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Effects of three different concentrate proportions and rapeseed meal supplement to grass silage on animal performance of dairy-breed bulls with TMR feeding

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Abstract

A 3×2 factorial design with growing dairy-breed bulls was used to study the effects on animal performance of (1) proportion of concentrate (rolled barley) in the diet, and (2) inclusion of rapeseed meal (RSM) in the barley-based concentrate in a total mixed ration (TMR). The interactions between concentrate proportion and RSM supplement were also examined.

Three feeding experiments comprised in total of 84 Finnish Ayrshire bulls and 6 Friesian bulls. The bulls were fed TMR *ad libitum*. The three concentrate proportions were 300 (L), 500 (M) and 700 (H) g/kg dry matter (DM), fed without RSM (RSM−) or with RSM (RSM+). Rapeseed meal was given so that the crude protein (CP) content of the concentrate was raised to 160 g/kg DM in the RSM+ diets. In the RSM− diets the CP content of the concentrate was 128 g/kg DM, so the CP content increased 25% with RSM supplementation. Increasing the proportion of concentrate led to a linear improvement in daily live weight gain (LWG) ($P<0.05$), but there were no significant treatment differences in the DM intake (kg/d). Increasing the proportion of concentrate also led to significantly higher CP ($P<0.001$) and phosphorus (P) ($P<0.001$) supply and significantly improved DM and organic matter (OM) digestibility ($P<0.001$). However, the digestibility of neutral detergent fibre (NDF) decreased ($P<0.001$) as the proportion of concentrate increased. The feed conversion rate (kg DM/kg LWG) decreased significantly with increasing concentrate proportion ($P<0.001$). Rapeseed meal supplement had no effect on animal performance, but the supply of CP ($P<0.01$) and P ($P<0.001$) was higher when RSM was included in the diet. The CP ($P<0.001$) and NDF ($P<0.05$) digestibilities were also higher for the RSM+ diets than for the RSM− diets. Because RSM at the concentration used did not affect animal performance, there is no reason to use RSM supplementation for finishing dairy bulls when there is good quality grass silage and barley-based concentrate in the TMR ration. This study also shows that there is a need to update the Finnish feeding recommendations for dairy-breed growing bulls, and extra calculations are needed for the energy and protein supply of growing dairy bulls.

Keywords: Beef production; Dairy-breed bulls; Total mixed ration; Supplementary protein; Concentrate supplementation

1. Introduction

Beef production in Finland is based mainly on raising Finnish Ayrshire and Friesian bulls born on dairy farms. The supply of domestic beef has been decreasing in

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Finland during recent years, giving rise to a clear discrepancy between the demand for and supply of domestic beef. Because of this trend the average carcass weight of bulls has increased from 270 kg (1999) to 320 kg (2004) in five years. However, there exist no data from feeding trials about the performance of dairy-breed bulls when the carcass weight is over 300 kg.

Previously livestock production in Finland was largely based on grass silage feeding, but in recent years barley has been used more in cattle feeding since the European Union policy has reduced the price of grain relatively to that of forages. Nowadays grain is such an inexpensive source of energy that it may be economically advantageous to feed cattle grain-based diets rather than silage-based diets. A number of studies have examined the response to concentrate feeding level with grass silage in growing cattle (Drennan and Keane, 1987b; Martinsson, 1990; Agnew and Carson, 2000). Increasing the amount of concentrates usually increases the total feed intake but decreases the forage intake in separate feeding. However, the use of total mixed ration (TMR) in beef production systems is receiving considerable attention although only a few studies (e.g. Caplis et al., 2005; Keane et al., 2006) have been published on different proportions of concentrates in TMR feeding. Relative to the dairy cow, much less research has been carried out on the TMR feeding of beef cattle and there is lack of information on the effects of different proportions of concentrates in TMR feeding on the performance of dairy-breed bulls with high carcass weights.

In Finland, rapeseed meal (RSM) is the most important protein feed used in concentrates for cattle, and the need for supplementary RSM in growing cattle has been studied in a series of four research trials (Aronen, 1990; Aronen and Vanhatalo, 1992a,b; Aronen et al., 1992). The initial live weight (LW) of these bulls was 100 kg and the final LW 500 kg, on the average. Inclusion of RSM in the diet was found to have a positive effect on animal performance in some feeding experiments (Aronen and Vanhatalo, 1992a; Aronen et al., 1992). This positive effect was often mediated by increasing grass silage intake, but the effect is possible only with separate feeding. Thus it is of interest to obtain more information concerning animal performance when growing cattle are fed a TMR diet. Besides, the possibility that the enhanced animal performance was caused by an increased amount of amino acids flowing to the intestines could not be excluded. There are also experiments in which increasing protein intake by using either a rumen undegradable (fish meal) (Drennan et al., 1994) or degradable (soybean meal) (Drennan et al., 1994; Steen and Robson, 1995; Steen, 1996) protein source did not significantly affect animal growth, so the effect of protein supplementation in different experiments has been rather inconsistent. In addition, there are no data from any study on the performance of dairy-breed bulls when the protein source is RSM with TMR feeding.

The objectives of the present study with growing dairy-breed bulls raised to a final LW of 630 kg were to determine the effects on animal performance in various growth periods of (1) the proportion of concentrate in the diet, and (2) the inclusion of RSM in the barley-based concentrate in TMR feeding. Possible interactions between concentrate proportion and protein supplement were also examined.

2. Materials and methods

2.1. Animals, feeds, housing and diets

The first experiment started in March 2002, the second in October 2002 and the third in May 2003. The trials were conducted in the experimental barn of the North Ostrobothnia Research Station of MTT Agrifood Research Finland. The first experiment comprised 30 Finnish Ayrshire bulls; the second experiment comprised 29 Finnish Ayrshire bulls and one Friesian bull. The third experiment comprised 25 Finnish Ayrshire bulls and five Friesian bulls. Two animals were excluded from the study due to several occurrences of bloat, two animals due to pneumonia and two animals due to hoof problems. There was no reason to suppose that the diets had caused these problems.

All animals were purchased from local dairy farms when they were initially 48 kg LW and 15 d old on average. Before the beginning of the trials the animals were housed on peat bedding in six pens (3.0 × 3.5 m; 5 calves in each) providing 2.1 m^2 per calf. They received milk replacer, grass silage and a commercial pelleted calf starter (12.3 MJ of metabolizable energy (ME)/kg of DM) during the preweaning period (from 0.5 to 2.5 months old). The average dry matter intake (DMI) during the preweaning period was 1.34 kg/d and the average ME intake was 18.4 MJ/d. During the postweaning period (from 2.5 to 6.5 months old) the animals received grass silage and concentrates (commercial pelleted calf starter, barley and RSM). During the postweaning period the average DMI was 4.56 kg/d and ME intake 55.2 MJ/d. All the animals remained generally healthy throughout the preweaning and postweaning periods after the first 2 weeks when there were some incidences of diarrhea with episodes lasting 2 d on average. During the preweaning period, some calves lost hair from their legs and