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Inclusion of sugar beet pulp in cereal-based diets for fattening lambs

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Abstract

Eighteen Merino lambs were used to investigate the effects on feed intake, animal performance and ruminal fermentation and blood biochemistry parameters of the partial substitution of barley grain (12% of the concentrate) with sugar beet pulp (SBP) during the fattening period. Lambs (15.4 ± 0.14 kg initial weight) were fed concentrate and barley straw ad libitum and slaughtered at 25 kg body weight. Concentrate intake and live body-weight gain were greater ($P < 0.05$) in lambs fed control diet than those receiving SBP concentrate, whereas straw intake was not significantly ($P > 0.05$) affected by treatments. Partial substitution of barley with SBP in the concentrate gave significantly ($P < 0.05$) higher acetate molar proportions, and lower propionate molar proportions and total volatile fatty acid concentrations in the rumen contents. Ruminal pH was higher ($P < 0.05$) and osmolality lower ($P < 0.05$) in lambs receiving the SBP concentrate. Blood parameters (pH, CO_2 pressure, base excess, bicarbonate and packed cell volume) were not affected by treatments. The inclusion of SBP in cereal-based diets for fattening lambs seems to enhance the ruminal environment and prevent ruminal acidosis, but has no positive effects on feed intake or animal performance.
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Keywords: Sugar beet pulp; Acidosis; Rumen; Fattening lambs; Cereal

1. Introduction

The goal of feeding high-grain diets to growing lambs is to achieve maximum growth rates, better feed-to-gain conversion and improved carcass characteristics, leading to increased profit opportunities. In the most common lamb-finishing system in Spain, feedlot lambs are fed high-grain diets up to the desired market weight (25–30 kg) at 5–7 weeks after weaning (Sañudo et al., 1998). However, this feeding program, based on diets almost devoid of forage (<10% of total dry matter intake), is usually associated with digestive disorders, such as ruminal acidosis (Nocek, 1997; Owens et al., 1998; Enemark et al., 2002). Dietary additives (ionophores, dietary buffers) are regularly used to prevent the low pH and control the growth of microbes associated with the aetiology of ruminal acidosis (Jouany, 1994; Galyean and Rivera, 2003).

However, some of the feed additives used in these diets have been banned by European Union regulations and others (avilamycin, flavophospholipol, monensin, salinomycin) will be phased out in the near future (Martel et al., 2001). This fact, combined with current public concerns about the use of additives in animal production, demonstrates the need to implement alternative means of obtaining similar production benefits to maintain profitability and competitiveness.

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Nutritionally healthy diets will avert nutrition-related disorders and, thus, promote health and productivity. Partial substitution of cereal grains with pectin-rich feedstuffs, such as sugar beet pulp (SBP), could prevent such disorders in the ruminal environment (Livesey et al., 2003) as their fermentation produces lower lactate and propionate than starch-rich feeds (Van Soest et al., 1991; Hall et al., 1998). However, results of experiments with sheep and cattle have not always supported the above hypothesis—ruminal pH was not always increased when cereal grains were partly substituted with SBP (Rouzbehan et al., 1994; Mandebvu and Galbraith, 1999). Likewise, results on feed intake and animal performance have also been inconsistent, with positive and negative effects being reported (Galbraith et al., 1989; Rymer and Armstrong, 1989; Rouzbehan et al., 1994; Normand et al., 1999, 2001; Berthelot et al., 2001).

As with some additives, the inclusion of pectin-rich feeds in the diet could have beneficial effects, enhancing ruminal fermentation in young, growing ruminants fed high-grain diets, but there is little information in the literature on the effects of these feeds in the diet of weaned lambs. Thus, the objective of this study was to evaluate the effect on feed intake, animal performance, ruminal fermentation parameters and blood biochemical parameters of the partial substitution of barley grain with SBP in the diet for young finishing lambs.

2. Materials and methods

2.1. Animals and diets

Eighteen weaned male Merino lambs, with an average initial age of 8–9 weeks, were used. Experimental treatments (diet without or with SBP) were allocated to animals by stratified randomisation on the basis of live body weight (LBW, 15.4 kg (S.E. 0.14 kg)), resulting in two groups of lambs with a similar distribution of initial LBW:

(1) A control group, which was fed barley straw and a concentrate without SBP (50% barley, 23% corn, 19% soya bean meal, 5% molasses and 3% of vitamin and mineral supplement).
(2) A SBP group, which received barley straw and a concentrate with SBP (38% barley, 12% SBP, 23% corn, 19% soya bean meal, 5% molasses and 3% of vitamin and mineral supplement).

All the ingredients of each concentrate were mixed and ground in a mill and fed to the animals as dry meal. The chemical composition of the feeds is shown in Table 1. Lambs remained with their dams until weaning and creep feeding was available from the third week after birth. Previously to weaning, animals were dewormed with Ivomec® (Merial Laboratorios, Spain) and vaccinated against enterotoxaemia (Miloxán®, Merial Laboratorios, Spain). At weaning, animals were weighed and housed individually in 1 m × 1 m pens. Concentrate and forage were supplied in separate feeding troughs. Fresh drinking water was always available.

Table 1
Chemical composition (g kg^{-1}) of barley straw and control and sugar beet pulp concentrates

	Barley straw	Control concentrate	Sugar beet pulp concentrate
Dry matter	916	867	867
Crude protein	23	152	155
Neutral detergent fibre	802	113	130
Soluble fibre	–	74	99
Starch	–	385	327
Ash	50	62	68

Animal handling followed the recommendations of European Council Directive 86/609/EEC for protection of animals used for experimental and other scientific purposes.

2.2. Experimental procedure

After 6 days of adaptation to the control diet, each group received the corresponding experimental diet, beginning at 09:00 h, to allow for ad libitum consumption during the day. The amount of feed offered and refused were weighed daily, and samples were collected for subsequent analyses. The amount of feed offered was adjusted daily on the basis of the previous day intake, allowing refusals of 15–20%. Fresh water was provided daily.

Animals were weighed before morning feeding twice a week to ∼24 kg LBW and then every 2 days until slaughter (at ∼25 kg LBW). When a lamb reached the intended LBW, feed and water were withdrawn; 1 h later, the lamb was weighed again and a blood sample taken by jugular venopuncture using heparinized vacutainers. Each lamb was immediately anaesthetized with sodium pentobarbitone (Eutalender®, Normon, Spain), slaughtered by exsanguination from the jugular vein and eviscerated.

Total digestive tract and reticulum–rumen were weighed before and after emptying. Rumen fluid (RF) was strained through two layers of cheesecloth, pH was immediately measured and samples were collected for subsequent ammonia-N (10 ml RF acidified with 10 ml

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