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Conjugated linoleic acid (CLA) during last week of gestation and lactation alters colostrum and milk fat composition and performance of reproductive sows

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ABSTRACT

The objectives of this experiment were to study the effect of dietary supplement of a commercial source of CLA, supplied either in the gestation/lactation period or during the post-weaning period, on sow and piglet performance and on the transfer of CLA into colostrum and milk. The experiment was designed to assess both the effect of dietary CLA supplementation to the sow in lactation and on the piglets in the nursery. There were four treatments for nursery piglets arranged factorially, two dietary treatments for origin sows (0 g/kg *vs* 10 g/kg CLA) and two treatments for weaned piglets (0 g/kg *vs* 10 g/kg CLA). Immediately after parturition, 10 mL of colostrum was collected from the functional glands of each sow. On day 23 after farrowing, milk samples were also collected. Lower backfat thickness was observed after 28 days of lactation in all groups, and the loss was higher for the control than CLA group ($P<0.004$). No effect of dietary treatment was observed for colostrum crude fat content, but a lower concentration of crude fat was observed in milk from sows fed the diet containing CLA ($P<0.01$). Feeding sows a CLA (10 g/kg) enriched diet during gestation and lactation increased the concentration of CLA and altered the concentration of fatty acids in colostrum and milk. Dietary CLA produced higher saturated fatty acids (SFA) and lower monounsaturated fatty acids (MUFA) concentration in all cases, but no alteration in total polyunsaturated fatty acids (PUFA) concentration. Dietary CLA had a positive influence on the C17:0 ($P=0.007$), C18:0, SFA, *c*9, *t*11 and *t*10, *c*12 proportions ($P<0.001$) and a negative effect on C16:1*n*-7 ($P<0.001$), MUFA ($P<0.05$), MUFA/SFA ($P<0.01$), C16:1*n*-7/C16:0 and C18:1*n*-9/C18:0 ($P<0.001$) ratios in the colostrum. Dietary CLA had a positive influence on the C14:0, C15:1, C16:0, C18:0, *c*9, *t*11, *t*10, *c*12, C20:0, C20:1, C20:5*n*-3 and SFA proportions ($P<0.001$) and a negative effect on C16:1*n*-9, C16:1*n*-7, C17:1, C18:1*n*-9, C20:4*n*-6, MUFA, MUFA/SFA, C16:1*n*-7/C16:0 and C18:1*n*-9/C18:0 ($P<0.001$) in milk. CLA administration to sows reduced backfat thickness loss during the lactation period and led to higher piglet weight at weaning. No effect of sow or piglet diet was observed on the main productive characteristics.

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1. Introduction

Conjugated linoleic acid (CLA) is a generic term used to describe geometric and positional isomers of the 18-carbon fatty acid with two conjugated double bonds. The two isomers most studied for their biological effects are *cis*-9, *trans*-11 CLA (*c*9, *t*11), the predominant isomer produced in ruminant mammals, and *trans*-10, *cis*-12 CLA (*t*10, *c*12).

Conjugated linoleic acid intake during lactation also modifies milk fatty acid composition (Chin et al., 1994; Bee, 2000), and CLA infusion into the abomasum has been shown to depress milk fat concentration in ruminants (Chouinard et al., 1999). Furthermore, dietary CLA isomers are excreted in colostrum and milk and are therefore available to the suckling piglets (Bee, 2000), where they can also alter fatty acid composition and lipid metabolism.

The perinatal period is associated with abrupt changes in energy supply both for the dam and the piglet. Weaned piglets must rely on body energy reserves until intake of colostrum and milk to meet their energy demand. Thus, energy reserves at birth are crucial for newborn piglets to avoid early death. Sows' body reserves at the time of farrowing and their ability to obtain energy from lipid stores can exert a major influence on their performance in lactation and subsequent rebreeding (Reese et al., 1982). Chin et al. (1994) and West et al. (1998) reported an increased metabolic rate and a more efficient metabolic utilization of nutrients when CLA was incorporated into the diet, thus suggesting that CLA may have a beneficial effect on productive aspects of dams. Moreover, Morales et al. (2008) and Corino et al. (2009) have shown that CLA enhances immune function in piglets and decreases the negative effects of inflammatory response in piglets. Previous research has shown a rapid alteration of lipid metabolism induced by CLA feeding over a short period of time in pigs (Wiegand et al., 2001; Martín et al., 2007).

The aim of this research was therefore to evaluate the effect of feeding a CLA diet in late gestation (one week prior to farrowing) and lactation and weaning on colostrum and milk fat composition and on subsequent sow and piglet performance.

2. Material and methods

2.1. Animal and experimental diets

The animal care routine and experimental procedures used in this experiment were approved by the Complutense University in Madrid (16 November, 2006).

The experimental diets were provided as pellets and were formulated in order to supply an equal amount of digestible essential amino acids per megajoule (MJ) net energy (NE). Ingredients, chemical composition and main fatty acids of sows experimental diets are shown in Table 1. Diets were provided from 107 days of gestation until weaning (28 days after farrowing). Sows were fed twice daily and had *ad libitum* access to water. From day 108 to day 111 of pregnancy, daily rations of 25.5 MJ NE were given. Around farrowing, 20 MJ NE per day was provided, followed by 20–25 mJ NE on days 2–3 postfarrowing. Thereafter, feed was provided for *ad libitum* consumption.

In the nursery phase piglets received two different diets, prestarter (from 28 to 42 days of age) and starter (from 42 to 63 days of age), and two different dietary treatments for each diet (prestarter and starter): a control diet ($n = 24$) and a diet enriched in 10 g/kg CLA ($n = 24$). The piglets did not receive creep feed from birth to wean. All nursery diets were provided as pellets and were formulated in order to supply an equal amount of digestible essential amino acids per MJ NE. Feed and water were provided *ad libitum*. Ingredients, chemical composition and main fatty acids of piglet experimental diets are shown in Table 1.

2.2. Experimental design

Thirty-four sows (Landrace × large White) in the 3–4 parity with a uniform weight in the range 260–280 kg were randomly selected and assigned to 2 dietary treatments ($n = 17$): a control diet (S-CT) and a diet enriched with 10 g/kg CLA (S-CLA). Conjugated linoleic acid was included at the expense of lard. The sows were housed individually in pens (2.2 m × 2.4 m) with slatted floors.

At weaning, 288 piglets of 28 ± 3 days of life, half entire males and half females, from the two experimental treatments in lactation (144 per treatment) were randomly selected and used during 35 days of feeding experiment. Piglets with any sign of disease were removed from the trial. Pigs were allocated into 48 pens (24 pens from each sow treatment; 6 pigs per pen) with totally slatted floor and 0.25 m^2 per piglet.

In the nursery phase, the experiment was designed to assess both the effect of CLA dietary supplementation to the sow in lactation and to the piglets in nursery. Therefore, there were four treatments for nursery piglets arranged factorially, with two dietary treatments of origin sows (0 g/kg *vs* 10 g/kg CLA) and two-dietary CLA level in nursery (0 g/kg *vs* 10 g/kg CLA).

2.3. Measurements and sampling

Immediately after parturition, 10 mL of colostrum was collected from the functional glands of each sow. On day 23 after farrowing, milk samples were collected. Briefly, (10 mL) of milk were obtained after intramuscular injection in the neck