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Effect of 2 net energy feeding programs in combination with ractopamine on grow-finish pig growth performance and carcass characteristics

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ABSTRACT

Crossbred barrows were blocked by BW (28.4 kg) and allocated to 1 of 4 treatments (10 pens per treatment, 5 per pen) in a 2 × 2 factorial arrangement, with 2 NE levels [control vs. low (LE)] and with or without 7.5 mg/kg ractopamine hydrochloride (RAC) during the last 21 d of the 105-d feeding trial. The objectives were (1) to evaluate the BW growth, energy intakes, and energetic efficiency of high growth barrows fed high and low energy density diets during the grow-finisher phases, and (2) to evaluate the effect of feeding RAC when pigs were fed either high and low energy diets. Control diets were based on corn, soybean meal, corn DDGS, and LE diets were created by adjusting inclusion rates of soybean hulls and wheat middlings. Diets were formulated on an equal standardized ileal digestible Lys:NE basis within phase, and RAC diets had increased amino acid concentrations compared with non-RAC diets. From d 0 to 84, control pigs had greater ($P < 0.001$) ADG and G:F than LE pigs with similar ADFI ($P < 0.14$). During d 84 to 105, RAC increased ($P < 0.001$) ADG and G:F, whereas ADFI increased ($P < 0.008$) and G:F decreased ($P < 0.03$) in pigs fed LE diets. Overall, d 0 to 105, RAC increased ($P < 0.001$) ADG, G:F, and final BW, whereas LE diets decreased ($P < 0.015$) ADG, G:F, final BW and carcass weight. Overall NE utilization efficiency for live BW gain was greater for the LE ($P < 0.04$) and RAC ($P < 0.0001$) diets. Feeding RAC improved performance regardless of dietary NE, and NE conversion to carcass weight was similar between NE diets.

Key words: net energy, ractopamine, grow-finish pig, fiber

INTRODUCTION

The optimization of pork production systems requires knowledge of pig feed intakes, growth rates, and estimated measures of energetic efficiency (de Lange and Schreurs, 1995; Schinckel et al., 2008). In the United States, high energy feed ingredients have been directed toward bioenergy production (i.e., corn to ethanol and animal fats to biodiesel). This has resulted in the formulation of diets that are more diverse with decreased energy concentration and recent discussion of the optimal utilization of high fiber feed ingredients in the United States (Kerr and Shurson, 2013; Lindberg, 2014).

The compositional growth of pigs is the major factor affecting their energetic efficiency (Schinckel et al., 2008). Diets with decreased energy concentrations and increased fiber content may reduce the lipid accretion rates to a greater extent than protein accretion. If reducing the energy density of the diet decreases the ratio of lipid-to-protein accretion, the amount of BW gain produced per unit energy intake will likely be affected (De Greef and Verstegen, 1995).

Currently the lean gain of young pigs may be limited by their energy intakes from 20 to 50 kg of BW (Schinckel and Delange, 1996). The energy intakes of barrows above 90 kg of BW may be greater than that

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needed for maximal protein accretion (Campbell and Taverner, 1988; Williams et al., 1994). A small reduction in daily energy intake of barrows may improve their efficiency of energy utilization above 90 kg of BW.

Carcass weight gain is economically important because most pork processors pay producers based on carcass weight. One disadvantage of diets with increased fiber concentrations is their effect of reducing carcass weight gain by reducing DP (Kennelly and Aherne, 1980; Pond et al., 1988; Xu et al., 2010a). Ractopamine (**RAC**) is a feed additive that increases carcass lean gain and DP (Schinckel et al., 2003b). It is possible that the reduction of the fiber content of the diets and feeding of RAC the last 21 d before market may result in increased carcass weights in pigs previously fed low energy, high fiber diets.

The feeding of corn distillers dried grains with solubles (**DDGS**) has increased awareness of carcass fat quality and iodine levels (Whitney et al., 2006; White et al., 2009; Xu et al., 2010b). The energy density of the diet, including crude fiber content, has been shown to affect the fatty acid composition of fat tissue in pigs (Bee et al., 2002). The effect of feeding corn DDGS in combination with high and low NE diets on belly fat iodine values (**IV**) has not been reported.

The objectives of this study were (1) to evaluate the BW growth, energy intakes, and energetic efficiency of high growth barrows fed high and low energy density diets during the grow-finisher phases; (2) to evaluate the effect of feeding RAC when pigs were previously fed either high and low energy diets; (3) to evaluate the economic returns of the alternative feeding strategies; and (4) to evaluate dietary differences in carcass fat IV.

MATERIALS AND METHODS

Experimental Design

All procedures were approved by Purdue University Animal Care and Use Committee. Barrows were transported by trailer to the Swine Environmental Research Building at the Animal Science Research and Education Center for trial at 24 d of age, assigned to pens with 10 pigs per pen (1.83 m × 2.44 m), and fed common nursery diets. Then, after a nursery period of 34 d, pigs were weighed and allotted to the experimental treatments. A total of 200 crossbred barrows (TOPIGS Tempo × TOPIGS 20, Topigs Norsvin USA, Burnsville, MN) were blocked by BW (28.4 ± 0.02 kg), housed 5 barrows per pen, and randomly allocated to 1 of 4 treatments (10 pens per treatment) in a 2 × 2 factorial arrangement, with 2 NE levels (control vs. low, **LE**) and with or without 7.5 mg/kg of ractopamine hydrochloride during the last 21 d of the 105-d feeding trial. Within each block, pens (1.83 m × 2.44 m) were randomly assigned to 1 of 4 dietary treatments. Pens had totally slatted concrete floors with ad libitum access to a single-hole self-feeder and nipple waterer. Rooms were mechanically ventilated, and a minimum temperature of 18.3 to 20°C was maintained.

There were five 21-d nutritional phases (grower 1, grower 2, grower 3, finisher 1, and finisher 2 with or without RAC). The diets were formulated on equal standardized ileal digestible lysine:NE ratio (Table 1 and 2) for each phase using ingredient NE values from the NRC (2012). The lysine:NE ratios used were based on previous research on the lysine requirements of pigs (TOPIGS, 2013). The control grower diets and finisher 1 diets contained 20% DDGS and were typical of those used in the United States. The finisher 2 diet contained 10% DDGS as a means to reduce the effect of DDGS on fat quality (Xu et al., 2010a). The NE content of the control diets increased from 2,462 kcal/kg (grower 1) to 2,536 kcal/kg (finisher 2 with no RAC). The control diet with RAC was high energy (2,637 kcal/kg) with 4.0% added fat. The energy content of the LE diets decreased from 2,461 kcal/kg (grower 1) to 2,319 kcal/kg (finisher 2 with no RAC). This decrease in NE content was primarily caused by the increase in the percentage of wheat middlings (from 5 to 20%) and soybean hulls (2 to 7.9%) from grower 1 to finisher 2 with no RAC. The LE finisher 2 diet with RAC contained 4% soybean hulls and 10% wheat middlings and contained 2,385 kcal/kg.

The difference in the NE content of the diets increased from grower 1 to finisher 2 because based on prior data, the daily feed and energy intakes for these pigs is more limiting at the beginning (grower 1) and less at the other phases. The energy concentrations of the LE diets were targeted to result in more optimal NE intakes relative to that required for maximum lean gain and protein deposition at each phase.

The NDF content of the control diets increased from 13.3 to 13.5% from grower 1 to finisher 1 diets. The finisher 2 control diets with 0 and 7.5 mg/kg of RAC contained 11.44 and 11.09% NDF. The NDF content of the low energy diets increased from 15.44 to 20.78% from grower 1 to finisher 1 diets. The finisher 2 low energy diets with 0 and 7.5 mg/kg of RAC contained 22.44 and 15.95% NDF, respectively.

Individual BW and pen feed intake data were collected every 21 d corresponding to diet changes. The day before slaughter, pigs were scanned ultrasonically using an Aloka 500v linear array ultrasound unit with a 3.5-MHz, 17-cm linear probe (Corometrics Medical Systems, Wallingford, CT) to obtain measurements of 10th-rib backfat depth and LM area.

Pigs were transported to a commercial pork processor at 163 d of age, and HCW was recorded. Carcasses were measured with an optical probe (Fat-O-Meter, Carometec, Herlev, Denmark) between the third and fourth ribs anterior of the last rib. Percent lean was predicted by the equation percent lean = 54.67 − (0.4125 × backfat depth, mm) − (0.00656 × carcass weight) + (0.14332 × muscle depth, mm).

At the commercial pork processor an approximate 5 cm × 5 cm sample was collected from the anterior portion of the belly proximal to the mid-