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Comparative effect of graded replacement of maize by paddy with and without enzymes on carcass traits of broilers

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Abstract
The present study was planned to evaluate the comparative effect of graded replacement of maize by paddy with and without enzymes on carcass traits of broilers. The study was conducted for a period of five weeks. In the experiment 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 (T1) and two (T2) acted as a 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. This study revealed that use of enzymes had increased their dressed, eviscerated and drawn weights. Thus, carcass quality traits had improved due to enzymes supplementation. Use of paddy without and with enzymes at graded levels had a significant effect on the organs weight but no specific trend was noticed.

Keywords: Paddy, maize, broiler, graded levels, carcass traits, enzyme

1. Introduction
Corn is the principal energy source in poultry diets, and it is also an important cereal for humans. In recent years, industry and human consumption of corn has been expanding rapidly, leading to inadequate supplies and high prices. This trend has necessitated a search for feedstuffs that could be used as an alternative to corn in broiler diets. Many studies have been published on replacing corn with alternative feedstuffs in broiler diets such as sunflower meal [1], pearl millet [2] as well as palm kernel cake [3]. One alternative is paddy rice available for use as a replacement for corn in broiler diets. Although the nutrient composition of paddy rice is slightly lower than maize. Paddy was used in this experiment to decrease feed cost and also to increase the use of locally grown grains

Paddy has lower nutritive value than maize. 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 [4]. 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.

The use of enzymes as feed additives in the feed industry has a history of around 25 years. Two main fibre degrading enzymes used in poultry feed are, cellulase (β-glucanase) and xylanase. Cellulase breakdown β-glucans that are particularly prevalent in barley, oat, rice and their by products. Xylanase breakdown arabinoxylans particularly prevalent in grains and their by-products. Their ability to improve feed conversion ratio and weight gain of poultry has been demonstrated by many research workers [5]. Thus, the aim of this experiment was to study the comparative effect of replacing corn by paddy with and without enzymes on 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.). The comprehensive programme of the experiment is described in terms of material and methods.

2.2 Experiment
The experiment was planned to evaluate the response of broiler chickens to use of paddy instead of maize at graded level with and without enzymes with reference to carcass trait in broiler production.

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 the complete house was fumigated using formaldehyde and potassium permanganate four days prior to the commencement of the experiment. Feeders and waterers were carefully cleaned with detergent. Artificial heat was provided to chicks during the early period of growth using electric bulbs (100 watts) as the experiment was conducted in the 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.

2.4 Experimental Diet
Diets were formulated as per ICAR feeding standards. Thus, control diet (T1) (Table- 1) was containing 2800 Kcal ME/kg and 22% CP for 5 weeks while other control diet (T2) (Table-1) 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 (Table- 2). 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.

Table 1: Composition of control broiler diet

Ingredients	Control diet1 (T1)	Control diet2 (T2)
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- 1)	
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 diet1 (T1) +	20% paddy instead of maize
4.	T4	Control diet1 (T1) +	40% paddy instead of maize.
5.	T5	Control diet (T1) + 60% paddy instead of maize.	
6.	T6	Control diet (T1) + 80% paddy instead of maize.	
7.	T7	Control diet (T1) + 100% paddy instead of maize.	
8.	T8	Control diet2 (T2) +	20% Paddy instead of maize
9.	T9	Control diet2 (T2) +	40% Paddy instead of maize
10.	T10	Control diet2 (T2) +	60% Paddy instead of maize
11.	T11	Control diet2 (T2) +	80% Paddy instead of maize
12.	T12	Control diet2 (T2) +	100% Paddy instead of maize
13.	T13	Control diet1 (T1) + 60% paddy instead of maize + enzyme	
		(Cellulase, xylanase, pectinase and phytase) @ 50g/100kg feed.	
14.	T14	Control diet1 (T1) + 80% paddy instead of maize + enzyme	
		(Cellulase, xylanase, pectinase and phytase) @ 50g/100kg feed.	
15.	T15	Control diet1 (T1) + 80% paddy instead of maize + enzyme	
		(Cellulase, xylanase, pectinase and phytase) @ 50g/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, 270 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 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.

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 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 de-feathering using hot water (50-55ºC). 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.

2.10 Statistical analysis

Data obtained during the experiment were analyzed statistically [6] and differences among the treatments were tested for significance [7].

3. Results and discussion

Effect of varying levels of paddy with and without enzymes on the carcass yield of broilers is furnished in Table 3. Use of enzymes in diets with different levels of paddy had resulted in to superior dressed weight. Further, use of higher levels of enzymes was responsible for higher dressed weight in any level of paddy instead of maize in the diet. Similarly, eviscerated weights were also influenced by the level of enzymes supplemented in the diet. Higher eviscerated weights were recorded in broilers offered diets containing paddy and supplemented with enzymes. The drawn weights were also influenced significantly due to use of varying levels of paddy and supplementation of enzymes. Use of enzymes had either increased the drawn weights in broilers or did not influence it significantly. Diets with either 20% or 100% paddy instead of maize supplemented with enzyme had no significantly influence on the drawn weights of broilers.

Table 3: Comparative effect of graded levels of paddy with and without enzymes on the carcass yield (% live weight) of broilers

Treatments	Dressed weight (%)	Eviscerated weight (%)	Drawn weight (%)
T1	78.37^{d}±0.46	73.46^{e}±0.50	78.24^{e}±0.37
T2	82.10^{b}±0.58	77.64^{b}±0.43	81.50^{b}±0.37
T3	77.47^{e}±0.51	70.55^{h}±0.48	76.51^{g}±0.48
T8	78.89^{d}±0.94	71.09^{g}±0.29	76.98^{g}±0.65
T4	80.30^{c}±0.32	75.58^{c}±0.28	79.92^{d}±0.11
T9	81.33^{b}±0.67	77.22^{b}±0.46	81.26^{b}±0.27
T5	80.41^{c}±0.25	75.93^{c}±0.51	79.73^{d}±0.23
T10	82.50^{b}±0.41	77.98^{a}±0.56	81.43^{b}±0.19
T13	84.21^{a}±0.32	78.67^{a}±0.45	83.53^{a}±0.26
T6	79.69^{c}±1.03	74.76^{d}±0.68	78.64^{e}±0.35
T11	80.33^{c}±0.81	75.07^{d}±0.45	79.45^{d}±0.19
T14	81.53^{b}±0.60	75.97^{c}±0.49	80.70^{c}±0.15
T7	78.63^{d}±0.65	71.73^{g}±0.48	77.54^{f}±0.12
T12	78.84^{d}±0.48	71.94^{f}±0.41	77.78^{f}±0.18
T15	79.33^{c}±0.59	72.62^{f}±0.22	77.98^{f}±0.22
C.D.	1.08	0.81	0.47

Means bearing different superscript differ significantly (p<0.05)

Data (Table 3) revealed that use of enzymes had increased the dressed, eviscerated as well as drawn weights in broilers. Thus, carcass quality traits had improved due to enzymes supplementation. However these findings did not resembled with those of some researchers [8, 9].

Effect of varying levels of paddy with and without enzymes on the organs weight of broilers is depicted in Table 4. In control diet, use of enzymes mostly increased the organs weight. While, with increasing levels of paddy, use of enzymes had inconsistent effect on the weight of various organs. However, this was not true with the spleen. At different levels of paddy inconsistent effect was seen. The weight of pancreas did not differ significantly between control as well as 20% paddy diet instead of maize. While, in case of giblet mostly opposite trend was noticed. In control group, use of enzyme increased the giblet weight but use of 20% paddy instead of maize reduced the weight of spleen significantly. (p<0.05).

Table 4: Comparative effect of graded levels of paddy with and without enzymes on the organs weight (% live weight) of broilers

Treatments	Heart	Gizzard	Liver	Spleen	Pancreas	Giblet
T1	0.36^{g}±0.00	1.83^{h}±0.01	2.03^{h}±0.01	0.15^{b}±0.01	0.23^{d}±0.01	4.22^{h}±0.01
T2	0.59^{b}±0.01	2.20^{c}±0.02	2.19^{g}±0.01	0.12^{c}±0.00	0.23^{d}±0.00	4.98^{d}±0.01
T3	0.56^{c}±0.01	2.07^{d}±0.01	2.37^{d}±0.00	0.16^{a}±0.01	0.29^{a}±0.01	5.00^{c}±0.00
T8	0.46^{f}±0.01	1.85^{g}±0.02	1.82^{j}±0.01	0.11^{c}±0.01	0.28^{a}±0.00	4.13^{j}±0.01
T4	0.56^{c}±0.01	1.81^{h}±0.01	2.19^{g}±0.01	0.11^{c}±0.00	0.23^{d}±0.01	4.56^{g}±0.01
T9	0.56^{c}±0.01	1.78^{i}±0.01	2.24^{f}±0.02	0.16^{a}±0.01	0.26^{b}±0.01	4.58^{g}±0.02
T5	0.52^{d}±0.01	1.82^{h}±0.01	2.44^{c}±0.02	0.16^{a}±0.01	0.21^{e}±0.01	4.78^{e}±0.02
T10	0.44^{f}±0.01	1.78^{i}±0.01	1.82^{j}±0.02	0.12^{c}±0.01	0.27^{b}±0.01	4.04^{k}±0.02
T13	0.48^{e}±0.01	1.87^{g}±0.01	1.84^{j}±0.01	0.17^{a}±0.01	0.22^{d}±0.01	4.19^{h}±0.02
T6	0.48^{e}±0.00	1.99^{e}±0.02	2.28^{e}±0.01	0.12^{c}±0.00	0.21^{e}±0.01	4.75^{e}±0.01
T11	0.52^{d}±0.01	2.22^{c}±0.00	1.94^{i}±0.01	0.15^{b}±0.01	0.29^{a}±0.01	4.68^{f}±0.01
T14	0.45^{f}±0.01	1.93^{f}±0.01	1.79^{k}±0.02	0.12^{c}±0.01	0.27^{b}±0.01	4.17^{i}±0.02
T7	0.53^{d}±0.00	2.41^{a}±0.02	2.54^{a}±0.01	0.16^{a}±0.01	0.28^{a}±0.01	5.48^{a}±0.01
T12	0.68^{a}±0.01	2.41^{a}±0.01	1.94^{i}±0.01	0.16^{a}±0.01	0.25^{c}±0.01	5.03^{c}±0.01
T15	0.50^{e}±0.01	2.30^{b}±0.01	2.48^{b}±0.00	0.11^{c}±0.01	0.29^{a}±0.00	5.28^{b}±0.03
CD	0.02	0.02	0.02	0.01	0.01	0.03

Means bearing different superscript differ significantly (p<0.05)

Effect of varying levels of paddy with and without enzymes on the organs weight of broilers (Table 4) revealed that use of enzymes with control diet increased the weight of most of the organs except spleen which has reduced significantly (p<0.05). Conversely, incorporation of 20% and 60% paddy instead of maize supplemented with enzymes reduced the most of the organs weight significantly. While, 40% inclusion of paddy instead of maize only reduced the weights of gizzard and giblet but other organs weight were increased significantly. Use of 80% paddy instead of maize with 30g enzyme/Q diet increased the most of the organs weight except liver and giblet which has reduced significantly but the use of 50g enzyme/Q diet reduced the weight of most of the organs. Complete replacement of maize with paddy with 30g enzyme/Q diet, increased the weight of only heart while other organs weight were either reduced or were not affected. But when 50g enzyme/Q diet was supplemented, it reduced the weight of heart, gizzard and spleen but increased the weight of rest of the organs. Thus, no specific trend was noted. Significantly higher total meat yield in enzyme supplemented diet was observed [10]. It was reported that supplementation of phytase significantly affected the dressing percentage, shank, liver and gizzard weights [11].

Effect of varying levels of paddy without and with enzymes on the processing losses of broilers is given in Table 5. Blood loss has reduced due to use of enzymes with the control diet. Addition of enzymes with paddy diets (20%, 40%, 60%, 80% and 100%) also reduced the blood loss. Use of higher dose of enzymes tends to increase the blood loss with paddy diet instead of maize (T12 vs. T15). Feather loss usually increased with the use of enzymes with different diets. Use of higher levels of enzymes increased the feather loss. The loss due to head increased due to use of enzymes with control diet as well as with the use of lower levels of paddy in place of maize. But when paddy was incorporated at higher levels, use of enzymes increased the loss due to the head. Losses due to shank and wing tips increased due to use of enzymes with the control diet. But when enzymes were incorporated with 20% and 40% paddy instead of maize diet, there was the reduction in this loss. With diets containing higher levels of paddy (60%, 80% and 100%) use of enzymes had inconsistent effect on the losses due to shank and wing tips. Total processing losses had increased due to use of enzymes with control diet or with diets containing 60%, 80% and 100% paddy instead of maize. With lower levels of paddy in the diet (20% and 40%) there was the reduction in the total processing losses in broilers.

Table 5: Comparative effect of graded levels of paddy with and without enzymes on the processing losses (% live weight) of broilers

Treatments	Blood	Feather	Head	Shank & wing tips	Total
T_1	4.90^{g}±0.02	5.99^{g}±0.02	2.73^{j}±0.01	5.44^{k}±0.02	19.06^{l}±0.03
T_2	5.34^{f}±0.02	6.43^{d}±0.02	3.01^{e}±0.00	6.17^{e}±0.02	20.95^{e}±0.03
T_3	6.03^{b}±0.02	5.63^{i}±0.02	3.72^{a}±0.02	6.34^{c}±0.01	21.72^{b}±0.03
T_8	4.85^{h}±0.02	6.67^{b}±0.02	3.64^{b}±0.02	6.04^{g}±0.01	21.20^{c}±0.02
T_4	5.64^{d}±0.02	6.03^{f}±0.01	2.94^{g}±0.01	6.13^{f}±0.01	20.74^{g}±0.03
T_9	4.57^{i}±0.01	5.48^{j}±0.02	2.74^{j}±0.01	5.49^{j}±0.01	18.28^{m}±0.01
T_5	4.92^{g}±0.02	5.71^{h}±0.01	2.81^{i}±0.01	6.02^{g}±0.01	19.46^{k}±0.03
T_{10}	4.47^{j}±0.02	6.54^{c}±0.02	2.98^{f}±0.01	6.19^{e}±0.01	20.18^{j}±0.03
T_{13}	5.36^{f}±0.01	6.69^{b}±0.01	2.92^{g}±0.01	5.86^{i}±0.01	20.83^{f}±0.02
T_6	6.03^{b}±0.01	5.42^{k}±0.02	2.83^{i}±0.01	5.97^{h}±0.01	20.25^{i}±0.02
T_{11}	5.40^{e}±0.02	6.24^{e}±0.02	2.89^{h}±0.01	6.22^{d}±0.01	20.75^{g}±0.02
T_{14}	4.47^{j}±0.01	6.70^{a}±0.01	2.92^{g}±0.01	6.23^{d} ±0.01	21.04^{d}±0.02
T_7	5.90^{c}±0.01	5.40^{k}±0.01	3.01^{e}±0.01	6.50^{b}±0.02	20.81^{f}±0.02
T_{12}	5.43^{e}±0.02	6.75^{a}±0.02	3.10^{d}±0.01	5.43^{k}±0.02	20.68^{h}±0.02
T_{15}	6.13^{a}±0.01	6.54^{c}±0.02	3.27^{c}±0.01	6.55^{a}±0.01	22.49^{a}±0.02
CD	0.03	0.03	0.02	0.02	0.04

Means bearing different superscript differ significantly (p<0.05)

When we compared the data related to effect of enzymes (Table 5), it indicated that on control diet use of enzymes increased the processing losses significantly ($p<0.05$). While, when 20% and 40% paddy was used instead of maize, use of enzymes increased the blood and feather losses and reduced the head shank and wing tip losses. With higher levels of paddy instead of maize, use of 30g enzymes/Q diet reduced only blood loss but other processing losses were increased. However, when 50g enzymes/Q diet was used, except feather loss, other losses were increased.

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