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Effects of a Locally Produced Blood Meal on Performance, Carcass Traits and Nitrogen Retention of Broiler Chickens

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Abstracts: The study was designed as a 2×5 factorial arrangement with main effects of feeding blood meal as a replacement of 0, 25, 50, 75 or 100% of dietary fish meal and the duration of this substitution at 1-42 or 21-42 days of age. One thousand 1 day old male Cobb 500 broiler chicks assigned randomly to each of 40 floor pens (25 birds/pen) and were fed five isonitrogenous and isocaloric feeds formulated to contain 20.38 and 17% crude protein and 2900 and 3000 kcal kg^{-1} metabolizable for starter and grower periods, respectively. Duration of dietary manipulation didn't affect the measured parameters. More than 25% blood meal/fish meal substitution ratios significantly increased chickens daily weight gain and decreased the cost of producing a unit of meat. Other traits didn't affect by dietary fish meal/blood meal replacement ratio. Spleen and proventriculus percents and small intestine length affected by level of replacement but didn't follow a distinct pattern. These results indicate that this locally produced blood meal is a suitable substitute for dietary fish meal and a full replacement didn't cause any adverse effect on performance, carcass important traits and dietary nitrogen retention of broiler chickens.

Key words: Blood meal, nitrogen retention, performance, functional characteristics, broiler chickens

INTRODUCTION

There are a continues effort on the replacement of the more expensive protein concentrates mainly fish meal in poultry diets with cheaper and less competitively demanded feeding resources (Dafwang *et al*., 1986; Udedibie *et al*., 1988; Fanimo *et al*., 1998; Dongmo *et al*., 2000). This will be accompanied with a reduction in feeding cost and consequently cost of producing a unit of the product like meat.

Blood meal is a by-product of the slaughtering industry and is used as a protein source in the diets of non-ruminants and ruminants. The quality of blood meal's protein is affecting by methods of preparation (McDonald *et al*., 1992), so that finding a variation in the quality of products from different animal processing plants is not uncommon.

Blood meal is very rich in lysine and is a good source of arginine, methionine, cystine, leucine but is very poor in isoleucine and contain less glycine than either fish meal or bone meal (NRC, 1994). Especially, blood meal can compensate the lysine and methionine deficiencies in vegetable protein based diets (McDonald *et al*., 1992). The characteristic smell of blood meal reduces its palatability and then a 5% limit is a usual recommendation for its usage in diets. Today, mostly blood meal is being used as by-pass protein ingredient in ruminant diet (Kamalak *et al*., 2005; Taylor, 2005).

There are some reports indicating that inclusion 1 to 4% blood meal in diets can improve poultry performance (Petkov *et al*., 1980; Nuarautelli *et al*., 1987; Donkoh *et al*., 2001). Other authors used higher level of dietary blood meal without any adverse effect on growth of chickens (Toor and Fahimullah, 1972; Hassan *et al*., 1974; Onwudike, 1981; Donkoh *et al*., 1999, 2001, 2002). There are some opposite reports too. In Hassan Khan and Ansari (2007) study, diets containing more than 3% blood meal unfavorably influenced feed intake and body weight gain of broiler chickens.

The present project is designed to investigate effects of different levels of dietary fish meal replacement by a locally produced blood meal and the duration of this replacement on the performance, carcass traits, dietary nitrogen retention and economic advantage of production of broiler chickens during starter and grower phases of growth.

MATERIALS AND METHODS

Preparation of blood meal: Blood meal was prepared from the Ardabil Slaughtering House in Iran. It was a mixture product of bloods of cattle, sheep and goat. Daily random

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sampling was carried out during one month and the samples of each week were mixed and divided to three sub-samples. Study carried out in September 2007 at research farm of University of Mohaghegh Ardabili, Ardabil, Iran.

Chemical analysis of blood meal: Dried blood meal sample was analyzed in laboratory chemically for proximate constituents (AOAC, 2000). Functional characteristics including water holding capacity, flow characteristics, dry matter solubility, bulk density and particle size measured (Sujeewa, 2000). Metabolisabe energy of blood meal determined via Sibbald (1986) methods.

Husbandry and diets: Table 1 show the components and characteristics of the blood meal used in this study and its comparison to NRC (1994).

Table 1: Composition of the locally produced blood meal used in the experiment (g kg^{-1})

Nutrients		NRC (1994)
Moisture	246.8	100.0
Crude protein	652.0	811.0
Ether extract	32.1	16.0
Crude fiber	17.0	5.0
Gross energy (kcal kg^{-1})	4891.0	-
Metabolisable energy (kcal kg^{-1})	2608.0	2830.0
Ash	82.0	44.5
Calcium	5.4	5.5
Phosphorous	3.0	2.5
TVN (mg N/100 g)	892.0	-

The study was designed as a 2×5 factorial arrangement with main effects of feeding blood meal as a replacement of 0, 25, 50, 75 or 100% of dietary fish meal and the duration of this substitution at 1-42 or 21-42 days of age. One thousand 1 day old male Cobb 500 broiler chicks assigned randomly to each of 40 floor pens (25 birds/pen) and were fed five isonitrogenous and isocaloric feeds formulated to contain 20.38 and 17% crude protein and 2900 and 3000 kcal kg^{-1} metabolisable energy for starter and grower periods, respectively (Table 2).

The fish meal used in the experiment was a local production containing 92% dry matter, 2580 kcal kg^{-1} metabolisable energy, 602.4 (g kg^{-1}) crude protein, 50 (g kg^{-1}) ether extract and 101 (g kg^{-1}) ash. Feed intake and body weight gain recorded for each pen at the end of the experimentally period (42 days of age).

Carcass traits and relative organ weights measurements: At the end of experimental period (42 day), 3 birds per replicate pen were randomly selected for carcass analysis. These birds were starved over night, weighed and sacrificed. The carcass traits measured were the percent of dressed weight, thigh and breast while the relative organs measured were the percents of liver, kidneys, heart, pancreas, spleen, proventriculus, gizzard and small intestine. The length of small intestine (cm)

Table 2: Ingredient and chemical composition of the experimental diets with different dietary fish meal replaced by the locally produced blood meal (g kg^{-1} as fed basis)

	Blood meal/fish meal replacement ratios									
	0		25%		50%		75%		100%	
Ingredients (g kg^{-1})	S*	G	S	G	S	G	S	G	S	G
Coru	650.0	600.0	650.0	600.0	650.0	590.0	650.0	590.0	650.0	590.0
Soybean meal	237.4	163.2	237.4	163.2	237.5	165.1	237.4	165.3	237.4	165.2
Wheat	-	150.0	-	150.0	-	150.0	-	150.0	-	150.0
Fish meal	70.0	50.0	52.5	37.5	35.0	25.0	17.5	12.5	-	-
blood meal	-	-	16.2	11.5	32.3	23.2	48.5	34.6	64.7	46.2
Soybean oil	1.5	3.5	2.2	3.6	2.2	7.2	2.5	7.5	2.8	7.6
Oyester shell	11.1	10.2	11.1	10.4	9.5	10.6	11.7	10.6	12.1	10.9
Dicalcium phosphate	10.1	10.0	12.5	11.5	14.5	13.2	17.0	15.0	19.0	16.5
Salt	3.0	2.2	3.2	2.4	3.5	2.6	3.5	2.8	3.8	3.0
Lysin	0.4	1.6	0.3	1.6	0.3	1.5	0.3	1.4	0.2	1.4
Methionine	1.7	1.7	1.4	1.7	1.7	2.0	2.0	2.2	2.3	2.4
Vit and min sup**	14.9	7.6	13.2	6.5	11.5	9.7	9.7	8.1	7.8	6.9
Analysis (g kg^{-1})										
Crude protein	203.8	170.0	203.8	170.0	203.8	170.0	203.8	170.0	203.8	170.0
Metabolisabe energy (kcal kg^{-1})	2900.0	3000.0	2900.0	3000.0	2900.0	3000.0	2900.0	3000.0	2900.0	3000.0
Calcium	9.7	8.5	9.7	8.5	9.7	8.5	9.7	8.5	9.7	8.5
Ava P	4.9	4.3	4.9	4.3	4.9	4.3	4.9	4.3	4.9	4.3
Sodium	1.5	1.5	1.6	1.6	1.6	1.6	1.7	1.7	1.7	1.7
Met+Cys	7.7	7.7	7.7	7.7	7.8	7.8	7.8	7.8	7.8	7.8
Lysin	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9
Relative price***	1.0	1.0	0.97	0.98	0.94	0.97	0.92	0.95	0.89	0.93

*S and G represent starter (1-21 days) and grower (22-42 days) periods, **Vitamin and mineral premix provided per kilogram: vitamin A, 4000000 IU; cholecalciferol 800000 IU; vitamin E, 14000 IU; vitamin K3, 760 mg; vitamin B2, 2800 mg; vitamin B6, 1520 mg; vitamin B12, 7.6 mg; nicotinic acid, 18000 mg; folic acid, 560 mg; pantothenic acid, 4400 mg; choline chloride, 190000 mg; biotin, 45.3 mg; zinc, 16000 mg; manganese, 25600 mg; iron, 12800 mg; copper, 3200 mg; selenium, 64 mg; iodine, 320 mg, ***To calculation the relative prices of diets the blood meal free starter and grower diets was chosen as unit

measured too. All the carcass traits and the relative organs weights were expressed as percentages of live weights.

Nitrogen balance assay: To measure the nitrogen retained by the broiler chickens, 2 birds per replicate were transferred to individual metabolic cages. Feed consumption for 4 days towards the close of the experimental period was measured and the corresponding faeces voided for the same period were collected, weighed and dried at 55-60°C for 72 h. The procedure for collection and processing of the faecal samples for chemical analysis and computation of the N-balance indices are as reported by Aletor *et al.* (1989). The nitrogen retained was calculated as the algebraic difference between the feed nitrogen content (on dry matter basis) and the nitrogen content of the feaces.

Statistical analysis: Data on performance and carcass traits and nitrogen retention were analyzed with the general linear model procedure and differences among treatments means were classified by Duncan's multiple range test (Version 6.12, SAS, 1997).

RESULTS AND DISCUSSION

The dry matter solubility of blood meal was in the range of 2.02-2.6 that is lower than fish meal ($p<0.05$). Water holding capacity, bulk density and flow characteristics didn't differ from fish meal (Table 3).

Dietary manipulation for 1-42 days of age increased the kidney percent ($p<0.05$) but other measured parameters didn't affect (Table 4).

Inclusion of blood meal instead of dietary fish meal was accompanied by an improvement in final body weight, daily weight gain and reduction in the cost of each kilogram weight gain of broiler chickens; so that the final weight of birds fed the diet with 75% substitution of fish meal by blood meal was significantly higher than birds fed the diet with 25% replacement ($p<0.05$). Latest birds showed the lower daily weight gain too ($p<0.05$).

Daily feed intake, feed conversion ratio and daily nitrogen retention in broiler chickens didn't influence by substitution ratio.

Table 5 shows that spleen and proventriculus percents and small intestine length affected by level of replacement ($p<0.05$) but didn't follow a distinct pattern. The duration of dietary manipulation didn't affect the major carcass traits and the only difference was the higher kidney percent in birds fed the manipulated diets for whole the experimental period (1-42 day) ($p<0.05$). There was no significant interaction between experimental factors.

Functional properties of blood meal and other animal based protein concentrates are mainly dependent to their protein content and quality (Sujeewa, 2000). Water holding capacity of animal protein concentrates is an important factor for pellet manufacturing (Goodband *et al.*, 2002; Sujeewa, 2000). The lower dry matter solubility of blood indicate a more favorite availability of the product dry matter for birds because the solubility mainly attributed to mineral salts contents of products (Sujeewa, 2000). The relatively high bulk density and lower coarse particle (>350 μm) distribution of blood meal in compare to fish meal indicate that blood meal have a lesser preservation potential and have to use in fresh form.

The comparable performance of birds fed diets containing blood meal and fish meal indicate that the protein quality of the locally produced fish meal is not so

Table 3: The functional characteristics of the locally produced blood meal

Parameters	Fish meal	Particle size (μm)	Fish meal
Dry matter solubility	2.34	13-20	<297	11.93	22
Water holding capacity (%)	127.7	165-175	297-349	42.63	36
Bulk density (g mL^{-1})	0.673	0.38-0.65	350-589	15.60	18
Flow characteristics (mm)	28.22	25-46	590-1000	15.30	16
			>1000	14.53	8

Table 4: Effects of dietary fish meal protein replacement with protein from the modified meat meal on performance traits and nitrogen retention of broiler chickens

BM/FM replacement (%)	FI* (g/chick/day)	FBW(42 day) (g)	WG (g/chicks/day)	FCR	CWG (R/kg w)	NR (g/chicks/day)
0	118.0	2137.0^{ab}	49.95^{ab}	2.36	6406^{a}	2.71
25	113.0	2101.0^{b}	49.33^{b}	2.30	6097^{ab}	2.64
50	115.0	2197.0^{ab}	52.23^{a}	2.21	5838^{b}	3.05
75	117.0	2238.0^{a}	52.57^{a}	2.22	5735^{b}	2.35
100	119.0	2209.0^{ab}	52.33^{a}	2.28	5762^{b}	2.64
SE**	5.5	99.8	2.17	0.15	378	0.26
Duration of BM/FM replacement (day)						
1-42	117.6	2183.0	51.42	2.29	5974	2.76
22-42	115.2	2169.0	51.14	2.26	5961	2.42
SE**	0.1	100.0	2.07	0.11	377	0.26

*FI: Feed intake, FBW: Final Body Weight (42 day), WG: Weight Gain, FCR: Feed Conversion Ratio, CWG: Feed Cost per kg Weight Gain (Iranian Rial), NR: Nitrogen Retention, ** Standard error. Values in the same column in each comparison group, with no common superscript different significantly ($p<0.05$)

Table 5: Effects of dietary fish meal replacement with locally produced blood meal on carcass traits

Effect of blood meal/fish meal replacement (%)	Carcass	Breast	Thigh	Liver	Kidney	Heart	Pancreas	Spleen	Proventriculus	Gizzard	Small intestine	Small intestine length (cm)
	(%)											
0	89.90	26.4	27.40	2.30	0.51	0.45	0.23	0.11^{b}	0.54^{a}	1.46	4.47	194.0^{ab}
25	90.30	25.8	28.20	2.10	0.49	0.45	0.21	0.12^{ab}	0.44^{b}	1.53	4.29	202.0^{ab}
50	90.10	24.6	28.20	2.10	0.52	0.58	0.23	0.12^{ab}	0.53^{ab}	1.44	4.64	207.0^{a}
75	89.80	25.3	27.70	2.00	0.48	0.56	0.22	0.15^{a}	0.48^{ab}	1.48	4.34	206.0^{a}
100	89.60	26.7	27.20	2.20	0.49	0.57	0.21	0.13^{ab}	0.53^{ab}	1.49	4.23	192.0^{b}
SE	0.25	1.6	0.24	0.26	0.14	0.09	0.07	0.06	0.09	0.10	0.48	16.5
Duration of replacement (day)												
1-42	89.90	26.1	27.90	2.13	0.53^{a}	0.50	0.21	0.12	0.51	1.48	4.48	204.0
22-42	89.70	25.4	27.60	2.13	0.46^{b}	0.54	0.22	0.13	0.49	1.48	4.31	197.0
SE	0.23	1.4	0.22	0.20	0.12	0.07	0.06	0.03	0.07	0.11	0.41	12.5

**Standard error $^{a-b}$: Values in the same column in each comparison group, with no common superscript different significantly ($p<0.05$)

better than blood meal and a suitable amino acid supplementation can lead to acceptable results with the blood meal as the main dietary animal protein concentrate. Table 2 shows that with increasing the dietary blood meal level in starter and grower ratios, the Methionine concentration increased from 0.17 to 0.24%. There are same reports on successful usage of blood meal in poultry ratios (Petkov *et al*., 1980; Nuarautelli *et al*., 1987; Toor and Fahimullah, 1972; Hassan *et al*., 1974; Onwudike, 1981). The starter fish meal free diet (used at up to 21 days of age) contained 6.47% blood meal that is more than the 5% recommended limit and caused no adverse effect on performance of birds. The proposed metabolisable energy value for blood meal by other authors for poultry diet formulation have a range from 2895 to 3221 kcal kg^{-1} (Fisher, 1989), but in this research in spite of the higher gross energy recorded for the blood meal samples than NRC (1994) (that resulted from its higher crude fat content), the measured metabolisable energy was lower than previous reports (Fisher, 1989). These differences can attribute to different blood meal manufacturing processes.

These results indicate that the quality of this locally produced blood meal is relatively lower than previous reports and may be improved by alterations in manufacturing process, but even in current form seems still a suitable substitute for common dietary fish meals in poultry industry of Iran, so that a full replacement didn't cause any adverse effect on performance, carcass important traits and dietary nitrogen retention of broiler chickens.

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