Workshop 5b

Whole organism protein metabolism

Discussion Leader : CFM de Lange (Guelph, CA)

Coordinator : N Le Floc'h (INRA, F)

Wednesday 12th 2007, ISEP

Program

3 oral presentations

Page

• Changing dietary lysine level from a deficient to a sufficient level greatly enhances growth rate of growing rats – *A Ishida* *531*

• Protein oxidation measured by breath test in mink fed bacterial protein meal – *ALF Helwing* *541*

• Oral and intravenous phenylalanine kinetics in adult mixed hounds – *AK Shoveller* *549*

11 posters

Topics for discussion

- *Modulation of whole body protein metabolism by nutrients*

- *Methodologies for AA requirement estimation*

- *Contribution of the gut to whole body protein metabolism*

Topics for discussion

- *Modulation of whole body protein metabolism by nutrients*

O • *A Ishida et al. "Changing dietary lysine level from a deficient to a sufficient level greatly enhances growth rate of growing rats"*

P *Priyankarage et al. "The effect of dietary methionine concentrations on the efficiency of energy utilisation in broiler chikens"*

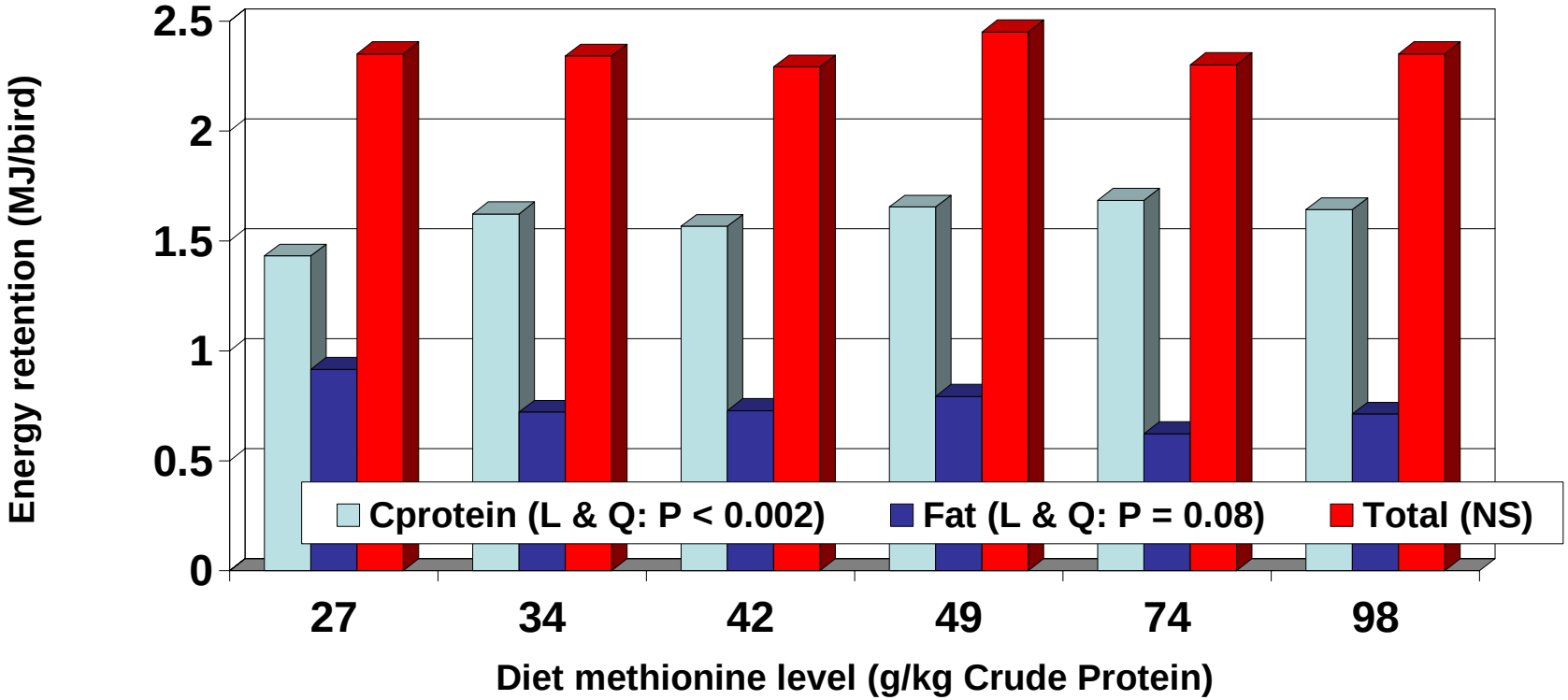
P *Magistrelli et al. "Nitrogen metabolites and enzymatic activity during the weaning period in goat kids"*

P *Ettle et al. "Influence of dietary tryptophan concentration on performance and dietary selection by starting pigs"*

P1: The effect of dietary methionine concentrations on the efficiency of energy utilisation in broiler chickens

N. Priyankarage[1], S.P. Rose[1], S.S.P. Silva[2] and V.R. Pirgozliev[3]

[1]The National Institute of Poultry Husbandry, Harper Adams University College, Newport, Shropshire,TF10 8NB, England; [2]Veterinary Research Institute, Peradeniya, Sri Lanka; [3]ASRC, SAC, West Mains Road, Edinburgh,EH9 3JG, Scotland



Methionine replaced glutamic acid

- Energy gain & efficiency of energy retention (RE / ME) were not affected by dietary methionine concentration

P2: Nitrogen metabolites and enzymatic activity during the weaning period in goat kids

D. Magistrelli[1], L. Pinotti[2] and F. Rosi[1]

[1]Department of Animal Science, Agricultural Faculty, University of Milan, Via G. Celoria 2, 20133 Milan, Italy; [2]Department of Veterinary Sciences and Technology for Food Safety, Veterinary Faculty, University of Milan, Via G. Celoria 10, 20133 Milan, Italy

- After receiving milk for 4 weeks, goat kids were fed milk or solid food (30% grass hay, 10% alfalfa, 19% maize, 15% soybean meal, 8% sugar beet pulp…; 15.6% crude protein, 16.7% starch); serial blood sampling and tissue sampling at day 50

	Solid Food	Milk	P
Liver weight, % of BW	2.17	2.76	<0.05
Plasma amino acids, mM	4.21	5.58	<0.01
Plasma urea, mM	5.67	7.66	<0.01
Plasma creatinine, mM	78.9	69.3	<0.01
α-amylase, U / g pancreas	8.23	29.5	<0.05

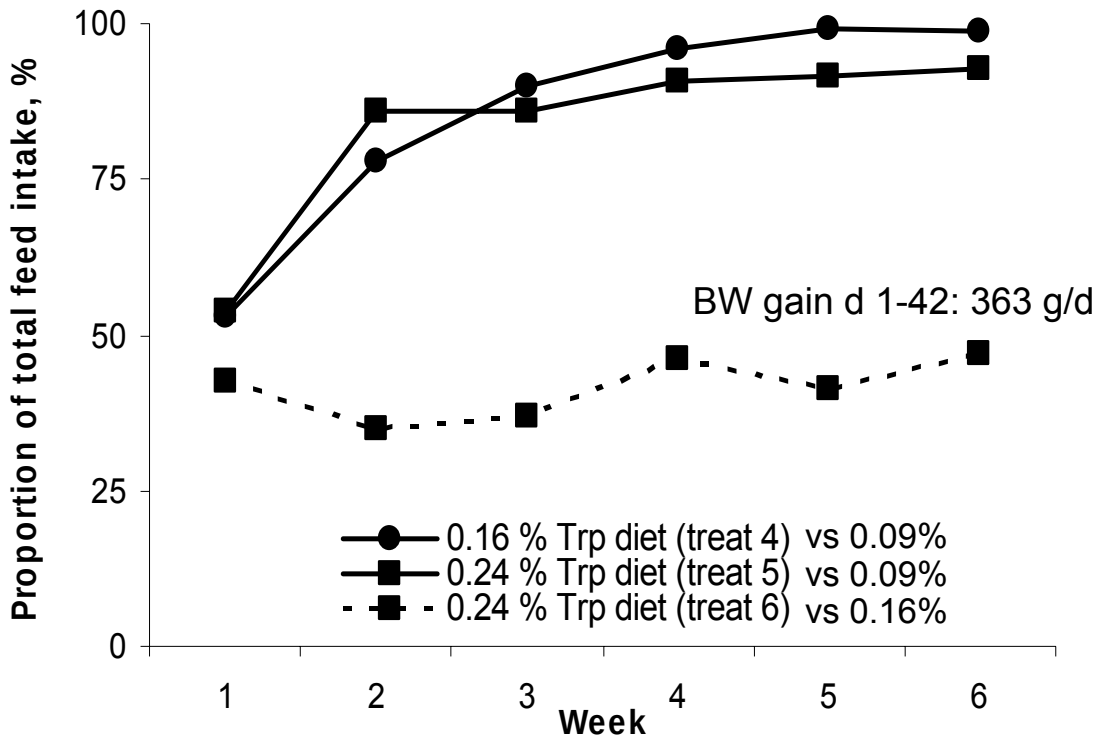
➢ Weaning affected protein metabolism and pancreatic amylase activity

P3: Influence of dietary tryptophan concentration on performance and dietary selection by starting pigs

T. Ettle[1], J. Bartelt[2], C. Relandeau[3] and F.X. Roth[4]

[1]BOKU University Vienna, Gregor Mendel Str. 33, 1180 Vienna, Austria; [2]Lohmann Animal Health GmbH & Co.KG, 27472 Cuxhaven, Germany; [3]Ajinomoto Eurolysine S.A.S., 153 rue de Courcelles, 75817, Paris, France; [4]TU Munich-Weihenstephan, Hochfeldweg 6, 85350 Freising, Germany

- Exp. 1: TRP requirements of piglets (init BW 7.2 kg) for maximum BW gain were:
  - ❑ >0.26% during d 1 to 25 (BW gain >346 g/d)
  - ❑ 0.25% during d 26 to 47 (BW gain 592 g/d)
- Exp. 2: BW gain 341 g/d at 0.16% TRP



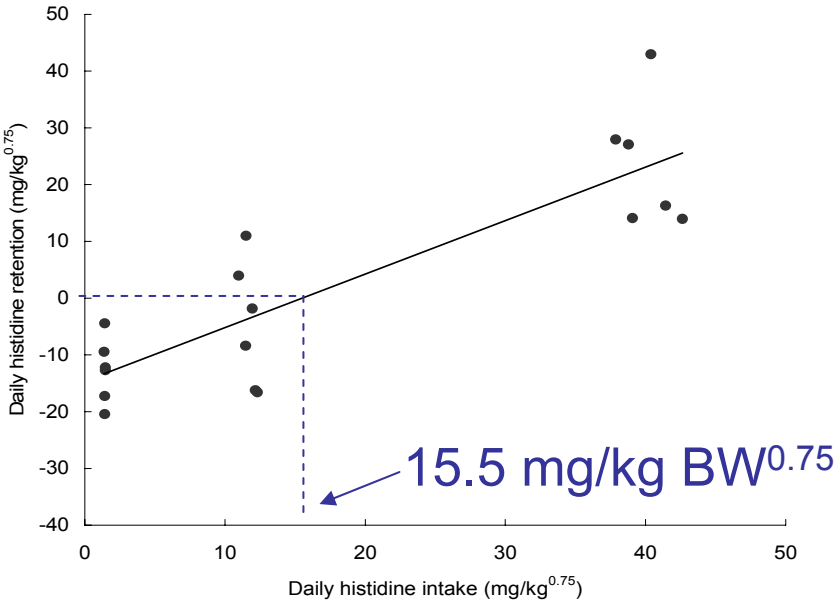
➢ Piglets were able to balance the intake of two diets on test

P4: Histidine maintenance requirement and the efficiency of its utilisation for protein accretion in pigs

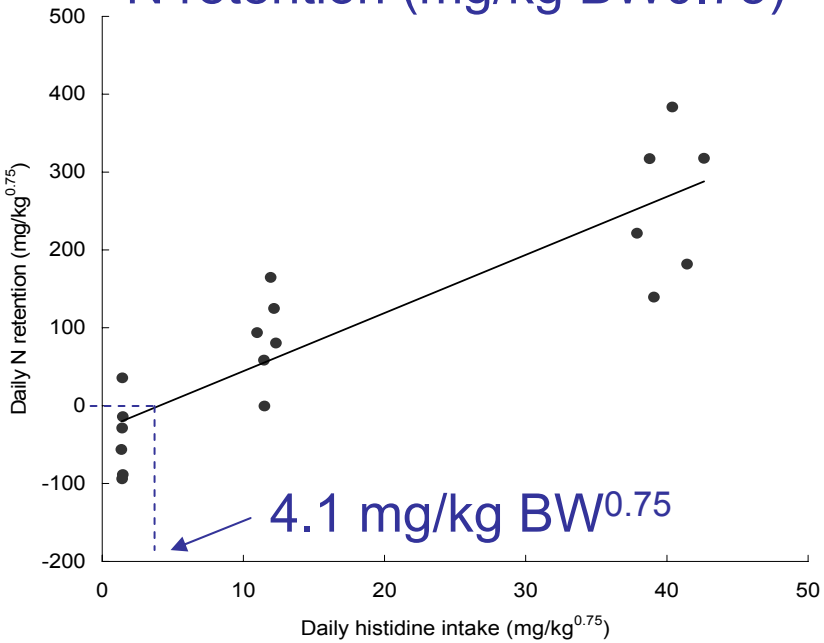
P. Patráš, S. Nitrayová and J. Heger

Slovak Agricultural Research Centre, Research Institute of Animal Production, Hlohovská 2, 949 92 Nitra, Slovakia

HIS retention (mg/kg $BW^{0.75}$)



N retention (mg/kg BW0.75)



- HIS intake corresponding to zero HIS retention was a better criterion of its maintenance requirements than HIS intake corresponding to zero N retention

Topics for discussion

- *Methodologies for AA requirement estimation*

O *ALF Helwing et al.* "Protein oxidation measured by breath test in mink fed bacterial protein meal"

P *Patrâš et al. "Histidine maintenance requirement and the efficiency of its utilisation for protein accretion in pigs"*

P *O'Connell et al. "Response of pigs in the weight ranges 35 to 60 kg and 80 to 100 kg to increasing ileal Threonine: ileal digestible Lysine ratios in the diet "*

P *Ringel et al. "Lysine requirement for maintenance in growing pigs"*

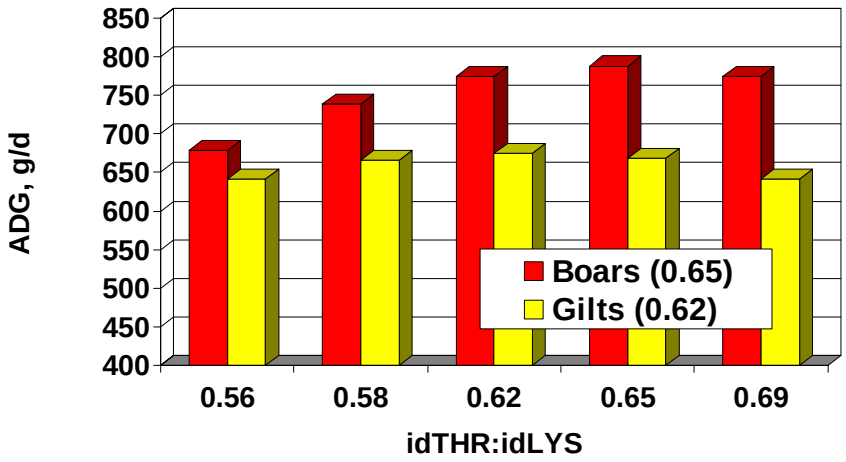
P *Sakomura et al. "Maintenance protein requirement and efficiency of utilization in poultry"*

P5: Response of pigs in the weight ranges 35 to 60 kg and 80 to 100 kg to increasing ileal digestible Threonine: ileal digestible Lysine ratios in the diet

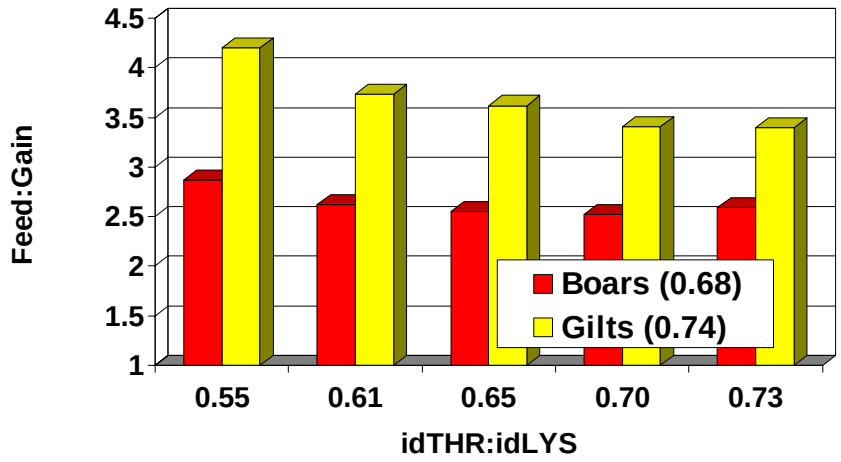
M.K. O'Connell[1], C. Relandeau[2], M. Overend[3] and P.B. Lynch[1]*

[1]Pig Production Development Unit, Teagasc, Moorepark, Fermoy, Co. Cork, Ireland; [2]Ajinomoto Eurolysine S.A.S., 153 rue de Courcelles, 75017 Paris, France; [3]Forum Products Ltd., 41-51 Brighton Road, Redhill, Surrey, RH16YS, England

35 to 60 kg BW



80 to 100 kg BW



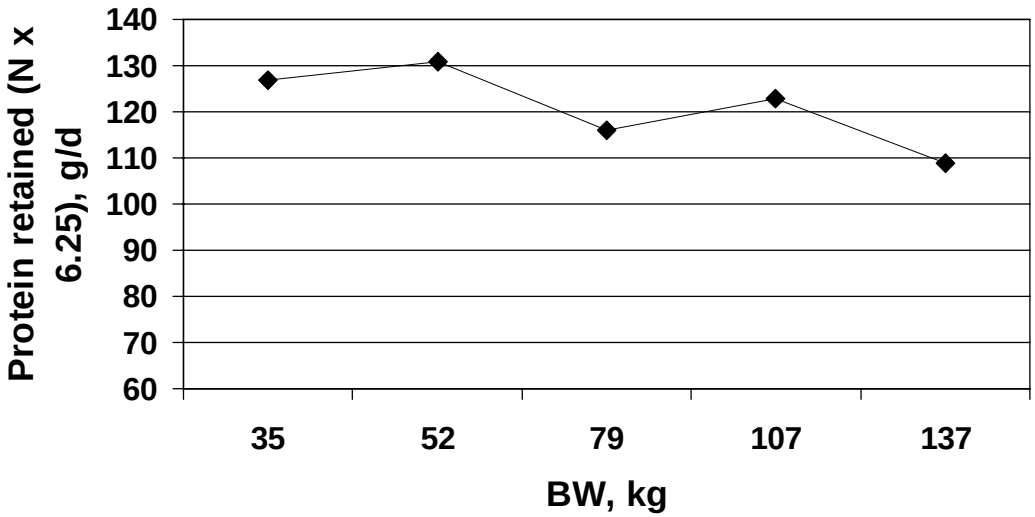
Lysine levels were below estimated requirements and differed between boars and gilts; AA levels were measured; ileal digestibility (id) values from CVB

- idTHR:idLYS ratio for maximum performance was influenced by both gender and BW
  - At the higher BW it was marginally higher for gilts than boars

P6: Lysine requirement for maintenance in growing pigs

J. Ringel and A. Susenbeth

Institute of Animal Nutrition and Physiology, Christian-Albrechts-University Kiel, 24098 Kiel, Germany



- Lysine intake kept constant at 11.5 g/d
- Reduction in PR reflects increase in maintenance lysine requirements

Based on N-balance bias of 11%, PR contains 7.2% lysine, gross efficiency of lysine utilization for PR 0.63:

➢ Lysine maintenance requirements are 71 mg / kg $BW^{0.75}$

P7: Maintenance protein requirement and efficiency of utilization in poultry

N.K. Sakomura, J.B.K. Fernandes, R. Neme, C.B.V. Rabelo and F.A. Longo

Universidade Estadual Paulista, Faculdade de Ciências Agrárias e Veterinárias, Via de Acesso Prof. Paulo Donato Castelane, s/n, Jaboticabal, São Paul, Brazil

	$N_{maint.}$ [1]	$N_{end.\ loss}$ [2]	K_g [3]
	mg / kg $BW^{0.75}$ / d		
Laying-type pullets	383	258	.67
Laying hens	307	181	.38
Broiler breeder pullets	323	179	.54
Broiler breeder hens	365	222	.40
Broiler chickens, male	212	198	.72
Broiler chickens, female	280	258	.72

$N_{maint.}$ & $N_{end.\ loss}$ N-balance with four diet N levels (3, 6, 8 & 15% CP) & linear regression analyses: [1] y=0, [2] x=0,

K_g Serial slaughter with four feeding levels (ad lib, -30, 50 & 70%): slope of N retention vs N intake

- N_{maint} and $N_{end\ loss}$ did not vary, but lower for broilers
- K_g was lowest for laying hens and broiler breeder hens

Topics for discussion

- *Contribution of the gut to whole body protein metabolism*

- *Shoveller et al. "Oral and intravenous phenylalanine kinetics in adult mixed hounds"*

- *Scharenberg et al. "Effect of feeding carefully dried and ensiled tanniniferous sainfoin on protein metabolism of lambs"*

- *Zhu et al. "Intake of fermentable fibre and body protein deposition in pigs fed methionine or tryptophan limiting diets"*

- *Bühler et al. "Influence of dietary benzoic acid on nitrogen metabolism in growing/finishing pigs"*

- *Bikker et al. "Growth response of pigs to dietary threonine/lysine ratio is affected by the withdrawal of anti microbial growth promoters"*

P8: Effect of feeding carefully dried and ensiled tanniniferous sainfoin on protein metabolism of lambs

A. Scharenberg[1], Y. Arrigo[1], A. Gutzwiller[1], H.D. Hess[1], U. Wyss[1], M. Kreuzer[3] and F. Dohme[1]

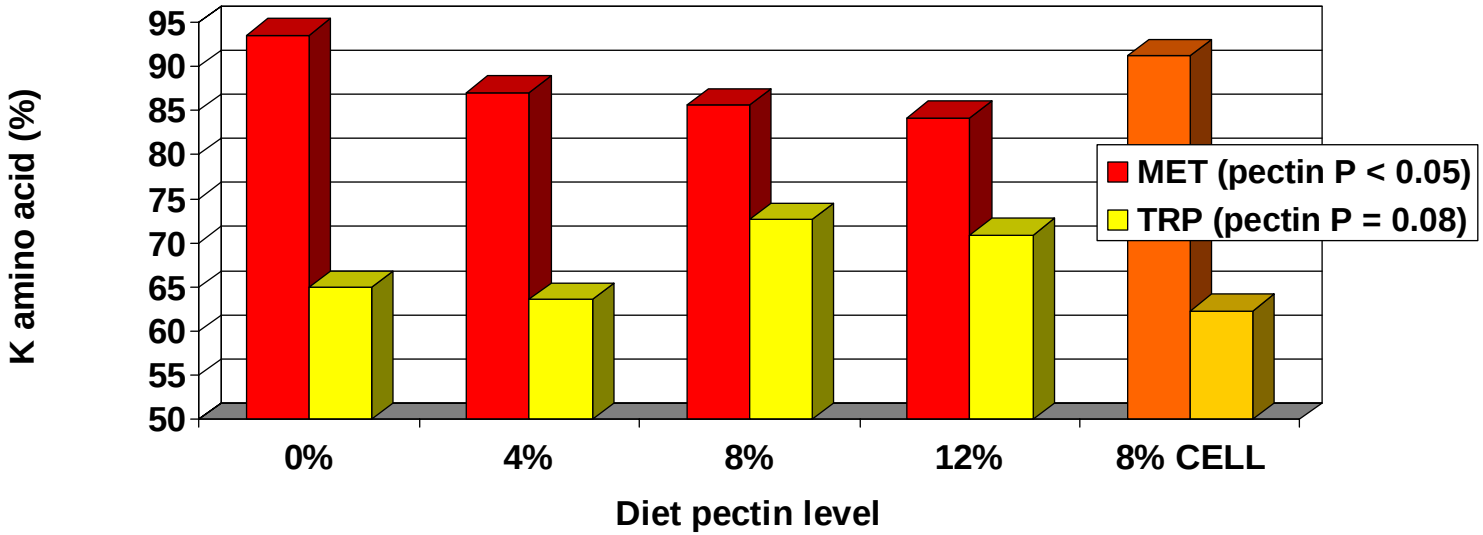
[1] Agroscope Liebefeld-Posieux Research Station ALP, Tioleyre 4, 1725 Posieux, Switzerland; [2] ETH Zurich, Institute of Animal Science, 8092 Zurich, Switzerland

- Condensed tannins (CT) in Sainfoin:
  - suppresses ruminal protein degradation: Adding PEG increases ruminal NH_3, BUN, urinary N excretion, and reduces plasma free amino acids – but not methionine
  - do not enhance Body N retention (PEG reduces fecal N excretion)
  - ➢ CT in Sainfoin could be beneficial in animals fed sufficient methionine
- Ensiling of sainfoin or a grass-clover mix:
  - decreases proportion of extractable CT, but not total CT
  - increases fecal N excretion and decreased N retention
  - ➢ Ensiling increases CT effects of sainfoin to an extent that was undesired

P9: Intake of fermentable fibre and body protein deposition in pigs fed methionine or tryptophan limiting diets

C.L. Zhu[1], M. Rademacher [2] and C.F.M. de Lange[1]

[1]Department of Animal and Poultry Science, University of Guelph, Canada; [2]Degussa AG, Hanau, Germany



- Non-fermentable fibre in the diet does not influence the use of MET, MET plus CYS and TRP for protein gain (PD) in pigs
- Increasing intake of fermentable fibre:
  - reduces the efficiency of using SID intake of MET, and MET plus CYS, for PD
  - increases the efficiency of using SID intake of TRP for PD

P10: Influence of dietary benzoic acid on nitrogen metabolism in growing/finishing pigs

K. Bühler, S. Gebert and C. Wenk

Institute of Animal Sciences, ETH Zurich, Universitätstrasse 2, 8092 Zurich, Switzerland

	Control	+benzoic acid	P
Grower period			
BW gain, g/d	683	750	0.06
N digestibility, %	0.837	0.868	<0.01
N balance, g/kg $BW^{0.75}$/d	1.74	1.81	0.37
Finisher period			
BW gain, g/d	823	856	0.17
N digestibility, %	0.871	0.880	0.30
N balance, g/kg $BW^{0.75}$/d	1.19	1.17	0.72

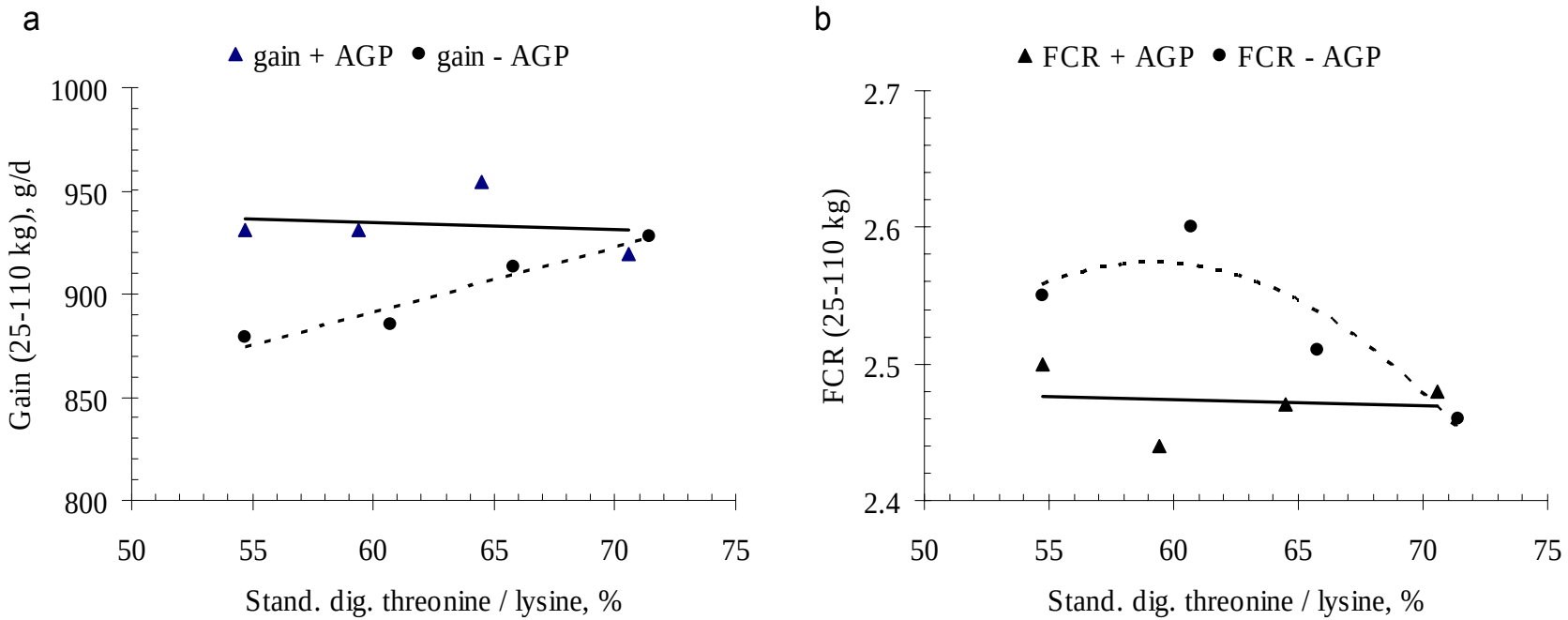
*Growth performance and N-balance study, **using 24 restricted fed pigs** from 26 to 105 kg BW; data pooled across 2 protein levels; interactions NS*

- Benzoic acid improved fecal N digestibility during grower phase and resulted in numerical improvements in BW gain

P11: Growth response of pigs to dietary threonine:lysine ratio is affected by the withdrawal of anti microbial growth promoters

P. Bikker[1], J. Fledderus[1], L. le Bellego[2] and M. Rovers[3]

[1]Schothorst Feed Research, PO Box 533, 8200 AM Lelystad, The Netherlands; [2]Ajinomoto Eurolysine s.a.s, 153 rue de Courcelles, 75817 Paris Cedex 17, France; [3]Orffa, Vierlinghstraat 51, 4251 LC Werkendam, The Netherlands



Growth performance study 25 to 110 kg BW; 2 phase feeding program; lysine levels 10% below estimated requirements

- Optimum dietary threonine to lysine ratio is higher in diets with anti-microbial growth promoters

Summary & General Discussion

- Difficult to interpret & apply findings of 'whole animal' AA requirements studies:
  - accuracy of estimation
  - requirements vary with animal type and state (BW, gender, health)
- Estimates of 'maintenance' AA requirements are variable:
  - reflecting methodology & possibly animal state
  - attributed to endogenous gut losses, minimum catabolism, integumental losses
- Amino acid requirements for production reflect:
  - (desired) rate of body, milk or egg protein production & some inefficiency
  - amino acid composition of these proteins can vary, especially HIS content
- Diet effects on aspects of AA utilization (digestibility, rumen fermentation & minimum catabolism) can be substantial:
  - can be attributed to condensed tannins, soluble fiber, acids and other aspects
- Animals have some ability to select diets according to nutrient requirements:
  - but for what body function?
  - what is impact of feed ingredient composition?

➢ Explore underlying concepts – using novel methods - that contribute to AA requirements for main body functions & relate these concepts to carefully conducted studies evaluating whole animal response to nutrient intake