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Research Article

Effect of Different Levels of Multi-Enzymes (Natuzyne Plus®) on Growth Performance, Carcass Traits and Meat Quality of Broiler Chicken

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Abstract

Background and Objective: Multi-enzymes has long been used in poultry nutrition to alleviate the anti-nutritional agents and improve the nutrient utilization. The response of multi-enzymes with respect of performance has been variable and there is an urgent need to identify the exact levels of supplementation for the commercial flocks. Therefore, the present study was designed to evaluate the effect of inclusion of different levels of multi-enzyme, Natuzyne Plus® on the parameters of growth performance, carcass characteristics and meat quality of broiler. **Materials and Methods:** Two hundred, unsexed, one day old (Ross 308) broiler chicks with initial weight of approximately 40 g were distributed in a completely randomized block design with four levels of Natuzyne Plus® (0, 0.5, 0.75 and 1 kg t⁻¹). Each group contains 5 repetitions with ten chicks each. Data were analyzed by one-way analysis of variance (ANOVA) as completely randomized block design using the GLM procedure of SAS version 9.2. Means were separated by Duncan multiple range test. **Results:** The weight gain, feed intake, feed conversion ratio were evaluated during the periods from 7-14, 15-21 and 22-35 days. Carcass traits, non-carcass components and meat quality were evaluated on 35 days. The parameters of performance were not affected by the enzyme supplementation of diets fed to broiler chickens, except for feed conversion ratio which was higher ($p < 0.05$) in group received 1 kg t⁻¹ on days 7-14 and 15-21 but not on days 22-25. Carcass and meat quality parameters were not affected by enzyme supplementation in the broiler diets, except for breast meat: Bone ratio and pH. **Conclusion:** Inclusion of Natuzyne Plus® up to 1 kg t⁻¹ in the diet of broiler chicken had no significant effect on performance, carcass quality or meat quality.

Key words: Multi-enzyme, Natuzyne Plus®, broiler performance, carcass characteristics, meat quality

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Poultry is one of the fastest growing industries within the agricultural sector, with huge interest in animal nutrition, research and development focused on improving health, disease resistance and productivity¹. As a result of continual research and development today's commercial broilers are 4 times larger at the same age and require a third of the food to achieve market weight compared to the broilers of 60 years ago². Unending increases cost of poultry feeds is the major problem in the developing countries where feed cost accounts for 50-70% of poultry production³.

Utilization of agro-industrial by products as feed ingredients is important strategy to reduce the feed cost and enhance the sustainable feed resources for poultry production⁴. However, many of these by products contain high levels of plant cell wall material, mainly non-starch polysaccharides which can't be digested by mammalian enzymes⁴. In order to balance utilization of such feed stuffs, nutritionists have proposed exogenous enzymes for poultry. Several authors have shown that the use of exogenous enzymes in cereal-based diets is very beneficial because they can help hydrolyze non-starch polysaccharide NSP, reduce digesta viscosity and most importantly improve nutrient absorption, growth and performance of the birds⁵⁻⁸. The addition of the multi-carbohydrase enzyme supplement to a broiler diet based on wheat, soybean meal, canola meal and peas resulted in a significant improvement in digestibility of protein, starch and NSP and consequently, improved growth performance⁹. Strategies for ensuring adequate nutrition of animals must be based on optimizing overall agricultural and livestock productivity from available resources, improving existing technologies and integrating technology that employs multipurpose crops and animals and recycling of crop residues and by products as feeding stuffs for animals³. Natuzyme Plus®, is a commercial multi-enzyme consist of phytase at 300,000 U kg⁻¹, β-glucanase at 1,000,000 U kg⁻¹, α-amylase at 750,000 U g⁻¹, cellulase at 4,200,000 U kg⁻¹, pectinase at 70,000 U kg⁻¹, xylanase at 5,000,000 U kg⁻¹ and protease at 3,000,000 U kg⁻¹¹⁰. Therefore, the objective of the present study was to evaluate the effect of inclusion of different levels of multi-enzyme (Natuzyme Plus®) on growth performance and carcass characteristics of broiler chicken.

MATERIALS AND METHODS

Experimental site: The present study was conducted at the Training and Research Farm, Poultry Unit, College of Animal

production, University of Bahri, Khartoum, during the period from 1st August, 2015-11th September, 2015 under standard management conditions where minimum and maximum temperature during the experiment ranged between 28-34 °C, respectively. The experiment lasts for 6 weeks.

Experimental birds housing and diets: Two hundred, unsexed, 1 day old (Ross 308) broiler chicks with initial weight of approximately 40 g were purchased from a local company (Inmaa for poultry production company, Omdurman-Sudan). During the first 3 days, the chicks were received multi-vitamins AD3E+coliston 0.2 mL/1 L in the drinking water and they were fed on pre-starter (pellets) at the rate of 100 g/day/chick in the first week (Table 1), then received the starter feed and finisher feed (mash) *ad libitum* for the rest of the experimental period with free access to water.

Chicks were vaccinated against Newcastle disease at 1 day old (spraying) and 21 days of age (in drinking water) and against Gambaro disease by using (Hipra Gambaro) at 12 days of age and repeated at 19 days old. Soluble multi-vitamins were given to the chicks before and after 3 days of the vaccination to guard against stress. After the 1st week, chicks were randomly divided into four groups (50 each) and each group was subdivided into 5 replicates, (10 each). The groups were then assigned to one of the 4 dietary treatments being: (A), basal diet (Control); or basal diet plus (B); 0.5, (C); 0.75, or (D); 1 kg Natuzyme Plus®/t⁻¹. The basal diet was formulated to be iso-caloric (2800, 29500 kcal kg⁻¹) and iso-nitrogenous (22, 20% CP) for both starter and finisher diets respectively, to meet the nutrient requirements of broilers¹¹. The percentage of ingredients and chemical composition of experimental diets at different stages are shown in Table 2 and 3.

The experimental chicks were kept in an open experimental wire mesh pen constructed on the concrete floor (1.5 m²) inside a closed system poultry house. Each pen was supplied with nipples line for drinking water and 2 feeders

Table 1: Ingredients composition of the pre-starter feed (pellets)

Ingredients	Percentage
Crude protein	22.00
Crude fat	7.00
Crude fiber	3.00
Sodium	0.19
Lysine	1.30
Methionine	0.55
Meth.+Cyst.	0.95
Calcium	0.95
Total phosphorus	0.65
ME (kcal kg ⁻¹) = 3200	

Table 2: Ingredients composition of broiler starter feed (mash)

Ingredients (%)	Treatments			
	A	B	C	D
Sorghum	70.0	70.0	70.0	70.0
Groundnut	21.5	21.5	21.5	21.5
Super concentrate	5.0	5.0	5.0	5.0
Wheat bran	2.0	1.1	1.55	1.1
Lime stone	1.0	1.1	1.0	1.1
Salt	0.2	0.2	0.2	0.2
Lysine	0.2	0.1	0.1	0.5
Methionine	0.1	0.5	0.5	0.5
Natuzyme Plus®	0.0	0.5	0.075	0.1

A: Basal diet (control), B: Basal diet+500 g Natuzyme Plus® t⁻¹, C: Basal diet+750 g Natuzyme Plus® t⁻¹, D: Basal diet+1 kg Natuzyme Plus® t⁻¹

Table 3: Ingredients composition of broiler finisher feed (mash)

Ingredients (%)	Treatments			
	A	B	C	D
Sorghum	75.0	75.0	75.0	75.0
Groundnut cake	16.5	16.5	16.5	16.5
Super concentrate	5.0	5.0	5.0	5.0
Wheat bran	2.0	1.6	2.025	2.0
Lime stone	1.0	1.0	1.0	1.0
Salt	0.2	0.2	0.2	0.2
Lysine	0.2	0.1	0.1	0.1
Methionine	0.1	0.1	0.1	0.1
Natuzyme Plus®	0.0	0.5	0.075	0.1

A: Basal diet (control), B: Basal diet+500 g Natuzyme plus® t⁻¹, C: Basal diet+750 g Natuzyme Plus® t⁻¹, D: Basal diet+1 kg Natuzyme plus® t⁻¹

(5 kg) which were cleaned and disinfected before feeding started. The feeders and water lines heights were adjusted, according to the progressive growth of the chicks.

Data collection: During the period of the experiment, data were collected on the following parameters, average body weight, average weight gain, average feed intake, feed conversion ratio and mortality using the replicate as the experimental unit.

Carcass evaluation: At the end of the trial, five birds per replicate were randomly selected and slaughtered for carcass analysis. The birds were fasted overnight, after which they were bled by severing the jugular vein. They were scalded in a hot water, defeathered and then eviscerated. All the cut parts including the internal organs were separated and weighed accordingly. Hot carcass weight was recorded and the dressed carcasses were weighed and the dressing percentage was obtained by expressing the dressed carcass weight as a percentage of live body weighed.

Breast, back, wings, drum stick, thigh and neck percentages were recorded as percentage of dressed carcass. Internal organs including liver, gizzard and heart were

weighed and recorded individually, weights of parts were expressed as percentage of respective slaughter body weight.

Chemical and physical analysis of breast muscle: A proximately 100 g of breast muscle from 5 replicates in each group was stored in freezer -20°C for evaluation of chemical and physical characteristics of the meat. After thawing, the crude protein, fat, ash and moisture contents were determined according to the procedure described by AOAC¹². Water holding capacity (WHC) of chicken breasts was determined in duplicate according to the centrifugal method described by Kim *et al.*¹³. The WHC (%) was estimated by calculating the percentage breast weight before and after centrifugation. For pH determination, 3 g samples of chicken breasts were homogenized with 27 mL of distilled water using a homogenizer at 6,000 rpm for 30 sec. The pH value of chicken breasts was determined in triplicate using an electronic pH meter (HI 99163, Hanna Instruments Inc., Woonsocket, RI, USA).

Statistical analysis: Data were analyzed by one-way analysis of variance as completely randomized block design using the GLM procedure of SAS¹⁴. Means were separated by Duncan multiple range test¹⁵ at p<0.05.

RESULTS AND DISCUSSION

In the present study (Table 4) increasing levels of Natuzyme Plus® had no effects on body weight and weight gain/g/day during the whole experimental periods. However, feed conversion ratio was higher (p<0.05) in the group received 1 kg t⁻¹ Natuzyme Plus® at 7-14 days. Moreover, at 15-21, lowest (p<0.05) feed conversion ratio recorded was in the group received 0.5 kg t⁻¹ Natuzyme Plus®. Similar results were reported by Pinheiro *et al.*¹⁶, Ranade and Rajmane¹⁷, who found that addition of Natuzyme plus® in the chicken diets increased live weight gain but the rate of increase was not significant. In contrast, many reports¹⁸⁻²⁰ observed an improvement in feed conversion ratio in broilers fed diets based on corn and soybean meal supplemented with enzyme complex (amylase, cellulase and protease). Exogenous enzymes added in broiler diets allow supplementation of endogenous enzyme production improves the assimilation of nutrients by the birds²¹, especially in the early stage of life. However, in the supply "on top" as in this study, this effect is reduced and decreases the significant effect detection probability²². Generally, results of the growth performance in the present study was inconsistent with previous reports

Table 4: Effect of different levels of Natuzyme Plus® on growth performance of broiler chicks

Table 4: Effect of different levels of Natuzymil Plus on growth performance of broiler chicks						
Parameters	Treatments				SE	p-value
	A	B	C	D		
7-14 days						
Body weight (g ⁻¹)	311.10	296.90	286.10	303.80	7.99	0.19
Weight gain (g/day)	147.70	163.20	149.00	159.60	7.63	0.41
Feed conversion ratio	0.86 ^b	0.89 ^b	0.88 ^b	1.08 ^a	0.02	0.001
15-21 days						
Body weight (g ⁻¹)	723.60	672.25	625.15	714.60	48.49	0.47
Weight gain (g/day)	275.45	255.20	236.85	278.60	14.41	0.16
Feed conversion ratio	1.18 ^{ab}	1.11 ^b	1.26 ^a	1.31 ^a	0.03	0.001
22-35 days						
Body weight (g ⁻¹)	1270.70	1289.30	1346.05	1302.80	51.92	0.767
Weight gain (g/day)	286.55	289.30	346.75	300.43	26.12	0.343
Feed conversion ratio	1.48	1.47	1.44	1.52	0.07	0.842

A: Basal diet (control), B: Basal diet+500 g Natuzyme Plus® t⁻¹, C: Basal diet+750 g Natuzyme Plus® t⁻¹, D: Basal diet+1 kg Natuzyme Plus® t⁻¹, LS: Level of significance, SE: Standard error, NS: No significance (p>0.05), ^{a, b}Means within a row with the different superscript letters significantly differ (p<0.05)

Table 5: Effect different levels of multi-enzyme, Natuzyme Plus®, on whole sale cuts and non-carcass components in broiler chickens

Parameters	Treatments				SE	p-value
	A	B	C	D		
Dressed carcass weight (g ⁻¹)	1112.00	797.19	1041.60	911.20	150.70	0.482
Cuts weight (g⁻¹)						
Breast	296.42	317.00	347.54	295.26	27.16	0.506
Thigh	100.93	90.81	101.10	100.42	7.47	0.721
Drumstick	72.35	80.52	75.55	64.70	6.10	0.263
Wings	78.97	78.89	76.46	66.98	3.71	0.112
Meat: bone ratio						
Breast	2.97 ^b	2.94 ^b	3.80 ^a	3.62 ^{ab}	0.19	0.0089
Drumstick	2.50	2.85	2.68	2.86	0.34	0.862
Thigh	3.32	3.65	3.86	2.85	0.37	0.278
Non-carcass component						
Gizzard	28.67	28.62	30.14	31.22	2.31	0.827
Liver	38.64	41.44	40.48	39.20	3.04	0.914
Heart	8.32	7.39	6.54	7.43	0.61	0.274

A: Basal diet (control), B: Basal diet+500 g Natuzyme Plus® t⁻¹, C: Basal diet+750 g Natuzyme Plus® t⁻¹, D: Basal diet+1 kg Natuzyme Plus® t⁻¹, LS: Level of significance, SE: Standard error, NS: No significance (p>0.05), ^{a, b}Means within a row with the different superscript letters significantly differ (p<0.05)

suggesting that extent of Natuzyme's beneficial effects and the nutrient equivalency values of multi-enzymes in diets with low-digestible feedstuffs might be somewhat higher than with high-digestible feedstuffs^{6,23}.

The results of carcass and non-carcass characteristics of finisher broiler fed different levels of Natuzyme plus® are presented in (Table 5). There were no significant differences (p>0.05) in the parameters measured except for breast meat: bone ratio, which was higher (p<0.05) in diet C compared to A and B. Similar results were published recently by Mahmood *et al.*²⁴, who reported that carcass characteristics, e.g., carcass yield, breast meat yield, thigh weight, abdominal fat pad and relative liver and heart weights, were not affected by exogenous enzyme supplementation to broiler diets. Unlike previous reports²⁵, supplementing different levels of multi-enzyme did not improve the carcass characteristics of broilers. This could be attributed to the differences in dietary

ingredients among various studies with a large diversity and concentration of chemical characteristics existing among plant-based feed ingredients, as well as interactions among constituents within feed ingredients and diets, improvements in nutrient digestibility and animal performance from adding exogenous enzymes to growing animal diets depends on understanding these characteristics in relation to enzyme activity²⁶.

The results of physiochemical characteristics of breast muscle in broiler fed different levels of multi-enzyme, Natuzyme Plus® are presented in Table 6. No significant differences were observed for chemical composition of breast muscle among the dietary treatments. However, the pH was significantly lower (p<0.05) in the group received diet containing 1 kg t⁻¹ Natuzyme Plus®. Data reporting the effect of exogenous enzymes on meat quality of broiler is very scarce, however, recently Dalolio *et al.*²², investigated the

Table 6: Effect of different levels of multi-enzyme, Natuzyme Plus®, on physiochemical characteristics of broiler breast muscle

Table 6. Effect of different levels of multi-enzyme, Natuzyne Plus [®] , on physicochemical characteristics of broiler breast muscle						
	Treatments					
Parameters	A	B	C	D	SE	p-value
Chemical composition (%)						
Moisture	74.45	74.68	74.82	73.66	0.47	0.340
Crude protein	18.89	18.95	18.42	19.47	0.39	0.344
EE (%)	1.44	1.52	1.37	1.62	0.12	0.461
Ash	1.09	1.09	1.09	1.04	0.04	0.718
Physical characteristics						
pH	5.84 ^{ab}	5.94 ^a	5.98 ^a	5.78 ^b	0.03	0.007
Cooking loss	29.33	29.28	30.10	31.26	1.19	0.622
WHC	0.84	1.02	1.18	1.15	0.09	0.060

A: Basal diet (control), B: Basal diet+500 g Natuzyme Plus® t⁻¹, C: Basal diet+750 g Natuzyme Plus® t⁻¹, D: Basal diet+1 kg Natuzyme Plus® t⁻¹, LS: Level of significance, SE: Standard error, NS: No significance (p>0.05). ^{a, b}Means within a row with the different superscript letters significantly differ (p<0.05)

effect of the inclusion of different levels of an enzyme complex consisting of phytase, protease, xylanase, β -glucanase, cellulase, amylase and pectinase on the parameters of performance, carcass yield and meat quality of broilers. The authors reported that the parameters of performance, carcass yield and carcass parts and meat quality were not affected by the enzyme supplementation of diets fed to broiler chickens. According to Werner *et al.*²⁷, the addition of enzymes does not affect quality parameters of the meat; they are interconnected with color and pH, which are mainly hampered by the loss of exudate and temperature pitches. Ravindran *et al.*²⁸ while working with diets based on corn and soybean meal supplemented with the multi-enzymes, also did not observe any effects (p>0.05) regarding the parameters pH, water loss capacity, water retention capacity, color and luminosity in carcass for broilers at 42 days of age.

Poultry industry is characterized by high production volume, mainly by the broiler industry. In this sense, the productive reality the use of exogenous enzymes can provide obtaining percentage gains in carcass characteristics, making it an extremely attractive alternative from an economic point of view²⁹. However, there is great need for extensive research that point advantages when it reduces the nutritional value of diets and also those that correlate the cost-benefit of the inclusion of exogenous enzymes in diets for broilers²². All these factors combined with the proper management of poultry production will allow consecutive increases in productivity.

CONCLUSION

Based on the results of the present study, it can be concluded that the inclusion of the multi-enzyme, Natuzyme Plus® up to 1 kg t⁻¹ in diets of broilers did not significantly influence the performance, the carcass yield and the quality of the meat.

SIGNIFICANCE STATEMENTS

This study discovers that the inclusion of multi-enzyme, Natuzyme Plus® at different levels did not change neither performance nor carcass characteristics of broilers. This study help the researchers to evaluate the accurate levels of multi-enzyme inclusion in well formulated, low fiber broiler diets.

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