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Influence of β-glucanase supplementation on the metabolisable energy and ileal nutrient digestibility of normal starch and waxy barleys for broiler chickens

V. Ravindran [a,*], Z.V. Tilman [a], P.C.H. Morel [a], G. Ravindran [a], G.D. Coles [b]

[a] *Institute for Food, Nutrition and Human Health, Massey University, Palmerston North, New Zealand*
[b] *Crop and Food Research, Lincoln, New Zealand*

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Abstract

The influence of β-glucanase supplementation on the nitrogen-corrected apparent metabolisable energy (AME_n) and apparent ileal digestibility (AID) coefficient of starch, protein and amino acids in four barley cultivars that differed in fibre contents (hulls) and starch characteristics (waxiness), was investigated. The cultivars included a conventional, hulled normal starch barley (C-NS), a hull-less normal starch barley (H-NS) and two hull-less waxy barleys (H-W1 and H-W2). The AME_n of the two hull-less waxy cultivars were determined to be lower ($P<0.05$) than those of C-NS and H-NS. The AME_n of the C-NS and H-NS barleys, irrespective of the presence or lack of hulls, were similar ($P>0.05$). β-Glucanase supplementation improved the AME of all barley cultivars, but the magnitude of response was markedly greater ($P<0.05$) in waxy genotypes compared to the normal starch genotypes. The cultivar type had no influence ($P>0.05$) on the AID of protein and most amino acids. Enzyme supplementation improved ($P<0.001$) the AID of protein and amino acids in all barley cultivars. The average AID of the 18 amino acids was increased by 11.9% by enzyme addition, ranging from 5.1% for methionine to 18.1% for threonine. These data suggest that starch characteristics and type of β-glucan may influence the available energy in barley for broiler chickens. These characteristics

* Corresponding author. Tel.: +64 6 350 5528; fax: +64 6 350 5684.
E-mail address: V.Ravindran@massey.ac.nz (V. Ravindran).

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may be equally or more important than fibre contents in determining the feeding value of barley for poultry.

Keywords: Barley cultivars; Broilers; β-Glucanase supplementation; Nutrient digestibility; Metabolisable energy

1. Introduction

Compared with wheat and maize, the feeding value of conventional hulled barley for poultry is limited because of two components. First, the presence of hulls that increase the insoluble fibre content and dilute the available energy and nutrient concentration of the grain whilst having little or no anti-nutritive effect (Svihus and Gullord, 2002). Second, the presence of mixed-link (1-3) (1-4) β-glucans that increase digesta viscosity, lower the digestion and absorption of nutrients and reduce bird performance. It is common knowledge that the adverse effects of β-glucans can be largely overcome by supplementation with exogenous β-glucanases (Bedford, 1995). Reports on responses to the supplementation of β-glucanase on the feeding value of barley, however, have been inconsistent, which may be related *inter alia* to cultivar differences (Newman and Newman, 1987; Villamide et al., 1997; Scott et al., 1998).

Removal of the hull in hull-less genotypes and the resultant reduction in fibre contents should therefore improve the nutritive value of barley for poultry. Although it is generally thought that the available energy and nutrient digestibility will be higher in hull-less cultivars compared to conventional, hulled cultivars, the growth performance of pigs and poultry fed diets based on hull-less barley has not been consistently superior to that of animals fed hulled barley (Moss et al., 1983; Thacker et al., 1988; Edney et al., 1989). Another breeding development has been the hull-less barley cultivars that exhibit unusual characteristics such as widely varying ratios of amylose to amylopectin in the starch (Holtekjølen et al., 2006). The starch in normal genotypes consists of 650–840 g kg^{-1} amylopectin, whereas that in waxy types consists of 850–1000 g kg^{-1} amylopectin (Ullrich et al., 1986; Tester et al., 2004). Owing to structural differences, amylopectin is more susceptible to hydrolysis by amylases than amylose and it is hypothesised that starch in waxy grains should therefore be more digestible than that in normal starch grains (Leach and Schoch, 1961). Several reports have compared diets based on normal starch and waxy grains on bird performance, but with contradictory results (Nelson et al., 1975; Moss et al., 1983; Newman and Newman, 1987; Bergh et al., 1999). Since the starch characteristics are of nutritional significance, comparison of metabolisable energy and nutrient digestibility in waxy and normal starch grains is of practical interest.

The present study was designed to examine the influence of exogenous β-glucanase supplementation on the nitrogen-corrected apparent metabolisable energy (AME_n) and apparent ileal digestibility coefficient (AID) of starch, protein and amino acids in a conventional hulled barley cultivar and three hull-less barley cultivars that differed in their starch properties.