Nutritional evaluation of Processed Animal Proteins in poultry

Marinus van Krimpen and Jan van Harn

WAGENINGEN
UNIVERSITY & RESEARCH

100years
1918 — 2018

Content

- Reasons for nutritional evaluation
- Energy and protein/amino acid digestibility
  - Broilers
  - Laying hens
- Phosphorus digestibility
- Performance
  - Broilers
  - Laying hens
- Conclusions

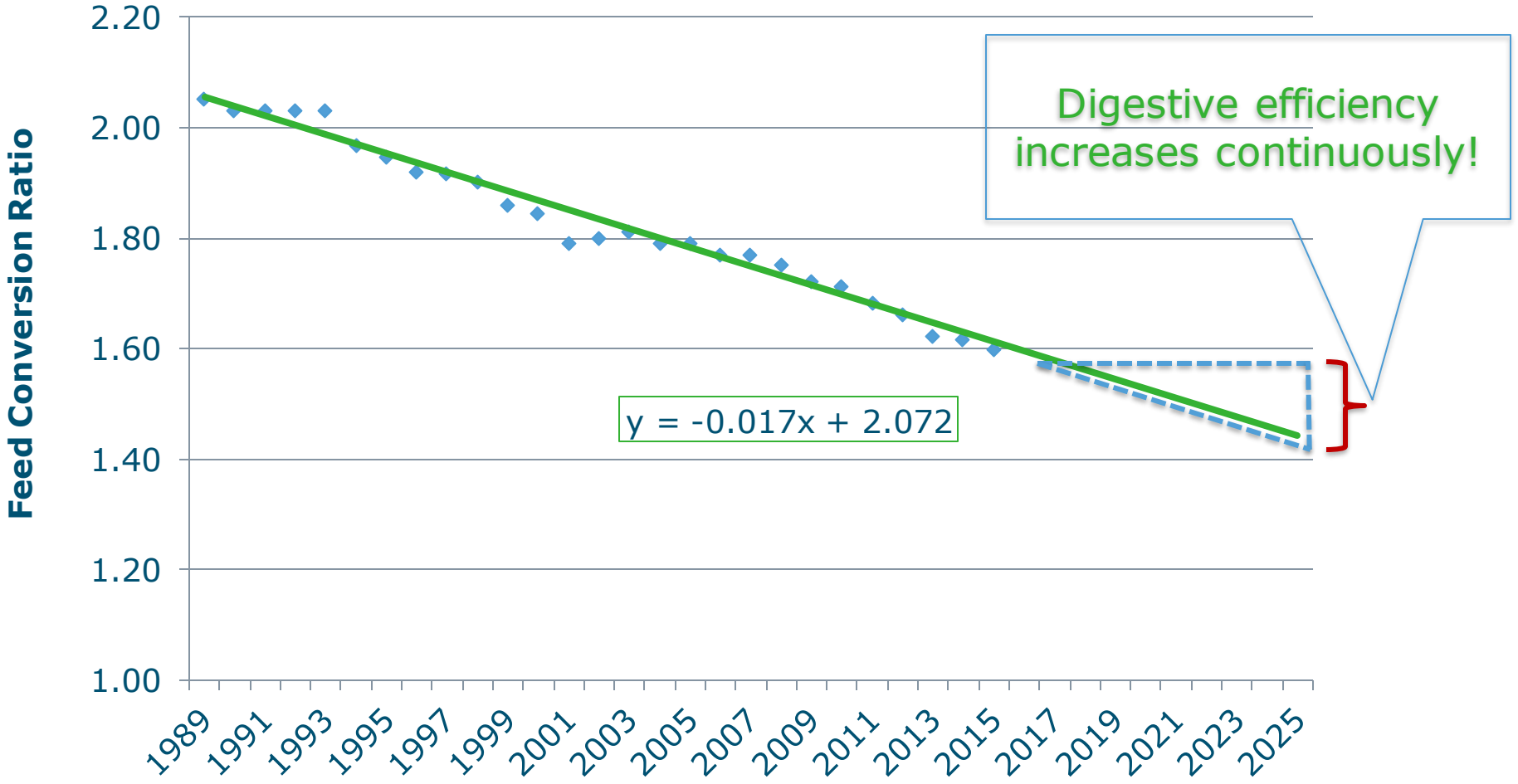
Reasons for nutritional evaluation of PAPs

- Valuable protein, energy, and mineral source

	CP (g/kg)	AME (MJ/kg)	P (g/kg)
Pork meat meal (Dutch)	581	13.0	22.8
Soybean meal	468	9.0	6.8

- Functional properties (e.g. promoting natural behaviour)?
- Ban on PAP in animal feed since December 2000 → reintroduction in e.g. poultry diets expected
- Changed PAP characteristics (processing methods)
- Changed genetic potential of poultry

Feed conversion ratio over time (corr. 2200 g BW)



(Source: KWIN_V)

EFPRA study: energy and protein digestibility in broilers

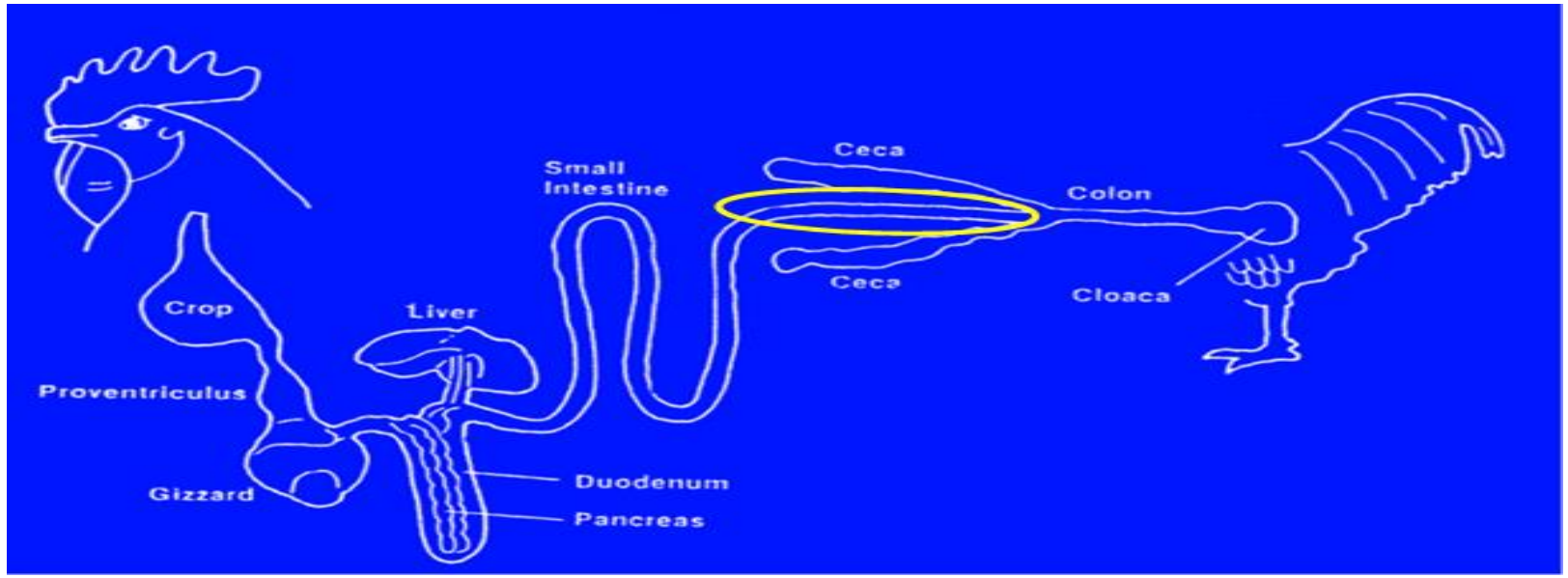
Pre-experimental period (0 -14 days)

Experimental period (14 – 23 days)

(Van Harn et al., in progress)

Digestibility study

- Aim: to determine in PAP_1 and PAP_2 broiler diets:
  - total tract digestibility of proximate components
  - ileal phosphorus, calcium, amino acid digestibility
  - AME (metabolizable energy value)



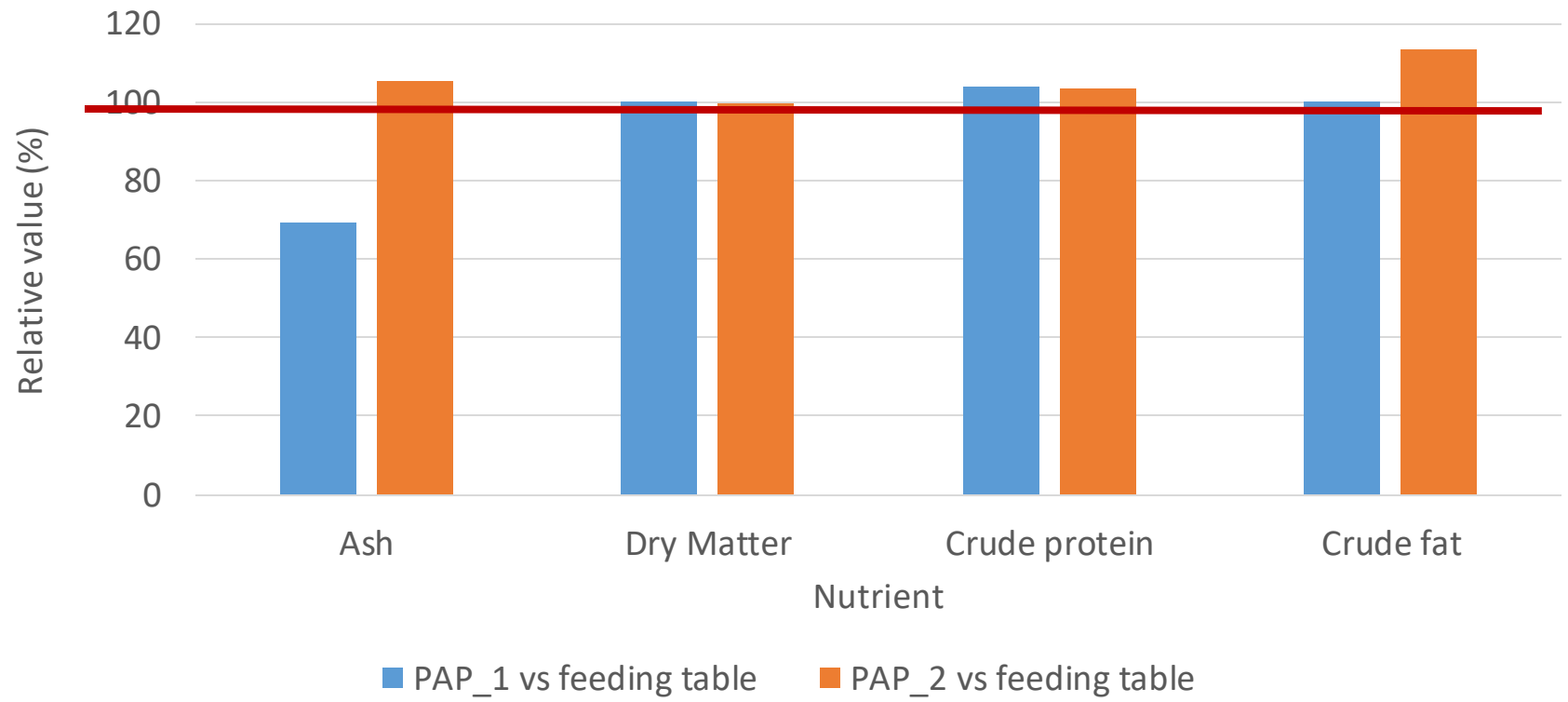
(Van Harn et al., in progress)

PAP characteristics

Parameter	Unit	PAP_1	PAP_2
Processing Method		(1/ pressure & sterilisation)	(7 / mild method)
Dry matter	g/kg	946	948
Ash	g/kg	121	233
Phosphorus	g/kg	19.3	41.9
Calcium	g/kg	28.3	78.0
Crude fibre	g/kg	40	16
N Dumas	g/kg	97	96
Crude protein (6.25 * N_{Dumas})	g/kg	609	601
Crude fat	g/kg	144	101

(Van Harn et al., in progress)

Relative nutrients (%) PAP's vs. CVB (2007)



- PAP_1: Low in ash
- PAP_2: High in crude fat

(Van Harn et al., in progress)

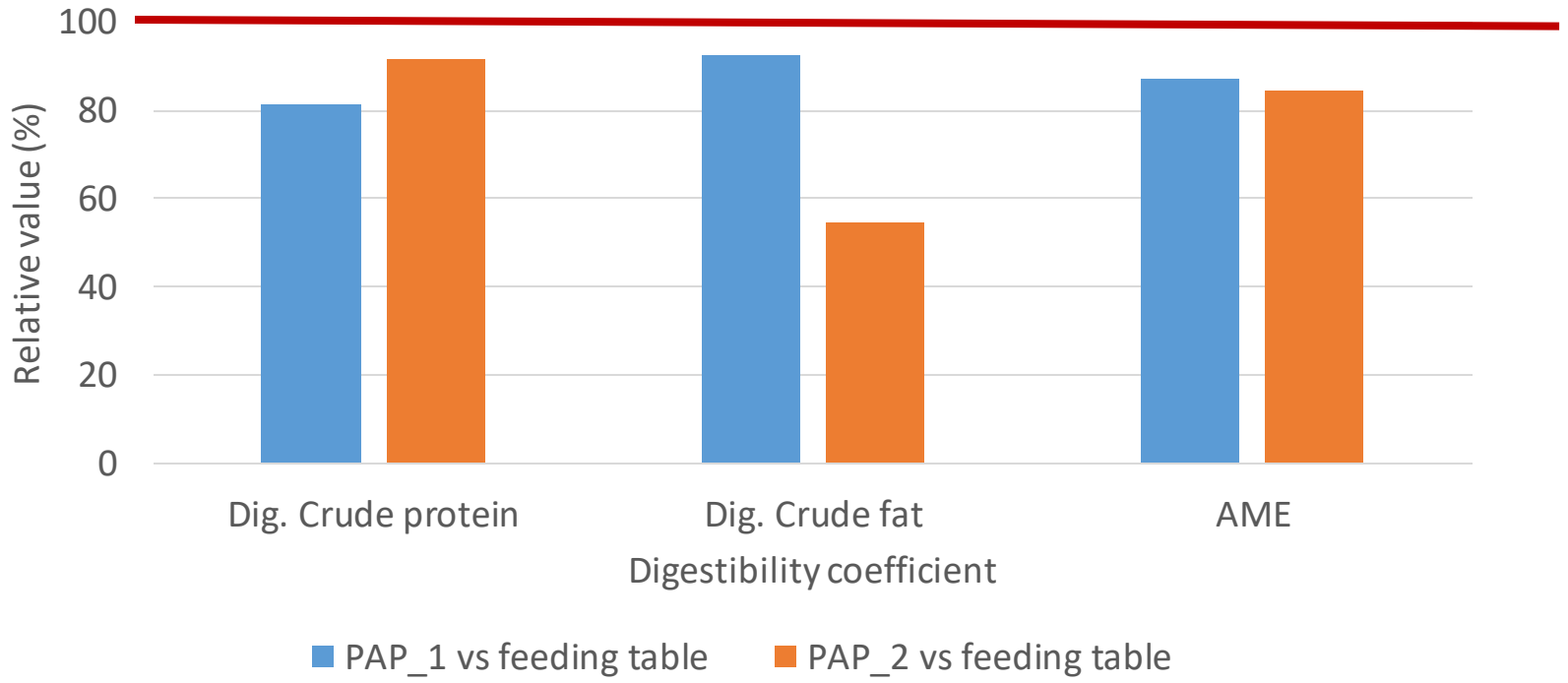
Nutrient digestibility tested PAP's

Nutrient	PAP_1	PAP_2	F prob
Ileal digestibility			
Dry matter	60.9 [b]	76.6 [a]	0.004
Crude protein	60.9 [b]	68.8 [a]	0.036
Amino Acids (total)	63.6	68.1	0.332
Faecal digestibility			
Dry matter	54.5 [b]	65.6 [a]	0.008
Organic matter	55.0 [b]	67.1 [a]	0.007
Ash	42.3 [b]	52.2 [a]	0.004
Crude fat	79.6 [a]	47.2 [b]	<.001

- PAP_1: High in digestibility-% crude fat
- PAP_2: High in digestibility-% crude protein, amino acids

(Van Harn et al., in progress)

Relative digestibility (%) PAP's vs. CVB (2007)



- PAP_1: Nutrient digestibility ± 90% of CVB value
- PAP_2: Fat digestibility 55% of CVB value
- AME: PAP_1 87% of CVB, PAP_2 85% of CVB

(Van Harn et al., in progress)

Digestibility of PAPs in laying hens

METABOLISM AND NUTRITION

Effect of four processed animal proteins in the diet on digestibility and performance in laying hens

M. M. van Krimpen,*[1] T. Veldkamp,* G. P. Binnendijk,* and R. de Veer†

*Wageningen UR Livestock Research, PO Box 65, NL-8200 AB Lelystad, the Netherlands; and †Animal Nutrition Group, Department of Animal Sciences, Wageningen University, PO Box 338, NL-6700 AH Wageningen, the Netherlands

Source: Poultry Science, 2010 (89)

Digestibility study with pork meat meal

- 45% protein in the diet from pork meat meal
  - Sonac 50 (19% in diet)
  - Sonac 60 (16% in diet)
  - Daka 40 (22% in diet)
  - Daka 58 (16% in diet)
- Basal diet without animal protein (soybean meal)

(Van Krimpen et al., 2010)

Chemical composition of pork meat meals

		Sonac_60	Daka_58	Sonac_50	Daka_40
Ash	g/kg	183	252	336	437
Protein	g/kg	617	597	558	417
Fat	g/kg	117	118	96	99
Calcium	g/kg	52	82	116	161
Phosphorus	g/kg	30	42	59	77
Gross Energy	MJ/kg	19.8	18.9	16.1	13.6

Conclusion: large variation in chemical composition

(Van Krimpen et al., 2010)

Digestibility and Metabolisable energy

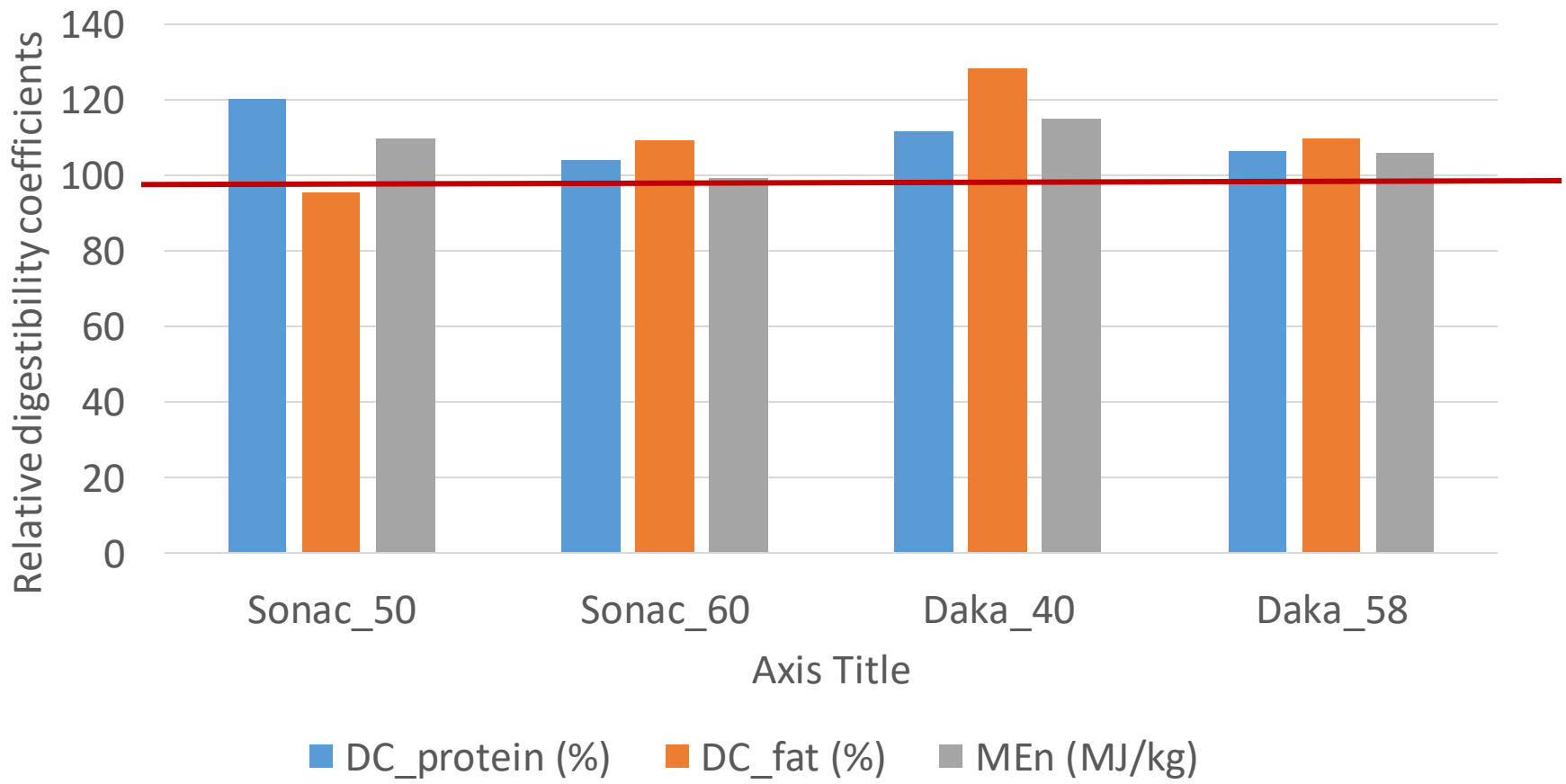
	Sonac_60	Daka_58	Sonac_50	Daka_40
DC_protein (%)	83.4	85.3	90.1	81.4
DC_fat (%)	97.2	94.5	81.2	79.7
AME_n (MJ/kg)	14.33	14.16	12.54	9.64
Dig. Lysine (g/kg)	28.0	23.8	28.3	15.4
Dig. Meth. (g/kg)	7.7	6.6	7.3	3.7

Conclusion:

- Variation in digestibility; important to know origin!
- Valuable source of energy and amino acids in laying hens

(Van Krimpen et al., 2010)

Relative digestibility coefficients compared to CVB (2011)



(Van Krimpen et al., 2010)

Phosphorus digestibility of Bone meal

Determination of pre-cecal phosphorus digestibility of inorganic phosphates and bone meal products in broilers

J. van Harn,[*,1] J. W. Spek,[*] C. A. van Vuure,[†] and M. M. van Krimpen[*]

[*] *Wageningen Livestock Research, PO Box 338, 6700 AH Wageningen, the Netherlands; and* [†] *Darling Ingredients International, Kanaaldijk Noord 20–21, 5691 NM, Son en Breugel, the Netherlands*

Source: Poultry Science (2017)

Results, pre-cecal digestibility sources

Product	Crude protein (g/kg)	P (g/kg)	Ca (g/kg)	pcdP-% ingredient
Delfos	0	168	234	94.5 [a]
Calfos	100	140	308	86.9 [b]
Bone meal	350	105	222	78.2 [c]
MCP	0	220	182	88.5 [a,b]
DCP	0	190	275	82.4 [b,c]
P-value				<.001
LSD				6.9

(Van Harn et al., 2017)

Effect of PAPs on performance

LIVESTOCK RESEARCH
WAGENINGEN UR

Rapport 318

Effect van varkensvleesmeel in vleeskuikenvoer op technische resultaten, slachtrendementen, strooiselkwaliteit, voetzoollaesies en darmgezondheid

Effect of pork meat meal in broiler diets on performance, slaughter yields, litter quality, foot pad dermatitis and gut health

J. van Harn
R.J. Molenaar (GD voor Dieren - Deventer)
T. Veldkamp

April 2010

Material and Methods

- 2 feeding phases 0 – 10 d and 11 – 35 d
- 4 dietary treatments: inclusion of Pork Meat Meal (PMM)
  - Vegetable diet
  - ≈ 3.5% PMM (CP 67%) replacing 10.0% CP in basal diet
  - ≈ 6.0% PMM (CP 67%) replacing 17.5% CP in basal diet
  - ≈ 8.5% PMM (CP 67%) replacing 25.0% CP in basal diet
- Exchange of soybean meal and potato protein by PMM
- Diets: Iso-caloric, similar protein- en AA contents
- Observations: Performance results, Processing yields, Foot pad lesions

(Van Harn et al., 2010)

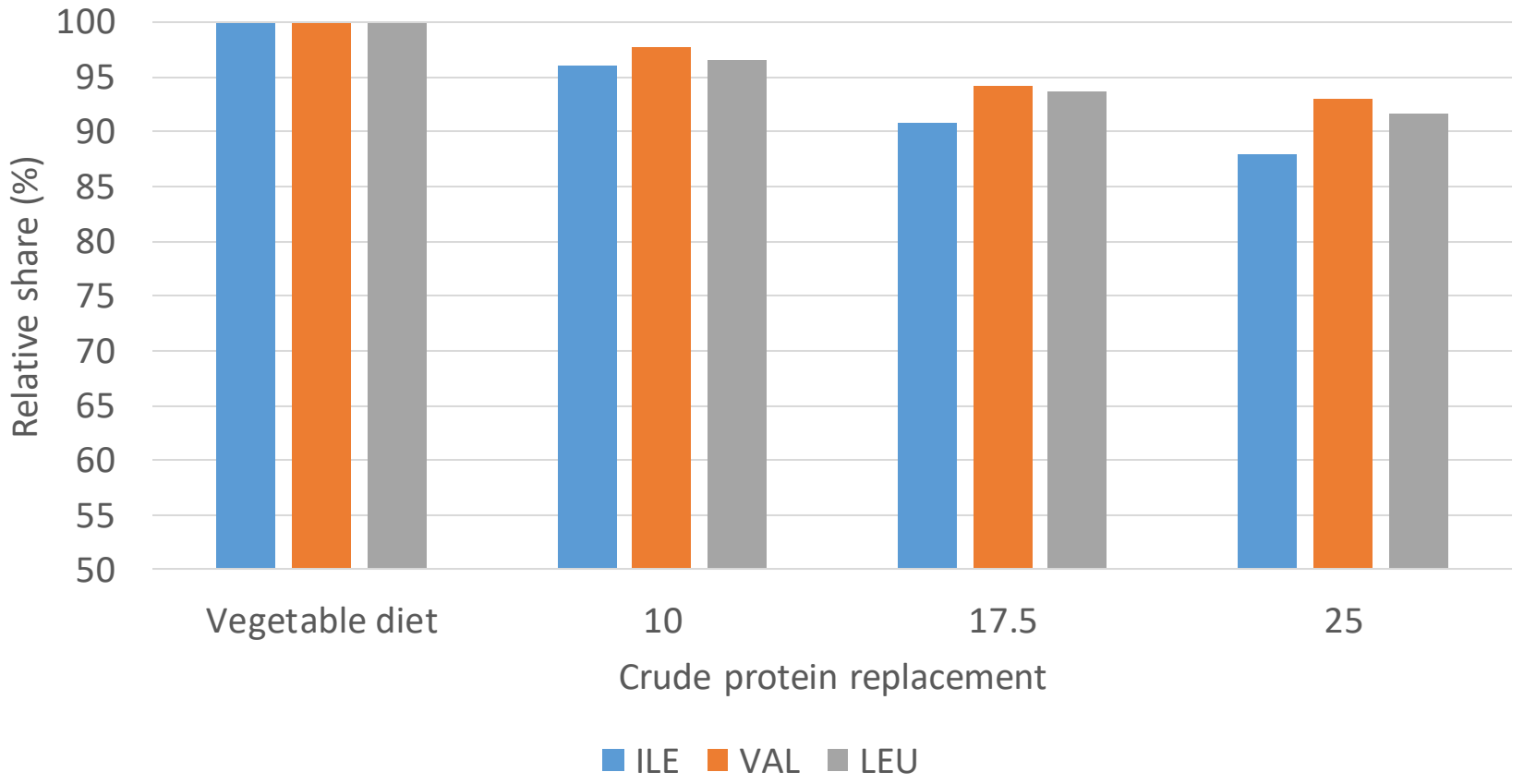
Performance broiler study

		Crude Protein replacement		
Parameter	Vegetable diet	10	17.5	25
Body weight 35 d (g)	2303	2323	2285	2259
Body weight gain (g)	2260	2281	2242	2216
Body weight gain (g/d/d)	64.6	65.2	64.1	63.3
Mortality (%)	3.1	2.4	1.9	1.8
Feed conversion ratio	1.560 [a]	1.567 [a]	1.593 [b]	1.607 [b]
Feed conversion ratio 2300 g	1.559 [a]	1.560 [a]	1.597 [b]	1.619 [c]
Feed intake (g)	3520	3571	3566	3559

a,b,c Means within a row are significantly different ($P < 0.05$).

(Van Harn et al., 2010)

Relative share of non-essential amino acids (Vegetable diet = 100%)



(Van Harn et al., 2010)

EFPRA broiler study

- Replacement of soybean meal by PAP_1 and PAP_2
  - 40% in starter diet
  - 30% in grower diet
  - 20% in finisher diet

(Van Harn et al., in progress)

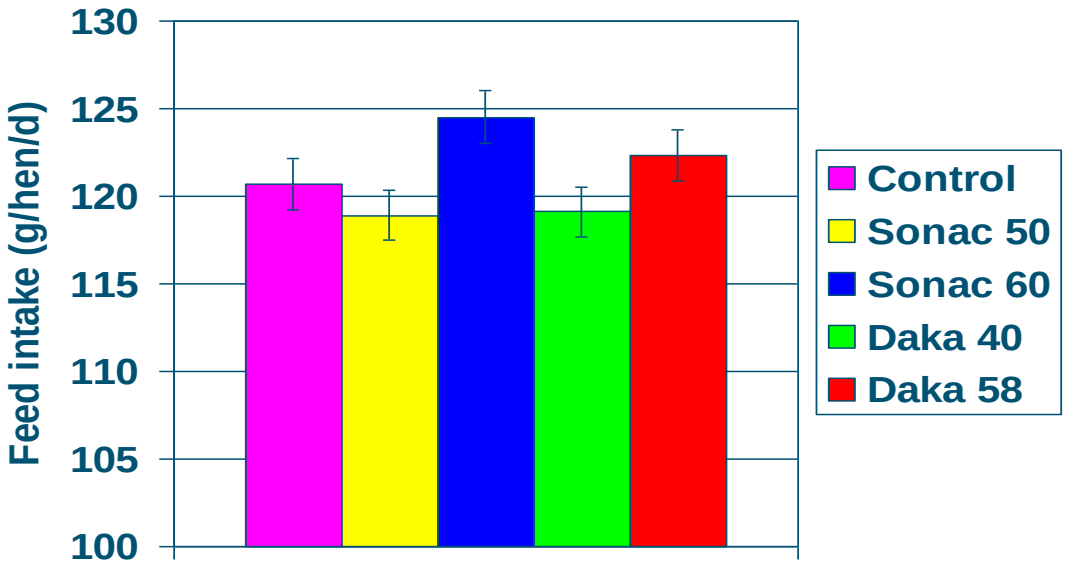
Corrected AME conversion ratio (0 – 42 d)

	Control	PAP 1	PAP 2	F-prob
Feed conversion ratio (g/g)	1.381 [b]	1.411 [a]	1.406 [a]	0.034
FCR 3850g[1]	1.389	1.390	1.413	0.374
Calculated AME diet (MJ/kg)	12.50	12.50	12.50	
Realised AME diet (MJ/kg)	12.50	12.23	12.24	
Calculated AME conversion ratio	17.26	17.64	17.58	
Realised AME conversion ratio	17.26	17.26	17.21	

(Van Harn et al., in progress)

Performance in laying hen study

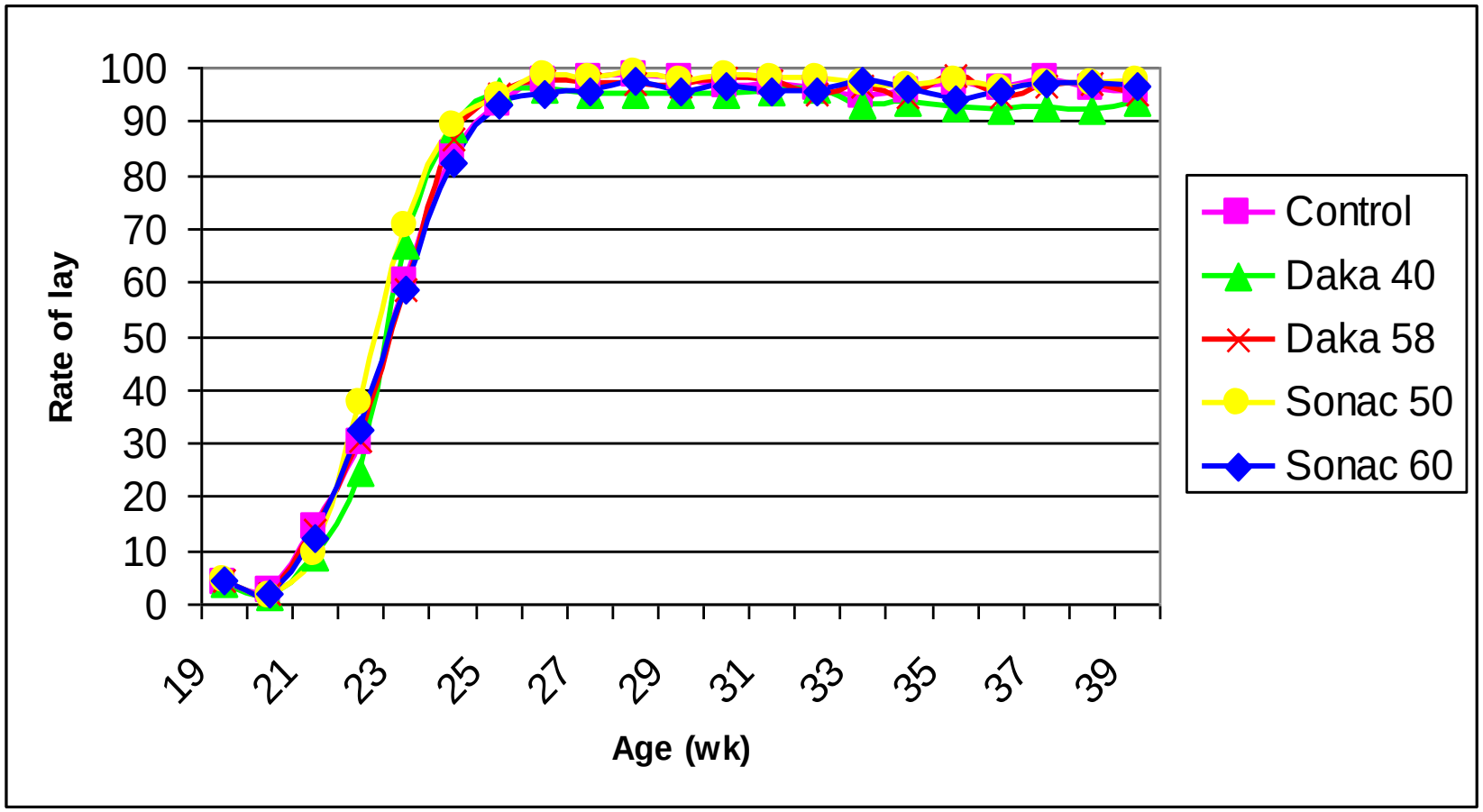
Average feed intake (g/hen/d)



(P=0.102)

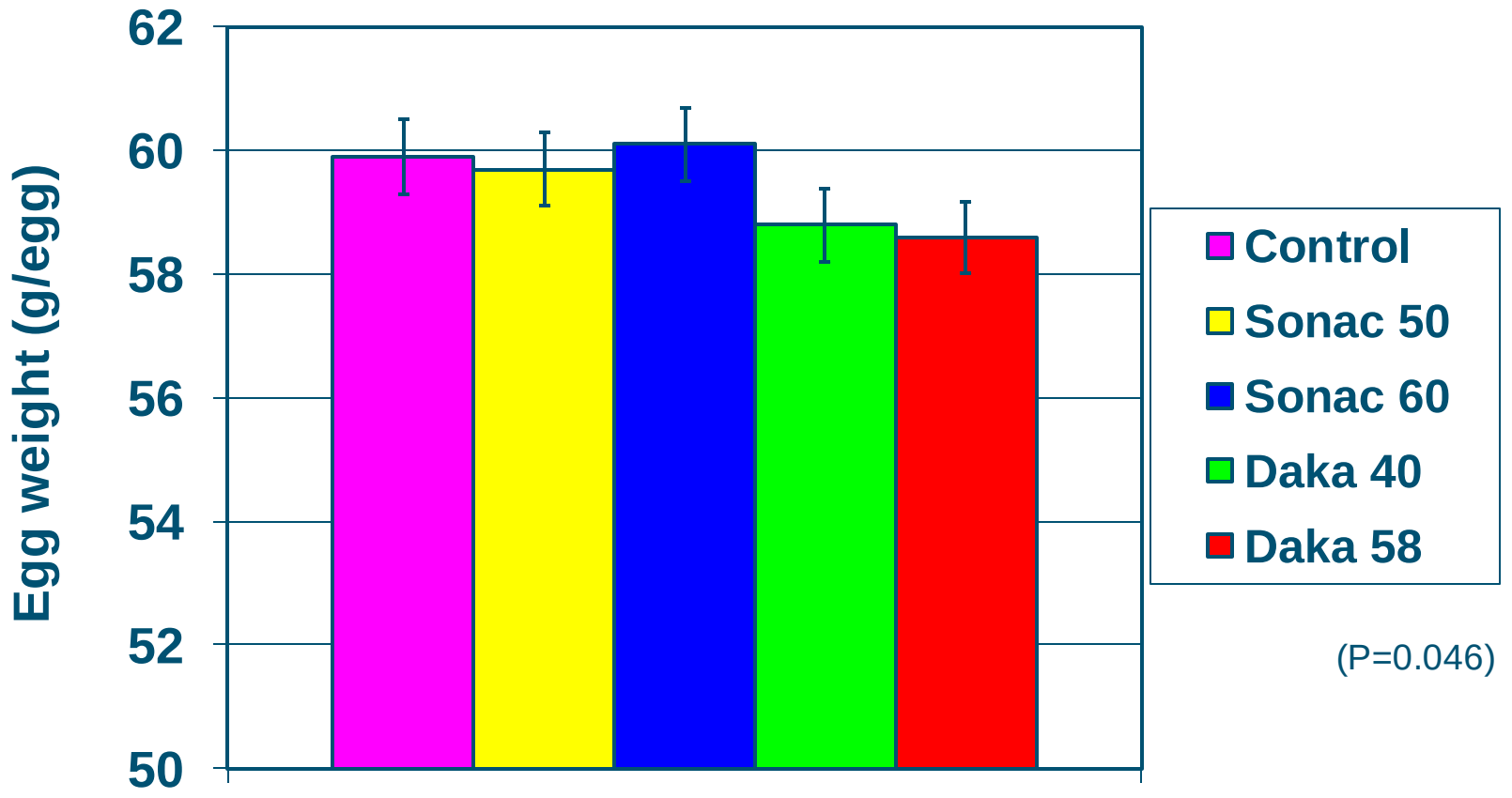
(Van Krimpen et al., 2010)

Development of rate of lay (%)



(Van Krimpen et al., 2010)

Average egg weight (g/egg)



(P=0.046)

(Van Krimpen et al., 2010)

Conclusions: Nutritional evaluation of PAPs

- Valuable sources of energy, amino acids, macro minerals
- Intensive PAP processing seem to affect nutrient digestibility in broilers → validation studies needed
- For maintaining broiler performance → non-essential AA
- CVB Table values in line with findings in laying hens
- PAPs-fed laying hens → similar performance as control diet (SBM) fed hens

- High quality, locally sourced protein source → replace imported soybeans

Thanks for your attention!

WAGENINGEN
UNIVERSITY & RESEARCH

100years
1918 — 2018

Marinus.vankrimpen@wur.nl