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Augmenting Feeding Value of Rice Gluten Meal through Dietary Addition of Enzymes in Broilers

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ABSTRACT

A biological experiment of 42 days duration was undertaken to study the growth performance of broilers. A total of 384, day-old chickswere divided into 12 dietary treatments following 3×4 factorial design having 4 replicates per treatment with 8 birds in each. Twelve experimental diets were prepared by incorporating control, two different levels (15 and 17.5%)of rice gluten meal (RGM), and three different types of enzymes namely xylanase (X), protease (P) and multienzymes (M). Data pertaining to the growth performance of birds revealed no significant (P>0.05) difference in RGM levels (15 and 17.5%), but FCR was significantly (P<0.05) poor in 17.5% RGM level. Either of the three supplementations (X, P and M) significantly (P<0.05) improved the growth performanceof the birds, best response being observed with protease supplementation. Thus,it may be concluded thatprotease supplementation may increase the effective and safe inclusion level of alternate protein source RGM from 15 to 17.5% for economic broiler production.

Key words: Broiler, Enzymes,Growth, Protein, Protease, Rice glutenmeal

INTRODUCTION

The search of alternative feed ingredients in poultry nutrition is a continuous process in the pursuit of economical poultry production. India is the second largest producers of rice in the world after China, producing approximately 109.7 MT rice in 2016-17 (Agriculture Statistics, 2018). Now-a-days, certain newer rice by-products are available in appreciable quantities from rice processing industries and at cheaper rate such as rice gluten meal (RGM), which can be utilized in feeding poultry.The RGM is a by-product of wet-milling of rice obtained after starch extraction and syrup preparation. It is a relatively newer feedstuff having brownish colour and coarse powdery texture. Commercial traders categorise RGM as a high crude protein and energy ingredient which is priced lower than soybean meal.

Initial research finding showed that RGM can be included up to 10% level in broiler chicken ration without affecting feed efficiency and dressing percentage (Sherazi*et al.,* 1995).Metwally and Farahat (2015) found that broiler fed RGM with different inclusion rates up to 12.5% had the same growth performance.Overall, very little research data is available on feeding value of RGM in poultry and no data is available regarding augmenting its feeding value through dietary addition of enzymes in broilers. Hence, this study was conducted for substrate specific selection of enzyme for RGM and its effect on the growth performance of broilers.

MATERIALS AND METHODS

Experimental layout for feeding different level of RGM with or without enzymes is presented in Table 1. In an experiment based on factorial design 384, day-old chicks (CARIBRO-Vishal) were randomly divided into 48 replicates of eight birds each. There were twelve different treatments with 4 replicates for each treatment. Dietary treatments were according to 3×4 factorial arrangements; 0, 15 and 17.5% of RGM, supplemented with either no enzyme, or protease, xylanase or multienzymes supplementation. Mixing ratio 50 g per 100 kg feed for protease, 10 g per 100 kg feed for xylanase and 25 g per 100 kg feed for multienzymes were used as per manufacturer

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Table 1. Experimental layout for feeding different level of RGM with or without enzymes

Treatment	Rice gluten meal (%)	No. of replicates	Birds/ replication	Total	Enzymes
T_1	0.0	4	8	32	-
T_2	0.0	4	8	32	Xylanase
T_3	0.0	4	8	32	Protease
T_4	0.0	4	8	32	Multienzymes
T_5	15	4	8	32	-
T_6	15	4	8	32	Xylanase
T_7	15	4	8	32	Protease
T_8	15	4	8	32	Multienzymes
T_9	17.5	4	8	32	-
T_{10}	17.5	4	8	32	Xylanase
T_{11}	17.5	4	8	32	Protease
T_{12}	17.5	4	8	32	Multienzymes

instructions.

Data pertaining to chemical composition of dietary ingredients (%) analysedas per (AOAC, 2000) on as is basis is presented in Table 2. Ingredients and nutrient composition (%) of pre-starter (0-14 days), starter (14-28 days)and finisher (28-42 days) diets with or without enzymes for different level of RGM are presented in Table 3. All the rations were formulated to meet the nutrient requirements of the birds as per ICAR (2013) standard. *In vitro* pepsin-pancreatin digestibilities (IVPPD) of RGM and soybean meal were measured according to the method of Gopalkrishnan and Jamuna (2000). The IVPPD of RGM was found to be 81.92% and that of soybean meal was 88.15%.No detectable amount of aflatoxin B1 and ochratoxin were found in RGM as estimated by thin layer chromatography (AOAC, 2000).

The three commercial enzyme preparations *i.e.* protease, xylanase and multienzymes were used as per manufacturer instructions after assessing their activity as per standard methods (Kamra and Agarwal, 2003).Activity of protease and xylanase were 600,000± 849 and 150,000 ± 683 units/g, respectively. Multienzymes activity were estimated for cellulase 15,000±275, xylanase 18, 500±328, β-glucanase 12,500 ±128, amylase 1500±46, pectinase 150±16, protease

Table 2. Chemical composition of dietary ingredients (%) on as is basis

Ingredients	Moisture	DM	CP	EE	CF	TA	NFE	Ca	P	GE (kcal/kg)	*ME (kcal/kg)
Maize	8.6	91.3	9	3.9	1.8	1.4	83.8	0.03	0.29	4447	3350
SBM	9.1	90.9	44.5	0.9	6.2	3.1	45.2	0.32	0.68	4097	2400
DORB	10.1	91.8	14	1.6	15.9	5.8	62.6	0.3	1.54	3854	2000
RGM	7.6	92.3	49.9	5.7	7.4	3.3	33.5	0.84	0.98	4742	3031
Soybean oil	-	-	-	-	-	-	-	-	-	8900	8450
Lime stone powder	1.4	98.6	-	-	-	-	-	33.89	-	-	-
DCP	7.2	92.7	-	-	-	-	-	22.92	16.04	-	-

SBM, soyabean meal; DORB, de-oiled rice bran; RGM, rice gluten meal, DCP, di-calcium phosphate; DM, dry matter;CP, crude protein; EE, ether extract; CF, crude fibre; TA, total ash; NFE, nitrogen-free extract; GE, gross energy; ME, metabolizable energy*calculated value

Table 3. Ingredient and nutrient composition of experimental diets

Diets	Pre-starter			Starter diets			Finisher diets		
Ingredients	T_1	RGM-15	RGM-17.5	T_1	RGM-15	RGM-17.5	T_1	RGM-15	RGM-17.5
Maize	54.42	59.40	60.00	55.63	60.70	61.62	62.00	67.07	67.97
SBM	38.40	20.70	17.80	37.10	19.20	16.20	31.30	13.40	10.40
RGM	0.00	15.00	17.50	0.00	15.00	17.50	0.00	15.00	17.50
Oil	3.00	0.70	0.40	3.50	1.20	0.80	3.22	0.90	0.50
LSP	1.40	1.30	1.30	1.35	1.32	1.32	1.20	1.14	1.14
DCP	1.82	1.95	1.95	1.55	1.70	1.70	1.45	1.60	1.60
Constant*	0.765	0.765	0.765	0.765	0.765	0.765	0.765	0.765	0.765
Total	100.00	100.00	100.00	100.00	100.0	100.0	100.0	100.0	100.00
Nutrient composition									
CP	21.99	22.06	22.07	21.52	21.52	21.52	19.50	19.50	19.50
ME **	2998	3001	3001	3050	3050	3050	3100	3100	3100

SBM, soyabean meal; DORB, de-oiled rice bran; RGM, rice gluten meal, DCP, di-calcium phosphate; LSP, lime stone powder; CP, crude protein; ME, metabolizable energy; **calculated value; *Constant 0.765included salt 0.4%, trace mineral premix 0.1%, vitamin premix 0.15%, vitamin B complex 0.015%, choline chloride 0.05% and toxin binder 0.05%.(ICAR,2013)

5000±136, lipase 15± 3.8 and β-mannanase 400±31.

The research work was carried out at the Division of Avian Nutrition and Feed Technology, ICAR-Central Avian Research Institute (CARI), Izatnagar, India as per the guidelines and approval of Institute Animal Ethical Committee (IAEC) and Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA).Theinitial body weight, final body weight, overall body weight gain, feed intake (g/bird) andfeed conversion ratio were recorded.

Data analyzed for mean, standard errors and analysis of variance as per method of Snedecor and Cochran (1989) and comparison of means were done using Tukey's test (1949) using software of Statistical Package for Social Sciences (SPSS) 16.0 version.

RESULTS AND DISCUSSION

Data pertaining to the growth performance of birdsare presented in Table 4. Perusals of data revealed no significant (P>0.05) difference in RGM levels (15 and 17.5%)on body weight gain and feed intake, but FCR was significantly (P<0.05) poorer when RGM was included at 17.5%. Supplementation of either of the three enzymes (X, P and M) significantly (P<0.05) improved the body weight gain and FCR of the birds, best response being observed with protease supplementation. Incorporation of RGM up to 15% did not cause any significant change in body weight gain and feed intake. Thus, it is evident that RGM can be incorporated safely up to 15% in the broiler ration. However, some notable studies (Wani, 2017) reported decrease in body weight gain and poor FCR when RGM was included at 20% inclusion level.Thus, it seems that RGM may not be incorporated in broiler ration at a level higher than 15%. Major drawbacks that hindered the incorporation of RGM in broiler ration included poor energy and protein digestibility of RGM, factors associated with the level and type of crude fibre present in it along with poor feed intake (Metwally and Farahat, 2015; Malik *etal*.,2017). Some of these drawbacks, particularly associated with non-starch polysaccharide, poor energy and protein digestibility can be overcome by supplementation of exogenous enzymes (Giannenas*et al.,* 2017; Wani, 2017). Results of the present experiment suggest that all the three enzyme preparations were effective in improving body weight gain and FCR. In general, this is inagreement with earlier study(Wani, 2017) which indicate that enzyme supplementation improved the utilization of RGM in

broilers. Enzyme supplementations leads to increase feeding value of the dietary raw materials, reduction in the variation of nutrient quality of the diet, increased nutrient digestibility, reduction in water content of the excreta, reduced viscosity of intestinal contents and accelerated rate of passage of digesta through the gastrointestinal tract (Lazaro *et al.,* 2004). However, the best response was obtained when the ration was supplemented with proteasesfindings corroborate well with those available in literature (Wani, 2017).

Our results are in agreement with many previous reports (Metwally andFarahat, 2015; Kumar *et al.,*2016; Malik*et al.,* 2017; Wani, 2017). However, Sherazi*et al.* (1995) reported decrease in body weight gain (BWG) on incorporation of rice protein meal up to 10% level. Metwally and Farahat (2015) reported that 12.5% RGM level did not affect the FCR in broiler chicken. Kumar *et al*. (2016) reported no significant (P>0.05) difference in the dry matter (DM) intake, average daily gain, (ADG) and feed efficiency by replacing 75% of ground nut cake with RGM in the concentrate mixture of growing calves. Contrary to our results, Wani (2017) reported significant (P<0.05) decrease in the feed intake when RGM was included in the diet 17.5% level,

Table 4. Effect of feeding different level of RGM with or without enzymes on growth performance

Treatments	Initial body weight (g)	Final body weight (g)	Weight gain (g)	Feed consumption (g)	FCR
T_1	44	1747^{ab}	1704^{ab}	3068	1.80
T_2	42	1788^{abc}	1744^{abc}	3074	1.76
T_3	43	1785^{abc}	1741^{abc}	3076	1.76
T_4	41	1880^{d}	1836^{d}	3047	1.66
T_5	44	1775^{abc}	1731^{abc}	3074	1.77
T_6	45	1778^{abc}	1735^{abc}	3065	1.77
T_7	44	1837^{cd}	1793^{cd}	3065	1.71
T_8	42	1810^{bcd}	1766^{bcd}	3095	1.75
T_9	44	1723^{a}	1680^{a}	3065	1.82
T_{10}	41	1803^{bc}	1759^{bc}	3084	1.75
T_{11}	44	1828^{cd}	1784^{cd}	3089	1.73
T_{12}	42	1782^{abc}	1739^{abc}	3068	1.76
Pooled SEM	0.10	8.14	8.15	4.02	0.01
Levels of RGM					
0	44	1800	1757	3066	1.75^{a}
15	43	1800	1757	3074	1.75^{a}
17.5	44	1785	1741	3077	1.78^{b}
Effect of enzymes					
-	42	1748^{a}	1705^{a}	3069	1.80^{b}
X	44	1790^{b}	1746^{b}	3074	1.76^{a}
P	43	1816^{b}	1773^{b}	3077	1.73^{a}
M	44	1824^{b}	1780^{b}	3070	1.72^{a}
Significance					
RGM	NS	NS	NS	NS	P<0.05
Enzyme	NS	P<0.01	P<0.01	NS	P<0.01
RGM x enzyme	NS	P<0.05	P<0.05	NS	NS

$^{a,b,\ c,d}$Values bearing different superscript in a column differ significantly

but BWG and FCR between the control and various treatment groups did not differed significantly (P>0.05) up to 17.5% inclusion level of RGM.

Our results are in disagreement with Wani (2017) and Giannenas*et al.* (2017) with respect to response of enzymes supplementation. Wani (2017) reportedthat enzyme supplementation had shown significantly (P<0.01) decreased feed intake with no significant (P>0.05) effect on BWG and FCR. Giannenas*et al.* (2017) reported that broilers which were fed the corn gluten meal up to 20.10% level supplemented with protease in the diet showed significantly (P>0.05) lower feed intake and weight gain.

CONCLUSIONS

Supplementation of protease enzymes at 50 g per 100 kg feed improved body weight gain and FCR in broilers fed RGM diet. Thus, it may be concluded that protease supplementation may increase the effective and safe inclusion level of alternate protein source RGM from 15 to 17.5% for commercial broiler production.

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