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The effects of xylanase supplementation on performance, characteristics of the gastrointestinal tract, blood parameters and gut microflora in broilers fed on wheat-based diets☆

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Abstract

The aim of this study was to investigate the effects of xylanase supplementation on performance, characteristics of the gastrointestinal tract, blood parameters and gut microflora in broilers fed on wheat-based diets. The experimental diets consisted of a wheat-based diet supplemented with 0 or 1 g/kg enzyme preparation (xylanase activity was 1218 U/g). The diets were fed between 7 and 49 days of age. Enzyme supplementation (ES) improved ($P<0.05$) growth performance and feed conversion efficiency. The addition of enzyme to a wheat-based diet reduced the relative weights of the duodenum, jejunum, pancreas ($P<0.05$) and colon ($P<0.01$) in 21-day-old broiler chickens. Enzyme preparation reduced digesta viscosity in the proventriculus and jejunum of 21-day-old broiler chickens ($P<0.05$) and in colon of 49-day-old broiler chickens ($P<0.05$). The pH of the digesta in the crop, duodenum and jejunum was increased ($P<0.05$) in 21-day-old broiler chickens and was reduced in the caecum of 49-day-old broiler chickens ($P<0.05$) with enzymes. There was no significant difference

Abbreviations: NSP, non-starch polysaccharides; GIT, gastrointestinal tract; T_4, thyroxine; T_3, triiodothyronine; IGF-I, insulin-like growth factor I; RIA, radioimmunoassay; VFA, volatile fatty acids; GH, growth hormone; ES, enzyme supplementation

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between the two experimental groups in counts of lactobacillus and coliform bacteria in the caecum. Enzyme supplementation increased the concentration of blood insulin-like growth factor I (IGF-I) ($P<0.01$) of 21-day-old broilers, triiodothyronine (T_3) and insulin ($P<0.05$) at 49 days. ES reduced the concentrations of blood thyroxine (T_4) ($P<0.01$) and uric acid ($P<0.05$) at 49 days, but had no effect on glucose concentration ($P>0.05$). In conclusion, ES can improve performance and digestive parameters and can change some blood parameters in broiler chickens fed a wheat-based diet.

Keywords: Xylanase; Wheat; Growth; Characteristics of the gastrointestinal tract; Metabolism; Broiler chicken

1. Introduction

Although maize is the predominant source of energy for poultry diets in China, it is difficult to maintain diet formulation at least cost using maize as the main cereal in poultry feeding. Wheat contains non-starch polysaccharides (NSP) that reduce the utilization of nutrients. Arabinoxylans are the main NSP in wheat that increase viscosity of digestive content in the small intestine and interfere with digestion and absorption of nutrients when fed to poultry. As a result, feed conversion efficiency and growth are reduced and the incidence of pasting vents is increased (Friesen et al., 1992; Marquardt et al., 1994). Also NSP can modify gut microflora and increase fermentation in the small intestine of the chicken, which can be detrimental to nutrient utilization (Choct et al., 1996, 1999).

Enzyme supplementation of diets based on rye, wheat, barley or oats can reduce the mentioned adverse effects (Bedford and Classen, 1992; Bedford, 2000). Enzymes decrease the viscosity of gut contents, resulting in improvements in nutrient digestibility and performance when added to poultry diets (Campbell and Bedford, 1992; Marquardt et al., 1994). In general, the response to enzyme supplementation (ES) of cereal-based diets is significantly higher in younger than in older birds.

The mode of action of NSP-hydrolyzing enzymes is not completely understood, and is being debated (Bedford and Schulze, 1998; Meng et al., 2005). Enzymes hydrolyse part of NSP reducing digesta viscosity in the small intestine (Bedford and Classen, 1992), improving nutrient digestibility and modifying the gut microflora (Meng et al., 2005; Simon, 1998; Choct et al., 1999; Bedford, 2000; Engberg et al., 2004).

As mentioned above, ES can change the nutritional status and improve growth performance of broiler chickens fed a wheat diet, but which are also closely related to the regulation of metabolism and functioning of the growth-related endocrine system. For example, the hormones of the thyroid and somatotrophic axes are not only linked to growth but also to protein, carbohydrate and fat metabolism in broilers (Buys et al., 1999). Although GH is known to stimulate growth directly or indirectly through IGF-I by increasing skeletal growth and muscle deposition, it also affects lipid and carbohydrate metabolism. A high correlation exists between the relative changes in plasma IGF-I and T_3 concentrations and the relative growth rate of broiler cockerels (Buys et al., 1999). Nutritional status is an important factor in the regulation of plasma hormones and intermediary metabolism in broiler chickens (Buyse et al., 2002; Swennen et al., 2005). So we hypothesized that the effects of ES on growth performance may be associated with changes in the concentration