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Effect of varying levels of enzyme supplementation with high levels of paddy replacing maize on the performance and economics of broiler production

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Abstract
The study was planned to evaluate the effect of varying levels of enzyme supplementation with high levels of paddy replacing maize on the performance and economics of broiler production. The study was conducted for a period of five weeks. In experiment 126, day old chicks were randomly distributed into 07 dietary treatments each with 3 replicates of 6 chicks each and T_1 acted as a control. The control diets were formulated to contain 2800 Kcal ME/kg and 22% CP and enzymes @ 30gm/100kg feed. Remaining 06 treatments, were formulated by supplementing higher levels (60%,80% and 100%) of paddy replacing maize varying levels (@ 30gm/100kg feed and @ 50gm/100kg feed) of enzymes. Maximum and significantly (p<0.05) higher weight gain, feed intake, was recorded in broilers assigned T_5, T_7, diet while, FER and PI was found in T_5 diet. Significantly (p<0.05) higher net return over feed cost on total b.wt. gain (Rs) of broilers was recorded in T_5 diet.

Keywords: Paddy, maize, broiler, performance, economics, enzyme

1. Introduction
Feed costs form more than 60% of costs for a poultry farm with maize and soybean meal being the key feed ingredients. Adequate feed availability and feed prices are very crucial in sustainable operations of a poultry farm. Maize is the primary source of energy for the Indian poultry industry and constitutes 60% of the compound feed. Maize is primarily rain-fed and competes with crops such as wheat and paddy which has assured prices from the Government. Hence, any monsoon failure is a threat for the crop as was evident in the drought year 2009-10, when maize production fell by 12-15% although it recovered in crop year 2010-11 with an estimated production of 19 million tonnes [1]. Still maize prices are expected to remain high due to high demand from poultry and starch sector and limited supply available. Poultry sector consumes 52% of domestic maize production and demand from poultry sector is expected to outstrip supplies in near future. India needs to double its maize production in next ten years to meet the growing domestic demand from the feed industry. Paddy which is available in rural areas at bulk in economical rates where maize is not available can be alternate to maize. Because it is available with the farmers and they have not to purchase from the market which adds to the price of commodity.
Broilers have a limited ability to effectively use diets containing lower-quality ingredients with high fibre content. Cereals such as wheat, barley, oats, rye, and their by-products contain a high proportion of partly soluble dietary fibre polysaccharide residues (non-starch polysaccharides, NSP), which depress growth in broiler chickens [2]. However, supplementation of exogenous enzymes to cereal-based diets is often followed by improved performance [3, 4, 5]. Thus, enzyme supplementation has become increasingly popular in poultry feeds.

2. Material and methods
2.1 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.

2.2 Experiment
The experiment was planned to evaluate the effect of varying levels of enzyme supplementation with high levels of paddy replacing maize on the performance and economics of broiler production. Experiment was conducted for a period of five weeks.

2.3 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 the 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.

2.4 Experimental Diet
Diets were formulated as per ICAR [6] feeding standards. Thus, control diet (T_1) was containing 2800 Kcal ME/kg and 22% CP) was prepared using enzymes @ 30gm/100kg feed. Rest of the diets were formulated using whole paddy instead of maize @ 60%, 80% and 100% with the mixture of fibrolytic enzymes. Two levels of enzymes were used in the study. One level was 30g/Q diet and other level was 50g/Q diet. The mixture of fibrolytic enzymes used in the diets was containing cellulase, xylanase, pectinase and phytase.

Table 1: Composition of control broiler diet

Ingredients	Control diet (T_1)
Maize	59.50%
Soybean meal (SBM)	37.00%
Mineral mixture (MM)	03.00%
Methionine	00.50%
Enzyme	30gm/100kg feed
Vitamin (B complex)	+
Total	100.00%

Table 2: Proximate composition and major elements content (%) of feed ingredients.

Constituents	Maize	Soybean meal	Paddy
Moisture	13.43	12.73	12.25
Dry matter	86.57	87.27	87.75
Crude protein	8.60	45.00	8.40
Ether extract	3.80	0.80	2.05
Crude fiber	2.20	6.60	8.79
NFE	63.36	28.22	63.32
Ash	8.61	6.65	5.19
Calcium	0.19	0.288	0.11
Phosphorus	0.27	0.660	0.29
ME (Kcal/kg)	3340	2250	2661

Table 3: Composition of mineral mixture (%)

Ingredients	(%)
Dicalcium phosphate	57.18
Ground limestone	28.61
Common salt	12.52
Manganese sulphate	01.34
Zinc sulphate	0.330
Potassium iodide	0.020
Total	100.0

Table 4: Dietary treatments

S. No.	Treatment groups	Treatment given
1.	T1	The control diet for broilers was formulated as per ICAR [6] specifications with mixture of enzymes (Cellulase, xylanase, pectinase and phytase) @ 30gm/100kg feed.
2.	T_2	Control diet (T_1) + 60% Paddy instead of maize
3.	T_3	Control diet (T_1) + 80% Paddy instead of maize
4.	T_4	Control diet (T_1) + 100% Paddy instead of maize
5.	T_5	Control diet (T_1) + 60% paddy instead of maize + enzyme (Cellulase, xylanase, pectinase and phytase) @ 50g/100kg feed in place of 30g/100kg feed.
6.	T_6	Control diet$_1$ (T_1) + 80% paddy instead of maize + enzyme (Cellulase, xylanase, pectinase and phytase) @ 50g/100kg feed in place of 30g/100kg feed.
7.	T_7	Control diet$_1$ (T_1) + 80% paddy instead of maize + enzyme (Cellulase, xylanase, pectinase and phytase) @ 50g/100kg feed in place of 30g/100kg feed.

2.5 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).

2.6 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, 126 chicks were selected for experiment. During the experiment, all the chicks were vaccinated as per the schedule.

2.7 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 126 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 seven treatments. Each treatment consisted of three replicates of six chicks in each replicate.

2.8 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.

2.9 Measurement and observations

The following observations were recorded during the experimental period:

(a) Body weight: The birds were weighed individually on weekly basis to know the body weight gain of broilers till five weeks of age. Weight gains in different groups of broilers were calculated on weekly basis considering the body weights of broilers, recorded during different interval.

(b) Feed intake: Weekly feed consumption of broilers was recorded replicate wise on the basis of feed offered and left over feed recorded at the end of that week. During metabolic trial, separate record of feed consumption and left over feed was maintained to know the actual quantity of feed consumed by the bird in a particular group.

(c) Feed efficiency ratio (FER): To calculate FER, the body weight gain and feed consumption in each week of experiment were used. FER was calculated using following formula: FER = Body weight gain (g) / Feed consumption (g)

(d) Performance index (PI): It was calculated as per the formula proposed by Bird (1955). PI = Body weight gain (g) x FER

(e) Economics of broiler production

The feed cost per kg body weight gain was calculated for each dietary treatment using average value of three replicates per treatment. The feed cost was calculated using prices of feed ingredients approved by N.D.V.S.U., Jabalpur.

3. Statistical analysis: Data obtained during the experiment were analyzed statistically using the methods described by Snedecor & Cochran [7]. Differences among the treatments were tested for significance [8].

4. Result and discussion

Effect of varying levels of enzymes with higher levels of paddy instead of maize on the performance of broilers is furnished in Table 05. Maximum and significantly (P<0.05) higher weight gain was recorded in broilers assigned T_5 diet. It was followed by those allotted T_7, T_2, T_6, T_1, T_3 and T_4 diet. Minimum and significantly (P<0.05) lower FER was observed in broilers assigned T_4 diet. Like weight gain, feed intake was significantly (P<0.05) higher in broilers offered T_7 and T_5 diet. It was significantly lower in groups' assigned T_1 diet. The FER was significantly (P<0.05) higher in broilers assigned T_1 and T_5 diet. It was significantly lower in broilers assigned T_3 diet. The PI was maximum and significantly (P<0.05) higher in broilers assigned T_5 diet. It was significantly (P<0.05) lower in broilers offered T_4 diet.

Table 5: Effect of varying levels of enzymes with higher levels of paddy on the performance of broilers (0-5 weeks)

Treatments	Weight gain (g)	Feed intake (g)	FER	PI
T_1	1601.8^{c}±16.10	2519.23^{d}±44.78	0.64^{a}±0.01	1019.2^{b}±6.50
T_2	1667.5^{b}±3.72	2701.67^{b}±11.37	0.62^{b}±0.00	1028.83^{b}±0.81
T_5	1738^{a}±7.41	2757.87^{a}±6.67	0.63^{a}±0.00	1094.9^{a}±6.67
T_3	1583.07^{c}±20.51	2708.2^{b}±24.72	0.58^{d}±0.00	925.63^{d}±15.46
T_6	1602.87^{c}±7.14	2676.23^{b}±10.28	0.60^{c}±0.00	959.6^{c}±8.15
T_4	1526.13^{d}±9.94	2585.33^{c}±16.81	0.59^{c}±0.00	900.9^{e}±11.52
T_7	1696.6^{b}±12.61	2803.57^{a}±13.92	0.60^{c}±0.00	1025.9^{b}±10.02
C.D.	30.61	54.66	0.01	23.55

Means bearing different superscript differ significantly (p<0.05)

Study on inclusion of higher doses of paddy with higher doses of enzymes revealed significant (p<0.05) increase in the weight gain, FER and PI **(**Table 05). The feed intake had also increased significantly except with 80% paddy diet where significant (p<0.05) reduction was noticed. Thus, use of higher dose of enzymes (50g/100 kg feed) was responsible for better performance in broilers. The low nutrient digestibility in paddy rice is due to presence of non-starch polysaccharides. Hence, addition of enzymes like cellulase, and xylanase increases the nutrient availability and improves the performance of poultry. Improvement in weight gain, efficiency of feed utilization and reduced sticky droppings have been reported [9]. Researchers indicated improvement in nutritive value, feed utilization, body weight gain and reduction in excreta volume due to supplementation of non-starch polysaccharidases such as cellulases, pectinases, hemicellulases, arabinoxylanases and B-glucanases [10]. The improvement in performance of broilers fed low phosphorus diet supplemented with phytase (500 FTU/kg) is due to the release of phosphorus from phytate mineral complex [11, 12] and consequent more retention of phosphorus [13]. Enzyme supplementation have been found to improve broiler performance by two mechanisms one by increasing the feed intake and improving the nutrient digestibility [14, 15]. The performance of broilers was significantly affected by the supplementation of phytase enzyme was also reported [16].

Effect of varying levels of enzymes with higher levels of paddy on the economics of broiler production is given in Table 06. Treatment means of the cost of feed/kg weight gain revealed that it was maximum in broilers assigned T_3 diet. While, significantly (p<0.05) lower feed cost/kg weight gain was noted in broilers assigned T_5 diet.

The total cost of feed for weight gain was although maximum in groups allotted T_5 diet but statistically it was similar to those allotted T_7 diet. It was significantly (p<0.05) lower in those receiving T_4 diet. Total gain (receipt) obtained was also maximum in broilers assigned T_5 diet. However, it was least in broilers assigned T_4 diet.

The net return over feed cost/kg weight gain was maximum in broilers assigned T_5 diet but statistically it was similar to those allotted T_7 diet and it was minimum and significantly (p<0.05) lower in broilers allotted T_3 diet. While, the net return over feed cost on total weight gain was maximum and significantly (p<0.05) higher in broilers offered T_5 diet and was minimum in groups assigned T_3 diet but statistically it was similar to those allotted T_4 diet.

Table 6: Effect of varying levels of enzymes with higher levels of paddy on the economics of broiler production

Treatments	Body wt. gain (g)	Feed intake (g)	Cost of feed/kg (Rs)	Cost of feed/kg b.wt. gain (Rs)	Total cost of feed for wt. gain (Rs)	Gain (Rs)	Net return over feed cost/kg b.wt. gain (Rs)	Net return over feed cost on total b.wt. gain (Rs)
T_1	1601.8^{c}±16.10	2519.23^{d}±44.78	29.43	46.23^{b}±0.41	74.13^{c}±1.33	118.53^{c}±1.19	27.77^{c}±0.41	44.4^{d}±0.40
T_2	1667.5^{b}±3.72	2701.67^{b}±11.37	28.13	45.57^{c}±0.07	76^{b}±0.30	123.40^{b}±0.25	28.43^{b}±0.07	47.4^{c}±0.06
T_5	1738^{a}±7.41	2757.87^{a}±6.67	28.33	44.93^{d}±0.09	78.13^{a}±0.19	128.60^{a}±0.53	29.07^{a}±0.09	50.47^{a}±0.35
T_3	1583.07^{c}±20.51	2708.2^{b}±24.72	27.66	47.3^{a}±0.20	74.9^{b}±0.68	117.17^{c}±1.51	26.7^{d}±0.20	42.27^{e}±0.83
T_6	1602.87^{c}±7.14	2676.23^{b}±10.28	27.86	46.53^{b}±0.23	74.57^{b}±0.28	118.57^{c}±0.52	27.47^{c}±0.23	44^{d}±0.53
T_4	1526.13^{d}±9.94	2585.33^{c}±16.81	27.15	46^{b}±0.38	70.2^{d}±0.47	112.93^{d}±0.75	28^{b}±0.38	42.73^{e}±0.78
T_7	1696.6^{b}±12.61	2803.57^{a}±13.92	27.35	45.17^{c}±0.12	76.67^{a}±0.38	125.57^{b}±0.94	28.83^{a}±0.12	48.9^{b}±0.56
CD	30.61	54.66	-	0.62	1.58	2.26	0.62	1.38

Means bearing different superscript differ significantly (p<0.05)

Further, with same level of paddy, use of higher level of enzymes (Table 06) produced more gain (Rs.) and more return over feed cost/kg weight gain as well as on total weight gain. Still more, use of higher level of enzymes (Table 06) was responsible for more net return in broilers. This was also related to higher weight gain in broilers accompanied with lower feed consumption. Researcher concluded that supplementation of 0.05% NSP hydrolysing enzymes (one gram contained 437 IU of cellulose, 1736 IU of xylanase and 383 IU of pectinase) was economical [17]. Feed cost/kg body weight gain in different enzymes treated groups were statistically similar to that of control except diet supplemented with phytase + multienzyme + xylanase enzyme was observed [18].

Enzyme supplementation significantly reduced feed cost per kilogram weight gain and consequently improved cost saving. The observed reduction in feed cost/kg weight gain resulting from enzyme supplementation which enhanced cost saving on the production of the birds may probably be due to reduction in feed intake, improved feed conversion efficiency and utilization that resulted to the weight gains of the broilers. Similar results have been reported by earlier studies [19, 20, 21].

5. Conclusion

Use of higher dose of enzymes (50g/100 kg feed) was responsible for better performance in broilers and also it was found most economical with 60% paddy replacing maize in broiler production.

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