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Review Article

PHYTATE AND PHYTASE IN BROILERS --A REVIEW

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Abstract: The vegetable feed ingredients used in the preparation of poultry feed contains nearly two thirds of the phosphorus as phytates. The phytates are not only indigestible /unavailable but also are known to interfere with the utilization of other nutrients. Apart from the anti-nutritional effects the phytates bind with other minerals and make them unavialble to the birds. One of the best ways to overcome the ill effects of the phytate is by the use of phytate degrading enzymes (phytase). Hence the present work was undertaken to review the antinutritive effects and by the use of phytase how to ameliorate the ill effects.
Keywords: Phytates, Anti nutritive effect, Phytase.

INTRODUCTION

The exogenous enzymes as additives to animal feedstuffs is gaining acceptance in livestock feed industry. The major feed ingredients of livestock are of vegetable origin. The vegetable feed ingredients contain variable level of and phytate, which cannot be broken down by monogastric animals as they lack some of the needed enzymes.

PHYTATE

Phytate (phytic acid), myoinositol hexakis dihydrogen phosphate, is a normal component of all seeds. Around 70-80 per cent of the phosphorus in the cereal grains and oil seeds exists in the form of phytic acid (Ravindran *et al.,* 1999**).** Among the feedstuffs it is highest in cereal byproducts (73-84 per cent) followed by oil seed meals (51-82 per cent), cereals and millets (60-73 per cent) (Tyagi *et al.,* 1998). Phytic acid is the main storage form of phosphorous in plants. In general phytate phosphorus is mostly unavailable to birds. Bioavailability of phytate phosphorus in maize and soybean meal for poultry range from 10 to 30 per cent (Nelson, 1967; Calvert *et al*., 1978).

The total phosphorus, phytate phosphorus and phytic acid content of some commonly used feed ingredients are given in the Table 1.

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ANTI-NUTRITIVE EFFECTS

Effects of Phytate

Phytic acid being a reactive cation can form salts with nutritionally important minerals like Zn $^{2+,}$ Ni^{2+}, Co^{2+}, Mn^{2+}, Ca^{2+}, and Fe^{2+} with decreasing order of stability (Cheryan, 1980) and these complexes appear to be resistant to the digestive process. The net result is that a portion of the dietary mineral pool is unavailable to the animal. (Maenz, 2001). Further, at low pH, phytate being negatively charged and protein being positively charged forms insoluble complexes with proteins and at high pH, both phytate and proteins are negatively charged and multivalent cations like calcium are involved in forming phytate protein complexes, lowering the digestibility of the proteins. The binding of the calcium by phytate reduces the activity of trypsin (Singh and Krikorian, 1982: Caldwell, 1992) still lowering the digestibility of protein, since calcium is essential for the activity and stability of this enzyme

EFFECTS OF ENZYME ADDITION

i) Effect on reduced excretion and increased utilization:

The phosphorus excretion by pigs and poultry can be reduced by 30 per cent by including phytase in their diets. (Kies *et al.,* 2001) Mitchell and Edwards (1996) demonstrated that 600 IU phytase could replace up to 0.1 per cent inorganic phosphorus and a combination of 1,25 dihydroxy cholecalciferol and phytase could replace 0.2 per cent inorganic phosphorus in diets of young chicks. Substantiating this, Korin *et al.,* (1999) found that supplementation of phytase (600 FTU/Kg) increased the hydrolysis of phytate phosphorus content of soybean meal and corn from 34.9 and 30.8 to 72.4 and 59.0 per cent respectively. Confirming the increased availability of phosphorus, Singh *et al*., (2003) reported that phytase supplementation to the wheat-based diet reduced the non-phytate phosphorous requirement from 0.50 per cent to 0.30 per cent without affecting the performance of the broilers.

ii) Effects on digestibility:

Supplementation of phytase (1200 FTU/Kg) to cereal or oil seed containing diet of broilers improved the digestibilities of protein (4.2-7.3 and 2.4-6 per cent) and amino acids (3.4-9 per cent and 2.6-4.8 per cent) in cereals and oil seeds respectively (Ravindran *et al.,* 1999). But Zhang *et al*. (1999) observed improvement in the apparent digestibility of protein (9 per cent) in broilers even at 600 FTU of phytase supplementation. Selvakumar (2004) also reported that supplementation of phytase (562.5 IU/Kg) to corn–soya based broiler diet improved the digestibility of crude protein and ether extract by 0.5 and 2.3 per cent respectively.

iii) Effect on viscosity:

Balamurugan (2004) reported that supplementation of NSP enzyme either alone or in combination with phytase to corn soya based broiler diet reduced the intestinal viscosity by 3-10 per cent over that of the control. Selvakumar (2004) observed reduced intestinal viscosity (3 per cent) in broilers due to supplementation of phytase (562.5 IU/kg).

iv) Effect on nutrient retention:

Sebastian *et al.* (1996) observed supplementation of phytase (600 IU/Kg) to corn soya based broiler diet (low phosphorus level-0.5per cent) increased the calcium and phosphorus retention in male chickens by 12.4 and 12.2 per cent respectively. Korin *et al.* (1999) in their study to assess the influence of phytase on individual ingredients found the total phosphorus retention to be 34.8, 27.0, 16.0, 31.9, 40.3, 15.5 and 39.4 per cent in corn, soya, wheat, wheat middlings, barley, deoiled rice bran and canola respectively and the retention was enhanced to 40.9, 58.0, 33.8, 43.4, 55.5, 26.5 and 45.7 per cent respectively due to supplementation of phytase (600 FTU/Kg).

v) Effect on weight gain and feed convertion ratio:

Many authors have reported increased weight gain due to the addition of NSP degrading enzymes either alone or in combination with phytase (Zanella *et al.,* 1999; Wu *et al.,* 2004; Meng *et al.,* 2005; Ramesh and Devegowda 2005).Many authors have reported improvement in feed conversion ratio due to the addition of NSP degrading enzymes either alone or in combination with phytase (Srivastava *et al.,* 2005; Meng *et al.,* 2005).

Conclusion

The phytase addition generally increases the phyate degradation it was inferred that the enzyme addition improved the nutrient utilization and reduced the cost of production in broiler production. Further work is needed to find out the exact nutrient reduction in which the performance is economically better.

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Table 1: Total phosphorus, phytate phosphorus and phytic acid content (%DM) of some common feed ingredients

Ingredients	Total phosphorus mean ± SD (range)	Phytate phosphorus		Phytic acid mean ± SE (range)
		Absolute mean ± SD (range)	% of Total Phosphorus mean ± SD (range)	
Maize	0.39 ± 0.3 (0.37-0.47)	0.25 ± 0.3 (0.21-0.33)	64 ± 5.6 (57-60)	0.89 ± 1.1 (0.74-1.17)
Sorghum	0.30 (0.27-0.32)	0.22 (0.20-0.24)	73 (72-74)	0.78 (0.71-0.85)
Wheat	0.44 ± 1.2 (0.40-0.49)	0.27 ± 0.5 (0.24-0.37)	61 ±3.9 (59-63)	0.95 ± 0.8 (0.8 - 1.31)
Broken rice	0.15 ± 0.8 (0.10-0.21)	0.09 ± 0.1 (0.09-0.1)	60 ± 2.0 (59-63)	0.32 ± 0.9 (0.30-0.33)
Pearl millet	0.31	0.31	74	0.82
Deoiled rice bran	1.77 ±1.0 (1.63-1.83)	1.49 ± 1.1 (1.33-1.6)	84 ± 9.2 (80-87)	5.28 ± 2.1 (4.71-5.61)
Wheat bran	1.11 ± 0.7 (1.08-1.19)	0.81 ± 0.8 (0.74-0.87)	73 ± 9.1 (70-76)	2.87 ± 1.3 (2.63-3.08)
Groundnut meal	0.60 ± 2.7 (0.56-0.91)	0.46 ±1.7 (0.39-0.54)	77 ± 6.6 (59-78)	1.63 ± 0.8 (1.38-1.91)
Soya bean meal	0.88 ± 0.7 (1.81-1.03)	0.56 ± 0.3 (0.51-0.64)	64 ± 4.9 (61-67)	1.98 ± 0.5 (1.81-2.29)
Sunflower meal	0.90 (0.88-0.91)	0.45 (0.45-0.46)	51 (50-52)	1.63 ± 0.1 (1.61-1.63)

(Tyagi *et al*., 1998)