Integrated Model Of Pork Production

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Abstract
Mathematical models are powerful tools for estimating the economic and environmental impacts of alternative management strategies for grower-finisher pig units, by integrating cumulative knowledge of nutrient utilization for growth and animal-environment interactions into one system. Models used in commercial pork production should be carefully tested, based on solid scientific principles and be flexible. Some illustrative examples of the commercial application of a pig growth model are provided and show the substantial benefit of applying such models in practice. Relatively user-friendly models are now available for use in commercial pork production in Ontario.

Introduction and background
An optimum feeding or management strategy for individual growing-finishing pig units is difficult to determine, as it is affected by many factors, including pig performance potentials, physical farm layout, feed intake, environmental conditions, available feed ingredients, feed processing, potential use of repartitioning agents such as Paylean™, phytase, and payment systems. Furthermore, it is becoming increasingly important to quantify the impact of pig production on the environment, i.e. nitrogen (N) and phosphorus (P) excretion, and the production of ammonia and green house gasses. Finally, the optimum strategy may change over time as environmental or economic conditions change. Financial losses and reductions in nutrient utilization can be substantial if management strategies are not optimized.
Mathematical models can integrate our vast amount of knowledge of nutrient utilization for growth and animal-environment interactions into one system. Such models can be used to explore in a quantitative manner the complex interactive effects of pig type, feeding level, diet nutrient content, the use of repartitioning agents and enzymes on nutrient utilization, pig growth performance, carcass quality and profits. Models of this type have two important applications in commercial pork production. First, they can be used to answer general questions that may apply to many different pig production facilities, such as the value of feeding Paylean™, enzymes such as phytase, or alternative pig feed ingredients. Second, they can be used to identify the optimum strategy for individual grower-finisher pig units by simulating alternative management and feeding strategies and comparing the predicted outcomes. The latter requires that pigs units characterized reasonably accurately. This applies in particular to operational lean tissue growth potentials, levels of feed intake at the various stages of growth, payment systems and the alternative management strategies that may be considered, i.e phase or split-sex feeding or shipping strategy, etc.
In this short contribution, some examples are provides to illustrate the value of computerized pig growth models as an advisory tool in commercial pork production. All simulation results presented here were obtained with a model which was developed by the International Pig Growth Modelling Group (University of Guelph, Canada; Massey University, New Zealand; Wageningen Agricultural University, The Netherlands; Cargill Animal Nutrition, formerly Ralston Purina International; www.porkmaster.com).

General assessment of alternative management strategies for growing-finishing pigs
In Table 1, pig growth performance and the environmental impact of alternative management strategies for growing-finishing pigs are estimated. The data show that an increase in feed wastage from 5 to 10% increases N and P losses into the environment by close to 10%. The use of phytase can reduce P excretion by about 35% provided that the available P (and thus total P) levels are adjusted appropriately. Given today's prices of phytase, dicalcium phosphate and the observed slight improvement in feed efficiency, profits per pig are slightly improved when phytase is used. Finally, the data show that feeding Paylean™ will improve average daily gain, feed efficiency, carcass dressing percentage and lean yield. However, the cost of Paylean™ is substantial and additional (balanced) protein needs to be supplied in the diet so that pigs can express increases in lean growth when they are fed this product. The main value of this product is that it allows reductions in variability in carcass weight at slaughter (by increasing growth rate of the slowest pigs in the barn), increasing the proportion of pigs in the optimum carcass weight categories and thus increasing average carcass value.

Conclusions

Pig growth models can be valuable tools to assist producers in improving the efficiency of pork production. Important applications of models include demonstrating the basic principles of nutrient utilization and performance in pigs, setting realistic production targets, and developing general feeding and management recommendations that may apply to the various production facilities. When models are applied to individual production units, detailed observations should be made on these units.

Pig growth models can never be perfect in predicting performance of different groups of pigs under varying conditions, simply because our knowledge of growth in the pig can never be complete. This implies that model-generated results should be interpreted with care and that model users should have a solid understanding of the theory included in the models, including its limitations. As more scientific information becomes available and, together with optimization mathematics, is integrated in mathematical pig growth models, these models will become even more powerful and a critical tool in commercial pork production.

***Table 1**. Estimated pig growth performance and environmental impact of alternative management strategies for growing finishing pigs*[1]

	Scenario					
	Base	*10% Feed wastage*	*Improved pig*	*+500 PTU phytase per kg feed*	*-5% Dietary protein*	*+5 ppm*[2] *Paylean*[TM]
Pig potential [3]	*Medium*	*Medium*	*High*	*Medium*		*Medium*
Dietary levels of standardized ileal digestible lysine, % / apparent fecal digestible P, %						
Phase 1	*1.00/0.254*	*1.00/0.254*	*1.10/0.280*	*1.00/0.175*	*1.00/0.175*	*1.00/0.254*
Phase 2	*0.80/0.221*	*0.80/0.221*	*0.90/0.215*	*0.80/0.149*	*0.80/0.149*	*0.80/0.221*
Phase 3	*0.65/0.177*	*0.65/0.177*	*0.75/0.221*	*0.65/0.103*	*0.65/0.103*	*0.80/0.181*
Pig growth performance						
Final BW, kg	*110.3*	*110.3*	*110.6*	*110.3*	*110.2*	*109.4*
Gain, g/d	*813*	*813*	*883*	*812*	*820*	*836*
Feed:Gain	*2.78*	*2.94*	*2.55*	*2.77*	*2.76*	*2.65*
Dressing %, %[4]	*80.2*	*80.2*	*79.9*	*80.2*	*80.2*	*80.7*
Lean yield, %[4]	*60.2*	*60.2*	*61.6*	*60.2*	*60.2*	*60.7*
Environmental impact, excretion per pig						
Nitrogen, kg	*4.02*	*4.37*	*3.89*	*4.00*	*3.67*	*3.94*
Phosphorus, g	*840*	*909*	*764*	*562*	*830*	*799*
Organic matter, kg	*30.9*	*42.0*	*28.4*	*30.3*	*30.6*	*29.2*
Methane, l	*291*	*291*	*293*	*294*	*276*	*294*

[1] Initial body weight of pigs is 25 kg. For all scenario's pigs are fed according to a three phase feeding program using corn and soybean meal based diets with added lysine.HCl. Diets are switched at 45 and 80 kg body weight. Feeding levels are 90% of voluntary daily DE intake according to NRC (1998) and include, unless stated otherwise, 5% feed wastage.

[2] Paylean[TM] was fed during 28 days prior to slaughter, and reduced feed intake 2.33% during this period.

[3] Pig potential represents the operation lean growth potential for pigs and is best expressed in units of whole body protein depositionl; this value is assumed to be 140 g/d for 'medium' pigs and 170 g/d for 'high' pigs.

[4] Typical Ontario carcass grading scheme; the impact of feeding Paylean[TM] on carcass characteristics will vary considerably with grading scheme.

References

A complete listing of references is available upon request.