Article: RT1108

Biotica Research Today
Vol 4:10
2022
680/682

How to cite this article?
Borah *et al.*, 2022. Role of Phytase in Poultry Ration. Biotica Research Today 4(10):680-682.

Role of Phytase in Poultry Ration

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Abstract

Phosphorus is available in inorganic and organic form in plants mostly in the seeds and cereals. Only 30% of it freely available and rest is present in the form of phytate-bound phosphorus known as phytic acid. Mammals have enzyme called phytase, a chemical found in their digestive system that breaks the phytic acid and releases the bound phosphorus. However, poultry lacks the enzyme. The feed needs to be supplemented with inorganic phosphorus sources, thereby making the formulated ration expensive. Therefore, the enzyme phytase could be added in the poultry ration @ 500 IU and 1000 IU ton^{-1} feed which may be more cost efficient and economical. Addition of phytase enzyme in poultry ration would results in better utilization of dietary phosphorus and other minerals like Ca, Zn, Cl, *etc*. It also improves digestibility of amino acid and ultimately results in better growth and performance of the poultry birds.

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Keywords
Nutrition, Phosphorus, Phytase, Poultry

Introduction

The cost of raising broilers and layers depends on 70-80% and 50-55% respectively on the cost of diet. Most crucial challenge to grow a poultry business is to manage the diet which should be cost effective. As the poultry diet mostly consists of seeds, cereal and grains. Among all the nutrients like water, carbohydrate, fat, protein, fiber, vitamins and minerals, the minerals plays an important role in maintaining the health as well as immune system. Any deficiency or excess in the supplementation of minerals may cause deterioration in the health of the birds. The poultry birds (both broilers and layers) needs all the seven essential elements *viz*., Ca, P, S, K, Mg, Na and Cl; out of which calcium and phosphorus being the most important minerals in the poultry diet. Dietary calcium is readily available from seeds and cereal grains like maize, rice polish and other energy rich ingredients freely in environment. It is present either in inorganic or organic form. Poultry birds can readily absorb the inorganic phosphorus available in foods; however, the organic phosphorus in the seeds of plants is poorly utilized, as it is a component of phytic acid (Jain, 2021).

Phytic Acid as Anti-Nutritional Factor

Phytic acid is an antinutritional constituent with a wide variety of insoluble salts with minerals including zinc, calcium, magnesium, copper and phosphorus. Poultry birds lack the enzyme "Phytase" which can break the phytic acid and release the organic phosphorus which is also known as Phytate Phosphorus. About 80% of the total phosphorus present in the plants, seed and oils are in the form of Phytate Phosphorus. It has been stated that about one third (30%) of the Phosphorus in feed stuffs of plant origin is non-phytate

Article History
Received on: 27th September 2022
Revised on: 13th October 2022
Accepted on: 14th October 2022

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and biologically available to poultry. Thus, it is important to understand the role of Phytate or Phytic acid and about the enzyme Phytase so that the unavailable phosphorus in the dietary feed stuffs can be made available to poultry birds. There are so many definitions available regarding phytic acid. It is a complex of calcium or magnesium which is also considered as a primary storage form of Phosphorus and Inositol in almost all the seeds. It is an anti-nutritional component in poultrydiet as it binds calcium and phosphorus and many other minerals and thereby makes them unavailable for absorption and also decreases their availability. The phosphorus in the form of phytic acid phosphorus, ranges from 60-80% of the total phosphorus present in the plant and feed stuffs where as cereal by products and oil seeds contain a moderate amount. It is actively present in the typical poultry ration ranges from 2.5 to 4 g kg^{-1}. The presence of phytic acid in cereals grains is not uniform. In rice, more than 80% of the phytate is present in the outer bran hence bran are good source of phosphorus. In rice and wheat, phytic acid increases with the maturity of grain and with fertilizer applications. The presence of phytic acid bound phosphorus in the feed stuffs depends on many factors like climate, location of cultivated area, age at cultivation, maturity stage, degree of processing and the part of the plant from which it is derived. It was demonstrated during 1976 by Nelson (Researcher) that phytate-phosphorus was poorly utilized by poultry birds (Punna and Roland, 1999). Out of all the minerals the greatest impact of phytate on mineral nutrition is on calcium availability. Diets containing more phytic acid require more calcium to compensate the proportion of unavailable insoluble calcium phytate. Complexes made by phytate with minerals are alkaline in nature. The alkalinity occurs due to the phytic acid released by harmful microbial load interacts with protein in the small intestine of the birds. This can be prevented by decreasing the pH of the small intestine by adding the enzyme Phytase.

Role of Phytase

To reduce the ill effect of the phytate or phytic acid the enzyme phytase is required but it is present in very limited level in chicken's intestine which creates problem. The total phosphorus available in the feed stuffs cannot be utilized properly and physiological requirements of the phosphorus cannot be made. The unused dietary phosphorus thus excreted in faeces and contaminates the environment in the form of nitrogenous waste products. To solve these problems and to meet the requirements of phosphorus, the poultry feed should be supplemented with inorganic commercial phosphorus such as Di-calcium Phosphate. To make the use of existing phytate bound phosphorus in seeds and feedstuffs the phytic acid must be broken down into organic compounds (hydrolysis) within the digestive tract that is carried out by enzyme phytase. The hydrolysis of phytic acid usually occurs in the small intestine of the poultry birds. Phytase is supplied in the poultry diet by mixing the commercially available phyatse enzyme with feed as supplement. The utilization of phytate bound phosphorus is influenced by some factors out of which dietary calcium is a matter of concern. Higher level of calcium in the diet completely prevents the phytic acid hydrolysis which means with the increasing concentration of calcium the availability of phytase phosphorus decreases. It is usually recommended the use of calcium especially in chicks at 1:1 ratio rather than 2:1. Vitamin D_3 (Cholecalciferol) also plays an important role in the utilization of Phytate phosphorus as vitamin D_3 increases the activity of intestinal phytase that occurs due to stimulation of calcium absorption. This makes the phytate phosphorus more soluble and available for utilization. Wheat and barley are rich source of Phytase enzyme. It is also produced by fungi, bacteria, yeast and some soil- microorganism (Peter and Velmurugu, 2007). Phystase has been used as commercial feed additive for more than 10 years. In broilers, phytase supplementation of low phosphorus maize-soya bean diet increased the availability of phosphorus to over 60% and decreased the amount of inorganic phosphorus by 50% (Panda *et al.,* 2020). The amount of phytase phosphorus released by microbial flora in the gut depends on the concentration and source of added dietary phytase, calcium, Vitamin D_3 and the calcium: phosphorus ratio. In absence of phytase enzyme only limited amount of phosphorus is utilized out of total phosphorus that is bound in the form of phytic acid. The remaining unused phosphorus is excreted in the environment and contaminates the lakes and stream. This occurs when the phosphorus comes in contact with the soil and gets binds with the soil particle and does not leech out from the soil. When the top soil gets eroded it passes in streams and lakes and can lead to good growth of algae, other aquatic plant life, and results in eutrofication. Eutrofication is the process by which a body becomes enriched with dissolved nutrients such with Phosphorus. Phosphorus then stimulates the growth of aquatic plant life. This process affects water quality because the plants consume dissolved oxygen. If this problem is allowed to continue unchecked, it can ultimately lead to death of fishes on large scale. Many attempts are currently being made to insert foreign genes into the relevant plant DNA enable it to synthesize Phytases. Phytases then would present in more amounts in cereal grain like soyabean meal. Developments in genetic engineering have resulted in the isolation of microorganism capable of producing large amounts of Phytase. It is now increasingly realized that phytase provides a cost effective alternative to inorganic phosphorus supplementation (Singh, 2008).

Conclusion

In conclusion, it is strongly recommended that phytase should be added to poultry feeds to make it more economical and cost effective. It also improves the

digestibility of phytase phosphorus to the extent that phosphorus supplementation of inorganic phosphorus like DCP (Di-Calcium Phosphorus) may become unnecessary in poultry ration.

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