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The effect of the method of dietary oil addition to pelleted diets on performance and nutrient digestibility in finishing pigs

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ABSTRACT

The primary aim of this study was to investigate the effect of method of vegetable oil blend application, either sprayed onto (SP) or incorporated within (IN) pelleted diets, on the performance and coefficient of total tract apparent digestibility (CTTAD) of dietary components in finishing pigs. A secondary aim was to evaluate the source of energy, *i.e.* starch *vs* oil on pig performance and the CTTAD. Diets were formulated from either by-products (maize gluten, maize gluten feed, pollards and rapeseed) or cereals (barley and wheat) to which vegetable oil was added (g/kg) in two different ways: 40 (IN) or 30 (SP) + 10 (IN). Two studies were conducted. In study 1, 48 Large White × Landrace pigs (average weight 50.4 kg, SD 3.5 kg) on a research herd were used to determine CTTAD of dry matter (DM), crude protein (CP), neutral detergent fibre (NDF), lipid, energy and phosphorus and digestible energy (DE) content. In study 2, 960 Landrace × Large White pigs on a commercial herd, housed in groups of 20 from 14 to 24 weeks of age, were used to assess production performance and carcass characteristics. Oil addition (40IN and 10IN + 30SP) increased the CTTAD of lipid and phosphorus (both $P<0.001$) and decreased phosphorus excretion ($P<0.01$) in both by-product-based and wheat/barley-based diets. The total amount of nitrogen excreted also decreased ($P<0.05$) when oil was added to the wheat/barley-based diets but not the by-product-based diets. The CTTAD, except for lipid CTTAD, and pig performance were similar whether oil was added by 40IN or 10IN + 30 SP. Lipid CTTAD of by-product-based diets increased ($P<0.001$) when oil was added by 10IN + 30SP compared with 40IN. The addition of oil (40IN and 10IN + 30SP) to by-product-based and wheat/barley-based diets improved the DE content of the diets on a DM basis by on average 0.6 and 0.85 MJ/kg DM, respectively in study 1 ($P<0.001$) and FCR by on average 0.18 and 0.19 kg/kg, respectively in study 2 ($P<0.001$). Pigs offered wheat/barley-based diets had higher DM CTTAD ($P<0.001$) in study 1 and higher growth rates ($P<0.001$), finish weights ($P<0.01$) and carcass weights ($P<0.001$) in study 2 compared with by-product-based diets. The excretion of nitrogen from wheat/barley-based diets was lower ($P<0.001$) than from by-product-based diets. In conclusion, the performance of pigs was better when they were offered wheat/barley-based diets. Oil addition improved FCR with both wheat/barley-based and by-product-based diets but the method of oil application had no significant effect on pig performance or the CTTAD of the diet.

Abbreviations: IN, incorporated within the pellet; SP, sprayed onto the pellet; DM, dry matter; CP, crude protein; NDF, neutral detergent fibre; DE, digestible energy; GE, gross energy; DEI, digestible energy intake; N, nitrogen; P, phosphorus; FCR, feed conversion ratio; NDF, neutral detergent fibre; CTTAD, coefficient of total tract apparent digestibility.

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1. Introduction

Cereals are the main energy source normally used in pig diets (Walker and Kilpatrick, 1980) and pig performance resulting from cereal-based diets, as opposed to diets where by-products replace a proportion of the cereal content, has been well established (Walker, 1989; Smits et al., 1993; Weatherup et al., 1998). Energy from cereals is derived mainly from the carbohydrate (starch) component. Animal fats and vegetable oils have a higher energy density and efficiency of utilization of metabolizable energy than carbohydrate and are therefore often considered more economical than cereal energy on the basis of cost per unit of ME (Just, 1982; Just et al., 1983; Whittemore, 1993). Consequently, fats and oils are commonly used as sources of energy in pig diets and are normally included in diets where high fibre by-products replace cereals. These by-products are usually less expensive than cereals and are therefore attractive when cereal prices are high.

Work by Weatherup et al. (1998) compared cereal and by-product-based diets of similar calculated digestible energy (DE) content. Dressing percentage and feed:carcass gain conversion ratios were improved with cereal-based diets but overall there was no difference in feed intake between cereal and by-product-based diets. However, when Magowan et al. (2004) compared by-product-based diets plus oil inclusion with cereal-based diets of similar DE content, they found that feed intake and pig performance were higher with cereal-based diets and that the inclusion of oil to the by-product-based diets lowered feed intake. Similarly Tribble et al. (1979) observed lower feed intakes when oil was included in sorghum-soyabean-based pig diets. Magowan et al. (2004) suggested that the reduction in feed intake when oil was included in the by-product-based diets could have been associated with a reduction in palatability, as a result of oil addition where half of the oil was incorporated within the pellet and the other half was sprayed onto the pellet. The commercial partners within this study, who themselves manufacture compound pig feed, favour a mixture of the methods, *i.e.* 'spraying' and 'incorporation', as they perceive that the mixture of methods maintains pellet quality. However, there is a lack of information on the effect of method of oil addition to pelleted diets for pigs on the digestibility of the diet and effect on pig performance.

This study aimed to investigate the effect of the method of oil addition, either incorporated into the pellet or sprayed onto the pellet on the CTTAD of the dietary components and the performance of finishing pigs. A secondary aim was to compare pig performance and the CTTAD of the dietary components when pigs were offered energy from different sources, *i.e.* oil *vs* starch (cereal).

2. Materials and methods

2.1. Experimental diets

Six experimental diets were formulated. Three diets were based on by-products (maize gluten, maize gluten feed, pollard and rapeseed) and three were based on wheat and barley (Table 1). In four of the diets (2 by-product-based and 2 wheat/barley-based), 40 g/kg of vegetable oil blend was included. Oil was either totally incorporated within the pelleted diet or the majority of it was sprayed onto the pellet with a small proportion being incorporated due to manufacturing restrictions. Therefore within the by-product-based and wheat/barley-based diets there were three treatments (1) no oil

Table 1
Composition (g/kg) of experimental diets.

	By-products-based			Wheat/barley-based		
	Basal	40 IN[a]	10 IN + 30 SP[a]	Basal	40 IN[a]	10 IN + 30 SP[a]
Ingredients (g/kg)						
Barley	245	235	235	451	433	433
Wheat	175	168	168	250	240	240
Maize	35	34	34	–	–	–
Maize gluten	50	48	48	–	–	–
Maize gluten feed	50	48	48	–	–	–
Pollard	150	144	144	–	–	–
Rapeseed	75	72	72	–	–	–
Soyabean meal (50% CP)	181	173	173	247	237	237
Molasses (Molaferm)	10	10	10	10	10	10
Vegetable oil (IN)		40	10	–	40	10
Vegetable oil (SP)		–	30	–	–	30
Limestone	20	19	19	22	21	21
Salt	3	3	3	3	3	3
L-Lysine	0.8	0.8	0.8	0.5	0.5	0.5
L-Threonine	0.2	0.2	0.2	0.3	0.3	0.3
Mineral/vitamin premix[b]	5	5	5	5	5	5
Mono di calcium phosphate	–	–	–	11.1	11.1	11.1
Antibiotic (Tylan G250)	0.16	0.16	0.16	0.16	0.16	0.16

[a] IN: oil incorporated into the pellet; SP: oil sprayed onto the pellet.
[b] Vitamin A, 8000 g/kg; Vitamin D_3, 2000 g/kg; Vitamin E, 60 g/kg; Vitamin K, 1 g/kg; Vitamin B_2, 2 g/kg; Vitamin B_{12}, 10 mg/kg; niacin, 10 g/kg; pantothenic acid, 8 g/kg; cobalt, 0.5 g/kg; copper, 12.5 g/kg; iodine, 1 g/kg; iron, 100 g/kg; manganese, 30 g/kg; selenium (selenite), 0.15 g/kg; zinc, 70 g/kg.