Evaluating Growth and Carcass Characteristics of Barrows Fed a Triglyceride Form of Conjugated Linoleic Acid

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Introduction

One of the most interesting polyunsaturated fatty acids to gain attention in recent years is conjugated linoleic acid (CLA). CLA was first recognized as an anticarcinogen after being isolated from extracts of grilled ground beef which exhibited anticarcinogenic activity against chemically induced mouse skin cancer (Ha et al., 1987). CLA occurs naturally and is reported to have significant biological effects. In a pig feeding trial, Eggert et al. (2001) showed that gilts fed a free fatty acid form of CLA had depressed average daily gain, but noted no difference in feed consumption. Eggert et al. (2001) also noted that bellies of gilts fed CLA were firmer compared to those fed sunflower oil.

In past studies, CLA was presented as a free fatty acid; that is, the individual fatty acids were not linked to a glycerol molecule. Grosch and Laskawy (1984) demonstrated that high levels of linoleic acid in the free fatty acid form are associated with a "burning-bitter" sensation. Eggert et al. (2001) observed that average daily gain was depressed, with no statistical differences in intake, although numerical trends were apparent. Similarly, Latour et al. (2000) demonstrated that rats consumed less CLA in a free fatty acid form and consequently grew at a much slower rate when compared to rats consuming a triglyceride form of CLA. The triglyceride form of CLA used in the Latour et al. (2000) study, was obtained from swine fat, where the animals had consumed a free fatty acid form of CLA.

The purpose of this study was to investigate the growth potential and carcass characteristics of barrows fed a triglyceride form of CLA during the last 6 weeks of production.

Materials and Methods

Thirty-five pigs (Dekalb genetics) were randomly assigned to individual pens and given *ad libitum* access to a standard diet for a 14-day acclimation period. At day 14, pigs were sorted by weight and randomly assigned to one of three dietary treatments: a) control; b) 0.5% CLA; or c) 1.0% CLA (Alpha Food Ingredients, Northfield, IL.). Diets were formulated to be isocaloric, isonitrogenous, and to meet or exceed the NRC (1998) recommendations for finishing swine. Feed intake and body weight gains were recorded at 3 and 6 weeks (termination or processing time of animals) of feeding.

At the end of the six-week feeding period, pigs were slaughtered, and carcass composition and meat quality parameters were evaluated. After 24 h at 2°C, standard carcass measurements were collected. Percent carcass fat-free lean was determined according to Orcutt et al. (1990) as described by NPPC (1991).

Fresh pork color, firmness, and marbling scores at the cut surface of the 10th and 11th rib interface were evaluated at 2°C, 24 h after exsanguination by a committee of six trained experts. Quality scores were reported according to established guidelines (NPPC, 1991). After visual quality assessment, the chop was analyzed for color using a HunterLab Colorimeter (D25 A Optical Sensor, Hunter Associates Laboratory, Reston, VA). Hunter Color “L”, “a”, and “b” values were determined using illuminant “A” and a 2° standard observer. Postmortem loin pH

was obtained at 45 min (pH45) and 24 h (pH24) after exsanguination by an Ingold glass electrode pH probe (M6/DXK/S7-25, Ingold, Mettler, Toledo, OH). The probe was inserted 1 inch deep into the loin muscle at a point near the 10th rib.

Water-holding capacity was determined on a chop using the drip loss method (Rasmussen and Stouffer, 1996). Briefly, muscle samples were collected from one of the 1-inch thick loin chops using a 1-inch diameter coring device. Samples were placed in drip loss tubes so the cut surface of the meat was perpendicular to the long axis of the tube. Drip loss analysis was evaluated in triplicate from 7.0 g core samples. After 24 h at 4°C the drip loss containers plus sample were reweighed. Muscle samples were removed and discarded and containers were re-weighed with exudates. Percentage drip loss was calculated and recorded.

Bellies were fabricated from intact carcasses according to normal processing specifications. Belly thickness was measured at two locations and averaged. Fresh bellies were subjected to the "flop" test, which involved suspension of the belly over a bar for a 24 hr period and scoring the amount of flop/bend subjectively (1=good, 5=poor) and objectively by assessing the ending distance between the ends of the belly and normalizing it to overall belly length.

The experimental units (individual pigs) were completely randomized within the animal facility. Feed intake and body weight gains were analyzed by repeated measure, while carcass quality measurements were assessed by least significant difference. All data were analyzed using the General Linear Models procedure of SAS® (SAS Institute, 2001). Statements of significance were based on ($P < 0.05$) unless otherwise noted.

Results and Discussion

Regardless of dietary treatment, there were no significant differences in body weight, average daily gain, average daily feed consumption, or feed conversion (Table 1).

Carcass dressing percentage for control, 0.5% and 1.0% CLA (73.56 ± 2.11, 72.94 ± 2.11, or 72.65 ± 2.11, respectively) were not different across treatments. Dietary treatment did not alter belly firmness, loineye area, subjective measurements of loin quality (color, firmness, and marbling), or ultimate 24 loin pH. However, there were significant dietary effects in percent drip loss, last rib fat thickness, 10^{th} rib fat depth, and percent fat free lean (Table 1). More specifically, barrows receiving the 0.5% CLA diet had significantly improved drip loss, when compared to controls, with the 1.0% CLA group being intermediate. The main reason for reduced water being trapped in the muscle (or improved water-holding capacity) is related to the integrity of the muscle cell membranes. Addition of greater amount of triglycerides that are more resistant to insults, such as pH and oxidation, would likely improve membrane stability. Unfortunately, the improvement in drip loss was only observed in the 0.5% CLA group.

The fact that dietary CLA improved carcass leanness is exciting and consistent with the literature. Others have suggested that dietary CLA improves carcass leanness, and therefore, should be classified as a repartitioning agent. The exact mechanism by which CLA improves carcass leanness is likely by inhibiting fat deposition. Muscling in pigs fed CLA was largely unaffected, as shown by lack of differences across loineye area estimates. Therefore, it is possible that pigs fed CLA, for some reason, were incapable of depositing as much fat as their control counterparts, and thus, greater amounts of nutrients were available to be "re"-partitioned into muscle. Then, in some sort of feedback mechanism, the nutrient demand placed on the animal would be lowered, and therefore lower feed intakes would be required, thereby numerically reducing ADG. Alternatively, slower growing pigs (as in feed-restricted) are leaner.

From a practical standpoint, however, if pigs fed CLA simply grew slower because it took time to acclimate to the diet, it may be possible to subject pigs to CLA earlier, perhaps in a grower diet. Then, given that CLA-fed pigs in this study tended to experience some compensatory gain, younger pigs would have greater time to acclimate and "catch-up" to control diets, yet retain an advantage in leanness. A study of this nature would be necessary to determine whether CLA truly repartitions nutrients and improves performance or whether it simply improves leanness by reducing feed intake.

Implications

This study indicates that CLA may reduce back fat thickness in market pigs. However, the previously reported effects of CLA on belly firmness and quality were not observed in this study. Also, CLA had no effect on loin muscle characteristics.

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Table 1. Growth performance and carcass characteristics of barrows fed a control, 0.5% conjugated linoleic acid (CLA), or 1.0% CLA supplemented diet

	Control	0.5% CLA	1.0% CLA
Final Body Weight, lbs	260.9 ± 5.38	244.9 ± 5.38	253.9 ± 5.38
Average daily gain, lb/d	2.27 ± 0.11	1.92 ± 0.11	2.16 ± 0.11
Feed conversion	1.46 ± 0.08	1.62 ± 0.08	1.50 ± 0.08
Belly firmness	2.38 ± 0.32	2.33 ± 0.32	2.09 ± 0.32
Loineye Area, $in.^2$	6.08 ± 0.75	6.23 ± 0.75	6.47 ± 0.75
Loin L value	52.41 ± 1.97	53.43 ± 1.97	52.43 ± 1.97
Loin A value	11.22 ± 0.86	10.39 ± 0.86	10.86 ± 0.86
Loin marbling	2.31 ± 0.51	2.06 ± 0.51	2.35 ± 0.51
Loin firmness	2.38 ± 0.49	2.44 ± 0.49	2.25 ± 0.49
Loin 24-hour pH	5.56 ± 0.03	5.52 ± 0.03	5.54 ± 0.03
Loin drip loss, %	2.41 ± 0.13[a]	1.67 ± 0.13[b]	2.18 ± 0.13[ab]
Last rib fat thickness, in.	1.29 ± 0.19[a]	1.01 ± 0.19[b]	1.01 ± 0.19[b]
10^{th} rib fat depth, in.	0.97 ± 0.20[a]	0.75 ± 0.20[b]	0.75 ± 0.20[b]
Percent fat free lean	49.53 ± 1.72[a]	52.41 ± 1.72[b]	52.89 ± 1.72[b]

[a,b]Means within a within a row with different superscripts are significantly different ($P<0.05$).