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Effect of low protein diet with balanced amino acids with protease on performance and litter quality of commercial broiler

J J ROKADE[1], D THYAGARAJAN[2], A V OMPRAKASH[3] and R KARUNAKARAN[4]

Central Avian Research Institute, Izatangar, Uttar Pradesh 243 122 India

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ABSTRACT

An experiment was carried out to evaluate nutritional interventions to minimize nitrogen excretion in broilers. Three dietary treatments with 42 birds each were subjected to standard protein diet (T_1), low protein with balanced amino acids (T_2) and low protein with balanced amino acids plus enzyme (T_3). Production performance (body weight, feed efficiency and liveability) and litter quality was assessed on second, fourth and sixth week of age. No significant difference was noticed in body weight, liveability and feed efficiency between treatment and control groups. Statistical analysis also revealed that treatments with high protein (T_1) had high pH, moisture and litter nitrogen value. The present study revealed that low protein diet with balanced amino acid profile plus protease supplementation can minimize nitrogen excretion in litter without affecting production performance of the bird and also a cost effective approach.

Key words: Broiler, Low protein, Moisture, Nitrogen excretion, pH

Dietary protein level has major effect on growth performance and overall cost of broiler production. As the "Best performance at the lowest cost possible" is the aim of poultry farming, various approaches are adopted, one being supplementation of high quality proteins in the ration. This approach however, ignores the bird's capability to utilize excess amino acids in the ration. These excess amino acids are under-utilized and are deaminated and nitrogen is excreted as uric acids (Kamran *et al.* 2010), also most nitrogen excretion is reported to be due to amino acids imbalance in the ration.

The reduction in nitrogen concentration in poultry litter is emphasized in recent years due to its negative impact on environment. Intensive poultry farming demands more emphasis on this aspect as the amount of excreta generated is quite significant. Nitrogen excretion can be marginally reduced by low protein diet with balanced amino acids in the ration. Further the supplementation of an enzyme (protease) which improves the utilization of available proteins proves to be beneficial. Hence this study was designed to evaluate nutritional methods to reduce nitrogen excretion in commercial birds using low protein diet with balanced amino acids, with or without enzyme supplementation.

Present address: [1]Ph.D. Scholar ((jaydeepvet@gmail.com), Head, P.G.T. & E. [2]Director of Distance Education (drthyagu2002 @yahoo.com), [3]Professor and Head, (acrotomprakash @gmail.com), PRS, [4]Professor (drrkarunakaranphd @gmail.com), Department of Animal Nutrition, Madras Veterinary College, Chennai.

MATERIALS AND METHODS

Broiler chicks (126) procured commercially were subjected to feeding trial for 6 weeks period randomly placed in 3 treatments with 3 replicates of 14 birds each. First group was fed with standard protein (T_1) whereas second group was fed on low protein diet with balanced amino acids without enzyme (T_2) and with enzyme protease @ 170 g/ton (T_3). All the birds were managed under similar condition. Three types of rations, pre-starter (0 to7 days), broiler starter (8 to 21 days) and broiler finisher (22 to 42 days) were prepared. The ration was prepared using feed ingredient like maize, soya, sunflower oil along with required quantity of mineral mixture oil and dicalcium phosphate. The composition of the feed and its proximate principals are given in Tables 1 and 2 respectively.

Biweekly body weights and feed efficiency at second, fourth and sixth week were recorded for all the experimental birds. Mortality of the flock was recorded regularly. Different litter parameters like moisture, pH, nitrogen, were estimated. Three samples per each replicate of respective treatments were analysed at second, fourth and sixth week. Nitrogen content of the litter sample was determined by Kjeldahl method. Cost: benefit ratio was calculated for all the treatments. All the data were analysed statistically using MS-Excel and SPSS to arrive at meaningful conclusion.

Table 1. Ingredient's composition of the experimental broiler feed

Ingredients (per cent)	Pre starter (0 to 7 days)		Broiler starter (8 to 21 days)		Broiler finisher (22 to 42 days)	
	T1	T2 and T3*	T1	T2 and T3*	T1	T2 and T3*
Maize	50.80	56.90	53.50	59.60	59.60	63.60
Soybean meal	40	34.30	38.30	32.30	32.30	28.74
SFOC EXT	2.75	2.80	0.95	1.30	1.30	0.15
Mineral mixture	1.72	1.76	2.15	2.20	2.20	2.24
DCP	1.55	1.60	1	1	1	1
Oil	3	2.28	3.94	3.26	3.26	4.05
DL methionine	0.14	0.17	0.16	0.19	0.19	0.16
Lysine	0.04	0.19	—	0.15	0.15	0.06

*Protease enzyme: 170 g/tonne of feed.

Table 2. Nutrient composition of the experimental ration

Nutrient per cent	Pre starter		Starter		Finisher	
	T1	T2 and T3	T1	T2 and T3	T1	T2 and T3
CP*	23.00	21.07	22.02	20.04	20	18.50
ME**(K cal)	3000	3004	3100	3106	3200	3204
Lysine**	1.30	1.30	1.20	1.20	1.06	1
Methionine**	0.50	0.50	0.50	0.50	0.45	0.45

*Analysed values; **calculated values.

RESULTS AND DISCUSSION

Mean body weight and feed efficiency of broilers as influenced by different treatments are presented in Table 4. At fourth and sixth week T_1 recorded numerically highest body weight among all other treatments. However T_2 and T_3 also recorded marginally equal body weight with that of T_1. Present study revealed that birds fed with low CP and balanced level of methionine and lysine level showed better body weight gain from second week of age. Fariborz and Hasan (2006) recorded significantly higher body weight gain and feed efficiency with low CP diet with high methionine, lysine, arginine, threonine, isoleucine and tryptophan. The insignificant marginal reduction in body weight in present study may be due to balancing of only methionine and lysine in feed. Feed efficiency of broiler as influenced by different treatments was statistically insignificant. However, according to Bregendahl *et al.* (2002), Hidalgo *et al.* (2004) and Kamran *et al.* (2008) low dietary crude protein level adversely affected feed efficiency. This was actually due to low CP with imbalanced amino acids content in feed. Addition of protease in low CP did not show any effect on feed efficiency. Liveability of broiler between 0 and 6 week as influenced by different treatments was insignificant in present study. This result was in agreement with Chisato Yonemochi *et al.* (2003) and Corzo *et al.* (2005) who reported that Livability of broiler from 0 to 6 week was not influenced by two levels of dietary protein.

Mean per cent moisture percent, pH; nitrogen content of poultry litter as influenced by different treatments is presented in Table 3. The treatments with low protein with or without enzyme supplementation recorded less moisture compared to standard protein treatments irrespective of age. T_1 showed high moisture compared to T_3. The increased moisture content of litter may be due to excessive heat production because of higher dietary protein. Larbier and Leclercq (1992) inferred that increase in one percentage point in protein level increases water consumption by three per cent which subsequently increase litter moisture. Significant difference was noticed between treatments for pH and nitrogen ($P \geq 0.05$). T_1 recorded higher pH and nitrogen percent compared to T_2 and T_3. Treatments with high protein (T_1) in diet recorded significantly higher pH compare to low protein diet with or without enzyme supplementation irrespective of age. This is in agreement with Panetta *et al.* (2005), Fariborz and Hasan (2006) and Namroud *et al.* (2009). The dietary CP content had significant effect on pH of the litter ($P \geq 0.05$). The bacteria

Table 3. Effect of different dietary proteins, enzyme supplementation on benefit cost ratio

Treatment	Production cost per bird (₹)	Returns per birds (₹)	Profit per bird (₹)	Production cost per kg live (₹)	Net profit per kg live (₹)	BCR
T_1	110.23	149.09	38.85	66.54	23.45	1.35
T_2	109.72	148.03	38.31	66.70	23.29	1.35
T_3	109.54	148.65	39.11	66.32	23.68	1.36

Table 4. Effect of dietary protein, enzyme on production performance and litter quality

Treatments	Production performance						Livability
	Body weight (mean ± SE) (NS) (g)			Feed efficiency (mean ± SE) (NS)			
	Second week	Fourth week	Sixth week	Second week	Fourth week	Sixth week	
T_1	337.52±11.01	935.18±14.49	1656.54±30.19	1.060±0.01	1.667±0.87	1.837±0.07	97.62
T_2	337.60 ± 8.45	881.38±45.97	1644.79±38.88	1.059±0.02	1.826±0.38	1.904±0.51	100
T_3	349.36±17.66	916.38±17.93	1651.65±41.01	1.041±0.04	1.723±0.18	1.880±0.11	97.62

Treatments	Litter quality								
	Litter moisture (mean ± SE)			Litter pH (mean ± SE)			Litter nitrogen (mean ± SE)		
	Second week (NS)	Fourth week	Sixth week	Second week	Fourth week	Sixth week	Second week (NS)	Fourth week	Sixth week
T_1	20.26±0.37	21.87^{b}±0.80	22.33^{a}±0.54	7.07^{b}±0.06	8.20^{b}±0.12	8.40^{b}±0.58	3.00±0.10	4.30^{c}±0.05	4.57^{b}±0.18
T_2	19.46±0.20	20.50^{ab}±0.50	21.13^{ab}±0.28	6.80^{ab}±0.15	7.90^{ab}±0.17	8.00^{a}±0.57	2.80±0.11	3.96^{b}±0.08	4.20^{ab}±0.05
T_3	19.50±0.32	19.70^{a}±0.85	20.00^{b}±0.50	6.73^{a}±0.08	7.80^{a}±0.58	7.93^{a}±0.88	2.76±0.14	3.63^{a}±0.08	3.93^{a}±0.17

*, Significant (P≥0.05); NS, not significant; SE, standard error. Mean values within columns and row (overall) bearing at least one common superscript do not differ significantly.

that are involved in the breakdown of uric acid to ammonia which has a relatively high optimum pH so decrease in pH would reduce the reduction of bacterial activity that will automatically result in less ammonia emission from litter (Mobley and Hausinger 1989). The efficiency of protein utilization of birds fed on low protein diets was superior to that of birds fed on the commercial control diet coupled with significantly less (P≥0.05) nitrogen excretion (Deschepper and De groote 1995, Chisato Yonemochi *et al.* 2003, Yamazaki *et al.* 2007).

The cost benefit ratio between different treatments groups fed with different dietary proteins, enzyme supplementation is presented in Table 3. Benefit cost ratio as well as net profit/kg live weight was highest in T_3 followed by T_2 and T_1. Ammonia and nitrous oxide being the product of excess nitrogen in litter leads to eutrophication and acidification of surface water, therefore reducing litter nitrogen without affecting birds performance helps to address these issues as well.

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