

Effect of Supplementing Xylanase, Manase and Proteases Combination in Corn Based Diets on Growth Performances, Carcass Characteristics and Nutrient Digestibility Broiler Chicken

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ABSTRACT

Background and Objectives: The study aimed to assess the effects of supplementing a combination of xylanase, mannanase, and proteases in corn-based diets on the growth performance, carcass characteristics, and nutrient digestibility of broiler chickens. These enzymes were supplemented at different levels of nutrient density during the starter and finisher phases of broiler growth. The objective was to determine whether supplementing a combination of xylanase, mannanase, and proteases would improve growth performance, carcass traits, and nutrient digestibility in broiler chickens.

METHODOLOGY: Six diets were formulated with three nutrient density levels (high density [HD], medium density [MD], and low density [LD]) and two enzyme supplementation levels using Winzyme MXP® (0.01%) containing xylanase, mannanase, and proteases. Diets were fed during the starter phase (days 1–21) and finisher phase (days 22–35) to five replicates of 10 birds each. Parameters measured included feed intake, weight gain, feed conversion ratio, carcass characteristics, organ weights, and nutrient digestibility.

RESULTS: Feed intake was similar across all diets ($P>0.05$). Weight gain was unaffected during the starter phase ($P>0.05$) but was higher in the finisher phase for the high-density diet (HD) and enzyme-supplemented diets ($P<0.05$). Feed conversion ratio (FCR) improved during the finisher phase and overall in HD and enzyme-supplemented diets ($P<0.05$). Carcass and organ weights showed no significant differences except for the highest gizzard weight and abdominal fat percentage in the medium-density diet (MD) ($P<0.05$). Crude protein digestibility was highest in the HD diet ($P<0.05$), while crude fat digestibility was highest in diets without enzymes ($P<0.05$). An interaction effect was observed for crude protein digestibility ($P<0.05$), but not for crude fat digestibility ($P>0.05$).

CONCLUSION: Enzyme supplementation positively influenced growth performance, particularly during the finisher phase of the study. However, the interaction between diet density and enzyme supplementation did not significantly affect the overall growth performance or other measured parameters.

KEYWORDS: Xylanase, mannanase, proteases, broiler chickens, nutrient digestibility, growth performance, carcass characteristics, feed conversion ratio, enzyme supplementation.

INTRODUCTION

In commercial poultry diets, mostly vegetable source of ingredients like cereals, legumes and oil seeds (and their by-products) are basic broiler feed ingredients. Plant cell walls and associated structures are fibrous and rich in non-starch polysaccharides (NSPs) (1) and certain anti-nutritional factors (ANFs) (2). Protease inhibitors, gossypols, phytates, lectins, saponins, tannins, oligosaccharides and NSPs are major contributors of ANFs, (3). Among vegetable sources, maize and soybean meal (SBM) are extensively used in broil

er's diet because of their high nutritional value (4); however, these ingredients also contains ANFs. For example, SBM contains 29 and corn contains 9% NSPs, respectively (5). Diets high in NSPs can lead to increased intestinal viscosity (6) leading to reduction in nutrient digestibility (7) and ultimately a reduction in growth performance (8).

Chicken lack digestive capacity to fully utilize the nutritive value of cereal grains because of gastrointestinal limitations and minimal endogenous enzyme

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production (9). The intact NSPs in broiler gut can hamper digestion and consequently disrupt the intestinal balance, leading to low productivity of birds (Dierick, et al., 1995). The most important effects are associated with the NSP's molecular structure and complexity, which is generally classified as "soluble" or "insoluble". More than 20 years ago, development of highly efficacious enzymes that act on both soluble and insoluble NSP were considered the future challenge for sustainable agriculture (Choct, 1997). Soluble NSPs have a molecular structure that facilitates interactions with environment (10). In gut, NSP-water interactions increases the viscosity of the digesta (11), which hinders proper nutrient digestion and absorption, prolongs the retention time of the intestinal contents and alters fore- and hind-gut microbial populations (12).

To counter this problem and to increase NSPs digestibility, exogenous enzymes are widely used in poultry industry. Supplementation of exogenous enzyme in corn-based diets is becoming more prevalent due to variable ingredient quality and increased use of high fiber diet. Exogenous enzyme supplementation not only improves the bird's performance but also plays a crucial role in reduction of feed cost (13). Enzymes like xylanases, proteases, beta mannanases, amylases, cellulases and phytases are frequently used in animal feed (14). Basically exogenous enzymes are used to fill the gap of endogenous enzymes by increasing the digestibility of feed (15).

Multi-enzyme activity products have been used commercially in broiler diets for over two decades (16). Żyla, LEDOUX (17) reported that multi enzymes synergize the effect of enzymes than if used separately. Tang, Hao (18) reported that adding proteases and xylanases simultaneously has a positive effect on energy utilization and nutrient digestibility. Likewise combination of NSPase and β-mannanase enzyme supplementation in a low energy diet improves bird's performance (19).

The purpose of this study was to evaluate the efficacy of commercial enzyme cocktail Winzyme MXP® in corn based diet and its effects on growth performance, carcass characteristics and nutrient digestibility in broilers chickens.

METHODOLOGY

Experiment was conducted at a poultry farm in Faisalabad.

House cleaning and preparation

- Shed cleaned, disinfected, fumigated, and ventilated before chick arrival.

- 2-inch sawdust bedding with chick paper for the first week.
- Drinkers and feeders sanitized and sun-dried.
- Temperature pre-set for uniform brooding conditions.
- Biosecurity: Daily drinker cleaning, limestone at entrance, formalin spray around shed.

Experimental Design

- Birds: 300 Ross-308 broiler chicks, divided into 30 replicates (10 chicks each).
- Diets: Six treatments with three nutrient density levels (HD, MD, LD) and enzyme supplementation (HDE, MDE, LDE).
- Enzyme: Winzyme MXP® @0.01% (Endo-1,4-D-xylanase, β-mannanase, proteases).
- Phases: Starter (Day 1–21) & Finisher (Day 22–35).

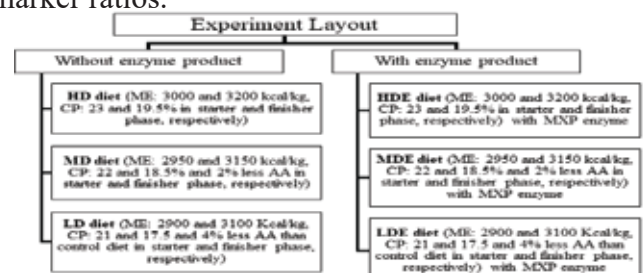
Lighting, Temperature & Vaccination

- Ross Broiler Handbook guidelines followed.
- Initial temp: 95°F, reduced weekly to 75°F by Week 5.
- Vaccination: Newcastle Disease (ND) & Infectious Bursal Disease (IBD).

- Vitamin supplementation to reduce stress.

Parameters Studied

- Growth Performance:
 - o Feed Intake = Feed Offered – Feed Refused
 - o Body Weight Gain = Final Weight – Initial Weight
 - o Feed Conversion Ratio (FCR) = Feed Consumed / Weight Gain
- Carcass Characteristics:
 - o Dressing % = (Carcass Weight / Live Weight) × 100
 - o Breast % = (Breast Weight / Carcass Weight) × 100
 - o Thigh % = (Thigh Weight / Carcass Weight) × 100
 - o Internal Organ Weights (Gizzard, Liver, Heart)
- Nutrient Digestibility:
 - o Proximate analysis of feed & feces (Dry Matter, CP, Fat, Fiber, Ash).
 - o Acid Insoluble Ash (AIA) used as marker.
 - o Digestibility coefficient calculated using marker ratios.



Statistical Analysis

Data were analyzed under completely randomized design with factorial treatment arrangement using General Linear Model of Minitab Statistical Software 17 (Minitab Inc. 2010). Means were compared using Tukey's Test.

RESULTS

- Feed Intake
 - o No significant effect of energy density or enzyme supplementation on feed intake during both starter (7-21 days) and finisher (22-35 days) phases ($P>0.05$).
 - o No interaction between energy density and enzyme level on feed intake ($P>0.05$).
 - Weight Gain
 - o No effect of energy density or enzyme supplementation on weight gain during the starter phase ($P>0.05$).
 - o During the finisher phase, weight gain was higher in high-density (HD) diets compared to low-density (LD) diets ($P<0.05$), but not significantly different from medium-density (MD) diets.
 - o Birds fed enzyme-supplemented diets had higher weight gain compared to those without enzymes during the finisher phase and overall period ($P<0.05$).
 - Feed Conversion Ratio (FCR)
 - o No effect of energy density or enzyme supplementation on FCR during the starter phase ($P>0.05$).
 - o In the finisher phase, FCR was better in HD diets than LD diets ($P<0.05$), but not significantly different from MD diets.
 - o Enzyme supplementation had no significant effect on FCR ($P>0.05$).
- Supplementing xylanase, mannanase, and proteases in corn-based diets improved weight gain during the finisher phase but did not significantly affect feed intake or FCR. High-energy diets were more effective in enhancing growth performance compared to low-energy diets.

DISCUSSION

In the present study, dietary HE level improved BWG and FCR compare with the LE diets. This is consistent with the previous studies(20), in which high energy improved FCR in broilers. In addition, these results were in line with those of Saleh, Watkins (21) and Cho and Kim (22) who have shown that BW and feed conversion were significantly improved by increasing dietary nutrient density. Similarly, Barbour, Farran (22) reported that broilers fed high ME increased BWG and FCR more than low ME treatment without

any difference in FI among treatments. Richards (23) also reported that modern broilers selected for rapid growth do not regulate voluntary FI according to different ME level. The high and low ME level treatments did not impact FI, which may explain the improvement of BWG and FCR observed in our study

Feed intake was also unchanged by enzyme both in starter and finisher phase, which agrees with the results reported by previous researchers (16,17) and disagrees the results reported by in which they reported that feed intake affected by the addition of enzymes in diets. Waheed (2001) reported that feed intake and growth rate were not significantly ($P>0.05$) affected by the supplementation of multi-enzyme in both grower and finisher diets also revealed that feed intake was not effected significantly ($P>0.05$) for different groups. Dhakal, Sah (30) reported that enzyme supplementation had no effect on feed intake, whereas Bekta, Fabijanska (28) examined the effect of dietary inclusion of enzyme on growth performance of broilers. They reported that, feed intake was increased significantly by 9% respectively for the birds fed on diets supplemented with enzyme. No difference was observed with enzymes supplementation on growth performance for starter phase. Many studies in which researchers reported that enzyme addition in diets resulted into improved weight gain. There are studies which second the results in present study that enzymes are more effective in older age than later, contrary Olukosi, Cowieson (4) concluded that the chicks benefited more from enzyme addition at a younger age and that the contribution of the enzymes to nutrient retention decreased with age in chickens. Feed conversion ratio was unchanged with enzyme supplementation in this study which are in line with the findings of whereas disagrees with the findings of where they reported that enzyme supplementation improved FCR similarly Ohtani and Yayota (29) reported significantly increased FCR were showed by those birds fed on enzyme supplemented diets when compared to those birds fed on non-enzyme supplemented diets (control diets).

No difference of experimental diets on weight gain for starter phase but it was significantly improved for high density diets in finisher phase and during overall period of experimental trial. Furthermore, enzyme addition also improved weight gain during finisher phase and during overall trial period, which agrees with the findings of previous studies by (16) whereas results reported by were contrary to present findings (26). There was no a treatment effect of a cocktail or density on carcass

quality in the present experiment. Consistent with our results, Kidd, Morgan who found that carcass yields and internal organs were not affected due to enzyme addition. Researchers also reported that the inclusion of the enzyme did not affect the meat quality and carcass characteristics, whereas some researchers also reported that enzyme supplementation improved meat quality (Abudabos, 2012; Cho and Kim, 2013; El-Masry, et al., 2017; Law, et al., 2018). However, the results are not always consistent. Experimental animal fed the diets with xylanase significantly reduced meat quality. The reason for the difference is unknown, Some of them showed that meat quality is affected by lots of factors, including nutrition, husbandry conditions, breed, and handling before and after slaughter. However, it could be assumed that the possible reason for the different results could be due to the different inclusion levels and types of enzyme, age of animals, and different composition of diet.

CONCLUSION

Based on the findings, enzyme supplementation can improve growth performance, particularly during the finisher phase. It is recommended that future studies explore varying enzyme concentrations or combinations to determine the optimal dose for better performance outcomes. Further research should also investigate how diet formulation can enhance protein utilization, as crude protein digestibility was highest in the high-density diet. Although the results showed limited effects on carcass and organ weights, more targeted research into how dietary enzyme interactions influence body composition could provide insights for improving overall health and production. Additionally, conducting longer-term studies would help determine the long-term effects of enzyme supplementation and varying nutrient densities.

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Authors Contributions:

Muhammad Asfar Zaman: Substantial contributions to the conception and design of the work.

Nimra Fatima: Design of the work and the acquisition. Drafting the work.

Umme Farwa: Final approval of the version to be published.

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