           FCR         1.499         1.38         1.52         0.180         0.734 </td <td>BWG (g)</td> <td>13</td> <td></td> <td>1419.69ª</td> <td>1160<sup>b</sup>.73</td> <td><math>1344.83^{a}</math></td> <td><math>1382.26^{a}</math></td> <td>1252.40 b</td> <td><math>1381.88^{a}</math></td> <td>1252.78<sup>b</sup></td> <td>21.7</td> <td>0.001</td> <td>0.001</td> <td>0.028</td>	BWG (g)	13		1419.69ª	1160 <sup>b</sup> .73	$1344.83^{a}$	$1382.26^{a}$	1252.40 b	$1381.88^{a}$	1252.78 <sup>b</sup>	21.7	0.001	0.001	0.028
	Durnett test         Stature         El (g)       190.26       194.72       186.25       188.75       187.99       68.61a         BWG (g0       172.57a       162.85a       163.82a       146.39b       168.61a       5.69       0.005         BWG (g0       172.57a       162.85a       163.82a       146.39b       168.61a       5.69       0.005         FCR       0.860a       0.920a       0.870a       0.870a       0.020       0.005         Grower       1310.21       1328.32       1314.79       1059.89       1358.27       1440.44       0.736         BWG (g)       7/44.2a       642.92b       671.08a       585.18b       674.51a       177.19       0.020       0.022         BWG (g)       7/44.2a       1.155       1.149       1.253       1.344.83b       0.734       0.736         FCR       1.14a       1.25a       1.344.83b       2733.2b       2794.36b       0.734       0.736         BWG (g)       1.14a       1.27a       1.18a       1.25a       0.024       0.002       0.025         BWG (g)       1.14a       1.27a       1.1490.6a       1160.73b       1344.83b       0.024       0.024 </td <td>Durnett test       5.34       0.693         Stater       190.26       194.72       186.25       188.75       187.99       5.34       0.693         FI(g)       172.57a       162.85a       163.82a       146.39b       168.61a       5.69       0.005         RVG       0       172.57a       162.85a       163.82a       146.39b       168.61a       5.69       0.005         RVC       0.860a       0.920a       0.870a       0.870a       0.020       0.005         ROWER       1310.21       1328.32       1314.79       1059.89       1358.27       140.04       0.736         RVG       (g)       141       1.55       1.49       1.38       1.52       17.19       0.023         RVG       (g)       141       1.55       1.49       1.38       1.52       17.19       0.734         FCR       1.141       1.55       1.49       1.38       1.52       1.49       1.53       1.52         FI(g)       134.306       1419.06       1160.73b       134.83b       50.3       0.023       0.734         FCR       1.1.4b       1.27a       1.49       1.25a       0.149       0.736       0.010      <t< td=""><td>FCR</td><td>[</td><td>1.27<sup>b</sup></td><td><math>1.18^{\mathrm{b}}</math></td><td>1.49ª</td><td><math>1.25^{b}</math></td><td>1.22<sup>b</sup></td><td><math>1.38^{a}</math></td><td><math>1.22^{b}</math></td><td><math>1.38^{a}</math></td><td>0.022</td><td>0.001</td><td>0.001</td><td>0.006</td></t<></td>	Durnett test       5.34       0.693         Stater       190.26       194.72       186.25       188.75       187.99       5.34       0.693         FI(g)       172.57a       162.85a       163.82a       146.39b       168.61a       5.69       0.005         RVG       0       172.57a       162.85a       163.82a       146.39b       168.61a       5.69       0.005         RVC       0.860a       0.920a       0.870a       0.870a       0.020       0.005         ROWER       1310.21       1328.32       1314.79       1059.89       1358.27       140.04       0.736         RVG       (g)       141       1.55       1.49       1.38       1.52       17.19       0.023         RVG       (g)       141       1.55       1.49       1.38       1.52       17.19       0.734         FCR       1.141       1.55       1.49       1.38       1.52       1.49       1.53       1.52         FI(g)       134.306       1419.06       1160.73b       134.83b       50.3       0.023       0.734         FCR       1.1.4b       1.27a       1.49       1.25a       0.149       0.736       0.010 <t< td=""><td>FCR</td><td>[</td><td>1.27<sup>b</sup></td><td><math>1.18^{\mathrm{b}}</math></td><td>1.49ª</td><td><math>1.25^{b}</math></td><td>1.22<sup>b</sup></td><td><math>1.38^{a}</math></td><td><math>1.22^{b}</math></td><td><math>1.38^{a}</math></td><td>0.022</td><td>0.001</td><td>0.001</td><td>0.006</td></t<>	FCR	[	1.27 <sup>b</sup>	$1.18^{\mathrm{b}}$	1.49ª	$1.25^{b}$	1.22 <sup>b</sup>	$1.38^{a}$	$1.22^{b}$	$1.38^{a}$	0.022	0.001	0.001	0.006
	Starter         Starter         Starter         Starter         F1(g)         190.26         194.72         186.25         188.75         187.99         188.75         187.99         168.61a         5.34         0.693         5.34         0.693         5.69         0.005         5.69         0.005         5.69         0.005	Starter Fl (g) 190.26 194.72 186.25 188.75 187.99 168.61a BWG (g0 172.57a 162.85a 163.82a 146.39b 168.61a FCR 0.860a 0.920a 0.920a 0.870a Grower Fl (g) 1310.21 1328.32 1314.79 1059 89 1358.27 Fl (g) 1441 1.55 1.49 1.38 1.52 Fl (g) 2738.28a 2793.28a 2757.7a 2894.96b 2803.22a BWG (g) 1459.56a 1344.06b 1140.06a 1160.73b 1344.83b FCR 1.14a 1.27a 1.18a 1.52 BWG (g) 1459.56a 1344.06b 1160.73b 1344.83b FCR 1.14a 1.27a 1.18b 1.25a 0.043 BWG (g) 1459.56a 1344.06b 1160.73b 1344.83b FCR 1.14a 1.27a 1.18b 1.49b 1.25a BWG (g) 1459.56a 1344.06b 1160.73b 1344.83b FCR 1.14a 1.27a 1.18b 1.49b 1.25a BWG (g) 1459.56a 1344.06b 1160.73b 1344.83b FCR 1.14a 1.27a 1.18b 1.49b 1.25a BWG (g) 1459.56a 1344.06b 1160.73b 1344.83b FCR 1.14a 1.27a 1.18b 1.49b 1.25a BWG (g) 1459.56a 1344.06b 1160.73b 1344.83b FCR 1.14a 1.27a 1.18b 1.49b 1.25a BWG (g) 1459.56a 1344.06b 1160.73b 1344.83b FCR 1.14a 1.27a 1.18b 1.49b 1.25a BWG (g) 1459.56a 1344.06b 1160.73b 1344.83b FCR 1.14a 1.27a 1.18b 1.49b 1.25a BWG (g) 1459.56a 1344.06b 1160.73b 1344.83b FCR 1.14a 1.27a 1.18b 1.49b 1.25a BWG (g) 1459.56a 1344.06b 1160.73b 1344.83b FCR 1.14a 1.27a 1.18b 1.40b 1.25a BWG (g) 1459.56a 1344.06b 1160.73b 1344.83b FCR 1.14a 1.27a 1.18b 1.40b 1.25a BWG (g) 1459.56a 1344.05b BWG (g) 1459.56a 1344.05b BWG (g) 1459.56a 1346.64b 1466.64b 1466.66b 1466.64b 1466.64b 1466.64b 1466.64b 1466.64b 1466.66b 1466.66b 1466.64b 1466.64b 1466.64b 1466.66b 1466.64b 1466.66b 1466.64b 1466.64b 1466.64b 1466.64b 1466.64b 1466.64b 1466.64b 1	Dunnett test													
	FI (g)         190.26         194.72         186.25         188.75         187.99         5.34         0.693         5.34         0.693         5.69         0.005         5.69         0.005         5.69         0.005         5.69         0.005         5.69         0.005         5.69         0.005         5.69         0.005         5.69         0.005         5.69         0.005         5.69         0.005         5.69         0.005         5.69         0.005         5.69         0.005         5.69         0.005         5.69         0.005         5.69         0.005         5.69         0.005         6.71.08         5.85.18         6.74.51a         1.40.04         0.734         1.40.04         0.734         1.71.9         0.022         0.023         1.61.60         1.51         1.41.36         1.43.38         1.52         1.40.04         0.734         1.71.9         0.023         1.40.04         0.734         1.71.9         0.023         1.80.1         1.71.9         0.023         1.80.13         1.81.7         1.49.83         1.52.8         1.40.34         1.40.04         0.734         1.71.9         0.023         1.80.13         1.40.04         0.734         1.71.9         0.023         1.71.9         0.023         1.81.83	H (g) $190.26$ $194.72$ $186.75$ $187.75$ $187.79$ $187.79$ $187.79$ $168.61^{a}$ $5.34$ $0.693$ BWG (g0 $172.57^{a}$ $162.85^{a}$ $163.82^{a}$ $146.39^{b}$ $168.61^{a}$ $5.69$ $0.005$ GrowerGrower $0.860^{a}$ $0.920^{a}$ $0.870^{a}$ $0.870^{a}$ $0.870^{a}$ $0.020$ $0.005$ Grower $17(2)$ $1328.32$ $1314.79$ $1059.89$ $1358.27$ $1440.44$ $0.736$ BWG (g) $1310.21$ $1328.32$ $1314.79$ $1059.89$ $1358.27$ $1440.44$ $0.736$ FIR $1.41$ $1.55$ $1.49$ $1.38$ $1.52$ $174.90^{a}$ $0.022$ $0.002$ BWG (g) $1310.21$ $1328.32$ $1344.69^{a}$ $1.60.73^{a}$ $1344.83^{b}$ $0.734$ $0.734$ FCR $1.141$ $1.25^{a}$ $1.138^{a}$ $1.23^{a}$ $1344.83^{b}$ $0.734$ $0.736$ BWG (g) $1.459.56^{a}$ $1344.66^{a}$ $1160.73^{b}$ $1344.83^{b}$ $0.734$ $0.734$ FCR $1.14^{a}$ $1.27^{a}$ $1.18^{a}$ $1.25^{a}$ $1.49^{b}$ $1.25^{a}$ $0.010$ RWG (g) $1.459.56^{a}$ $1344.66^{b}$ $1149.06^{a}$ $1140.06^{a}$ $1.25^{a}$ $0.024$ $0.001$ FCR $1.14^{a}$ $1.27^{a}$ $1.18^{a}$ $1.25^{a}$ $1.28^{a}$ $0.010^{a}$ RWG (g) $1.510, R510, R510, R520, represent corr-solvean meal basal diet, diet containing %10 raw flaxseed, diet containing %20 flaxeed and diet $	Starter													
g0         172.57a         162.85a         163.82a         146.39b         168.61a         5.69           0.860a         0.920a         0.880a         0.970b         0.870a         0.870a         0.0020           g1         1310.21         1328.32         1314.79         1059.89         1358.27         0.0020         0.020           g1         704.92a         642.92b         671.08a         585.18b         674.51a         140.04           g1         1.41         1.55         1.49         1.38         1.52         0.180           g1         1.41         1.55         1.49         1.38         1.52         0.180           g1         1459.56a         1344.06b         1419.06a         1160.73b         1344.83b         570.3           g1         1.459.56a         1344.06b         1419.06a         1160.73b         1344.83b         57.83         57.3           g1         1.47a         1.27a         1.18a         1.49b         1.25a         0.024	BWG (g0         172.57a         162.85a         163.82a         146.39b         168.61a         5.69         0.005           FCR         0.860a         0.920a         0.880a         0.970b         0.870a         5.69         0.005           Grower         1310.21         1328.32         1314.79         1059.89         1358.27         140.04         0.736           BWG (g)         704.92a         642.92b         671.08a         585.18b         674.51a         177.19         0.022           FCR         1.41         1.55         1.49         1.38         1.52         149.03         0.734           Finisher         7         1.41         1.55         1.49         1.38         1.52         0.180         0.734           FCR         1.41         1.55         1.49         1.38         1.52         0.180         0.734           FUS         2738.28a         2793.28a         2793.23a         0.043         0.734           BWC (g)         1.459.56a         1.149         1.27a         1.499         1.25a         0.043           BWC (g)         1.570 and RFS20 represent corn-soybean meal basal diet, diet containing %10 raw flaxseed, diet containing %20 flaxseed and diet containing %20 flaxseed and diet containing %20 flaxseed,	BWG (g0 172.57a 162.85a 163.82a 146.39b 168.61a FCR 0.860a 0.920a 0.880a 0.970b 0.870a Grower F1 (g) 1310.21 1328.32 1314.79 1059.89 1358.27 BWG (g) 704.92a 642.92b 671.08a 585.18b 674.51a FCR 1.41 1.55 1.49 1.38 1.52 FCR 1.41 1.55 0.492a 671.08a 585.18b 674.51a FCR 1.41 1.55 1.49 1.38 1.52 FOR 1.41 1.55 0.492a 671.08a 585.18b 674.51a FCR 1.41 1.55 1.49 1.38 1.52 FOR 1.41 1.55 0.492a 671.08a 585.18b 674.51a FCR 1.41 1.55 1.49 1.38 1.52 FOR 1.41 1.55 1.49 1.25a FOR 1.410.06a 1160.73b 1344.83b FCR 1.14a 1.27a 1.18a 1.49b 1.25a FCR 1.14a 1.27a 1.18a 1.49b 1.25a FCR 1.14a 1.27a 1.18b 1.49b 1.25a FCR 1.14a 1.27a 1.18b 1.49b 1.25a FCR 1.14a 1.27a 1.18b 1.49b 1.25a			94.72	186.25	188.75	187.99					5.34	0.693		
	FCR         0.860 <sup>a</sup> 0.920 <sup>a</sup> 0.880 <sup>a</sup> 0.970 <sup>b</sup> 0.870 <sup>a</sup> Grower         F1(g)         1310.21         1328.32         1314.79         1059.89         1358.27         140.04         0.736           BWG (g)         704.92 <sup>a</sup> 642.92 <sup>b</sup> 671.08 <sup>a</sup> 585.18 <sup>b</sup> 674.51 <sup>a</sup> 17.19         0.022           FCR         1.41         1.55         1.49         1.38         1.52         17.19         0.024           Finisher         1.41         1.55         1.49         1.38         1.52         17.19         0.024           FU (g)         2738.28 <sup>a</sup> 2793.28 <sup>a</sup> 2793.28 <sup>a</sup> 275.72 <sup>a</sup> 2894.96 <sup>b</sup> 2803.22 <sup>a</sup> 50.3         0.180         0.734           FU (g)         1459.56 <sup>a</sup> 1419.06 <sup>a</sup> 1160.73 <sup>b</sup> 1344.83 <sup>b</sup> 57.8         0.010           FCR         1.14 <sup>a</sup> 1.27 <sup>a</sup> 1.18 <sup>a</sup> 1.49 <sup>b</sup> 1.25 <sup>a</sup> 50.3         0.043           FCR         1.14 <sup>a</sup> 1.27 <sup>a</sup> 1.18 <sup>a</sup> 1.49 <sup>b</sup> 1.25 <sup>a</sup> 0.042         57.8         0.010           FCR         1.14 <sup>a</sup> 1.27 <sup>a</sup> 1	FCR         0.860 <sup>a</sup> 0.920 <sup>a</sup> 0.870 <sup>b</sup> 0.870 <sup>a</sup> 0.970 <sup>b</sup> 0.870 <sup>a</sup> 0.020         0.005           Grower         F1 (g)         1310.21         1328.32         1314.79         1059.89         1358.27         140.04         0.736           BWG (g)         704.92 <sup>a</sup> 642.92 <sup>b</sup> 671.08 <sup>a</sup> 585.18 <sup>b</sup> 674.51 <sup>a</sup> 1.32         1.31         0.020         0.005           FCR         1.41         1.55         1.49         1.38         1.52         1.49         1.38         1.52           Finisher         FCR         1.41         1.55         0.149         1.38         1.52           Finisher         FCR         1.41         1.55         0.043         0.043           BWG (g)         1459.56 <sup>a</sup> 1344.06 <sup>b</sup> 1149.06 <sup>a</sup> 1.49 <sup>b</sup> 1.25 <sup>a</sup> BWG (g)         1.459.56 <sup>a</sup> 1344.66 <sup>b</sup> 1.49 <sup>b</sup> 1.25 <sup>a</sup> 0.043         0.024         0.001           FCR         1.14 <sup>a</sup> 1.27 <sup>a</sup> 1.18 <sup>a</sup> 1.49 <sup>b</sup> 1.25 <sup>a</sup> 0.024         0.010         0.024         0.010           FCR         1.14 <sup>a</sup> 1.27 <sup>a</sup> <t< td=""><td></td><td></td><td>5<b>2.</b>85ª</td><td><math>163.82^{a}</math></td><td><math>146.39^{b}</math></td><td><math>168.61^{a}</math></td><td></td><td></td><td></td><td></td><td>5.69</td><td>0.005</td><td></td><td></td></t<>			5 <b>2.</b> 85ª	$163.82^{a}$	$146.39^{b}$	$168.61^{a}$					5.69	0.005		
g) $\begin{array}{cccccccccccccccccccccccccccccccccccc$	Grower F1 (g) 1310.21 1328.32 1314.79 1059.89 1358.27 BWG (g) 704.92a 642.92b 671.08a 585.18b 674.51a FCR 1.41 1.55 1.49 1.38 1.52 Finisher FI (g) 2738.28a 2793.28a 2725.72a 2894.96b 2803.22a BWG (g) 1459.56a 1344.06b 1419.06a 1160.73b 1344.83b FCR 1.14a 1.27a 1.18a 1.49b 1.25a Control, FS10, FS20 and RFS20, represent corn-soybean meal basal diet, diet containing %10 raw flaxseed, diet containing %10 electron irradiated flaxseed, respectively. Standard error of means: Flax seed: <sup>4</sup> Irradiation: Feed intake: <sup>6</sup> Body weight gain. <sup>7</sup> Feed conversion ratio.	GrowerH (g)1310.211328.321314.791059.891358.27140.040.736BWG (g)704.92a642.92b677.108a585.18b $674.51a$ 17.190.022FCR1.411.551.491.381.521.900.734Finisher1.411.551.491.381.52Finisher2738.28a2793.28a2793.28a2793.28a2793.28a2793.28aFCR1.14a1.27a1.18a1.49b1.25a0.043BWG (g)1459.56a1344.06b1160.73b1344.83b275.7a20043FCR1.14a1.27a1.18a1.49b1.25a0.0240.010FCR1.14a1.27a1.18a1.49b1.25a0.0240.001FCR1.14a1.27a1.18a1.49b1.25a0.0240.001FCR1.14a1.27a1.18a1.49b1.25a0.0240.001FCR1.14a1.27a1.18a1.49b1.25a0.0240.001FCR1.14a1.27a1.18a1.49b1.25a0.0240.001FCR1.14a1.27a1.18a1.49b1.25a0.0240.001FCR1.14a1.27a1.18a1.49b1.25a0.0240.001FCR1.14a1.27a1.18a1.49b1.25a0.0240.001FCR1.14a1.27a1.18a1.49b1.25a0.0240.001<			.920a	$0.880^{a}$	$0.970^{b}$	$0.870^{a}$					0.020	0.005		
g) $1310.21  1328.32  1314.79  1059.89  1358.27$ $140.04$ $704.92^{a}  642.92^{b}  671.08^{a}  585.18^{b}  674.51^{a}$ $1.7.19$ $17.19$ 1.41  1.55  1.49  1.38  1.52 $0.1802738.28^{a}  2793.28^{a}  2793.28^{a}  2894.96^{b}  2803.22^{a} 1.440^{b}  1419.06^{a}  1160.73^{b}  1344.83^{b} 1.27^{a}  1.18^{a}  1.49^{b}  1.25^{a} 0.024$	F1 (g)       1310.21       1328.32       1314.79       1059.89       1358.27       140.04       0.736         BWG (g)       704.92a       642.92b       671.08a       585.18b       674.51a       17.19       0.022         FCR       1.41       1.55       1.49       1.38       1.52       1.49       0.734         Finisher       704.92a       642.92b       671.08a       585.18b       674.51a       0.180       0.734         Finisher       1.41       1.55       1.49       1.38       1.52       0.180       0.734         Finisher       2738.28a       2793.28a       2725.72a       2894.96b       2803.22a       50.3       0.043         BWG (g)       1459.56a       1344.06b       1160.73b       1344.83b       277.8       0.010         FCR       1.14a       1.27a       1.18a       1.49b       1.25a       0.024       0.001         FCR       1.14a       1.27a       1.18a       1.49b       1.25a       0.024       0.001         FCR       1.14a       1.27a       1.18a       1.49b       1.25a       0.024       0.001         FCR       1.14a       1.27a       1.49b       1.25a       0.024	F1 (g)       1310.21       1328.32       1314.79       1059.89       1358.27       140.04       0.736         BWG (g)       704.92a       642.92b       671.08a       585.18b       674.51a       17.19       0.022         FCR       1.41       1.55       1.49       1.38       1.52       17.19       0.022         Finisher       704.92a       642.92b       671.08a       585.18b       674.51a       17.19       0.022         Finisher       1.41       1.55       1.49       1.38       1.52       0.140       0.734         FI (g)       2738.28a       2793.28a       2725.72a       2894.96b       2803.22a       803.22a       50.3       0.043         BWG (g)       1459.56a       1344.06b       1419.06a       1160.73b       1344.83b       2758       0.010         FCR       1.14a       1.27a       1.18a       1.49b       1.25a       0.024       0.001         FCR       1.14a       1.27a       1.18a       1.25a       0.024       0.001         FCR       1.14a       1.27a       1.18a       1.49b       1.25a       0.024       0.001         FCR       1.14a       1.27a       1.18a       1.49b <td>Grower</td> <td></td>	Grower													
g) $704.92^{a}$ $642.92^{b}$ $671.08^{a}$ $585.18^{b}$ $674.51^{a}$ $17.19$ 1.41 $1.55$ $1.49$ $1.38$ $1.52$ $0.1802738.28^{a} 2793.28^{a} 2793.28^{a} 2793.28^{a} 2894.96^{b} 2803.22^{a}1.459.56^{a} 1344.06^{b} 1419.06^{a} 1160.73^{b} 1344.83^{b}1.14^{a} 1.27^{a} 1.18^{a} 1.49^{b} 1.25^{a} 0.024$	BWG (g)         704.92 <sup>a</sup> 642.92 <sup>b</sup> 671.08 <sup>a</sup> 585.18 <sup>b</sup> 674.51 <sup>a</sup> 17.19         0.022           FCR         1.41         1.55         1.49         1.38         1.52           Finisher         1.41         1.55         1.49         1.38         1.52           Finisher         2738.28 <sup>a</sup> 2793.28 <sup>a</sup> 2725.72 <sup>a</sup> 2894.96 <sup>b</sup> 2803.22 <sup>a</sup> BWG (g)         1459.56 <sup>a</sup> 1344.06 <sup>b</sup> 1419.06 <sup>a</sup> 160.73 <sup>b</sup> 1344.83 <sup>b</sup> 27.8         0.010           FCR         1.14 <sup>a</sup> 1.27 <sup>a</sup> 1.18 <sup>a</sup> 1.49 <sup>b</sup> 1.25 <sup>a</sup> 27.5         20.010           FCR         1.14 <sup>a</sup> 1.27 <sup>a</sup> 1.18 <sup>a</sup> 1.25 <sup>a</sup> 0.024         0.001           FCR         1.14 <sup>a</sup> 1.27 <sup>a</sup> 1.14 <sup>b</sup> 1.25 <sup>a</sup> 0.024         0.001           FCR         1.14 <sup>a</sup> 1.27 <sup>a</sup> 1.49 <sup>b</sup> 1.25 <sup>a</sup> 0.024         0.001           FCR         1.14 <sup>b</sup> 0.270 <sup>a</sup> 1.25 <sup>a</sup> 0.25 <sup>a</sup> 0.043         0.002           FCR         1.14 <sup>a</sup> 1.27 <sup>a</sup> 1.18 <sup>a</sup> 1.25 <sup>a</sup> 0.0	BWG (g)         704.92a         642.92b         671.08a         585.18b         674.51a         17.19         0.022           FCR         1.41         1.55         1.49         1.38         1.52           Finisher         1.41         1.55         1.49         1.38         1.52           Finisher         0.180         0.734         0.734           Finisher         1.41         1.55         1.49         1.38           FI (g)         2738.28a         2793.28a         2775.2a         2894.96b         2803.22a           BWG (g)         1459.56a         1344.06b         1419.06a         1160.73b         1344.83b         50.3         0.043           FCR         1.14a         1.27a         1.18a         1.49b         1.25a         50.3         0.001           FCR         1.14a         1.27a         1.18a         1.49b         1.25a         0.024         0.001           FCR         1.14a         1.27a         1.18a         1.49b         1.25a         0.024         0.001           FCR         1.14a         1.27a         1.18a         1.49b         1.25a         0.024         0.001           Control, FS10, RFS10, RFS10, RFS20, represent corn-soybean mea			128.32	1314.79	1059.89	1358.27					140.04	0.736		
	FCR       1.41       1.55       1.49       1.38       1.52         Finisher       1.41       1.55       1.49       1.38       1.52         Finisher       2738.28ª       2793.28ª       2725.72a       2894.96 <sup>b</sup> 2803.22a         BWG (g)       1459.56a       1344.06 <sup>b</sup> 1419.06a       1160.73b       1344.83 <sup>b</sup> 277.8       0.010         FCR       1.14a       1.27a       1.18a       1.49 <sup>b</sup> 1.25 <sup>a</sup> 0.024       0.001         FCR       1.14a       1.27a       1.18a       1.49 <sup>b</sup> 1.25 <sup>a</sup> 0.024       0.001         Control, FS10, RFS10, FS20 and RFS20, represent corn-soybean meal basal diet, diet containing %10 raw flaxseed, diet containing %10 electron irradiated flaxseed, diet containing %20 flaxseed and diet containing %20 electron irradiated flaxseed, respectively.         Standard error of means: 3Flax seed; 4Irradiation; 5Feed intake; 6Body weight gain; 7Feed conversion ratio.	FCR         1.41         1.55         1.49         1.38         1.52         0.180         0.734           Finisher         1.41         1.55         1.49         1.38         1.52         0.180         0.734           Finisher         2738.28a         2793.28a         2775.72a         2894.96b         2803.22a         50.3         0.043           BWG (g)         1459.56a         1344.06b         1419.06a         1160.73b         1344.83b         277.8         0.010           FCR         1.14a         1.27a         1.18a         1.49b         1.25a         0.024         0.001           FCR         1.14a         1.27a         1.18a         1.49b         1.25a         0.024         0.001           FCR         1.14a         1.27a         1.149b         1.25a         0.024         0.001           FCR         1.14a         1.27a         1.49b         1.25a         0.024         0.001           FCR         1.14a         1.27a         1.49b         1.25a         0.024         0.001           FCR         1.14a         1.27a         1.49b         1.25a         0.044 store tore store			t2.92b	671.08a	$585.18^{b}$	674.51 <sup>a</sup>					17.19	0.022		
2738.28 <sup>a</sup> 2793.28 <sup>a</sup> 2725.72 <sup>a</sup> 2894.96 <sup>b</sup> 2803.22 <sup>a</sup> 50.3 1459.56 <sup>a</sup> 1344.06 <sup>b</sup> 1419.06 <sup>a</sup> 1160.73 <sup>b</sup> 1344.83 <sup>b</sup> 27.8 1.14 <sup>a</sup> 1.27 <sup>a</sup> 1.18 <sup>a</sup> 1.49 <sup>b</sup> 1.25 <sup>a</sup> 0.024	Finisher         Finisher         50.3         0.043         50.3         0.043         50.3         0.043         50.3         0.043         50.3         0.043         50.3         0.043         50.3         0.043         50.3         0.043         50.3         0.043         50.3         0.043         50.3         0.043         50.3         0.043         50.3         0.043         50.3         0.043         50.3         0.043         50.3         0.043         50.3         50.3         0.043         50.3         0.043         50.3         50.3         0.043         50.3         50.3         0.043         50.3         0.043         50.3         7.8         0.010         50.3         7.8         0.010         50.3         1.14a         1.27a         1.14b         1.27a         1.149a         1.25a         0.001         7.27a         0.001         7.27a         0.001         7.27a         0.001         7.27a         0.001         7.27a         0.001         7.27a         1.14a         1.27a         1.14b         1.27a         1.29a         0.001         7.25a         0.001         7.27a         1.29a         0.001         7.27a         7.27a         7.27a         7.27a         7.27a         7.27a	Finisher       Finisher       50.3       0.043         FI (g)       2738.28ª       2793.28ª       2725.72ª       2894.96b       2803.22ª         BWG (g)       1459.56a       1344.06b       1419.06a       1160.73b       1344.83b       27.8       0.010         BWG (g)       1459.56a       1344.06b       1419.06a       1160.73b       1344.83b       27.8       0.010         FCR       1.14a       1.27a       1.18a       1.49b       1.25a       0.024       0.001         Control, FS10, RFS10, FS20 and RFS20, represent corn-soybean meal basal diet, diet containing %10 raw flaxseed, diet containing %10 electron irradiated flaxseed, do       0.024       0.001         Containing %20 flaxseed and diet containing %20 electron irradiated flaxseed, respectively.       510 raw flaxseed, diet containing %10 electron irradiated flaxseed, diet containing %10 electron irradiated flaxseed, diet containing %10 electron irradiated flaxseed, do         Standard error of means; <sup>3</sup> Flax seed; <sup>4</sup> Irradiation; <sup>5</sup> Feed intake; <sup>6</sup> Body weight gain; <sup>7</sup> Feed conversion ratio.       1.14.00.10.10.10.10.10.10.10.10.10.10.10.10.			1.55	1.49	1.38	1.52					0.180	0.734		
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	FI (g)       2738.28a       2793.28a       2725.72a       2894.96b       2803.22a         BWG (g)       1459.56a       1344.06b       1419.06a       1160.73b       1344.83b         FCR       1.14a       1.27a       1.18a       1.49b       1.25a         Control, FS10, FFS10, FS20 and RFS20, represent corn-soybean meal basal diet, diet containing %10 raw flaxseed, diet containing %10 electron irradiated flaxseed, diet containing %10 electron irradiated flaxseed, dist containing %20 flaxseed and diet containing %20 electron irradiated flaxseed, respectively.	FI (g)       2738.28a       2793.28a       2725.72a       2894.96b       2803.22a         BWG (g)       1459.56a       1344.06b       1419.06a       1160.73b       1344.83b         FCR       1.14a       1.27a       1.18a       1.49b       1.25a         Control, FS10, FFS10, FFS20 and RFS20, represent corn-soybean meal basal diet, diet containing %10 raw flaxseed, diet containing %10 electron irradiated flaxseed	Finisher													
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	BWG (g)       1459.56a       1344.06 <sup>b</sup> 1160.73 <sup>b</sup> 1344.83 <sup>b</sup> 27.8       0.010         FCR       1.14 <sup>a</sup> 1.27 <sup>a</sup> 1.18 <sup>a</sup> 1.49 <sup>b</sup> 1.25 <sup>a</sup> 0.024       0.001         FCR       1.14 <sup>a</sup> 1.27 <sup>a</sup> 1.18 <sup>a</sup> 1.49 <sup>b</sup> 1.25 <sup>a</sup> 0.024       0.001         Control, FS10, RFS10, FS20 and RFS20, represent corn-soybean meal basal diet, diet containing %10 raw flaxseed, diet containing %10 electron irradiated flaxseed, diet containing %10 electron irradiated flaxseed, dist containing %20 flaxseed and diet containing %20 flaxseed intake; %Body weight gain; 7Feed conversion ratio.	BWG (g)1459.56a1344.06b1419.06a1160.73b1344.83b27.80.010FCR1.14a1.27a1.18a1.49b1.25a0.0240.001FCR1.14a1.27a1.18a1.49b1.25a0.0240.001Control, FS10, RFS10, FS20 and RFS20, represent corn-soybean meal basal diet, diet containing %10 raw flaxseed, diet containing %10 electron irradiated flaxseed, d0.0240.001Control, FS10, RFS10, FS20 and RFS20, represent corn-soybean meal basal diet, diet containing %10 raw flaxseed, diet containing %10 electron irradiated flaxseed, d0.0240.001Standard error of means; 3Flax seed; 4Irradiation; 5Feed intake; 6Body weight gain; 7Feed conversion ratio.20.60.0010.0240.001				2725.72 <sup>a</sup>	2894.96 <sup>b</sup>	2803.22 <sup>a</sup>					50.3	0.043		
$1.14^{a}$ $1.27^{a}$ $1.18^{a}$ $1.49^{b}$ $1.25^{a}$ $0.024$	FCR 1.14 <sup>a</sup> 1.27 <sup>a</sup> 1.18 <sup>a</sup> 1.49 <sup>b</sup> 1.25 <sup>a</sup> 9.001 Control, FS10, RFS10, FS20 and RFS20, represent corn-soybean meal basal diet, diet containing %10 raw flaxseed, diet containing %10 electron irradiated flaxseed, distance of distance and diet containing %20 flaxseed and diet containing %20 flaxseed and diet containing %20 flaxseed. Teed intake: 6Body weight gain: 7Feed conversion ratio.	FCR 1.14 <sup>a</sup> 1.27 <sup>a</sup> 1.18 <sup>a</sup> 1.49 <sup>b</sup> 1.25 <sup>a</sup>		•		1419.06 <sup>a</sup>	1160.73 <sup>b</sup>	1344.83 <sup>b</sup>					27.8	0.010		
	<sup>(C</sup> ontrol, FS10, RFS10, FS20 and RFS20, represent corn-soybean meal basal diet, diet containing %10 raw flaxseed, diet containing %10 electron irradiated flaxseed, di containing %20 flaxseed and diet containing %20 electron irradiated flaxseed, respectively. Standard error of means: <sup>3</sup> Flax seed: <sup>4</sup> Irradiation; <sup>3</sup> Feed intake; <sup>6</sup> Body weight gain; <sup>7</sup> Feed conversion ratio.	Control, FS10, RFS10, FS20 and RFS20, represent corn-soybean meal basal diet, diet containing %10 raw flaxseed, diet containing %10 electron irradiated flaxseed, d containing %20 flaxseed and diet containing %20 electron irradiated flaxseed, respectively. Standard error of means; <sup>3</sup> Flax seed; <sup>4</sup> Irradiation; <sup>3</sup> Feed intake; <sup>6</sup> Body weight gain; <sup>7</sup> Feed conversion ratio.			1.27a	$1.18^{a}$	$1.49^{\circ}$	1.25 <sup>a</sup>					0.024	0.001		
	UMIIMU VIIOT VI TIUMIU I IMV UCOM TIIMUMANIA A AAN TIIMUMA AANT II AIPIN PARA AANA AANT ATAATI ATAATI ATAATI	$\frac{1}{3}$	Standard error of means:	<sup>3</sup> Flax set	d: 4Irradi	iation: <sup>5</sup> Fee	d intake: 6B	odv weight g	ain: 7Feed cor	version ratio.						

Beheshti Moghadam et al., 2017

Poultry Science Journal 2017, 5(2): 153-163

157

There were no significant interactions in FI, BWG, and FCR, during starter and grower periods, though this effect was significant for BWG and FCR during finisher period (P < 0.05; Table 3). Irradiation of flaxseed significantly increased (P < 0.05) BWG in grower and finisher periods, and improved FCR in all periods of the experiment. Significant differences were observed between the control and other treatments for FI in finisher periods, as well as for BWG and FCR in all three phases of the experiment (P < 0.05).

Relative weights of thigh, breast, liver, and abdominal fat of birds are shown in Table 4. F20 diets increased thigh and decreased breast percentage (P < 0.05). Feeding irradiated FS increased fat pad yield from 1.45% to 1.91% (P < 0.05). Flaxseed had a significant effect on liver weight. Chicks fed FS20 had lower liver percentage compared to chicks fed FS10 (P < 0.05). However, a significant interaction was observed in liver percentage (P < 0.05). There were significant differences between control and other treatments for thigh, fat pad, and liver percentage (P < 0.05).

Table 4. Effects of experimental diets on carcass characteristics of broilers at day 42 (% of live body weight)

Tukey		Dietar	y Treatme	ents <sup>1</sup>			Irrad	iation	Flax	seed	SEM <sup>2</sup>		P-value	
test	Control	FS10	RFS10	FS20	RFS20	-	Yes	No	10%	20%	SEIVI -	FS <sup>3</sup>	R 4	FS×R
Thigh		27.1	27.6	29.3	28.3		27.9	28.2	27.4 <sup>b</sup>	28.8 a	0.510	0.008	0.556	0.163
Breast		34.5	34.6	32.6	32.5		33.6	33.6	34.6 <sup>a</sup>	32.6 <sup>b</sup>	0.600	0.003	0.950	0.887
Fat pad		1.55	1.91	1.35	1.91		1.91 a	1.45 <sup>b</sup>	1.73	1.63	0.105	0.540	0.006	0.515
Liver		3.08	3.20	3.06	2.80		3.00	3.07	3.14 a	2.93 <sup>b</sup>	0.090	0.039	0.458	0.050
Dunnett														
test										. /				
Thigh	27.3 <sup>b</sup>	27.1 <sup>b</sup>	27.6 <sup>b</sup>	29.3ª	28.3 <sup>b</sup>				•		0.460	0.006		
Breast	33.8	34.5	34.6	32.6	32.5						0.560	0.242		
Fat pad	1.97ª	1.55 <sup>b</sup>	1.91ª	1.35 <sup>b</sup>	1.91ª						0.150	0.049		
Liver	3.26 <sup>a</sup>	3.08 <sup>a</sup>	3.20 <sup>a</sup>	3.06 <sup>a</sup>	2.80 <sup>b</sup>						0.080	0.009		
			1									01.1.0		

<sup>1</sup>Control, FS10, RFS10, FS20 and RFS20, represent corn-soybean meal basal diet, diet containing %10 raw flaxseed, diet containing %10 electron irradiated flaxseed, diet containing %20 flaxseed and diet containing %20 electron irradiated flaxseed, respectively.

<sup>2</sup>Standard error of means; <sup>3</sup>Flaxseed; <sup>4</sup>Irradiation.

<sup>a,b</sup>Values within a row with different superscripts differ significantly P < 0.05.

As shown in table 5, there were no interactions in cholesterol, triglyceride, and AST activity on days 21 and 42. Neither flaxseed nor irradiation had significant effects on serum cholesterol, triglyceride, and AST concentration at day 21, while the effect of flaxseed on AST activity on day 42 was significant (P < 0.05; Table 5). Broilers fed FS20 had significantly lower (P < 0.05) cholesterol and AST concentrations at 42 days of age. However, there were insignificant differences between the treatments for cholesterol, triglyceride and AST concentrations at 21 days of age.

The effects of irradiation dose and flaxseed levels on the apparent digestibility of EE, DM and OM in the ilea of broilers are shown in Table 6. Apparent digestibility of DM, OM, and EE increased in birds fed irradiated FS diets (P < 0.05). However, feeding FS20 reduced apparent ileal digestibility DM, OM, and EE when compared to FS10 (P < 0.05). There was a significant difference for EE, DM and OM between the control and FS treatments. Irradiation decreased (P < 0.05) digesta viscosity of birds fed FS diets (Table 6). Dietary FS levels had significant impact on digesta viscosity in birds fed FS20, as these birds had a higher viscous digesta than those fed FS10 (P < 0.05). There was a significant difference in digesta viscosity between the control and other treatments.

$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	0         RFS10           50         121.25           1         52.4           2         51.1           44         121.88           5         59.5           50         121.25           50         121.25           50         121.25           50         121.25           1         52.4           2         59.5           50         121.25           1         52.4           2         51.1           2         51.1           2         51.1           2         51.1           2         51.1           2         51.1           2         51.1           2         51.1           2         51.1           2         82.6           2         82.6           2         50.5a           2         50.5a           2         50.5a           2         50.5a           2         50.5a           2         50.5a           3         50.5a           3         50.5a           5	FS20 110 64.0 53.8 53.8 105.88 66.1 26.8 66.1 26.8 <sup>b</sup> 66.1 26.8 <sup>b</sup> 66.1 26.8 <sup>b</sup> 66.1 26.8 <sup>b</sup> 66.1 26.8 <sup>b</sup> interest by a sectively respe	RFS20 116.20 50.0 60.5 74.8 34.5 34.5 34.5 50.0 60.5 60.5 60.5 34.5 <sup>b</sup> 34.5 <sup>b</sup> asal diet, diet c y.	Yes 55.8 1: 55.8 1: 55.8 1: 78.7 47.0 47.0 0 ontaining %1	No 54.5 58.0 69.8 40.0 113.16 69.8 40.0	10% 121.88 56.7 56.7 78.0 56.4 <sup>a</sup> 56.4 <sup>a</sup> 56.4 <sup>a</sup>	20%	8.08 8.05 9.27 7.82 4.39 6.34 6.34 6.34 8.93 8.93 8.02 8.02 8.02 8.02 8.02 6.58 hectron irrac	FS <sup>3</sup> 0.300 0.322 0.962 0.215 0.099 0.099 0.099 0.58 0.58 0.58 0.58 0.58 0.537 0.658 0.208 0.393 0.010 0.393 diated flaxsei	R 4 0.766 0.679 0.817 0.817 0.443 0.055 0.279 0.279 ed, diet cont	FS×R 0.654 0.353 0.3559 0.957 0.914 0.914 aining %20
I d Cholesterol (mg/dL) 122.5 Triglyceride (mg/dL) 45.1 AST <sup>5</sup> (IU/L) 62.2 AST <sup>5</sup> (IU/L) 62.2 Cholesterol (mg/dL) 120.4 Triglyceride (mg/dL) 73.5 Mart (IU/L) 73.5 AST (IU/L) 73.5 AST (IU/L) 126.25 122.5 Cholesterol (mg/dL) 126.25 122.5 Triglyceride (mg/dL) 126.25 122.5 AST (IU/L) 49.2 45.1 AST (IU/L) 78.6 73.5 AST (IU/L) 58.6 73.5 Cholesterol (mg/dL) 134 <sup>a</sup> 120.4 Triglyceride (mg/dL) 78.6 73.5 AST (IU/L) 58.6 73.5 Control, FSI0, FS20 and RFS20, repres axseed and diet containing %20 electron irradii Standard error of means; <sup>3</sup> Flax seed; <sup>4</sup> Irradiatic	50 121.25 1 52.4 2 51.1 14 121.88 5 82.6 2 59.5 5 59.5 1 52.4 2 51.1 1 52.4 2 51.1 1 52.4 2 51.1 2 51.5 2 59.5 2 59.5 2 59.5 2 51.1 2 51.1	110 64.0 53.8 66.1 105.88 66.1 26.8 66.1 26.8 <sup>b</sup> 66.1 26.8 <sup>b</sup> 66.1 26.8 <sup>b</sup> 66.1 26.8 <sup>b</sup> can meal b respectively $P < ($	116.20 50.0 60.5 60.5 74.8 34.5 34.5 34.5 60.5 60.5 60.5 60.5 34.5 <sup>a</sup> 74.8 74.8 74.8 34.5 <sup>a</sup> 74.8 54.0 50.0 60.5 51.0 50.0 50.0 50.0 50.0 50.0 50.0 5	118.73 11 51.2 1 55.8 11 78.7 1 47.0 4 47.0 0 0ntaining %1	16.25 34.5 58.0 13.16 59.8 40.0 10.0 raw flaxsee	121.88 1 48.7 56.7 78.0 56.4 <sup>a</sup> 56.4 <sup>a</sup> 56.4 <sup>a</sup>	57.0 57.1 70.4 30.7b 30.7b	8.08 8.05 9.27 7.82 4.39 6.34 6.34 6.34 6.34 8.93 8.93 8.02 8.02 8.02 8.02 6.58 6.58 dectron irra	0.300 0.322 0.962 0.215 0.099 0.004 0.099 0.099 0.537 0.658 0.537 0.658 0.208 0.208 0.208 0.208 0.208 0.208 0.208	0.766 0.679 0.817 0.817 0.817 0.279 0.279 0.279	0.654 0.205 0.353 0.559 0.957 0.914 0.914 aining %21
Cholesterol (mg/dL) 122.5 Triglyceride (mg/dL) 45.1 AST <sup>5</sup> (IU/L) 62.2 2 d Cholesterol (mg/dL) 120.4 Triglyceride (mg/dL) 73.5 AST (IU/L) 53.2 Munett test 12.6 Cholesterol (mg/dL) 126.25 122.5 AST (IU/L) 49.2 45.1 AST (IU/L) 41.5 62.2 Cholesterol (mg/dL) 134 <sup>a</sup> 120.4 Cholesterol (mg/dL) 134 <sup>a</sup> 120.4 Cholesterol (mg/dL) 134 <sup>a</sup> 120.4 Cholesterol (mg/dL) 134 <sup>a</sup> 120.4 Cholesterol (mg/dL) 78.6 73.5 AST (IU/L) 58.6 <sup>a</sup> 53.2 Cholesterol (mg/dL) 78.6 73.5 AST (IU/L) 58.6 <sup>a</sup> 53.2 Cholesterol (mg/dL) 78.6 73.5 AST (IU/L) 78.6 73.5 AST (IU/L) 78.6 73.5 Cholesterol (mg/dL) 78.6 73.5 AST (IU/L) 78.0 and RFS0, represented and diet containing %20 electron irradii standard error of means; <sup>3</sup> Flax seed; <sup>4</sup> Irradiatic Values within a row with different superscription and the transpersented at the transpersente	50         121.25           1         52.4           2         51.1           44         121.88           5         59.5           50         121.25           50         121.25           50         121.25           50         121.25           50         121.25           50         121.25           60         121.25           7         51.1           82.6         53.5           60         121.25           1         52.4           2         51.1           2         51.1           2         51.1           2         51.1           2         51.1           2         51.1           2         51.1           2         51.1           2         51.1           2         51.1           2         51.1           2         51.1           2         51.1           2         51.1           2         51.1           2         51.1           3         51.1           4	110 64.0 53.8 66.1 105.88 66.1 26.8 64.0 53.8 64.0 53.8 66.1 26.8 <sup>b</sup> 66.1 26.8 <sup>b</sup> 66.1 26.8 <sup>b</sup> 66.1 26.8 <sup>b</sup> 53.8 53.8 <sup>b</sup> 53.8 <sup>b</sup> 54.0 55.8 <sup>b</sup> 53.8 <sup>b</sup> 53.8 <sup>b</sup> 53.8 <sup>b</sup> 54.0 56.8 <sup>b</sup> 53.8 <sup>b</sup> 54.0 56.8 <sup>b</sup> 56.10 56.8 <sup>b</sup> 56.10 57.8 <sup>b</sup> 56.10 57.8 <sup>b</sup> 56.10 56.	116.20 50.0 60.5 74.8 34.5 34.5 34.5 50.0 50.0 60.5 60.5 60.5 34.5 <sup>a</sup> 74.8 74.8 74.8 34.5 <sup>b</sup> seal diet, diet c	118.73 1 55.8 55.8 1 119.22 1 78.7 6 47.0 4 47.0 0 0 taining %1	16.25 54.5 58.0 59.8 59.8 40.0 13.16 40.0 7 raw flaxsee	121.88 1 48.7 56.7 78.0 56.4 <sup>a</sup> 56.4 <sup>a</sup> 56.4 <sup>a</sup>	113.10 57.0 57.1 111.22 70.4 30.7 <sup>b</sup> 30.7 <sup>b</sup> ining %10 e <sup>i</sup>	8.08 8.05 9.27 7.82 4.39 6.34 6.34 6.34 6.34 7.89 8.02 8.02 8.02 8.02 6.58 6.58 hectron irrat	0.300 0.322 0.962 0.215 0.099 0.099 0.099 0.099 0.537 0.658 0.58 0.58 0.58 0.537 0.658 0.393 0.010 0.393 diated flaxse	0.766 0.679 0.817 0.443 0.055 0.279 0.279 ed, diet cont	0.654 0.205 0.353 0.559 0.914 0.914 aining %2
Triglyceride (mg/ dL)45.1AST <sup>5</sup> (IU/L) $(IU/L)$ $62.2$ 2 dCholesterol (mg/ dL) $120.4$ Triglyceride (mg/ dL) $73.5$ AST (IU/L) $73.5$ unnett test $73.5$ Unnett test $73.5$ T d $126.25$ $122.5$ Cholesterol (mg/ dL) $49.2$ $45.1$ AST (IU/L) $41.5$ $62.2$ Cholesterol (mg/ dL) $126.25$ $122.5$ Cholesterol (mg/ dL) $73.6$ $53.2$ AST (IU/L) $13.4^{sh}$ $120.4$ Cholesterol (mg/ dL) $73.6$ $53.2$ Cholesterol (mg/ dL) $73.6$ $73.5$ AST (IU/L) $78.6^{sh}$ $53.2$ Cholesterol (mg/ dL) $78.6^{sh}$ $53.2$ Sata dard dict containing %20 electron irradii $58.6^{sh}$ $53.2$ Control, FS10, FS20, represe $58.6^{sh}$ $53.2$ Control, FS10, RS10, FS20 and RFS20, represe $58.6^{sh}$ $53.2$ Control, FS10, RS10, FS20 and RFS20, represe $58.6^{sh}$ $53.2$ Control, FS10, RS10, FS20 and RFS20, represe $58.6^{sh}$ $53.2$ Control, FS10, RS10, FS20 and RFS20, represe $58.6^{sh}$ $53.2$ Control, FS10, RS10, FS20 and RFS20, represe $58.6^{sh}$ $53.2$ Control, FS10, RS10, FS20 and RFS20, represe $58.6^{sh}$ $53.2$ Control, FS10, RS10, FS20 and RFS20, represe $58.6^{sh}$ $53.2$ Control, FS10, RS10, FS20 and RFS20, represe $58.6^{sh}$ $53.2$ Control, FS10, RS10, FS20 and RFS20, represe <td< td=""><td>1         52.4           2         51.1           44         121.88           5         59.5           50         121.25           50         121.25           1         52.4           2         59.5           50         121.25           1         52.4           2         51.1           2         51.1           2         51.1           2         51.1           2         51.1           2         51.1           2         82.6           5         82.6           5         82.6           5         50.5a           2         50.5a           2         50.5a           2         50.5a           2         50.5a           2         50.5a           2         50.5a           3         <t< td=""><td>64.0 53.8 66.1 26.8 66.1 26.8 110 64.0 53.8 64.0 53.8 66.1 26.8<sup>b</sup> 66.1 26.8<sup>b</sup> 66.1 26.8<sup>b</sup> 66.1 26.8<sup>b</sup> 53.8<sup>b</sup> 66.1 26.8<sup>b</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 54.0<sup>c</sup> 53.8<sup>c</sup> 54.0<sup>c</sup> 53.8<sup>c</sup> 54.0<sup>c</sup> 53.8<sup>c</sup> 54.0<sup>c</sup> 53.8<sup>c</sup> 54.0<sup>c</sup> 53.8<sup>c</sup> 54.0<sup>c</sup> 53.8<sup>c</sup> 54.0<sup>c</sup> 53.8<sup>c</sup> 54.0<sup>c</sup> 53.8<sup>c</sup> 54.0<sup>c</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 54.0<sup>c</sup> 53.8<sup>c</sup> 54.0<sup>c</sup> 55.8<sup>c</sup> 55.8<sup>c</sup> 55.8<sup>c</sup> 56.8<sup>c</sup> 56.1<sup>c</sup> 57.8<sup>c</sup> 56.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup></td><td>50.0 60.5 74.8 34.5 34.5 34.5 50.0 50.0 60.5 60.5 74.8 74.8 74.8 34.5<sup>b</sup> asal diet, diet c y.</td><td>51.2 55.8 55.8 119.22 11 78.7 47.0 47.0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td><td>54.5 58.0 59.8 40.0 13.16 40.0 7 aw flaxsee</td><td>48.7 56.7 78.0 56.4ª 56.4ª ed, diet conta</td><td>57.0 57.1 111.22 70.4 30.7<sup>b</sup> 30.7<sup>b</sup> ining %10 e<sup>1</sup></td><td>8.05 9.27 7.82 4.39 6.34 6.34 8.93 8.93 8.93 8.02 8.02 8.02 6.58 6.58 hectron irrat</td><td>0.322 0.962 0.215 0.099 0.004 0.004 0.537 0.658 0.58 0.58 0.58 0.58 0.537 0.658 0.333 0.010 0.333 diated flaxse</td><td>0.679 0.817 0.443 0.055 0.279 0.279 ed, diet cont</td><td>0.205 0.353 0.559 0.914 0.914 aining %2</td></t<></td></td<>	1         52.4           2         51.1           44         121.88           5         59.5           50         121.25           50         121.25           1         52.4           2         59.5           50         121.25           1         52.4           2         51.1           2         51.1           2         51.1           2         51.1           2         51.1           2         51.1           2         82.6           5         82.6           5         82.6           5         50.5a           2         50.5a           2         50.5a           2         50.5a           2         50.5a           2         50.5a           2         50.5a           3         50.5a           3 <t< td=""><td>64.0 53.8 66.1 26.8 66.1 26.8 110 64.0 53.8 64.0 53.8 66.1 26.8<sup>b</sup> 66.1 26.8<sup>b</sup> 66.1 26.8<sup>b</sup> 66.1 26.8<sup>b</sup> 53.8<sup>b</sup> 66.1 26.8<sup>b</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 54.0<sup>c</sup> 53.8<sup>c</sup> 54.0<sup>c</sup> 53.8<sup>c</sup> 54.0<sup>c</sup> 53.8<sup>c</sup> 54.0<sup>c</sup> 53.8<sup>c</sup> 54.0<sup>c</sup> 53.8<sup>c</sup> 54.0<sup>c</sup> 53.8<sup>c</sup> 54.0<sup>c</sup> 53.8<sup>c</sup> 54.0<sup>c</sup> 53.8<sup>c</sup> 54.0<sup>c</sup> 53.8<sup>c</sup> 53.8<sup>c</sup> 54.0<sup>c</sup> 53.8<sup>c</sup> 54.0<sup>c</sup> 55.8<sup>c</sup> 55.8<sup>c</sup> 55.8<sup>c</sup> 56.8<sup>c</sup> 56.1<sup>c</sup> 57.8<sup>c</sup> 56.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup> 57.8<sup>c</sup></td><td>50.0 60.5 74.8 34.5 34.5 34.5 50.0 50.0 60.5 60.5 74.8 74.8 74.8 34.5<sup>b</sup> asal diet, diet c y.</td><td>51.2 55.8 55.8 119.22 11 78.7 47.0 47.0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td><td>54.5 58.0 59.8 40.0 13.16 40.0 7 aw flaxsee</td><td>48.7 56.7 78.0 56.4ª 56.4ª ed, diet conta</td><td>57.0 57.1 111.22 70.4 30.7<sup>b</sup> 30.7<sup>b</sup> ining %10 e<sup>1</sup></td><td>8.05 9.27 7.82 4.39 6.34 6.34 8.93 8.93 8.93 8.02 8.02 8.02 6.58 6.58 hectron irrat</td><td>0.322 0.962 0.215 0.099 0.004 0.004 0.537 0.658 0.58 0.58 0.58 0.58 0.537 0.658 0.333 0.010 0.333 diated flaxse</td><td>0.679 0.817 0.443 0.055 0.279 0.279 ed, diet cont</td><td>0.205 0.353 0.559 0.914 0.914 aining %2</td></t<>	64.0 53.8 66.1 26.8 66.1 26.8 110 64.0 53.8 64.0 53.8 66.1 26.8 <sup>b</sup> 66.1 26.8 <sup>b</sup> 66.1 26.8 <sup>b</sup> 66.1 26.8 <sup>b</sup> 53.8 <sup>b</sup> 66.1 26.8 <sup>b</sup> 53.8 <sup>c</sup> 53.8 <sup>c</sup> 54.0 <sup>c</sup> 53.8 <sup>c</sup> 53.8 <sup>c</sup> 54.0 <sup>c</sup> 53.8 <sup>c</sup> 54.0 <sup>c</sup> 55.8 <sup>c</sup> 55.8 <sup>c</sup> 55.8 <sup>c</sup> 56.8 <sup>c</sup> 56.1 <sup>c</sup> 57.8 <sup>c</sup> 56.8 <sup>c</sup> 57.8 <sup>c</sup>	50.0 60.5 74.8 34.5 34.5 34.5 50.0 50.0 60.5 60.5 74.8 74.8 74.8 34.5 <sup>b</sup> asal diet, diet c y.	51.2 55.8 55.8 119.22 11 78.7 47.0 47.0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	54.5 58.0 59.8 40.0 13.16 40.0 7 aw flaxsee	48.7 56.7 78.0 56.4ª 56.4ª ed, diet conta	57.0 57.1 111.22 70.4 30.7 <sup>b</sup> 30.7 <sup>b</sup> ining %10 e <sup>1</sup>	8.05 9.27 7.82 4.39 6.34 6.34 8.93 8.93 8.93 8.02 8.02 8.02 6.58 6.58 hectron irrat	0.322 0.962 0.215 0.099 0.004 0.004 0.537 0.658 0.58 0.58 0.58 0.58 0.537 0.658 0.333 0.010 0.333 diated flaxse	0.679 0.817 0.443 0.055 0.279 0.279 ed, diet cont	0.205 0.353 0.559 0.914 0.914 aining %2
AST <sup>5</sup> (IU/L) (2.2 2 d Cholesterol (mg/dL) 120.4 Friglyceride (mg/dL) 73.5 AST (IU/L) 73.5 AST (IU/L) 73.5 tunnett test 73.5 Cholesterol (mg/dL) 126.25 122.5 Friglyceride (mg/dL) 49.2 45.1 AST (IU/L) 41.5 62.2 AST (IU/L) 134 <sup>a</sup> 120.4 Cholesterol (mg/dL) 134 <sup>a</sup> 120.4 Triglyceride (mg/dL) 78.6 73.5 AST (IU/L) 58.6 <sup>a</sup> 53.2 Control, FS10, FS20 and RFS20, repres control, FS10, RS20, repres asseed and diet containing %20 electron irradii biandard error of means; <sup>3</sup> Flax seed; <sup>4</sup> Irradiati	<ul> <li>51.1</li> <li>51.1</li> <li>14 121.88</li> <li>82.6</li> <li>59.5</li> <li>59.5</li> <li>51.1</li> <li>52.4</li> <li>51.1</li> <li>52.4</li> <li>51.1</li> <li>52.4</li> <li>51.1</li> <li>52.4</li> <li>51.1</li> <li>52.5</li> <li>59.5</li> <li>50.5</li> <li>50.5</li></ul>	53.8 105.88 66.1 26.8 26.8 110 64.0 53.8 66.1 105.88 66.1 26.8 <sup>b</sup> 66.1 26.8 <sup>b</sup> 66.1 26.8 <sup>b</sup> 66.1 705.88 <sup>b</sup> 66.1 705.88 <sup>b</sup> 66.1 705.88 <sup>b</sup> 66.1 706.8 <sup>b</sup> 66.1 707.88 <sup>b</sup> 66.1 706.8 <sup>b</sup> 707.88 <sup>b</sup> 66.1 707.88 <sup>b</sup> 66.1 707.86 <sup>b</sup> 66.1 707.86 <sup>b</sup> 66.1 707.88 <sup>b</sup> 67.88 <sup>b</sup> 66.1 707.88 <sup>b</sup> 67.88 <sup>b</sup> 66.1 707.88 <sup>b</sup> 67.88 <sup>b</sup>	60.5 116.57 74.8 34.5 34.5 116.20 50.0 60.5 60.5 74.8 74.8 74.8 34.5 <sup>b</sup> asal diet, diet c y.	55.8 55.8 119.22 1 78.7 6 47.0 47.0 0 0ntaining %1	58.0 13.16 59.8 40.0 10.0 raw flaxsee	56.7 121.16 78.0 56.4 <sup>a</sup> 56.4 <sup>a</sup> ed, diet conta	57.1 111.22 70.4 30.7 <sup>b</sup> ining %10 el	9.27 7.82 4.39 6.34 8.93 8.93 8.93 8.02 8.02 8.02 4.53 6.58 6.58	0.962 0.215 0.099 0.004 0.537 0.58 0.58 0.58 0.58 0.58 0.538 0.333 0.010 0.333 diated flaxse	0.817 0.443 0.055 0.279 ed, diet cont	0.353 0.559 0.914 0.914 aining %2
2 d Cholesterol (mg/dL) 120.4 Friglyceride (mg/dL) 73.5 AST (IU/L) 53.2 bunnett test 1.1 Cholesterol (mg/dL) 126.25 122.5 Friglyceride (mg/dL) 49.2 45.1 AST (IU/L) 41.5 62.2 Cholesterol (mg/dL) 134 <sup>a</sup> 120.4 Cholesterol (mg/dL) 134 <sup>a</sup> 120.4 Friglyceride (mg/dL) 78.6 73.5 Cholesterol (mg/dL) 78.6 73.5 Cholesterol (mg/dL) 78.6 73.5 Cholesterol (mg/dL) 58.6 <sup>a</sup> 53.2 Cholesterol (mg/dL) 58.6 <sup>a</sup> 53.2 Cholesterol (mg/dL) 78.6 73.5 Chutcul, FS10, FS20 and RFS20, repres Control, FS10, FS20 and RFS20, representation of the containing %20 electron irradii Values within a row with different superscription	44     121.88       5     59.5       50     59.5       50     121.25       1     52.4       2     51.1       44a     121.88a       5     51.1       14a     121.88a       5     51.1       6     82.6       5a     52.6       6ant corn-soyb       iated flaxseed,       ony <sup>5</sup> Aspartate       ts differ signifi	105.88         66.1         26.8         110         64.0         53.8         64.0         53.8         64.0         53.8         64.0         53.8         64.0         53.8         64.0         53.8         66.1         26.8         66.1         26.8         ean meal b.         respectively $P < \zeta$ is antily $P < \zeta$	116.57 74.8 34.5 34.5 116.20 50.0 60.5 60.5 74.8 74.8 34.5 <sup>b</sup> asal diet, diet c y.	119.22 1 78.7 6 47.0 4 7.0 0 47.0 0	13.16 59.8 40.0 0 raw flaxsee	121.16 1 78.0 56.4ª 56.4ª ed, diet conta	111.22 70.4 30.7 <sup>b</sup> ining %10 e <sup>1</sup>	7.82 4.39 6.34 8.93 7.89 8.02 8.02 4.53 6.58 6.58 hectron irrat	0.215 0.099 0.004 0.537 0.658 0.58 0.658 0.58 0.58 0.333 0.010 0.393 0.019 diated flaxse	0.443 0.055 0.279 ed, diet cont	0.559 0.957 0.914 aining %2
Cholesterol (mg/ dL) 120.4 Triglyceride (mg/ dL) 73.5 AST (IU/L) 53.2 burnett test 1.4 Cholesterol (mg/ dL) 126.25 122.5 Triglyceride (mg/ dL) 49.2 45.1 AST (IU/L) 41.5 62.2 AST (IU/L) 134 <sup>4</sup> 120.4 Cholesterol (mg/ dL) 134 <sup>6</sup> 73.5 Cholesterol (mg/ dL) 78.6 73.5 Cholesterol (mg/ dL) 78.6 73.5 Cholesterol (mg/ dL) 58.6 <sup>3</sup> 53.2 Control, FS10, FS20 and RFS20, repressive and diet containing %20 electron irradii standard error of means; <sup>3</sup> Flax seed; <sup>4</sup> Irradiatit Values within a row with different superscripti	14         121.88           2         59.5           2         59.5           50         121.25           1         52.4           2         51.1           44         121.88ª           5         51.1           2         51.1           2         51.1           2         51.1           2         51.1           2         51.1           2         51.1           2         82.6           2         59.5a           2         50.5a           3         50.5a           3         50.5a           3         50.5a           2         50.5a           3         50.5a           3         50.5a           3         50.5a           3         50.5a	105.88 $66.1$ $26.8$ $110$ $64.0$ $53.8$ $64.0$ $53.8$ $64.0$ $53.8$ $66.1$ $26.8$ $66.1$ $26.8$ $66.1$ $26.8$ $66.1$ $26.8$ $66.1$ $26.8$ $66.1$ $26.8$ $66.1$ $26.8$ $66.1$ $26.8$ $66.1$ $26.8$ $66.1$ $26.8$ $66.1$ $26.8$ $66.1$ $26.8$ $66.1$ $26.8$ $66.1$ $26.8$ $66.1$ $66.1$ $66.1$ $26.8$ $66.1$ $66.1$ $66.1$ $66.1$ $66.1$ $66.1$ $66.1$ $66.1$	116.57 74.8 34.5 34.5 116.20 50.0 60.5 60.5 74.8 74.8 34.5 <sup>b</sup> asal diet, diet c y.	119.22 1 78.7 47.0 47.0 4	13.16 59.8 40.0 .0 raw flaxsee	121.16 1 78.0 56.4ª 56.4ª ed, diet conta	111.22 70.4 30.7 <sup>b</sup> ining %10 el	7.82 4.39 6.34 8.93 8.93 8.02 8.02 8.02 4.53 6.58 6.58 hectron irrat	0.215 0.099 0.004 0.537 0.658 0.58 0.658 0.658 0.208 0.208 0.393 0.010 0.393 diated flaxse	0.443 0.055 0.279 ed, diet cont	0.559 0.914 0.914 aining %2
Triglyceride (mg/dL) 73.5 AST (IU/L) 53.2 AST (IU/L) 53.2 Ununett test 73.1 Cholesterol (mg/dL) 126.25 122.5 Triglyceride (mg/dL) 49.2 45.1 AST (IU/L) 41.5 62.2 Cholesterol (mg/dL) 134 <sup>a</sup> 120.4 Triglyceride (mg/dL) 134 <sup>a</sup> 120.4 AST (IU/L) 58.6 <sup>a</sup> 73.5 Cholesterol (mg/dL) 78.6 73.5 Cholesterol (mg/dL) 78.6 73.5 Softrol, FS10, FS20 and RFS20, repres axseed and diet containing %20 electron irradii Standard error of means; <sup>3</sup> Flax seed; <sup>4</sup> Irradiatit	5         82.6           50         59.5           50         121.25           1         52.4           2         51.1           44a         121.88a           5         51.1           6         52.4           7         51.1           82.6         51.1           82.6         51.1           82.6         52.6           82.6         50.5a           2         59.5a           3         50.5a           3         50.5a           5         50.5a           5         50.5a           5         50.5a           5         50.5a           5         50.5a           5         50.5a	66.1 26.8 26.8 110 64.0 53.8 64.0 53.8 66.1 26.8 <sup>b</sup> 66.1 26.8 <sup>b</sup> ean meal b respectively respectively for an other sectively for an other sectively for a sect	74.8 34.5 116.20 50.0 60.5 74.8 34.5 <sup>b</sup> asal diet, diet c y.	47.0 47.0 ontaining %1	40.0 D raw flaxsee	78.0 56.4ª ed, diet conta	70.4 30.7 <sup>b</sup> ining %10 e	4.39 6.34 8.93 7.89 8.02 8.02 4.53 6.58 6.58 hectron irrac	0.009 0.004 0.537 0.58 0.58 0.268 0.268 0.268 0.208 0.393 0.010 0.393 diated flaxse	0.055 0.279 ed, diet cont	0.957 0.914 aining %2
AST (IU/L) 53.2 bunnett test 1 d Cholesterol (mg/dL) 126.25 122.5 Friglyceride (mg/dL) 49.2 45.1 AST (IU/L) 41.5 62.2 Cholesterol (mg/dL) 134 <sup>a</sup> 120.4 Cholesterol (mg/dL) 134 <sup>a</sup> 120.4 Friglyceride (mg/dL) 78.6 73.5 Friglyceride (mg/dL) 58.6 <sup>a</sup> 53.2 Control, FS10, FS20 and RFS20, repres axseed and diet containing %20 electron irradii biandard error of means; <sup>3</sup> Flax seed; <sup>4</sup> Irradiatit Values within a row with different superscript	2         59.5           50         121.25           1         52.4           2         51.1           44a         121.88a           5         51.1           6a         22.6           7         51.1           82.6         5           82.6         5           7         59.5a           2         50.5a           3         50.5a           5         50.5a           5         50.5a           5         50.5a           5         50.5a           5         50.5a	26.8 110 64.0 53.8 53.8 105.88 <sup>b</sup> 66.1 26.8 <sup>b</sup> 66.1 26.8 <sup>b</sup> ean meal $\overline{b}$ respectively $P < c$ i anitotram	34.5 116.20 50.0 60.5 74.8 34.5 <sup>b</sup> asal diet, diet c y. sferase.	47.0 , ontaining %1	40.0 .0 raw flaxsee	56.4ª ed, diet conta	30.7 <sup>b</sup> ining %10 el	6.34 8.93 7.89 8.02 7.31 4.53 6.58 6.58 hectron irrac	0.004 0.537 0.658 0.208 0.208 0.208 0.393 0.010 0.393 diated flaxse	0.279 ed, diet cont	0.914 0.914 0.914
unnett test 1 d Cholesterol (mg/dL) 126.25 122.5 Friglyceride (mg/dL) 49.2 45.1 AST (IU/L) 41.5 62.2 AST (IU/L) 134 <sup>a</sup> 120.4 Cholesterol (mg/dL) 134 <sup>a</sup> 120.4 Friglyceride (mg/dL) 78.6 73.5 Friglyceride (mg/dL) 58.6 <sup>a</sup> 53.2 Control, FS10, FS20 and RFS20, repres axseed and diet containing %20 electron irradii bandard error of means; <sup>3</sup> Flax seed; <sup>4</sup> Irradiatit	50         121.25           1         52.4           2         51.1           44         121.88 <sup>a</sup> 5         51.1           6         82.6           8         59.5a           sent corn-soyb         sent corn-soyb           iated flaxseed,         on; <sup>5</sup> Aspartate           ta differ signif         ta differ signifi	110 64.0 53.8 53.8 $105.88^{b}$ 66.1 $26.8^{b}$ ean meal $\overline{b}$ respectively respectively ranitorrant	116.20 50.0 60.5 116.57 <sup>a</sup> 74.8 34.5 <sup>b</sup> 34.5 <sup>b</sup> asal diet, diet c y.	ontaining %1	.0 raw flaxsee	ed, diet conta	ining %10 e	8.93 7.89 8.02 7.31 4.53 6.58 6.58 dectron irrac	0.537 0.658 0.208 0.208 0.208 0.393 0.010 0.393 0.019 diated flaxse	ed, diet cont	aining %,
Cholesterol (mg/dL) 126.25 122.5 Cholesterol (mg/dL) 126.25 122.5 Lirglyceride (mg/dL) 49.2 45.1 AST (IU/L) 41.5 62.2 Cholesterol (mg/dL) 134 <sup>a</sup> 120.4 Cholesterol (mg/dL) 78.6 73.5 Firglyceride (mg/dL) 78.6 73.5 Cholesterol (mg/dL) 58.6 <sup>a</sup> 53.2 Control, FS10, FS20 and RFS20, repres asseed and diet containing %20 electron irradii Standard error of means; <sup>3</sup> Flax seed; <sup>4</sup> Irradiatit	50         121.25           1         52.4           2         51.1           44         121.88a           5         82.6           2         59.5a           3         50.5a           3	110 64.0 53.8 53.8 $105.88^{b}$ 66.1 $26.8^{b}$ ean meal b respectively P < ( icantly $P < ($	116.20 50.0 60.5 116.57 <sup>a</sup> 74.8 34.5 <sup>b</sup> asal diet, diet c y.	ontaining %1	.0 raw flaxsee	ed, diet conta	ining %10 e	8.93 7.89 8.02 8.02 7.31 4.53 6.58 6.58 6.58 dectron irrac	0.537 0.658 0.208 0.208 0.208 0.393 0.010 0.393 diated flaxse	ed, diet cont	aining %,
The constraint of the form of	50         121.25           1         52.4           2         51.1           44         121.88a           5         82.6           5a         59.5a           sent corn-soyb           iated flaxseed,           om, <sup>5</sup> Aspartate           ts differ signif	110 64.0 53.8 105.8% 66.1 26.8% ean meal b respectively raminotram i aminotram	116.20 50.0 60.5 116.57 <sup>a</sup> 74.8 34.5 <sup>b</sup> asal diet, diet c y. sferase.	ontaining %1	.0 raw flaxsee	ed, diet conta	ining %10 el	8.93 7.89 8.02 8.02 7.31 4.53 6.58 6.58 hectron irrac	0.537 0.658 0.208 0.208 0.010 0.393 0.019 diated flaxse	ed, diet cont	aining %
$\begin{array}{llllllllllllllllllllllllllllllllllll$	121.25 152.4 251.1 $14^{a}$ 121.88 <sup>a</sup> 5 82.6 $2^{a}$ 59.5 <sup>a</sup> sent corn-soyb lated flaxseed, on; <sup>5</sup> Aspartate ts differ signif	110 64.0 53.8 66.1 $105.88^{b}$ 66.1 $26.8^{b}$ ean meal b respectively raminotram	110.20 50.0 60.5 116.57a 74.8 34.5 <sup>b</sup> asal diet, diet c y. sferase.	ontaining %1	0 raw flaxsee	ed, diet conta	ining %10 el	6.59 7.89 8.02 7.31 4.53 6.58 6.58 lectron irrac	0.208 0.658 0.208 0.010 0.393 0.019 diated flaxse	ed, diet cont	aining %
Triglyceride (mg/dL) $49.2$ $45.1$ AST (IU/L) $41.5$ $62.2$ AST (IU/L) $134^{a}$ $120.4$ Cholesterol (mg/dL) $134^{a}$ $120.4$ Triglyceride (mg/dL) $78.6$ $73.5$ AST (IU/L) $58.6^{a}$ $53.2$ AST (IU/L) $58.6^{a}$ $53.2$ Sontrol, FS10, RF510, FS20 and RFS20, repressaxseed and diet containing %20 electron irradiitandard error of means; ${}^{3}$ Flax seed; ${}^{4}$ IrradiatiValues within a row with different superscript	152.4251.1251.114a121.88a582.62a59.5a2ent corn-soybiated flaxseed,on; <sup>5</sup> Aspartatets differ signif	$64.0$ $53.8$ $53.8$ $105.88^{b}$ $66.1$ $26.8^{b}$ ean meal b, respectively <i>P</i> < ( icantly	50.0 60.5 116.57 <sup>a</sup> 74.8 34.5 <sup>b</sup> asal diet, diet c y. sferase.	ontaining %1	.0 raw flaxsee	ed, diet conta	ining %10 e	7.89 8.02 7.31 4.53 6.58 lectron irrad	0.658 0.208 0.208 0.393 0.393 0.019 diated flaxse	ed, diet cont	aining %
AST ( $IU/L$ ) 41.5 62.2 2 d $II-J$ 134 <sup>a</sup> 120.4 Cholesterol ( $mg/dL$ ) 134 <sup>a</sup> 120.4 Friglyceride ( $mg/dL$ ) 78.6 73.5 AST ( $IU/L$ ) 58.6 <sup>a</sup> 53.2 Control, FS10, FS20 and RFS20, repress control, FS10, RFS10, FS20 and RFS20, repress control, FS10, RFS10, FS20 and RFS20, repressivation and diet containing %20 electron irradii tandard error of means; <sup>3</sup> Flax seed; <sup>4</sup> Irradiati tandard error of means; <sup>3</sup> Flax seed; <sup>4</sup> Irradiati	2 51.1 14a 121.88a 5 82.6 2a 59.5a 2aent corn-soyb aent c	53.8 105.88 <sup>b</sup> 66.1 26.8 <sup>b</sup> ean meal $\overline{b}$ . respectively respectively respectively respectively respectively respectively	60.5 116.57 <sup>a</sup> 74.8 34.5 <sup>b</sup> asal diet, diet c y. sferase.	ontaining %1	0 raw flaxsee	ed, diet conta	ining %10 e	8.02 7.31 4.53 6.58 lectron irrac	0.208 0.010 0.393 0.019 diated flaxse	ed, diet cont	aining %;
2 d Cholesterol (mg/dL) 134 <sup>a</sup> 120.4 Friglyceride (mg/dL) 78.6 73.5 AST (IU/L) 58.6 <sup>a</sup> 53.2 control, FS10, FS20 and RFS20, repres axseed and diet containing %20 electron irradia thandard error of means; <sup>3</sup> Flax seed; <sup>4</sup> Irradiatit Values within a row with different superscript	<ul> <li>121.88<sup>a</sup></li> <li>82.6</li> <li>82.6</li> <li>59.5<sup>a</sup></li> <li>59.5<sup>a</sup></li> <li>54.5<sup>a</sup></li> <li>57.5<sup>a</sup></li> <li>57.5<sup>a</sup></li> <li>58.5<sup>b</sup></li> <li>59.5<sup>a</sup></li> <li>59.5<sup>b</sup></li> <li>59.5<sup>a</sup></li> <li></li></ul>	$\begin{array}{c} 105.88^{b} \\ 66.1 \\ 26.8^{b} \\ \hline 26.8^{b} \\ \hline ean meal b \\ respectively \\ respectivels \\ a minotrans \\ i cantly \ P < ($	116.57 <sup>a</sup> 74.8 34.5 <sup>b</sup> asal diet, diet c y. sferase.	ontaining %1	0 raw flaxsee	ed, diet conta	ining %10 el	7.31 4.53 6.58 lectron irrac	0.010 0.393 0.019 diated flaxse	ed, diet cont	aining %
Cholesterol (mg/dL) $134^{a}$ $120.4$ Friglyceride (mg/dL) $78.6$ $73.5$ AST (IU/L) $78.6^{a}$ $53.2$ Control, FS10, FS20, repression RFS20, repression tradistication of the containing %20 electron irradiation tradisticated and diet containing %20 electron irradiation transformed error of means; <sup>3</sup> Flax seed; <sup>4</sup> Irradiation tradistication with different superscription of the containing %20 electron irradiation transformed error of means; <sup>3</sup> Flax seed; <sup>4</sup> Irradiation tradistication of the containing %20 electron irradiation transformed error of means; <sup>3</sup> Flax seed; <sup>4</sup> Irradiation tradistication transformed error of means; <sup>3</sup> Flax seed; <sup>4</sup> Irradiation tradistication transformed error of means; <sup>3</sup> Flax seed; <sup>4</sup> Irradiation tradistication tradistication transformed error of means; <sup>3</sup> Flax seed; <sup>4</sup> Irradiation tradistication tradistication transformed error of means; <sup>3</sup> Flax seed; <sup>4</sup> Irradiation tradistication transformed error of means; <sup>3</sup> Flax seed; <sup>4</sup> Irradiation tradistication tradistication transformed error of means; <sup>3</sup> Flax seed; <sup>4</sup> Irradiation tradistication tradistication tradistication tradistication tradistication tradistication tradistication transformed error of means; <sup>3</sup> Flax seed; <sup>4</sup> Irradiation tradistication tradi	14.a121.88a582.62.a59.5a2.ent corn-soyb2.ent corn-soybatted flaxseed,on; <sup>5</sup> Aspartatets differ signif	$\begin{array}{c} 105.88^{\text{b}} \\ 66.1 \\ 66.1 \\ 26.8^{\text{b}} \\ \hline \text{ean meal } b_{\text{i}} \\ \text{respectively} \\ \text{respectively} \\ \text{a minotrans} \\ \text{icantly } P < ($	116.57 <sup>a</sup> 74.8 34.5 <sup>b</sup> asal diet, diet c y. sferase.	ontaining %1	0 raw flaxsee	ed, diet conta	ining %10 el	7.31 4.53 6.58 lectron irrac	0.010 0.393 0.019 diated flaxse	ed, diet cont	aining %
Values within a row with different superscript	is 22.6 is 22.6 is 59.5 <sup>a</sup> is the corn-soyb is the flaxseed, on; <sup>5</sup> Aspartate ts differ signif	$\frac{66.1}{26.8^{b}}$ $\frac{26.8^{b}}{\text{ean meal }b_{t}}$ $\frac{1}{\text{respectively}}$ $\frac{1}{\text{respectively}}$ $\frac{1}{\text{respectively}}$	74.8 74.8 34.5 <sup>b</sup> asal diet, diet c y. sferase.	ontaining %1	0 raw flaxsee	sd, diet conta	ining %10 el	4.53 6.58 lectron irrac	0.393 0.019 diated flaxse	ed, diet cont	aining %
Lingtycentae (mg/ dL) / 5.5 / 5.3 AST (IU/L) 58.6ª 53.2 Control, FS10, RFS10, FS20 and RFS20, repres inseed and diet containing %20 electron irradii itandard error of means; <sup>3</sup> Flax seed; <sup>4</sup> Irradiatio itandard error of means; <sup>3</sup> Flax seed; <sup>4</sup> Irradiatio Values within a row with different superscript	$\frac{2}{10}$ $\frac{2.0}{59.5^a}$ sent corn-soyb ated flaxseed, on; <sup>5</sup> Aspartate ts differ signif	$26.8^{\text{b}}$ ean meal b respectively aminotrans icantly $P < ($	/4.8 34.5 <sup>b</sup> asal diet, diet c y. sferase.	ontaining %1	0 raw flaxsee	sd, diet conta	ining %10 el	4.23 6.58 lectron irrac	0.393 0.019 diated flaxse	ed, diet cont	aining %.
AST (IU/L) 58.6 <sup>a</sup> 53.2 ontrol, FS10, RFS10, FS20 and RFS20, repres usseed and diet containing %20 electron irradi tandard error of means; <sup>3</sup> Flax seed; <sup>4</sup> Irradiati Values within a row with different superscript	<u>a</u> 59.5 <sup>a</sup> sent corn-soyb ated flaxseed, on; <sup>5</sup> Aspartate ts differ signif	$\frac{26.8^{b}}{\text{ean meal } b_{i}}$ $\frac{26.8^{b}}{\text{respectively}}$ $\frac{1}{2}$	34.5 <sup>b</sup> asal diet, diet c y. sferase.	ontaining %1	0 raw flaxsee	ad, diet conta	ining %10 el	6.58 lectron irrac	0.019 diated flaxse	ed, diet cont	aining %
ontrol, F510, RF510, F520 and RF520, repres xseed and diet containing %20 electron irradi tandard error of means; <sup>3</sup> Flax seed; <sup>4</sup> Irradiati Values within a row with different superscript	ient corn-soyb ated flaxseed, on; <sup>5</sup> Aspartate ts differ signif	ean meal ba respectively aminotrans icantly P < (	asal diet, diet c y. sferase.	ontaining %1	0 raw flaxsee	sd, diet conta	ining %10 el	lectron irrac	diated flaxse	ed, diet cont	aining %
Turbow toot	Dietary Treatments <sup>1</sup>	nents <sup>1</sup>		Irr	Irradiation	т Ц	Flax seed	CEM/2		<i>P</i> -value	
ukey test Control FS10	RFS10	FS20	RFS20	Yes	No	10%	6 20%		FS 3	$R^{4}$	FS×R
EE <sup>5</sup> (%) 55.6 <sup>c</sup>	69.8a	50.9d	68.5 <sup>b</sup>	69.1 <sup>a</sup>	53.2 <sup>b</sup>	62.7a	<sup>7</sup> a 59.7 <sup>b</sup>	<sup>b</sup> 0.240	0.0001	0.0001	0.0001
DM <sup>6</sup> (%) 74.5 <sup>c</sup>	$78.5^{a}$	69.3d	$77.3^{b}$	77.9a	71.9 <sup>b</sup>	76.5 <sup>a</sup>	ja 73.3b	b 0.130		0.0001	0.0001
OM <sup>7</sup> (%) 70.4c	79.5 <sup>a</sup>	65.5d	$78.6^{\mathrm{b}}$	79.0a	$68.0^{\mathrm{b}}$	74.9 <sup>a</sup>	а 72.05	<sup>b</sup> 0.130	0.001	0.0001	0.0001
Viscosity (centipoise) 3.78	2.99	5.20	3.40	$3.20^{\mathrm{b}}$	4.49a	3.39 <sup>b</sup>		a 0.340	0.0164	0.0016	0.1563
Dunnett test											
EE 71.4 <sup>a</sup> 55.6 <sup>b</sup>	$69.8^{\mathrm{b}}$	$50.9^{\mathrm{b}}$	$68.5^{b}$					0.240	0.0001		
DM 79.4a 74.5b	78.5 <sup>b</sup>	69.3 <sup>b</sup>	77.3 <sup>b</sup>					0.130			
OM 85.4ª 70.4 <sup>b</sup>	79.5b	$65.5^{\rm b}$	78.6 <sup>b</sup>					0.130			
	2.99ª	$5.20^{a}$	$3.40^{a}$					0.400			
20, rel	corn-soybean	meal basal	diet, diet contai	ning %10 raw	flaxseed, diet	t containing %	%10 electron	irradiated fl	laxseed, diet	containing %	20 flaxsee
and diet containing %20 electron irradiated flaxseed, respectively	seed, respectiv	rely.		I		1				1	
<sup>2</sup> Standard error of means; <sup>3</sup> Flax seed, <sup>4</sup> Irradiation; <sup>5</sup> Ether extract; <sup>6</sup> Dry matter; <sup>7</sup> Organic matters.	on; <sup>5</sup> Ether extr	act; <sup>6</sup> Dry ma	atter; <sup>7</sup> Organic n	latters.							

159

Poultry Science Journal 2017, 5(2): 153-163

#### Discussion

Feed intake was not affected by FS inclusion level which is in agreement with previous findings that supplemented corn-soybean meal diets with FS (2.5-10%) was not effective (Mridula et al., 2011; 2015). In the present study, inclusion of 20% FS in grower and finisher phases decreased BWG by 16% and 21% compared to the control group, respectively. Ajuyah et al. (1993) reported a 17% decline in body weight of birds fed 15% FS compared to chicks fed corn-soybean diet. Birds fed diets containing flaxseed had greater FCR compared to chicks fed control corn-soy diet. This result is in agreement with findings of Beheshti Moghadam et al. (2017) who reported that FCR was higher in chicks fed diets containing 15% FS compared to corn-soy diet. Mridula et al. (2015) also observed increases in FCR in broilers fed diets containing 15% flaxseed. The depression in bird performance of broilers fed raw flaxseed appears to be due to poor energy availability (Rodriguez et al., 2001) and ANF (Hernandez, 2013) such as cyanide. High levels of fiber and cvanide adversely affect digestibility and utilization of nutrients by birds (Esonu and Udedibie, 1993). Irradiation improved FCR and BWG of birds fed F20 compared to control, FS10 and RFS10 diets.

Nayefi et al. (2015) reported that broilers fed diets containing 10% electron irradiated cotton seed meal had higher feed intake and BWG compared to birds fed diet containing raw cotton seed meal. The greater BWG was attributed to the reduction in gossypol by irradiation. Previously, Chamani et al. (2009) reported that gamma irradiation (15-45 kGy) decreased glucosinolate and improved apparent ileal digestibility of amino acids in canola meal fed to broiler breeders. The observed effects of irradiated diets on birds' performance in the current study could be due to the effects of ionizing radiation on linatine, though these effects have not previously been reported in the literature. It is possible that using the high levels of irradiated flaxseed can have positive impacts on performance indices by decreasing the cyanide content in broiler chickens fed FS diets.

The increase in the relative weight of thigh of birds fed FS20 compared to FS10 is in contrast with that of Mridula *et al.* (2011; 2015) who indicated no changes in the thigh percentage at 2.5-15% level of flaxseed in the diets of broilers. Feeding FS20 led to decrease in fat deposition

which is in line with findings of Najib et al. (2011). However, this is in contrast to Arshami et al. (2010) who reported no adverse effects of flaxseed (5-10%) on breast weight and abdominal fat of chickens. In the present study, the experimental diets were iso-energetic, so the reduction of fat deposits could be due to fatty acid composition of the diets. Esteve-Garcia (2012) stated that poultry diets that are high in polyunsaturated fatty acid can improve FCR and reduce fat deposition compared to diets containing monounsaturated fatty acid from tallow or vegetable oil sources. In other words, there is an optimum ratio of n-6 and n-3 fatty acid that leads to a decrease in adipose tissue. In the present study, feeding diets containing flaxseed (at 10% and 20%) to broilers had no effect on liver weight. Feeding RFS20 diet to broilers decreased liver percentage compared to other diets. Similar results were observed when 5-10% flaxseed were fed to pullet chicks (Arshami *et al.*, 2010). The reduction of liver weight may be a result of reduction in cyanogenic glycosides content as a function of irradiation. Gharaghani et al (2008) observed that liver weight decreased in broilers fed irradiated (10-30 kGy) canola meal. In contrast, Nayefi et al. (2015) observed no significant effect of irradiation of cotton seed meal at doses of 30 kGy on the relative weight of liver and other organs of broiler.

The current study did not show any impacts of experimental diets on blood plasma lipid parameters. Our findings are in agreement with results of Nayefi et al. (2015) who reported that feeding electron irradiated cotton seed meal had not significant effect on blood parameters triglyceride cholesterol including and concentrations. The activity of AST at day 42 decreased as the dietary flaxseed levels increased to 20% in the diets. Similarly, Omer et al. (2013) reported that AST activity decreased in rabbits receiving 15% flaxseed in their diets. In contrast to this result, Yassein et al. (2015) showed that feeding moderate levels of flaxseed (5-10%) had no significant effect on AST activity on laying hens. However, high dose of flaxseed (12-16%) increased blood AST activity in broilers (Al-Nawass, 2015). These researchers attributed this effect to the presence of hydrogen cyanide in flaxseed, which can lead to the accumulation of toxins in the liver and increase secretion of liver enzymes into the blood.

We found that irradiation decreased 15% and 22% of total cyanide and fiber contents of flaxseed, respectively. These results could confirm one of the reasons for increasing digestibility of irradiated flaxseed diets. Although in the present study, irradiation improved apparent DM, OM and EΕ digestibility of flaxseed containing diets, RFS diets still had lower digestibility compared to the control group. Chamani et al. (2009) fed gamma irradiated (15-45 kGy) canola meal to the broiler breeders and showed an increase in apparent digestibility of amino acids with increasing doses of irradiation. Glucosinolate levels also decreased by 58% in gammairradiated canola meal at 45 kGy. Shawrang et al. (2013) conducted a digestion trail and showed an increase in energy and protein digestion of electron irradiated barley (10-30 kGy) as compared to control group.

In the present study, feeding FS20 to broilers increased ileal viscosity compared with FS10 and control diets. Irradiation decreased intestinal viscosity of broilers fed FS20. Studies using gamma or electron radiation showed a decrease in viscosity of rice and barley (Wu *et al.*, 2002). Shawrang *et al.* (2013) reported that electron irradiation (10-30 kGy) linearly decreases viscosity of barley grain by 78%. Byun *et al.* (2008) showed that radiolysis of the glycosidic bonds of beta-glucan decreased the

#### References

- Ajuyah AO, Hardin RT & Sim JS. 1993. Effect of dietary full-fat flaxseed with and without antioxidant on the fatty acid composition of major lipid classes of chicken meats. Poultry Science, 72: 125–136. DOI: 10.3382/ps.0720125
- Al-Nawass KJ. 2015. Effect of different levels of golden flaxseed (*Linum usitatissimum* L.) powder on some blood biochemical parameters in male and female broiler. Research Opinions in Animal & Veterinary Sciences, 5: 425-428.
- Alzueta C, Rodríguez ML, Cutuli MT, RebolÉ A, Ortiz LT, Centeno C & TreviÑo J. 2003. Effect of whole and demucilaged linseed in broiler chicken diets on digesta viscosity, nutrient utilization and intestinal microflora. British Poultry Science, 44: 67-74. DOI: 10.1080/0007166031000085337
- Arshami J, Pilevar M & Elahi M. 2010. Effects of long-term feeding flaxseed on growth and

molecular weight, water solubility of polysaccharides, granule size and viscosity. Gamma irradiation at doses lower than 50 kGy could change  $\beta$ -glucan (purified from black yeast) with high solubility and low viscosity (Byun *et al.*, 2008). The depolymerization of starch (Wu *et al.*, 2002) has also been associated with the decrease in viscosity caused by ionizing irradiation.

#### Conclusion

In summary, results of the current study show that electron beam irradiation at 20 kGy of flaxseed is an effective way to improve performance, ileal digestibility, and reduce digesta viscosity of broiler chickens. Further research on the use of irradiated flaxseed in combination with carbohydrase enzymes and its impact on broiler performance and nutrient utilization are warranted.

### Acknowledgements

This study was financially supported by Sari Agricultural Sciences and Natural Resources University, Sari, Iran. Authors wish to thank Mrs. Nayefi and Zarbal Company (Amol, Iran) for providing technical assistance to carry out this work. Also, a special thanks to Professor Howard Bradbury that provide Cyanide kit from the Australian National University, Canberra, Australia.

carcass parameters, ovarian morphology and egg production of pullets. International Journal of Poultry Science, 9: 82–87.

- Association of Official Analytical Chemists (AOAC). 2005. Official methods of analysis, volume 1, 18th edition. AOAC, Arlington, VA, USA.
- Bahraini Z, Salari S, Sari M, Fayazi J & Behgar M. 2017. Effect of radiation on chemical composition and protein quality of cottonseed meal. Animal Science Journal, 88: 1425-1435. DOI: 10.1111/asj.12784
- Beheshti Moghadam MH, Shehab A, Cherian G.
  2017. Methionine supplementation augments tissue n-3 fatty acid and tocopherol content in broiler birds fed flaxseed. Animal Feed Science Technology, 228: 149-158.
  DOI:10.1016/j.anifeedsci.2017.04.014
- Bhatty RS. 1995. Nutrient composition of whole flaxseed and flaxseed meal. Flaxseed in Human Nutrition (ed. SC Cunnane, LU

Thompson). pp  $22\Box 42$ . AOCS Press, Champaign, IL, USA.

Bradbury MG, Egan SV & Bradbury JH. 1999. Determination of all forms of cyanogens in cassava roots and cassava products using picrate paper kits. Journal of the Science of Food and Agriculture, 79: 593-601. DOI: 10.1002/(SICI)1097-0010(19990315)79:4<593::AID-

JSFA222>3.0.CO;2-2

Byun EH, Kim JH, Sung NY, Choi JI, Lim ST, Kim KH, Yook HS, Byun MW & Lee JW. 2008. Effects of gamma irradiation on the physical and structural properties of  $\beta$ glucan. Radiation Physics and Chemistry, 77: 781–786. DOI:

10.1016/j.radphyschem.2007.12.008

- Chamani M, Molaei M, Foroudy F, Janmohammadi H & Raisali G. 2009. The effect of autoclave processing and gamma irradiation on apparent ileal digestibility in broiler breeders of amino acids from canola meal. African Journal of Agricultural Research, 4: 592–598.
- Chung MWY, Lei B & Li-Chan ECY. 2005. Isolation and structural characterization of the major protein fraction from NorMan flaxseed (*Linum usitatissimum* L.). Food Chemistry, 90: 271–279. DOI: 10.1016/j.foodchem.2003.07.038
- Egan SV, Yeoh HH & Bradbury JH. 1998. Simple picrate paper kit for determination of the cyanogenic potential of cassava flour. Journal of the Science of Food and Agriculture, 76: 39-48. DOI: 10.1002/(SICI)1097-0010(199801)76:13.3.CO;2-D
- Esonu BO & Udedibie ABI. 1993. The effect of replacing maize with cassava peel meal on the performance of weaner rabbits fed diets containing cassava root, peel and seviate. Nigerian Journal of Animal Production, 9: 81-85.
- Esteve-Garcia E. 2012. Fats and fatty acids in meat □ type broiler birds. Fats and Fatty Acids in Poultry Nutrition and Health (ed. G Cherian, Poureslami R), pp. 7□36. Context Products Ltd, Packington, Leicestershire, UK.
- Folch J, Lees M & Sloane-Stanley GH. 1957. A simple method for the isolation and purification of total lipids from animal tissues. Journal of Biological Chemistry, 226: 497-507.
- Gharaghani H, Zaghari M, Shahhosseini G & Moravej H. 2008. Effect of gamma irradiation

on anti- nutritional factors and nutritional value of canola meal for broiler chickens. Asian-Australasian Journal of Animal Sciences, 21: 1479 – 1485.

- Hall CIII, Tulbek MC & Xu Y. 2006. Flaxseed. Advances in Food and Nutrition Research, 51: 1-97. DOI: 10.1016/S1043-4526(06)51001-0
- Hernandez FIL. 2013. Performance and fatty acid composition of adipose tissue, breast and thigh in broilers fed flaxseed: a review. Current Research in Nutrition and Food Science, 1: 103-114. DOI: 10.12944/CRNFSJ.1.2.01
- Leeson S & Summers JD. 2005. Commercial Poultry Nutrition. University Books. Guelph, Ontario, Canada.
- Mridula D, Kaur D, Nagra1 SS, Barnwal P, Gurumayum S & Singh KK. 2011. Growth performance, carcass traits and meat quality in broilers, fed flaxseed meal. Asian-Australasian Journal of Animal Sciences, 24: 1729 – 1735. DOI: 10.5713/ajas.2011.11141
- Mridula D, Barnwal P & Singh KK. 2015. Screw pressing performance of whole and dehulled flaxseed and some physico-chemical characteristics of flaxseed oil. Journal of Food Science and Technology, 52: 1498–1506. DOI: 10.1007/s13197-013-1132-6
- Najib H & Al-Yousef YM. 2011. Performance and essential fatty acids content of dark meat as affected by supplementing the broiler diet with different levels of flaxseeds. Annual Review & Research in Biology, 1: 22–32.
- Nayefi M, Salari S, Sari M & Behgar M. 2016. Nutritional Value of electron beam irradiated cottonseed meal in broiler chickens. Journal of Animal Physiology and Animal Nutrition, 100: 643-648. DOI: 10.1111/jpn.12418
- Omer HAA, Sawsan MA, AbdEl-Maged AA & Azza MMB. 2013. Utilization of Flaxseeds (*Linum usitatissimum L.*) in Rabbit Rations. 2. Influence of Flaxseeds Levels Supplementations on Blood Constituents, Carcass Characteristics and Fatty Acids Profile. Life Science Journal, 10: 2625-2637.
- Ortiz LT, Rebolé A, Alzueta C, Rodríguez ML & Treviño J. 2001. Metabolisable energy value and digestibility of fat and fatty acids in linseed determined with growing broiler chickens. British Poultry Science, 42: 57-63. DOI: 10.1080/713655010
- Rodríguez ML, Alzueta C, Rebolé, A, Ortiz LT, Centeno C & Treviño J. 2001. Effect of inclusion level of linseed on the nutrient

utilisation of diets for growing broiler chickens. British Poultry Science, 42: 368–375. DOI: 10.1080/00071660120055359

- SAS Institute, Inc. (2013) SAS/STAT User's Guide, 9.4 for windows. SAS Institute, Inc, Cary, NC, USA.
- Shawrang P, Sadeghi AA & Ghorbani B. 2013. The effect of electron beam irradiation on  $\beta$ glucan content, X-ray diffraction of starch, protein subunit patterns, and in vivo digestibility of barley grain in cockerels. Turkish Journal of Veterinary and Animal Sciences, 37: 443-448. DOI: 10.3906/vet-1202-25
- Short FJ, Gorton P, Wiseman J & Boorman KN. 1996. Determination of titanium dioxide added as an inert marker in chicken digestibility studies. Animal Feed Science

and Technology, 59: 215–221. DOI: 10.1016/0377-8401(95)00916-7

- Wu D, Shu Q, Wang Z & Xia Y. 2002. Effect of gamma irradiation on starch viscosity and physicochemical properties of different rice. Radiation Physics and Chemistry, 65: 79-86. DOI: 10.1016/S0969-806X(01)00676-4
- Yassein SA, El-Mallah GM, Ahmed SM, El-Ghamry AA, Abdel-Fattah MM and El-Hariry DM. 2015. Response of laying hens to dietary flaxseed levels on performance, egg quality criteria, fatty acid composition of egg and some blood parameters. International Journal of Research Studies in Biosciences, 3: 27-34.
- Zar JH. 2009. Biostatistical analysis. Pearson Prentice Hall. Upper Saddle River, NJ, USA. 960 Pages.



# Poultry Science Journal

ISSN: 2345-6604 (Print), 2345-6566 (Online) http://psj.gau.ac.ir



### تاثیر دانه کتان پرتوتابی شده بر عملکرد، خصوصیات لاشه، فراسنجههای خونی و قابلیت هضم مواد مغذی در جوجههای گوشتی

Beheshti Moghadam MH1, Rezaei M1, Behgar M2 & Kermanshahi H3

<sup>۱</sup> کروه علوم دامی، دانشکده علوم دامی و شیلات، دانشگاه علوم کشاورزی و منابع طبیعی ساری، ساری، ایران <sup>۲</sup> موسسه تحقیقات فناوری و علوم هستهای، کرج، ایران <sup>۳</sup> کروه علوم دامی، دانشکده کشاورزی، دانشگاه فردوسی مشهد، مشهد، ایران

> Poultry Science Journal 2017, 5 (2): 153-163 DOI: 10.22069/psj.2017.13717.1271

#### چکیدہ

**کلمات کلیدی** جوجه گوشتی دانه کتان عملکرد پرتوتابی الکترون قابلیت هضم مواد مغذی

نویسنده مسئول Mansour Rezaei mrezaei2000@yahoo.com

> تاریخچه مقاله دریافت: ۲۶ جولای ۲۰۱۷ ویرایش: ۱۶ سپتامبر ۲۰۱۷ پذیرش: ۲۸ سپتامبر ۲۰۱۷

هدف از این مطالعه، بررسی اثرات تغذیهای دانه کتان پرتوتابی شده بر عملکرد، خصوصیات لاشه، فراسنجههای خونی، ویسکوزیته محتویات هضمی و قابلیت هضم مواد مغذی در جوجههای گوشتی بود. این آزمایش به صورت فاکتوریل ۲ × ۲ با یک تیمار شاهد، در قالب طرح کاملاً تصادفی با ۳۲۰ قطعه جوجه یک روزه، در ۵ تیمار و ۴ تکرار (۱۶ جوجه در هر تکرار) انجام شد. تیمارهای آزمایشی شامل جیره ذرت- سویا (جیره شاهد)، جیرههای حاوی ۱۰ و ۲۰ درصد دانه کتان بدون پرتوتابی و ۱۰ و ۲۰ درصد دانه کتان پرتوتابی شده با دز ۲۰ کیلوگری انجام شد. تغذیهی دانه کتان پرتوتابی شده منجر به افزایش وزن بدن در دورههای رشد و پایانی شد (۲-۰ < P). در دورهی پایانی جوجههای گوشتی تغذیه شده با جیره حاوی ۲۰ درصد دانه کتان، کمترین افزایش وزن را داشتند و همچنین درصد سینه در این تیمار در مقایسه با جوجههای تغذیه شده با ۱۰ درصد دانه کتان کمتر بود (۹<۰/۰۵). در صد ران در جوجههای تغذیه شده با ۲۰ در صد دانه کتان نسبت به ۱۰ در صد کتان بالاتر بود (۲۰۸ > P). در تیمار حاوی ۲۰ درصد دانه کتان پرتوتابی شده، درصد جگر به طور معنیداری نسبت به تیمارهای دیگر کاهش یافت (P < ۰/۰۵). پرندگانی که با جیرههای حاوی۲۰ درصد دانه کتان پرتوتابی شده و بدون پرتوتابی تغذیه شده بودند، نسبت به پرندگانی که ۱۰ درصد دانه کتان پرتوتابی شده و بدون پرتوتابی را مصرف کرده بودند، فعالیت آنزیم آسپارتات آمینوترانسفراز کمتری را نشان دادند. با مصرف دانه کتان در تیمارها، قابلیت هضم ماده خشک، ماده آلی و چربی خام کاهش یافت (P < ۰/۰۵). قابلیت هضم ظاهری ماده خشک، ماده آلی و چربی خام در تیمارهای حاوی دانه کتان پرتوتابی شده نسبت به تیمارهای حاوی دانه کتان بدون پرتوتابی افزایش یافت. همچنین مصرف دانه کتان پرتوتابی شده نسبت به دانه کتان بدون پرتوتابی، ویسکوزیته محتویات هضمی را به طور معنىدارى كاهش داد. نتايج اين مطالعه نشان داد، پرتوتابى دانه كتان موجب افزايش مصرف دانه كتان در جیره، بدون هیچ گونه اثر منفی روی عملکرد جوجههای گوشتی میشود.

Please cite this article as: Beheshti Moghadam MH, Rezaei M, Behgar M & Kermanshahi H. 2017. Effects of Irradiated Flaxseed on Performance, Carcass Characteristics, Blood Parameters, and Nutrient Digestibility in Broiler Chickens. Poult. Sci. J. 5 (2): 153-163.

© 2017 PSJ. All Rights Reserved