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Comparative effect of graded replacement of maize by paddy with and without enzymes on nutrient utilization in broilers

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Abstract
The present study was planned to analyse the comparative effect of graded replacement of maize by paddy with and without mixture of fibrolytic enzymes on nutrient utilization in broilers. The study was conducted for a period of five weeks. In the experiment out of 300 chicks, 270, day old chicks were randomly distributed into 15 dietary treatments each with 3 replicates of 6 chicks each. Out of fifteen dietary treatments, treatment one (T_1) and two (T_2) acted as control. The control diets were formulated to contain 2800 Kcal ME/kg and 22% CP. Remaining 13 treatments, were formulated by supplementing graded levels of paddy replacing maize with and without enzymes. Perusal of the treatment means of the various nutrients indicated that supplementation of enzymes was responsible for increase in the retention of most of the nutrients. It was totally true with the retention of crude protein, crude fibre and NFE. There was some difference on the retention of EE, Ca and P.

Keywords: Paddy, maize, broiler, nutrient utilization, enzyme

Introduction
Poultry production in India during last few decades has taken a shape of industry. However in recent years poultry production has crippled many times due to rising feed cost and diseases. Feed accounts for more than two-third of production cost. Traditionally maize is used as an energy source in poultry feeds. Total requirement of maize would be around 112 million tonnes in 2025 with allocation of 28 million tonnes for poultry (45% of poultry diet) (Mandel, 2009) [7]. Thus major challenge is the shortage of feedstuffs. It is, therefore, essential to identify alternate energy feed stuffs for economic poultry production.
Rice is the most important cereal food crop of India, which occupies about 24 per cent of gross cropped area of the country. It contributes 42 per cent of total food grain production and 45 per cent of total cereal production of the country. Rice production in India has increased during last 60 years by about 3.5 times from 250.3 lakh tons during the first 5-yr plan period to 857.3 lakh tons during the tenth plan period. India is the second largest producer of rice in the world next to China. In India, paddy occupies the first place both in area and production. The average productivity of rice in India, at present, is 2.2 tons/ha (CRRI, 2011) [3].
Paddy is rice grain after threshing and winnowing and retains its hull. Paddy on an average contains 7-8% crude protein, 12-14% crude fibre, 2-3% ether extract, 74-75% NFE, 36-38% available carbohydrates and is a good source of energy (Sikka, 1990) [9]. The steeply increasing price of maize, and its less production and availability to livestock feed has created increased interest in alternate feedstuffs for poultry feeding.
Poultry do not have enzymes for hydrolysis of non-starch polysaccharides (NSPs) resulting into low bioavailability of such nutrients. The potential of such enzymes has been recognized for years and indeed various enzyme preparations have been used in monogastric diet to increase productivity. Advances in enzymology and fermentation technology have resulted in large scale commercial production of feed grade enzymes. Use of enzymes may improve nutrient utilization leading to economical production.

Material and methods
Location and Place of work
The proposed experiment was conducted in the Department of Animal Nutrition, College of Veterinary Science & Animal Husbandry, Nanaji Deshmukh Veterinary Science University,

Jabalpur (M.P.). The comprehensive programme of the experiment is described in terms of material and methods.

Experiment

The experiment was planned to evaluate the response of broiler chicken to use of paddy instead of maize at graded level with and without enzymes with reference to nutrients utilization in broiler production.

Housing

The experimental chicks were reared in the battery brooder house. The battery brooders were cleaned, white washed and disinfected by blow lamping and complete house was fumigated using formaldehyde and potassium permanganate four days prior to commencement of experiment. Feeders and waterers were carefully cleaned with detergent. Artificial heat was provided to chicks during early period of growth using electric bulbs (100 watts) as the experiment was conducted in spring season. Daily temperature (°C) and humidity (%) in house was recorded.

Randomly distributed chicks were placed in separate tiers of the battery brooders in order to provide equal floor space for each replicate. Separate feeder, waterer and faecal tray, were used in this experiment. The battery brooders were kept side by side in clean well ventilated room provided with two exhaust fans and two ceiling fans in order to avoid ammonia and faecal fermented foul smell. The windows and ventilators were kept open for fresh air. Provision was also made for the supply of light with the help of tube lights.

Experimental Diet

Diets were formulated as per ICAR (1998) feeding standards. Thus, control diet (T_1) was containing 2800 Kcal ME/kg and 22% CP for 5 weeks while other control diet (T_2) was prepared using enzymes @ 30gm/100kg feed. Rest of the diets were formulated using whole paddy instead of maize @ 20%, 40%, 60%, 80% and 100% with and without the mixture of fibrolytic enzymes. The mixture of fibrolytic enzymes used in the diets was containing cellulase, xylanase, pectinase and phytase. Two levels of enzymes were used in the study. One level was 30g/Q diet and other level was 50g/Q diet. 30g enzyme/Q diet was used with diets containing 20, 40, 60, 80 and 100% paddy instead of maize while, 50g enzyme/Q diet was used only with diets containing 60, 80 and 100% paddy instead of maize.

Table 1: Composition of control broiler diet

Ingredients	Control diet$_1$ (T_1)	Control diet$_2$ (T_2)
Maize	59.50%	59.50%
Soybean meal (SBM)	37.00%	37.00%
Mineral mixture (MM)	03.00%	03.00%
Methionine	00.50%	00.50%
Enzyme	-	30.00g
Vitamin (B complex)	+	+
Total	100.00%	100.00%

Table 2: Dietary treatments

S. No.	Treatment groups	Treatment given
1.	T1 (control)	Formulated as per ICAR (1998) specifications (Table-01)
2.	T2	The control diet for broilers was formulated as per ICAR (1998) specifications with enzymes (Cellulase, xylanase, pectinase and phytase) @ 30gm/100kg feed.
3.	T3	Control diet$_1$ (T_1) + 20% paddy instead of maize.
4.	T4	Control diet$_1$ (T_1) + 40% paddy instead of maize.
5.	T5	Control diet (T_1) + 60% paddy instead of maize.
6.	T6	Control diet (T_1) + 80% paddy instead of maize.
7.	T7	Control diet (T_1) + 100% paddy instead of maize.
8.	T_8	Control diet$_2$ (T_2) + 20% Paddy instead of maize
9.	T_9	Control diet$_2$ (T_2) + 40% Paddy instead of maize
10.	T_{10}	Control diet$_2$ (T_2) + 60% Paddy instead of maize
11.	T_{11}	Control diet$_2$ (T_2) + 80% Paddy instead of maize
12.	T_{12}	Control diet$_2$ (T_2) + 100% Paddy instead of maize
13.	T_{13}	Control diet$_1$ (T_1) + 60% paddy instead of maize + enzyme (Cellulase, xylanase, pectinase and phytase) @ 50g/100kg feed.
14.	T_{14}	Control diet$_1$ (T_1) + 80% paddy instead of maize + enzyme (Cellulase, xylanase, pectinase and phytase) @ 50g/100kg feed.
15.	T_{15}	Control diet$_1$ (T_1) + 80% paddy instead of maize + enzyme (Cellulase, xylanase, pectinase and phytase) @ 50g/100kg feed.

Enzyme

"Biograin Special CB4" enzyme was used in the experiment. It was manufactured by Advanced Bio Agrotech Ltd. Pune. This enzyme contained xylanase (80,000 I.U.), cellulase (20,000 I.U.), pectinase (1500 I.U.), and phytase enzyme (1000 FTU**)**

Experimental birds

A total of 300 day old broiler chicks duly vaccinated against Marek's disease were purchased from the reputed hatchery at Jabalpur. Out of which, 270 chicks were selected for experiment. During the experiment, all the chicks were vaccinated as per the schedule.

Experimental Designs

The design of experiment was completely randomized design. All the day old broiler chicks were individually weighed at the start of the experiment and 270 birds of identical weight were selected. The chicks were randomly assigned to various groups so that weight of the chicks in any two groups did not differ significantly ($p<0.05$). Overall, there were fifteen treatments. Each treatment consisted of three replicates of six chicks in each replicate.

Feeding and Watering

The feed was offered *ad-libitum* in linear chick feeders. Aluminium plates of appropriate size and small tin boxes were used in each cage to offer water during early weeks. Due

care was taken so that the chicks reach the feeder and waterer in the first week of age. Later in the experiment, large size feeders and waterers were attached to each cage in opposite direction. All mash system of feeding was practiced during the experiment.

Fresh and clean drinking water was made available to birds all the time. Thus, in the entire study uniform condition of housing, brooding, feeding and watering was maintained for all the groups of the experiment.

Nutrients utilization

A three day metabolic trial was conducted to observe the retention of nutrients in terms of energy, nitrogen and minerals from different diets. It was conducted in the beginning of 5th week. During collection period, the excreta were collected quantitatively at every 24 hours. It was dried in hot air oven at 100°c and then weighed to know the accurate quantity of dry matter excreted. Weighed samples were finely grinded and stored till the completion of analysis.

Statistical analysis

Data obtained during the experiment were analyzed statistically using the methods described by Snedecor & Cochran (1980) [10]. Differences among the treatments were tested for significance by Duncan's New Multiple Range Test (1955) [4].

Results and discussion

Comparative effect of supplementation of graded levels of paddy with and without enzymes on retention of nutrients is furnished in Table 03. The comparative dry matter retention with and without enzymes indicated significantly ($p<0.05$) higher dry matter retention in broilers allotted diet supplemented with enzymes, except broilers assigned T_3, T_8 and T_4, T_9 diet. Further, inclusion of higher levels of enzymes was responsible for higher dry matter retention. Perusal of the treatment means of the various nutrients indicated that supplementation of enzymes was responsible for increase in the retention of most of the nutrients. It was totally true with the retention of crude protein, crude fibre and NFE. There was some difference on the retention of EE, Ca and P. In comparison to T_3, in T_8 group of broilers and in comparison to T_6 in T_{11} and T_{14} group of broilers, retention of EE had reduced due to supplementation of enzymes. Similarly, in comparison to T_4, calcium retention in T_9 group and in comparison to T_6 and T_7 group, phosphorus retention has reduced in enzyme supplemented group.

Table 3: Comparative effect of graded levels of paddy with and without enzymes on nutrients utilization (%) in broilers.

Treatments	DM	CP	EE	CF	NFE	Ca	P
T_1	$68.62^{c}\pm0.06$	$62.25^{f}\pm0.25$	$65.34^{e}\pm0.25$	$47.81^{b}\pm0.15$	$80.77^{g}\pm0.38$	$67.86^{b}\pm0.10$	$57.17^{c}\pm0.28$
T_2	$71.01^{a}\pm0.86$	$63.73^{e}\pm0.23$	$77.20^{a}\pm0.36$	$52.82^{a}\pm0.19$	$85.54^{b}\pm0.69$	$70.12^{a}\pm0.22$	$60.20^{a}\pm0.37$
T_3	$67.96^{d}\pm0.34$	$60.61^{h}\pm0.46$	$65.75^{e}\pm0.44$	$41.28^{f}\pm0.31$	$79.73^{h}\pm0.16$	$63.38^{e}\pm0.12$	$56.28^{d}\pm0.34$
T_8	$66.12^{f}\pm0.13$	$61.53^{g}\pm0.31$	$64.39^{f}\pm0.45$	$46.44^{c}\pm0.41$	$82.79^{e}\pm0.45$	$63.82^{d}\pm0.16$	$58.34^{b}\pm0.53$
T_4	$66.60^{e}\pm0.40$	$60.39^{h}\pm0.52$	$64.09^{f}\pm0.12$	$37.02^{i}\pm0.23$	$75.33^{j}\pm0.47$	$64.35^{d}\pm0.19$	$55.15^{b}\pm0.27$
T_9	$66.71^{e}\pm0.25$	$63.16^{e}\pm0.29$	$65.75^{e}\pm0.27$	$44.26^{d}\pm0.37$	$82.86^{e}\pm0.32$	$64.12^{d}\pm0.19$	$58.43^{b}\pm0.36$
T_5	$67.99^{d}\pm0.67$	$64.63^{d}\pm0.31$	$64.53^{f}\pm0.42$	$36.31^{j}\pm0.40$	$81.86^{f}\pm0.38$	$64.04^{d}\pm0.10$	$57.34^{c}\pm0.27$
T_{10}	$70.01^{b}\pm0.49$	$65.71^{c}\pm0.27$	$67.36^{d}\pm0.34$	$42.46^{e}\pm0.25$	$84.96^{b}\pm0.21$	$64.76^{c}\pm0.73$	$58.56^{b}\pm0.69$
T_{13}	$70.97^{a}\pm0.82$	$67.09^{b}\pm0.17$	$73.09^{b}\pm0.31$	$44.10^{d}\pm0.12$	$87.96^{a}\pm0.14$	$65.09^{c}\pm0.34$	$60.23^{a}\pm0.53$
T_6	$64.23^{g}\pm0.42$	$60.45^{h}\pm0.49$	$68.16^{c}\pm0.26$	$31.47^{l}\pm0.43$	$78.00^{i}\pm0.24$	$61.83^{f}\pm0.15$	$52.26^{f}\pm0.39$
T_{11}	$66.10^{f}\pm0.19$	$61.22^{g}\pm0.34$	$60.68^{h}\pm0.27$	$37.89^{h}\pm0.17$	$82.81^{e}\pm0.15$	$62.01^{f}\pm0.08$	$55.50^{d}\pm0.83$
T_{14}	$67.10^{e}\pm0.22$	$63.17^{e}\pm0.24$	$62.09^{g}\pm0.40$	$38.66^{g}\pm0.35$	$84.77^{c}\pm0.26$	$62.15^{f}\pm0.42$	$55.13^{e}\pm0.18$
T_7	$66.03^{f}\pm0.08$	$60.95^{g}\pm0.36$	$55.13^{j}\pm0.34$	$29.46^{m}\pm0.38$	$81.10^{g}\pm0.11$	$58.34^{g}\pm0.26$	$50.16^{h}\pm0.34$
T_{12}	$66.97^{e}\pm0.22$	$61.26^{g}\pm0.18$	$58.90^{i}\pm0.43$	$34.81^{k}\pm0.36$	$81.64^{f}\pm0.29$	$58.53^{g}\pm0.39$	$51.60^{f}\pm0.59$
T_{15}	$69.15^{c}\pm0.19$	$67.85^{a}\pm0.38$	$64.67^{f}\pm0.45$	$36.33^{j}\pm0.45$	$83.64^{d}\pm0.17$	$58.67^{g}\pm0.55$	$51.35^{g}\pm0.46$
CD	0.76	0.59	0.62	0.57	0.59	0.57	0.82

Effect of enzymes level with same level of paddy on nutrient utilization (Table 03) indicated that dry matter utilization as well as utilization of most of the nutrients under study increased with enzymes supplementation. It was exception with ether extract and phosphorus where reduced utilization was noted in some of the groups. Xylanases break xylan backbone of soluble arbinoxylans and thus prevent formation of viscous polymers resulting in better digestion and absorption of nutrients (Bedford and Morgan, 1996) [1]. Improvement in the nitrogen retention with supplementation of phytase might be due to release of bound proteins (Ravindran *et al.*, 1999) [8]. Kaur *et al.* (2007) [6] also observed that supplementation of enzyme improves the utilization of all the nutrients, irrespective of the dietary crude fibre level. Berwal *et al.* (2008) [2] observed that higher body weight gain in enzymes supplemented group may be due to reduced digesta viscosity.

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