EFFECTS OF FEEDING CONCENTRATE DIETS CONTAINING NARROW-LEAFED LUPIN, YELLOW LUPIN OR SOYA WHEN COMPARED WITH A CONTROL DIET ON THE PRODUCTIVITY OF FINISHING LAMBS

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ABSTRACT

An experiment investigated the hypothesis that incorporating lupins (*Lupinus* spp.) into lamb finishing diets would not alter lamb productivity and carcass characteristics when compared with a soya bean (*Glycine max*) meal concentrate or a commercial concentrate diet. The 4 dietary treatments were: narrow-leaf lupin (cv. Prima), yellow lupin (cv. Wodjil), soya bean meal and a commercial (control) lamb finisher diet. Eighty male Suffolk-cross castrated lambs were used. Diets were formulated so as to be iso-nitrogenous (160 g kg DM^{-1}) and iso-energetic (ME 11.0 MJ kg DM^{-1}). The experiment comprised of 3 phases: a 14-d covariate period, a 14-d adaptation period (14 days prior to day 0) and an 8-week measurement period (Day 0-56). During the covariate period, lambs were kept as one group on pasture. During the adaptation period, lambs were housed and offered increasing amounts of their treatment diets. Each blocking group was allocated at random to a set of four adjacent pens within 4 treatment blocks. During the measurement period, animals were offered straw and concentrate *ad libitum*, with refusal margins of 0.10 to 0.15 d-1. Lambs were weighed and condition scored every 7-d throughout the experiment. The measurement period was split into two phases. From Day 0-28, live weight data from all lambs was collected to determine liveweight gain, with the mean of each replicate pen of 5 lambs used in the data analysis. The mean liveweight gain of lambs offered concentrates incorporating soya, narrow-leaf lupin, yellow lupin or a commercial control diet were 185, 229, 193 and 166 g d-1, respectively. There was no significant effect (P > 0.05) of dietary treatment on the liveweight gain of lambs offered the different dietary treatments. From Day 29 onwards, lambs were selected-out for slaughter and their carcass characteristics determined. The killing out percentage of lambs offered the soya, narrow-leaf lupin, yellow lupin or commercial control concentrate diet was 50.1, 50.7, 51.3 and 50.1%, respectively. Lambs offered a commercial control concentrate or concentrates containing yellow lupin took, on average, 31 days to finish for slaughter, with lambs offered narrow-leaf lupin and soya diets taking 29 and 32 days, respectively.

KEYWORDS

Lupinus luteus, *Lupinus angustifolius*, ruminant feed, liveweight gain, sheep

INTRODUCTION

Livestock farmers worldwide are aiming to reduce reliance their on imported and bought-in feedstuffs, which may be subjected to world market price fluctuations and have a high environmental footprint. Soya bean (*Glycine max*) meal is an important component of animal feed and in the EU feed sector alone soya bean meal constituted 53% of the total protein supplement used in 2001 (Brookes, 2002). In 2004, approximately 732,177 t of soya beans, 22,891 t of soya oil and 6,905 t of soya meal were imported in the UK (Defra, 2006). Oil seed rape and palm kernel cake and meal are typically used in commercial concentrate diets for sheep in the UK. Between July 2007 and April 2008, 698,000 t of oil seed rape (*Brassica napus*) cake and meal and 373,000 t of other (i.e. palm kernels (*Elaeis guineensis*), coconut (*Cocos nucifera*), shea (*Vitellaria paradoxa*) and illipe (*Shorea stenoptera*) nuts) oil seed cake and meal were used in the retail production of animal feedstuffs in the UK (Defra, 2008). Lupins (*Lupinus* spp.) as a high protein, high energy, nitrogen-fixing grain legume, have the potential to be used as a home-grown feedstuff in livestock feeds in the UK. Lupins are not traditionally grown as a field crop in the UK but the high nutritional value of the grain, with both a high protein content (compared with peas or beans) and oil content, which gives them high energy value and the low levels of anti-nutritional metabolites in more recent varieties in has led to a renewed interest in their potential as a feed in UK livestock diets (Wilkins and Jones, 2000). Research has tended to focus on the effects of the Australian sweet lupins, also known as narrow-leafed lupins (*Lupinus angustifolius*) (Hill, 2005), with an estimated 550, 000 t of lupin grain being fed to sheep in Western Australia each year (Murray, 1994). However, there have been few studies comparing the effects of yellow lupins (*Lupinus luteus*), the species that are more typically grown in European countries. The current study investigated the effects of incorporating either yellow lupins, narrow-leafed lupins or soya bean meal into the concentrate diets of finishing lambs on lamb

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productivity and carcass characteristics when compared to a commercial UK lamb finisher diet.

MATERIALS AND METHODS

EXPERIMENTAL DESIGN, DIETARY TREATMENTS AND ANIMALS

The experiment comprised of a lamb finishing experiment with 4 dietary treatments, with 20 lambs on each treatment. Eighty male castrated suffolk-cross lambs were sourced from the same late-lambing flock for the experiment. The experiment was divided into 3 phases: a 14-d co-variate period, a 14-d adaptation period (14 days prior to day 0) and an 8-week measurement period (Day 0-56). The 4 dietary treatments were narrow-leaf lupin (cv. Prima), yellow lupin (cv. Wodjil), soya bean meal and a commercial (control) lamb finisher diet. The formulations of the diets, showing the percentages of each of the main ingredients are presented in Table 1. Diets were formulated so as to be iso-nitrogenous (target nitrogen concentration of 25.7 g kg DM^{-1}; 16% CP) and iso-energetic (target ME 11.0 MJ kg DM^{-1}). The two lupin varieties for the experiment were produced on the same experimental site (at IBERS) and harvested according to standard practice.

EXPERIMENTAL APPROACH AND MEASUREMENTS

During the covariate period, the lambs were kept as one group on a ryegrass/clover sward. At the start of the adaption period, lambs were allocated to their replicate blocking group within each treatment on the basis of live weight and body condition score. Prior to the measurement period, lambs were housed and dietary treatments were gradually introduced, along with straw as the fibre component of the diet. Each blocking group was allocated at random to a set of four adjacent pens and treatment groups were allocated at random to pens within this. Lambs were bedded on oilseed rape straw (non-edible) during the measurement period and fresh water was available at all times. During the measurement period, the animals were offered straw and supplemental concentrate ad libitum, with feeding levels designed to ensure a refusal margin of 0.10 to 0.15 each day. The measurement period ran for a maximum of 56 days and was divided into two phases. During week 1-4, liveweight gain data from all lambs were recorded. From week 5 onwards, lambs were selected-out for slaughter when they reach a target fat class of 3 L and their days to finish recorded. Live weight and cold carcass weight was then used to determine killing-out percentages. Concentrate as offered was DM sampled, with sub-samples of the feed offered being collected daily and bulked weekly, freeze dried and ground for chemical analysis. Individual lambs were weighed and condition scored every 7 days throughout the co-variate, adaptation and measurement period. At the start and end of the intake measurements phase (i.e. weeks 1 and 4) lambs were weighed on consecutive days.

RESULTS AND DISCUSSION

DIET COMPOSITION

The dry matter content of the concentrate diets were 859, 850, 867 and 874 g kg $freshweight^{-1}$ for the soya bean meal, narrow leaf lupin, yellow lupin and control diet, respectively. The nitrogen concentration of the soya bean meal, narrow-leaf lupin, yellow lupin and control diet was 32.2, 32.9, 33.4 and 30.8 g kg DM^{-1}, respectively. The ME concentration of the soya bean meal, narrow-leaf lupin, yellow lupin and control diet was 12.5, 12.8, 12.6 and 12.6 MJ kg DM^{-1}, respectively. Nitrogen and ME concentration values of all diets were slightly higher than the target concentrations determined in the formulations but were still within an acceptable range.

LIVEWEIGHT GAIN AND CARCASS CHARACTERISTICS

There was no significant effect ($P > 0.05$) of dietary treatment on the liveweight gain of lambs offered the different dietary treatments. The mean liveweight gain of lambs offered concentrates incorporating soya, narrow-leaf lupin, yellow lupin or a commercial control diet were 185, 229, 193 and 166 g d^{-1}, respectively (s.e.d. 34.6) (Fig. 1). This result is comparable to the liveweight gains of 233 g d^{-1} recorded by Weise et al. (2003) for lambs offered narrow-leaf lupin. Overall, the findings from this study show that both narrow-leaf and yellow lupins could be used as a home-grown alternative to imported soya or a bought-in commercial concentrate, containing rapeseed meal and palm kernel, for finishing lambs in the UK without any adverse effects on lamb productivity or carcass killing out percentages.

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Table 1. Dietary ingredients (%) of treatment concentrate diets incorporating soya, narrow-leaf lupin, yellow lupin or a commercial control lamb finisher offered to growing lambs for 56 days.

Ingredient	Soya	Narrow-leafed lupin	Yellow lupin	Control
Wheat	41.3	42.6	49.45	31.9
Barley	20	20	20	15.1
Wheatfeed	15			15
Soya	11.05			
Narrow-leafed lupin		22.6		
Yellow lupin			15.75	
Rapeseed ext.				14.75
Palm kernel exp.				11
Minerals and vitamins	4.15	3.5	4.3	3.75
Sugar beet pulp	2.5	2.5	2.5	2.5
Molasses	6	8	8	6

Table 2. Carcass characteristics and number of days to finish of lambs offered concentrates incorporating either soya bean meal, narrow-leaf lupins, yellow lupins or a commercial control lamb finisher diet *ad libitum*.

	Soya	Narrow-leafed lupin	Yellow lupin	Control
Empty liveweight	38.5	38.3	38.5	37.6
Hot carcass weight	19.3	19.4	19.8	18.8
Killing out %	50.1	50.7	51.3	50.1
Days to finish	32	29	31	31

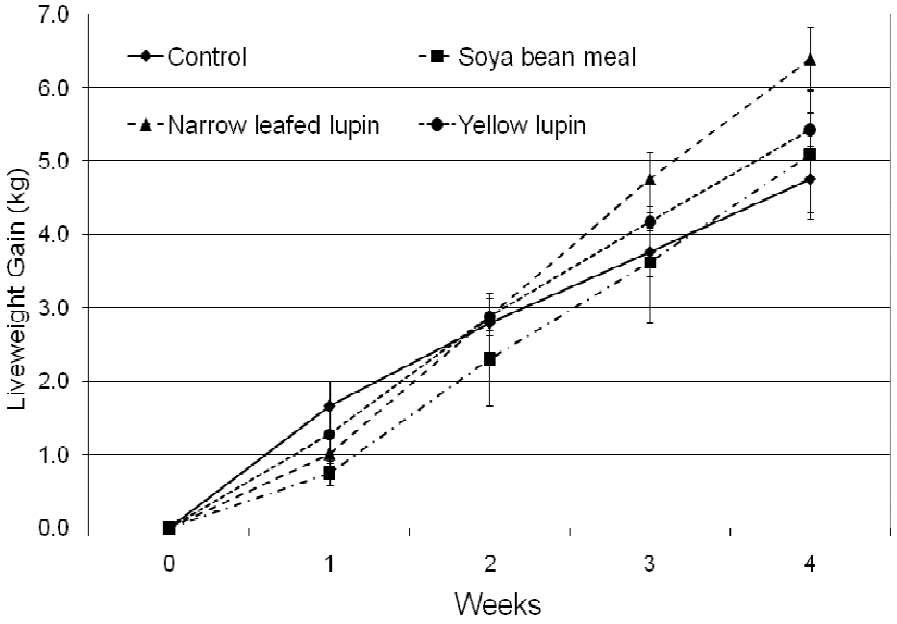

Fig. 1. Liveweight gain (g d^{-1}) of lambs offered concentrates incorporating either soya bean meal, narrow-leaf lupins, yellow lupins or a commercial control lamb finisher diet *ad libitum* over 28 days.

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