FAT AND PROTEIN SUPPLEMENTATION OF CALF-FED HOLSTEIN STEERS

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Introduction

Holstein steers have a greater maintenance energy requirement (Zinn and Borquez, 1993) and visceral organ mass (Istasse et al., 1990), and consume approximately 8% more feed than traditional beef steers (NRC, 1987; Fox et al., 1988). Because of their heavy mature weights, Holstein steers calves grow faster than beef steers at comparable weights (Thonney, 1987), capable to increasing their live weight by greater than 1%/d during the first 60 d in the feedlot (Smith et al., 1999; Zinn et. al., 1999; 2000)! Consequently, a primary constraint on growth during the early feedlot period is GI tract capacity. Thus, in order to fully express growth potential, receiving and growing diets for the calf-fed Holstein must be nutrient dense. Increasing diet nutrient density by modifying level and source of NDF (Ware and Zinn, 2004), grain processing, increasing the concentration and quality of protein (Zinn and Shen, 1998; Zinn et al., 2000), or addition of supplemental, are possible strategies to obtain better performance in the first days of feedlot to Holstein steers calves. This presentation we will focus primarily on fat, and to a lesser extent, protein supplementation.

Supplemental fats

The tabular NE values of commercial feed fats for feedlot cattle are 6.00 and 4.50 Mcal/kg for maintenance and gain, respectively (NRC, 1996). Estimates based on these values are consistent with empirically derived measures when total fat intake did not exceed 0.96 g/kg of BW (Zinn, 1994). When fat intake has exceeded 0.96 g/kg of BW, the NE value of fat declines (Zinn and Plascencia, 2002).

The decrease in observed/expected dietary NE with fat supplementation can be directly attributed to the influence of level of supplementation on intestinal fatty acid digestion (**IDF**). In a 7-trial summary, Plascencia et al (2003) observed that 89% of the variation in intestinal fatty acid digestion is explained by the equation: IDF, % = 87.56 – 8.59 Fatty acid intake, g kg^{-1} BW. Given that one gram of digestible fat has an ME value of 9 Kcal (100% of its physiological fuel value); and the partial efficiency of utilization of ME from dietary fat for BW gain is 67% (Czerkawsky et al., 1966; Garrett, 1980; Zinn, 1994), the NE_g value of dietary fat may be calculated as 6.03 Kcal/g IDF. For example, if total fatty acid intake were 0.75 g/kg BW (ie. 3.5% total dietary fat), then the expected NEg value of the fat is 4.89 Mcal/kg [6.03 x (.8756 – (.0859 *0.75))]. Increasing the level of fatty acid intake to 1.50 g/kg BW (ie. 7% total dietary fat), the expected NE_g value of fat decreases by 8% to 4.50 Mcal/kg. Corresponding NE_m values for fat at the two levels of intake are 6.04 and 5.60 Mcal/kg, respectively [where $NE_m = (NE_g + 0.41)/0.877$].

The impact of fatty acid intake on feeding value of fat is particularly important when comparing relative responses in beef versus Holstein steers. Holstein steers are large in frame size, having heavier mature weights for a given placement weight (weight at which cattle enter the feedlot) than conventional beef steers. Furthermore, they have a 9% greater maintenance energy requirement than beef steers (Zinn and Borquez, 1993; NRC, 1996). Consequently, at comparable initial weight and days on feed Holstein steers are expected to have greater DMI and hence fatty acid intake than conventional beef steers. However, when level of fatty acid intake is taken into consideration, there is very little evidence to suggest that the feeding value of supplemental fat is different for Holsteins than has been observed for beef breeds.

In a series of comparative slaughter trials (carcass specific gravity), Zinn (1988) compared the feeding value of supplemental fat in a finishing diet fed to crossbred steers and calf-fed Holstein steers. The 88% concentrate (steam-flaked barley-based) finishing diet was supplemented with or without 4% yellow grease. With both crossbred and Holstein steers fat supplementation increased empty body weight gain (12.5 and 4.4%, respectively). However, with the crossbred steers fat supplementation did not affect carcass component gain. Whereas, with Holstein steers fat supplementation increased empty body fat and energy gain. With crossbred steers fat supplementation increased ribeye area (the expected result of increased weight gain). In both crossbred and Holstein steers fat supplementation increased percentage KPH (a consist effect of fat supplementation).

Fat supplementation did not affect dressing percentage, marbling score, or retail yield. Using the replacement technique, the NEm and NEg value of supplemental fat was 6.40 and 5.20 Mcal/kg, respectively, for crossbred steers, and 6.00 and 4.85 Mcal/kg, respectively for Holstein steers. Based on fatty acid intake (0.85 g/kg BW), observed NE values for supplemental fat fed to Holsteins were consistent with expected (5.99 and 4.84 Mcal/kg, respectively). The basis for the higher NE value for supplemental fat when fed to crossbed steers is not certain. Adjusting for the lower fatty acid intake (0.74 g/kg BW), the NE value of supplemental fat should have been only slightly (1%) greater than tabular values.

In a 151-d finishing trial involving seventy-two Holstein steers (273 kg), Zinn et al. (1998) observed that the addition of 5% YG did not effect ADG ($P > 0.10$), but decreased (6.3%, $P < 0.01$) DMI, and increased feed efficiency (4.7%, $P < 0.01$), and dietary NE (6%, $P < 0.01$). The replacement NEm and NEg values for supplemental fat were 5.00 and 3.97 Mcal/kg, respectively (83% of the tabular values). These low NE values were actually in close agreement with expected (4.95 and 3.93 Mcal/kg, respectively) due to low IDF (65.2%).

In a 144-d finishing trial Plascencia et al. (1999) evaluated the influence of free fatty acid (FFA) content of yellow grease on feedlot growth-performance in ninety-six

Holstein steers (375 kg). Dietary treatments consisted of an 88% concentrate finishing diet supplemented with 0 or 5% supplemental fat. Fat supplementation increased ADG (11%; $P < 0.05$), DMI/ADG (9%; $P < 0.05$); and diet NE (6.4%; $P < 0.05$). The replacement NEm and NEg values for supplemental fat averaged 5.39 and 4.37 Mcal/kg, respectively. Again, observed NE values were in good agreement with expected values (5.49 and 4.40 Mcal/kg, respectively), based on level of fatty acid intake and IDF (73%). Fat supplementation increased dressing percentage (1.2%; $P < 0.10$) and KPH (20.4%; $P < 0.05$), but did not affect ribeye area or fat thickness.

Due to their very heavy mature weights, Holstein steers have the genetic potential of achieving and maintaining high rates of gain throughout the growing and finishing phases. Zinn et al (2000) observed that in well managed calf-fed Holstein steers (initial weight of 122 kg), one can expect ADG of greater than 1.6 and 1.7 kg during the initial 56 and 112 d on feed, respectively. Even with conventional steam-flaked corn-based, fat supplemented diets (as are characteristic of most southwestern feedlots) containing an energy density of 2.21 Mcal/kg NEm (DM basis) the required DMI in order to achieve 1.6 kg ADG is 4.64 kg, a DMI of 2.78% of BW. Removing supplemental fat (4%) from the diet will lower the NEm to 2.06 Mcal/kg and increase the required DMI to 5.04 kg/d, or 3.02% of BW! Sustained DMI of 3% of BW may be untenable. Although we are not aware of any studies evaluating the feeding value of supplemental fat in light-weight calf-fed Holstein steers (100-120 kg BW) during the initial 120 d in the feedlot, fat supplementation my be the only practical means for optimizing dietary energy density and rate of ADG.

Protein supplementation

A typical Holstein production system includes weaning at 35 to 40 d of age, followed by rearing on a high-grain starter diets until 140 to 150 d of age. Calves are then transported to commercial feedlots weighing between 120 to 140 kg. In most southwestern feedlots, Holstein calves are typically fed a single diet throughout the entire growing-finishing period. This diet usually contains between 12 and 13 % crude protein, using urea is the sole source of supplemental N. Based on NRC(1996) Level-1 model, this conventional diet meets the average metabolizable protein requirements across the overall (roughly 340- to 370-d) feeding period. However, the diet does not supply metabolizable amino acid requirements of calves during the initial growing phase (112 to 140 d; NRC, 1996; Zinn and Shen, 1998; Zinn et al., 2000). Zinn et al (2000) observed that lysine, methionine and threonine are first limiting amino acids in diets for calf-fed Holsteins fed corn-based diets during the initial 112 d on feed. The NRC (1996) Level-1 approach provides reliable estimates of metabolizable amino acid requirements. Failure to meet protein requirements during the early growing phase may lead to marked reductions in overall ADG and gain efficiency, increased carcass fatness, reduced yield grade.

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