

## Effect of Ipil Ipil and Bean Leaves Supplementation on Egg Production, Egg Quality and Growth Performance of Japanese Quail (*Coturnix Japonica*)

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### Abstract

This study was conducted in the Department of Physiology and Pharmacology to determine the effect of Ipil ipil and bean leaves supplementation on egg production, egg quality and growth performance of Japanese quail. A total of 40 "Japanese Quail" at the age of 42 days (06 weeks) old were divided into four groups T<sub>0</sub>, T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> respectively. Group T<sub>0</sub> was considered as control which fed only with commercial layer ration. Group T<sub>1</sub> was supplemented with formulation of 2 gm grinded Ipil Ipil leaves, Group T<sub>2</sub> with 2 gm grinded Bean leaves and Group T<sub>3</sub> with 2 gm grinded Ipil Ipil leaves plus 2 gm grinded Bean leaves per kg feed respectively. Observations were recorded for growth performance, egg production and egg quality of quail. Increased egg production rate was observed in Ipil Ipil supplemented groups (group T<sub>1</sub>). Body weights were increased significantly ( $p < 0.05$ ) in all treated groups in respect to the control and highest was recorded in combined Ipil Ipil and Bean leaves supplemented groups (Group T<sub>3</sub>). In treatment groups, there were significant increase in egg production, but in case of control group, the egg production was not increased. There was no significant pathological change in any internal organs of the layer of treated groups. Best result was found in the group T<sub>3</sub>. The present study reveals that combined supplementation of Ipil Ipil and Bean leaves gives better result over the other groups in respect to growth performance, egg production and egg quality.

**Key Words:** *Ipil ipil; Bean leaves; Egg and growth performances; Japanese quail*

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### Introduction

Bangladesh is a highly populated country and growth of population is increasing very fast in comparison to its land size, as a result huge pressure is created on people's basic needs. Demand of protein of this booming population is a great threat for us. There are so many sources of protein but it is impossible to fulfill the demand without Poultry meat and egg. Different types of poultry are present. Quail is one of them. Quail meat is popular to all of us and there is no religious restriction to consume. According to our socio-economic situation, the knowledge of our farmer is very little because most of them are not properly trained for quail production.

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Now a day's our unemployed young generation is coming in this business for long return of value and profit. Pharmaceutical companies take this advantage. They are convincing farmers for using synthetic phytase as a growth promoter and egg increaser for chicken as well as quail. As a result, each and every quail is a depot of antibiotics and other inorganic substances. When these quails are consumed by human these antibiotic and other inorganic residue enters into human body and causing serious human health hazards with drug resistance (Kibria, *et al.* 2009).

So, scientists are again concentrating on the use of our ancient medicinal system to find beneficial herbs and plants which can be safely used to increase the production. Such plants, Ipil Ipil (*Leucaena leucocephala*) and Bean (*Dolichos lablab*) are common plant which can be used as an alternative source of phytase.

A phytase (myo-inositol hexakisphosphate phosphohydrolase) is any type of phosphatase enzyme that catalyzes the hydrolysis of phytic acid (myo-inositol hexakis-phosphate) – an indigestible, organic form of phosphorus that is found in grains and oil seeds – and releases a usable form of inorganic phosphorus. While phytases have been found to occur in animals, plants, fungi and bacteria, phytases have been most commonly detected and characterized from fungi.

Phytic acid and its metabolites have several important roles in seeds and grains, most notably, phytic acid functions as a phosphorus store, as an energy store, as a source of cations and as a source of myo-inositol (a cell wall precursor). Phytic acid is the principal storage forms of phosphorus in plant seeds and the major source of phosphorus in the grain-based diets used in intensive livestock operations. The organic phosphate found in phytic acid is largely unavailable to the animals that consume it, but the inorganic phosphate that phytases release can be easily absorbed. Ruminant animals can use phytic acid as a source of phosphorus because the bacteria that inhabit their gut are well characterized producers of many types of phytases. However, monogastric animals do not carry bacteria that produce phytase, thus, these animals cannot use phytic acid as a major source of phosphorus and it is excreted in the feces.

Phytic acid and its metabolites have several other important roles in Eukaryotic physiological processes. As such, phytases which hydrolyze phytic acid and its metabolites, also have important roles. Phytic acid and its metabolites have been implicated in DNA repair, clathrin-coated vesicular recycling, control of neurotransmission and cell proliferation. The exact roles of phytases in the regulation of phytic acid and its metabolites and the resulting role in the physiological processes described above are still largely unknown and the subject of much research. Phytase is used as an animal feed supplement often in poultry and swine – to enhance the nutritive value of plant material by liberation of inorganic phosphate from phytic acid (myo-inositol hexakisphosphate).

Phytate is the major form of phosphorus found in cereal grains, beans and oilseed meals feed to poultry birds (Ravindran, *et al.* 1994). Approximately 61-70% phosphorus found in poultry diet ingredients is in the form of phytatephosphorus. But the monogastric animals like poultry birds are unable to utilize this phytate phosphorus, as they lack endogenous phytase, which necessitates in the addition of inorganic feed containing phosphates to poultry diets in order to meet the phosphorus requirements of poultry (Yu, *et al.* 2004). It results in relatively large amounts of phosphorus in the manure that contribute to environmental pollution (Guoy, *et al.* 2009). Exogenous phytase of microbial origin can be used as an alternative that can help to reduce phosphorus excretion in poultry (Yu, *et al.* 2004). The beneficial effect of exogenous phytase in poultry ration has been supposed to be due to the direct hydrolytic effects on phytate and the subsequent improvement in the availability of minerals, amino acids, and energy (Selle & Ravindran, 2007). It has also been suggested that phytase in poultry diets improves gut health as indicated by reduced secretions from the gastrointestinal tract (GIT) which consequently improves the efficiency of utilization of energy (Oduguwa, *et al.* 2007; Pirgozliev, *et al.* 2008). The main objective of this current review therefore is to determine the effect of dietary phytase feed additives on the growth performance, feed efficiency, protein/amino acid digestibility, energy utilization, mineral retention, and bone growth and egg production of quail. By realizing all sorts of problem we are planning to rear quail by using herbal medication like Ipil ipil and bean leaves extract instead of any synthetic agent, to avoid human health hazards as well as economic Quail production in Bangladesh.

## **Materials and Methods**

### **Experimental Design**

The experiment was conducted at the Department of Physiology and Pharmacology, Hajee Mohammad Danesh Science and Technology University, Dinajpur. A total of 40 quails are randomly selected and divided into 4 groups (T0, T1, T2 and T3) for assessing the effect of ipil ipil and bean leaves supplementation on egg production, egg quality and growth performance of quail. Group T0; considered as control, fed only with commercial layer ration, group T1; supplemented with formulation of 2g grinded ipil ipil leaves per kg feed, group T2; supplemented with formulation of 2 g grinded bean leaves per kg feed and group T3; supplemented with formulation of 2 g grinded ipil ipil leaves with 2g grinded bean leaves per kg feed. All the quail of control and treated groups were closely observed for 4 weeks and following parameters were studied.

### **Collection and management of quails**

At 42 days of age, Japanese layer quails were collected from A. R. Enterprise (quail hatchery and farm), Bogra. Body weights of assigned quails were taken with digital weight balance and the data were recorded. The finally selected 40 quails were housed under normal husbandry condition and reared quail in quail cage. All the birds were fed with commercial crumbled and mesh feed at the rate of 30g per bird per day and fresh water ad-libitum. Measurement of body weight was performed with the help of digital balance.

### **Collection and preparation of experimental diet**

Ipil ipil and bean leaves were collected from the Brac Nursery, Dinajpur. The ipil ipil and bean leaves were dried and grinded. The grinded leaves were added with commercial quail ration and served to recommended groups.

### **Egg production record**

Egg production was recorded for each quail at the same time each day during laying period. The incidence of broken eggs and soft-shelled eggs were identified and recorded. The number of eggs laid on successive days by a particular quail determined the length of each sequence and the number of pauses in each quail's oviposition determined the number of sequences. For each quail, the length of laying sequence was determined on the day the last egg of the quail was laid.

### **Observation of egg quality**

Egg qualities wear measured from those eggs laid by quails of different treatment group. Measured egg qualities were egg weight, shell dry weight, fresh albumin weight, fresh yolk weight, egg shell thickness, height of the thick albumin, height of the yolk, width of the yolk, width of the egg, and diameter of the egg albumin. For quality determination egg weight was recorded by an electric weighing balance. The length of egg was measured by a slide calipers. The width was also estimated by slide calipers. The eggs were then carefully broken down on a glass plate (40 × 20 cm) to determine the internal egg qualities.

### **Weight of different egg component**

The method outlined by Chowdhury (1988) was followed for partition in different egg components. At first, egg was broken on glass plate. Then the yolk was separated carefully from albumin with the help of a spatula and transferred to a previously weighed petridish by a spatula and weighed. Precautions wear taken at all stages to avoid rupture of yolk. The shell of the broken eggs wear rinsed and washed thoroughly in tap water keeping the membranes intake. The washed shells with membrane were immersed in a beaker of water for removal of the shell membranes. The shell and shell membranes were oven dried separately at 105°C over night keeping them in a glass petridish. On the following day, oven dried shell and shell membranes were taken. Finally the following calculations were made for different components suggested by Chowdhury (1988).

**Fresh yolk weight:** (weight of yolk + weight of petridish) - weight of petridish.

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**Fresh albumin weight:** (Weight of wet albumin + weight of petridish) - weight of petridish.

#### **Shell thickness**

After removing of shell membrane, shell thickness (mm) was measured by screw gauge.

#### **Statistical analyses**

Data were analyzed by analysis of variance using Completely Randomized Design with factorial arrangement of time and treatments (Steel and Torrie, 1986). All analyses were performed by MSTATC and SPSS program.

### **Results and Discussion**

This study investigated the effect of ipil ipil and bean leaves supplementation on growth performance, egg production and egg quality of quail.

#### **Egg Production**

Egg production of different groups of quail were recorded from 6 weeks to 10 weeks quail treated with ipil ipil, bean leaves and combined ipil ipil plus bean leaves. The average egg production of different groups of quail were recorded. Quails treated with ipil ipil leaves showed average egg production  $21.8 \pm 0.32$  within 06-10 weeks, bean leaves treated groups showed average egg production  $22.5 \pm 0.50$  and combined treatment supplementation showed average egg production  $23.3 \pm .47$  within 6 weeks to 10 weeks. (Table 1). Control group showed average egg production  $17.5 \pm 0.34$ . Result showed highest egg production in combined treatment group ( $23.3 \pm 0.47$ ) and lowest in control group ( $17.5 \pm 0.34$ ). Moreover, ipil ipil and bean leaves supplementation increase egg production. Our study express the same results.

Treatment Groups	Egg production (06-10) weeks	Percentage (%)
T <sub>0</sub> (control)	$17.50^c \pm 0.34$	45.71%
T <sub>1</sub> (ipil ipil)	$21.80^b \pm 0.33$	55.47%
T <sub>2</sub> (bean leaves)	$22.50^{ab} \pm 0.50$	57.38%
T <sub>3</sub> (ipil ipil + bean )	$23.30^a \pm 0.47$	59.28%

**Table 1: Egg production.**

**Note:** Values followed by different superscripts in the same column are statistically significant ( $p < 0.05$ ).

#### **Body growth**

Body weight of different groups of quails were recorded from 06 to 10 weeks quail treated with ipil ipil leaves, bean leaves and combined ipil ipil plus bean leaves. The average body weight of different group of quails were recorded. Quails treated with ipil ipil leaves showed average Body weight gain  $123.5^a \pm 3.30$  to  $149.2^a \pm 5.14$  gm within 06-10 weeks, bean leaves treated groups showed body weight gain  $123.8^a \pm 3.42$  to  $149.0^a \pm 6.49$  gm and combined treatment supplementation showed body weight  $126.8^a \pm 2.78$  to  $155.1^a \pm 7.15$  gm within 06-10 weeks (Table 2). Control group showed average body weight gain  $128.5^a \pm 4.00$  to  $151.9^a \pm 5.48$  gm. Result showed that the body weight of different groups more or less same with the control group. Results are contrary to that observed by Saima, et al. (2014) A 28 days' trial was conducted to evaluate efficacy of microbial phytase in diets for Japanese quails. For this purpose, 900 experimental birds were divided into six groups, each group containing 150 chicks and further sub-divided into 10 replicates. Diet A (positive control) was formulated according to NRC (1994) requirements set for the Japanese quail (CP 24% and ME 2900 Kcal/Kg). Diet B differed from diet A in Ca (Calcium) and P (Phosphorus) i.e. 0.15% Ca and 0.20% P less than Diet A, respectively. Four different levels of phytase enzyme (250, 500, 750, 1000 FTU/kg of feed) were added to diet B to formulate diets C, D, E and F treatments respectively.

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Results revealed that body weight gain, feed consumption, FCR, keel/shank length, dressing percentage of birds in groups consuming 750 and 1000 FTU/kg phytase were significantly higher ( $P < 0.05$ ) than those of B, C and D. The growth performance of group E and F was comparable with those of group A (+ ve control). Maximum leg weakness, swollen joints and crippled legs were observed in group B (39.30%) followed by C, D (21.33% and 16.0%).

Group	Body weight (gm.)	
	06 weeks (starting of the experiment)	End of 10 weeks
T <sub>0</sub>	128.5 <sup>a</sup> ± 4.00	151.9 <sup>a</sup> ± 5.48
T <sub>1</sub>	123.5 <sup>a</sup> ± 3.30	149.2 <sup>a</sup> ± 5.14
T <sub>2</sub>	123.8 <sup>a</sup> ± 3.42	149.0 <sup>a</sup> ± 6.49
T <sub>3</sub>	126.8 <sup>a</sup> ± 2.78	155.1 <sup>a</sup> ± 7.15

**Table 2:** Body weight.

**N.B:** Values followed by same superscripts in the same column are not statistically significant ( $p < 0.05$ ).

### Egg quality

(Table 3) demonstrate that there exist a significant ( $P < 0.05$ ) difference among the mean values like Length of the egg (mm), height of the thick albumin (mm), diameter of the albumin (mm), shell thickness (mm) corresponding to the different level of ipil ipil and bean leaves treatment. But no significant ( $P > 0.05$ ) difference among the mean values like weight of the egg (gm), width of the egg (mm), height of the yolk (mm), width of the yolk (mm), shell dry wt (gm) corresponding to the different level of ipil ipil and bean leaves treatment. These results indicate that treated with ipil ipil and bean leaves had no adverse effect on external and internal qualities of eggs.

Parameter	Group T <sub>0</sub> (Mean ± SEM)	Group T <sub>1</sub> (Mean ± SEM)	Group T <sub>2</sub> (Mean ± SEM)	Group T <sub>3</sub> (Mean ± SEM)
Weight of the Egg (g)	09.70 <sup>b</sup> ± 0.633	10.20 <sup>b</sup> ± 0.512	09.80 <sup>b</sup> ± 0.663	10.50 <sup>a</sup> ± 0.341
Width of the Egg (mm)	25.67 <sup>a</sup> ± 0.065	25.54 <sup>a</sup> ± 0.060	25.14 <sup>b</sup> ± 0.063	24.74 <sup>c</sup> ± 0.182
Height of Thick Albumin (mm)	3.14 <sup>b</sup> ± 0.073	3.39 <sup>a</sup> ± 0.048	3.60 <sup>a</sup> ± 0.097	3.54 <sup>a</sup> ± 0.061
Length of Egg (mm)	32.66 <sup>a</sup> ± 0.148	31.21 <sup>b</sup> ± 0.301	30.98 <sup>b</sup> ± 0.230	32.06 <sup>a</sup> ± 0.249
Diameter of				
Albumin (mm)	45.59 <sup>a</sup> ± 0.116	42.79 <sup>c</sup> ± 0.257	43.76 <sup>b</sup> ± 0.293	41.34 <sup>d</sup> ± 0.242
Height of Yolk (mm)	6.61 <sup>b</sup> ± 0.111	6.84 <sup>ab</sup> ± 0.107	6.12 <sup>c</sup> ± 0.086.	6.92 <sup>a</sup> ± 0.103
Egg shell thickness (mm)	0.17 <sup>b</sup> ± 0.008	0.16 <sup>c</sup> ± 0.009	0.12 <sup>d</sup> ± 0.004	0.19 <sup>a</sup> ± 0.007
Width of the yolk (mm)	29.52 <sup>b</sup> ± 0.127	29.63 <sup>b</sup> ± 0.109	28.15 <sup>c</sup> ± 0.384	30.60 <sup>a</sup> ± 0.285
Shell dry weight (g)	3.19 <sup>ab</sup> ± 0.058	3.05 <sup>b</sup> ± 0.050	3.13 <sup>ab</sup> ± 0.105	3.38 <sup>a</sup> ± 0.089

**Table 3:** Effect of ipil ipil, bean leaves and combined treatment on egg quality parameters of quail.

**Note:** Values followed by same superscripts in the same column are not statistically significant ( $p > 0.05$ ), different superscripts indicate that difference is significant ( $P < 0.05$ ).

\* = Significance at the 0.05% level

NS = Non significance

## **Conclusions**

In our research project egg production and body weights were increased in ipil ipil and bean leaves supplementation. From the present field and laboratory trial, it can be concluded that combined supplementation of grained ipil ipil and bean leaves is highly beneficial for enhancing egg production without making any hazards of Japanese quail and our formulations could be used as an egg enhancer and growth promoter for layer especially for older quail.

## **Conflict of interest**

None to declare.

## **References**

1. Abeyrathna HMWN., et al. "Effects of the Level of Dietary Rice Bran with or without Phytase, on Performance and Egg Parameters of Laying Japanese quail". *Tropical Agricultural Research* 26.1 (2014): 39-47.
2. Abou-Elezz FMK., et al. "Nutritional effects of dietary inclusion of Leucaena leucocephala and Moringa oleifera leaf meal on Rhode Island Red hens' performance". *Cuban Journal of Agricultural Science* (2011).
3. Adelson PA., et al. "Phosphatase and phytase activities in nodules of common bean genotypes at different levels of phosphorus supply". *Plant and Soil* 312 (2008): 129-138.
4. Ademola SG., et al. "Effects of native and microbial phytase on laying performance, shell ash and phosphorus content of hens fed mash and pelleted diets". *Online Journal of Animal and Feed Research* 3.6 (2013): 230-234.
5. Ahmad M., et al. "Effect of phytase supplementation of diets with different levels of rice bran and non-phytate phosphorus on productive performance, egg quality traits, leukocytes profile and serum lipids of laying hens reared indoor under high environmental temperatures". *Animal Feed Science and Technology* (2015): 222-233.
6. Ahmadi H and Rodehutscord M. "A meta-analysis of responses to dietary nonphytate phosphorus and phytase in laying hens". *Poultry Science* 91 (2012): 2072-2078.
7. Ahmed, E.S., et al. "Effect of Dietary Enzyme supplementation on Egg Laying Performance and Nutrient Digestibility of Japanese Quails". *IJAVMS* 6.5 (2012): 377-384.
8. Anna M., et al. "Effect of exogenous phytase on egg quality in laying hens". *Acta Fytotechnica et Zootechnica* 17.3 (2014): 79-83.
9. Attia Y.A., et al. "Effect of phytase with or without multienzyme supplementation on performance and nutrient digestibility of young broiler chicks fed mash or crumble diets". *Italian Journal of Animal Science* 11 (2012): e56.
10. Berry S and D'Mello JPF. "A of leucaena leucocephala and grass meals as sources of yolk pigments in diets for laying hens". (1980).
11. Casartelli E.M., et al. "Effect of phytase in laying hen diets with different phosphorus sources". *Brazilian Journal of Poultry Science* 7.2 (2004).
12. Francesch, M., et al. "Effects of an experimental phytase on performance, egg quality, tibia ash content and phosphorus bioavailability in laying hens fed on maize- or barley-based diets". *Brazilian Journal of Poultry Science* 46.3 (2005): 340-348.
13. Gao CQ., et al. "Effect of a novel plant phytase on performance, egg quality, apparent ileal nutrient digestibility and bone mineralization of laying hens fed corn-soybean diets". *Animal feed Science & Technology* 186.1 (2013): 101-105.
14. George M., et al. "The phytase of navy beans (*Phaseolus vulgaris*)". *Journal of Food Science* 42.4 (2006): 1094-1097.
15. Guoy., et al. "Effects of sodium gluconate and phytase on performance and bone characteristics in broiler chickens". *Animal Feed Science and Technology* 150 (2009): 270-282.
16. Hughes AL., et al. "Effect of Quantum phytase on nutrient digestibility and bone ash in White Leghorn laying hens fed corn-soybean meal-based diets". *Poultry Science* 88 (2009): 1191-1198.
17. Jalal MA and SE Scheideler. "Effect of Supplementation of Two Different Sources of Phytase on Egg Production Parameters in Laying Hens and Nutrient Digestibility". *Poultry Science* (2000).

18. Jubarah SK., et al. "Effect of phytate on laying hen performance, carbonic anhydrase activity and total cholesterol level". (2010).
19. Mohammed KA., et al. "Effects of phytase supplementation on performance and egg quality of laying hens fed diets containing rice bran. Egypt". *Poultry Science* 30.3 (2010): 649-659.
20. Lazali M., et al. "Localization of phytase transcripts in germinating seeds of the common bean (*Phaseolus vulgaris L.*)". *Planta* 240 (2014): 471-447.
21. Lim HS., et al. "Effects of Phytase Supplementation on the Performance, Egg Quality, and Phosphorous Excretion of Laying Hens Fed Different Levels of Dietary Calcium and Nonphytate Phosphorous". *Poultry Science* 82 (2003): 92-99.
22. Liu N., et al. "Efficacy of Phytases on Egg Production and Nutrient Digestibility in Layers Fed Reduced Phosphorus Diets". *Poultry Science* 86 (2007): 2337-2342.
23. Lucky NJ., et al. "Effect of dietary exogenous phytase on laying performance of chicken at older ages". *Bangladesh Journal of Animal Science* 43.1 (2014): 52-55.
24. Mansoori B and Modirsanei M. "Effect of dietary available phosphorus and phytase on production performance of old laying hens and tibia bone quality". *IJVM* 9.2 (2015): 125-134.
25. Mohebbifar A and Torki M. "Phytase supplementation of low phosphorous diets included graded levels of rice bran on productive performance of laying hens". *International Conference on Biology Environment and Chemistry* 1 (2010).
26. Musapuor A. "The Effects of Phytase and Different Level of Dietary Calcium and Phosphorous on Phytate Phosphorus Utilization in Laying Hens". *International Journal of Poultry Science* 4.8 (2005): 560-562.
27. Narasimha J., et al. "Additive Effect of NSP Enzymes and Phytase on Performance, Egg Quality, Nutrient Retention and Gut Health of Laying Hens Fed Corn-Soybean Meal Based Low Energy Diets". *IOSR Journal of Agriculture and Veterinary Science* 6.5 (2013): 22-28.
28. Oduguwa O., et al. "Energy metabolizability and digestibility of amino acids by broilers fed malted sorghum sprouts supplemented with polyethylene glycol, charcoal, phytase and xylanase". *British Poultry Science* 48 (2007): 55-63.
29. Pace SC. "The Effect of High Phytase Inclusion in Laying Hen Diets". (2014).
30. Pirgozliev V., et al. "Effects of dietary phytase on performance and nutrient metabolism in chickens". *British Poultry Science* 49 (2008): 144-154.
31. Ravindran V., et al. "Total and phytate phosphorus contents of various foods and feedstuffs of plant origin". *Food Chemistry* (1994).
32. Saber K., et al. "Effect of phosphorus deficiency on acid phosphatase and phytase activities in common bean (*Phaseolus vulgaris L.*) Under symbiotic nitrogen fixation". *Symbiosis* 47 (2009): 141-149.
33. Saima MA Shad., et al. "Effect of microbial phytase supplementation on growth performance of Japanese quails". *The Journal of Animal & Plant Sciences* 24.1 (2014): 19-23.
34. Selle PH & Ravindran V. "Microbial phytase in poultry nutrition". *Animal Feed Science and Technology* 135 (2007): 1-41.
35. Sharifi MR., et al. "The effects of dietary nonphytate phosphorus levels and phytase on laying performance and egg quality parameters of Japanese quails (*Coturnix japonica*)". *European Poultry Science* 76.1 (2011): 13-19.
36. Tang HO., et al. "Effects of a thermostable phytase on the growth performance and bone mineralization of broilers". *Journal of Applied Poultry Research* 21 (2012): 476-483.
37. Tischler A., et al. "Effect of dietary NPP level and phytase supplementation on the laying performance over one year period". *Poljoprivreda* 21 (2015): 68-72.
38. Yan L., et al. "Comparative Effects of Phytase Derived from *Escherichia coli* and *Aspergillus niger* in Sixty Eight-week-old Laying Hens Fed Corn-soy Diet". *Asian-Australian Journal of Animal Science* 22.10 (2009): 1391-1399.
39. Yu B., et al. "Exogenous phytase activity in the gastrointestinal tract of broiler chickens". *Animal Feed Science and Technology* 117.3 (2004): 295-303.
40. Ziae N., et al. "Effects of Reduced Calcium and Phosphorous Diets Supplemented with Phytase on Laying Performance of Hens". *Pakistan Journal of Biological Sciences* 12.10 (2009): 792-797.

41. Źyła K., et al. "Effects of phytase B on laying performance, eggshell quality and on phosphorus and calcium balance in laying hens fed phosphorus-deficient maize-soybean meal". *Czech Journal of Animal Science* 56.9 (2011): 406-413.

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