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# Effect of Using Enzyme Complex on Productivity and Hatchability of Broiler Breeders Fed a Corn-Soybean Meal Diet

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## Abstract

A total number of 5520 female and 480 male breeders (Arbor Acres plus) at 42wks of age were used in a 10-week-trial to investigate the effect of an enzyme complex on the quality and quantity of egg production as well as hatchability of broiler breeders fed a corn-soybean meal diet. There were two dietary treatment groups: a control group fed on a corn-soybean based diet, and the multi-enzyme group that received the same diet plus an enzyme complex including xylanase, amylase, protease, phytase, ß-glucanase, hemicellulase, and pectinase. Results showed that egg production rate and egg mass were numerically increased as a result of enzyme supplementation and differences between the treatment groups were significant at week 46 ($P<0.05$). Hatchability was not influenced by supplementing multi-enzyme mixture in the diet. The proportion of cracked and broken eggs was signed ($P<0.05$) improved after using multi-enzyme supplementation in the diet of breeders. In conclusion, egg production and egg mass were increased as a result of multi-enzyme preparation. Significant improvements achieved in egg shell quality led to a greater number of eggs for hatching, though hatchability itself, was not improved by multi-enzyme supplementation.

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## Introduction

Over the past decade, dietary enzymes have been used as a tool to inactivate specific antinutritional factors in monogastric animals, especially in poultry. The use of exogenous enzymes to degrade indigestible dietary components has yielded inconsistent results mainly because of the presence of complex substrates in feedstuffs and the use of enzymes often not suitable for effective hydrolysis of such components (Slominski, 2011). Cleophas *et al.* (1995) suggested that a combination of different enzymes of different activities is required for complete degradation of complex non-starch polysaccharides (NSP) and improved nutrient utilization. Recent *in vitro* studies showed that a combination of carbohydrase enzymes is more effective in NSP depolymerization of soybean meal, canola meal, and peas than when the individual carbohydrases were used (Meng and Slominski, 2005; Meng *et al.,* 2005). Enzymes can have a synergistic effect thus, some crude forms might be effective in improving performance. One enzyme coexisting in the crude form might be boosted by the presence of a small amount of another enzyme, resulting in an improvement in poultry performance. The synergistic effect of commercial enzymes was reported by Tahir *et al.* (2005) and was further discussed in a review by Slominski (2011).

Although the use of enzyme complex to enhance nutrient utilization has been extensively studied in broilers (Aftab, 2009; Kocher *et al.,* 2003; Yu and Chung, 2004) and commercial layers (Novak et al., 2008; Scheideler *et al.*, 2005; Yao *et al.*, 2007), only a few studies have dealt with broiler breeders in which single enzyme application was investigated. For example, Berry *et al.* (2003) examined the effects of dietary phytase on egg production, fertility, and hatchability in broiler breeders and they found that phytase supplementation tended to improve fertility and hatchability. Little information is available about the effect of multi-enzyme preparation on broiler breeder performance. The objective of the current study was to investigate the effect of an enzyme complex on productivity, egg broken percentage, and hatchability in broiler breeders fed a corn-soybean meal diet.

## Materials and Methods

### Birds and housing

The experiment involved a total number of 5520 female and 480 male breeders (Arbor Acres plus) in a litter-floored house. The birds divided into two equal groups (treatments) of 2760 female and 240 male birds and housed at density of 1800 $cm^2$ per bird. Each group was subdivided into 4 replications; each consisting of 690 female and 60 male breeders. The age of all birds was 42wk at the beginning of the experiment. The experiment lasted for 10 weeks in the laying period (from 42 to 51 wk). The daily photoperiod consisted of 16hours of light and 8hrs of dark. The lights were turned on at 04:00 and turned off at 20:00. Thermoneutral

temperature was maintained throughout the trial (23 ± 1˚C). Birds were reared on litter floor. Feed and water were supplied *ad libitum* throughout the feeding trial. In both groups, eggs were collected daily at seven collection times: 09:00, 10:30, 12:00, 13:30, 15:00, 16:30 and 18:00 h.

**Dietary treatments**

Broiler breeders were subjected to two different treatments. Treatment 1 was control group, in which a commercial corn-soybean meal diet was fed to the broiler breeders during the laying period. The commercial diet designated as the control met recommendations of breeder requirements (Leeson and Summers, 2000). Treatment 2 was prepared by supplementing an enzyme complex to the control diet at 0.35% at the expense of wheat bran in the control diet. The experimental diets offered in mash form and contained 2,750 Kcal of ME and 16.3% of CP (Table 1). Enzyme supplementation included activities of xylanase (150U/Kg), amylase (200U/Kg), protease (2000 U/Kg), phytase (200U/Kg), ß-glucanase (300 U/Kg), hemicellulase (1000 U/Kg), and pectinase (1500 U/Kg).

**Table 1. Composition of the basal diet used in laying period of breeders (42 to 51 wk)**

| Ingredient | Amount in the diet (%) |
|---|---|
| Corn | 65.25 |
| Soybean meal (44% CP) | 24.50 |
| Wheat bran | 0.35 |
| Dicalcium phosphate | 1.40 |
| Oyster shell | 7.70 |
| Mineral premix[1] | 0.25 |
| Vitamin premix[2] | 0.25 |
| NaCl | 0.30 |
| | |
| *Analyzed values* | |
| Calculated ME (Kcal/Kg) | 2750 |
| CP (%) | 16.30 |
| Sulfur amino acids (%) | 0.62 |
| Lys (%) | 0.84 |
| Ca (%) | 3.00 |
| Available P (%) | 0.36 |

[1]Mineral premix consisted of the following in milligrams per kilogram of diet: Mn, 120; Zn, 120; Fe, 180; Cu,10; I, 2.5; Co, 1.0.

[2]Vitamin premix consisted of the following per kilogram of diet: vitamin A, 13,200 IU; cholecalciferol, 4,000 IU;vitamin E, 66 IU; vitamin B12, 34.6 µg; riboflavin, 13.2 mg; niacin, 110 mg; pantothenic acid, 22 mg; vitamin K,4 mg; folic acid, 2.2 mg; thiamine, 4 mg; pyridoxine, 8 mg; and biotin, 252 µg.

The multi-enzyme cocktail was added at the expense of wheat bran (0.35% of diet) in the enzyme-supplemented dietary treatment.

**Measurements**

Hen-day egg production was calculated by dividing the total number of eggs collected during a period (week) by total number of hens. Egg mass was determined by multiplying egg production by the average of egg weight for each week. The eggs were incubated at 37.6°C and 55% relative humidity in a commercial incubator with automatic egg turning. Eggs were transferred to a hatcher (Petersime, PT100, USA) at day 19. Eggs from different treatments were labeled, and placed in standard incubator trays randomly placed inside the incubator. Percent hatchability was calculated by dividing total chickens placed for growout to the total egg set. The obvious shell cracks and breaks were recorded and presented as a percent of total egg laid.

**Statistical Analysis**

The t-test was used to compare treatment means (house records) at a single time point. Statistical analysis was done by means of JMP software (SAS, 2005). A significance level of 5% was used.

## Results and Discussion

Hen-day egg production of the control and multi-enzyme groups is presented in Figure 1. Hen-day egg production was significantly ($P<0.05$) higher in multi-enzyme group than the control at 46 wks of age. Birds received multi-enzyme supplementation had numerically higher egg production rate than control for the rest of laying period. This was in line with previous research on commercial layer strains which revealed that multi-enzyme supplementation (xylanase, amylase and protease) increased egg production performance (Scheideler *et al.*, 2005). they indicated that higher egg production was attributed to significantly higher retention of protein. Francesch *et al.* (1995) also used different doses of a multi-enzyme mixture in commercial laying hen diets and found that production rate was numerically increased even though the elevation was statistically insignificant. In the study of Berry *et al.* (2003), they added phytase to a corn-soybean meal diet at 300U/Kg and observed an increase in overall hen-day egg production of broiler breeder by 10%. The multi-enzyme mixture used in the present study had several activated enzymes including xylanase, amylase, protease, phytase, ß-glucanase, pentosanase, hemicellulase, and pectinase. The production rate was 3.5% higher in the multi-enzyme group than control at week 46 (68 *vs* 64.5%) (Figure 1), and this difference was significant. Several factors including the dosage of phytase, the age of the bird and the quality and type of diet may account for variability between results of the present study and those reported by Berry *et al.* (2003). The phytase activity in the enzyme cocktail used at this experiment was 50% lower than that

used by Berry *et al.* (2003) (200 *vs* 300U/Kg). The age of breeders and diet specifications were also different between the studies.

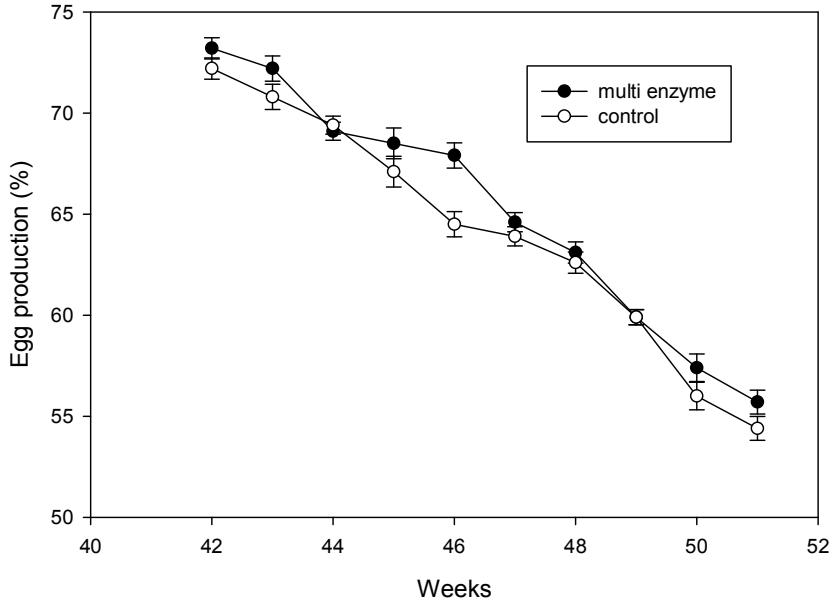


**Figure 1. Effect of multi-enzyme supplementation on hen-day egg production in broiler breeders.**

Egg mass showed a similar trend as egg production (Figure 2). The difference between the control and the multi-enzyme group was significant ($P<0.05$) for egg mass in week 46. Egg mass was determined by two components, egg weight and egg production. The similar trend of egg mass and egg production implies that variability in egg mass was mainly due to differences in egg production. Similar finding has been reported by Khajali *et al.* (2008) where birds fed a multi-enzyme supplemented diet had numerically higher egg mass throughout the experiment.

Little published information is available about the influence of multi-enzyme supplementation on the hatchability of eggs in broiler breeders. Berry *et al.* (2003) reported that supplementing broiler breeder diets with phytase did not make any improvement in hatchability. This was also confirmed by the finding of the present study. Our observation indicated that hatchability in broiler breeders was not responsive to dietary enzyme supplementation (Figure 3). The reason can be

explained by the fact that the key nutrients supporting hatchability (vitamins and micro minerals) are supplemented at levels far beyond the requirements of broiler breeder. Leeson and Summers (2000) reported that vitamins and trace minerals used by breeder companies were at least twice than what needed by the birds. Therefore, enzyme supplementation may not improve the hatchability to a great extent. Hatchability showed a decreasing trend by age in both groups.

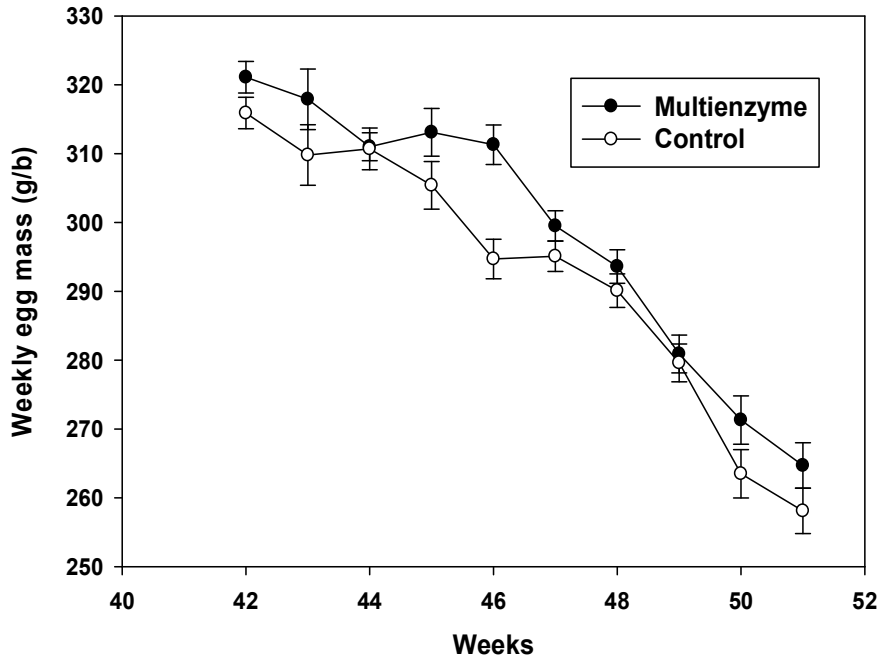


**Figure 2. Effect of multi-enzyme supplementation on egg mass of broiler breeders.**

Cracked egg percentage is a measure of egg shell quality. As depicted in Figure 4, multi-enzyme addition to breeder diet resulted in lower number of cracked and broken eggs. The significant reduction in cracked eggs in the multi - enzyme group can be explained by the action of phytase and its interaction with other enzymes. About two third of the total phosphorus in poultry diets present in the form of phytic acid (Singh, 2008). It has been reported that phytase supplementation improves bioavailability of phytate phosphorus resulting in improved feed intake, egg production and performance of laying hens (Rama Rao *et al.,* 1999; Sohail and

Roland, 2000). Phytic acid has a strong chelating potential to form a variety of complexes with cations (Ca, Mg, Zn, Mn and Cu), rendering these cations biologically unavailable (Singh, 2008). The significant improvement in egg shell quality may be explained by the action of phytase and the synergetic effect between phytase and the other enzymes in the mixture. It should be noted that phytase as a single enzyme may not considerably improve cracked eggs in commercial laying hens (Tangendjaja *et al.,* 2002).

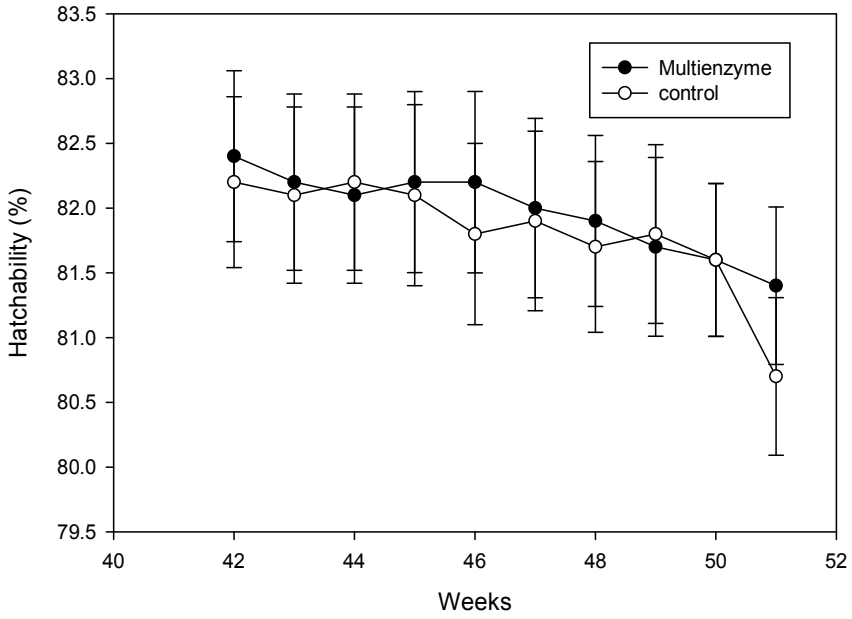


**Figure 3. Effect of multi-enzyme supplementation on hatchability in broiler breeders.**

The percentage of cracked eggs was significantly ($P<0.05$) lower in the enzyme-received group than the control throughout the feeding trial (Figure 4). It is well documented that phytase increases bioavailability of not only phosphorus but also of metabolizable energy, amino acids, macro and micro elements (Khajali and Slominski, 2012). The formation of chelate between phytate and NSP hinders the phytate hydrolysis and therefore, that application of NSP-degrading enzymes in combination with phytase is more effective in improving nutrient digestibility. This could be regarded as the main reason why multi-enzyme supplementation

resulted in significant improvement in the percentage of cracked eggs. There was an increasing trend in cracked eggs by age in both groups. However, it was more severe in the control than in the multi-enzyme group. This was in line with the previous reports indicating that egg shell quality decreases as birds grow older (Nys, 1986; Roberts, 2004).

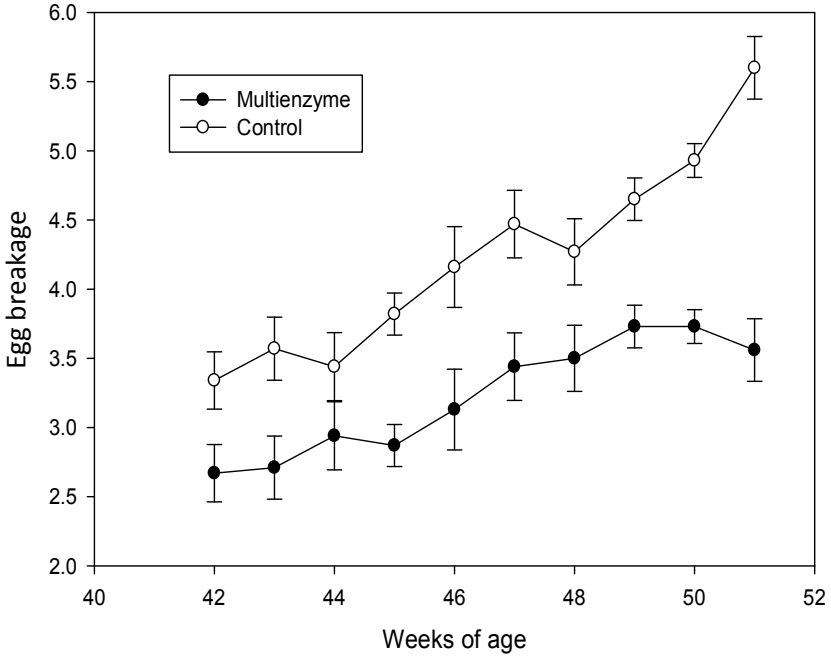


**Figure 4. Effect of multi - enzyme supplementation on proportion of cracked and broken egg in broiler breeders.**

Egg size increases with advancing age and at the same time shell weight increases or stays the same. Either way, the increase in egg weight is not accompanied by a proportional increase in shell weight, therefore, the ratio of shell weight to egg weight (often referred to shell percentage) decreases. There is some evidence that the inability of the hen to produce an increased amount of egg shell is related to the activity of 25-hydroxycholecalciferol-1-hydroxylase, an enzyme involved in calcium homeostasis (Roberts, 2004). Manipulations that decrease egg size may improve egg shell quality in older hens (Keshavarz, 2003). In conclusion,

egg production and egg mass were increased as a result of multi-enzyme supplementation. Significant improvements in egg shell quality led to a greater number of eggs for hatching. However, hatchability itself, was not improved by multi-enzyme supplementation.

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