Animal Feed Science and Technology 207 (2015) 190–195

Contents lists available at ScienceDirect

Animal Feed Science and Technology

journal homepage: www.elsevier.com/locate/anifeedsci

Effect of emulsifier (lysophospholipids) on growth performance, nutrient digestibility and blood profile in weanling pigs

P.Y. Zhao, H.L. Li, M.M. Hossain, I.H. Kim *

Department of Animal Resource & Science, Dankook University, Cheonan, Chungnam 330-714, South Korea

ARTICLE INFO

Article history:
Received 14 August 2014
Received in revised form 24 March 2015
Accepted 8 June 2015

Keywords:
Blood profile
Growth performance
Lysophospholipids
Nutrient digestibility
Weanling pigs

ABSTRACT

This study was conducted to evaluate the effect of dietary supplementation of emulsifier (lysophospholipids; LPL) on growth performance, nutrient digestibility and blood profile in weanling pigs. A total of 144 weanling pigs [(Landrace × Yorkshire) × Duroc] with an average body weight (BW) of 7.95 ± 0.97 kg were randomly allotted to one of four treatments for a 35 d experiment. There were two phases with different net energy (NE) including phase 1 (d 0–14) and phase 2 (d 15–35). The treatments included: (1) RET, reduced energy treatment (NE = 10.57 and 10.32 MJ/kg for phase 1 and phase 2), (2) BDT, basal diet treatment (NE = 10.87 and 10.63 MJ/kg), (3) RET05, RET + 0.5 g/kg LPL, and (4) RET10, RET + 1.0 g/kg LPL. During d 0–14, 15–35, and the overall period, average daily gain (ADG) in pigs fed the BDT and RET10 treatments was greater ($P < 0.05$) than pigs fed the RET treatment. Pigs fed the BDT and RET10 treatments had higher ($P < 0.05$) gain:feed than those fed the RET treatment during d 15–35. On d 14 and 35, the apparent total tract digestibility (ATTD) of dry matter, gross energy, and crude fat in pigs fed the RET05 and RET10 treatments was increased ($P < 0.05$) compared with RET and BDT treatments, while RET05 treatment had higher ($P < 0.05$) ATTD of nitrogen than RET and BDT treatment. On d 35, pigs fed the BDT treatments had higher ($P < 0.05$) low-density lipoprotein cholesterol concentration compared with those fed the RET treatments. Triglyceride concentration was decreased ($P < 0.05$) in RET05 and RET10 treatments compared with that in RET and BDT treatments on d 35. However, no effects were detected on high-density lipoprotein cholesterol and total cholesterol concentrations on d 14 and 35 among dietary treatments. In conclusion, LPL addition improved ADG, nutrient digestibility, but decreased the serum triglyceride concentration when a reduced energy diet was given to weanling pigs.

1. Introduction

Lipids are essential components for a variety of body functions in animals. Lipids are found in both animals and plants. Plant lipids are usually in the form of oils, and animal lipids are in the form of concentrated fats. Lipids also reserve higher

Abbreviations: ADFI, average daily feed intake; ADG, average daily gain; ATTD, apparent total tract digestibility; BW, body weight; CP, crude protein; DM, dry matter; GE, gross energy; G:F, gain:feed; HDL, high-density lipoprotein; H_2S, hydrogen sulfide; LDL, low-density lipoprotein; LPL, lysophospholipids; ME, metabolizable energy; N, nitrogen; NH_3, ammonia; SEM, standard error of the mean.

* Corresponding author.
E-mail address: inhokim@dankook.ac.kr (I.H. Kim).

http://dx.doi.org/10.1016/j.anifeedsci.2015.06.007
0377-8401/

energy available to animals than carbohydrates and proteins, therefore, dietary lipids have been considered as an importance mean to increase energy concentrations of swine diets. The addition of fat to the diet of weanling pigs has been reported to improve ADG and feed efficiency during the later stages primarily (Cera et al., 1990; Howard et al., 1990; Li et al., 1990). However, the digestion of dietary lipids is difficult by weanling pigs, especially during the early period after weanling (Cera et al., 1988; Li et al., 1990).

Emulsifiers are molecules that have two parts. One part of the molecule is called hydrophilic, and the other part is called hydrophobic. The emulsifier molecule dissolves with its hydrophilic part in the water and its hydrophobic part in the oil droplet. Thus, emulsifiers can keep the oil droplets in the emulsion distributed which is good for the digestion and absorption of lipids. Lysophospholipids (LPL) are regarded as an emulsifier and contribute to improve digestion of lipids in weanling pigs. Previous researchers have added it into swine diets aimed to improve the dietary lipid digestibility, thus improve growth performance of pigs. Xing et al. (2004) demonstrated that LPL improved average daily gain (ADG) during d 15–35 after weaning and overall period, but did not affect average daily feed intake (ADFI) or gain:feed (G:F). However, Overland and Sundstol (1995) observed that LPL improved G:F during d 0–14 after weaning, ADG and G:F during the overall period, but had no significant effect on pig performance during d 15–35 after weaning. The apparent total tract digestibility (ATTD) of dry matter (DM), gross energy (GE), and crude protein (CP) on d 28 was decreased by LPL supplementation in weanling pigs (Xing et al., 2004), but Soares and Lopez-Bote (2002) did not observe any effect of dietary LPL supplementation on DM, CP, and crude fiber digestibility in weanling pigs. Previous studies showed that soy-derived lecithin has beneficial effects on lowering serum cholesterol and triglycerides, while increasing high-density lipoprotein (HDL) cholesterol levels in the blood of rats (Jimenez et al., 1990; Iwata et al., 1993). However, no enough researches focused on blood characteristics in weanling pigs. As the inconsistent results and lacking studies, further researches need to be taken. In addition, we wanted to know that if emulsifier supplementation would be beneficial to growth performance, nutrient digestibility and blood profile in weanling pigs.

2. Materials and methods

The experimental protocols describing the management and care of animals were reviewed and approved by the Animal Care and Use Committee of Dankook University. The LPL obtained from soybean lecithin by the exclusive proprietary technology developed by the UK based company Pathway-Intermediates (Lipidol; EASY BIO System Inc., Seoul, South Korea).

2.1. Experimental design, animals and housing

A total of 144 weanling pigs [(Landrace × Yorkshire) × Duroc] with an average body weight (BW) of 7.95 ± 0.97 kg were used in a 35-d experiment. Pigs were randomly allotted to four treatments according to their BW and sex (three gilts and three barrows/pen, six pens/treatment). There were two phases with different net energy (NE) including phase 1 (d 0–14) and phase 2 (d 15–35). The treatments included: (1) RET, reduced energy treatment (NE = 10.57 and 10.32 MJ/kg for phase 1 and phase 2), (2) BDT, basal diet treatment (NE = 10.87 and 10.63 MJ/kg), (3) RET05, RET + 0.5 g/kg LPL, and (4) RET10, RET + 1.0 g/kg LPL. The LPL was added in the diets replaced on equal amount of corn in this experiment. The diets were formulated to meet or exceed NRC (2012) nutrient requirements (Table 1). All pigs were allowed ad libitum access to feed and water throughout the experiment, and were housed in an environmentally controlled room, which proved 0.26 m^2 per pig. Temperature during wk 1 was maintained at 32 °C and was lowered 2.5 °C each week thereafter.

2.2. Experimental procedures and sampling

Individual pig BW and pen feed intake were recorded at the beginning and the end of each dietary phase and used to calculate ADG, ADFI, and G:F. Chromium oxide (0.2%) was added to the diet as an indigestible marker at each phase for 7 d before fecal collection to determine ATTD of DM, nitrogen (N), crude fat, and GE (Fenton and Fenton, 1979). On d 14 and 35, fecal samples were collected randomly from two pigs (one barrow and one gilt) in each pen via rectal massage. All feed and fecal samples were stored at −20 °C until analysis.

On d 14, blood samples were collected from the cervical vein into nonheparinized vacuum tubes (Becton Dickinson Vacutainer Systems, Franklin Lakes, NJ) from two pigs (one gilt and one barrow) in each pen and the same pigs were sampled again on the final day of the experiment.

2.3. Laboratory analysis

Before chemical analysis, fecal samples were dried at 57 °C for 72 h, after which they were ground to pass through a 1-mm screen. Experimental feeds were analyzed for CP (Method 990.03; AOAC, 2007), calcium and phosphorus (Method 985.01; AOAC, 2007), crude fat (Method 960.39; AOAC, 2007) and crude fiber (Method 962.09; AOAC, 2007). The amino acid profile of diets was analyzed by HPLC (Hitachi L-8800 Amino Acid Analyzer, Tokyo, Japan) as described in Lu et al. (2008). All samples were hydrolyzed at 110 °C for 24 h in 6 N HCl before analysis. Methionine was analyzed as Met sulfone after cold performic acid oxidation overnight before hydrolysis. The feces were analyzed for DM (Method 930.15; AOAC, 2007), crude protein (Method 990.03; AOAC, 2007), and crude fat (Method 960.39; AOAC, 2007). Chromium was analyzed via UV