Animal Feed Science and Technology 174 (2012) 108–112

Contents lists available at SciVerse ScienceDirect

Animal Feed Science and Technology

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

Short communication

The effect of feeding lentil on growth performance and diet nutrient digestibility in starter pigs

J.L. Landero[a], E. Beltranena[a,b], R.T. Zijlstra[a,*]

[a] Department of Agricultural, Food and Nutritional Science, University of Alberta, Edmonton, Alberta T6G 2P5, Canada
[b] Alberta Agriculture and Rural Development, Edmonton, Alberta T6H 5T6, Canada

ARTICLE INFO

Article history:
Received 15 October 2011
Received in revised form 13 February 2012
Accepted 15 February 2012

Keywords:
Digestibility
Lentil
Performance
Starter pig

ABSTRACT

The effects of substitution of soybean meal with increasing levels of green lentil (*Lens culinaris*) were evaluated in 240 starter pigs from 9 to 20 kg. Five pelleted wheat-based diets containing 0, 75, 150, 225, or 300 g lentil/kg were formulated to contain 9.76 MJ net energy (NE)/kg and 1.20 g standardised ileal digestible lysine (Lys)/MJ NE and were fed for 3 weeks starting 2 weeks after weaning at 19 days of age. Lentil was added by replacing soybean meal and wheat and the diets were balanced for NE using canola oil and for amino acids using crystalline Lys, threonine, methionine and tryptophan. Increasing dietary inclusion of lentil linearly decreased ($P<0.001$) the diet apparent total tract digestibility coefficient for crude protein from 0.821 to 0.798 and digestible energy value from 14.4 to 14.0 MJ/kg. For the entire trial (day 0–21), increasing dietary inclusion of lentil linearly decreased ($P<0.05$) average daily gain (ADG) and quadratically reduced ($P<0.01$) feed efficiency (G:F). Specifically, pigs fed 75–225 g lentil/kg had a similar ADG and G:F than pigs fed 0 g lentil/kg, whilst the inclusion of 300 g lentil/kg reduced ($P<0.01$) both ADG and G:F by 10%. Differences in feed intake were not observed ($P>0.05$). In conclusion, inclusion of green lentil should not exceed 225 g/kg in diets for nursery pigs to maintain similar performance as pigs fed a diet with soybean meal as the main supplemental protein feedstuff.

1. Introduction

Prices of traditional feed ingredients for pig diets can be high. Pork producers continue to search for ways to reduce feed cost, including the use of alternative feed ingredients. Lentil (*Lens culinaris*) is a non-oilseed legume seed or pulse crop primarily grown for human consumption. Lentil seed has a lower crude protein (CP) and amino acid content but a higher net energy (NE) value than soybean meal (NRC, 1998). Lentil can be a cost-effective source of dietary protein and energy replacing soybean meal when excess production or low food-grade lentil is available for inclusion into swine diets. However, the anti-nutritional factors (ANF) contained in lentil seed (Wang and Daun, 2006) might limit its inclusion, especially in diets for young pigs.

Research in pigs fed lentil is limited. Lentil has been incorporated into diets for grower-finisher pigs (23–100 kg) at an inclusion up to 400 g lentil/kg replacing partially or completely soybean meal, without reducing growth performance (Bell and Keith, 1986; Castell and Cliplef, 1988, 1990). However, studies with starter pigs fed lentil has not been published to date.

Abbreviations: ADFI, average daily feed intake; ADG, average daily gain; ANF, anti-nutritional factors; BW, body weight; CATTD, apparent total tract digestibility coefficient; CP, crude protein; DE, digestible energy; DM, dry matter; G:F, feed efficiency (ADG/ADFI); Lys, lysine; NE, net energy; SID, standardised ileal digestible.

* Corresponding author. Tel.: +1 780 492 8593; fax: +1 780 492 4265.
E-mail address: ruurd.zijlstra@ualberta.ca (R.T. Zijlstra).

0377-8401/$ – see front matter © 2012 Elsevier B.V. All rights reserved.
doi:10.1016/j.anifeedsci.2012.02.010

Table 1
Ingredient composition and analysed nutrient content (g/kg diet as fed) of experimental diets.

	Lentil (g/kg diet)				
	0	75	150	225	300
Ingredient					
Wheat, hard red spring	625.9	601.5	577.0	552.6	528.1
Soybean meal, 460 g CP/kg	200.0	150.0	100.0	50.0	–
Lentil, 259 g CP/kg[a]	–	75.0	150.0	225.0	300.0
Lactose	50.0	50.0	50.0	50.0	50.0
Canola oil	30.0	27.5	25.0	22.5	20.0
Herring fish meal, 700 g CP/kg	50.0	50.0	50.0	50.0	50.0
Limestone	9.1	9.3	9.5	9.7	9.9
Celite[b]	8.0	8.0	8.0	8.0	8.0
Mono/dicalcium phosphate	8.0	8.2	8.4	8.6	8.8
Vitamin premix[c]	5.0	5.0	5.0	5.0	5.0
Mineral premix[d]	5.0	5.0	5.0	5.0	5.0
Salt	5.0	5.0	5.0	5.0	5.0
L-Lysine HCl, 780 g/kg	1.8	2.4	3.0	3.6	4.2
L-Threonine, 990 g/kg	1.2	1.6	2.0	2.4	2.8
DL-Methionine, 990 g/kg	0.6	0.9	1.3	1.6	2.0
L-Tryptophan, 990 g/kg	0.1	0.3	0.5	0.7	0.9
Choline chloride, 600 g/kg	0.3	0.3	0.3	0.3	0.3
Analysed composition[e]					
Moisture	111	111	109	117	116
Crude protein	213	204	196	195	186
Crude fat	50	49	44	41	37
Crude fibre	22	21	21	22	21
Ash	59	59	58	57	50
Acid detergent fibre	38	38	37	40	36
Neutral detergent fibre	147	118	120	129	109
Gross energy (MJ/kg)	16.9	16.9	16.7	16.5	16.5

[a] Human food grade; SaskCan Pulse Trading, Rosetown, SK, Canada.
[b] Celite 281 (World Minerals Inc., Santa Barbara, CA) used as acid insoluble ash.
[c] Supplied per kilogram of diet: 7500 IU of vitamin A, 750 IU of vitamin D, 50 IU of vitamin E, 37.5 mg of niacin, 15 mg of pantothenic acid, 2.5 mg of folacin, 5 mg of riboflavin, 1.5 mg of pyridoxine, 2.5 mg of thiamine, 4 mg of vitamin K, 0.25 mg of biotin and 0.02 mg of vitamin B_{12}.
[d] Supplied per kilogram of diet: 125 mg of Zn, 50 mg of Cu, 75 mg of Fe, 25 mg of Mn, 0.5 mg of I and 0.3 mg of Se.
[e] Diets were formulated to contain (as fed): 9.76 MJ NE/kg, 11.7 g SID lysine/kg, 4.5 g SID methionine/kg, 7.7 g SID threonine/kg and 2.4 g SID tryptophan/kg.

Such young pigs are a more sensitive model for feed ingredient evaluation than the grower-finisher pigs (Beltranena et al., 2008). Research is needed to determine the dietary inclusion of lentil for optimum growth performance in starter pigs.

The hypothesis for the present study was that pigs offered diets containing lentil in substitution for soybean meal and formulated to an equal NE and standardised ileal digestible (SID) amino acid content would have growth performance and dietary nutrient digestibility similar to pigs fed diets without lentil. The objectives were to determine whether a dose response existed for growth performance and apparent total tract digestibility coefficients (CATTD) of dietary energy and protein of starter pigs (9–20 kg; 33–54 days of age) fed diets containing 0 up to 300 g lentil/kg.

2. Materials and methods

2.1. Experimental design and diets

The animal procedures for the study were approved by the University of Alberta Animal Care and Use Committee for Livestock and followed principles established by the Canadian Council on Animal Care (CCAC, 2009). The study was conducted at the Swine Research and Technology Centre, University of Alberta (Edmonton, AB, Canada).

In total, 240 pigs (Duroc × Large White/Landrace F_1; Hypor, Regina, SK, Canada) were weaned at 19 ± 1 day of age. Pigs were selected based on average daily gain (ADG) during the first 14 days post weaning and body weight (BW) on day 14 after weaning (9.0 ± 1.6 kg); lighter and heavier pigs were not used. Pigs were divided within gender into heavy and light BW, randomly placing one heavy and one light barrow and gilt into one of 60 pens, for 12 pens of four pigs each for each of the five experimental diets. After weaning, pigs were fed sequentially commercial phase 1 [241 g CP/kg, 11.1 MJ NE/kg, 16.4 g SID lysine (Lys)] and phase 2 (203 g CP/kg, 11.0 MJ NE/kg, 12.4 SID Lys/kg) diets (Viterra Feed Products, Sherwood Park, AB, Canada) for 2 and 12 days, respectively.

A wheat-based control diet and four diets containing 75, 150, 225, or 300 g of green lentil/kg were formulated by replacing soybean meal and wheat with lentil (Table 1). The green lentil sample was grown in Saskatchewan, Canada in 2010 and was classified as human food grade. Wheat and lentil were ground in a hammer mill using a 3.2-mm screen. Diets without antimicrobials or growth promoters were formulated to provide 9.76 MJ NE/kg and 1.20 g SID Lys/MJ NE with other amino acids formulated as an ideal ratio to Lys (NRC, 1998) using established NE (Sauvant et al., 2004) and SID amino acid (NRC,