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Effects of electron beam irradiated soybean meal and corn on blood lipid profile in broiler breeder

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Abstract

The main purpose of current study was to determine effect of Electron Beam Irradiation (EBI) on nutritional value of corn and soybean meal on blood lipid profile in broiler breeder. Sixteen Rosters and 80 Hen Ross 308 (46-week-age) with in average BW 5.71 and 4.65, respectively, were randomly distributed into 4 treatment group (4 repeated cage for each treatment) and received experimental diets (at 0, 30, 40 and50 KGy levels) as NRC requirement needs. At the end of study from each repeated cages 2 hens selected randomly and 5cc blood sample was taken from wing vain using disposable syringe. Blood samples were centrifuged at 5000 rpm for 10 minute and plasma was separated and stored at -20 °c until used. Triglyceride, Cholesterol, HDL and LDL levels were determined by calorimetric method. According to the results, there was no significant difference in Triglyceride, Cholesterol, HDL and LDL levels among treatment birds compare to control group (*P*=<0.05).

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Introduction

The three-dimensional structures of proteins are essential for understanding protein function and activity. Detailed knowledge of protein structures has been vital for our understanding of numerous biological processes, from enzymatic reactions to immune evasion by viruses. In the case of enzymes their structures have revealed how substrates and inhibitors interact with them and have provided insight into the mechanisms of enzyme-catalyzed reactions (Parker, 2003).

Food irradiation, the use of ionizing radiation to destroy harmful biological organisms in food, is a safe, proven process that has many useful applications. To amplify this point, members of the World Health Organization's (WHO) Food Safety Unit have described food irradiation as possibly the most significant contribution to public health to be made by food science and technology since the pasteurization of milk. Food irradiation has been endorsed by numerous health organizations and has now been approved for many applications by governments around the world. In spite of these facts, food irradiation has not yet been widely accepted (Diehl, 1995).

In addition, to establishing the minimum required dose, it is also necessary to estimate the maximum acceptable dose. This need arises not only because government regulations establish a maximum upper dose limit (the maximum allowable dose) for a particular application, but also because high doses can have negative sensory effects on foods. To understand how such effects can arise, we briefly summarize the effects of ionizing radiation on the primary components of foods, including the carbohydrates, lipids and proteins, as well as some important micronutrients (vitamins). The molecules of interest are relatively large in comparison with water, although not nearly so large as DNA. For example, the simple sugar glucose has a molecular weight of 180. For such large molecules any excess energy is most likely to be absorbed in those parts of the molecule having the greatest electron density, or where bonds are relatively weak. Consequently, it is not surprising that the products of radiolysis are nearly identical to the products resulting from cooking, for example (Diehl, 1995; Mead *et al.,* 1999).

While Amino Acids (A.As) by themselves are relatively sensitive to free radical attack following irradiation, they are much less sensitive when buried in the rigid structure of a protein molecule. Consequently, low and medium doses cause only a minor breakdown of food proteins into lower molecular weight protein fragments and amino acids. In fact, experimental evidence suggests that such treatments cause less protein degradation than steam heat sterilization. At high doses, however, irradiation can result in protein denaturation (unfolding of the protein structure), with resulting loss of food quality. Lipids are substances in the blood that are related to cholesterol. They are a kind of fat found in certain foods and made by the liver. Life Line Screening offers the complete lipid panel screening, which measures 3 different kinds of lipids: Triglycerides are the most common type of fat. Like cholesterol, they circulate in blood but are stored in the body for extra energy. Triglyceride levels increase significantly after eating. A high triglyceride level combined with a low HDL or high LDL can speed up the process of plaque formation in the arteries.

Low-density lipoprotein, or LDL, carries about 65% of the cholesterol in blood. Known as the "bad" cholesterol, LDL can build up in the walls of the arteries that feed the heart and brain. Along with other substances, it can form plaque a thick, hard deposit that can clog those arteries. When this happens, the condition is known as atherosclerosis. High-density lipoprotein, or HDL, carries about 30% of the cholesterol in blood. HDL is known as "good" cholesterol because it carries LDL away from the arteries and back to the liver, where it's passed from the body. A high HDL level helps prevent heart disease, while a low HDL level increases the risk of heart attack and stroke (Cuningham, 2013).

The aim of this study was to investigate effects of irradiated soybean meal and corn electron on blood Triglyceride, Cholesterol, HDL and LDL levels in broiler breeder.

Material and methods

Sample preparation and irradiation treatments

The corn sample (Brazilian variety) was obtained from the Fajr Company (Tehran, Iran). Eight kg corn sample was divided into four equal portions and packed in polyethylene bags. Three polyethylene packages samples were exposed to 10 Mega Volte (MeV) electron beam using a Rhodotron accelerator model TT-200 (IBA Co., Belgium) installed at the Yazd irradiation center, Radiation Applications Research School (of Atomic Energy Organization of Iran) by various levels (0, 30, 40 and 50 kGy). All irradiations were performed at laboratory temperature. Regarding the low thickness of the samples packages, single sided irradiation has been used. The required doses were delivered to the samples by adjusting the conveyer speed when each of the sample batches passed under the beam.

Table 1. The compositions of experimental diets for Broiler Breeder in 1000 kg.

ingredients	A	B	C	D
Corn	526	526	526	526
Soybean meal	190	190	190	190
Wheat	160	160	160	160
DCP	11	11	11	11
Shell	40	40	40	40
Calcium Carbonate	35	35	35	35
Barn	28	28	28	28
Vitamine Cop.	2.5	2.5	2.5	2.5
Mineral Cop.	2.5	2.5	2.5	2.5
Salt	2.5	2.5	2.5	2.5
Methionine	0.7	0.7	0.7	0.7
Lysine	0.2	0.2	0.2	0.2
Phytase	0.4	0.4	0.4	0.4
Aluminum Sulphate	1.2	1.2	1.2	1.2

A: 0, B: 30, C: 40 and D: 50 KGy levels on nutritional value of corn and soybean meal

Table 2. Calculated values of experimental diets.

	A	B	C	D
ME (Kcal/Kg)	2700	2700	2700	2700
CP (%)	15	15	15	15
P (%)	0.33	0.33	0.33	0.33
Ca (%)	2.9	2.9	2.9	2.9
Met+ Cys	0.62	0.62	0.62	0.62
Lys	0.63	0.63	0.63	0.63

ME: Metabolizable Energy, CP: Crude Protein, P: Phosphorous, Ca: Calcium, Met: Methionine, Cys: Cysteine, Lys: Lysine

Experimental birds

Sixteen Rosters and 80 Hen Ross 308 (46-week-age) with an average BW of 5.71 and 4.65, respectively, were randomly distributed into 4 treatment group (4 repeated cage for each treatment) and received experimental diets as a NRC mentioned needs. All experimental birds had free excess to fresh water during the study. At the first hours of experiment to decrease effect of stress 10 ml /10 lit water vitamin supplements was given to birds.

Experimental diet

All experimental diets are formulated by NRC 2001 suggestions using User Friendly Feed Formulation Done Again (UFFDA). All experimental diet was Iso-caloric and Iso-nutrigenous. There was difference just between EBI levels of corn and soybean meal. The compositions of experimental diets are shown in table 1 and 2. All experimental birds received experimental diets for 8 week.

Sample collection

At the end of study from each repeated cages 2 hens selected randomly and 5cc blood sample was taken using wing vain using disposable syringe. Blood samples were centrifuged at 5000 rpm for 10 minute and plasma was separated and stored at -20 ^{o}c until used. Plasma TG, Chl, HDL and LDL concentration were determined by calorimetric method using auto analyzer (300 ALCYON).

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Statistical analysis

Data were analyzed as a complete randomized design (CRD) using SAS (9.1) software and the least square means compared with Duncan's multiple range tests. Statistical model used in this study was: $Yij=\mu+Ti+eij$

Result and discussion

Effects of nuclear Irradiated soybean and corn on plasma lipid profile in broiler breeder are shown in Table 1.

According to the results, there was no significant difference in Triglyceride levels, levels among treatment birds compare to control group (*P=<0.05*). The least level was found out in group A whereas the maximum level was in group B. Additionally, there was no significant difference in Cholesterol levels among treatment birds compare to control group (*P=<0.05*). In this parameter the least and the most amount were in group A and B, respectively. In levels of HDL, there was no significant difference among treatment birds compare to control group (*P=<0.05*). Maximum level was in group C and the minimum was determined in group B. Finally, According to the results, there was no significant difference in LDL levels among treatment birds compare to control group (*P=<0.05*). The lowest and highest levels were D and A groups, respectively.

Table 3. Table 1. Effect of different levels of Irradiated soybean and corn on blood biochemical parameters in broiler breeder.

Group	N	Triglyceride (mg/dL)	Cholesterol (mg/dL)	HDL (mg/dL)	LDL (mg/dL)
A	20	489.5 ± 6.64	132.375 ± 0.81	13.625 ± 0.16	21 ± 0.56
B	20	517.5 ± 6.64	136 ± 0.81	13.207 ± 0.16	19.29 ± 0.56
C	20	510.125 ± 6.64	135.33 ± 0.81	13.915 ± 0.16	19.392 ± 0.56
D	20	516.04 ± 6.64	135.375 ± 0.81	13.875 ± 0.16	18.29 ± 0.56
F value		1.333	0.508	0.536	0.650
Coefficient of variation		4.53%	3.39%	6.50%	14.27%

A: 0; B: 30; C: 40 and D: 50 KGy. SE: Standard error.

Lipids are fats and oils composed of the same elements (carbon, hydrogen, and oxygen) as carbohydrates. The lipid portion of foods consists primarily of the triglycerides, in which the three hydroxyl groups of simple glycerol are replaced with long fatty acid side chains. At low and medium doses, the effect of irradiation on the nutritional content of lipids is minimal. In addition, it is also important to note that such doses will not cause the formation of aromatic or heterocyclic rings, or the condensation of aromatic rings, all of which are considered to be carcinogenic, and are known to form at high cooking temperatures. However, the irradiation of lipids at high doses, and especially in the presence of oxygen, can lead to the formation of liquid hydroperoxides. While not necessarily harmful, these substances often have undesirable odors and flavors (rancidity). The unsaturated fatty acids are more prone to develop rancidity. Lipid oxidation can be significantly reduced by freezing, and/or by oxygen removal prior to irradiation (Miller, 2005). About effects of irradiated soybean meal and corn electron on blood lipid profile in broiler breeder we could not find any article to compare our results with previous researchers. We believe further researches needs to make effects EBI on blood lipid profile in broiler breeder. Changes in the lipid fraction, especially on linoleic and linolenic acid content by peroxidation in grains, have already been described by Vaca and Harms-Ringdahl (1986). On the other hand, chemical modifications in the lipid fraction of food by formation of radicals and hydrocarbon fragments are well known, and the radiolysis products are used as indicators for irradiation treatment (Balboni and Nawar, 1970; Ammon *et al.,* 1992; Schreiber and Schulzki, 1993; Nawar, 1994). In natural lipids the cis-configuration of unsaturated fatty acids predominate and the transmutation of the normal cis-configuration into the trans form is nearly impossible under conditions of metabolisms in cells of plants or animals. In general, trans forms of monoenic and dienoic fatty acids with methylene interrupted double bonds occur only as minor constituents (Geibler *et al.,* 2003). Finally, (Brito, 2002) has demonstrated that irradiation doubles the amount of trans fat in irradiated compared to non-irradiated ground beef. Well-established nutrition science suggests that doubling of trans fat will increase the risk of chronic heart disease associated with this harmful fat.31 Further, an increase in trans-fat also increases the risks of a variety of other human health problems, including increasing levels of LDL and decreasing levels of HDL.

The results of this feeding experiment did not show significant effects on blood Triglyceride, Cholesterol, HDL and LDL levels in broiler breeder. We think further researches needs to achieve to identify effects of EBI food stuffs on poultries bood lipid profile.

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