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Effects of grain source and monensin level on growth performance, carcass traits and fatty acid profile in feedlot beef steers

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ABSTRACT

A study was conducted to evaluate growth performance, carcass traits, and composition of fatty acid in carcass of feedlot steers fed diets varying in grain source and monensin levels. Two hundred crossbred steers (initial body weight [BW] 488 ± 36.9 kg) were blocked by BW, allotted to 20 pens, and then randomly assigned to 5 treatments (4 pens per treatment) with 2 × 2 + 1 factorial arrangement. Treatments were barley (100 g/kg barley silage, 900 g/kg barley-based concentrate, and 28 mg/kg monensin) which is a standard feedlot diet for western Canadian feedlots, and diets substituting hard or soft wheat for barley combining with 28 or 44 mg/kg monensin. Dry matter intake (DMI) was higher ($P < 0.02$) for wheat than for barley diets but it was not different between hard and soft wheat diets. Increasing monensin supplementation reduced ($P < 0.01$) DMI. Final BW, average daily gain and gain:feed were not different between treatments. Carcass traits were not affected by treatments except that dressing fraction was greater ($P < 0.05$) for steers fed barley than wheat diets. Additionally, steers fed soft wheat had less ($P < 0.05$) back fat and greater ($P < 0.05$) meat yield compared with hard wheat diet. Substitution of wheat for barley grain did not affect the total monounsaturated fatty acid and polyunsaturated fatty acid, but decreased ($P < 0.05$) vaccenic acid (*t*11-18:1; VA) and a-linolenic acid (18:3n-3; ALA) in the pars costalis diaphragmatic muscles of beef cattle. These results indicate that wheat can effectively replace barley grain in finishing ration without negatively influencing growth performance, carcass traits, and FA composition in beef. Supplementing monensin with higher level than currently practical level had no evident effect on growth rate, feed efficiency and carcass traits, although DMI was decreased.

Abbreviations: ADG, average daily gain; ALA, α-linolenic acid; BH, biohydrogenation; BUN, blood urea nitrogen; BW, body weight; *c*, cis; CLA, conjugated linoleic acid; CP, crude protein; DM, dry matter; DMI, dry matter intake; EE, ether extract; FAME, fatty acid methyl esters; G:F, gain:feed intake; HCW, hot carcass weights; HW, hard wheat; LA, linoleic acid; LM, longissimus; MH, 44 mg monensin/kg dietary DM; ML, 28 mg monensin/kg dietary DM; MUFA, monounsaturated fatty acid; aNDF, neutral detergent fibre; NEg, net energy for gain; OA, oleic acid; PCD, pars costalis diaphragmatic; PI, processing index; PUFA, polyunsaturated fatty acid; SCD, stearoyl-CoA desaturase; SFA, saturated fatty acid; SW, soft wheat; *t*, trans; USFA, unsaturated fatty acid; VA, vaccenic acid.

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1. Introduction

Wheat grain is grown primarily to produce flour for human use with the milling byproducts being used as livestock feed. However, with adverse growing or harvesting conditions, there is an increase in the amount of wheat that fails to meet the quality grade for human consumption and is fed to livestock in North America. Traditionally, the majority of wheat has been used as feed for poultry and swine as beef cattle producers have been reluctant to use large quantities of feed because wheat has the most rapid rate of starch digestion in the rumen among the cereal grains (Owens et al., 1997). Rapid starch digestion in the rumen increases the production rate of fermentation acids, thus increases the incidence of ruminal acidosis. In general, wheat is higher in starch and protein, and lower in fibre than barley (NRC, 2000), resulting in a total digestible nutrient and net energy for gain content that is comparable to corn. However, owing to the number of different types of wheat, that is soft, hard, and durum the physical characteristics and nutrient content of wheat can vary considerably. Recently, He et al. (2013) reported that although ruminal pH slightly decreased, ruminal fermentation and nutrient digestibility in the total digestive tract were not affected with increasing the rate of wheat inclusion in finishing diets.

Grain kernel hardness has been described as the resistance of the kernel to fracture (Anjum and Walker, 1991). In barley, grain hardness is gaining importance in quality determination, while the wheat industry has used it for decades to differentiate grain quality and market classes. Hard wheat kernels require more force to fracture while soft wheat grains require less energy, caused by differences in the endosperm starch–protein matrix. McAllister et al. (1993) concluded that the protein matrix seemed to be the major factor responsible for differences in ruminal digestion of starch. Rapid starch degradation may lower ruminal pH, depress fiber digestion, and cause digestive disturbances such as acidosis, rumenitis, liver abscesses and bloat (McAllister et al., 1990). Dugan et al. (2007) reported that the most prominent *trans*-18:1 isomers in feedlot back fat were 10t-18:1 and vaccenic acid (*t*11-18:1; VA). In addition, Dugan et al. (2011) reported that cattle that were fed grain with highly fermentable starch shifted in the BH pathways towards producing *t*10-18:1 from VA. There is little information available on the effect of high wheat grain diet on fatty acid profile in beef.

Additionally, ionophores, particularly monensin are commonly fed to beef cattle in North American feedlots, and generally improve feed efficiency of cattle. However, recently there is indication that high energy density diets such as diets that contain highly processed grain are less responsive to monensin addition (DiLorenzo and Galyean, 2010). Hence, there has been trend to increase monensin in feedlot diets to levels up to 48 mg monensin/kg diet DM (Xu et al., 2013). As the use of growth-promoting antibiotics in livestock is under increasing public scrutiny, information on the value of using high-levels of monensin in feed yard diets is needed but very limited. Therefore, the objectives of this study were firstly to compare sources of grain (barley vs. wheat) or type of wheat (hard vs. soft wheat) on growth performance, carcass traits, and beef fatty acid profile; and secondly to determine whether there is merit to increase level of monensin in high-grain finishing diets.

2. Materials and methods

The study received approval of the institutional Animal Care Committee of the Agriculture and Agri-Food Canada, Research Centre, Lethbridge, Alberta, and was conducted according to the guidelines of Canadian Council on Animal Care (2009).

2.1. Animals, experimental design, and diets

Two hundred crossbred yearling steers (initial body weight [BW], 488 ± 36.9 kg) were used in a finishing study to investigate the effects of grain type (barley vs. wheat), wheat source (hard vs. soft wheat), monensin level, and the interaction between wheat source and monensin levels on growth performance, feed efficiency, and carcass traits. Upon arrival at the Lethbridge Research Centre feedlot unit, steers were treated with Fremicon 7/Somnugen, IBR Express 5-PHM, and Ivomec (Pfizer Animal Health, Kirkland, Quebec, Canada). Prior to start the study, steers were implanted with Component TE-S with Tylan (Tylan, Elanco Animal Health, Guelph, ON, Canada).

A total of 20 out-door feedlot pens (17 m × 12.7 m; 10 steers per pen with 1.2 m bunk space per head) with standard feed bunks were used. Pens were equipped with automatic waters and fenced with porosity fencing on 2 sides. The steers were blocked by weight and randomly assigned to pens. Steers were fed 1 of 5 experimental diets. The diets included barley (BML; 900 barley grain and 100 g/kg barley silage with 28 mg monensin/kg dietary dry matter [DM]), diets substituting hard wheat (HW) or soft wheat (SW) for all barley grain combining with 28 (ML) or 44 mg (MH) monensin/kg dietary DM: (1) BML, (2) HWML, (3) HWMH, (4) SWML, and (5) SWMH. The supplement contained minerals and vitamins in meet nutrient requirements for beef cattle gaining 1.5 kg/d (NRC, 2000; Table 1). The barley and wheat grains were obtained from the same source for the whole study. All grains were dry-rolled with 0.82 processing index (PI). The ration was prepared daily using a feeder wagon equipped with a mixing auger and a weigh scale, and offered ad libitum with 0.05–0.10 refusals in each feed bunk. Steers were managed to achieve a target end-point of 720 kg of BW (unshrunk basis). Steers were adapted to experimental diets by gradually increasing the proportion of concentrate over a period of 4 wk before starting the experiment.