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Vibhuti Choudhary
M.Sc. Scholar, Department of Animal Production, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan, India

Siddhartha Mishra
Professor, Department of Animal Production, RCA, MPUAT, Udaipur, Rajasthan, India

JL Chouchary
Emeritus Professor, Department of Animal Production, RCA, MPUAT, Udaipur, Rajasthan, India

Girdhari Lal Meena
Professor, Department of Animal Production, RCA, MPUAT, Udaipur, Rajasthan, India

Kapil Dev Ameta
Professor, Department of Animal Production, RCA, MPUAT, Udaipur, Rajasthan, India

Corresponding Author:
Vibhuti Choudhary
M.Sc. Scholar, Department of Animal Production, RCA, MPUAT, Udaipur, Rajasthan, India

Effect of phytase supplementation with graded crude protein levels on carcass characteristics of pratapdhan chicken

Vibhuti Choudhary, Siddhartha Mishra, JL Chouchary, Girdhari Lal Meena and Kapil Dev Ameta

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Abstract
Enhancing feed efficiency while lowering production costs is a key priority in poultry farming, particularly with native breeds like Pratapdhan. This study was conducted to evaluate the effect of phytase supplementation (1500 FTU/kg) in diets with graded levels of crude protein (CP) on growth performance, carcass characteristics in Pratapdhan chickens. Five dietary treatments were tested with four replications, each replication consisting of 10 chicks: T_1 (Control, 20% CP), T_2 (20% CP + phytase), T_3 (19% CP + phytase), T_4 (18% CP + phytase) and T_5 (17% CP + phytase), all diets being iso-caloric (ME 2800 kcal/kg). Carcass traits such as live weight was significantly (p<0.01%) highest in T_3 (811.11±0.70) and lowest in T_5 (726.08±0.41), dressed weight was significantly highest in T_3 (728.82±0.64) and lowest in T_5 (611±0.41), eviscerated weight was significantly highest in T_3 (622±0.58) and lowest in T_1 (531±0.41) and giblet weight were significantly higher (p<0.01) in T_3 (55.92±0.31) and lowest in T_5 (43.15±0.68). While dressing percentage was recorded significantly highest in T_3 (89.86±0.14) and lowest in T_4 (83±0.10), eviscerated percentage was recorded highest in T_3 (76.68±0.12) and lowest in T_4 (73.13±0.15). Phytase supplementation had no significant effect on heart and liver weight as a percentage of live weight, however, gizzard percentage was significantly improved in T_3 (3.72±0.03).
In conclusion, supplementing phytase at 1500 FTU/kg in diets with a 5% reduction in crude protein not only maintains but enhances carcass quality in Pratapdhan chickens offering a promising nutritional strategy for sustainable and cost-effective poultry production.

Keywords: Pratapdhan chicken, crude protein, carcass traits, phytase

Introduction
Poultry farming is a rapidly evolving segment of the global agricultural landscape, representing a vital source of animal protein, income generation and rural development. Encompassing the breeding and management of domesticated birds such as chickens, ducks and turkeys, this sector caters to the escalating demand for meat and eggs driven by population growth and shifting consumer preferences worldwide (Mottet *et al*. 2007) [4]. The intensification of poultry production, characterized by advances in genetics, nutrition and health management, has transformed it into a cornerstone of food security, particularly in developing countries.
A major concern in poultry nutrition is lowering protein and energy levels in feed to enhance sustainability and reduce production expenses. However, feeding birds with diets low in crude protein (CP) and metabolizable energy (ME) often leads to reduced growth rates, poorer feed efficiency and increased fat accumulation. Supplementing low-CP diets with essential amino acids can help maintain growth performance, even under challenging health conditions. Yet, according to Liu *et al*. (2017) [2], precisely meeting the amino acid needs of poultry remains exact mechanism behind phytase's ability to enhance prececal amino acid digestibility (pcAAD) is not fully understood (Selle *et al*. 2006; Selle *et al*. 2012; Selle and Ravindran *et al*. 2007) [8, 7, 6], complex and adjusting the balance between starch and protein in the diet might

offer a more effective solution. Enzyme supplementation, particularly with phytase, is considered a promising approach to achieve this balance. Although the evidence shows that phytase consistently improves pcAAD. This improvement potentially allows for further reduction of dietary CP without compromising performance. Studies have demonstrated that phytase addition boosts body weight gain, overall carcass weight and breast muscle mass in broilers fed lysine-deficient diets (Selle *et al*., 2006; Walk and Rao *et al.* 2019) [8, 12]. Moreover, phytase at 1,500 FTU/kg has been found to offset the negative effects on feed conversion ratio when broilers are given diets with CP lowered by 15 g/kg compared to standard protein levels.

In summary, poultry farming remains integral to food and nutritional security globally and in India. Leveraging enzyme supplementation, particularly phytase, alongside judicious management of dietary protein offers promising pathways to enhance the productivity of indigenous breeds like Pratap Dhan. Such approaches not only improve growth performance and feed efficiency but also contribute to sustainable and economically viable poultry production systems. Continued research and development in these areas will be essential for meeting the rising demand for poultry products while addressing environmental and resource challenges.

Materials and Methods Experimental birds and diets

The present study was conducted using 200 day-old, straight-run Pratapdhan chicks obtained from the AICRP on Poultry Breeding, Rajasthan College of Agriculture, Udaipur. The chicks were randomly assigned to five dietary treatment groups, each with four replicates of 10 birds. They were reared under a deep litter system following standard management practices. The experimental diets aimed to evaluate the effect of phytase supplementation combined with graded crude protein levels on the growth and carcass traits of Pratapdhan chickens. The chicks were fed five different iso caloric experimental rations containing five different levels of crude protein viz. 19, 18 and 17%. The experimental diets comprised of Maize, Soyabean De Oiled Cake (DOC), De oiled Rice Bran (DORB), Rice bran oil, Dicalcium Phosphate and vitamin mineral premix as depicted in Table-1

Table 1: Ingredients and nutrient composition or ration

Ingredient	T_1	T_2	T_3	T_4	T_5
Maize	52	52	53	54.5	55
Soya DOC	31	31	28	25.5	22
DORB	12	12	14	15	18
RB oil	1	1	1	1	1
DCP	1.5	1.47	1.47	1.47	1.47
PM	2.5	2.5	2.5	2.5	2.5
Phytase	0	0.03	0.03	0.03	0.03
Total	100	100	100	100	100
CP	20.07	20.07	19.05	18.18	17.01
ME Kcal/kg	2811	2811	2809	2816	2805

At the end of the trial, eight birds from each treatment group were slaughtered to evaluate carcass traits. The parameters measured included live weight (g), dressed weight (g), dressing percentage, eviscerated weight and giblet weight. Additionally, two male Pratapdhan chickens from each treatment group were randomly selected at the end of the feeding trial. These birds were fasted for 24 hours with free access to water, weighed and then slaughtered to determine internal organ weights (heart, liver and gizzard) along with dressed weight. The organ weights were expressed as a percentage of live body weight.

Statistical Analysis

The observations recorded during the experiment was statistically analysed by using standard procedure for analysis of variance of CRD (Completely Randomized Design) as suggested by Snedecor and Cochran (1994) [10].

Results and Discussion

All dietary treatments were formulated to be iso-caloric, with metabolizable energy values ranging from 2805 to 2811 kcal/kg of diet. However, the crude protein (CP) levels were adjusted to 20%, 20%, 19%, 18%and 17% in T_1, T_2, T_3, T_4 and T_5, respectively, with phytase supplementation included in treatments T_2 through T_5. All other nutrients in the experimental diets were maintained within the normal recommended ranges across treatment groups (Table 1). The carcass traits are presented in Table 2 and illustrated in Figure 1.

Table 2: Effect of Phytase supplementation with Graded Crude Protein Levels on carcass traits in Pratapdhan chicks.

Particulars	T_1	T_2	T_3	T_4	T_5	SEm	CD
Live weight (g)	712.20±1.65	771.93±0.91	811.11±0.70	740.71±0.63	726.08±0.41	0.96	2.92
Dressed weight (g)	621.25±0.05	619.00±0.70	728.82±0.64	614.75±0.45	611.00±0.41	0.55	1.68
Eviscerated weight (g)	531.00±0.41	535.00±1.08	622.00±0.58	542.00±0.71	532.30±0.48	0.69	2.10
Giblet weight (g)	48.44±0.82	49.80±0.33	55.92±0.31	50.29±0.75	43.15±0.68	0.62	1.87
Dressing percent	87.23±0.21	80.19±0.08	89.86±0.14	83.00±0.10	84.15±0.60	0.13	0.38
Eviscerated percentage	74.55±0.22	69.30±0.09	76.68±0.12	73.13±0.15	73.31±0.08	0.143	0.43
Organ weight as % of live weight							
Heart	0.79±0.03	0.74±0.04	0.77±0.04	0.74±0.03	0.83±0.02	0.04	N/A
Liver	2.72±0.21	2.71±0.16	2.73±0.15	2.79±0.19	2.77±0.15	0.17	N/A
Gizzard	4.06±0.02	3.18±0.06	3.72±0.03	3.73±0.06	3.53±0.05	0.05	0.15

Figures presenting a different superscript within its row denotes a statistically significant divergence (p<0.01)

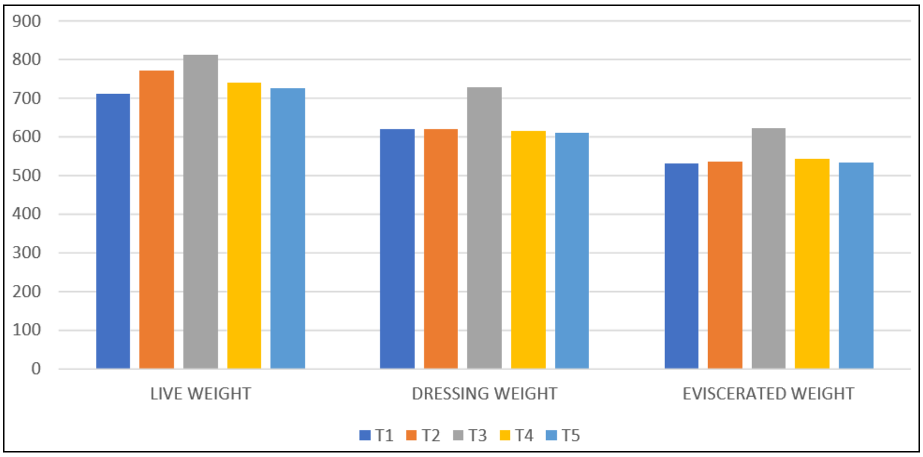

Fig 1: Effects of supplementing phytase on carcass traits in Pratapdhan chicken.

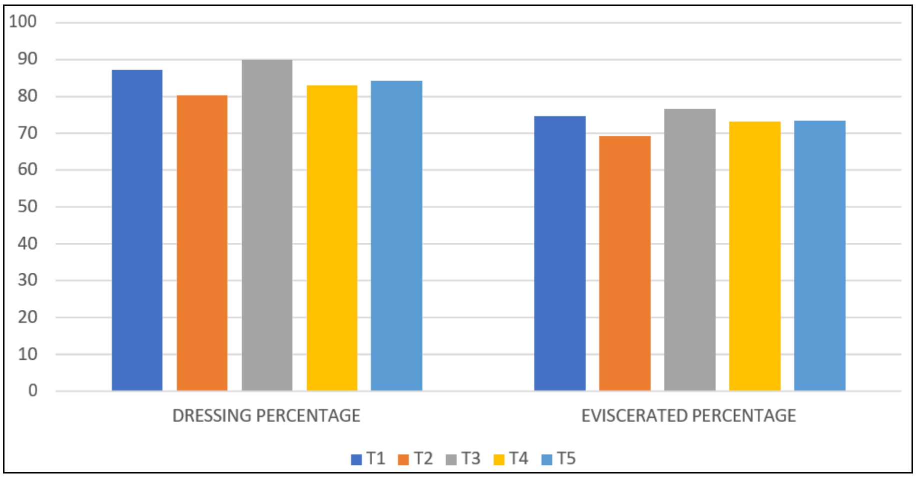

Fig 2: Effects of supplementing phytase on carcass traits in Pratapdhan chicken.

The data with respect to carcass traits of Pratapdhan chicks is presented in presented in Table 2 and depicted graphically in Figure 1. The parameters evaluated included live weight, dressed weight, eviscerated weight, dressing percentage, giblet weight and organ weights expressed as a percentage of live weight. At the end of the experimental period one male from each replicate was sacrificed to study carcass traits of Pratapdhan chicks, thus four birds from each treatment group were used for the carcass studies.

The mean live weight values were 712.20±1.65, 771.93±0.91, 811.11±0.70, 740.71±0.63and 726.08±0.41 for T_1, T_2, T_3, T_4 and T_5, respectively. The live weight was significantly highest in T_3, followed by T_2, T_4 and T_5, with the lowest value observed in T_1. The comparatively higher body weights observed in this trial may be attributed to the fact that slaughter birds were male chickens, which generally attain greater body mass than the combined average weight of mixed-sex flocks.

Across treatments, the dressed weight averaged 621.25^b±0.05 g, 619.00^c±0.70 g, 728.82^a±0.64 g, 614.75^d±0.45 g and 611.00^e±0.41 g for T_1, T_2, T_3, T_4 and T_5, respectively. Significantly highest dressed weight was recorded in T_3 as compared to other treatment groups. The pronounced advantage observed in T_3 and T_1 reflects enhanced carcass yield and muscle deposition, most likely attributable to improved dietary nutrient assimilation and utilization efficiency.

The mean eviscerated weights were 531.00±0.41g, 535.00±1.08g, 622.00±0.58 g, 542.00±0.71 g and 532.30±0.48g for T_1, T_2, T_3, T_4 and T_5, respectively. The mean eviscerated weight was significantly highest in T_3 followed by T_4, T_5, T_2 and lowest in T_1. However, the difference amongst T_5, T_2 and T_1 was found to be non-significant.

The mean giblet weights were 48.44±0.82 g, 49.80±0.33 g, 55.92±0.31 g, 50.29±0.75 g and 43.15±0.68 g for T_1, T_2, T_3, T_4 and T_5, respectively. Giblet weight was significantly highest in T_3 followed T_4, T_2, T_1 and lowest in T_5. However, the difference between T_4, T_2 and T_1 was found to be non-significant.

The dressing percentage varied significantly among treatments, with mean values of 87.23±0.21, 80.19±0.08, 89.86±0.14, 83.00±0.10 and 84.15±0.60 for T_1, T_2, T_3, T_4 and T_5, respectively. The highest dressing percentage was recorded in T_3 followed by T_1, T_5, T_4 and lowest in T_2.

The mean eviscerated percentages were 74.55±0.22, 69.30±0.09, 76.68±0.12, 73.13±0.15and 73.31±0.08 for T_1, T_2, T_3, T_4 and T_5, respectively. The eviscerated percentage was significantly highest in T_3 followed by T_1, T_5, T_4 and lowest in T_2 while the difference in T_5 and T_4 was found to be non-significant.

The mean heart weights expressed as a percentage of live weight, were 0.79±0.03, 0.74±0.04, 0.77±0.04, 0.74±0.03and 0.83±0.02 for T_1, T_2, T_3, T_4 and T_5, respectively. The differences were found to be statistically non-significant.

The mean liver weights were 2.72±0.21, 2.71±0.16, 2.73±0.15, 2.79±0.19and 2.77±0.15 for T_1, T_2, T_3, T_4 and T_5, respectively. When expressed as a percentage of live weight, liver weight was highest in T_4 and T_5, followed by T_3 and T_1

and lowest in T_2. However, the differences among treatments were statistically non-significant.

Evaluation of gizzard weight revealed mean values of 4.06±0.02, 3.18±0.06, 3.72±0.03, 3.73±0.06and 3.53±0.05 for T_1, T_2, T_3, T_4 and T_5, respectively. The gizzard weight was significantly highest in T_1, followed by T_4 and T_3 and lowest in T_5 and T_2. Differences between T_3 and T_4 were minor and statistically non-significant, suggesting similar gizzard development under these treatments.

The findings of Kriseldi *et al*. (2021) [1] broilers were fed corn-soybean meal-based diets with either standard or increased nutrient density, supplemented with phytase at 4,500 FTU/kg. The increased nutrient density diets contained slightly higher levels of digestible amino acids (SAA, Lys, Thr, Val, Ile) and AMEn compared with the control diets. Phytase inclusion, alone or combined with higher nutrient density, significantly improved breast meat yield and overall carcass quality. These findings demonstrate that phytase can positively influence carcass characteristics, supporting both growth and meat accretion beyond its classical role in phosphorus and calcium utilization.

The results of this study are supported by the findings of Zeleke *et al*. (2022) [13], who evaluated the effect of extracted phytase supplementation on Cobb 500 broilers were fed diets supplemented with phytase at 0, 300, 600 and 1200 FTU/kg for 42 days in a completely randomized design. The inclusion of phytase significantly influenced carcass characteristics, particularly dressed weight and breast weight, which were higher in birds fed phytase- supplemented diets compared to the control group. While most other carcass components remained similar among treatments, the improved dressed and breast weights indicate that phytase can enhance meat yield even under standard dietary conditions. These effects are likely associated with better nutrient utilization and protein efficiency mediated by phytase supplementation.

Comparable results were observed by Sampath *et al*. (2023) [5], where Ross-308 broilers were fed standard or phosphorus- and calcium-deficient diets supplemented with graded levels of exogenous phytase (250, 500, 1000, 1500 and 3000 U/kg) from starter (1-7 d) to finisher (21-35 d) phases. Broilers receiving phytase-supplemented diets exhibited significant improvements in gizzard weight and breast muscle development, alongside enhanced carcass quality traits such as breast meat yield. These results indicate that phytase not only improves growth performance and nutrient utilization but also positively affects carcass and meat quality in Pratapdhan chicken, with 1000 U/kg or higher levels providing the most pronounced effects.

A study by Mahmoud *et al*. (2024) [3] where Hubbard broilers were fed standard basal diets supplemented with graded levels of phytase (50, 75, 100, 150 and 200 g/ton) from day 1 to day 35. The inclusion of higher doses of phytase (150-200 g/ton) significantly improved carcass yield, breast meat protein percentage and reduced abdominal fat, while lower doses (50-100 g/ton) showed comparatively smaller effects. These findings confirm that phytase positively influences carcass characteristics and meat composition without compromising bird health.

Vasanthi *et al*. (2023) [11] reported exceptionally high dressing percentages of 90.50% in Siruvidai males and 88.85% in females at 16 weeks of age under farm conditions. These values are comparable to those observed in the present study, although the birds evaluated belonged to different genetic groups. This indicates that high dressing yields can be achieved across diverse poultry types, while also reflecting the inherent variability in carcass traits among breeds.

These findings suggest that while phytase can enhance certain carcass traits, the effects may vary depending on factors such as diet composition, phytase dosage and Pratapdhan chicken genetics.

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Conflict of Interest

Not available

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