Livestock Science 157 (2013) 210–217

Contents lists available at ScienceDirect

Livestock Science

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

Pea starch meal as a substitute for cereal grain in diets for lactating sows: The effect on sow and litter performance

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ARTICLE INFO

Article history:
Received 14 January 2013
Received in revised form
18 June 2013
Accepted 19 June 2013

Keywords:
Sow
Lactation
Pea starch
Performance
Piglets
Blood glucose

ABSTRACT

The major by-product from the production of pea protein concentrate is pea starch, and this starch can be an alternative source of starch compared to for instance starch from wheat in diets for pigs. However, differences in energy utilization between pea starch and cereal starch could affect the animals' production performance. In this study data from 100 Norwegian Landrace x Yorkshire sows was collected to investigate if inclusion of 20% pea starch meal (*Pisum sativum* L) in diets for lactating sows affected sow and litter performance. Two cereal grain based diets were formulated, but in one of the diets part of the wheat inclusion was replaced with pea starch meal. Data collection included registrations of sow daily feed consumption, individual weight and backfat measures, litter weights, measurement of blood glucose level after feeding and reproductive performance. Sows offered the pea diet had a higher average daily ($P<0.0001$), weekly ($P<0.01$) and total feed consumption ($P<0.0001$) during lactation. They also had a lower weight loss during the first three weeks of lactation ($P<0.001$). During the last two weeks of lactation sows in both groups were on average gaining weight, but the sows offered the control diet had the highest gain in this period ($P<0.05$). There was a tendency for a higher backfat loss in the pea group during the first three weeks of lactation ($P=0.10$), but no difference was found in overall backfat loss between treatments ($P>0.05$). Dietary treatment did not affect litter performance during lactation ($P>0.05$). The weaning-to-service interval was higher among the first parity sows offered the pea diet compared to the first parity sows offered the control diet ($P<0.05$). Blood glucose was not affected by dietary treatment within the chosen timeframe of this study ($P>0.05$). This study shows that pea starch meal can be used as an alternative source of starch in diets for lactating sows. The sows offered the pea diet had the highest feed consumption during lactation, and although this was not reflected in higher weaning weights, it was reflected in an improved body condition at weaning.

1. Introduction

Peas (*Pisum sativum* L) have traditionally been viewed as an alternative protein source in diets for pigs, and rank intermediate to soybean meal and cereal grains in terms of digestible energy (Gatel and Grosjean, 1990). Peas are

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http://dx.doi.org/10.1016/j.livsci.2013.06.023

produced worldwide and can therefore be considered as a cheaper and more available protein alternative in diets for pigs than for instance soybean meal (Smith et al., 2013). Several studies have found that peas can be used as a protein source in diets for pigs as long as the diets are fortified with synthetic amino acids to balance the low content of sulfur amino acids and tryptophan (Castell et al., 1996; Gatel and Grosjean, 1990; Le Guen et al., 1995b). In studies with young pigs and grower-finisher pigs it has been discussed whether content of antinutritional factors in peas such as for instance amylase inhibitors, tannins, and trypsin inhibitors (Abrahamsson et al., 1993; Grala et al., 1999; Le Guen et al., 1995a) can have an adverse effect on digestibility and production. However, several studies have found that inclusion of 10–20% peas in diets for young pigs (Castell et al., 1996; Gatel and Grosjean, 1990), and 20–40% peas in diets for grower-finisher pigs (Stein et al., 2004, 2006) did not adversely affect production. The inclusion of peas in diets for sows however, has had more varying results (Gatel et al., 1988; Linnemann et al., 1975). Linnemann et al. (1975) concluded that an inclusion of 10–20% peas in the diets for pregnant and lactating sows through four parities led to a decrease in number of piglets born alive, while Gatel et al. (1988) found no adverse effect on sow and litter performance during seven successive parities with an inclusion of 16% peas in diets for gestating sows and 24% peas in diets for lactating sows. The common factor in all the studies mentioned this far, with the exception of Smith et al. (2013), are that they have looked at pea as a partial or total replacement of the protein inclusion in the pig diets. Since starch is the ingredient in pig diets that yield the most energy (Wiseman, 2006), and the major by-product from the production of pea protein concentrate is pea starch, this can be an alternative source of starch compared to for instance maize, wheat and potato starches (Ratnayake et al., 2002). However, pea starch is less well digested in the small intestine of the pig compared to cereal starch, and this might influence the energy utilization of the feed. The main objective of this study was to investigate the effect on sow and litter performance when replacing part of the wheat inclusion in diets for lactating sows with 20% pea starch meal.

2. Material and methods

2.1. Herd, management and feed types

This study was based on data from a commercial piglet production unit connected to a sow-pool system. A sow-pool is a co-operation between several pig producers where one central herd supplies other producers (satellite units) with pregnant sows in a leasing system (Dalin et al., 1997; Engblom, 2008). The pregnant animals are transported to the satellite unit three weeks before expected parturition, and then transported back after weaning for rebreeding or culling. The central herd is responsible for the management of gilts and sows during rearing, mating and gestation, while the satellite units are responsible for the pregnant females from three weeks before expected parturition and until weaning of their litter. Data were collected from a total of 100 Norwegian Landrace x Yorkshire sows. The sows farrowed in two batches (June and October 2010), with 50 sows in each batch. Upon arrival in the satellite unit the sows were blocked within three parity groups; first parity sows, second parity sows and ≥third parity sows. Within block the sows were randomly allotted to one of two diets. Both diets were a pelleted lactation feed containing 10.20 MJ NE/kg. The lysine content per kg feed was 8.7 g in the control diet and 11.2 g in the pea diet. Both diets met or exceeded the suggested requirements of all nutrients including amino acids for lactating sows (Trottier and Johnston, 2001). The diets differed by the substitution of 25% wheat with 20% pea starch meal in the pea group diet (Table 1). The added

Table 1
Composition of experimental diets.

	Control diet	Pea diet	Unit
Ingredients (as-fed basis)			
Wheat	48.93	24.97	%
Barley	15.00	15.50	%
Oat	15.95	15.00	%
Pea starch meal	–	20.00	%
Soybean meal	8.85	13.40	%
Fish meal	1.00	1.00	%
Animal fat	4.00	4.00	%
Molasses	1.50	1.50	%
Calcium carbonate (limestone)	1.53	1.56	%
Monocalcium phosphate	0.85	0.75	%
Sodium bicarbonate	0.06	0.06	%
Salt	0.45	0.45	%
Mineral mix[a]	1.10	1.10	%
Vitamin mix[b]	0.11	0.11	%
Calculated composition (as-fed basis)			
Protein	15.40	17.40	%
Fat	7.66	7.18	%
Water	12.25	11.63	%
Starch	42.49	40.47	%
Lysine	0.87	1.12	%
Methionine	0.24	0.25	%
Methionine+cysteine	0.55	0.56	%
Threonine	0.58	0.69	%
Tryptophane	0.19	0.21	%
Crude fiber	4.03	3.79	%
Ca	0.90	0.90	%
P	0.52	0.52	%
Na	0.20	0.20	%
Vitamin E	0.01	0.01	%
NE	10.20	10.20	MJ/kg
Analyzed composition (as-fed basis)			
Crude protein	15.00	17.30	%
Crude fat	7.50	7.30	%
Water	12.30	12.10	%
Crude fiber	3.90	3.90	%
Ca	0.80	0.85	%
P	0.54	0.52	%
Na	0.20	0.22	%
Vitamin E	181	194	mg/kg

[a] The mineral mix provided the following amounts per kilogram of feed: 203 mg of Zn (ZnO); 80 mg Fe ($FeSO_2 \cdot H_20$); 60 mg Mn (MnO); 15 mg Cu (CuO); 0.75 mg I ($Ca(IO_3)_2$; 0.3 mg Se (Na_2SeO_3).

[b] The vitamin mix provided the following amounts per kilogram of feed: 10640 IU vitamin A; 1216 IU cholecalciferol (vitamin D); 165 mg DL-α-tocopheryl acetate (vitamin E); 4.56 mg menadione (vitamin K3); 6.08 mg riboflavin. 16.7 mg D-pantothenic acid; 30.4 μg cyanocobalamine; 30.4 mg niacin; 1.03 mg biotin;2.85 mg folic acid; 580 mg choline.