European Journal of Science, Innovation and Technology
ISSN 2786-4936
Vol. 2 No. 1 (2022)

'Viscous' Cereals-Based Diets for Poultry: The Need for Enzyme Supplementation

James T. Mbachiantim[1], Ntinya C. Johnson[2] and Victor M. Ogbamgba[2]
[1]Federal University of Agriculture, Makurdi, Department of Nutrition and Dietetics, Nigeria
[2]Rivers State University, Port Harcourt, Department of Animal Science, Nigeria

Abstract. Viscous cereals-based diets, particularly those of barley and rye, lead to poor animal performance and feed efficiency in non-ruminants, particularly poultry, as they lack the natural enzymes that degrade some of the major dietary components of these cereals. Thus, the components confer attributes of anti-nutritional factors in these viscous cereals. They are mainly β-glucans in barley and arabinoxlans in rye, respectively. The suppression or removal of the negative impacts of these anti-nutritional components of these cereals would undoubtedly have positive effects in animal diets involving barley and rye and thus aid in improving performance and feed efficiency. Therefore, the identifications of these factors and matching them with appropriate exogenous enzymes for their degradation is to the rescue. From this standpoint therefore, the enrichment of barley-based diets with β-glucanase and a mixture of arabinoxylanase and β-glucanase in rye-based diets significantly improved poultry performance and feed efficiency and thereby lead to improved production indices.

Key words: Barley and Rye, Anti-nutritive factors, Performance, Feed Efficiency and Poultry

Introduction

Exogenous feed enzymes at present is widely believed by all stakeholders, including the nutritionists as the way to go when it comes to formulating diets for optimal performance for poultry. This is hinged on the premise that supplemented enzymes lead to improved animal performances and feed efficiencies (Walsh, Power & Headson, 1993). To this extent, various preparations of amylase have been used to improve poor performances in chicks fed barley-based diets involving increase in the availability of barley-starch to the animals. The main concept was the degradation of specific substrates in barley or the viscous cereal grains to their simplest forms for easy utilization and absorption by the animal (Annison, 1991). Currently, more advances have been made in the area of enzymology with respect to improving the nutritive values of viscous cereals: mainly barley and rye for poultry. The successes achieved in these areas have enabled the use of barley and rye in the nutrition of poultry with significant improvements in animal performance and feed efficiency (Bedford, Classen & Campbell, 1991). The objectives of this paper therefore are to examine the types of enzymes used in improving the nutritive values of barley and rye, including the mode of actions of the enzymes in their functions, respectively.

Barley, Bird Performance and Enzyme Use in Enhancing Barley Nutritive Value

Nutrition is a very important component of poultry production as it accounts for about 70-80% of the total cost of production. Traditionally, cereal grains, such as corn, wheat, barley and rye are used primarily as energy sources in diets for poultry and pigs. As part of means of reducing cost of production and increasing the revenue of the farmer, barley has traditionally been used to replace wheat and corn in poultry rations due to its historically lower cost relative to wheat and corn. Additionally, barley has higher levels of bioavailable amino acids, particularly lysine and available phosphorus compared to corn and wheat. Barley is also thought to yield a firm white fat that packing plants prefer. Due to these benefits and more barley has become a popular feed ingredient in poultry and swine diets (Castell & Cliplef, 1991; Newman & Newman, 1990).

The well-known anti-nutritional factor in barley is β-glucans. β-glucans are actually polymers of glucose containing a mixture of β1, 3 and β1, 4 linkages that make their physico-chemical characteristics completely different from that of cellulose with a straight-chain glucose polymer with only β 1, 4 linkages. Barley content of the mixed β-glucans is as high as 3 to 4% which confer on barley its poor nutritive value in poultry as they lack glucanase that degrades them (Newman & Newman, 1990; Campbell et al., 1989). From the fore scenarios, the use of enzymes in particular the β-glucanases in barley-based diets for poultry was triggered with very profound successes and benefits. The benefits are in the areas of improved growth performances and feed efficiencies. Improvements of up to 17% in live weight gains and 19% in feed efficiencies have been demonstrated with barley-based diets supplemented with β-glucanases for poultry (Newman & Newman, 1987). However, barley is known to also contain reasonable amounts of soluble non-starch polysaccharides other than β-glucans implying that a mixture of β-glucanase and arabinoxylanase can even give better production indices. Therefore, there are still opportunities for more benefits with enzymes in the poultry and swine industries.

Rye, Bird Performance and Enzyme Use in Improving Rye Nutritive Value

From the agronomic standpoint, rye (*Secale cereale*) is an attractive crop species as is known for higher yields compared to other cereals especially on poor quality sandy soils and aids in better management of the soil by minimizing soil erosion. Hitherto, the low nutritive value can be significantly improved if its anti-nutritional factors are overcome as it would make available to the animal industry an alternative feed source from previously little used crop. The reduction in performance in the feeding value of rye is principally due to the presence of soluble pentosans. Therefore, strategies that can degrade these soluble pentosans would no doubt increase the nutritive value of rye. This was well-established in the studies of Fengler, Aherne and Robbles (1990) as water-extractable soluble factor from rye was demonstrated to be mainly responsible for the poor nutritive value of rye is the soluble arabinoxylans. Therefore, the addition of arabinoxylanases to rye-based broiler diets significantly enhanced the growth performances, feed efficiencies of the animals and of the feed, respectively (Bedford & Classen, 1992). To this extent therefore, the supplementation with linear increases levels of: 0.11, 0.22, 0.44 and 0.88/kg of a mixture of enzyme preparations of arabinoxylanase and β-glucanase activities to rye-wheat-based diets significantly enhanced the weight gain of birds up to 27% and feed efficiency up to 100%, respectively (Pettersson & Aman, 1989).

Conclusions

The use of exogenous enzymes in diets of swine and poultry as to improve performance and feed efficiency has been a long-aged practice in practical animal production. Today, therefore, the uses of these enzymes by the animal industries are very common. The enzymes degrade both the soluble and insoluble polysaccharides which are the primary anti-nutritional factors in barley and rye thereby breaking them into smaller usable forms for the animal's use. In this way, the enzymes aid in improving animal performance and at the same time also improve feed efficiency resulting to minimized nutrients in the animal manure into the environment. Overall, therefore, the uses of these enzymes to improve performance and feed efficiency is highly recommended, especially for barley- and rye-based diets, particularly for poultry.

References

Annison, G. (1991). Relationship between the levels of soluble nonstarch polysaccharides and the apparent metabolizable energy of wheat assayed in broiler chickens. *J. Agric. Food Chem., 39,* 1252-1256.

Bedford, M. R. & Classen, H. L. (1992). Reduction of intestinal viscosity through manipulation of dietary rye and pentosanase concentration is effected through changes in the carbohydrate composition of the intestinal aqueous phase and results in improved growth rate and food conversion efficiency of broiler chicks. *J. Nutr., 122,* 560-569.

Bedford, M. R., Classen, H. L., & Campbell, G. L. (1991). The effect of pelleting, salt, and pentosanase on the viscosity of intestinal contents and the performance of broilers fed rye. *Poult. Sci., 70,* 1571-1577.

Campbell, G. I., Rossnagel, B. F., Classen, H. I., & Thacker, P. A. (1989). Genotypic and environmental differences in extract viscosity of barley and their relationship to its nutritive value for broiler chickens. *Anim. Feed Sci. Technol., 26,* 221-230.

Castell, A. G. & Cliplef, R. L. (1991). Evaluation of the 1988 NRC requirements for energy when market pigs are fed barley-based diets. *Can. J. Anim. Sci., 71,* 557-566.

Fengler, A. I., Aherne, F. X., & Robbles, A. R. (1990). Influence of germination of cereals on viscosity of their aqueous extracts and nutritive value. *Anim. Feed Sci. Technol., 28,* 243-253.

Newman, C. W. & Newman, R. K. (1990). Nutritional aspects of barley as a livestock feed. *Proc. West Sect. Am. Soc. Anim. Sci., 41,* 99-107.

Newman, R. K. & Newman, C. W. (1987). Beta-glucanase effect on the performance of broiler chicks fed covered and hulless barley isotypes having normal and waxy starch. *Nutr. Reports International, 36,* 693-699.

Pettersson, D. & Aman, P. (1989). Enzyme supplementation of a poultry diet containing rye and wheat. *Brit. J. Nutr., 62,* 139-149.

Walsh, G. A., Power, R. F., & Headson, D. R. (1993). Enzymes in the animal-feed industry. *TIBTECH, 11,* 424-430.