

ISSN 1682-8356  
ansinet.org/ijps



INTERNATIONAL JOURNAL OF  
**POULTRY SCIENCE**

**ANSI***net*

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## Effect of Pellet and Mash Diets Associated with Biozyme Enzyme on Broilers Performance

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**Abstract:** This experiment was conducted to investigate the effect of form of diets with different levels of biozyme enzyme on broilers performance. 800 Arbor Acres strain chickens were used in a factorial arrangement 2×3 with 2 form of diets (pellet and mash) and 3 levels of biozyme (0, 0.75 and 1.5 kg/ton) in a randomized completely design with 6 treatments and 3 replicates in each treatment and 45 birds/replicates. The weight gain (WG), feed intake (FI) and feed conversion ratio (FCR) were measured weekly from week 1-6. Carcass components were recorded at the end of trial (day 42). The WG were significantly ( $P<0.05$ ) greater in broiler fed pellet diets than comparable groups. The birds fed diet containing 0.75 kg/ton biozyme had greater WG (56.31 vs. 54.77 and 54.57 gram) and better FCR (1.7 vs. 1.79 and 1.84) than birds fed diets containing the two others levels. The weight of breast, thigh, abdominal fat and liver were significantly ( $P<0.05$ ) greater in broilers fed 0.75 kg/ton Biozyme and pellet diet. Heart weight in broilers fed pellet diets were significantly ( $P<0.05$ ) heavier than the broilers fed mash diets (9.56 vs. 8.056 gram). On the other hand, Right ventricle to Total ventricle ratio was not affected by form of diet. It is concluded that the performance and carcass characteristics were improved in pellet diets.

**Key words:** Pellet, mash, biozyme, performance, broiler

### Introduction

It is well recognized that feed represents the most significant cost of broiler production. Most production costs estimates range from 60-70% as being feed costs. Certainly, the major portion of feed costs is for the ingredients used. However, the cost of feed processing represents a significant portion of feed costs and likely gives the greatest opportunity for influencing broiler performance beyond nutritional adequacy (Behnke and Beyer, 2004). The technique which is used in feed processing of poultry is different such as: using the feed additive like enzymes, probiotic, and etc, or changing in the feed processing e. g. extruded, milling, pelleting and etc. Using each of these techniques are depending on their facility and purpose of breeder for producing. In the recent decade, usage of poultry feed in the form of pellet have a lot of benefits such as: decreased ingredient segregation, less time and energy expended for prehension, destruction of pathogenic organisms, thermal modification of starch and protein, improved palatability and these benefits attract a lot of adherent (Behnke, 1994). Where as, manufacturing plant is not available to all breeders, usage of other processing can be effective. Since the commercial introduction of exogenous enzymes over 15 years ago, their use has increased greatly, not only in traditional markets where wheat and barley are the principal grains, but also in countries where corn and sorghum form a major part of the poultry diet. Research related to the variability of corn and soybean meal (Coon *et al.*, 1990; Lesson *et al.*,

1993; Leske *et al.*, 1993; Wyatt *et al.*, 1999; Douglas *et al.*, 2000; Barrier-Guillot *et al.*, 2001) has helped to identify the significant feeding value variability among corn and soy samples and to show potential opportunities for improvement. The chemical composition of maize can be varied from batch to batch resulting in considerable variation in its energy value for poultry (Cowieson, 2005). Commercial and academic studies have shown that the judicious use of exogenous enzymes can ameliorate these inconsistencies in the nutritional value of maize, improving body weight gain, FCR and flock uniformity (Acamovic, 2001; Adeola and Bedford, 2004). Marsmann *et al.* (1997) suggested that improvement in the nutritional value of soybeans could be achieved with protease and carbohydrase enzyme supplementation. These researchers reported improvement in the digestibility of the non-starch polysaccharide fraction of soybean meal with the enzyme supplementation. Recently, Biochem company make an effort to produce Biozyme enzyme that containing Avizyme 1502 and Betafin S<sub>1</sub> for improving inadequacy of diet which based on corn-soybean meal. There is limited published information about the effect of this enzyme on broiler performance. The combined effects of this enzyme and form of diet are rarely investigation. The purpose of the present set of experiments was to investigate the effect of pellet and mash diets associated with Biozyme enzyme on broiler performance.

Table 1: Ingredient composition and calculated analysis (kg/ton) of the basal diets (as fed basis)

Ingredient	Starter	Grower	Finisher
Yellow corn	442	451	488
Soybean meal	330	330	260
Wheat	120	120	200
Shell	10	9.15	8.7
Bicarbonate soda	1.5	-	-
Salt	1	1	1
Fish meal	50	50	-
Lucern meal	20	20	10
Premix <sup>1</sup>	6	6	5
DL-methionine	1.8	1.8	1.6
Lysine	0.7	0.7	0.35
Dicalcium phosphate	12	12	10
Oil	5	5	15
Clinacoccus	-	0.35	-
Natozyme	-	-	0.35
Total	1000	1000	1000
ME (kcal/kg)	2800	2890	2950
CP	21.8	20	17.81

<sup>1</sup>Supplied per kilogram of diet: vitamin A 10000 IU; vitamin D<sub>3</sub>, 9790 IU; vitamin E, 121 IU; B<sub>12</sub>, 20 $\mu$ g; Riboflavin, 41.4 mg; Calcium pantothenate, 40 mg; Niacin, 22 mg; Choline, 840 mg; Biotin, 30 $\mu$ g; Thiamin, 4 mg; Zn sulfate, 60 mg; Mg oxide 60 mg.

## Materials and Methods

In this study, 800 Arbor Acres strain chickens were used in a factorial arrangement 2 $\times$ 3 with 2 form of diets (pellet and mash) and 3 levels of biozyme (0, 0.75 and 1.5 kg/ton) in a randomized completely design with 6 treatments and 3 replicates in each treatment and 45 birds/replicates. Biozyme was used, containing betaine (480000 mg/kg), Endo 1.4 beta xylanase (150 U/kg), protease (2000 U/kg) and Alpha-amylase (200 U/kg) (Producer Biochem Company). The basal diets were based on corn and soybean meal. Three sets of basal diets were used: one for broiler starter (1-21 day), two for broiler grower (22-35 day), and the other for broiler finisher (36-42 day). The ingredient composition and Analysis of the basal diets are shown in Table 1. Despite similar chemical composition of basal diets, according two form of diets (pellet vs. mash) and adding different levels of enzyme to each form of diet 6 dietary treatments were used diet 1 (0 kg/ton enzyme and pellet), diet 2 (0.75 kg/ton and pellet), diet 3 (1.5 kg/ton and pellet), diet 4 (0 kg/ton enzyme and mash), diet 5 (0.75 kg/ton enzyme and mash) and diet 6 (1.5 kg/ton enzyme and mash). The pellet and mash feeds were of the same composition and were manufactured from the same stocks of feed ingredients.

10 cm thick of wood shavings was laid under the poultries. The chickens were weighted on the first day and were placed to the divisions each contained 45 chickens in the poultry. Commercial broiler rations were provided ad libitum from 0 to 42 days. Water was supplied to both groups at ad libitum level by refreshing constantly. Room temperature was maintained at

32 $\pm$ 1 $^{\circ}$ C during the first week and gradually decreased to 24 $^{\circ}$ C by the end of the third week. Live weight, feed consumption, feed conversion and weight gain calculated weekly from week 1-6. On day 42, two birds (close to the mean pen weight) were selected, fasted for 4h, and after being weighted killed. After the removal of feathers, viscera, shanks and neck, the weights of the eviscerated hot carcass, abdominal fat, breast muscle, thigh, total heart and right ventricle weight were measured.

For performance and carcass measurements, individual birds were considered as the experimental unit. All data were subjected to two-way analysis of variance using the general linear models procedure of the SAS<sup>®</sup> (SAS Institute, 1997) to determine the main effects (form of diets and levels of biozyme) and their interaction. To compare results between form of diet and levels of enzyme by Duncan was performed. Significant differences were considered at P<0.05.

## Results and Discussion

**Form of diet:** The results of broiler performance is shown in Table 2. The weight gain (59.94 vs. 50.5) and feed intake (101.9 vs. 96.9) were significantly (P<0.05) greater in broilers fed pellet diets than mash diets. FCR was intensively affected by form of diet that on pellet form was better. Hull *et al.* (1968) reported birds fed pelleted diets a 5% better feed conversion, but regrinding the pellets resulted in a lower feed conversion than the meal diet. Combs (1959) and Calet (1965) observed that birds fed crumble for starter and pellet for grower and finisher period had higher weight gain and better feed conversion ratio (FCR) than broiler fed mash for whole period (similar results reported by Proudfoot and Hulan, 1982). Kilburn and Edwards (2001), found that pelleting the rations significantly increased body weight and improved feed conversion ratio. Van Biljon (2005), reported that chickens on the crumble-pellet dietary regimen were significantly heavier at 42 days when compared with birds fed either all-mash, or fed the ground crumble-pellet regimen. Who also found that feed conversion in the chickens on the crumbles and pellet was significantly better than the chickens fed the ground crumble-pellet diet and the all-mash diet. The better performance and net return in birds on pellet, emphasis the importance of feed mills to produce excellent quality pellets to help broiler producers to obtain maximum growth and feed conversion and therefore maximum income from their broilers. The physical form may have a stimulatory effect in the digestive tract that improves nutrient utilization of the pellet. Improved feed conversion with pellet diet was due to increase body weight, which is in general agreement with most of reports (Johannes, 2005; Clarke and Wiseman, 2005; Engberg *et al.*, 2002) but in disagreement with others (Canan Bolubaksi *et al.*,

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Table 2: Weight gain, feed intake and FCR of broilers as influenced by form of diet and Biozyme

Treatments	Form of diet	Biozyme	Weight gain <sup>1</sup>	Feed intake <sup>1</sup>	FCR (g/g) <sup>2</sup>
1	pellet	0	58.77 <sup>a</sup>	100.8 <sup>ab</sup>	1.72 <sup>bc</sup>
2	Pellet	0.75	61.13 <sup>a</sup>	104 <sup>a</sup>	1.7 <sup>c</sup>
3	Pellet	1.5	59.91 <sup>a</sup>	101.3 <sup>ab</sup>	1.6 <sup>c</sup>
4	Mash	0	50.37 <sup>b</sup>	94 <sup>c</sup>	1.87 <sup>ab</sup>
5	Mash	0.75	51.49 <sup>b</sup>	97.3 <sup>bc</sup>	1.9 <sup>a</sup>
6	Mash	1.5	49.62 <sup>b</sup>	99.4 <sup>abc</sup>	2 <sup>a</sup>
Main effect means					
Form of diet		Pellet	59.94 <sup>a</sup>	101.9 <sup>a</sup>	1.7 <sup>b</sup>
		Mash	50.5 <sup>b</sup>	96.9 <sup>b</sup>	1.9 <sup>a</sup>
Levels of Biozyme		0	54.57 <sup>a</sup>	97.4 <sup>a</sup>	1.795 <sup>a</sup>
		0.75	56.31 <sup>a</sup>	100.5 <sup>a</sup>	1.793 <sup>a</sup>
		1.5	54.77 <sup>a</sup>	100.4 <sup>a</sup>	1.84

<sup>a</sup>Values in same column without common superscripts letters (a-c) are significantly different (P<0.05). <sup>1</sup>Each mean represents from one bird (gram/bird/day). <sup>2</sup>corrected for mortality.

Table 3: Carcass characteristic of broilers at 42 days of age<sup>1</sup> as influenced by form of diet and biozyme supplementation

Weight of organs (g)	Form of diet		Levels of enzymes		
	Pellet	Mash	0	0.75	1.5
Carcass	2373 <sup>a</sup>	1940 <sup>a</sup>	2132 <sup>a</sup>	2216 <sup>a</sup>	2121 <sup>a</sup>
Thigh	525 <sup>a</sup>	438 <sup>a</sup>	486 <sup>ab</sup>	495 <sup>a</sup>	463 <sup>b</sup>
Breast	606 <sup>a</sup>	467 <sup>a</sup>	522 <sup>a</sup>	556 <sup>a</sup>	531 <sup>a</sup>
Abdominal fat	55.8 <sup>a</sup>	31 <sup>b</sup>	40.5 <sup>a</sup>	47 <sup>a</sup>	43 <sup>a</sup>
Heart	9.56 <sup>a</sup>	8.05 <sup>b</sup>	80.33 <sup>a</sup>	9.08 <sup>a</sup>	9 <sup>a</sup>
RV/TV	0.45 <sup>a</sup>	0.46 <sup>a</sup>	0.49 <sup>a</sup>	0.44 <sup>a</sup>	0.45 <sup>a</sup>

Values in same column without common superscripts letters (a-c) are significantly different (P<0.05).

2005). The results of carcass traits are shown in Table 3. The weight of carcass, breast, thigh and abdominal fat was influenced by the form of diet. Heart weight in broiler fed pellet diets were significantly (P<0.05) heavier than the broilers fed mash diets. On the other hand, Right ventricle to total ventricle ratio (RV/TV) was not affected by form of diet (P>0.05). Munt *et al.* (1995), shown that pellet form effect on the carcass traits such as gizzard and plucked empty body. Julian (1994), who reported that ascetic broiler chickens are growing significantly faster during the first week post-hatch and that suggestion slowing their growth might help to prevent, or control the incidence of ascites. Canan Bolubaksi *et al.* (2005) found that RV/TV ratio and heart weight ratio were significantly higher in pellet group and they had higher mortality rate due to ascites than the mash form diets. The relationship between pelleted feed and ascites was confirmed by Arca *et al.* (1985), who observed a 15% incidence with pellet feed versus 4% with mash feed. Ascites is the severe syndrome, causing enormous losses, in the broiler industry all over the world. Not only due to mortality but also caused to reduce body weight and increased condemnation at slaughter (Shlosberg and Bellaiche, 1996; Wideman and Robert, 1999). The ratio of the right ventricle to the total ventricle mass is a gross indicator of ascites (Mc Govern *et al.*, 1999). Metabolic pressure increase when the broilers feed much more pellet diet which this lead to failure of right ventricle, but in this study, broilers didn't have any problems on their right ventricle with increasing feed intake. We didn't see incidence of ascit in broilers and it

was a result of the best control of environmental condition in this experiment.

**Levels of enzyme:** As shown in Table 2, we also observed that Biozyme supplementation improved weight gains, feed intake and feed conversion ratio (FCR). The birds fed diet containing 0.75 kg/ton Biozyme had greater weight gain (56.31 vs. 54.77 and 54.57 gram/bird/day) and better FCR (1.793 vs. 1.795 and 1.85) than birds fed diets containing the two others levels. Douglas *et al.* (2000) demonstrated that supplementation of maize/soy diets with a commercial carbohydrate/protease preparation improved the energy value of the diets. Garcia *et al.* (2003) observed that using Amylase enzyme of maize/soy diets improved feed efficiency, but it has no significantly effect on carcass traits. Zanella *et al.* (1999), also reported that enzyme supplementation improved overall crude protein digestibility in corn/soy-based broiler diets by 2.9% (80%±0.7 vs. 82.9%±0.7). Performance studies by the same research group demonstrated that the enzyme supplementation improved body weight and feed conversion ratio by 1.9 and 2.2%, respectively. Greenwood *et al.* (2002), reported that addition of Avizyme 1502 in to reduced ME diet (2, 3 and 4% in starter, grower and finisher) improved performance in terms of 42-day body weight and FCR. Additionally, Kidd *et al.* (2001), found that Avizyme 1500 improved significantly 49-day mortality corrected feed conversion when applied OTT into a diet with increased lysine and TSAA levels compared to the ones found in IS. Enzymes

may hydrolyse polysaccharides that are involved in encapsulation of starch or protein, rendering compounds available for digestion that were previously not accessible to endogenous enzymes. Additionally, enzymes may hydrolyse antinutrients such as Phytin (Cowieson *et al.*, 2004), enzyme inhibitors or Lectins (Huo *et al.*, 1993), increasing the efficiency of endogenous enzymes and improving the net energy of maize. It has also been demonstrated that the use of various exogenous enzymes can improve the nutritional value of diets by reducing the loss of exogenous material.

In this experiment, levels of enzyme were significant effect on carcass traits where as the weight of heart and RV/TV ratio didn't influence by them. Broiler fed diets containing enzymes had heavier weight of breast, thigh and abdominal fat than the others and this results are agree with other studies (Wyatt *et al.*, 1999). Caf *et al.* (2002), and Waldroup *et al.* (2002), reported that adding enzyme supplementation of broilers feed corn-soy bean meal had significant effect on abdominal fat and other carcass traits and this is the result of getting energy from enzyme supplementation diets. Greenwood *et al.* (2002) found that adding Avizyme 1502 in corn-soy meal broiler diet has not effect on carcass traits. Esteve-Garcia and Stefan (2000) investigated that the effect of DL-methionin and betaine on growth performance and carcass characteristics in broilers and shown that betaine positive effect on carcass traits. We also found that the carcass traits were improved by the synergism effect of Biozyme. One of the importance ingredient of Biozyme component is a betaine that donor methyle groups and this improve carcass traits.

**Interaction effect:** Results of Table 2 indicated interaction between form of diet and levels of enzyme. The weight gain and feed intake were significantly ( $P < 0.05$ ) greater in diet 2 (0.75 kg/ton enzyme and pellet) than the other diets, but diet 3 was the best FCR. Interaction between pellet and levels of enzymes shown that processing of pellet didn't have any effect on Biozyme activity. However, the weight gain was influenced by the interaction effects more than the feed conversion ratio. Al Bustany (1996) found that enzyme supplementation was more effective on the mash than on the pelleted diets for improving the feed conversion ratio and reducing the frequency of sticky droppings, as indicated by the significant interaction between form of diet and enzyme supplementation. Yuben *et al.* (2004), found that the Xylanase supplementation improved weight gains and feed conversion in pellet form of diet. Inborr and Bedford (1994), investigated of adding enzyme to steam pelleting during fed processing and shown that conditioning at 75°C for 30s reduced  $\beta$ -glucanase activity compared with control mash diets to 66% of initial activity, whereas 15min conditioning at

75°C reduced recovery to 49%. They also report that there condition was a negative effect of conditioning temperature and a positive effect of enzyme level on live weight gain and feed efficiency. These results showed that the use of supplemental Biozyme in corn-based diets for broilers was beneficial, irrespective of the presentation method of processing diets. Furthermore, recent work by the author has demonstrated that Xylanase, amylase, protease and Phytase can be used effectively in combination to improve the performance of broiler chickens fed on maize/soy diets that have been "down-specified" in terms of energy, amino acids, calcium and phosphorus (Dansico Animal Nutrition, Unpublished data). These data showed that both FCR and body weight gain of birds fed on a low nutrient density diet (reduced by approximately 1.2 g/kg available phosphorus, 1.2 g/kg calcium, 0.57  $\mu$ j/kg metabolizable energy and 1-3% in amino acids) could be returned to that of birds fed on a nutritionally adequate diet when the low nutrient density diet was supplemented with Xylanase, amylase, protease and Phytase (Cowieson, 2005).

## References

- Acamovic, T., 2001. Commercial applications of enzyme technology for poultry production. *World's Poult. Sci.*, 57: 225-243.
- Adeola, O. and M.R. Bedford, 2004. Exogenous dietary xylanase ameliorates viscosity-induced anti-nutritional effects in wheat-based diets for white pectin ducks. *Br. J. Nutr.*, 92: 87-94.
- Al Bustany, Z., 1996. The effect of pelleting an enzyme-supplemented barley-based broiler diet. *Anim. Feed Sci. Tec.*, 58: 283-288.
- Arca, J., G. Soto and E. Avila, 1985. Efecto de la presentaci on del syndrome ascitico en el pello de engorda. *Proc. 11<sup>th</sup> Cong. Latin-American de Avicultura, Acapulca, Mexico*, pp: 735-744.
- Barrier-Guillot, B., J-P. Metayer and L. Roffidal, 2001. Composition et valeur energetique de 25 lots de mais grain chez le coq adulte. *Quatriemes Jouinees de la Recherche Avicole, Nantes*, 27-29 mars 2001.
- Behnke, K.C., 1994. Factors affectors affecting pellet quality. *Maryland Nutrition Conference. Dept. of Poultry Science and Animal Science, Collage of Agriculture, University of Maryland, College Park*.
- Behnke, K.C. and R. Scott Beyer, 2004. Effect of feed processing on broiler performance. Ph. D. Dissertation, Kansas State University, Manhattan.
- Caf, M.B., C.A. Borges, C.A. Fritts and P.W. Waldroup, 2002. Soybean meal based diets. *J. Appl. Poult. Res.*, 11: 29-33.
- Calet, C., 1965. The relative value of pellets versus mash and grain in poultry nutrition. *Worlds Poult. Sci.*, 21: 23-52.

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- Canan Bolubaksi, S., M. Sinan Aktas and M. Guzed, 2005. The effect of feed regimen on Ascites induced by cold temperatures and growth performance in male broilers. *Poult. Sci.*, 4: 326-329.
- Clarke, E. and J. Wiseman, 2005. Effect of variability in trypsin inhibitor content of soybean meals on true and apparent ileal digestibility of amino acids and pancreas size in broiler chicks. *Anim. Feed Sci. Tec.*, 121: 125-138.
- Combs, G.F., 1959. Maryland-Research Broiler Nutrition. Proceedings University of Maryland 1959 Nutrition Conference for feed Manufacturers, March 19-20, pp: 33-54.
- Coon, C.N., K.L. Leske, O. Akavanichan and T.K. Cheng, 1990. Effect of oligosaccharide-free soybean meal on true metabolisable energy and fibre digestion in adult roosters. *Poult. Sci.*, 69: 787-793.
- Cowieson, A.J., T. Acamovic and M.R. Bedford, 2004. The effect of phytic acid and phytase on the digestibility of maize starch for growing chickens. In: Proceedings of the International Poultry Scientific Forum, Atlanta, Georgia, USA, p: 31.
- Cowieson, A.J., 2005. Factors that affect the nutritional value of maize for broilers. *Poult. Sci.*, 119: 193-305.
- Douglas, M.W., C.M. Parsons and M.R. Bedford, 2000. Effect of various soybean meal sources and Avizyme on chick growth and ileal digestible energy. *J. Appl. Poult. Res.*, 9: 74-80.
- Engberg, R.M., M.S. Hedemann and B.B. Jensen, 2002. The influence of grinding and pelleting of feed on the microbial composition and activity in the digestive tract of broiler chickens. *Br. Poult. Sci.*, 43: 569-579.
- Esteve-Garcia, E. and M. Stefan, 2000. The effect of DL-methionine and betaine on growth performance and carcass characteristics in broilers. *Anim. Feed Sci. and Tec.*, 87: 58-93.
- Garcia, M.I., M.J.R. Aran-bar., P. Medel and G.G. Mateos, 2003. Amylase supplementation of broiler diets based on corn. *Poult. Sci.*, 82: 436-442.
- Greenwood, M.W., C.A. Fritts and P.W. Waldroup, 2002. Utilization of Avizyme 1502 in corn-soy meal broiler diets with and without antibiotics. *Poultry Sci.* 91<sup>ST</sup> Annual meeting. Abstracts, S 23, pp: 116.
- Huo, G.C., V.R. Fowler, J. Inbarr and M.R. Bedford, 1993. The use of enzymes to denature antinutritive factors in soybean. In: Proceedings of the Second International Workshop on Antinutritional Factors in Legume Seed, Wageningen, Netherlands, and p: 60.
- Hull, S.J., P.W. Waldroup and E.L. Stephenson, 1968. I. Utilization of unextracted soybeans by broiler chicks. II. Influence of pelleting and regrinding on diets with infra-red cooked and extruded soybeans. *Poult. Sci.*, 47: 11-15.
- Inbarr, J. and M.R. Bedford, 1994. Stability of feed enzymes to steam pelleting during feed processing. *Anim. Feed Sci. Tec.*, 46: 179-196.
- Johannes Van Biljon, N., 2005. The effect of feed processing and feed conversion and mortality in male. Department of production Animal and community Health Faculty of veterinary Science University of Pretoria.
- Julian, R.J., 1994. Metabolic disorders and welfare of broilers. Proc. 9<sup>th</sup> European Poultry Conference, Glasgow, U. K. 1, pp: 64-69.
- Kidd, M.T., G.W. Morgan, Jr., S.R. Rogers, E.E. Pierson, and C. Wyatt, 2001. Commercial broiler responses to enzyme and diet density. *Poult. Sci.*, 80: Abstract 114.
- Kilburn, J. and H.M. Edwards, 2001. The response of broilers to the feeding of mash or pelleted diets containing maize of vary particle size. *Br. Poult. Sci.*, 42: 484-492.
- Leske, K.L., C.J. Jevne and C.N. Coon, 1993. Extraction methods for removing soybean alpha-galactosides and improving true metabolisable energy for poultry. *Anim. Feed Sci. Tec.*, 41: 73-78.
- Lesson, S., A. Yersin and L. Volker, 1993. Nutritive value of the 1992 corn crop. *J. Appl. Poult. Res.*, 2: 208-313.
- Marsman, G.J., H. Gruppen., A.F. Vander poul, R.P. Kwakkel, M.W. Versteegen and A.G. Voragen, 1997. The effect of thermal processing and enzyme treatments of soybean meal on growth performance, ileal nutrient digestibilities, and characteristics in broiler chicks. *Poult. Sci.*, 76: 864-872.
- Mc Govern, R.H., J.J.R. Feddes, F.E. Robinson and J.A. Hanson, 1999. Growth performance, carcass characteristics, and the incidence of Ascites in broilers in response to feed restriction and litter oiling. *Poult. Sci.*, 78: 522-528.
- Munt, R. Hc., J.G. Dingle and M.G. Sumpa, 1995. Growth, carcass composition and profitability of meat chockens given pellets mash or free-choice diet. *Br. Poult. Sci.*, 36: 277-284.
- Proud Foot, F.G. and H.W. Hulan, 1982. Effect of reduced feeding time using all-mash or crumble-pellet dietary regimens on broiler chicken performance, including the incidence of a acute death syndrome. *Poult. Sci.*, 61: 750-754.
- SAS Institute, 1997. SAS/STAT<sup>®</sup> User's Guide: Statistics, Version 6.12. SAS Institute Inc., Cary, Nc.
- Shlosberg, A. and M. Bellaiche, 1996. Hematocrit values and mortality from ascites sliva, J.M.L., Dale, N., and Luchesi, J.B., 1988. Effect of pelleted feed on the incidence of ascites in broilers reared at low altitudes. *Avian Dis.*, 32: 376-378.

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- Van Biljon, N.J., 2005. The effect of feed processing and feed texture on body weight, feed conversion and mortality in male broilers. Dissertation, University of Pretoria.
- Waldroup, P.W., M.B. Café, C.A. Fritts and M.W. Greenwood., 2002. The Arkansas experience with Avizyme. Multi-state Poultry Meeting.
- Wideman, J.R. and F. Robert, 1999. Cardiac output in four-, five-, six- week- old and hemodynamic responses to intravenous injections of epinephrine. *Poult. Sci.*, 78: 392-403.
- Wyatt, C.L., M.R. Bedford and L.A. Waldron, 1999. Role of enzymes in reducing variability in nutritive value of maize using the ileal digestibility method. Page 108-111 In: *Proceedings of Aust. Poultry. Sci. Symp.* 10., Sydney, Australia.
- Yuben, B. Wu. and V. Ravindran, 2004. Influence of whole wheat inclusion and Xylanase supplementation on the performance on the performance, digestive tract measurements and carcass characteristics of broiler chickens. *Anim. Feed Sci. Tec.*, 116: 129-139.
- Zanella, I., N.K. Sakomura, F.G. Silversides, A. Figueirido, and M. Pack, 1999. Effect of enzyme supplementation of broiler diets based on corn and soybeans. *Poult. Sci.*, 78: 561-568.