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Effects of high fat, modified wet, corn distiller's grains plus solubles on beef steer performance and carcass characteristics ☆

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ABSTRACT

Corn distiller's grains plus solubles (DGS) have become a common replacement for shelled corn in diets of finishing steers. Numerous studies have evaluated DGS inclusion, both wet (WDGS) and dry (DDGS), into feedlot diets with conflicting reports on feedlot performance and subsequent meat quality. Many authors have failed to describe the nutrient composition of the DGS utilized in their studies making it difficult to determine why different studies have different results. The objective of this study was to evaluate the feedlot performance and subsequent meat quality characteristics of steers fed high fat (10.36 ± 0.72%), modified wet corn distiller's grains plus solubles (HWDGS) at 0, 25, 40, and 70% of the diet dry matter (DM). Angus cross steers (n=240; 335 ± 55 kg) were blocked by source and stratified within block (3 blocks) by body weight (BW) to 32 treatment pens containing either 6 or 10 steers/pen. Pens within block were randomly assigned to one of four diets containing 15% corn silage: (1) 76.9% shelled corn, 6.4% soybean meal 1.5% limestone, 0.2% premix (0 HWDGS); (2) 25.0% HWDGS, 58.20% shelled corn 1.6% limestone, 0.2% premix (25 HWDGS); (3) 40.0% HWDGS, 42.74% shelled corn 2.06% limestone, 0.2% premix (40 HWDGS); (4) 70.0% HWDGS, 12.30% shelled corn 2.5% limestone, 0.2% premix (70 HWDGS). Target BW at harvest was 591 kg ± 23 kg with 121 steers harvested on day (d) 161 and 117 steers on d 224. Hot carcass weight and liver abscess scores were recorded on d of harvest. Longissimus muscle area, rib fat thickness, marbling score, and kidney, pelvic and heart fat were measured after a 24 h chill. No significant differences were observed between treatments regarding average daily gain (ADG) or BW. Steers fed 0 HWDGS had significantly lower average daily feed intake (ADFI) than steers fed HWDGS and the response was quadratic at lower ADFI. Steers fed 70 HWDGS had lower (P < 0.05) dry matter intake (DMI) compared to steers fed lower HWDGS concentrations. Steer gain to feed ratio (G:F) was significantly higher for steers fed 70 HWDGS compared to 0, 25, or 40 HWDGS with a quadratic response at higher % HWDGS diets. Mean United States Department of Agriculture (USDA) quality grade was average choice. Mean USDA yield grade was 3.0. Steers fed 70 HWDGS had significantly smaller rib eye areas and a linear trend (P=0.08) to have lower USDA quality grades compared to steers fed lower HWDGS inclusion rates. Increasing dietary HWDGS increased polyunsaturated fatty acid (PUFA) and PUFA/saturated fatty acid concentrations in intramuscular fat with both a linear

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and quadratic effect. High fat modified WDGS can be fed up to 70% of diet DM without compromising feedlot performance, carcass characteristics, or meat quality.

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1. Introduction

Corn distiller's grains plus solubles (DGS) are the main by-product of the fuel ethanol industry and are a source of crude protein (CP) (24–30%) and energy (6–12% fat) (NRC, 1996; Uwituze et al., 2010). Corn distiller's grains with solubles are increasingly used as a feedstuff in the cattle industry because of their availability, nutrient value and lower relative cost to shelled corn (Leupp et al., 2009). Considerable research has evaluated the dietary inclusion of DGS below 40% of the diet dry matter (Leupp et al., 2009; Vander Pol et al., 2009; Schoonmaker et al., 2010), however, little attention has been given to the fat content of DGS and little information is available regarding modified wet DGS inclusion levels above 50% of the diet. Previous studies have evaluated DGS inclusion into feedlot diets but few studies have included the chemical composition of DGS utilized, making it difficult to determine why authors have observed different results. In a study conducted by Vander Pol et al. (2006), average daily gain (ADG) and dry matter intake (DMI) showed a quadratic increase as high fat, modified wet distiller's grains plus solubles (HWDGS) inclusion rate increased from 0 to 50% dry matter (DM), respectively. Alternatively, Corrigan et al. (2009a) fed wet distiller's grains plus solubles (WDGS) from 0 to 40% inclusion rate and found a quadratic decrease in DMI across treatments, however gain to feed ratio (G:F) increased linearly as WDGS were increased in the diet. Luebbe et al. (2012) reported a linear decrease in hot carcass weight (HCW), 12th rib fat, marbling score, and calculated United States Department of Agriculture (USDA) yield grade as HWDGS inclusion increased. However, Koger et al. (2010) reported an increase in HCW, 12th rib fat, and USDA yield grade with diets containing WDGS compared to a dry-rolled corn/soybean meal diet.

With such variation in results, one possible explanation could be the different nutrient composition of the WDGS utilized in each study. Little research has been conducted on crude fat concentration differences in WDGS. A study conducted by Vander Pol et al. (2006) compared dietary fat in HWDGS compared to corn oil and observed that adding fat from HWDGS improves performance, whereas supplementing corn oil decreased G:F, suggesting that the fat within HWDGS is different than corn oil. However, supplementing a diet with HWDGS also, changes the composition and concentration of other nutrients (CP, Ca, P, etc.) that can affect cattle performance whereas, corn oil addition only changes the fatty acid composition of the diet. Dry matter intake tended to decrease as dietary fat increased in the Vander Pol et al. (2006) study. Zinn (1989) noted that with an increase in dietary fat, DMI is most likely negatively affected with a subsequent negative effect on ADG. However, Ham et al. (1994) fed HWDGS plus thin stillage as 40% of the diet and observed greater gain and improved efficiency with no negative effects on carcass characteristics. When HWDGS were compared to a high-moisture/dry – rolled corn mixture, findings showed that regardless of dietary inclusion, HWDGS generated higher energy values (Vander Pol et al., 2006) compared to a control diet.

Historically, in the United States (US) and in other countries ethanol production from corn grain has resulted in the generation of DGS containing 9–12% crude fat on a DM basis (Davis, 2002). More recently, US ethanol plants have adopted technologies to remove a portion of the corn oil from condensed distiller's solubles for use as a feedstock to produce biodiesel decreasing the crude fat content in DGS to 5–8% (Vance, 2013). Differences in crude fat content of DGS could affect the energy density and digestibility of DGS, and differences in energy density and digestibility could account for differences in feedlot performance of cattle fed DGS reported by different investigators. Carcass characteristics may be affected by higher HWDGS inclusion rates and the resulting increased fat in the diet could shift the fatty acid profile via biohydration resulting in shorter shelf life of the retail beef produced. Therefore, our hypothesis was to expect lower daily DMI and higher unsaturated fatty acid/saturated fatty acid profiles in beef as inclusion levels of HWDGS increased without negatively affecting the carcass characteristics of USDA quality grade and yield grade. The objectives of this study were to evaluate feedlot performance [including G:F, ADG, DMI and average daily feed intake (ADFI)], as well as selected carcass characteristics (including marbling score, USDA quality grade and USDA yield grade) and meat quality of growing/finishing beef steers fed 0, 25, 40, or 70% of the diet DM as modified wet (41–61% moisture), higher fat (9–12%) corn distiller's grains with solubles.

2. Materials and methods

2.1. Animals and diets

Care and handling of animals used in this study was approved by the Illinois State University Institutional Animal Care and Use Committee, protocol number 28-2010.

Two hundred and forty Angus cross steers (335 ± 55 kg BW) were blocked (3 blocks) by source (farm of origin) and stratified by BW within each block to 32 treatment pens with unequal treatment replication per block. Block 1 and Block 2 each contained 10 pens with 6 steers/pen. Block 3 contained 12 pens with 10 steers/pen. Pens within each block were randomly assigned to one of four treatments: (1) 76.9% shelled corn/6.4% soybean meal/15.0% corn silage/1.5% limestone/0.2% premix **(0 HWDGS)** ($n=8$ pens); (2) 25.0% HWDGS/58.20% shelled corn/15.0% corn silage/1.6% limestone/0.2% premix **(25 HWDGS)** ($n=8$ pens); (3) 40.0% HWDGS/42.74% shelled corn/15.0% corn silage/2.06% limestone/0.2% premix **(40 HWDGS)** ($n=8$ pens); (4) 70.0% HWDGS/12.30% shelled corn/15.0% corn silage/2.5% limestone/0.2% premix **(70 HWDGS)** ($n=8$pens). Diets were formulated to include HWDGS at 0, 25, 40, or 70% of the