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Effects of an exogenous enzyme, Roxazyme® G2 Liquid, on digestion and utilisation of barley and sorghum grain-based diets by ewe lambs

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Abstract

A study was conducted to determine effects of a predominantly xylanase/endoglucanase exogenous enzyme (EE) product on digestion and production characteristics of growing lambs (25.3 kg) fed barley or sorghum grain-based diets. Dorset cross ewe lambs were allocated within four liveweight (LW) block groups to one of eight treatments (2 × 4 factorial design) comprising either whole barley or cracked sorghum grain diets (630 g/kg, DM basis) treated with one of four levels of a concentrate applied EE (0, 1.22, 4.88 and 9.76 ml/kg ration DM). Dietary digestibility was determined 4 and 8 weeks after EE treatments commenced and the lambs were fed for 84 d (until average LW > 40 kg). Compared with lambs fed barley-based diets, the lambs fed sorghum-based diets had superior ($P<0.05$) feed conversion to LW (7.13 and 5.80 kg as fed/kg, respectively) and daily wool growth, although average daily LW gain (172 g) was not affected by diet. Supplementing lambs with EE did not change

Abbreviations: ADFom, acid detergent fibre; CMC, carboxymethyl-cellulose; CP, crude protein; DM, dry matter; DOMD, digestible OM in DM; DOMR, digestible OM apparently fermented in the rumen; EDTA, ethylene diamine tetra acetic acid; EE, exogenous enzyme; EMNP, efficiency of microbial N production; FCE, feed conversion efficiency; LAP, liquid associated protozoa; lignin (sa), sulphuric acid lignin; LW, liveweight; ME, metabolisable energy; aNDFom, neutral detergent fibre; OM, organic matter; PD, purine derivatives; RG2, Roxazyme® G2 Liquid (DSM Nutritional Products Pty Ltd., Basel, Switzerland); RF, rumen fluid; RS, reducing sugar; VFA, volatile fatty acid

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voluntary feed intakes or total tract digestibility of NDF and starch compared to the lambs fed EE untreated diets. Lambs fed the sorghum diet exhibited a linear increase in total tract ADF digestibility with increasing rate of EE treatment and N balance also increased linearly, potentially due to improved ruminal protein availability. However EE supplementation did not improve lamb performance in terms of LW gain, feed conversion efficiency or wool growth.

Keywords: Enzymes; Digestibility; Barley; Sorghum; Lambs; Growth

1. Introduction

In order to achieve the genetic potential of the current generation of domestic animals, ruminant diets are becoming more nutrient dense, with inclusion of grain in diets to increase energy density. Hogan and Flinn (1999) reported that in 1990/1991, 1.3 million tonnes of cereal grain was eaten by ruminants in Australia, with barley and sorghum representing the most common grains fed. Sorghum grain has corneous endosperm areas characterised by starch granules embedded in a continuous protein matrix (McAllister and Cheng, 1996). This association lowers rumen starch degradability in sorghum to about 0.49, compared to 0.90 for barley grain-based diets (Herrera-Saldana et al., 1990). Barley grain is high in fibre (201 g NDF/kg DM, McDonald et al., 2002), and the outer hull, which contains about 0.96 of the total cellulose present (Newman and Newman, 1992), forms a barrier to microbial colonisation and digestion, particularly in whole grains (McAllister et al., 1990). As a biological grain-processing method, judicious application of an exogenous enzyme (EE) product containing fibrolytic enzyme activities has the potential to improve barley fibre degradation. Similarly, an EE product containing proteolytic enzyme activities may improve sorghum starch availability in the rumen.

Improvements in N retention (McAllister et al., 2000; Titi and Tabbaa, 2004) and total tract fibre digestibilities (Titi and Tabbaa, 2004) have been reported for EE supplementation of lambs fed barley-based diets, and Mora et al. (2002) found increased ruminal starch digestion (average 0.85 *versus* 0.75 for control) in sheep and lambs fed a 50% sorghum grain diet with the application of bacterial and fungal amylases. However, responses in grain-fed sheep to EE supplementation have been variable with no changes in DM intake (Rojo et al., 2005) or total tract digestibility (McAllister et al., 1999) also reported and generally there have been no significant improvements in sheep liveweight (LW) or feed conversion efficiency (FCE) performance (McAllister et al., 2000; Mora et al., 2002). Rate of EE application has been implicated in producing some of the variability in EE research results (Beauchemin et al., 2003). For example, Beauchemin et al. (1995) applied a mixed cellulose/xylanase EE product at six incremental levels to diets of alfalfa hay, lucerne hay or barley silage and found that only low and moderate levels of EE increased steer weight gain for alfalfa hay, but only high levels increased weight gain on the timothy hay. No response was observed for the barley silage. These results suggest effective rates of EE application need to be determined for specific dietary and EE product combinations.

This experiment investigated impacts of increasing levels of a mixed-activity EE product, Roxazyme® G2 Liquid (RG2, DSM Nutritional Products Pty Ltd., Basel, Switzerland) on