Dietary effects of optizyme P5® on the growth performance of day-old *Struthio camelus* var. *domesticus* (Ostrich) chicks

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Abstract

The effect of Optizyme P5 inclusion in ostrich chick starter diets on the growth performance of day-old ostrich chicks was investigated. Seven hundred day-old ostrich chicks with mean weight of 0.82 ± 0.11 kg were used. The chicks were split into two groups. Group one was on the control ostrich chick starter diet (D1) while group two had the exogenous enzyme complex included at a rate of 0.1 % (in its diet (D2)). Each treatment was replicated 7 times. Each replicate of 50 chicks constituted an experimental unit. Pens were used as a blocking factor in a Randomised Complete Block Design. Chick growth performance was monitored for 49 days. Dietary fortification with the exogenous enzyme did not affect ($p > 0.05$) live weight gain and average daily gain of the ostrich chicks (6.45 0.45 kg and 131.7 9.20 g/Day and 6.28 0.60 kg and 128.20 12.50 g/Day for chicks on D1 and D2 respectively). Birds offered exogenous enzyme fortified diet consumed significantly less ($p<0.001$) feed with a mean Dry Matter Intake (DMI) of 9.52 0.99 kg versus the 10.86 0.90 kg for those on the control diet. Efficiency of feed utilization was significantly high ($P<0.001$) for birds on diet D2 with a feed conversion ratio (FCR) of 1.52 0.1 versus an FCR of 1.68 0.11 for birds on the control diet. Dietary fortification of ostrich chick starter diet with Optizyme P5 improved feed utilisation efficiency.

Key words: Enzyme supplementation, growth performance and non-starch polysaccharides

Introduction

The ostrich, *Struthio camelus* var. *domesticus*, is the largest bird on the face of the earth (Cooper and Horbanczuk, 2004). It is found in the order Ratite, flightless and running birds, that also includes emu, cassowary, rhea and kiwi (Sibley and Ahlquist, 1990; Cooper and Horbanczuk, 2004). According to Cooper and Horbanczuk, (2004) the natural habitat of ostriches ranges from arid to semi-arid terrain to grasslands. Commercial ostrich production started in South Africa some 150 to 155 years ago (Hallam, 1992). In the Southern African Development Community (SADC) region, commercial ostrich farming is currently practised in South Africa and Zimbabwe (Cooper and Horbanczuk, 2004). The practice of ostrich farming has now spread to the United States of America and Israel (Cooper and Horbanczuk, 2004).

Despite their similarities with other birds, ostriches and all ratites have evolved special adaptations to survive in their natural environment. Of major interest and from a nutritional point of view are modifications to the gastrointestinal tract and the functional abilities these endow on the ratites (Angel, 1996). Ostriches as well as other ratites do not have teeth neither do they possess a crop.

The ostrich being a monogastric herbivore is a simple-stomached animal that has developed the ability to utilize forage (Smith and Sales, 1995). While all ratites are post-gastric fermenters, the fermentation sites differ within the ratite family. In ostriches, fibre fermentation occurs in the colon, yet in the emu, the distal ileum is the fermentation site. In the rhea, fermentation occurs in the enlarged caecum (Cooper and Horbanczuk, 2004). Ostriches and rheas are adaptable grazers/browsers (Sauer and Sauer, 1966; Cajal 1988). Being natural plant eaters, ostriches thrive on succulents, seeds, berries, grasses as well as tree leaves and shrubs. Williams *et al.* (1993) report that the weighted chemical composition of plants selected by free ranging ostriches in the Namib desert comprised of 11.2 % protein, 4.2 % lipid, 35.2 % fibre and 8.87 MJ/Kg metabolisable energy (ME). Milton *et al.* (1994) noted that in the wild, ostriches rarely eat dead grass and pointed out that an ostrich would require 5 6 Kg of fresh material in a day in their natural habitat.

Angel (1993) noted that the ability of the ostrich to utilize natural detergent fibre (NDF) increased linearly up to 10 weeks of age. At 10 weeks it continued to increase at a decreasing rate and reached a plateau at 17 weeks of age. The ability to utilize fibrous material is not well developed in the young ostrich chicks especially during the first three months of the brooding phase. The brooding phase performance therefore is a critical determinant to the profitability of an ostrich enterprise due to the inherent physiological inefficiencies in terms of nutrient harvesting from the largely plant material (cellulose, hemi-cellulose and pectin rich) that constitutes the key feed resource base for the young ostriches. The key cause is the limitation with respect to the spectrum of the endogenous digestive (cellulolytic, hemi-cellullolytic and pectinolytic) enzymes produced by young ostriches. The objective of the study was to determine the effect of fortifying the ostrich starter diets with Optizyme P5, (a complex of different activities: major ones being -glucanase and xylanase, side activities being cellulases, hemicellulases, proteases, amylases and -galactosidases) on the growth performance of ostrich chicks during the brooding phase.

Materials and Methods

Study Site

The trial was carried out at Dollar Block Ranch situated 71 km due North East from Bulawayo along Bulawayo-Nkayi Road, Zimbabwe. The ranch is in natural farming region IV characterised by low rainfall ranging from 450 to 600mm per annum with maximum temperatures of 28°C (Vincent and Thomas, 1960).

Dietary Treatments

Two dietary treatments were used. Both were ostrich starter diets: the control diet (D1) (not fortified) and the second diet (D2) that was fortified with Optizyme P5 at the rate of 1 kg / tonne of feed. Ingredient and chemical nutrient composition of the treatment diets as per the analyses as stated by the Association of Analytical Chemists (AOAC) (1995) is shown in Table 1.

Experimental Birds And Their Management

Seven hundred day-old ostrich chicks were used in the experiment. During the first three weeks the chicks were reared in 5m x 5m runs with associate brooding rooms of 3m x 5m. The latter housed the chicks overnight. Infrared lamps provided warmth during the night. Brooder floors were bedded with dry grass (disinfected with 10 % formalin prior to use and replaced every third day) to a depth of about 4 - 5cm.

At 21 days of age the chicks were transferred into larger pens and runs but maintaining their respective treatment groups up to day 49. The larger pens had 10m x 20m runs and 4m x 4m associate-rooms for night enclosures. Night enclosures were practised up to day 28 after which chicks slept in the runs. Chicks were fed and watered *ad lib* throughout the experimental period.

Experimental Design

The day-old ostrich chicks, mean weight of 0.82 $\pm$ 0.11 Kg, were randomly allocated to 7 earth-floored pens in groups of 100. Each pen had two compartments into which each group of 100 chicks was halved into two subgroups of 50 chicks each followed by balancing for weight within each subgroup. The subgroups acted as replicates thus each dietary treatment had 7 replicates. Groups within each pen were then allocated randomly to any one of the two dietary treatments [the control (D1) and one with synthetic enzyme inclusion (D2)] giving a Randomised Complete Block Design (RCBD) with pens as the blocking factor.

Data Collection

Feed offered and refusals were weighed and recorded daily. Chicks were weighed on induction day and thereafter on days 7, 14, 21, 28, 35 and 49. Weighing was done in the morning before feeding to minimise post-prandial gut variations. Average daily gains were computed from the total weight gains recorded during the trial period. Feed conversion ratios were computed by dividing the total feed intake of each replicate by the total weight gain of birds in the respective replicate.

Data Analysis

The effect of treatment (enzyme addition) on dry matter intake (DMI), live weight gain (LWG), feed conversion ratio (FCR) and average daily gain (ADG) was done using the general analysis of variance procedure of the General Statistical Package (GenStat Release 7.1, 2003). The linear model used in the analysis of variance procedure was:

$Y_{ij} = + T_i + b_j + _{ij,}$

where

Y_{ij} = measurement from the i^{th} treatment of the j^{th} replicate ($i = 1,2; j = 1,2,3 \ldots 7$),

= Overall mean common to all observations,

T_i = Effects of the i^{th} treatment ($i = 1,2$), b_j = effect of the j^{th} block ($_j = 1,2,3 \ldots 7$) and

$_{ij}$ = residual error term.

Table 1: Ingredient and Nutrient Composition of the Experimental Diets Fed to Ostrich Chicks During the Feeding Trial

Composition as fed basis (g/Kg)	**DIET 1 (D1)**	**DIET 2 (D2)**
Maize meal	400	400
Sorghum meal	200	200
Soyabean meal	300	300
Lurcene	60	60
Molasses	19.3	19.3
Monocalcium phosphate	13.7	13.7
Methionine	2.0	2.0
Lysine-HCl	2.5	2.5
Vit/Min Premix	2.5	2.5
Optizyme P5	-	1.0
Composition By Proximate Analysis (g/Kg)		
DM	893.00[a]	891.00[a]
*CP	194.00[a]	196.00[a]
CF	34.70[a]	34.10[a]
EE	51.30[a]	51.00[a]
Ash	54.00[a]	53.45[a]
Calcium	14.30[a]	14.50[a]
Phosphorus	8.10[a]	8.30[a]

*Treatment diets were iso-nitrogenous

Results

Results for DMI, LWG, ADG and FCR are shown in Table 2. WG and ADG were statistically similar ($P>0.05$) for chicks on diets D1 and D2 (Table 2). However chicks on treatment diet D2 consumed less feed ($P<0.001$) with a mean DMI of 9.56 0.99 kg and an FCR of 1.52 0.11 versus a mean DMI of 10.86 0.90 kg and an FCR of 1.68 0.11 for those on the control diet (Table 2). Chicks on D2 used less feed for every one-kilogram gain in live weight (FCR of 1.52) than those on the control diet (FCR of 1.68) that needed 9.50 % more feed for similar live weight gain. Figure 1 shows cumulative weight gains over the experimental period.

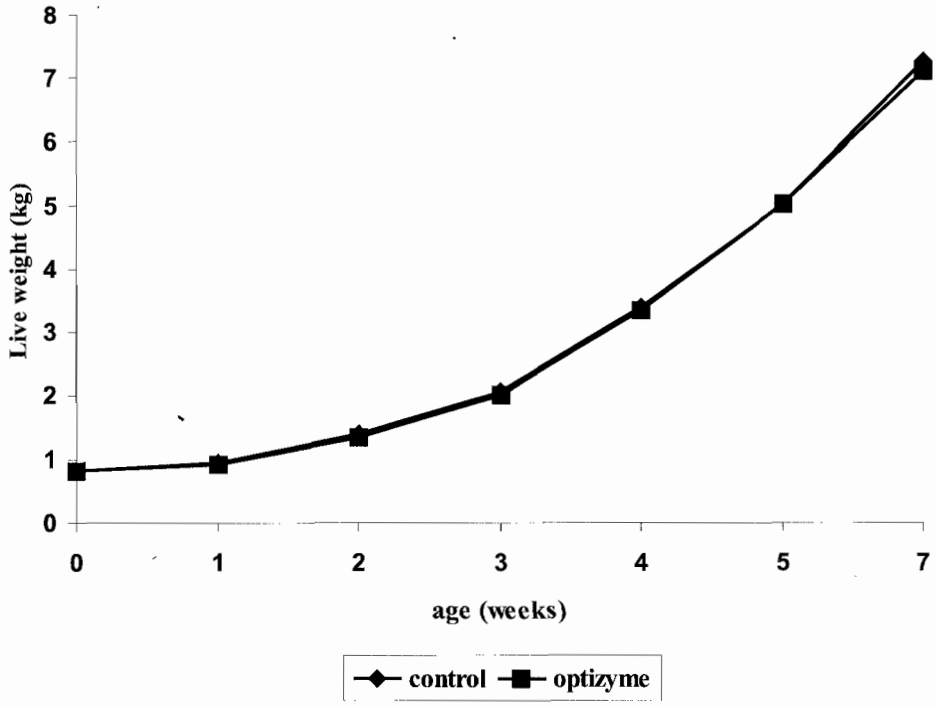
Discussion

In spite of the fact that chicks on the test diet (D2) consumed statistically less feed (Table 2), they still had a similar growth performance to those chicks that consumed more of the control (D1) diet feed (Table 2). It would seem that the enzyme had a beneficial effect on nutrient digestion, absorption and assimilation. Bedford (1993) states that exogenous enzyme inclusion usually results in the partial breakage of the polymeric structure of viscous non-starch polysaccharides (NSP) in the diet. The envisaged breakage of the NSP decreases their viscosity and produces a corresponding reduction in

Table 2: Mean Dry Matter Intake (DMI, Kg), Liveweight Gain (LWG, Kg), Average Daily Gain (ADG, g / Day) and Feed Conversion Ratio (FCR) Of The Chicks During The Trial Period

Treatment	**DMI**	**LWG**	**ADG**	**FCR**
Diet 1 (D1)	10.86[a]	6.45[a]	131.70[a]	1.68[a]
	(0.90)	(0.45)	(9.20)	(0.11)
Diet 2 (D2)	9.56[b]	6.28[a]	128.20[a]	1.52[b]
	(0.99)	(0.61)	(12.5)	(0.11)
LSD	0.3925	0.537	10.960	0.138
C.V (%)	2.9	5.9	6.5	6.6
F-Probability	0.001	0.465	0.467	0.030

[ab]Means with different superscripts within column are significantly different ($p<0.05$), Figures in parentheses are standard errors of each mean



their anti-nutritive effects (Bedford, 1993) by making the various macromolecular feed constituents more accessible to the hydrolytic action of the endogenous (animal secreted) digestive enzymes. This translates into more effective digestion and concomitant availing of nutrients in a micromolecular state that is absorbable and assimilable. These results are in agreement with the findings of Bremmers (1997) in whose study broiler chickens under exogenous enzyme diets consumed less feed for similar growth rates. However results from other researchers (Salobir *et al.*, 1995; Augelovicona and Michalik, 1997 and Richter *et al.*, 1999) point out that dietary exogenous enzyme inclusion improved LWG and DMI in chickens but maintained that their observations were a result of improved feed utilisation efficiency due to increased availability of nutrients from digestion. The significantly lower ($p<0.001$) mean DMI for chicks on D2 (Table 2) for a similar performance with those on D1 seem to indicate that there was an improvement in the digestion and bio-availability of energy and other nutrients (Bremmers, 1997), giving rise to a higher efficiency of feed utilisation. The reduction in feed intake after the exogenous enzyme inclusion is in agreement with the key tenet that dietary energy concentration is the key determinant of feed intake (Waldroup *et al.*, 1976; Pesti, 1982; and Pesti and Fletcher, 1983). Such exogenous enzymes are thought to increase energy availability to the birds through their reduction of the detrimental effects of the NSP on energy and other nutrients availability. As the level of metabolisable energy in the diet increases or decreases, feed intake changes inversely, although the rate of adjustment is not always sufficient to keep energy intake constant.

Diets low in available metebolisable energy (AME) would show improvements in ADG when exogenous enzymes are included (Schutte *et al.*, 1995), thus the non-improvement in ADG in D2 fed chicks indicates that the starter diet used was of high quality. The age of the animal is another contributing factor to variations. In general, the simpler a system is in terms of digestive abilities, the greater is the potential for exogenous enzymes to be nutritionally beneficial. As the animal matures, the benefits of adding these enzymes greatly diminishes as the animal synthesises and secretes into the GIT a more potent battery of its endogenous enzymes unlike the immature animal. The species of the animal also contributes a great deal to the observed variations in findings reported by different researchers. Some species have shorter feed transit times than others and less total postgastous microbial activity. Such species are less efficient and enzyme addition in such would generally point to a more marked improvement in animal performance. Differences in observations are also as a result of the differences in composition of the enzyme premixes, the spectrum of the various NSP that they can hydrolyse and the associative effects of the dietary ingredients and their chemical composition. If an

ostrich chick grows as fast on an enzyme-containing feed while consuming less feed than chicks fed a similar but enzyme-free diet, the explanation could be that the enzyme results in a release of extra energy; and that the extra energy may be the limiting factor in the feed intake. Assuming that a diet is adequate in essential nutrients, poultry will tend to consume feed to meet energy requirements (Angel *et al.,* 1995). The ratio of energy to other requirements is the basis for formulation of diets. The relationship between energy and feed consumption in ostriches is assumed to be similar to that of poultry, but this has not yet been proven (Angel *et al.,* 1995).

Conclusion

Optizyme P5 (an exogenous enzyme) inclusion increased efficiency of nutrient digestion and utilisation as demonstrated by the accompanying increased efficiency of feed utilisation.

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References

Angel, C.R. 1993. Research Update. Age change in the digestibility of nutrients in ostriches andVeterinarians (January 1993). Association of Avian Veterinarians Atlanta, GA, USA.

Angel, C.R. Scheideler S and Sell J. 1995. Ostrich nutrition. In: Proceedings of the 5th Australian Ostrich Association Conference, Queensland, Australia, pp 15-24.

Angel, C.R., 1996. A review of ratite nutrition. Animal Feed Science and Technology. 60:241 246.

Augelovicona, M. and Michalik, 1997. A test of enzymatic preparation in relation to the performance and commercial utilisation of feeds in broiler chickens. Zivocisna-Vyroba, 42: 175-180.

AOAC, 1990. Official Methods of Analysis (15th Edition) Association of Official Analytical Chemists, Washington D.C, USA.

Bedford, M.R. 1993. Matching enzymes to application. Feed Management, 44: 14-18.

Bremmers, R. 1997. Three-fold action of feed enzymes. World Poultry Elsevier, 13 (11): 39-40.

Cajal, J.L. 1998. The lesser rhea in the Argentine Puna region. Biological Conservation, 45: 81-91.

Cooper, R.G. and Horbanczuk JO, 2004. Ostrich Nutrition: a review from a Zimbabwean perspective. Rev. Sci. Tech. Off. Int. Epiz. 23 (3): 1033-1042.

Genstat Release 7.3, 2003. Lawes Agricultural Trust. Rothamsted Experimental Station, UK.

Hallam, M.G. 1992. The topaz introduction to practical ostrich farming. The Ostrich Producers Association of Zimbabwe. pp. 78. Superior Print and Packaging, Harare, Zimbabwe.

Milton, S.J. Dean, R. and Siegfried, R. 1994. Food selection by ostrich in Southern African Journal Wildlife Management, 58: 234-248.

Pesti, G.M. 1982. Characterisation of the response of male broiler chickens to diets of various protein and energy contents. British Poultry Science, 23: 527.

Pesti, G.M. and Fletcher D.L. 1983. The response of male broiler chickens to diets with various protein and energy contents during the growing phase. British Poultry Science, 24: 91.

Richter, G., Schurrz, M., Ochrimenko, W. I., Kohler, H., Schubert, R., Bitsch, R. and Jahrais, G. 1999. The effect of NSP-hydrolysing enzymes in diets of laying hens and broilers. Vitamine and Zusatszoffe, Germany.

Salobir, J., Kermauner, A., Bogdanic, C., Malensek, A., Stopar, J. and Striklec, M. 1995. Effect of enzyme preparation

polyzyme R-BX on the performance and intestinal viscosity of broiler chickens fed wheat\maize based diets. Zootecnica-International, 19: 82-85.

Schutte, J.B., de Jong, J. and Langhout, D.J. 1995. Effect of endo-xylanase preparation in wheat-based rations for broilers. Feed Compounder, 15: 20 - 24.

Sauer, E.G. and Sauer, E.M. 1996. The behaviour and ecology of the South African ostrich. In: The Living Bird, O.S. Pettingil Jr. and D.A. Lancaster (eds.) pp. 45-74. Fifth annual report of the Cornell Laboratory of Ornithology.

Sibley, C.G. and Ahlquist, J.E. 1990. Ratites and Tinamous in Phylogeny and Classification of Birds. Pp.272-288. Yale University Press, USA.

Smith, W.A. and Sales, J. 1995. Feeding and feed management. In: Smith, W. A. (ed.), Practical Guide for Ostrich Management and Ostrich Products. pp 8 - 12. Allentech Publications, Stellenbosch, RSA

Vincent, J. and Thomas, R.G. 1960. An Agricultural Survey of Southern Rhodesia (Part 1) - Agro-Ecological Survey. Government Printers, Salisbury, Southern Rhodesia.

Waldroup, P., Mitchell, W.R.J., Payne, J.R. and Johnson, Z.B. 1976. Characterisation of the response of broiler chickens to diets varying in nutrient density content. Poultry Science, 55: 130.

Williams, J.B., Siegfried, W.R., Milton, S.J., Adams N.J., Dean, W.R.J., Du Plessis, M.A., Jackson, S. and Nagy, K.A. 1993. Field metabolism, water requirements and foraging behaviour of wild ostriches in the Namib. Ecology, 74: 568-579.