**Supplementary Material S2: Details of the studies used in model evaluation**

Ekpe *et al.*, (2002) investigated the effects of increasing dietary di-calcium phosphate levels on P digestibility, retention and excretion. The total P excretion was separated into faecal and urinary P, since urine and faeces were collected and analysed separately. A total of 20 crossbreed barrows, C15 sows x Canabrid boars, (n=4 per treatment) with a BW of 54 kg received one of five dietary treatments: 0, 4.8, 9.7, 14.5 and 19.4 g/kg diet di-calcium phosphate, whilst keeping the total Ca content of the diet constant at 9 g/kg. The oP and NPP content of the diet were not analysed, neither was there a chemical analysis of the main ingredients used. Pigs were allowed *ad libitum* access to the diets.

Lopes *et al.*, (2009) like Ekpe *et al.*, (2002), evaluated the effect of increasing di-calcium phosphate: The main difference between the two experiments was in the experimental methodology. Lopes *et al.*, (2009) used radioisotopic kinetics and investigated actual P digestion from the lumen of the gastrointestinal tract to the bloodstream, as opposed to the total collection method. The study of Lopes *et al.*, (2009) provided an important validation for the P digestion module of the model. A total of 10 crossbred (no specified breed) barrows (n=2 per treatment) with a mean BW of 20kg, received one of five dietary treatment: 0, 5.2, 10.5, 17.5 and 21.8 g/kg diet di-calcium phosphate, while keeping the total Ca content of the diet constant at 6 g/kg. The feed allowance was offered twice daily. The oP and NPP contents of the diets were not analysed, but estimated using INRA feed tables (Sauvant *et al.*, 2004).

Trujillo et al. (2010) investigated the effect of different levels of oP through the supplementation of rice bran, with or without supplementation of 750 FTU of microbial *Aspergillus niger* phytase at the highest and lowest levels of oP. The NPP of the diets was relatively constant at 1.3 (±0.2) g/kg diet and so was the total dietary Ca at 5.59 (±0.8) g/kg diet. Twenty-four crossbred (Yorkshire x Landrace) x Hampshire barrows with a 87.5 (±2.51) kg BW (n=4 per treatment) were used in the experiment. To prepare the experimental diets, 0, 75, 150 and 300 g/kg of the basal corn-soybean meal based diet was replaced with equivalent amounts of rice bran. The phytate and non-phytate contents of the diets were not analysed, neither was there a chemical analysis of the main ingredients. No inorganic P was supplemented to the diets, while the total Ca and P were analysed for each diet. P digestibility was assessed by the total collection method. The pigs were offered food at 3% of BW. This experiment allowed the comparison of model behaviour to changes in the oP content of the diet and microbial phytase on P retained and excreted.

 Akinmusire and Adeola, (2009) studied the effect of different inclusion levels (0-500 g/kg diet) of canola or soybean meals supplemented to semi-purified diets, with and without the supplementation of 1000 FTU *Escherichia coli* phytase on P digestibility, for 17 kg BW pigs. A total of forty-eight and thirty-six barrows, of no specified breed, were used with n=8 and n=6 per treatment for canola and soybean meal, respectively. The feed allowance was based on the individual BW of the pigs. A total apparent P digestibility was calculated by analysing the collected faeces. The authors analysed the nutrient composition of the canola and soybean meal (g/kg), and thus accurate phytate and non-phytate contents of the diets were available. The actual phytase activity /kg for each diet had also been analysed. The dietary Ca level also increased by the supplementation of either the canola or soybean based meal.

Almeida and Stein, (2012) studied the effect of four levels of microbial *Escherichia coli* phytase supplementation, ranging from 0-1100 FTU, to corn-, dried distillers grains with solubles (DDGS)-, high P dried distillers grains (HP DDG)- and corn germ- based diets. We have concentrated upon the consequences of the better known corn and DDGS based diets. A total of 48 crossbreed Large White x Landrace pigs, (n=6 per treatment) were fed either the corn- or DDGS -based diets and received one of four levels of phytase inclusion per ingredient. Almeida and Stein et al. (2012) also used a P-free diet in order to measure basal endogenous P losses. The study also measured the phytate and non-phytate P contents of each feed ingredient, and the total dietary Ca content was constant for the corn-based diets at 5.2 g/kg, while the dietary Ca of the DDGS-based diets increased with phytase supplementation.

Jendza and Adeola, (2009) tested for the effects of graded levels of microbial phytase enzymes (ranging from 0 – 1000 FTU) on P digested and retained for two pig BW. There were 6 barrows per treatment with an average initial BW of either 20 or 51 kg. Pigs received two equal feed allowances daily with average daily feed intakes set at 4.0 and 3.7% of the initial BW, respectively. The oP and NPP contents of the diet were not analysed, but estimated using INRA feed tables (Sauvant *et al.*, 2004). The total Ca content of the diet was constant at 6.5 g/kg. It is important to note that Jendza and Adeola, (2009), as well as measuring total P excreted (g/day), also measured water soluble P excretion. Because the experiment suggested that phytase inclusion had a minimal effect on P digestibility at high BW, data from the latter were not considered further.

Stein *et al.*, (2011) determined the effect of variation in different dietary Ca levels on P digestibility, retention and excretion separated into faecal and urinary P g/day excreted. A total of 36 crossbred barrows with a BW of 23.1 (±4.4) kg, with six barrows per treatment received one of the six dietary treatments: 3.3, 4.6, 5.1, 6.7, 9.2 and 10.4 g/kg Ca achieved by supplementation with calcium carbonate. The oP and NPP content of the diet remained constant. The study analysed only the total P content of the diet, while the oP:NPP ratio of the diets was calculated. The calcium carbonate used in the experiment was analysed and contained 38.83% Ca. Pigs were fed the experimental diets at approximately 3 times their maintenance requirements for energy. Apparent P digestibility was assessed by a total collection method.

Poulsen *et al.*, (2010) evaluated the effect of dietary Ca content with and without microbial *A. niger* phytase supplementation in a plant phytase rich diet. The diet consisted of barley, wheat and soybean meal, and was not supplemented with any inorganic P. The study was conducted on 48 pigs (no specified breed) weighing 38.9 (±1.9) kg BW. The three dietary Ca levels investigated were measured to be 4, 6, and 8 g/kg diet, with or without 750 FTU phytase supplementation, and with the diet plant phytase activity being 650 FTU. Diet analyses also took place to estimate the total P and Ca content as well as the phytate content in g/kg dry matter. The study did not specify how the pigs were fed, but provided intakes of total P and Ca.