

The Efficacy of Avizyme 1500 for Improving Performance of Laying Hens

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ABSTRAK

SINURAT, A.P., P.P. KETAREN, A.J. Cowieson dan M.H.L. BENTO. 2012. Penambahan Avizyme 1500 dalam ransum untuk meningkatkan performan ayam petelur. *JITV* 17(3): 221-228.

Suatu percobaan telah dilakukan untuk menguji manfaat penambahan enzim- Avizyme 1500® (Danisco Animal Nutrition, Marlborough, UK) terhadap performan ayam petelur selama periode satu tahun produksi. Ransum kontrol disusun dengan bahan utama terdiri dari jagung dan bungkil kedelai untuk memenuhi kebutuhan gizi ayam petelur strain ISA Brown. Dua perlakuan yang diuji adalah ransum kontrol (C) dan ransum yang diberi enzim (C + 1000 g Avizyme/ton ransum. Setiap jenis ransum diberikan pada 80 ekor ayam petelur (20 ulangan dan 4 ekor/ulangan) mulai umur 20 hingga 72 minggu. Selama percobaan tersebut dilakukan pengamatan terhadap performan ayam petelur (konsumsi pakan, produksi telur, bobot telur, total berat produksi telur atau *egg mass*, konfersi pakan atau FCR, mortalitas, perubahan bobot badan dan kualitas telur). Perbedaan perlakuan dianalisis dengan menggunakan t-test. Hasil penelitian menunjukkan bahwa penambahan Avizyme 1500 kedalam pakan dapat menurunkan konsumsi pakan 4% ($P < 0,01$), mengurangi mortalitas dari 15% menjadi 3,75% ($P < 0,01$) serta memperbaiki efisiensi penggunaan pakan (FCR) sebanyak 3% ($P < 0,05$). Mortalitas yang tinggi pada ayam kontrol (15%) terjadi karena adanya infeksi *E.coli*, sesuai uji post-mortem yang dilakukan. Akan tetapi, produksi telur (HD and HH), bobot telur dan massa telur tidak nyata dipengaruhi oleh penambahan Avizyme didalam pakan. Kualitas telur (HU, indeks kuning telur, bobot kuning telur dan tebal kerabang tidak nyata dipengaruhi oleh penambahan Avizyme dalam ransum. Oleh karena itu disimpulkan bahwa penambahan 1000 g Avizyme /ton ransum dapat memperbaiki efisiensi penggunaan pakan (FCR) sebagai akibat penurunan konsumsi pakan, tanpa merubah produktifitasnya.

Kata Kunci: Produksi Telur, Enzim, Efisiensi Penggunaan Pakan (FCR), Kualitas Telur

ABSTRACT

SINURAT, A.P., P.P. KETAREN, A.J. COWIESON and M.H.L. BENTO. 2012. The efficacy of avizyme 1500 for improving performance of laying hens. *JITV* 17(3): 221-228.

A trial was conducted in order to study the effect of the supplementation of Avizyme 1500® (Danisco Animal Nutrition, Marlborough, UK) on the performance of laying hens for one year. A control diet based on corn – soybean meal was formulated to meet nutrient requirement of ISA Brown laying hens. Two treatments, the control diet (C) and C + 1000 g Avizyme/tonne diet were tested. Each diet was fed to 80 birds (20 replicates of 4 birds) from 20 to 72 weeks of age, and performances of birds (feed intake, egg production, egg size, egg mass, feed conversion ratio, and egg quality) were measured. All data were subject to analyses of variance following the t-test. Results showed that the addition of Avizyme 1500 to the feed reduced feed intake by 4% ($P < 0.01$), mortality by 75 % or from 15% to 3.75% ($P < 0.01$) and improved the feed conversion ratio by 3 % ($P < 0.05$). The high mortality of the control treatment (15%) is explained by an *E.coli* infection that was observed following the post-mortem examination of dead birds. The egg production (HD and HH), egg size and egg mass however were not significantly affected by the Avizyme supplementation. Egg quality (HU, yolk colour score, yolk weight and shell thickness) was not significantly affected by Avizyme supplementation. It can be concluded that the supplementation of 1000 g Avizyme /tonne of diet improved feed efficiency and this was mediated via a reduction in feed intake.

Key Words: Egg Production, Enzyme, Feed Conversion Ratio, Egg Quality

INTRODUCTION

Enzymes are naturally produced in all living organisms which act as catalyst to accelerate chemical reactions in the biological system. Nowadays, supplementation of exogenous enzymes have been

practiced commercially in aiming to improve nutrients digestibility of feed or feed ingredients. The application of dietary enzyme is normally associated with the inclusion of feed ingredients which contain high antinutritive substances such as crude fibre and non-starch polysaccharides (NSPs). Feed ingredients such as

wheat, wheat pollard, barley, deoiled rice bran, soybean meal, peanut meal, copra meal, and sunflower meal have been known to have a high NSPs (MALATHI and DEVEGOWDA, 2001; CHOCT, 1997). The presence of these substances have been reported to increase the digesta viscosity in the gut which reduce the nutrient absorption and affect the performance of birds. Supplementation of enzyme in feed with ingredients high NSPs contents such as wheat (GUTIERREZ DEL ALAMO *et al.*, 2008), barley (GARCIA *et al.*, 2008), flaxseed (JIA and SOLOMINSKI, 2010), rye (BEDFORD and CLASSEN, 1993; Lazaro *et al.*, 2003) have been reported to reduce the intestinal digesta viscosity and improved the nutrient digestibility. Improvement in the nutrient digestibility of the feed due to enzymes supplementation were followed by the improvement in broilers performance (GARCIA *et al.*, 2008; JIA and SOLOMINSKI, 2010), although some also showed no improvement in the performance (DOUGLAS *et al.*, 2000; GUTIERREZ DEL ALAMO *et al.*, 2008).

In some countries, poultry feed were formulated based on corn- soyabean meal. Both feedstuffs are known to have a good source of energy and protein, normally regarded as highly digestible for poultry, with relatively low NSPs content (MENG and SLOMINSKI, 2005). Therefore, the benefit of inclusion of exogenous enzyme in such diet are often questioned. CHESSON (2001) reviewed some literatures and concluded that inclusion of commercial enzyme preparations in maize-soyabean diets have failed to produce the benefits observed with other cereal-based diets. However, there are evidence that the nutrient values of corn (COWIESON, 2005) and soybean meal (DE COCA-SINOVA *et al.*, 2008) are variable. Some proofs that the supplementation of exogenous enzyme in corn-soybean diet improved the body weight 0.5 to 10.9% and the FCR 0.78 to 10.5% over control (COWIESON, 2005). Therefore, a trial was designed to study the effect of supplementation of a multi enzyme (consist of xylanase, amylase and protease) in improving the performance of laying hens.

MATERIALS AND METHODS

A trial was conducted to study the efficacy of an enzyme Avizyme 1500® (Danisco Animal Nutrition, Marlborough, UK) in laying hens at the poultry unit of the Indonesian Research Institute for Animal Production (Balai Penelitian Ternak), Bogor-Indonesia. One hundred and sixty (160) pullets - 18 weeks of age, strain Isa Brown were weighed individually and distributed randomly into individual cages. Each four cages were equipped with one feeder and considered as a replicate. The birds were reared according to normal laying hens management practices and feed and water were always available during the trial.

Two (2) treatments were tested in this trial. The treatments consisted of: A diet without enzyme supplementation (marked as Control or C) and C + Enzyme (T). The enzyme tested was the Avizyme 1500® which contains 600 U/g endo- 1,4 beta xylanase EC 3.2.1.8; 1600 U/g alpha amylase EC 3.2.1.1. and 4000 U/g protease EC 3.4.21.62. The control diet was formulated based on corn-soyabean meal, to meet the nutrient requirement of the laying hens which were adjusted according to the age of the birds (Table 1). No antibiotic nor coccidiostat was given in the feed during the trial. The dietary treatments were allocated randomly with 20 replicates each. The enzyme tested was mixed at 1000 g/tonne (T) in the diet. The diet was prepared in mash form and fed to the birds from 19 weeks to 72 weeks old or 52 weeks of egg production.

Birds were weighed individually at the beginning of the trial (at 19 weeks old age) and at the end of the trial to determine changing of the body weight due to the treatment. During the trial, feed intake was measured weekly and expressed as g/b/d, egg productions (HD and HH) and egg weight (g/egg) were recorded daily, but the data were analysed based on the average of 4 weeks period only. The egg quality was measured 2 times, i.e., at 31 and 67 weeks of age. The egg quality traits measured were: haugh unit (HU), egg yolk colour and shell thickness. Feed conversion ratio (FCR) was calculated by dividing the feed intake (gram) with the egg mass (gram) produced at the same period of time. The mortality of the birds were also recorded. The significance of differences between experimental and control groups was tested by a student's *t*-test (2 treatments and 20 replicates) following the procedures described by STEEL and TORRIE (1980).

RESULTS AND DISCUSSION

The mortality and the average body weight gain of birds during the one (1) year trial is shown in Table 2. The results showed that inclusion of the Avizyme 1500® in the diet did not significantly ($P > 0.05$) affect the average body weight gain of birds during one year trial. JALAL *et al.* (2007) also reported that supplementation of similar enzyme in the diet did not change the body weight of 3 (three) strains of laying hens fed for 28 weeks period. However, the enzyme supplementation significantly ($P < 0.01$) reduced the mortality of the birds from 15.00, to 3.75%. Post mortem analyses carried out on dead birds showed that the mortality was due to infections caused by *E. coli* (Colibacillosis) and *Haemophilus paragallinarum* (Coryza). Some dead birds were also found to have broken eggs in the abdomen cavity (egg yolk peritonitis), suspected as a result of infection by *E. coli* bacteria (Colibacillosis). There are some reports indicated that supplementation of enzymes in feed may

reduce the population of pathogenic bacteria in the digestive tracts of the birds (VAHJEN *et al.*, 1998; ENGBERG *et al.*, 2004). This may explain the lower mortality rates in birds fed enzyme-supplemented diet.

Feed intake of the birds during the one-year egg production is presented in Table 3. In all periods of observation, birds fed enzyme-supplemented diet have a lower feed intake than the control birds, although it was only statistically significant ($P < 0.05$) at 1st, 2nd, 3rd, 5th, 6th, 11th and 13th periods. The overall mean

(from 21-72 weeks of age) of feed intake of birds fed enzyme-supplemented diet was also significantly ($P < 0.01$) lower than those fed the control diet, i.e., 98.2 vs. 102.7 g/bird/d, respectively. SCHEIDELER *et al.* (2005) and JALAL *et al.* (2007) reported that similar enzyme (Avizyme[®]) supplementation in the corn-soya-based diet did not affect the feed intake significantly. This may be related to the lower dose of the enzyme applied in their study, i.e. 750 g/tonne feed.

Table 1. Composition of the control diet during the trial (g/kg)

Ingredient	Age of the birds					
	19-37 weeks		38-52 weeks		53-72 weeks	
Maize	674.40		675.00		675.00	
Soya bean meal 44	219.70		223.40		223.40	
Soya bean Oil	10.00		10.00		10.00	
NaCl	3.30		3.30		3.30	
DL Methionine	1.10		1.60		1.60	
Lysine- HCl	0.50		0.60		0.60	
Limestone	76.50		67.80		70.60	
Dicalcium phosphate	11.50		14.40		12.70	
Vitamin/Mineral mixtures *	3.00		4.00		4.00	
Compositions:	Calc.	Det.	Calc.	Det.	Calc.	Det.
Dry matter (%)	88.200	91.870	89.000	89.91	89.400	88.60
Crude Protein	15.980	14.820	16.240	19.23	16.250	19.60
ME, Kcal/kg	2910.000	ND	2921.000	ND	2921.000	ND
Calcium	3.250	4.300	3.250	4.33	3.250	3.65
Phosphorus (P)	0.590	0.550	0.529	0.84	0.529	0.60
Available P.	0.350	ND	0.350	ND	0.320	ND
Fat	4.170	4.330	4.180	6.09	4.180	3.46
Fibre	2.890	5.260	2.910	4.05	2.910	ND
Methionine	0.350	ND	0.412	ND	0.412	ND
Meth. + Cystine	0.585	ND	0.650	ND	0.650	ND
Lysine	0.836	ND	0.874	ND	0.874	ND
Sodium (Na)	0.220	ND	0.220	ND	0.225	ND

ND = Not determined; Calc. = calculated; Det.= determined.

*Each 1 kg contain: Vitamin A, 1,000,000 IU; Vitamin D3, 800,000 IU; Vitamin E, 4500 mg; Vitamin K3, 450 mg; VitaminB1, 450 mg; Vitamin B2, 1350 mg; Vitamin B6, 480 mg; Vitamin B12, 6 mg; Ca -d-pantothenate, 2400 mg; Folic acid, 270 mg; Nicotinic acid, 7200 mg; Ferros, 8300 mg; Copper, 700 mg; Manganese, 18500 mg; Zinc, 14,000 mg; Cobalt, 50 mg; Iodine, 70 mg; Selenium, 35 mg.

Table 2. Mortalities and body weight changes of chickens during one- year feeding trial

Observations	Treatments (Dose of enzyme in feed)		Significance (P)
	0 g/ton (Control)	1000 g/ton (Treated)	
Mortalities (%)	15.00 ^a	3.75 ^b	0.01
Avg. Body weight gain (g/bird)	164	146	0.60

Table 3. Feed intake of laying hens during one year egg production (g/bird)

Period of egg production, month	Control (C)	C + Enzymes	Significance (P)
1	89.2 ^a	84.8 ^b	0.01
2	89.2 ^a	86.3 ^b	0.03
3	90.4 ^a	88.6 ^b	0.03
4	90.1	87.3	0.24
5	94.4 ^a	89.4 ^b	0.03
6	96.7 ^a	91.3 ^b	0.03
7	97.2	94.2	0.25
8	104.3	99.7	0.09
9	100.9	96.6	0.08
10	105.3	101.7	0.19
11	126.8 ^a	118.4 ^b	0.01
12	125.7	119.9	0.19
13	124.7 ^a	118.9 ^b	0.03
Overall (1-13)	102.7 ^a	98.2 ^b	0.00

^{a,b}Means within a row with different superscript are significantly different (P < 0.05)
 C = Control (no enzyme); T = Control + 1000 g enzyme /tonne feed.

Egg production, egg weight and egg quality

Data on hen day egg production (HD) and hen house egg production (HH) of laying hens during one-year feeding trial is presented in Table 4. Results showed that the HD egg production was only significant (P < 0.05) during the 3rd and 4th period. However, results during the whole period, the dietary enzyme supplementation did not affect the hen-day egg production significantly (P > 0.05).

The HH egg production was only statistically significant (P < 0.05) at 3rd, 12th and 13th period of trial. In these periods, birds fed the control diet produced significantly (P < 0.05) less HH egg production than those fed with enzyme supplemented diet. The overall HH egg production was not significantly (P > 0.05) affected by the dietary enzyme supplementation. The overall mean HH egg production during one-year trial was 75.2 and 78.5% for birds fed the control diet (C) and enzyme supplemented (T) diet, respectively.

Data on the effect of enzyme supplementation in the diet on the egg size during one-year feeding trial is presented in Table 5. The egg size was not significantly

(P > 0.05) affected by dietary enzyme supplementation at all periods, although the egg size of birds fed enzyme supplemented diet tend to be heavier than the control. The average egg size during the whole period of birds fed the control diet was 61.77 g/egg and birds fed enzyme supplemented diet was 62.09 g/egg.

The effect of dietary enzyme supplementation on the egg quality are presented in Table 6. First measurement showed that the egg quality (yolk colour scores, yolk weight, Haugh Unit, shell weight and egg shell thickness) were not significantly (P > 0.05) affected by enzyme supplementation in the diet of laying hens, although the birds have been fed with treated diets for 12 weeks. However on the second measurement, i.e., at 67 week of age or 48 weeks after the treatments, there were a significant effect of dietary enzyme supplementation on shell weight (P < 0.01) and shell thickness (P < 0.01) but were not significantly (P > 0.05) affect the yolk colour score, yolk weight and Haugh. In this period, dietary enzyme supplementation significantly (P < 0.05) increased the egg shell weight and egg shell thickness.

Table 4. Hen-day (% HD) and Hen –house (% HH) egg production of laying hens during the trial

Period of egg production (month)	Hen-day egg production (%)			Hen house egg production (%)		
	Control (C)	Treated (T)	Significance (P)	Control (C)	Treated (T)	Significance (P)
1	70.09	70.58	0.90	70.0	70.6	0.89
2	80.95	79.29	0.38	80.6	78.8	0.50
3	79.34 ^a	85.31 ^b	0.01	77.3 ^a	85.3 ^b	0.00
4	73.80	74.11	0.99	71.3	73.1	0.63
5	86.73 ^a	79.97 ^b	0.01	81.7	77.6	0.25
6	84.88	81.50	0.21	78.7	79.3	0.84
7	84.38	81.55	0.28	77.8	79.4	0.65
8	83.27	80.02	0.12	76.5	76.5	0.97
9	84.29	84.73	0.86	76.2	81.4	0.16
10	84.84	86.43	0.60	76.7	83.2	0.12
11	85.57	83.41	0.55	75.8	80.4	0.21
12	81.47	81.07	0.53	69.9 ^a	78.1 ^b	0.03
13	76.40	79.23	0.15	65.4 ^a	76.3 ^b	0.01
Overall (1-13)	81.44	81.17	0.93	75.2	78.5	0.21

^{a,b}Means within a row with different superscript are significantly different (P < .05)

C = Control (no enzyme); T = Control + 1000 g enzyme /tonne feed.

Table 5. Average egg size (g/egg) of birds fed diet supplemented with enzyme during the trial (13 periods of 4 weeks)

Period of egg production, month	Control (C)	Treated (T)	Significance (P)
1	51.59	51.35	0.55
2	57.04	56.97	0.54
3	59.37	60.05	0.34
4	60.03	60.47	0.48
5	62.36	62.43	0.36
6	62.58	63.40	0.21
7	62.45	63.06	0.40
8	63.60	63.30	0.93
9	64.61	65.06	0.47
10	63.98	64.23	0.61
11	64.41	65.28	0.21
12	65.54	65.83	0.70
13	65.36	65.65	0.73
Overall means	61.77	62.09	0.46

C = Control (no enzyme); T = Control + 1000 g enzyme /tonne feed.

Feed conversion ratio

Data on feed conversion ratio (FCR) of laying hens during one-year egg production period is presented in Table 7. Statistical analyses showed that the only significant effect of enzyme dietary supplementation on the feed conversion ratio of laying hens was found at the 3rd, 9th, and 13th period (P < 0.05). In this period, the FCR of birds fed enzyme supplemented diet (1000 g enzyme/tonne feed) was significantly better than those fed with the control diet. The overall means of feed conversion ratio (FCR) for one-year trial were also significantly (P = 0.05) affected by the enzyme supplementation in the diet. The FCR of the birds fed

with control diet was 2.32 and supplementation of enzyme (1000 g enzyme/tonne feed) improved the FCR of the birds to 2.24.

Feed intake of birds in this study was quite low (i.e., 102.7 g/bird/day) as compared to normal intake of semi-heavy laying hens (Isa Brown strain). The standard feed intake of the Isa Brown birds during production period according to breeder standard is 115 g/bird/day (HUTAGALUNG, 2000). However, the low feed intake in this study may be due to a high ME of the diet (2900 kcal/kg). Results of this study showed that there was a significant reduction in feed intake by laying hens given 1000 g enzyme/tonne. The reduction was about 4% or approximately 4 g/bird/day. As it is

Table 6. Egg quality of birds fed enzyme- supplemented diet (at 31 and 67 weeks of age)

Parameters	at 31 weeks of age			at 67 weeks of age		
	Control (C)	Treated (T)	Significance (P)	Control (C)	Treated (T)	Significance (P)
Yolk colour score	6.5	6.2	0.07	6.0	5.8	0.48
Yolk weight, g/egg	14.1	17.0	0.25	16.0	17.0	0.08
Haugh Unit (HU)	88.4	88.9	0.63	89.6	90.4	0.61
Shell weight, g/egg	6.2	6.2	0.71	6.1 ^b	7.0 ^a	0.00
Shell thickness, mm	0.41	0.41	0.69	0.46 ^b	0.50 ^a	0.01

C = Control (no enzyme); T = Control + 1000 g enzyme /tonne feed.

^{a,b}Means within a row with different superscript are significantly different (P < .05)

Table 7. Feed conversion ratio of laying hens during the trial (13 periods of 4 weeks)

Period of egg productions	Control (C)	Treated (T)	Significance (P)
1	2.65	2.55	0.34
2	2.19	2.18	0.83
3	2.28 ^a	2.07 ^b	0.00
4	2.43	2.32	0.25
5	2.04	2.15	0.06
6	2.13	2.10	0.54
7	2.21	2.18	0.62
8	2.32	2.37	0.48
9	2.30 ^a	2.16 ^b	0.04
10	2.34	2.24	0.21
11	2.25	2.20	0.46
12	2.39	2.27	0.12
13	2.56 ^a	2.32 ^b	0.02
Overall means	2.32 ^a	2.24 ^b	0.05

^{a,b}Means within a row with different superscript are significantly different (P < .05)

C = Control (no enzyme); T = Control + 1000 g enzyme /tonne feed.

well known that feed intake of birds are controlled by the energy level in the diet. Since many study have shown that supplementation of enzyme increased the metabolisable energy of the diet (BEDFORD, 1995; SELLE *et al.*, 2003; MCDEVITT *et al.*, 2004; CHENG *et al.*, 2005), explains the reduction of feed intake in this study as a reflection of an increase in energy of the diet due to the enzyme supplementation.

A significant reduction in the mortality of birds during the one-year feeding trial was found in this trial. Veterinary examinations indicated that most of the dead birds caused by disturbances in the gastrointestinal tract. Supplementing the enzyme in the diet may have provided a better and healthier gastrointestinal of the birds, hence reduce the mortality. Previous reports (BEDFORD, 2000; SINLAE and CHOCT, 2000) showed that the population of pathogenic bacteria in the gastrointestinal of birds reduced when enzymes were included in the diet. The level of mortality of the control birds in this study was quite high as compared to standard performance of Isa Brown strain (6.7%) or normally found at the farmer level (8.2%) as reported by HUTAGALUNG (2000). This may be due to the fact that antibiotic and/or coccidiostat was not supplemented in the diet as normally practiced in commercial feed in Indonesia.

This study showed that the egg production (hen-day nor hen-house, egg mass production) and the egg size were not significantly affected by the enzyme supplementation in the diet. However, the HH and egg mass production of birds fed the Avizyme 1500[®] (1000 g/tonne feed) tend to be higher than the control due to a less mortality rate. The high nutrient density of the control diet (ME 2900 kcal/kg and CP 16%) used in this study may have provide sufficient nutrients to support the optimum egg production, and therefore any improvement in the nutrient availability due to the enzyme supplementation was not significantly reflected in the addition of egg production.

Results of this study also showed that the feed conversion ratio was significantly improved by the Avizyme 1500[®] supplementation at the 3rd, 12th, 13th period and also during one year period. The percentage of improvement as affected by inclusion of the Avizyme 1500[®] varied from 3.4% (the FCR for one year period) to 10.7% (the FCR at 13th period) as compared to the control. This results may reflect that there was a high variability between birds used in this experiment. This variability may be reduced when larger number of birds are to be used in the trial or when the homogeneity of the feed mixing is improved.

This study showed that the egg quality of laying hens was not affected by dietary enzyme supplementation when the egg quality was measured at 31 weeks old or 12 weeks after treatment. However, the response was different when measured in a longer

period (at 67 weeks of age), in which egg shell weight and egg shell thickness were significantly improved when birds fed with enzyme-supplemented diet.

CONCLUSION

This study conclude that the supplementation of the Avizyme 1500[®] in the corn-soya diet improved the performances of laying hens as indicated by a reduction of birds mortality and feed intake and improvement in feed conversion ratio.

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