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Effect of varying levels of enzyme supplementation with higher level of paddy replacing maize on the nutrient utilization and carcass traits of broilers

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Abstract
This study was planned to evaluate the effect of varying levels of enzyme supplementation with high levels of paddy replacing maize on the nutrient utilization and carcass traits of broilers. 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 and varying levels (@ 30gm/100kg feed and @ 50gm/100kg feed) of enzymes. Use of higher level of enzymes had caused higher retention of nutrients. The percent carcass yield was maximum in broilers assigned T_5 diet. No specific trend was found in organ weight and processing losses of broilers.

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

1. Introduction
There is a high demand of conventional feed ingredients for human consumption creating a competition between human and poultry for the same ingredients. The production levels of conventional feed ingredients are not proportionate enough to meet this high demand of poultry feed. The exorbitant cost of conventional feed ingredients necessitates formulating cost effective feed for broilers. Utilization of cheaper unconventional or certain locally available feed ingredients in place of conventional one has been widely advocated and practiced to mitigate this problem. However, the use of unconventional feedstuff for efficient poultry production is limited due to presence of indigestible components like fibre otherwise called as Non Starch Polysaccharides (NSP) [1]. The soluble non starch polysaccharide has an anti nutritive effect in poultry by modifying intestinal viscosity and intestinal transit time. This results in reduction of diffusion and assimilation rates of various nutrients. Poultry being mono-gastric, lack the ability to produce the enzymes (cellulase, hemi-cellulase and beta-glucanase etc.) which are necessary to digest beta type of linkages in non-starch polysaccharides which is rich in cell wall of plant materials [2]. Supplementation of enzymes has been increasingly investigated and applied during the past decade as a means of enhancing production efficiency and increasing the effectiveness of nutrient utilization. Enzyme supplementation counteracts anti nutritional effects of NSP, reduces the intestinal viscosity and the nutrient encapsulating effect of cell wall which in turn could result in increase in protein, starch and energy utilization [3]. The present study was conducted to investigate effect of varying levels of enzyme supplementation with higher level of paddy replacing maize on the nutrient utilization and carcass traits of broilers.

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.).

2.2. Experiment
The experiment was planned to evaluate Effect of varying levels of enzyme supplementation with higher level of paddy replacing maize on the nutrient utilization and carcass traits of broilers. 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 [4] 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: Dietary treatments

S. No.	Treatment groups	Treatment given
1.	T1	The control diet for broilers was formulated as per ICAR [4] 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.

2.8. Measurement and observations
The following observations were recorded during the experimental period:

- **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^{o}c and then weighed to know the accurate quantity of dry matter excreted. Weighed samples were fine grinded and stored till the completion of analysis.

- **Chemical analytical method:**

Feed ingredients as well as diets used in the study and excreta collected during the metabolic trial were analyzed for proximate composition using AOAC [5]. While, samples of feed and excreta were also used for estimation of Ca and P contents using specific method [6].

- **Carcass traits**

To study the carcass traits, two representative broilers from each replicate were slaughtered at the termination of experiment. Broilers were kept off feed for 12 hours before slaughter. During this period they were provided clean and fresh drinking water *ad libitum*.

Before slaughter, each broiler was weighed. By giving severe cut to the jugular vein, it was killed and allowed to bleed completely. For the complete bleeding, birds were hanged in inverted position on the iron rails. After complete bleeding, weight was recorded. The weight was again recorded after manual defeathering using hot water (50-55 ºC). Head, shank and wing tips were removed by giving cuts at atlanto-occipital, hock and knee joints, respectively and their weights were recorded. The dressed weights were recorded as follows:

Dressed weight = Live weight – Weight loss as blood, feathers, head, shank and wing tips.

After recording the dressed weight, a horizontal cut was applied posterior to keel bone. Breast was pushed forward to expose the viscera, which was then pulled out. Weight of the carcass was again recorded. Visceral organs like liver, heart, gizzard, spleen and pancreas were separated. The contents of gizzard were removed and epithelial linings were detached. Individual weights of the organs were taken. The eviscerated and drawn weights were calculated as below:

Eviscerated weight = Dressed weight – Weight of viscera

Drawn weight = Eviscerated weight + Weight of giblet (Liver, heart, gizzard)

Various processing losses such as blood, head, feather, shank and wing tips were also recorded.

2.9 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].

Result and Discussion

Effect of varying levels of enzymes with higher levels of paddy on nutrients retention in broilers is furnished in Table 03. With higher levels of inclusion of paddy in the diet, use of enzymes caused higher retention of most of the nutrients under study. In comparison to control diet (T_1), retention of EE, CF, and calcium had reduced due to use of enzymes on paddy based diet. Use of higher levels of paddy in the diet supplemented with the enzymes, tend to reduce the retention of nutrients. When we compared the effect of enzymes supplementation on same levels of paddy, it revealed that use of higher level of enzymes had caused higher retention of nutrients.

Table 3: Effect of varying levels of enzymes with higher levels of paddy on nutrients utilization (%) in broilers

Treatments	DM	CP	EE	CF	NFE	Ca	P
T_1	71.01^{a}±0.86	63.73^{d}±0.23	77.20^{a}±0.36	52.82^{a}±0.19	85.84^{b}±0.69	70.12^{a}±0.22	60.20^{a}±0.37
T_2	70.01^{a}±0.49	65.17^{c}±0.27	67.36^{c}±0.34	42.46^{c}±0.25	84.96^{b}±0.21	64.76^{b}±0.73	58.56^{b}±0.69
T_5	70.97^{a}±0.82	67.09^{b}±0.17	73.09^{b}±0.31	44.10^{e}±0.12	87.96^{a}±0.14	65.09^{b}±0.34	60.23^{a}±0.53
T_3	66.10^{c}±0.19	61.22^{e}±0.34	60.68^{f}±0.27	37.89^{g}±0.17	82.81^{d}±0.15	62.10^{c}±0.08	55.60^{c}±0.83
T_6	67.10^{c}±0.22	63.17^{d}±0.24	62.09^{e}±0.40	38.66^{b}±0.35	84.77^{b}±0.26	62.15^{c}±0.42	55.13^{c}±0.18
T_4	66.97^{c}±0.22	61.26^{e}±0.18	58.90^{g}±0.43	34.81^{d}±0.36	81.64^{e}±0.29	58.53^{d}±0.39	51.60^{d}±0.59
T_7	69.15^{b}±0.19	67.85^{a}±0.38	64.67^{d}±0.45	36.33^{f}±0.45	83.64^{c}±0.17	58.67^{d}±0.55	51.35^{d}±0.46
CD	1.27	0.67	0.92	0.73	0.81	1.09	1.39

Means bearing different superscript differ significantly ($p<0.05$)

Effect of varying levels of enzymes with higher levels of paddy on nutrients utilization (Table 03) indicated increased utilization of dry matter as well as various nutrients. As compared to low level of enzymes supplementation (30g/Q diet), clear cut trend was noticed on increased retention of nutrients at each level of paddy due to higher level (50g/Q diet) of enzymes supplementation. Improved nitrogen retention following the enzymes supplementation may be attributed to the reduced viscosity of digesta which improved the digestibility and this was similar to finding of other researcher [9]. Further, increase in crude fibre level irrespective of enzymes supplementation depresses the utilization of nutrients except NFE [10]. Researchers [11] also reported that nutrient retentions were significantly affected by the supplementation of phytase. Reduced nitrogen retention and increased intestinal viscosity due to enzymes supplementation in the diet was also reported [12].

Effect of varying levels of enzymes with higher levels of paddy on the carcass yield of broilers is given in Table 04. The percent dressed weight was maximum in broilers assigned T_5 diet. It was statistically similar to those assigned T_3 diet. Minimum dressed weight recorded in broilers offered T_1 diet was statistically similar ($p>0.05$) with those assigned T_4 diet. The eviscerated weight was also maximum and significantly ($p<0.05$) higher in broilers assigned T_5 diet. It was significantly ($p<0.05$) lower in those allotted T_7 diet. The drawn weight was also maximum and significantly ($p<0.05$) higher in broilers assigned T_5 diet. However, it was minimum and significantly ($p<0.05$) lower in groups assigned T_4 diet.

Table 4: Effect of varying levels of enzymes with higher levels of paddy on the carcass yield (% live weight) of broilers

Treatments	Dressed weight (%)	Eviscerated weight (%)	Drawn weight (%)
T_1	82.10^{b}±0.46	77.64^{a}±0.50	81.5^{b}±0.37
T_2	82.50^{b}±0.32	77.98^{a}±0.45	81.43^{b}±0.26
T_5	84.21^{a}±0.25	78.67^{a}±0.68	83.53^{a}±0.23
T_3	80.33^{c}±0.60	75.07^{b}±0.48	79.45^{d}±0.35
T_6	81.53^{b}±0.81	75.97^{b}±0.51	80.70^{c}±0.19
T_4	78.84^{e}±0.65	71.94^{c}±0.45	77.78^{e}±0.22
T_7	79.33^{c}±0.59	72.62^{c}±0.41	77.98^{e}±0.12
C.D.	1.38	1.25	0.65

Means bearing different superscript differ significantly ($p<0.05$)

Use of higher levels of enzymes with higher levels of paddy (Table 04) showed that the carcass quality traits were either increased significantly ($p<0.05$) or were not influenced. Dressed weight had increased significantly but eviscerated weights were not influenced statistically. The drawn weights had also increased but with 100% paddy diet no significant effect was noticed. Use of higher levels of enzyme leading to higher carcass quality traits might be related to higher body weight gain and lower processing losses in broilers. Researchers reported that enzyme supplementation had non-significant ($p>0.05$) effect on carcass yield of broilers which was dissimilar to above findings [13].

Effect of varying levels of enzymes with higher levels of paddy on the organs weight of broilers is furnished in Table 05. The heart and gizzard weights were maximum and significantly ($p<0.05$) higher in broilers assigned T_4 diet while liver and giblet in T_7 diet, spleen with T_5 and pancreas with T_3 diet. Use of higher dose of enzyme with 60% paddy (T_3 vs. T_6) reduced the weight of heart significantly. Similarly, weight of gizzard has reduced due to use of higher dose of enzyme with 60% and 80% paddy diet (T_5 and T_6). With T_6 diet, in comparison to T_3, weight of liver, spleen, pancreas as well as giblet reduced significantly ($p<0.05$). Minimum and significantly ($p<0.05$) lower weight of heart, gizzard and giblet was noted in broilers offered T_2 diet, liver with T_6, spleen with T_7 and pancreas with T_5 diet.

Table 5: Effect of varying levels of enzymes with higher levels of paddy on the organs weight (% live weight) of broilers

Treatments	Heart	Gizzard	Liver	Spleen	Pancreas	Giblet
T_1	$0.59^{b}\pm0.01$	$2.20^{c}\pm0.02$	$2.19^{b}\pm0.01$	$0.12^{b}\pm0.00$	$0.23^{b}\pm0.00$	$4.98^{b}\pm0.01$
T_2	$0.41^{e}\pm0.01$	$1.78^{f}\pm0.01$	$1.82^{d}\pm0.02$	$0.12^{b}\pm0.01$	$0.27^{a}\pm0.01$	$4.04^{e}\pm0.02$
T_5	$0.48^{d}\pm0.01$	$1.87^{e}\pm0.01$	$1.84^{d}\pm0.01$	$0.17^{a}\pm0.01$	$0.22^{c}\pm0.01$	$4.19^{d}\pm0.02$
T_3	$0.52^{c}\pm0.01$	$2.22^{c}\pm0.00$	$1.94^{c}\pm0.01$	$0.15^{a}\pm0.01$	$0.29^{a}\pm0.01$	$4.68^{c}\pm0.01$
T_6	$0.45^{d}\pm0.01$	$1.93^{d}\pm0.01$	$1.79^{e}\pm0.02$	$0.12^{b}\pm0.01$	$0.27^{a}\pm0.01$	$4.17^{d}\pm0.02$
T_4	$0.68^{a}\pm0.01$	$2.41^{a}\pm0.01$	$1.92^{c}\pm0.01$	$0.16^{a}\pm0.01$	$0.25^{b}\pm0.01$	$5.03^{a}\pm0.01$
T_7	$0.50^{c}\pm0.01$	$2.30^{b}\pm0.01$	$2.48^{a}\pm0.00$	$0.11^{b}\pm0.01$	$0.29^{a}\pm0.00$	$5.28^{a}\pm0.03$
CD	0.03	0.03	0.04	0.02	0.02	0.05

Means bearing different superscript differ significantly ($p<0.05$)

Use of higher dose of enzymes mostly reduced the weight of organs significantly ($p<0.05$). In comparison to low level of enzymes (Table-05), the use of high level of enzymes with 60% paddy instead of maize increased most of the organs weight except pancreas which reduced significantly. Conversely, with 80% paddy replacing maize diet, most of the organs weight had reduced significantly. While, with 100% paddy instead of maize, use of higher dose of enzymes reduced most of the organs weight except liver and pancreas which had increased significantly. Researchers [13] observed significant increase in the weight of pancreas with increase in crude fibre levels. Supplementation of phytase significantly increased the gizzard weight was also reported [11]. Researchers [14] observed no significant variation in dressing percentage and weight of giblet, lymphoid organs (spleen and bursa), proventriculus and abdominal fat.

Effect of varying levels of enzymes with higher levels of paddy on the processing losses of broilers is furnished in Table 06. Treatment means of the processing losses indicated that blood, shank & wing tips as well as total losses were maximum and significantly ($p<0.05$) higher in broilers assigned T_7 diet. While, feather and head losses were maximum with T_4 and T_6 diet, respectively. Minimum and significantly ($p<0.05$) lower loss through blood and shank & wing tips was observed in broilers assigned T_6 and T_4 diets. While, minimum losses due to feather and head were observed in broilers assigned T_3 diet and total loss was minimum in those allotted T_2 diet.

Table 6: Effect of varying levels of enzymes with higher levels of paddy on the processing losses (% live weight) of broilers

Treatments	Blood	Feather	Head	Shank & wing tips	Total
T_1	$5.34^{d}\pm0.02$	$6.43^{d}\pm0.02$	$3.01^{d}\pm0.00$	$6.17^{c}\pm0.02$	$20.95^{c}\pm0.03$
T_2	$4.47^{e}\pm0.02$	$6.54^{c}\pm0.02$	$2.98^{d}\pm0.01$	$6.19^{c}\pm0.01$	$20.18^{g}\pm0.03$
T_5	$5.36^{d}\pm0.01$	$6.69^{b}\pm0.01$	$2.92^{e}\pm0.01$	$5.86^{d}\pm0.01$	$20.83^{d}\pm0.02$
T_3	$5.40^{c}\pm0.02$	$6.24^{e}\pm0.02$	$2.89^{e}\pm0.01$	$6.22^{b}\pm0.01$	$20.75^{e}\pm0.02$
T_6	$4.47^{e}\pm0.01$	$6.70^{a}\pm0.01$	$3.64^{a}\pm0.01$	$6.23^{b}\pm0.01$	$20.04^{b}\pm0.02$
T_4	$5.43^{b}\pm0.02$	$6.75^{a}\pm0.02$	$3.10^{c}\pm0.01$	$5.43^{e}\pm0.01$	$20.68^{f}\pm0.02$
T_7	$6.13^{a}\pm0.01$	$6.54^{c}\pm0.02$	$3.27^{b}\pm0.01$	$6.55^{a}\pm0.01$	$22.49^{a}\pm0.02$
CD	0.02	0.05	0.03	0.03	0.06

Means bearing different superscript differ significantly ($p<0.05$)

Effect of varying levels of paddy with enzymes on the processing losses (Table 06), indicated no specific trend on it. Use of higher levels of paddy along with 30g enzyme/Q diet had reducing effect on the processing losses up to 60% level of inclusion but further increase in it has increasing and decreasing effect. Use of 50g enzyme/Q diet with higher levels of paddy (60%, 80% and 100%) produced conflicting result on the processing losses. In comparison to 30g enzyme/Q diet, use of 50g enzyme/Q diet with 60% paddy replacing maize, increased the blood and feather loss but reduced the head, shank and wing tip loss. While, with 80% paddy replacing maize, use of higher level of enzymes reduced the blood loss but increased the feather and head loss. Conversely, complete replacement of maize with paddy, use of 50g enzyme/Q diet reduced the feather loss but other losses were increased significantly. No similar work was reported.

4. Conclusion

Use of higher level of enzymes with higher level of paddy had caused higher retention of nutrients and improved the carcass quality traits in broilers. But no specific trend was recorded in organs weight and processing losses.

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