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Effects of Gamma Irradiated *Moringa oleifera* Seed Cake on Growth, Nutrient Digestibility and Blood Characteristics of Broilers.

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Abstract

The effect of gamma irradiated Moringa oleifera seedcake (GIMOSC) on performance, nutrient digestibility and blood characteristics of broiler chickens was investigated over eight weeks period. This study investigated the effect of gamma irradiated Moringa oleifera seedcake (GIMOSC) on performance, nutrient digestibility and blood characteristics of broiler chickens. One hundred and fifty day-old Arbor acre chickens used in this experiment were subjected to five dietary treatments as follows; Diet 1-the control, diet 2-raw (untreated MOSC), diets 3, 4, and 5 –GIMOSC at doses of 10, 30 and 50 kGy respectively at 5% level of inclusion. Broilers fed treated GIMOSC had similar ($p<0.05$) DWG, FI and FCR with the control (58.18 to 59.64 vs. 59.69; 106.66 to 108.57 vs. 104.22 g/bird/day and 1.81 to 1.84 vs. 1.75, respectively) and were significantly ($p<0.05$) better than values for raw MOSC. The haematological indices and serum chemistry of chickens fed treated MOSC were poorer than the control but significantly ($p<0.05$) better than those of raw MOSC. In conclusion, treatment of MOSC with gamma irradiation was effective in reducing its anti-nutritional contents and can be used as protein supplement in poultry diet. This study recommends the use of 30KGy in treatment of MOSC for improvement of its nutritive value.

Keywords: Moringa seed cake; Broiler chickens; Performance; Biochemical; Haematological indices

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Introduction

Chicken industry is one of the most dynamic of world agribusiness trade. Hence, research on meat production globally indicates poultry as the fastest growing livestock sector especially in developing countries. A major developmental challenge facing most developing countries like Nigeria in Africa is food insecurity due to the high population growth in Africa and low income. The demand for eggs and poultry meat has significantly increased in recent years across large parts of the continent (WHO, 2010). The livestock producers appear most hit in terms of the high cost of feed brought about by exorbitant cost of feed ingredients. Poultry production remains one of the veritable ways of achieving sustainable and rapid production of high-quality animal protein to meet the increasing demand of the Nigerian learning populace (Apata and Ojo, 2000). Limitation imposed by scarcity of soyabean and competition from human consumption have forced many farmers into employing alternative sources of protein feedstuffs for poultry feed of which *Moringa oleifera* is an example. Food/feed processing by irradiation is relatively a new treatment technique evolved in the course of technological progression. Irradiation has been applied in numerous different uses and in various aspects of life including industries, medicine, and agriculture. In agriculture, it has been widely employed to produce improved varieties in plants and animals. Food or feed processing through this method involves treating a material with radioactive particles from radioisotope sources of cobalt-60, Caesium-137 or with accelerated electrons with energies up to 10MeV or X-rays with energies up to 5MeV (Farkas, 2006). Radioactive rays are used in food pasteurization, sterilization, disinfection, disinfestations and inhibition of sprouting in cereals, nuts and seeds.

Past investigators (Farag, 1989; Sattar *et al*. 1990; El-Moshi *et al*. 1992) reported that gamma irradiation treatment with its radiolytic effects could destroy or significantly inactivate protease inhibitors. There is no information on the use of gamma irradiation for the treatment of M. *oleifera* seed cake for feeding broilers. Hence the study aims to investigate the effects of dietary raw and gamma irradiated *Moringa oleifera* seedcake on performance, serum and haematological characteristics, and nutrient digestibility of broiler chickens under the tropical environment of guinea savannah of Nigeria.

Materials and Methods

20kg of *Moringa oleifera* seed cake used for this work was obtained from Moringa processing plant at Afe Babalola University, Ado-Ekiti, Nigeria. *Moringa oleifera* seed cake (MOSC) was properly sundried to a permanent weight and milled and kept in airtight container before irradiation and included in the dietary mixture. The milled *Moringa oleifera* seed cake was divided into four equal portions and placed in opened polythene bags. A porion was left not irradiated representing raw or untreated *Moringa oleifera* seed cake sample. The other three bags of *Moringa oleifera* seed cake sample were irradiated at a time in a gamma L-110 machine until the required total doses of 10, 30 and 50 kGy were achieved. Five experimental diets were formulated made of a corn-soy reference diet (control diet) and four other diets containing raw (untreated *Moringa oleifera* seed cake) and gamma irradiated *Moringa oleifera* seed cake at doses of 10,30 and 50KGy respectively before inclusion in the diet at the same 5% level of inclusion corresponding to diets 1, 2, 3, 4 and 5 respectively at 5% level of inclusion (Table 1). One hundred and fifty day-old Arbor acre breed of broiler birds used for this experiment were obtained from Novic Farms, Ibadan, Oyo State Nigeria. The experiment was designed as a completely randomized design. The dietary treatments contained three replicates with 10 chicks per replicate. All the birds were raised under similar management practices throughout the eight-week experimental period. The birds were given feed and water *ad-libitum* and weighed weekly. The composition of the experimental diets for the broilers is presented on Table 1

Data Collection

At the end of the experiment, one broiler per replicate in all the treatments was taken at random for blood collection by decapitation. Blood for biochemical indices was collected in bottles without EDTA for the analysis of the biochemical parameters such as total protein, albumin, globulin, urea, and transaminase activities (serum aspartate amino transaminase (AST), alanine amino transaminase (ALT) and alkaline phosphatase (ALP)). The blood samples for haematological parameters were pretreated with ethylene diamine tetra-acetic acid (EDTA). Haematological indices examined include White Blood Cell (WBC), Red Blood Cell (RBC), Packed Cell Volume (PCV), Haemoglobin (Hb). Mean Cell Volume (MCV), Mean Cell Haemoglobin (MCH) and Mean Cell Haemoglobin Concentration (MCHC) were calculated from the values of the RBC, PCV and Hb respectively, according to the methods of Jain (1986).

Data Analysis

Data collected on the response criteria were subjected to analysis of variance in a completely randomized design model and differences between treatment means were separated using the Duncan's multiple range test (Steel and Torrie, 1980).

Results and Discussion

Performance characteristics of broiler chickens fed raw and graded doses of gamma irradiated Moringa oleifera seed cake-based diets

The performance characteristic of broilers fed raw and graded doses of gamma irradiated *Moringa oleifera* seed cake (MOSC) diets were presented on Table 2. The average daily weight gains of the birds were significantly ($p<0.05$) affected by the dietary inclusion of raw and graded doses of gamma irradiated MOSC diet. There was a decrease in the

average daily weight gains of birds fed with raw and a comparable average daily weight gains of birds fed with graded doses of the gamma irradiated diets. The feed intake values was very significantly ($p<0.05$) affected by the dietary replacements of soybean with graded doses of gamma irradiated MOSC. Except for raw diet (diet 2), there was a linear increase in the feed intake values of birds per day with graded doses of gamma irradiated MOSC in the diet. The feed conversion ratio of the birds was very significantly ($p<0.05$) affected by the increase in the doses of the gamma irradiated treated MOSC in the diet of the birds. The feed conversion ratio favoured the birds on the reference diet. There was no mortality recorded during the course of this trial.

Nutrient digestibility of broiler chickens fed gamma irradiated treated seed cake-based diets

The nutrient digestibility of broilers fed with gamma irradiated MOSC diet were presented on Table 3. The nutrient digestibility of crude protein, fat and crude fibre were significantly ($p<0.05$) affected with the inclusion of doses of gamma irradiated MOSC in the diet of the birds. The trend in the crude protein, fat and fibre digestibility revealed that the birds on the control diet had better nutrient digestibility compared with its counterparts in other treatment groups.

Haematological indices of broiler chickens fed gamma irradiated Moringa oleifera seed cake-based diets.

The hematology indices of the birds fed gamma irradiated treated *Moringa oleifera* seed cake diet is presented on Table 4. Haemoglobin, white blood cell, and the mean cell volume were very significantly ($p<0.05$) affected with the inclusion of graded doses of gamma irradiated MOSC in the diet of the birds. Mean cell haemoglobin concentration of the birds was not statistically ($p\geq0.05$) different with the inclusion of graded doses of gamma irradiated MOSC in the diet of the birds.

Serum biochemical indices of broiler chickens fed gamma irradiated treated Moringa oleifera seed cake-based diets

Table 5 presents the biochemical indices of the broilers given gamma irradiated treated MOSC diet. There was a significant ($p<0.05$) increase in the serum urea, albumin and total protein level with the inclusion of graded dose of gamma irradiated MOSC in the diet of the birds. The serum aspartate amino transaminase (AST), alanine transaminase (ALT) and alkaline phosphatase (ALP) levels of the birds significantly ($p<0.05$) decreased linearly with the inclusion of graded dose of gamma irradiated MOSC in the diets of the birds. Growth performance characteristics: Growth performance potential represents an important index in animal studies. Growth performance and feed utilization were affected significantly by dietary treatment for all treatment diets. The comparable growth performance of birds on control diet and those fed gamma irradiated diets at doses 10, 30 and 50 KGy could be attributed to better utilization of the feed by the birds as a result of inactivation/removal of anti-nutrients in MOSC by the irradiation process. This view is in accordance with the findings of Taghinejad *et al*., (2009) who reported that gamma irradiation at 30 kGy completely removed phytate from full-fat soybeans.

The average daily weight gains: Birds on the control diet had the highest average daily weight gains due to the highest feed intake while there was a corresponding decrease in the average daily weight gain in treatment 2 containing raw MOSC with the lowest feed intake. The comparable daily weight gains of the birds on control and those on treatments 3,4 and 5 may be due to better utilization of the feed by the birds. This is in line with the findings of Siddhuraju *et. al*., (2002) who reported reduction in phytate probably due to the chemical degradation to lower inositol phosphates and inositol by the action of free radicals produced by the irradiation. There was an indication that birds fed the control diet and those on gamma irradiated diets had better feed conversion ratios. The best FCR observed in birds on the control diet was due to the absence of anti-nutritional factors (ANFs) in the control diet followed by the birds fed 10KGy gamma irradiated diet. Dietary replacement of soyabean by raw MOSC led to very poor feed conversion ratios as observed in untreated MOSC group. The result is in agreement with past works (Makkar and Becker 1997) which reported that the phytochemicals, saponins, trypsin inhibitors are ANFs that affect monogastrics but do not affect ruminants because they are to some extent capable of degrading the toxins in their rumen. The ANFs present in the raw MOSC limited the utilization of the nutrients present in the diets by the birds as saponins reduce uptake of nutrients; carbohydrates and proteins hence reducing growth rate and feed efficiency in monogastric animals, phytates inhibit protein digestion by complexing them and tannins cause decreased feed intake in monogastric animals, bind dietary proteins including digestive enzymes by forming complexes with them that are not readily digested.

Absence of mortality in this study is an indication that most of the anti- nutrients in the treated MOSC diets have been eliminated or significantly reduced. Some of these anti-nutrients are known to cause death in animals. Tannins complex with and reduced absorption of iron in the gut (Butler, 1989). The observed significant ($p<0.05$) increase in total protein, of the test diet attest to the nutritional adequacy of gamma irradiated MOSC in meeting the protein needs of the birds. Onifade and Tewe (1993) had earlier reported that serum protein, albumins and globulins are generally influenced by total protein intake. ALP, AST and ALT levels in this study were similar in all the diets indicating normal organ function on feeding of moringa seed cake. The range of $2.27\text{-}2.52x10^{12}$/l for red blood cells (RBC) obtained in this study was lower than $3\text{-}6x10^{6}$/dl for chicken as reported by Madubuike and Ekenyem (2006). These results showed that moringa seed cake fed groups were normal and healthy. The range of PCV (30.05-32.75%) across all the experimental diets is within normal range of 22-35% reported by Jain (1993) and 28 - 30.70% reported by Ogbuewu *et al.* (2010). The MCV of 129.6-132.65fl obtained in this study is similar to the range between 115-127fl reported by Swenson (1993). The mean cell haemoglobin

concentration (MCHC) value of 27.8-28.55g/dl reported in this study are within the stipulated values of 25.3-32.5g/dl reported by Mitruka and Rawsley (1977).

Conclusion and Recommendations

From this study, broilers fed treated MOSC diet performed better than those fed raw MOSC diet while those fed the control diet performed significantly better than those fed raw and treated MOSC diet respectively. The adopted treatment method in this study was not sufficient to totally detoxify the anti-nutrients present in MOSC. The best result obtained from replacing soybean with treated *Moringa oleifera* seed cake diet was the use of 30KGy in treatment of MOSC at 5% inclusion level.

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Tables

Table 1: Composition of the experimental diets for broilers treated with gamma irradiation (%).

	Irradiation doses (KGy)				
Ingredients	**(control) 0**	**(untreated) 0**	**10**	**30**	**50**
Maize	52.00	52.00	52.00	52.00	52.00
GIMOSC	0.00	3.10	3.10	3.10	3.10
Soya bean meal	31.00	27.90	27.90	27.90	27.90
Wheat offal	10.00	10.00	10.00	10.00	10.00
Palm oil	1.50	1.50	1.50	1.50	1.50
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.25	0.25	0.25	0.25	0.25
Bone meal	1.15	1.15	1.15	1.15	1.15
Oystershell	1.50	1.50	1.50	1.50	1.50
Salt	0.25	0.25	0.25	0.25	0.25
*Vit/Min premix	0.25	0.25	0.25	0.25	0.25
Fish meal	2.00	2.00	2.00	2.00	2.00
Total	**100**	**100**	**100**	**100**	**100**

GIMOSC=Gamma irradiated Moringa oleifera seed cake
0.50 premix supplied, per kilogram of diet: vitamin A, 12,000 IU; vitamin D3, 2,000 IU; vitamin E, 50 IU; vitamin B1, 1 mg; vitamin B2, 3 mg; vitamin B6, 1 mg; vitamin B12, 10 µg; vitamin K, 2 mg; copper (cupric sulphate), 75 mg; nicotinic acid, 12 mg; pantothenic acid, 10 mg; iron, 200 mg; cobalt, 0.5 mg; manganese, 40mg; zinc, 90 mg, iodine, 1 mg; selenium, 0.2 mg; calcium, 31.25 g; sodium, 10 g

Table 2: Growth performance characteristics of broiler birds fed gamma irradiated *Moringa oleifera* seed cake diet.

	Irradiation doses of MOSC (KGy)					
Parameters	**(control) 0**	**(untreated) 0**	**10**	**30**	**50**	**SEM**
Daily weight gains (g/bird/day)	59.69^{a}	47.007^{b}	59.030^{a}	59.64^{a}	58.18^{a}	1.99
Feed intake (g/bird/day)	104.22^{ab}	98.473^{b}	106.66^{a}	108.57^{a}	107.13^{a}	3.94
Feed conversion ratio	1.75^{b}	2.100^{a}	1.807^{b}	1.82^{b}	1.84^{b}	0.05

*SEM= Standard error of mean; *=P<0.05; Means with different superscript along the same rows are significantly (P<0.05); MOSC=Moringa oleifera seed cake*

Table 3: Nutrient Digestibility of Broiler Chickens Fed Fed Gamma Irradiated *Moringa Oleifera* Seed Cake.
based diets

	Irradiation doses of MOSC (KGy)					
Parameters	**0(control)**	**0(untreated)**	**10**	**30**	**50**	**SEM**
Crude protein	77.603^{a}	61.107^{b}	76.730^{a}	77.530^{a}	75.630^{a}	2.600
Crude fibre	65.667^{a}	51.703^{b}	64.930^{a}	65.600^{a}	63.990^{a}	2.200
Fats	73.423^{a}	57.817^{b}	72.600^{a}	73.353^{a}	71.557^{a}	2.460

*SEM= Standard error of mean; *=P<0.05; **^{c} Means with different superscript along the same rows are significantly (P<0.05) different*

Table 4: Haematological Indices of Broiler Chickens Fed Gamma Irradiated *Moringa Oleifera* Seed Cake based diets.

	Irradiation doses of MOSC (KGy)					
Parameters	**0(control)**	**0(untreated)**	**10**	**30**	**50**	**SEM**
RBC(x 10^{12}/l)	2.360[a]	2.52[a]	2.27[a]	2.50[a]	2.29[a]	0.174
Haemoglobin (g/dl)	8.75[a]	9.30[a]	8.45[a]	9.30[a]	8.45[a]	0.606
PCV (%)	31.20[a]	32.60[a]	30.05[a]	32.75[a]	30.45[a]	2.126
MCV (fl)	132.25[a]	129.60[a]	132.35[a]	131.45[a]	132.65[a]	3.278
MCH (pg)	37.15[a]	36.95[a]	37.200a	37.300[a]	36.85[a]	0.665
MCHC(g/dl)	28.05[ab]	28.55[a]	28.15[ab]	28.350[ab]	27.80[b]	0.332
WBC(x 10^{9}/l)	231.00[a]	233.85[a]	229.80[a]	238.800[a]	238.80[a]	6.472

SEM= Standard error of mean=P<0.05; Means with different superscript along the same rows are significantly (P<0.05); RBC = Red Blood Cell PCV = WBC White Blood Cell, Packed Cell Volume, MCV = Mean Cell volume, MCH = Mean Cell Haemaglobin, MCHC= Mean Cell Haemoglobin Concentration, .MOSC=Moringa oleifera seed cake.

Table 5: Serum Biochemical Indices of Broiler Chickens Fed Gamma Irradiated *Moringa Oleifera* Seed Cake based diets.

	Irradiation doses of MOSC (KGy)					
Parameters	**0(control)**	**0(untreated)**	**10**	**30**	**50**	**SEM**
Total protein (g/l)	13.927[b]	14.230[ab]	14.600[a]	14.383[ab]	14.250[ab]	0.280
Urea (mmol/l)	4.657[b]	5.070[a]	4.880[ab]	4.973[ab]	4.677[b]	0.176
Albumin (g/l)	2.727[ab]	2.663[bc]	2.597[c]	2.800[a]	2.420[d]	0.055
AST(U/L)	80.000[a]	65.530[bc]	71.843[b]	56.843[d]	64.210[c]	3.935
ALT (U/L)	19.480[b]	15.443[d]	15.960[cd]	23.230[a]	18.710[bc]	1.716
ALP(U/L)	34.680[ab]	37.287[a]	27.600[cd]	25.760[d]	31.340[cb]	2.486

SEM= Standard error of mean=P<0.05Means with different superscript along the same rows are significantly (P<0.05); NS=Non-Significant (P>0.05); AST = Aspartate Amino transaminase, ALT = Alanine Amino transaminase ALP = Alkaline phosphatase MOSC=Moringa oleifera seed cake.*