



## Replacement of soya bean meal with peas and faba beans in growing/finishing pig diets: Effect on performance, carcass composition and nutrient excretion

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### ABSTRACT

There is now an increasing debate about the viability of using temperate-grown legumes in pig diets as a potential replacement for imported soya bean meal (SBM) and this is due to food security, sustainability and environmental concerns. Two trials were designed to examine nitrogen (N) retention, growth performance and carcass quality of grower and finisher pigs when fed nutritionally balanced SBM-free diets formulated to contain peas or faba beans at 300 g/kg, compared to an SBM-containing, pulse-free control diet. Trial 1 evaluated N digestibility/retention in four iso-energetic diets, comparing the SBM control with one diet formulated with peas and two with faba bean cultivars; a tannin-containing and a tannin-free variety. This trial employed a four by four Latin Square design with four male pigs housed in metabolism crates, fed twice daily at 0.9 of assumed *ad libitum* intake over four time periods during grower (30–55 kg) and finisher (55–95 kg) phases. Quantitative faecal and urine collection allowed determination of N coefficient of total tract apparent digestibility, coefficient of apparent metabolisability, and N balance. Results revealed that dietary treatment did not affect these N parameters ( $P > 0.05$ ) during either the grower or finisher phase. Trial 2 evaluated growth performance (feed intake, daily live weight gain and feed conversion ratio) and carcass quality parameters. Five diets (based on SBM, peas and one of three faba bean cultivars) balanced for standard ileal digestible amino acids and net energy were each fed to eight replicates of individually housed entire male pigs over the same growth phases as Trial 1. The inclusion of three faba bean varieties allowed comparison of animal responses between tannin/tannin-free and spring vs. winter bean cultivars. At ~95 kg, pigs were slaughtered and a comprehensive range of carcass measurements undertaken. Samples of shoulder backfat were also taken at slaughter to determine skatole and indole concentrations. As with N balance, feeding treatment did not affect performance data. Carcass parameters revealed pigs fed with the pea-based diet had a greater dressing percentage than those animals on faba bean-based diets. Pigs fed with the SBM

**Abbreviations:** CAM, coefficient of apparent metabolisability; CTTAD, coefficient of total tract apparent digestibility; DLWG, daily live weight gain; FCR, feed conversion ratio; SBM, soya bean meal.

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or pea-based diets also had greater lean meat percentages than those on faba-bean diets. Mean skatole concentrations for all pigs were below the accepted maximum threshold level of 0.2 µg/g. In conclusion, it is suggested that peas and faba beans can be successfully fed in balanced pig diets throughout the grower/finisher periods as alternatives to SBM.

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## 1. Introduction

In order to remain competitive in the global market, the pig sector must seek sustainable and viable solutions to the sourcing and level of dietary energy and nutrient inputs, whilst maintaining an acceptable level of output and animal performance. In temperate environments, there are increasing concerns surrounding the reliance by the pig industry on the importation of significant tonnages of soya bean meal (SBM). These concerns reflect wider debates surrounding resource use and sustainability in agricultural production (Leinonen et al., 2012, 2013). The implementation of regulations surrounding the development of 'Nitrate Vulnerable Zones' (NVZs) and their recent revision (DEFRA, 2013) provide clear evidence of how environmental legislation is impacting upon temperate pig production systems. In addition to the environmental aspects, debates about sustainability and higher feed prices mean that the pig feed industry is beginning to question its reliance on imported SBM.

Whilst SBM is a reliable source of high quality protein (Jezierny et al., 2010), the environmental impact of its sourcing, along with future price uncertainty, has led to increasing discussion about the use of protein alternatives in pig diets. Of particular interest are peas (*Pisum sativum*) and faba beans (*Vicia faba*) owing to the considerably reduced environmental concerns of growing these in temperate environments, due to their nitrogen-fixing ability (Crépon, 2006), compared to other protein crops such as rapeseed. The cultivation of these legumes in rotation systems reduces the reliance and energy expenditure associated with the use of substantial inputs of nitrogenous fertiliser. Additionally, when used to replace SBM in pig and poultry diets, peas and beans have been shown to have further environmental benefits including reduced acidification potential of pig and poultry production (Topp et al., 2012; Leinonen et al., 2013). Literature examining the nutritional value of peas and faba beans in pig diets have frequently reported equivocal conclusions (Fowler and Livingstone, 1977; Mateos and Puchal, 1980; Gatel, 1994; Castell et al., 1996). Given the improvement in modern pig genotypes and the current environmental concerns highlighted above, it would seem particularly timely to revisit this issue, particularly in view of the recent move to use standardised ileal amino acid digestibility as the basis for diet formulation.

If there is to be an increased use of temperate-grown legumes, then the pig industry needs to be convinced that there will be no detrimental impacts on growth performance or carcass/meat quality arising from the inclusion of these raw materials in pig diets, when compared with more conventional diets based on imported SBM. Confidence in the use of peas and faba beans in non-ruminant diets has not been strong, partly due to concerns surrounding the number of different cultivars available, irregularity of supply, high costs and the presence of anti-nutritional factors; trypsin inhibitor activity in peas and condensed tannin content in faba beans (Jezierny et al., 2010; Masey O'Neill et al., 2012).

Recent dose-response studies have shown that peas and faba beans can completely replace SBM without penalizing growth performance and commercially obtained carcass characteristics, when separately tested in growing and finishing pigs (Smith et al., 2013). The aim of the current study was to extend this work by investigating the potential of using a greater range of faba bean cultivars as viable and sustainable alternatives to SBM in grower/finisher pig diets. In addition, a more comprehensive range of slaughter/carcass parameters were undertaken to further examine the effect of these legumes on carcass quality. The hypothesis tested was that these legumes could be included in balanced grower and finisher pig diets to replace completely SBM, with no detrimental effects on animal performance, nitrogen digestibility or carcass/meat quality parameters. The inclusion of peas and different faba bean varieties allowed a range of factors to be evaluated within the bounds of this hypothesis, including legume type (pea vs. faba bean), bean tannin content (tannin-containing vs. tannin-free) and season (spring-sown vs. winter-sown beans).

## 2. Materials and methods

### 2.1. Diets

All animal protocols and procedures were conducted under both National and Institutional guidelines as approved in advance by the Ethical Review Committee of the School of Biosciences of the University of Nottingham, UK. Two trials were conducted; Trial 1 assessed nitrogen (N) digestibility/retention and Trial 2 evaluated growth performance and carcass quality in growing/finishing pigs when fed peas or faba beans as an alternative protein source to SBM in nutritionally balanced pelleted diets. Five dietary treatments were formulated for the grower phase; one control diet containing 140 g SBM/kg and four test diets each containing 300 g of home-grown legumes/kg with the legumes being white-flowered peas; cultivar 'Prophet', spring coloured-flowered faba beans 'Fuego', spring white-flowered faba beans 'Tattoo' or winter coloured-flowered faba beans 'Wizard'. The different varieties of faba beans were expected to have different effects, especially in relation to their anti-nutritional properties. Laboratory analyses of the specific varieties of legumes used in the trials (including trypsin inhibitor

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