AGP ban effects on amino

Dr Paul Bikker conducted his PhD at Wageningen University into energy and amino acid interactions on protein and lipid deposition in growing finishing pigs and the consequences for nutrient requirements. He joined Schothorst Feed Research in 1997 and is mainly responsible for research into nutritional manipulation of growth performance, reproduction and health in growing pigs and reproductive sows. His research outcomes are mainly used for nutritional recommendations for the feed industry.

Contact: Schothorst Feed Research, PO Box 533, 8200 AM Lelystad, The Netherlands. Email: pbikker@schothorst.nl

THE LITERATURE STRONGLY POINTS TOWARDS THE FACT THAT ANTIBIOTICS CAN HAVE AMINO ACID SAVING PROPERTIES. SO IT SEEMS THAT ANIMALS FED WITHOUT ANTIBIOTICS NEED MORE AMINO ACIDS IN THE DIET FOR OPTIMAL GROWTH AND PERFORMANCE. TRIALS AT SCHOTHORST FEED RESEARCH INVESTIGATED WHETHER THE AGP BAN REALLY HAS AN EFFECT ON THE AMINO ACID REQUIREMENTS. BY PAUL BIKKER, JAN FLEDDERUS, LAURENT LE BELLEGO AND MARC ROVERS.

During the past decades, diets for growing pigs have been fortified with antibiotics in prophylactic doses to reduce the risk of gastrointestinal disorders and improve growth performance of the animals. The use of these antimicrobial growth promoters (AGP) has been banned from pig diets in Europe from January 2006 onwards. Several authors (e.g. Dierick *et al*, 1986a,b) reported that the inclusion of AGP in pig diets improved the ileal digestibility and decreased the microbial degradation of amino acids in the digestive tract. Withdrawal of AGPs may stimulate microbial growth in the digestive tract, it may increase endogenous protein losses (mucus, enzymes, and bacteria) and reduce ileal digestibility of dietary amino acids. Therefore it was hypothesised that amino acid requirements are higher in pigs fed AGP-free diets. Furthermore, because of the specific amino acid pattern of endogenous protein, optimal dietary amino acid balance could be influenced. To verify this hypothesis, three experiments were conducted in growing pigs. Each experiment consisted of 288 group-housed pigs. The experimental unit consisted of pens with six pigs, castrates and females mixed. The pigs were grouped on the basis of sex and body weight and entered the pens at a body weight of 25 kg. The pigs received a grower diet during a three week period and a finisher diet thereafter, from about 40-110 kg. The pigs had free access to feed and water in a wet and dry feeder. At 110 kg the pigs were slaughtered and carcass lean meat percentage was determined by using an optical probe (HGP).

AGP BAN AND DIETARY AMINO ACID CONTENT

The first experiment was conducted to determine whether the inclusion of AGP in the diet influenced the

acid requirements

effect of dietary amino acid content (AA). This experiment comprised four treatments in a 2x2 factorial design with AGP (0 and 30 ppm salinomycine) and dietary standardised ileal digestible lysine content (6.7 and 7.4 g/kg) respectively. The other essential amino acids were included in a constant ratio to lysine: methionine + cysteine 69%, threonine 64% and tryptophan 20% of SID lysine.

It was shown that the higher lysine content and the inclusion of salinomycine increased daily gain and reduced the feed conversion ratio (FCR) (*Table1*). In the diets with and without AGP, the higher amino acid content increased daily gain by approximately 10 and 40 g/d and improved the FCR by 0.06 and 0.11 respectively. It was also shown that pigs responded more to variation in dietary amino acid content in diets without AGP. For daily gain, this interaction was significant. These results could indicate that amino acid supply is more critical in diets without AGP.

TABLE 1 – INFLUENCE OF AMINO ACID LEVEL AND INCLUSION OF AGP IN THE DIET ON GROWTH PERFORMANCE FROM 40-110 KG BODY WEIGHT IN EXPERIMENT 1.

Salinomycine, ppm	0		30		Effects[1]		
Stand. dig. lysine, g/kg	6.7	7.4	6.7	7.4	AA	AGP	AAxAGP
Feed intake, g/d	2.59	2.60	2.60	2.60	ns	ns	ns
Body gain, g/d	887	924	931	940	**	**	*
FCR	2.96	2.85	2.83	2.77	**	**	ns

[1] *Statistical significance of effects, * P<0.05, ** P<0.01.*

TABLE 2 – MAIN EFFECTS OF AMINO ACID LEVEL AND AGP IN THE DIET ON GROWTH PERFORMANCE FROM 40-110 KG BODY WEIGHT IN EXPERIMENT 2.

	Stand. digestible lysine, g/kg				AGP		Effects[1]	
	4.9	5.9	6.9	7.9	Yes	no	AA	AGP
Feed intake, g/d	2.51	2.49	2.50	2.49	2.49	2.50	ns	ns
Body gain, g/d	827	889	929	930	901	887	L**Q**	**
FCR	3.09	2.85	2.72	2.70	2.81	2.87	L**Q**	**
HGP Lean %	54.1	55.1	56.2	56.1	55.2	55.6	L**	ns

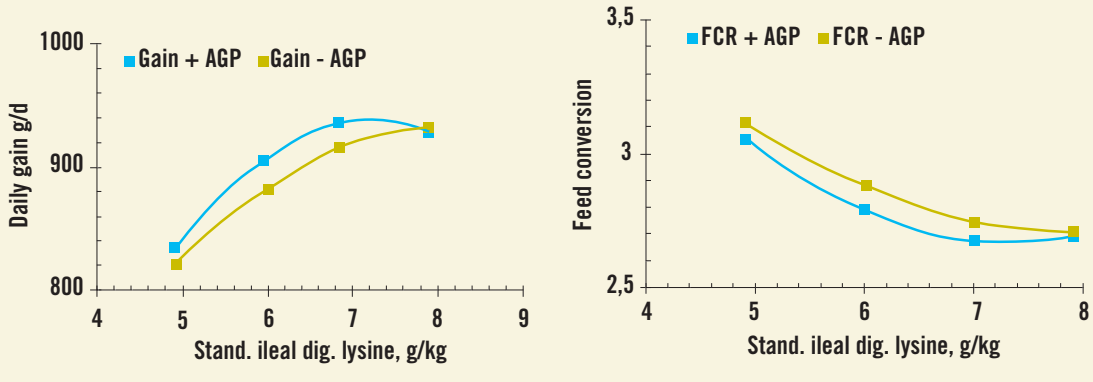
[1] *Statistical significance of effects, L linear and Q quadratic effect, * P<0.05, ** P<0.01.*

AGP EFFECTS ON AMINO ACID REQUIREMENTS

The second experiment determined the effect of AGP on the amino acid requirements. The experiment comprised four treatments in a 2x4 factorial design with AGP (0 or 30 ppm salinomycine) and amino acid level (4.9, 5.9, 6.9 and 7.9 g of standardised ileal digestible lysine/kg) as respective factors. Other essential amino acids were increased according to a constant ratio to lysine: methionine + cysteine 62%, threonine 67% and tryptophan 19%. Daily gain increased and FCR decreased significantly with incremental lysine levels in the diet (*Table 2*). The inclusion of AGP in the diet significantly improved daily gain and FCR. Lean percentage increased linearly with incremental levels of lysine without significant effect of AGP in the diet. In *Figure 1* the quadratic response curve for daily gain and FCR is presented for diets with and without AGP. In diets with AGP, daily gain increased quadratically and FCR decreased quadratically, with increasing amino acid content to a level of 6.9 g standardised digestible lysine/kg diet. However, in diets without AGP a further increase of standardised digestible lysine to 7.9 g/kg of diet improved both daily gain and FCR. Growth performance was similar for the treatments with and without AGP at the highest lysine

Jan Fledderus studied animal nutrition and physiology at Wageningen University in The Netherlands. After six years as a pig nutritionist at one of the country's leading feed producers, he joined Schothorst Feed Research in 1999 as a researcher in pig nutrition with the emphasis on feed evaluation and factors which influence the nutritional value of pig diets. In this position he is responsible for the *Schothorst Feedstuff Table,* available to clients of Schothorst Feed Research.

FIGURE 1 – INTERRELATIONSHIPS BETWEEN AGP AND AMINO ACIDS IN THE DIET

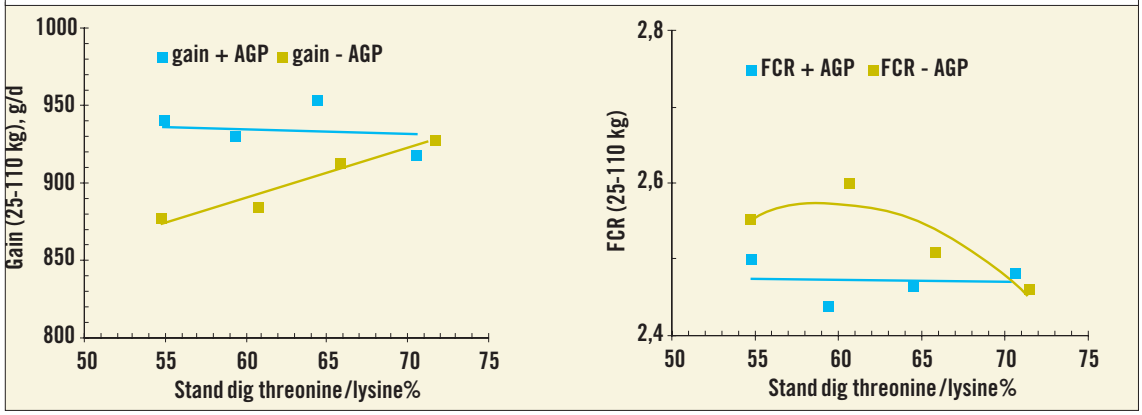


Why AGPs affect optimal amino acid levels

Present amino acid recommendations for growing pigs are generally based on experiments in which AGP were included in the diet. Therefore these may underestimate the optimal amino acid levels in diets free of AGP. Several reasons may explain this difference caused by the use of AGP:

- –> Less incorporation of amino acids in bacterial protein and lower bacterial degradation of amino acids to ammonia and biogenic amines (Dierick *et al*, 1986a,b).
- –> An increased ileal digestibility and absorption of amino acids by inclusion of an AGP in the diet (Dierick *et al*, 1986a,b).
- –> A thinner mucosal wall of the digestive tract in animals fed diets with AGP, probably related to a lower stress of the immune system (Visek, 1978). This agrees with an increased dressing percentage (+0.8%) with AGP in the diet and may allow a lower usage of amino acids by the digestive tract itself and a higher net portal flux of amino acids with AGP.
- –> A lower protein turnover with AGP in the diet as reported by Roth et al (1999) who suggested that this might have been due to reduced metabolic activity of intestinal tissues. Protein utilisation increased, probably because less amino acids were used by the GI tract and more amino acids were available for whole-body protein deposition.
- –> Lower bacterial fermentation and production and losses of endogenous protein on diets with AGP. Because of the high threonine content of endogenous protein (e.g. Reeds et al, 1999), increased production of endogenous protein after withdrawal of AGP may have increased the threonine requirements. This is supported by results of Zhu et al (2005) who found that increased fermentation in the digestive tract decreased threonine availability for growth.

FIGURE 2 – INTERACTIONS BETWEEN AGP AND DIETARY THREONINE CONTENT.



level. Exclusion of AGP from the diet reduced the mean daily gain by 16 g/d and increased the FCR by 0.06 ($P<0.01$). At the highest amino acid level, the AGP effect disappeared. These results indicate that an increase in dietary amino acid content can compensate for the loss in performance when the AGP is excluded from the diet. The results confirm that amino acid requirements of growing pigs are higher on diets free of AGP. In order to quantify the amino acid requirements, a linear plateau-model was used to determine lysine requirements for maximum daily gain and minimum FCR. The results of the linear plateau model indicated a standardised digestible lysine requirement of 6.7 g/kg with AGP in the diet and a requirement of 7.1 g/kg in diets without AGP.

AGP AND THREONINE BALANCE

The third experiment determined whether the withdrawal of AGP affected the optimal threonine/lysine balance in the diet. The experiment was conducted in a 2x4 factorial design with inclusion of the AGP (0 or 30 ppm salinomycine) and dietary threonine content (standardised digestible threonine/lysine ratio 55, 60, 65 and 71%) as respective treatments. Contents of other essential amino acids were above requirements. The results indicated significant interactions between dietary AGP and threonine content as illustrated for the weight range from 25-110 kg in *Figure 2*. Dietary threonine content had no effect on daily gain and FCR when the diet contained the AGP, whereas dietary threonine linearly increased daily gain ($P<0.05$) and quadratically decreased FCR for diets without AGP. The influence of withdrawal of AGP was relatively high at low dietary threonine levels and diminished with increasing dietary threonine content. Based on these results it can be concluded that the optimal dietary threonine/lysine ratio is higher in diets without AGP. The results do not allow an exact quantification of this effect.

CONCLUSION

Based on the results of this series of experiments, it can be concluded that the AGP ban influences the optimal amino acid content and amino acid balance in diets for growing pigs. We estimated that amino acid requirements without use of AGP increased by approximately 6%. In addition, the optimal threonine/lysine ratio is increased although the extent of this effect remains to be quantified. <-

Laurent Le Bellego works at AJINOMOTO EUROLYSINE, s.a.s. 153, rue de Courcelles, 75817 Paris Cedex 17, France
Marc Rovers works at ORFFA, Burgstraat 12, 4283 GG Giessen, The Netherlands