Effects of barley based diets with three different rumen degradable protein balances on performance and carcass characteristics of feedlot steers

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Abstract

The objective of this study was to determine the effect of dietary optimal or suboptimal rumen available protein to energy ratios generated by substituting barley grain by wheat –based dried distillers' grains with soluble (**wDDGS**) on finishing feedlot cattle performance.

Three hundred crossbred steers were randomly assigned to twelve pens (25 heads in each pen) and fed one of three grain based finishing diets with: (i) negative rumen degradable protein balance (**DPB**; -12 g/kg DM); (ii) neutral DPB (0 g/kg DM); and (iii) positive DPB (14 g/kg DM). Ration with negative DPB (conventional feed) contained 88.3% rolled barley grain, 7.0% supplement and 4.7% barley silage. For the rations with neutral - and positive DPB, the barley grain was replaced by wDDGS at 11 or 22% of the diet, respectively. Over the 131-d finishing period, animal performance and carcass traits were similar among steers fed either of 3 finishing diets. In conclusion, barley grain in common feedlot diets can be substituted by wDDGS up to 22%, without altering steer performance and carcass characteristics.

Introduction

Barley (*Hordeum vulgare* L.) has traditionally been the mainstay of the western Canadian feedlot industry (Koenig and Beauchemin, 2005), with feedlot rations containing up to 90% barley grain (Beliveau and McKinnon, 2008). However, barley has extremely high degradation rate and high degradability of protein and starch (>80%). This often results in three major problems: 1) digestive disorders, e.g. bloat and acidosis, which have serious economic impacts on the feeding program; 2) an imbalance between protein breakdown and microbial protein synthesis, resulting in unnecessary N loss from the rumen and inefficient utilization of barley and oat components; and 3) an inefficient utilization of barley components can result in environmental pollution. Besides, feed is the single largest cost (60-70%) of production facing beef operations in Canada. Hence, there is a need to develop a more efficient strategy to optimize grain utilization and reduce the risk of metabolic disorders for beef cattle industry. Due to large bioethanol production in North America, a large supply of bioethanol co-products like wDDGS is available in western Canada. Wheat grain has about 15% CP and the resulting wDDGS has about 39% CP, while energy values are similar between wheat and wDDGS (Nuez-Ortin and Yu, 2009).

We hypothesized that feed barley in combination with wDDGS will result in an increased availability of nutrients to the animal (i.e., metabolizable protein) and more synchronized protein to carbohydrate fermentation in the rumen. The objective of this study was to evaluate the effects of barley based diets with three protein: energy ratio on performance and carcass characteristics of feedlot steers.

Materials and Methods

Three hundred crossbred steers (442.0 ± 1.45 kg shrunk body weight; BW) were randomly assigned to one of twelve pens (25 heads in each pen) and fed one of three grain based finishing diets with: (i) negative rumen degradable protein balance (DPB; -12 g/kg DM); (ii) neutral DPB (0 g/kg DM); and (iii) positive DPB (14 g/kg

DM). Ration with negative DPB (conventional feed) contained 88.3% rolled barley grain, 7.0% supplement and 4.7% barley silage (DM basis). For the rations with neutral - and positive DPB, the barley grain was replaced by wheat-based dried distillers' grains with soluble (wDDGS) at 11 or 22% of the diet (DM basis), respectively, and 40 and 80 g/head limestone was added, respectively. The initial starter diet for all cattle consisted of 45% concentrates and 55% forage on a DM basis. The steers were introduced to the finishing diets in five steps of 3 d each. The amount of barley grain (conventional feed) or barley-wDDGS was increased in the diet by replacing ~10% barley silage/brome hay at each step. Animal feed intake and performance was determined every 14 days. Carcass measurements were taken after slaughter at a commercial processing plant once the animals reached 624 kg, based on a 131 day feeding period. Composite feed sample were analyzed for chemical composition and DPB was calculated using the DVE/OEB system (Tamminga et al. 1994). Data were analyzed in a completely randomized design with diet as fixed effect (DPB -12, 0 and 14) and pen was the experimental unit (n = 4).

Results and Discussion

Net energy value for gain was 1.23, 1.19, and 1.19 Mcal/kg DM; net energy value for maintenance was 1.87, 1.82, and 1.82 Mcal/kg DM; and metabolizable protein was 80.0, 92.1, and 104.5 g/kg DM for diets with negative -, neutral-, and positive DPB, respectively. Over the 131-d finishing period, dry matter intake (11.6 ± 0.20 kg/d), average daily gain (1.8 ± 0.01 kg/d), feed efficiency (Gain to feed intake ratio = 0.16 ± 0.01), final shrunk BW (677.8 ± 0.58 kg), and measured carcass traits including hot carcass weight (397.5 ± 3.40 kg), dressing percentage (58.6 ± 0.47%), carcass quality and yield grade were similar (P > 0.05) among steers fed either of 3 finishing diets.

In theory, a DPB value of 0 or slightly positive results in optimal microbial growth in the rumen (Tamminga et al. 1994). Therefore, feeding wDDGS at 11% of the total mixed ration results in an DPB of 0 for optimal microbial growth without overfeeding protein-N. In current study, cattle performance was similar among the three diets over the entire feeding period. This suggests that the range in dietary DPB used in this study was not large enough affect animal performance. Additionally, Yang et al. (2010) and Beliveau and McKinnon (2008) pointed out that while nutrient synchrony works in theory, there are other nutrient and feed characteristics and interactions that can affect the actual outcome in feeding trials.

Conclusion and Implications

Increasing feedlot diet DPB from -12 g/kg (control diet) to 14 g/kg, by substituting barley grain with wheat – based DDGS up to 22% of the diet DM did not affect on performance and carcass characteristics of feedlot steers. Partly substituting barley grain by wDDGS in barley based finishing diets may be an economically feasible way (depending on feed pricing) while maintaining feed requirements of feedlot cattle in western Canada.

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