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Effects of different levels of multi-enzymes (Polzyme® liquid) on the growth performance, carcass traits, and meat quality of broiler chickens

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ABSTRACT

The objectives of this study were to investigate different levels of multi-enzymes (polzyme®) liquid on the growth performance, carcass & relative organ weights and meat quality in broiler chicken. The study lasted 32 days and took place at Hajee Mohammad Danesh Science and Technology University April 2024. A total of 120 mixed-sex broiler chicks (Arbor acres), aged 7 days, were randomly assigned into four treatment groups (T0, T1, T2, and T3,) with each group consisting of three replicates, and each replicate containing 10 chicks. Four supplemental levels of multi-enzymes (polzyme®) liquid were added in to their drinking water. T0 was designated as control group, receiving solely commercial feed and tap water without (polzyme®) whereas T1, T2, and T3 were donated the commercial feed and tap water supplemented with 0.5, 1 and 1.5 ml / L of (polzyme®) liquid respectively. The current findings indicate that the of the addition of 0.5 ml / L multi-enzymes (polzyme®) to broiler's drinking water enhanced ($p<0.05$) their weight at 28 days of age and their final body weight and overall feed intake but did not have any effect of feed conversion ratio (FCR). Furthermore, polzyme® supplementation at 0.5 ml/L of Polzyme® in broiler drinking water showed significant influence ($p<0.05$) on relative organ's weights (breast, thigh, head, gizzard and intestine). However, supplementation at 1.5 ml/L Polzyme® in broiler drinking water showed significant influence ($p<0.05$) on cooking loss value of broiler breast, but not dripping loss. Therefore, it can be concluded that adding 0.5 ml/L of commercial multi-enzyme (Polzyme®liquid) to broiler drinking water had the best values for increasing growth performance, overall feed intake, carcass yield percentage (%), carcass weight, and relative organ weights between treatment groups. It also produced economic benefits.

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Introduction

In recent years, the broiler production industry has focused on achieving objectives such as effective productivity management, efficient nutrient utilization and high production efficiency (Dersjantet al., 2015). Several types of enzymes have been utilized in the poultry feed industry over the years, including cellulase, xylanase and associated enzymes, phytase, proteases, lipases, and galactosidase. The supplementation of poultry feed with exogenous enzymes can improve the nutritional value of feed in the digestive system of poultry. The current feed enzymes market is worth an estimated $ 700-800 million USD (Bao et al., 2013). The addition of enzymes to broiler nutrition mixes is done with the aim of enhancing the productivity of poultry meat production. Several authors have demonstrated that the utilization of enzymes can enhance manufacturing performances by up to 10% (Cowieson et al., 2000). The aim of adding enzymes is to improve bird performance and profitability by enhancing feed intake and utilization of dietary components (protein, amino acids, starch, lipids, and energy), however,

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there are many other reasons for the wider acceptance of feed enzymes and these will become more relevant in future production systems, these include, increase in the range of feedstuffs that can be used and reduce excreta moisture content (Collett et al., 2012). Improved immune function, gut health and intestinal morphology because of improved digestion (Bedford et al., 2012). Several reports have indicated that utilization of such commercial enzyme preparations can improve the productive performance of birds (Perić et al., 2002). The use of exogenous substrate specific enzymes (xylanase, beta-glucanase, amylase, etc.) in poultry feeds to improve bird performance is not a new concept and had been extensively researched (Adeola et al., 2011). The degradation of NSP has been proposed as the underlying mechanism to improve bird performance by releasing nutrients trapped within the cell and lowering digesta viscosity to enhance nutrient digestion and subsequent absorption (Bedford et al., 1998). Enzyme increase feed intake, total tract DM, fat and NSP (non-starch polysaccharide) digestion (Meng et al., 2006). Enzymes are involved in all anabolic and catabolic pathways of digestion and metabolism and are specific catalysts acting on one or limited groups of substrates (Khattak et al., 2006). (Ravindran et al., 2013) reported that the potential nutritive value of ingredients is not realized at the bird level and there is no common feed ingredient that is digested 100%. Therefore, the need to improve the digestion of these undigested substrates is the primary rationale for the use of exogenous enzymes (Ravindran et al, 2013). However, enzyme supplementation in water is simpler to apply, disseminate, and contact with the substrates is faster (Gupta et al., 2014). In addition, water supplementation of enzymes may lessen the harmful effects of aggressive heat exposure on enzyme activities when the pelleting temperature exceeds 85 °C and can replace expensive post-pelleting sparing systems (Perez-Vendrell et al., 1999). Enzyme supplementation in drinking water significantly increased the body weight of broilers during different periods of growth, from 14 to 35 days of age, from 20 to 41 days, and from 20 to 40 days of age (Haque et al., 2014). Thus, multienzymes through drinking water at 0.5 g/L had a positive and growth-boosting effect in broiler chickens. Recently, feed additives may be used intermittently and resulted in similar growth performance and more economic benefits than continuous supplementation (Attia et al., 2014).

Objectives: To evaluate the effects of different levels of multi-enzymes (Polzyme®liquid) on growth performance of broiler chickens. To assess the effects of different levels of multi-enzymes (Polzyme®liquid) on the carcass traits and meat quality of broiler chickens.

Materials and Methods

Location and period of the experiment

The experiment was conducted at the Poultry Farm of Hajee Mohammad Danesh Science and Technology University (HSTU), Dinajpur, to evaluate the effects of different levels of multi-enzymes (Polzyme® liquid) on the growth performance, carcass traits, and meat quality of broiler chicks aged 1 to 32 days. from 8 March until 8 April 2024. Laboratory analysis was performed in Dairy and Poultry Science Laboratory of HSTU, Dinajpur.

Experimental birds

On the hatching day, a total of 120 one-day-old mixed-sex broiler chicks (Arbor acres) were obtained from a commercial hatchery (Nourish Poultry and Hatchery Ltd.). The experimental design was CRD with 4 treatments (T0, T1, T2, and T3) and 3 replicates with 10 chicks in each replicate. Four supplemental levels of multi-enzymes (polzyme®) were added in to their drinking water. T0 was considered as control and fed with only commercial ration and tap water without any additives whereas T1, T2, and T3were donated as the broiler groups fed commercial ration and tap water supplemented with 0.5, 1 and 1.5 ml / L of polzyme® respectively.

Collection of experimental feed and additives

During the experiment, commercial feed from the local market (Nourish Poultry & Hatchery Ltd) were used. In the first week (1-7 days old), all chicks were fed a crumble pre-starter diet, that was out of the experiment, followed by a crumble starter diet in the second phase (8-14 days old), and lastly a pelleted grower diet in the third phase (15-32 days old). The feed additives used in the experiment was multi-enzymes (Polzyme® Liquid), purchased from the local market (Square Pharmaceuticals PLC. Bangladesh).

Experimental management practice

During the trail the following management procedures were implemented to ensure uniformity in feeding, lighting and environmental conditions. The overall management procedures were properly supervised. The chicks were given vitamin C, vitamin E, herbal extract, oligosaccharides, peroxidase and muramidase via drinking water after placement to help reduce any stress that might occur during transportation. Production parameters, such as body weight (BW), feed intake (FI), and feed conversion ratio (FCR), were measured weekly at various ages (7, 14, 21, 28, and 32 days) for each pen. Each day, mortality was recorded, and any died bird was weighed. The weight of the bird was then used to adjust both the feed intake and feed conversion ratio. Day-old chicks were vaccinated

Table 1. Nutrient composition of experimental diets

Ingredients	Broiler starter	Broiler grower
Maize	43.00 kg	43.64 kg
Wheat	10.00 kg	10.00 kg
Rice polish	4.00 kg	10.00 kg
Soybean	26.00 kg	22.50 kg
Meat and bone meal	9.00 kg	8.00 kg
Oyster shell	1.00 kg	1.00 kg
Salt	300 g	250 g
Methionine	200 g	180 g
Lysine	30 g	30 g
Vitamin premix (broiler)	250 g	250 g
Feed zyme	-	50 g
Soybean oil	5.87 kg	4.00 g
DCP	2.50 g	-
Choline chloride	100 g	100 g
Total	100.00 kg	100.00 kg

Source: nourish poultry and hatchery Ltd., Bangladesh.

Table 2. Ingredients of multi-enzymes (Polzyme® liquid)

	Each 1000 ml contains		
Ingredients	Units	Ingredients	Units
Protease	400000 IU	Pectinase	30000 IU
Cellulase	100000000 IU	B-Glucosidase	10000 IU
Xylanase	1500000 IU	Galactosidase	10000 IU
Lipase	6500 IU	Arabinase	7000 IU
Amylase	250000 IU		

Source: Square Pharmaceuticals PLC. Bangladesh.

conversion ratio. Day-old chicks were vaccinated against IB (Infectious Bronchitis) and NCD (New Castle Disease; spray vaccination) in the hatchery. During the experiment, the broilers were vaccinated against Newcastle Disease and Infectious Bursal Disease (Gumboro) as indicated below according to commercial practice.

Calculations

Body weight gain (g/bird) = final weight - initial weight

Feed intake (g/bird) = Feed intake per replication / Number of bird per replication

FCR = Feed intake / Weight

Dressing yield (%) = [Carcass weight (g) / Live weight bird (g)] x 100

Cooking loss (%) = [Raw weight - Cooked weight / Raw weight] x 100

Drip loss (%) = (Weight of collected liquid / Cooked weight) x 100

Statistical analysis

All the data were subjected to one-way analysis of variance (ANOVA) as a completely randomized design using (version 22.0 SPSS.). Significant differences among the treatment means were tested using Duncan post hoc. All data were expressed as mean ± standard error of mean (SEM). Differences were statistically considered at level of significance $p < 0.05$.

Results and Discussion

Effects of multi-enzyme (polzyme®) on body weight

Table 3 illustrates the impact of Polzyme® liquid supplementation in broilers' drinking water on body weight and weight gain. At the beginning of the trial (day 7), there were no significant differences in initial body weight among treatment groups, ensuring a uniform baseline.

Throughout the early stages of the experiment (days 14 and 21), enzyme supplementation did not significantly influence body weight or weight gain. However, from day 28 onwards, statistically significant differences ($p<0.05$) were observed among the treatment groups. Notably, birds receiving 0.5 ml/L Polzyme® (T1) exhibited a marked improvement in body weight and weight gain compared to the control and other treatment groups. Conversely, higher inclusion levels (1.5 ml/L) were associated with lower body weights, suggesting a potential diminishing or adverse effect at higher doses.

Final body weight at day 32 showed that the group supplemented with 0.5 ml/L Polzyme® achieved the highest performance, followed by the 1 ml/L group, with the 1.5 ml/L group showing the lowest performance. These findings indicate that moderate levels of enzyme supplementation in drinking water can positively impact growth performance in broiler chickens.The current findings indicate that the addition of multi-enzyme (Polzyme®) liquid in the drinking water of broiler chickens significantly ($p<0.05$) increased their 28-day body weight, final body weight, and weight gain (bird/g). similarly, (khedr et al., 2016) found there was a great significant difference ($P<0.05$) between the groups of multi-enzymes (in the final body weight (bird/g). Also, the current findings suggest that the birds that were given multi-enzymes (Polzyme®) exhibited a significantly ($P<0.05$) greater body weight in compared to the control group between the ages of 22 and 32 days. The present results are in contradiction to certain earlier studies about multi-enzyme supplementation, such as (Mohammed et al., 2018) who showed that there was no significant effect ($p<0.05$) in overall body weight and weight gain (bird/g) during the whole experiment period. (Mohammed et al., 2018) reported that levels of multi-enzymes had no significant effect on

Table 3. Effects of multi-enzyme (Polzyme®) on body weight (bird/g/week) and mortality %.

Parameter/Age in period	**Treatments**				
Body weight (bird/g/week)	T0	T1	T2	T3	**Level of Significance**
Initial weight	41.4 ± 0.1	41.4 ± 0.0	41.3 ± 0.1	41.4 ± 0.1	NS
At 7 days	191.8 ± 1.7	186.3 ± 5.3	188.0 ± 2.7	178.6 ± 0.8	NS
At 14 days	524.6 ± 4.4	513.3 ± 7.6	521.6 ± 4.3	500.2 ± 10.2	NS
At 21 days	1064.6 ± 17.4	1046.9 ± 24.9	1055.4 ± 14.6	1040.2 ± 17.8	NS
At 28 days	1709.9 ± 27.6^{c}	1820.5 ± 81.2^{d}	1692.7 ± 42.6^{b}	1639.9 ± 24.3^{a}	*
At 32 days	1967.4 ± 56.7^{b}	2046.5 ± 44.4^{d}	1977.6 ± 49.2^{c}	1897.6 ± 29.0^{a}	*
Final weight gain (0-32 days)	1926.0 ± 56.6^{b}	2005.1 ± 44.4^{d}	1935.7 ± 49.6^{c}	1856.2 ± 29.8^{a}	*
Mortality (%) (0-32 days)	3.3 ± 0.0	6.7 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	NS

Values are mean ± SEM, dcba means having different superscript in the same row differed significantly ($p<0.05$). NS = means non-significant. * = 5% level significant. Here, T0 = control, (commercial feed + drinking water without any additives), T1 = commercial feed + drinking water supplementation with 0.5 ml / L of polzyme. T2 = commercial feed + drinking water supplementation with 1 ml / L of polzyme, T3 = commercial feed + drinking water supplementation with 1.5 ml / L of polzyme.

body weight and body weight gain (bird/g) during the whole experimental period. (Ahmed et al., 2017) found that he maximum body weight was recorded in control group, while minimum weekly body weight was recorded in the group that got 20% enzymatic complex. Analysis of variance of body weight gain at day 35 showed the non-significant difference ($P<0.05$) in different treatments. However, (Yousef et al., 2023) found that birds who were given diets with Enzymes had a significantly increased body weight (BW) compared to the control group, namely during the 4th and 5th weeks of age, with a significant difference at ($P<0.05$), which is partially agreed with my findings. Furthermore, previous research has shown that the addition of enzymes in diets improves the utilization of nutrients resulting in improved body weight (Costa et al., 2008). Another study by (Ghobadi et al., 2012) found that adding of enzymes significantly ($P<0.05$) improved body weight compared to those without enzymes for broiler chicks during the period from 1 to 36 days of age. These findings indicate that feeding multi-enzymes to broiler chickens increases their performance.

Effects of multi-enzyme (polzyme®) on feed intake

Table 4 delineates the impact of Polzyme® supplementation on broiler feed consumption. No statistically significant variations in weekly feed consumption were noted over the initial four weeks, suggesting uniform intake among treatment groups. Nonetheless, the overall feed intake (bird/g) exhibited a substantial variance among the groups ($p < 0.05$). The control group (T0) demonstrated the highest overall feed consumption, whereas the group administered 0.5 ml/L Polzyme® (T1) ingested markedly less feed than all other treatments. A minor increase in feed intake was noted in the T2 group during the third week; however,

Table 4. Effects of multi-enzyme (Polzyme®) on feed intake

Parameter/Age in week	**Treatments**				
Feed intake (bird/g/week)	T0	T1	T2	T3	**Level of Significance**
7-14 days	406.9 ± 40.4	353.5 ± 30.6	407.4 ± 42.9	408.4 ± 5.7	NS
14-21 days	783.1 ± 9.5	747.9 ± 15.3	753.4 ± 19.8	733.7 ± 6.2	NS
21-28 days	1023.0 ± 10.6	946.1 ± 47.1	1039.8 ± 4.9	1034.1 ± 1.2	NS
28-32 days	496.5 ± 22.9	446.2 ± 35.9	492.3 ± 10.5	464.1 ± 5.3	NS
Total feed intake (7-32 days)	2709.5 ± 75.5^{d}	2486.3 ± 127.8^{a}	2695.0 ± 70.9^{c}	2640.4 ± 11.6^{b}	*

Values are mean±SEM, dcba means having different superscript in the same row differed significantly ($p<0.05$). NS = means non-significant. * = 5% level significant. Here, T0 = control, (commercial feed + drinking water without any additives), T1 = commercial feed + drinking water supplementation with 0.5 ml / L of polzyme. T2 = commercial feed + drinking water supplementation with 1 ml / L of polzyme, T3 = commercial feed + drinking water supplementation with 1.5 ml / L of polzyme.

Table 5. Effects of multi-enzyme (Polzyme®) on feed conversion ratio

Parameter/Age in period	**Treatments**				
FCR % (feed/gain)	T0	T1	T2	T3	**Level of Significance**
7-14 days	1.2±0.1	1.2±0.0	1.2±0.1	1.2±0.0	NS
14-21 days	1.5±0.1	1.3±0.0	1.4±0.0	1.4±0.0	NS
21-28 days	1.5±0.0	1.5±0.1	1.5±0.0	1.5±0.1	NS
28-32 days	1.6±0.1	1.9±0.2	1.7±0.0	1.7±0.0	NS
Final FCR (7-32 days)	1.4±0.0	1.2±0.1	1.4±0.0	1.4±0.0	NS

Values are mean±SEM, dcba means having different superscript in the same row differed significantly ($p<0.05$). NS = means non-significant. * = 5% level significant. Here, T0 = control, (commercial feed + drinking water without any additives), T1 = commercial feed + drinking water supplementation with 0.5 ml / L of polzyme. T2 = commercial feed + drinking water supplementation with 1 ml / L of polzyme, T3 = commercial feed + drinking water supplementation with 1.5 ml / L of polzyme.

this alteration was not statistically significant. The findings indicate that enzyme supplementation at 0.5 ml/L could diminish feed intake without negatively impacting growth performance.

The finding results of supplementation multi-enzyme (polzyme®) in broiler's drinking water at 0.5, 1 and 1.5 ml/L agrees with (Gitoee et al., 2015) who reported that no effect of the enzymes in 49 days (during experiment), but the main effect significantly affected the FI of birds in this period ($P < 0.01$). However, (Soisuwan et al., 2023) indicated that dietary treatments had no effects ($P > 0.05$) on the feed intake, body weight, body weight gain and feed conversion ratio of broilers during 1-21 days of age. Also, (Kumar et al., 2017) observed that the overall feed consumption throughout the experimental period (1-4 weeks) revealed that feed intake was significantly affect between treatment groups. Furthermore, (Attia et al., 2022) found that supplementing birds with multi-enzymes in their drinking water had no influence ($p<0.05$) on feed intake for the first three weeks of experiment. Also, (Shirmohammad et al., 2011) stated that that supplementation of multi-enzymes in their drinking water did not influence feed intake and and FCR of broilers during the experiment.

Effects of multi-enzyme (polzyme®) on feed conversion ratio

Table 5 shows the impact of Polzyme® supplementation on feed conversion ratio (FCR) in broilers. Mortality rates were continuously watched, and FCR levels were modified correspondingly. Throughout the experiment, there were no statistically significant changes ($p > 0.05$) in weekly or overall FCR between treatment groups. While minor numerical fluctuations occurred, enzyme supplementation at 0.5, 1.0, and 1.5 ml/L had no meaningful effect on feed efficiency. These results indicate that adding Polzyme® to drinking water had a neutral effect on broiler FCR under the experimental conditions.

same as, (Khedr et al., 2016). studied there was no significant difference at ($P<0.05$) in feed conversion Ratio in group fortified by complex enzymes respectively. (Nasr et al., 2022) reported according to the effect of multi-enzyme supplementation showed had no significant effect on resulted values of feed conversion ratio, but also feed consumption compared to control group. No significant difference ($P<0.05$) between broilers strains, enzymes for feed conversion ratio and daily weight gain were found (Rayan et al., 2015). Moreover, (Soisuwan et al., 2023) studied the effects of natural multi-enzymes supplementation on the growth performances of broilers, the dietary treatments had no effects ($P > 0.05$) on the feed conversion ratio, feed intake, body weight and body weight gain during 1-21 days of age. On the other hand, (Marsman et al., 1997) showed no improvement in feed conversion ratio or body weight gain when mixed-enzyme preparation was added to the broiler diets from 7 to 25 d of age. Moreover, (Kocher et al., 2002) reported that the addition of the enzymes complex containing glucanase, hemicellulose and pectinase from 4 to 38 days of age had no effect on BWG or FCR of male Cobb broilers.

Effects of multi-enzyme (Polzyme®) on carcass and relative organ weight

Table 6 delineates the impact of Polzyme® supplementation on carcass yield and the relative weights of organs in broilers. Statistically significant variations ($p < 0.05$) were noted in live and carcass weights across the treatment groups. Birds administered 0.5 ml/L Polzyme® (T1) demonstrated the greatest live and carcass weights, signifying improved growth performance at this dosage. The carcass yield % markedly increased in the T1 and T2 groups relative to

Table 6. Effects of multi-enzyme (Polzyme®) on carcass and relative organ weight

Parameter	Treatments				
	T0	T1	T2	T3	**Level of Significance**
Live	1822.7 ± 1.8^{a}	2174.0 ± 112.2^{d}	2044.00 ± 89.4^{b}	2096.0 ± 76.0^{c}	*
Carcass %	1343.0 ± 13.8^{a}	1673.3 ± 61.7^{c}	1566.3 ± 68.5^{b}	1588.0 ± 64.2^{b}	*
Carcass yield %	73.3 ± 0.7^{a}	76.7 ± 1.2^{c}	76.0 ± 0.0^{c}	75.3 ± 0.3^{b}	*
Breast %	463.3 ± 3.3^{a}	638.7 ± 14.3^{c}	540.7 ± 15.1^{b}	530.7 ± 5.8^{b}	*
Thigh weight %	300.0 ± 10.3^{a}	350.7 ± 20.9^{c}	318.3 ± 8.0^{b}	316.0 ± 5.0^{b}	*
Head weight %	37.3 ± 0.7^{a}	48.0 ± 3.1^{b}	46.7 ± 2.4^{b}	48.7 ± 0.7^{b}	*
Drumstick weight %	162.3 ± 3.8	210.7 ± 9.7	199.3 ± 5.7	170.7 ± 38.4	NS
Gizzard weight %	30.3 ± 1.5^{a}	47.3 ± 2.7^{c}	39.3 ± 3.3^{b}	40.0 ± 1.2^{b}	*
Liver weight %	47.3 ± 1.3	55.3 ± 2.9	50.0 ± 1.2	51.0 ± 4.4	NS
Heart weight %	8.0 ± 0.0	10.7 ± 0.7	9.3 ± 1.3	10.7 ± 1.8	NS
Intestine weight %	104.0 ± 4.0^{b}	109.3 ± 3.7^{c}	111.0 ± 2.5^{c}	94.0 ± 5.7^{a}	*
Legs weight %	66.0 ± 1.2	82.7 ± 5.9	80.0 ± 5.8	78.0 ± 1.2	NS
Wings weight %	131.3 ± 1.3	138.0 ± 8.3	138.7 ± 9.3	134.7 ± 5.8	NS

Values are mean±SEM, dcba means having different superscript in the same row differed significantly (p<0.05). NS = means non-significant. * = 5% level significant. Here, T0 = control, (commercial feed + drinking water without any additives), T1 = commercial feed + drinking water supplementation with 0.5 ml / L of polzyme. T2 = commercial feed + drinking water supplementation with 1 ml / L of polzyme, T3 = commercial feed + drinking water supplementation with 1.5 ml / L of polzyme.

the control group. The weights of the breast, thigh, head, gizzard, and gut were significantly influenced by enzyme supplementation ($p < 0.05$), however no notable alterations were observed in the weights of the wings, heart, liver, legs, or drumsticks. The results indicate that the inclusion of several enzymes significantly affects certain carcass features, especially at modest supplementation levels.

Similarly, (Hajati et al., 2009) found that enzyme supplementation increased carcass, and thigh percentage significantly ($p<0.05$). Also, this study verified a significant effect ($P < 0.05$) for breast performance at 42 days for broilers. Similar results were found by (Soto et al., 1996) who verified an effect ($P < 0.05$) of enzyme supplementation of the breast muscle in broilers with 42 days of age. Enzyme complex supplementation improved breast and wing performance ($P < 0.05$), but did not affect carcass yield characteristics in broilers aged 35 days (Dalólio et al., 2015). The present results are in contradiction to certain previous studies of multi-enzyme supplementation, that found found no significant influence of dietary enzyme supplementation on carcass features, such as relative weights of dressed carcass, liver, giblets, breast and legs, total edible parts, and abdominal fat pad (Sherif et al., 2009). The lack of significant differences in carcass characteristics between broiler chicks reported herein is consistent

Table 7. Effects of multi-enzyme (polzyme®) on cooking and drip loss

Parameter	Treatments				
	T0	T1	T2	T3	**Level of Significance**
Initial weight (g)	100.0 ± 0.0	100.0 ± 0.0	100.0 ± 0.0	100.0 ± 0.0	NS
Cooked weight (g)	80.7 ± 1.3^{b}	76.0 ± 2.3^{a}	83.3 ± 1.3^{c}	85.3 ± 1.3^{d}	*
Cooking loss (%)	19.3 ± 1.3^{c}	24.0 ± 2.3^{d}	16.7 ± 1.3^{b}	14.7 ± 1.3a	*
Drip loss weight (g)	6.7 ± 0.7^{a}	7.7 ± 0.3^{b}	9.7 ± 0.3^{c}	10.0 ± 0.0^{d}	**
Drip loss (%)	6.7 ± 0.7^{a}	7.7 ± 0.3^{b}	9.7 ± 0.3^{c}	10.0 ± 0.0^{d}	**

Values are mean±SEM, dcba means having different superscript in the same row differed significantly (p<0.05). NS = means non-significant. * = 5% level significant. Here, T0 = control, (commercial feed + drinking water without any additives), T1 = commercial feed + drinking water supplementation with 0.5 ml / L of polzyme. T2 = commercial feed + drinking water supplementation with 1 ml / L of polzyme, T3 = commercial feed + drinking water supplementation with 1.5 ml / L of polzyme.

with the findings of (Sayyazadeh et al., 2006), who found that adding enzymes to broiler diets had no influence on carcass yield, liver, gizzard, or abdominal fat contents. Also (Ghorbani et al., 2009) found that there were no significant variations in carcass yield or components. Moreover, (Gitoee et al., 2015) resulted that the analysis of carcass characteristics data showed that the dietary interventions had a significant impact ($P < 0.05$) only on the breast, thigh, and liver. According to (Lee et al., 2010), there were no significant differences in the relative weights of the liver, abdomen fat, right leg, or right breast muscle amongst the different treatment groups. Carcass, breast, and thigh weights (as a percentage of carcass) were significantly higher ($P < 0.01$) in birds fed multi-enzymes (ZADO®) supplement than the control group. But the treatment had no effect on the gizzard, liver, heart, spleen, bursa, abdominal fat, or dram (El-Sanhoury et al., 2017). Additionally, carcass relative weight increased in response to dietary 6% ZADO®. (Onilude and Oso, 1999) found that adding three enzyme mixtures (amylase, cellulase, and pectinase) to broiler diets aged between one to 42 days of age improved carcass weight. Furthermore, (Café et al., 2002) discovered a significant increase in dressing % at 42 days of age in broilers fed a diet supplemented with commercial enzymes. They agree with (Saleh et al., 2005), who found that broilers fed pure carbohydrases (cellulase, hemicellulose, and pectinase) had a higher carcass relative weight (70.3 g/100 BW) than the control group (68.6 g/100 BW), as were broilers fed a commercial enzymes (Energex) intermediate (70.0 g/100 BW.

Effects of multi-enzyme (polzyme®) on cooking and drip loss

Table 7 shows the effect of Polzyme® supplementation on broiler meat quality, specifically the cooking loss and drip loss percentages. Significant differences ($p < 0.05$) were found across treatment groups for both metrics. Broilers fed with 1.0 and 1.5 ml/L Polzyme® (T2 and T3) had the lowest cooking loss values, indicating better meat water retention. Drip loss increased considerably with greater enzyme inclusion levels ($p < 0.01$), with the T3 group exhibiting the highest results. These data indicate that, while Polzyme® supplementation increases cooking yield, it may also increase drip loss at greater concentrations, emphasizing the need of proper dose for meat quality.

Similarly, the findings on meat quality indicated that several parameters (cooking loss, pH 24 h, and meat color brightness) were significantly affected ($p< 0.05$) by the dietary treatments for breast meat (Yaqoob et al., 2022). The present results are in contradiction to certain previous studies of multi-enzyme supplementation, that found no significant influence of dietary enzyme supplementation on cooking and drip loss such s, the results that indicate There were no significant variations ($P>0.05$) seen in the pH value, water holding capacity (WHC), cooking loss, and drip loss across the different dietary treatments that included varying quantities of multi-enzymes in the diets (Lei et al., 2017). The addition of mixture enzymes did not have a significant impact on the meat quality parameters of broilers (pH, cooking loss, and water holding capacity) in a previous study by (Zakaria et al., 2010). On the other hand, (Selim et al., 2016) noted that the quality of meat was improved by the addition of pectinase (PE) to low-energy broiler diets.

Conclusions

To summarize, the present results suggest that supplementing broiler's drinking water with 0.5 ml/L of Polzyme® improved their weight at 28 days of age and their final body weight and overall feed intake but did not have any effect of feed conversion ratio (FCR). Furthermore, polzyme® supplementation at 0.5 ml/L of Polzyme® in broiler drinking water showed significant influence ($p<0.05$) on relative organ's weights (breast, thigh, head, gizzard and intestine). However, supplementation at 1.5 ml/L Polzyme® in broiler drinking water showed significant influence ($p<0.05$) on cooking loss value of broiler breast, but not dripping loss. As a result, adding 0.5 ml/L of commercial multi-enzyme (Polzyme®liquid) to broiler drinking water had the best values for increasing growth performance, overall feed intake, carcass yield percentage (%), carcass weight, and relative organ weights between treatment groups. It also produced economic benefits.

Acknowledgments

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Conflict of interests

The authors declare there is no Conflict of interests

References

Adeola, O., & A. J. Cowieson. (2011). Board invited review: Opportunities and challenges in using exogenous enzymes to improve nonruminant animal production. *Journal of Animal science 89*(10),3189-3218.

Ahmed, I., Munir, S., Jamal, M. A., Pasha, T. N., Ditta, Y., Mahmud, A., Khan A. K., Naveed, S., Talpur, M.Talpur, M. Z., & Jia, J. (2017). Effect of enzyme complex at different wheat-based diets on growth performance of broilers. Journal *of Entomology and Zoology Studies, 5*, 525-531.

Attia, Y. A., Al-Hamid, A. E.A., Ibrahim, M. S., Al-Harthi, M. A., Bovera, F., El-Naggar, A. (2014). Productive performance, biochemical and hematological traits

pollen, and mannan oligosaccharides continuously or intermittently. Livestock Science, 164, 87-95. https://doi.org/10.1016/j.livsci.2014.03.005

Attia, Y.A., Al-Khalaifah, H.S., Alqhtani, A.H., Abd El-Hamid, H.S., Alyileili, S.R., El-Hamid, A.E.H.E.A., El-Shafey, A.A. (2022). The impact of multi-enzyme fortification on growth performance, intestinal morphology, nutrient digestibility, and meat quality of broiler chickens fed a standard or low-density diet. Frontiers in Veterinary Science, 9, 1012462.

Bao, Y.M., Romero, L.F., Cowieson, A.J. (2013). Functional patterns of exogenous enzymes in different feed ingredients. World's Poultry Science Journal, 69(12), 759-773.

Bedford, M.R., Cowieson, A.J. (2012). Exogenous enzymes and their effects on intestinal microbiology. Animal Feed Science and Technology, 173(1–2), 76-85.

Bedford, M. R., & Schulze, H. (1998). Exogenous enzymes for pigs and poultry. Nutrition Research Reviews, 11, 91-114.

Café, M. B., Borges, C. A., Fritts, C. A., & Waldroup, P. W. (2002). Avizyme improves performance of broilers fed corn–soybean meal-based diets. *Journal of Applied Poultry Research, 11*, 29-33.

Collett, S.R. (2012). Nutrition and wet litter problems in poultry. *Animal Feed Science and Technology, 173*, 65-75.

Costa, F. G. P., Goulart, C. C., Figueiredo, D. F., Oliveira, C. F. S., Silva, J. H. V. (2008). Economic and environmental impact of using exogenous enzymes on poultry feeding. *International Journal of Poultry Science, 7*(4), 311-314.

Cowieson, A.J., Acamovic, T., Bedford, M.R. (2000). Enzyme supplementation of diets containing Camelina sativa meal for poultry. *British Poultry Science, 41*, 689-690.

Dalólio, F. S., Vaz, D. P., Moreira, J., Albino, L. F. T., & Valadares, L. R. (2015). Carcass characteristics of broilers fed enzyme complex. *Biotechnology in Animal Husbandry, 31*(2), 153-162.

Dersjant-Li, Y., Van De Belt, K., Van Der Klis, J. D., Kettunen, H., Rinttilä, T., & Awati, A. (2015). Effect of multi-enzymes in combination with a direct-fed microbial on performance and welfare parameters in broilers under commercial production settings. *Journal of Applied Poultry Research, 24*(1), 80-90.

El-Sanhoury, M. H. S., & Ahmed, A. M. H. (2017). Broiler performance, enzyme activity, and histological observations affected by multi-enzyme complex (ZADO®). *Egyptian Journal of Nutrition and Feeds, 20* (2), 309-320.

Onilude, A. A. & B. A. Oso (1999). Effect of fungal enzyme mixture supplementation of various fibrecontaining diets fed to broiler chicks 1: Performance and carcass characteristics. *World Journal of Microbiology and Biotechnology, 15*, 309-314.

Ghorbani, M. R., Fayazi, J., & Chaji, M. (2009). Effect of dietary Phytase and NSP-degrading enzymes in diets containing rapeseed meal on broiler performance and carcass characteristics. *Research Journal of Biological Sciences, 4*(3), 258–264.

Gitoee, A., Janmohammadi, H., Taghizadeg, A., & Rafat, S.A. (2015). Effects of multi-enzyme on performance and carcass characteristics of broiler chickens fed corn-soybean meal basal diets with different metabolizable energy levels. *Journal of Applied Animal Research, 43*(3), 295-302.

Gitoee, A., Janmohammadi, H., Taghizadeg, A., & Rafat, S. A. (2015). Effects of multi-enzyme on performance and carcass characteristics of broiler chickens fed corn-soybean meal basal diets with different metabolizable energy levels. *Journal of Applied Animal Research, 43*(3), 295-302.

Gupta, N. M., Sasan, J. S., & Singh, A. D. (2014). Effect of oral feeding of multi-enzymes on growth response of broiler chickens. *Haryana Veterinary, 53*, 156-157.

Hajati, H., Rezaei, M., & Sayyahzadeh, H. (2009). The effects of enzyme supplementation on performance, carcass characteristics, and some blood parameters of broilers fed on corn-soybean meal-wheat diets. *International Journal of Poultry Science, 8*(12), 1199-1205.

Haque, M. E., Mustari, A., & Rahman, M. M. (2014). Study on the effect of enzyme and methionine on growth performance and hemato-biochemical parameters in broilers. *Journal of Mineral, 1*, 1-13.

Khattak, F. M., Pasha, T. N., Hayat, Z., & Mahmud, A. (2006). Enzymes in poultry nutrition. *Journal of Animal & Plant Sciences, 16*(1–2), 1–7.

Khedr, M. N., Kamelia, M. Z., Tahia, E., & Elramy, S. M. (2016). Comparison between effects of complex enzyme and multi-enzyme supplementation on the productive performance of broilers. *Benha Veterınary Medical Journal, 31*(1),78-84.

Kocher, A., Choct, M., Porter, M. D., & Broz, J. (2002). Effects of feed enzymes on nutritive value of soybean meal fed to broilers. *British Poultry Science, 43*, 54-63.

Kumar, S., Choudhary, R. S., Goswami, S. C., Meel, S., Gadhwal, R.S., Manohar, D.S., & Mitharwal, N. (2017). Effect of feeding of multi-enzymes on performance of broiler chicks in hot arid zone of Rajasthan. *Veterinary Practitioner, 18*(1). 149-151.

Lee, S. Y., Kim, J. S., Kim, J. M., Ki, B., & Kang, C. W.

containing carbohydrolases and phytase on growth performance and intestinal viscosity in broiler chicks fed corn-wheat-soybean meal-based diets. *Asian-Australasian Journal of Animal Sciences, 23*, 1198–1204.

Lei, X. J., Lee, J. S., Park, J. H., Lee, I. S., Ingale, S., & Kim, I. H. (2017). Influence of exogenous multi-enzymes in broiler chickens fed on maize–wheat–soybean meal-based diets. *European Poultry Science / Archiv für Geflügelkunde, 81*, Article 210.

Marsman, G. J. P., Gruppen, H., Van Der Poel, A. F. B., Kwakkel, R. P., Verstegen, M. W. A., & Voragen, A. G. J. (1997). The effect of thermal processing and enzyme treatments of soybean meal on growth performance, ileal nutrient metabolisabilities, and chyme characteristics in broiler chicks. *Poultry Science, 76*, 864-872.

Meng, X., Slominski, B. A., Campbell, L. D., Guenter, W., Jones, O. (2006). The use of enzyme technology for improved energy utilization from full-fat oilseeds. Part I: Canola seed. *Poultry Science, 85*(6), 1025-1030.

Mohammed, A. A., Habib, A. B., Eltrefi, A. M., Shulukh, E. S. A., Abubaker, A. A. (2018). Effect of different levels of multi-enzymes (Natuzyme Plus®) on growth performance, carcass traits, and meat quality of broiler chicken. *Asian Journal of Animal and Veterinary Advances, 13*(1), 61-66.

Nasr, F. S. A., Mukhtar, M. A., Mohamed, K. A. (2022). Performance and carcass traits of broiler chickens fed varying levels of commercial multi-enzyme Nutrikem. *World Journal of Pharmaceutical Research, 11*(4), 187-199.

Perez-Vendrell, A. M., Brufau, J., Uzu, G., Geraert, P. A. (1999). Spraying enzymes before or after fat coating: In vitro recoveries and in vivo efficacious. *Proceedings of the Australian Poultry Science Symposium, 11*, 105-107.

Perić, L., Kovčin, S., Stanaćev, V., Milošević, N. (2002). Effect of enzymes on broiler chick performance. *Buletinul USAMV, 57*, 245–249, Cluj-Napoca, Romania.

Ravindran, V. (2013). Feed enzymes: The science, practice, and metabolic realities. *Journal of Applied Poultry Research, 22*, 628-636.

Saleh, F., Tahir, M., Ohtsuka, A., & Hayashi, K. (2005). A mixture of pure cellulase, hemicellulase, and pectinase improves broiler performance. *British Poultry Science, 46*, 602-606.

Sayyazadeh, H., Rahimi, G., & Rezaei, M. (2006). Influence of enzyme supplementation of maize, wheat, and barley-based diets on the performance of broiler chickens. *Pakistan Journal of Bio*logical Sciences, 9(4), 616-621.

Selim, N. A., Hemat, A. M. A., Heba, H. H., Waly, H. A., Fadl, A.A., & Shalash, S.M. (2016). Effect of pectinase enzyme supplementation and low-energy corn–soybean meal diets on broiler performance and quality of carcass and meat. Egyptian Poultry Science, 36(1), 319-335.

Sherif, K. E. (2009). Performance of broiler chicks fed plant protein diets supplemented with commercial enzymes. Journal of Animal and Poultry Production, 34(4), 2819-2834.

Shirmohammad, F., Mehri, M. (2011). Effects of dietary supplementation of multi-enzyme complex on the energy utilization in rooster and performance of broiler chicks. African Journal of Biotechnology, 10 (38), 7541-7547.

Soisuwan, K., Plaimast, H., Thongnum, A., Chotnipat, S., Nopparatmaitree, M. (2023). Effect of natural multi-enzyme supplementation on growth performance, gut microflora, carcass characteristics, and meat quality of broilers reared in tropical climates. Journal of Animal Health Production, 11(2), 129-138.

Soto-Salanova, M.F., Garcia, O., Graham, H., Pack, M. (1996). Uso De Enzimas Em Dietas De Milho E Soja Para Frangos De Corte. In: Conferência Apinco 96 De Ciência E Tecnologia Avícolas, 1996, Curitiba. Anais... Campinas: Facta, 1996. P. 71-76.

Yaqoob, M.U., Yousaf, M., Iftikhar, M., Hassan, S., Wang, G., Imran, S., Wang, M. (2022). Effect of multi -enzymes supplementation on growth performance, meat quality, ileal digestibility, digestive enzyme activity, and caecal microbiota in broilers fed low-metabolizable energy diet. Animal Bioscience, 35(7), 1059.

Yousef, N. M. E. (2023). Impact of supplementation of enzymes and probiotic on growth performance, intestinal microflora population, and immune responses in broiler chickens. *Doctoral dissertation*, Department of Animal Production, Faculty of Agriculture, Al-Azhar University.

Ghobadi, Z., & Karimi, A. (2012). Effect of feed processing and enzyme supplementation of wheat-based diets on performance of broiler chicks. *Journal of applied animal research, 40*(3), 260-266.

Zakaria, H. A. H., Jalal, M. A. R., & Ishmais, M. A. A. (2010). The influence of supplemental multi-enzyme feed additive on the performance, carcass characteristics, and meat quality traits of broiler chickens. *International Journal of Poultry Science, 9*, 126-133.