Maximising energy intake and growth potential of entire male pigs

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Why not castrate pigs?

- To take advantage of the high potential for lean tissue deposition in boars

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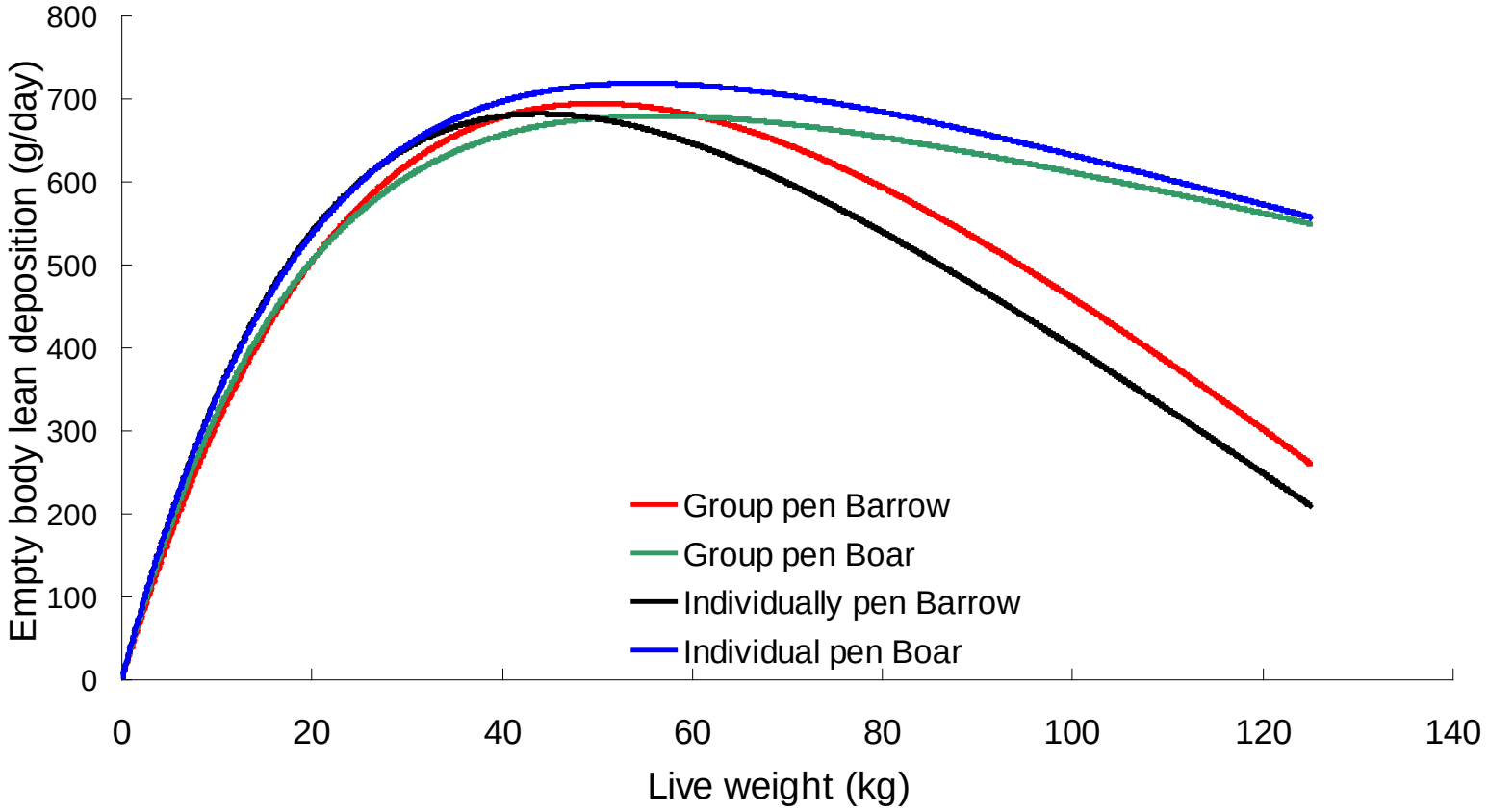
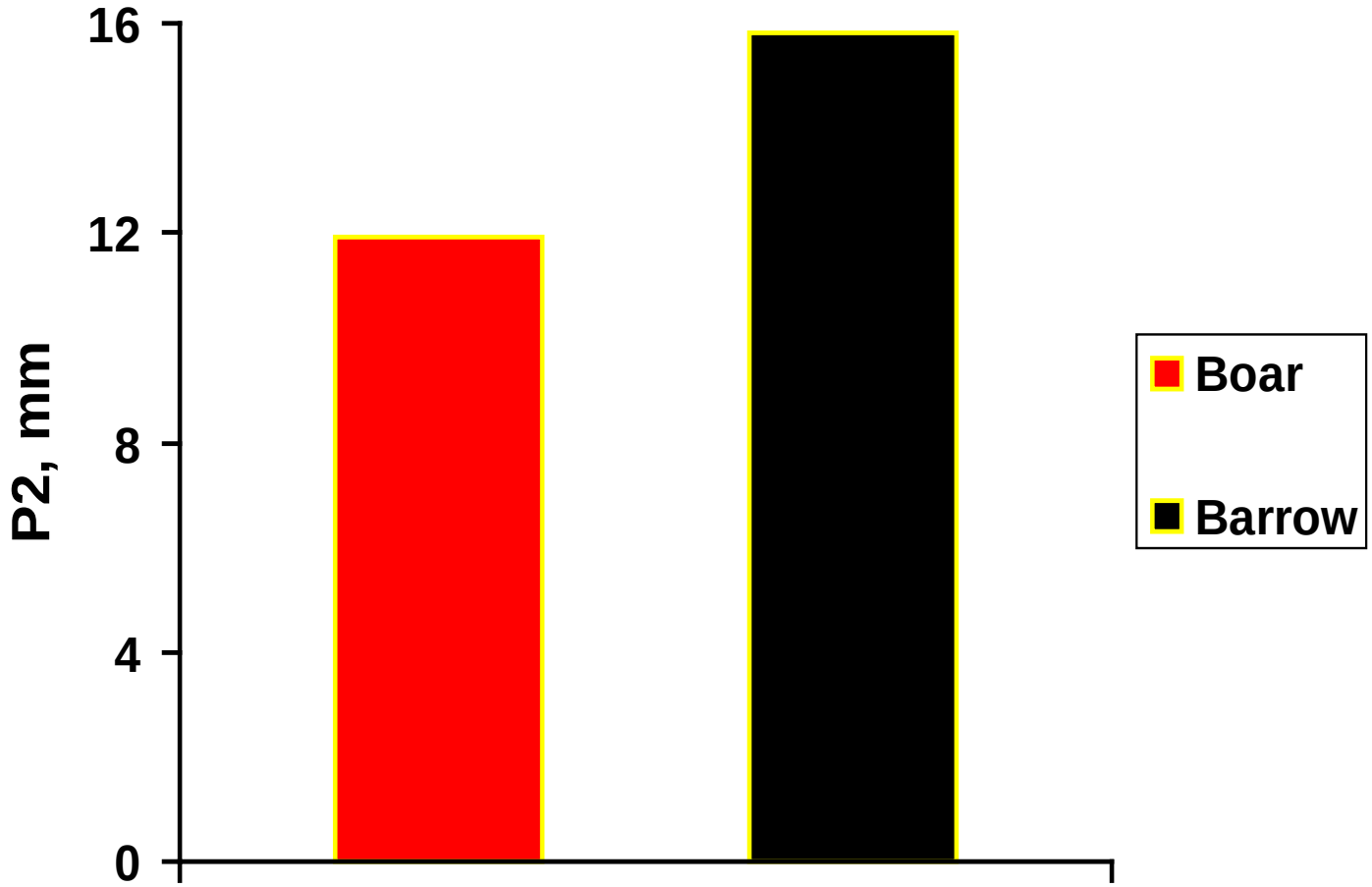


Suster *et al.* (2006)

Why not castrate pigs?

- To take advantage of the high potential for lean tissue deposition in boars
- To reduce carcass fat and back fat depth

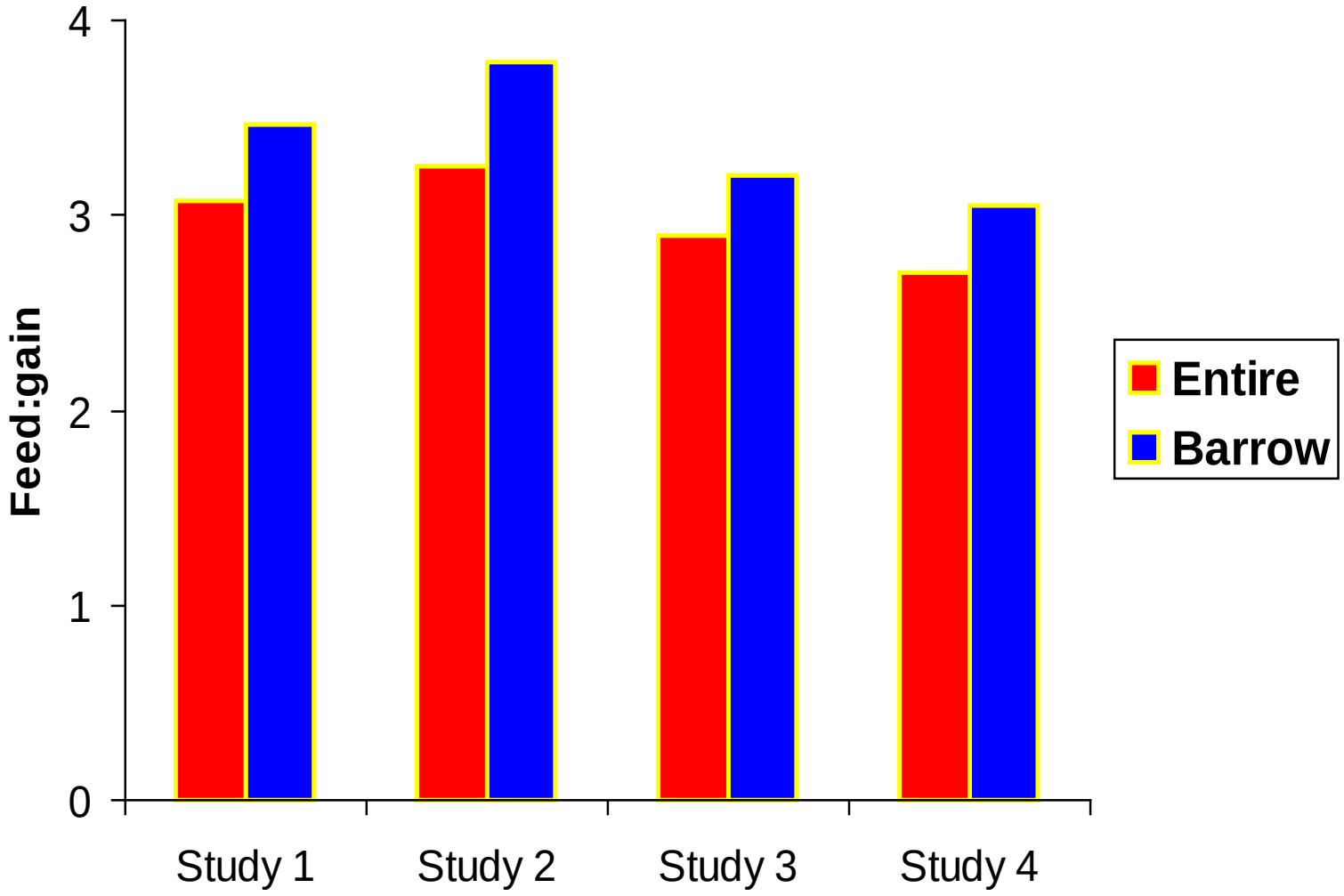


Dunshea *et al.* (2001)

Why not castrate pigs?

- To take advantage of the high potential for lean tissue deposition in boars
- To reduce carcase fat and back fat depth
- To improve feed conversion efficiency

Physically castrated barrows are less efficient than entire males (ca. 11%) from weaning to market



Dunshea *et al.* (unpublished)

Entire males have lower carcass weight, back fat and finisher feed intake and FCR compared to physically castrated barrows

	Effect	sed	95% CI	P-value	# studies
ADG (g/d)	-31	15.5	(-61.4, -0.58)	0.011	8
ADFI (g/d)	-467	30.9	(-531,-404)	<0.001	7
FCR	-0.48	0.030	(-0.54,-0.42)	<0.001	7
Carcass weight (kg)	-2.14	0.656	(-3.43,-0.86)	<0.001	10
Back fat (mm)	-4.9	0.29	(-5.05,-3.93)	<0.001	10

Dunshea (2010)

Why not castrate pigs?

- To take advantage of the high potential for lean tissue deposition in boars
- To reduce carcass fat and back fat depth
- To improve feed conversion efficiency
- To reduce cost of production and increase returns
- To improve animal welfare

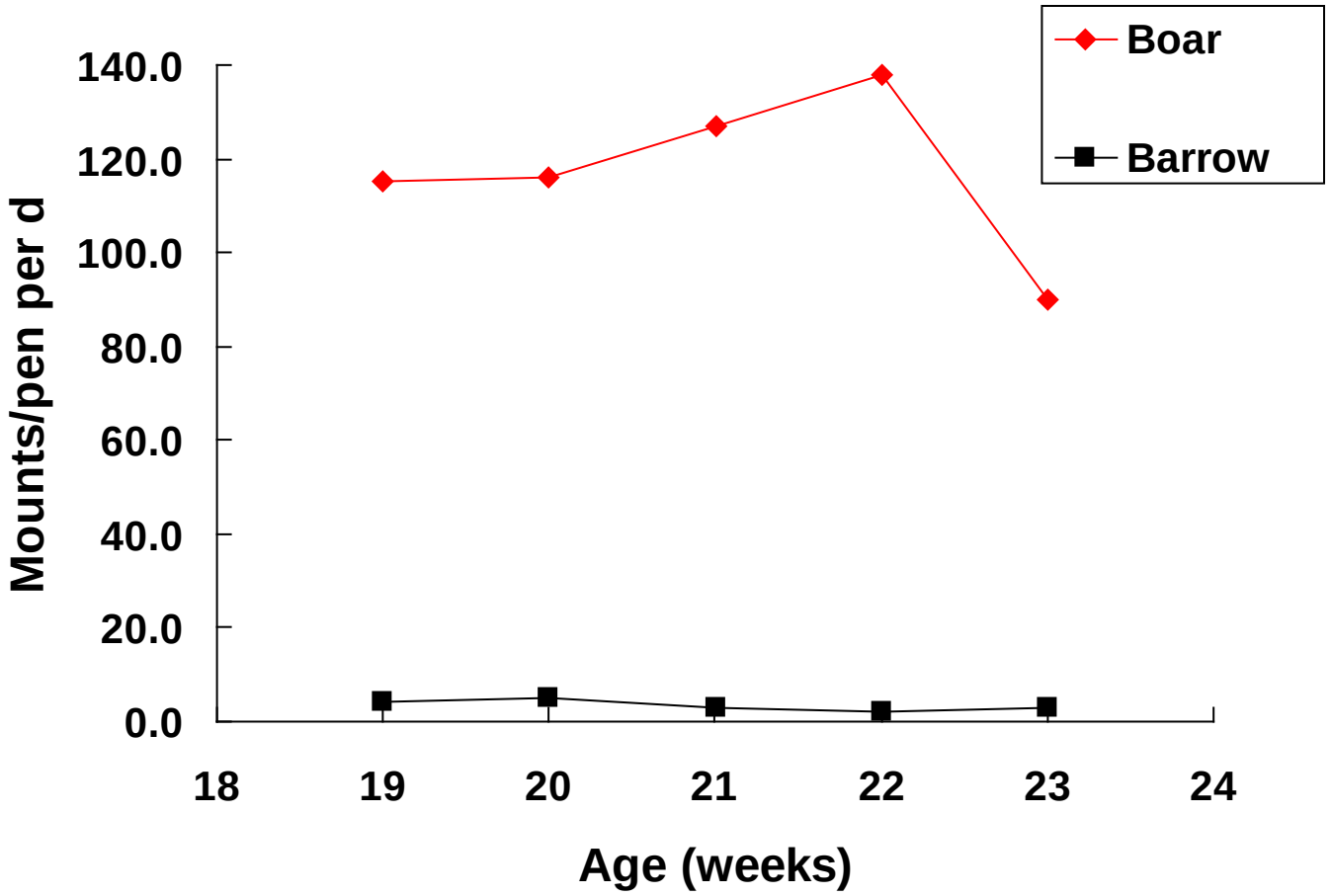
The animal welfare dilemma

- Castration without anaesthesia is viewed as painful and a welfare risk

but

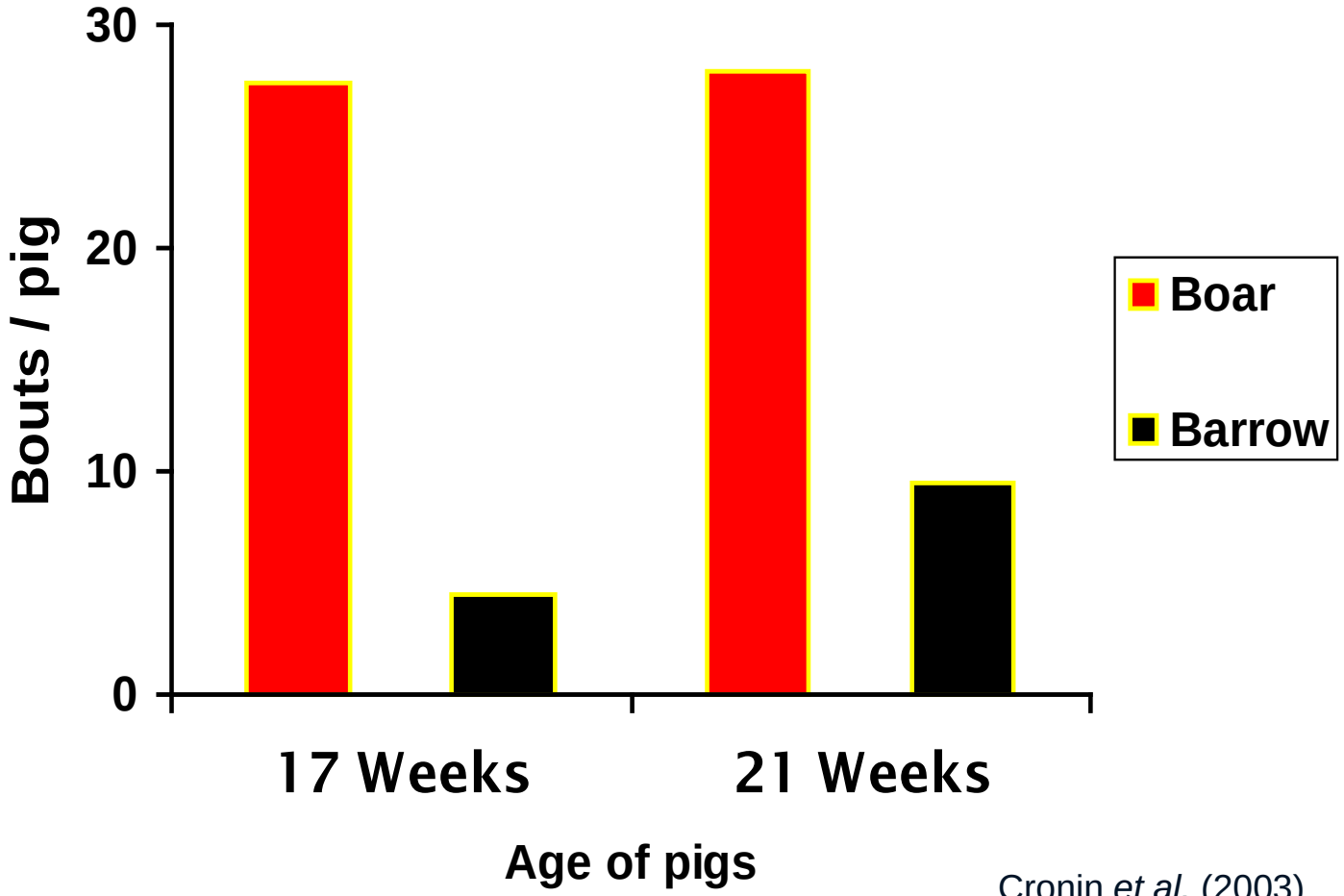
- Group-housed boars can exhibit negative behaviours that can be a welfare risk and can limit ffed intake and growth performance

Castration decreases mounting behaviour

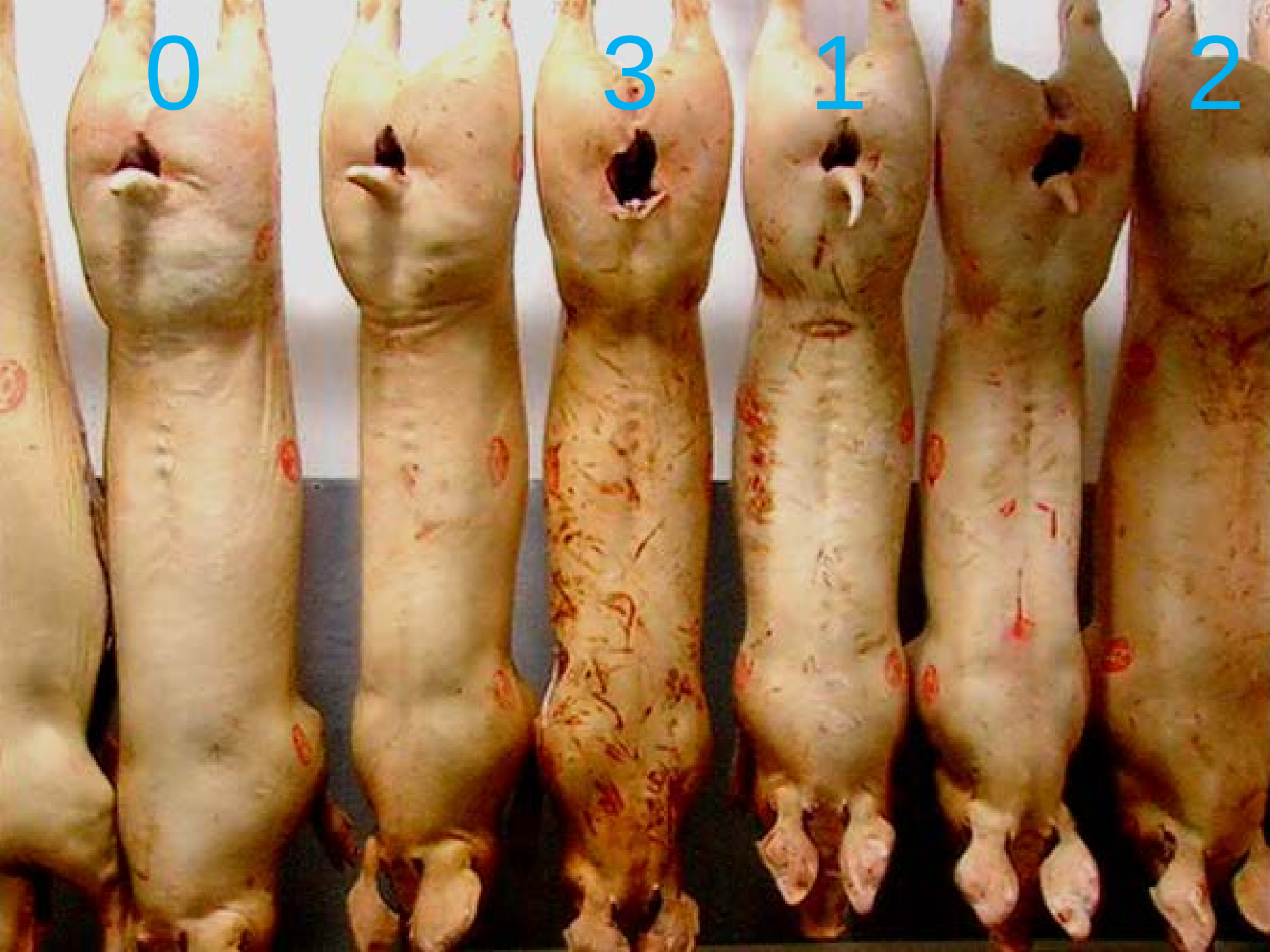


Cronin *et al.* (2003)

Castration decreases aggression



Cronin *et al.* (2003)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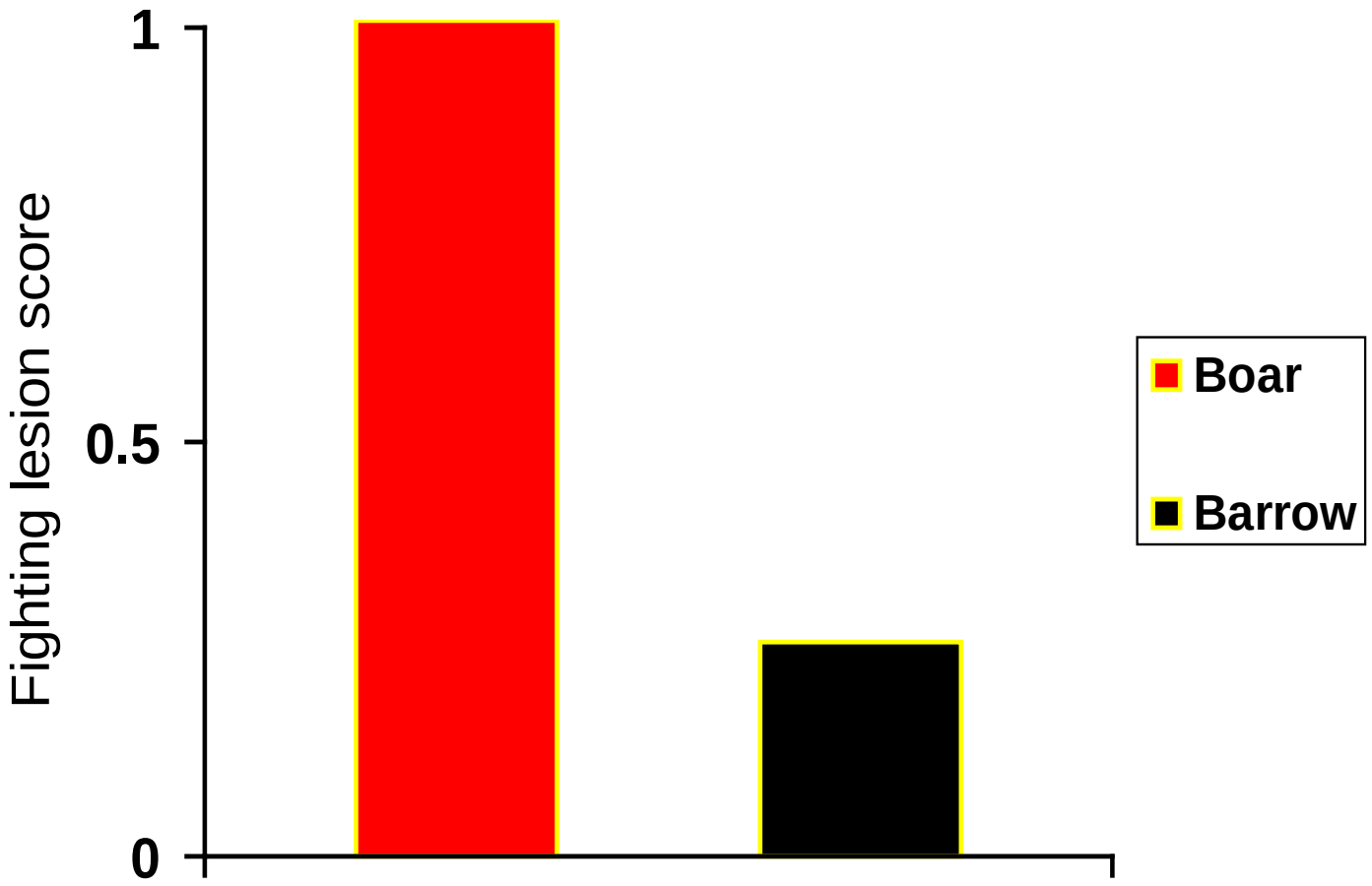
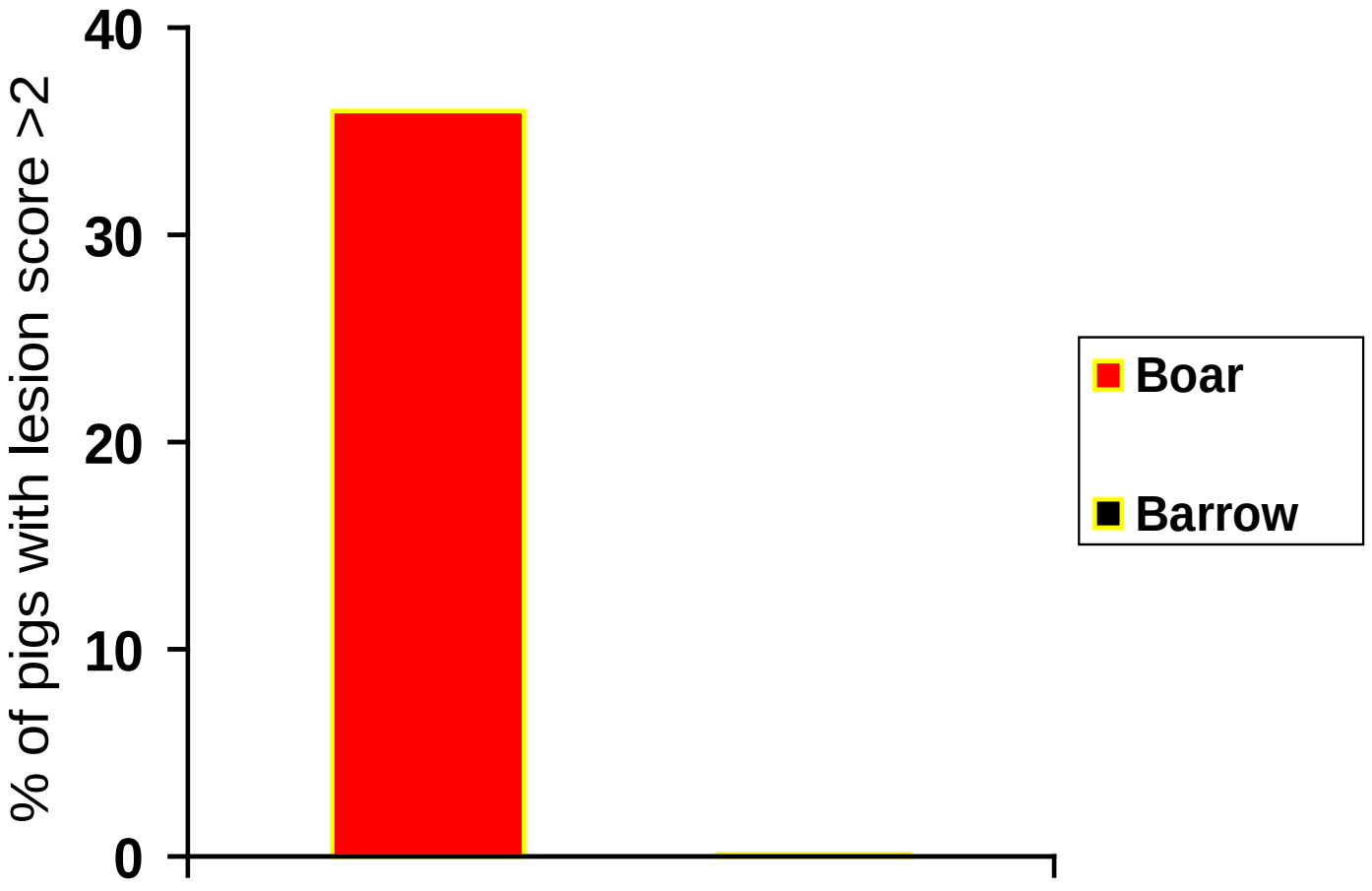
Castration reduces fighting lesions



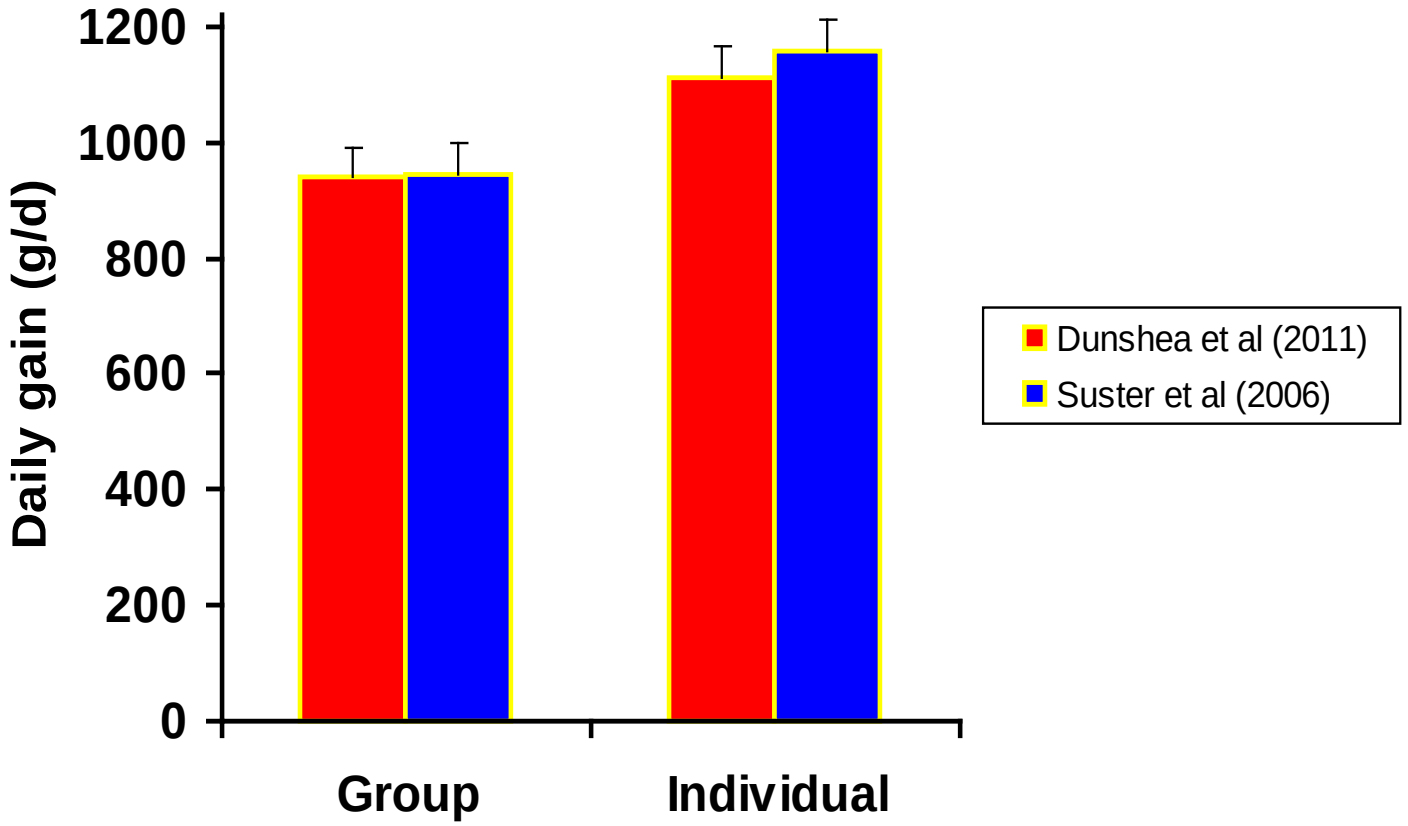
Dunshea *et al.* (2011)

Castration reduces the proportion of pigs with high fighting lesion scores

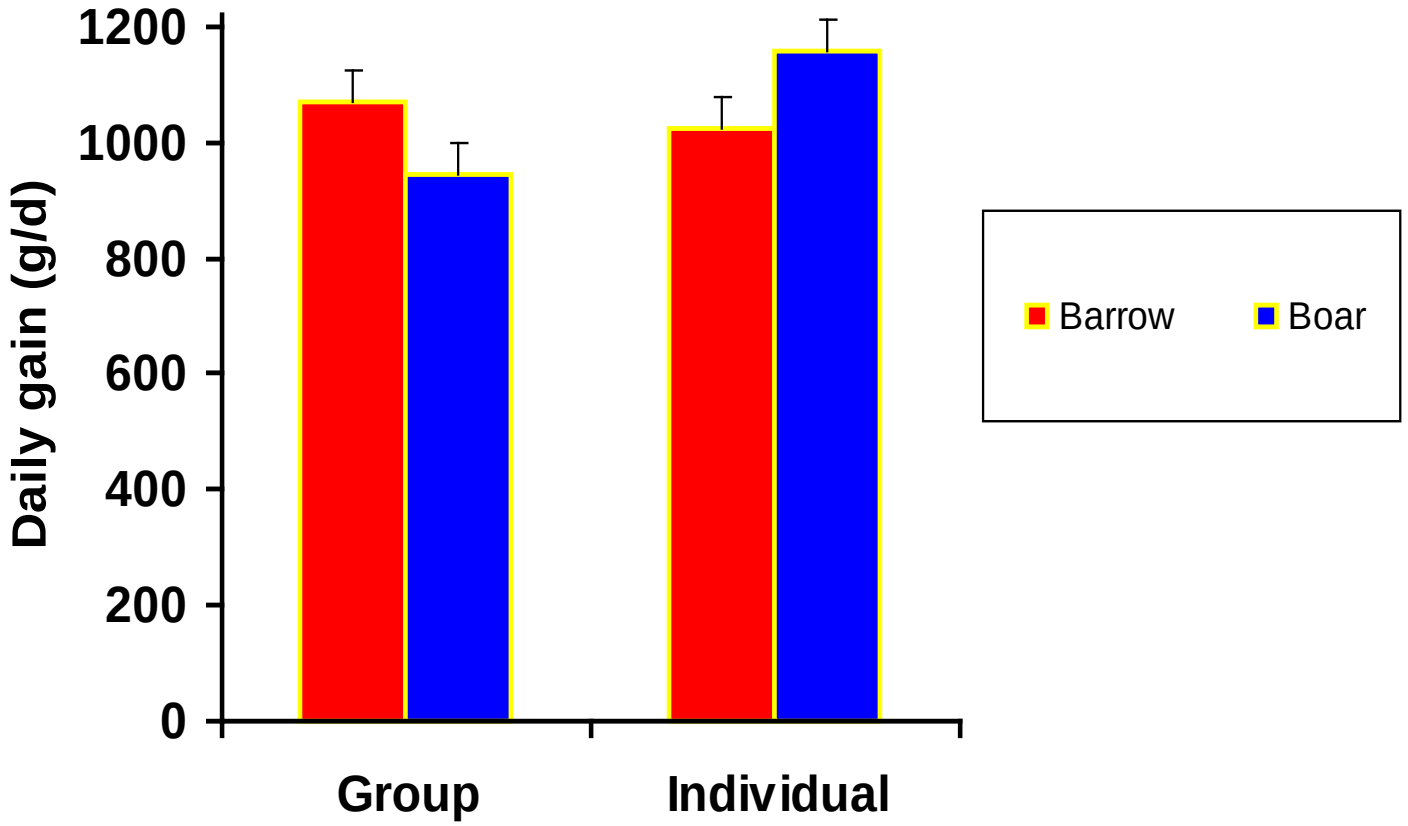


Dunshea *et al.* (2011)

Group-housed entire males grow less than their potential

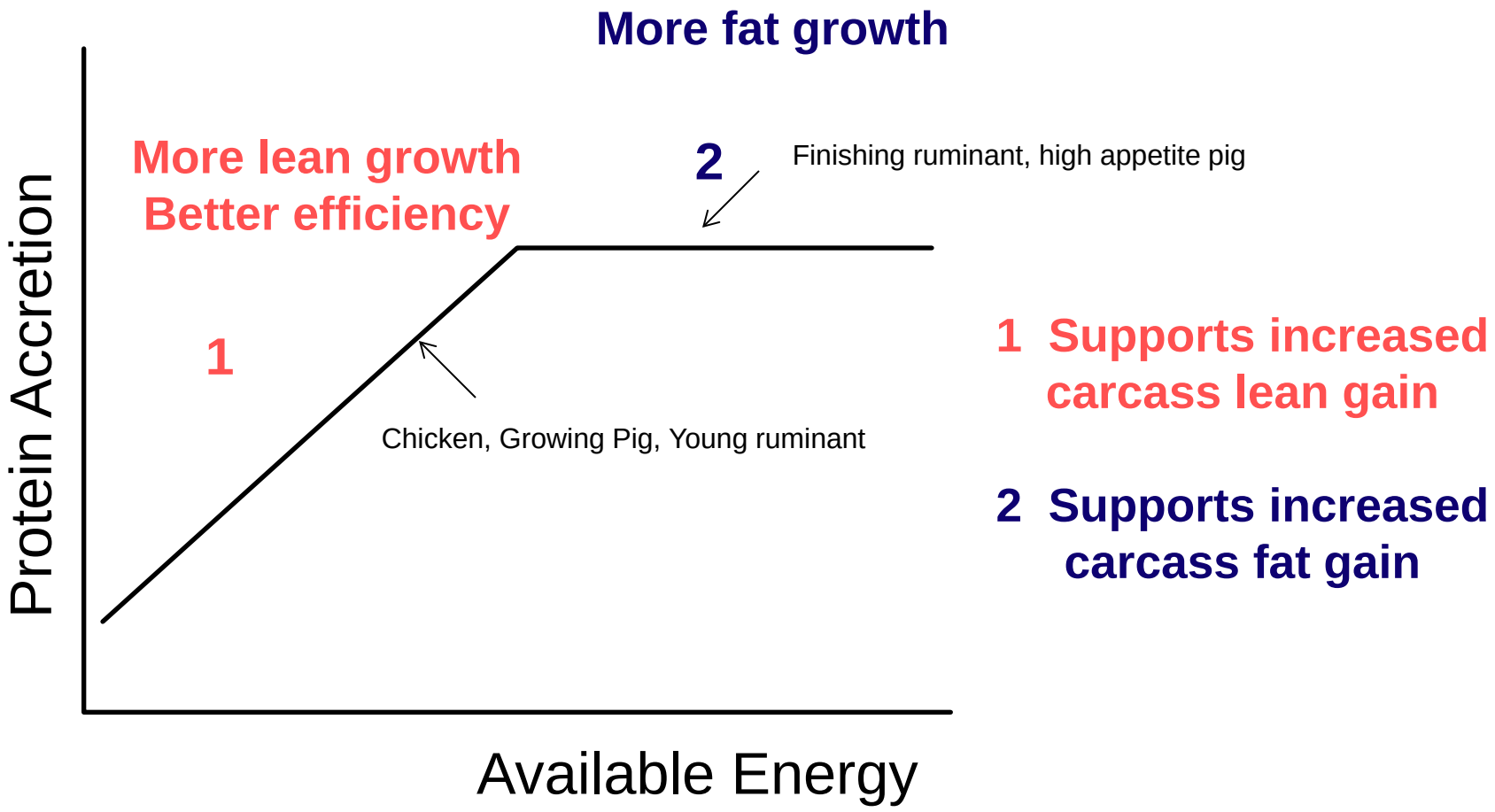


Group-housed entire males but not barrows grow less than their potential

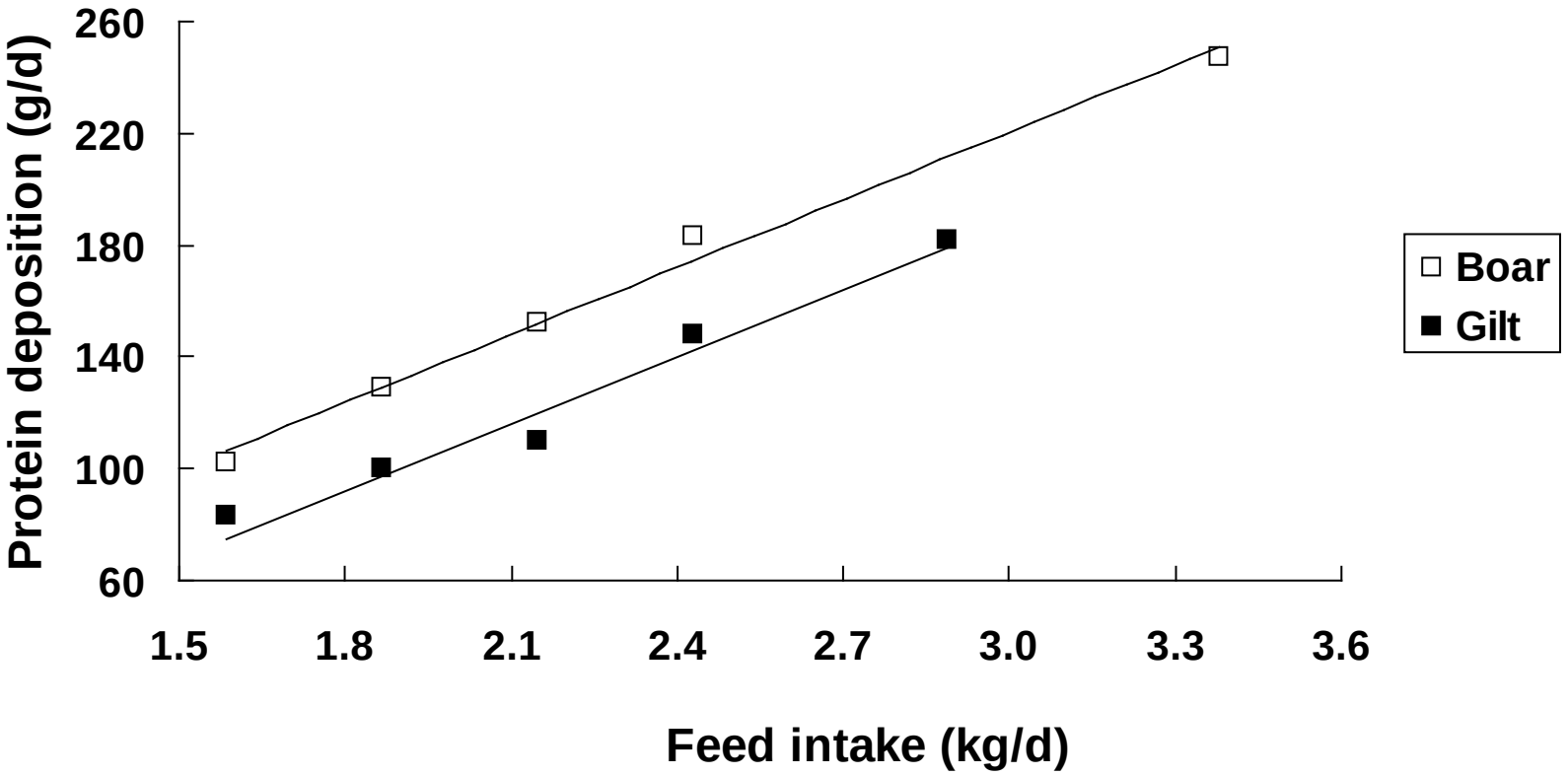


Suster *et al.* (2006)

Effects of increasing energy intake or available energy depends on species and physiological state

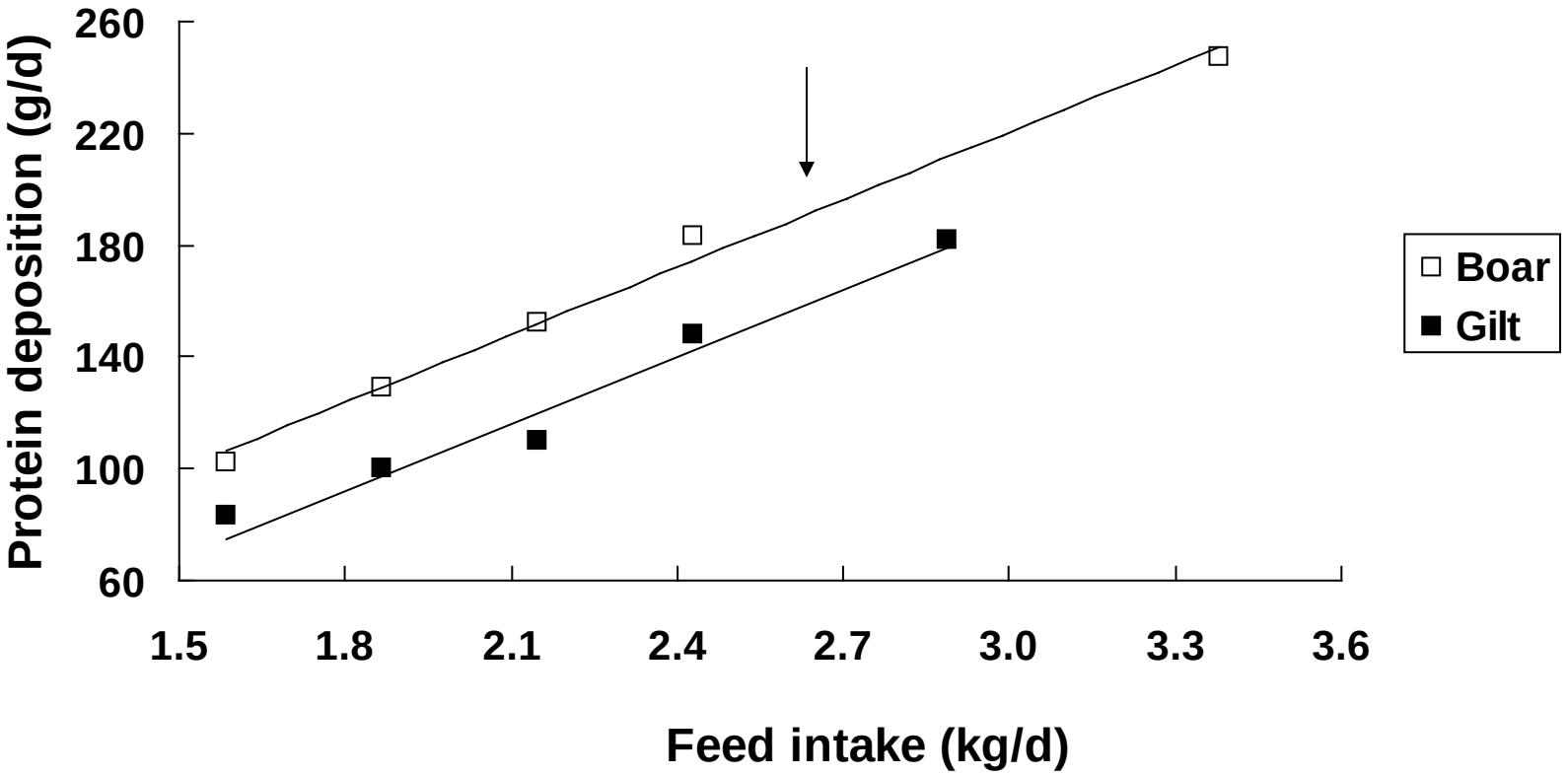


Protein deposition increases linearly with energy intake in improved pigs



King *et al.* (2005)

Feed intake may limit protein deposition in improved pigs under commercial conditions



King *et al.* (2005) & Dunshea (2005)

Boars have a higher lysine requirement than barrows and gilts

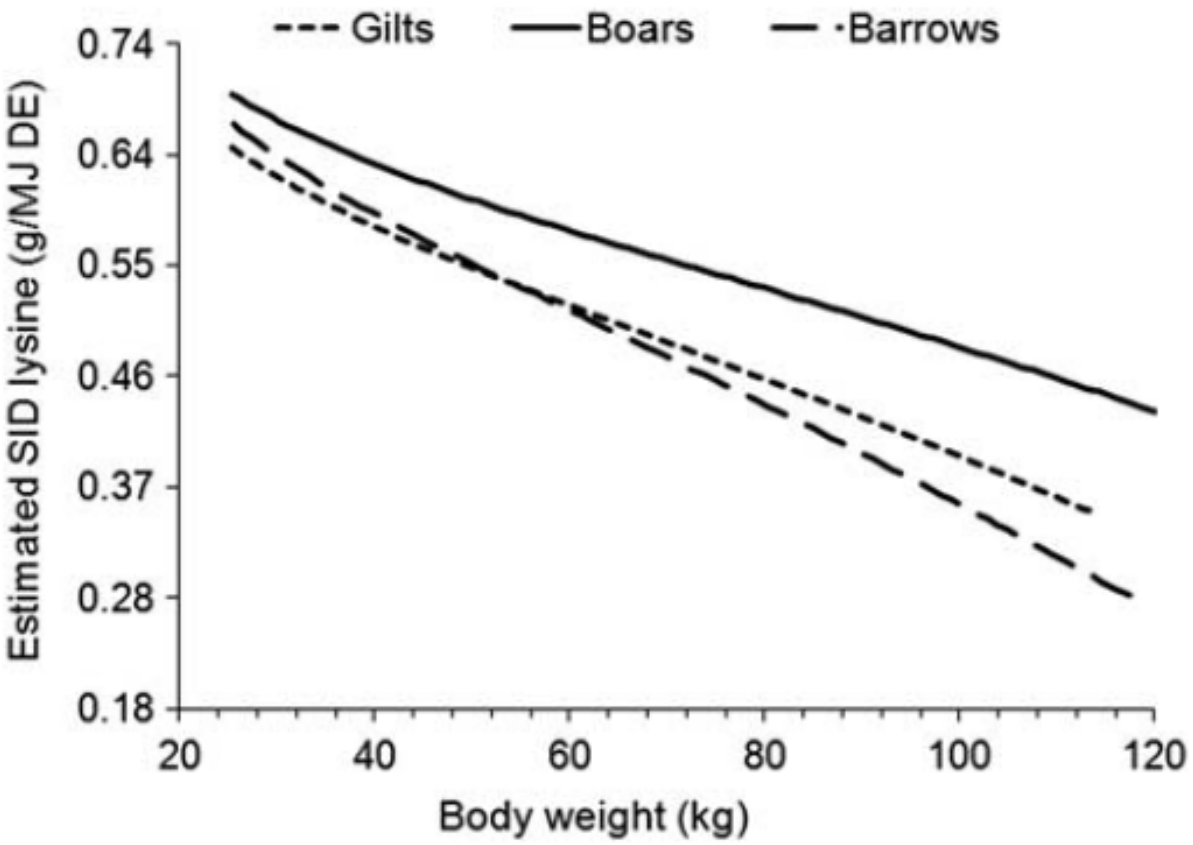


Figure 2 Relationship between estimated standardized ileal digestible (SID) lysine content (g/MJ DE) and BW in boars (solid line), barrows (dashed line) and gilts (dotted line). Estimates were obtained from InraPorc (van Milgen *et al.*, 2008) simulations of performance data (after Quiniou *et al.*, 2010).

How we mitigate against the negative behaviours and maintain available energy in boars

- Provide adequate access to feeders and drinkers
- Do not overstock and avoid remixing
- Provide comfortable environment and reduce risk of disease
- Dietary betaine to reduce energy expenditure
- Dietary enzymes to release nutrients from feed
- Dietary neuroleptics to control behaviour
- Immunocastration to control behaviour

How we mitigate against the negative behaviours and maintain available energy in boars

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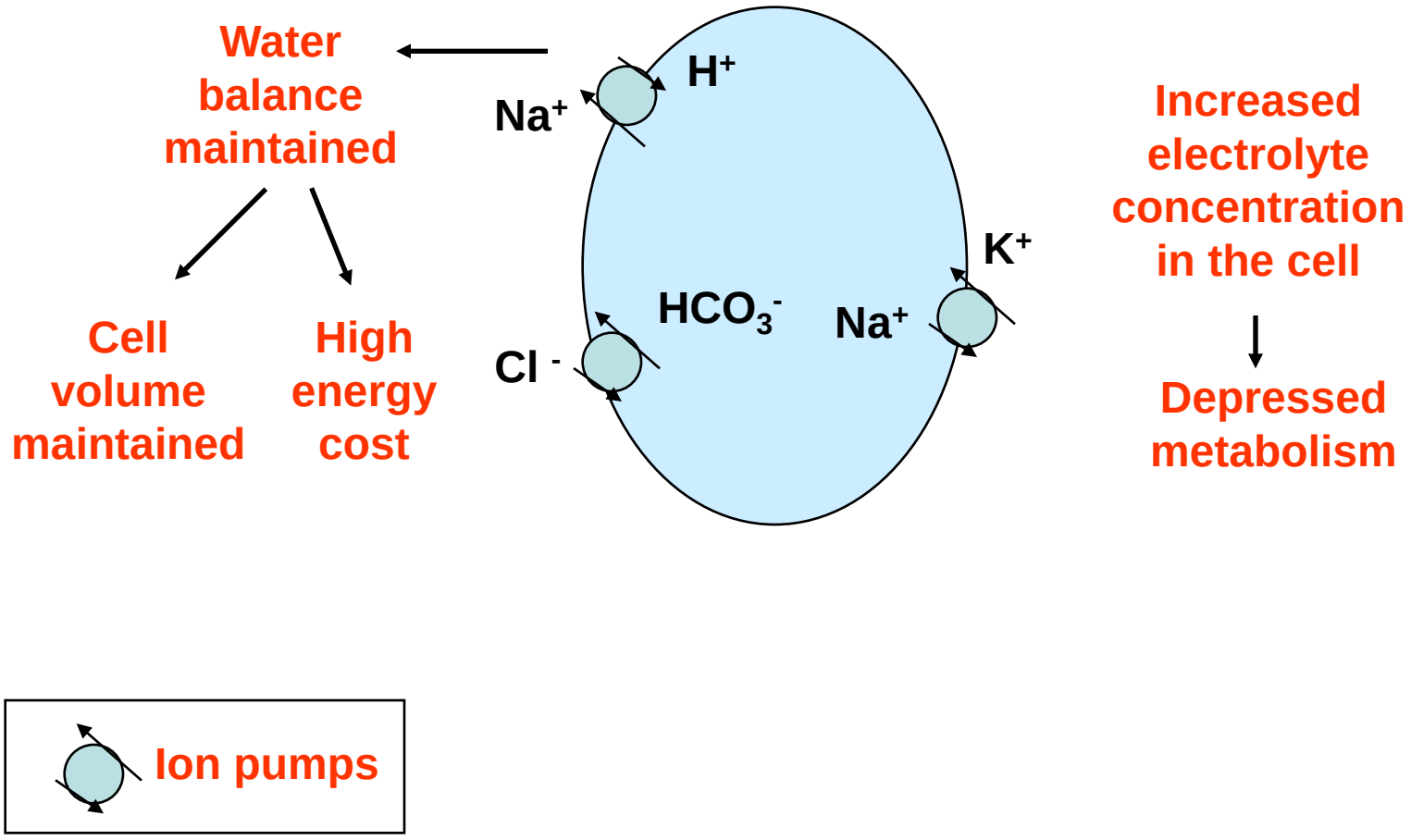
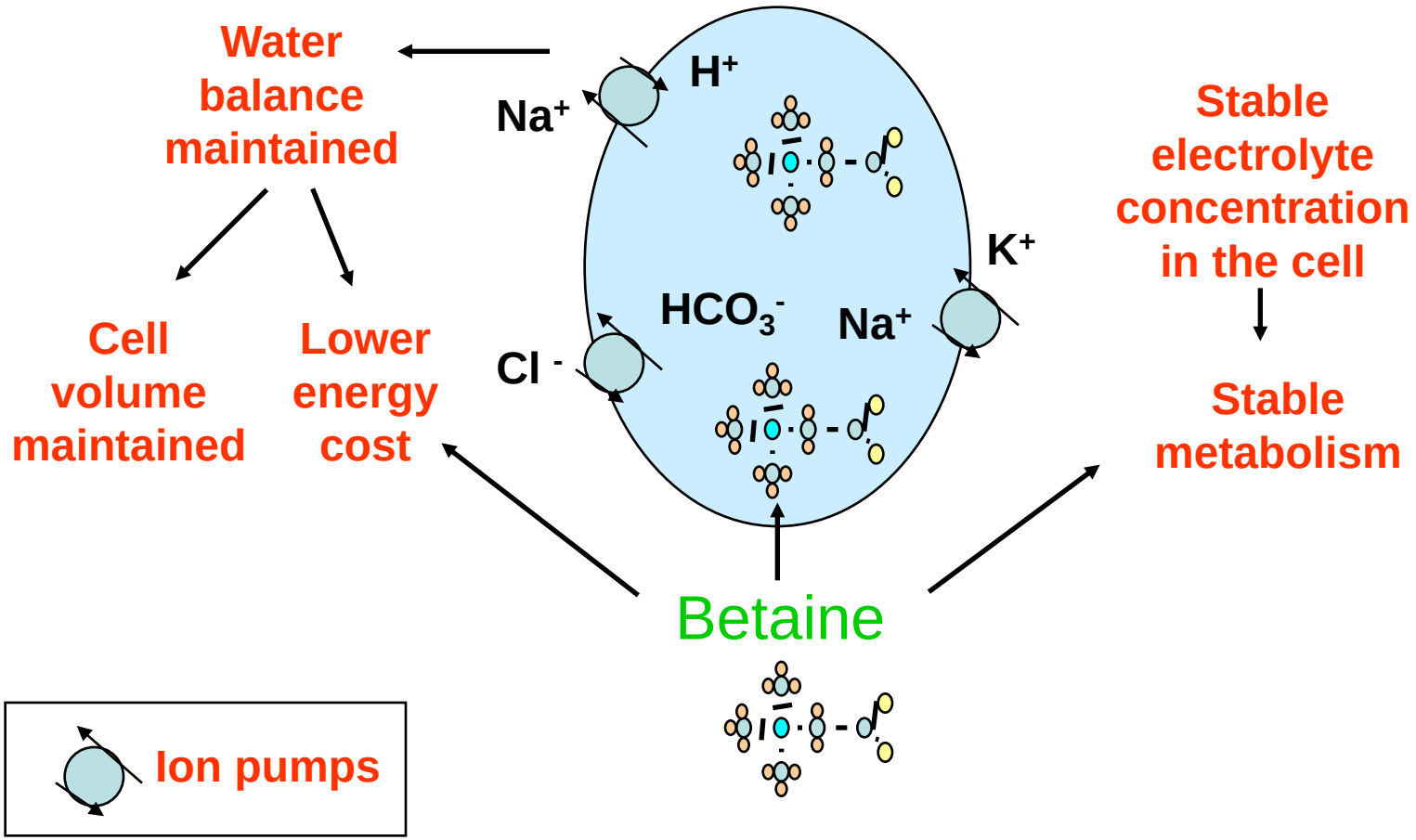
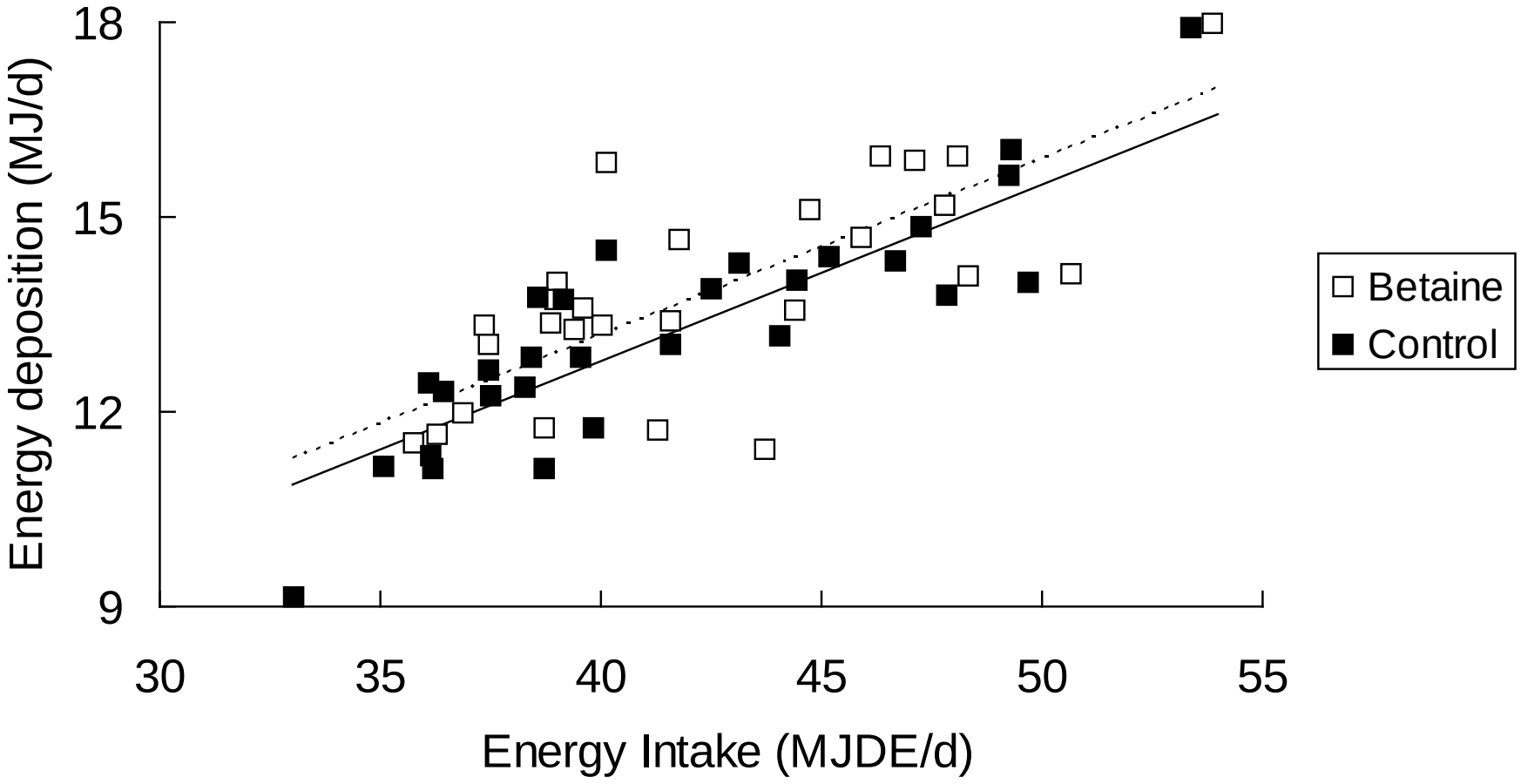
Hyperosmotic stress and compensation with ion pumps



Hyperosmotic stress, compensation with ion pumps and betaine

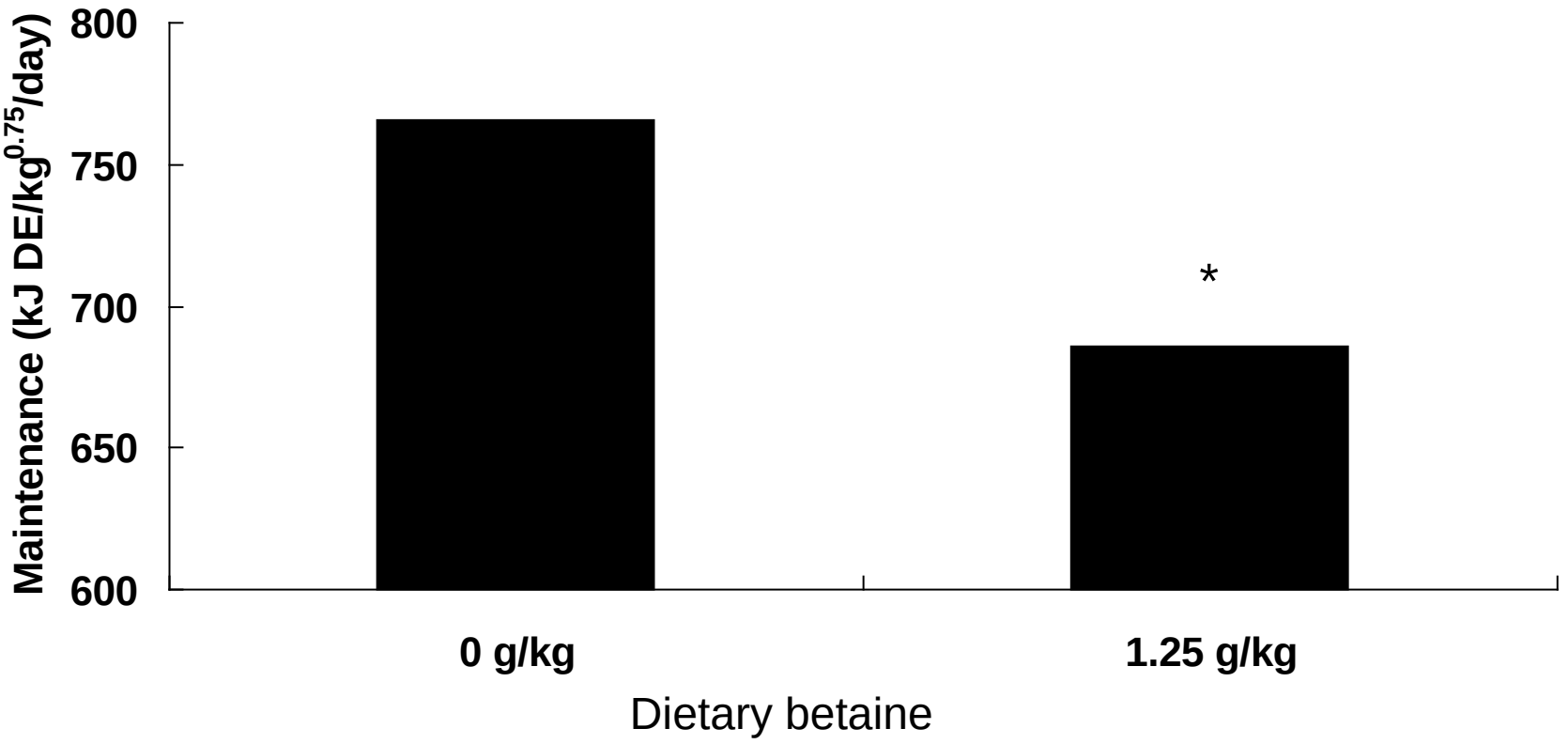


Dietary betaine increases the intercept of the relationship between energy intake and energy deposited in pigs by 0.5 MJ/d



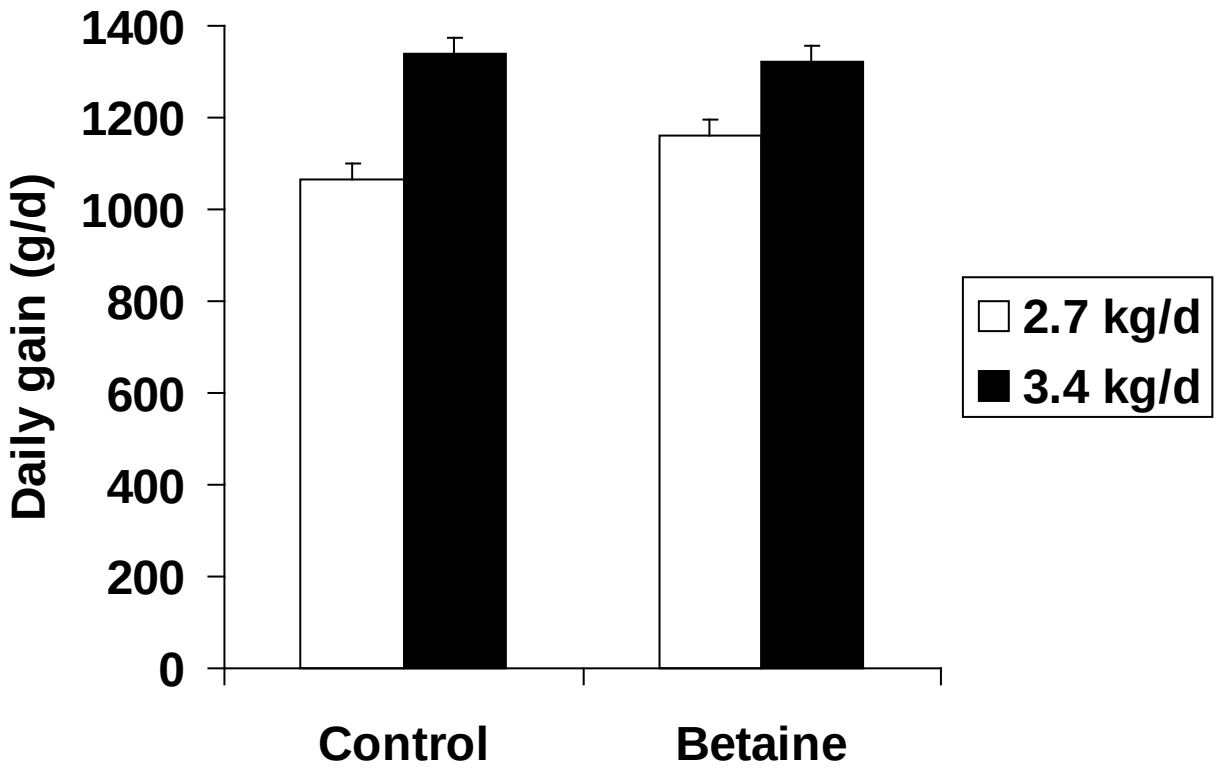
Dunshea et al (unpublished)

Dietary betaine decreases maintenance requirements (-10%) in growing pigs



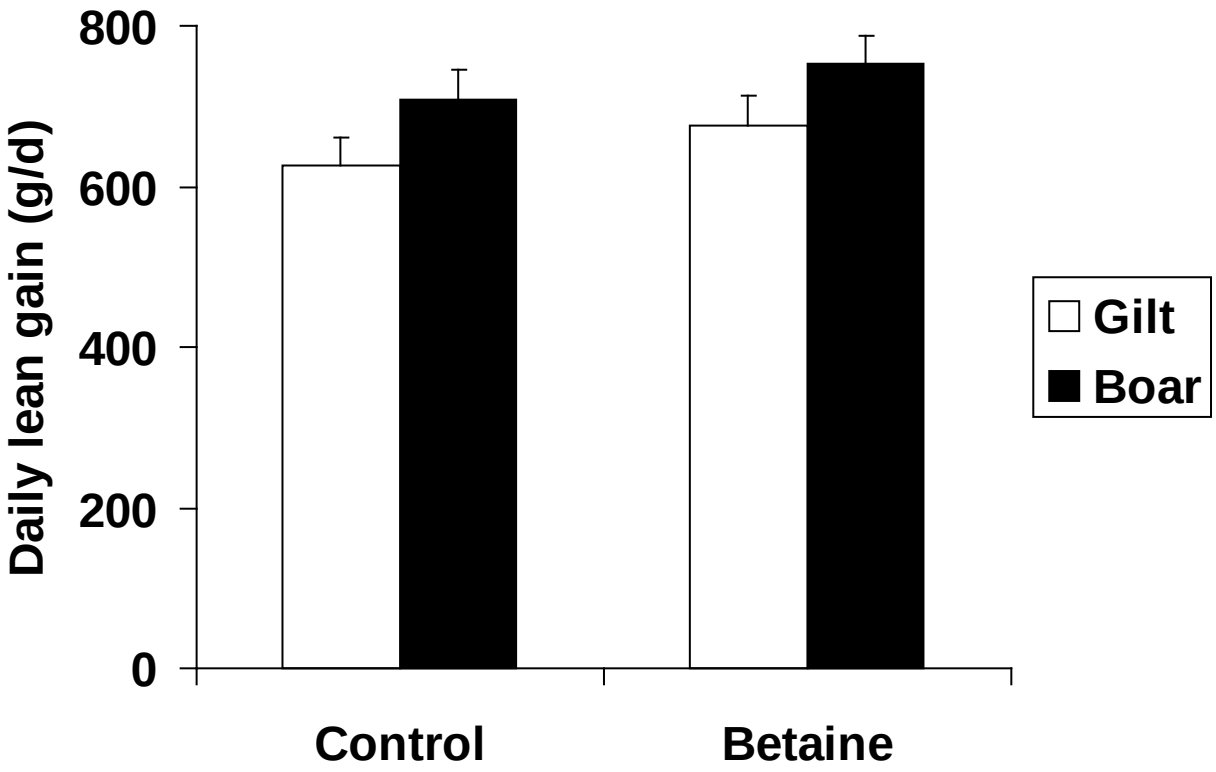
Campbell et al. (unpublished)

Betaine increases daily gain in restrictively fed (ca 2.7 kg/d) but not ad libitum fed (3.4 kg) pigs



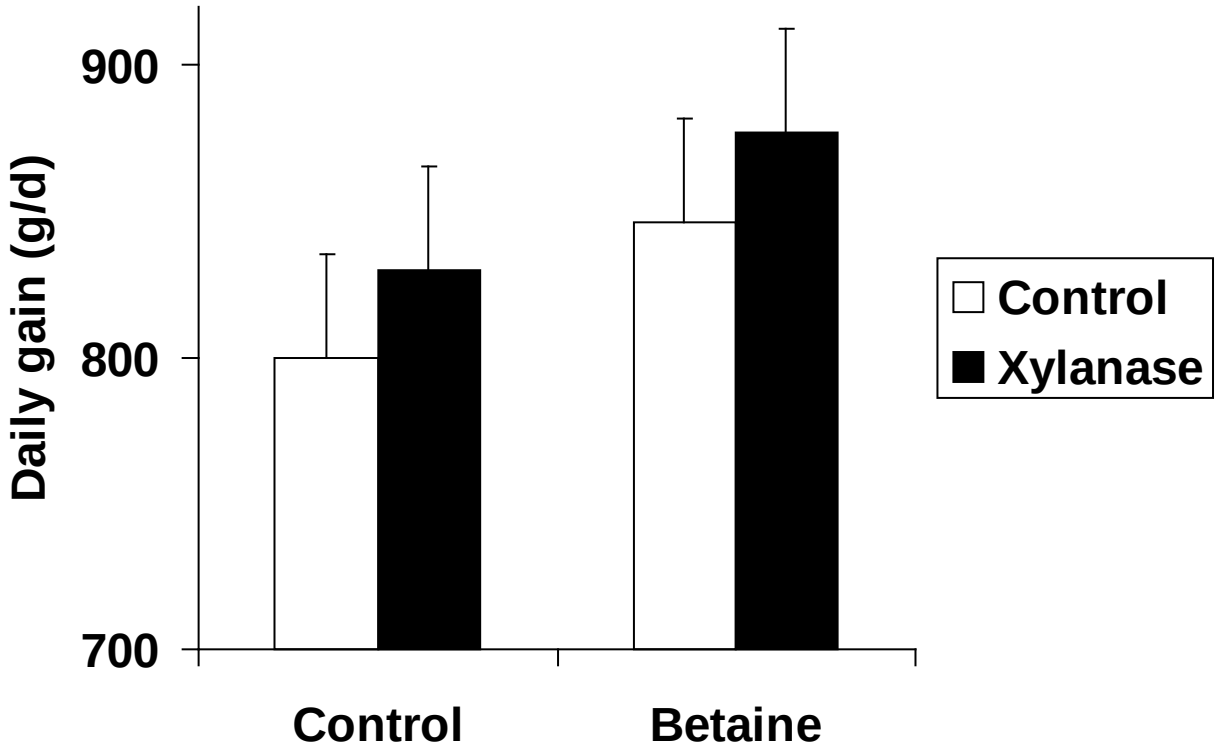
Suster *et al.* (2006b)

Betaine increases lean gain in gilts and boars fed 80% (2.5 kg/d) ad libitum



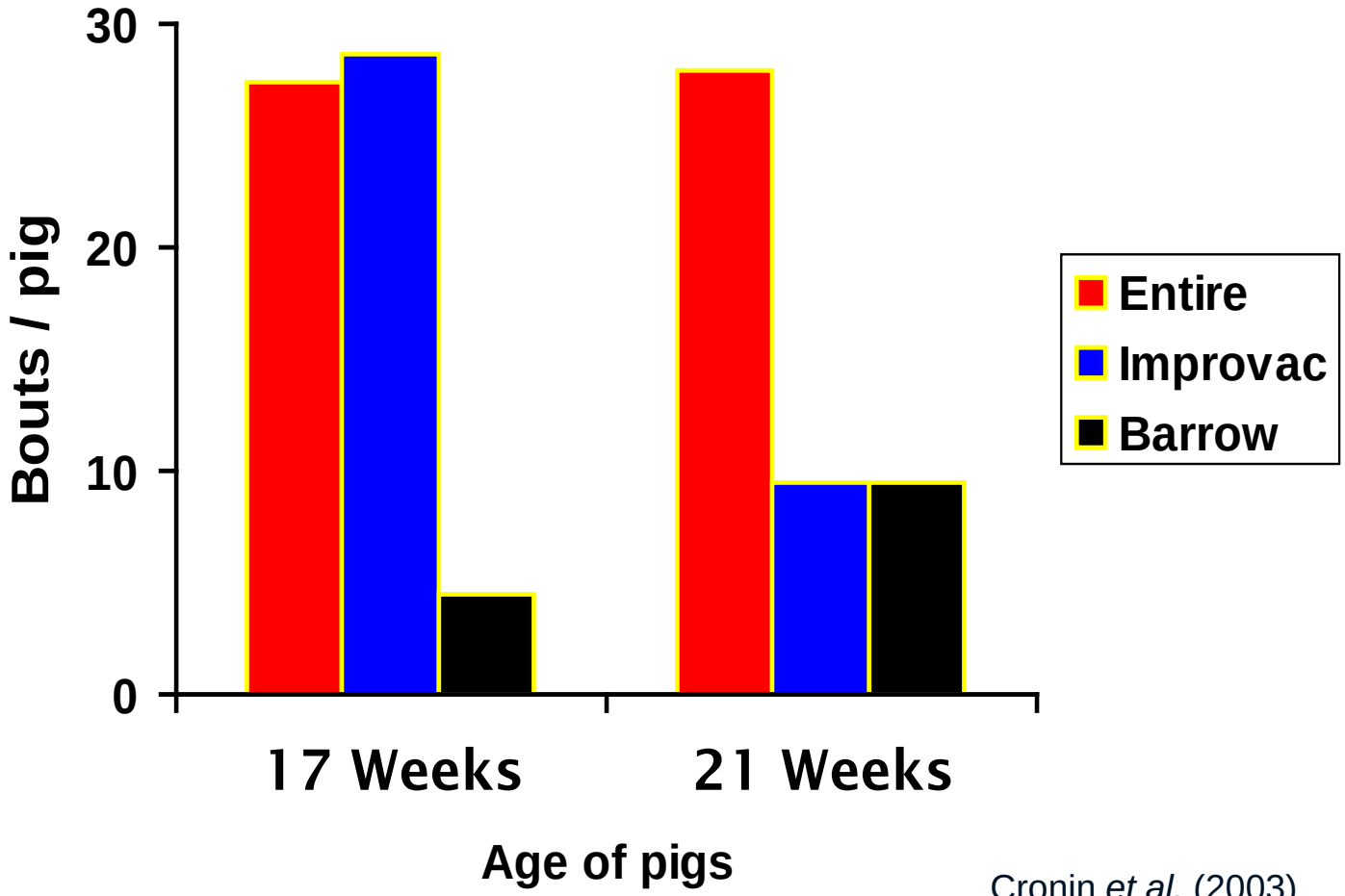
Dunshea et al (2009)

Betaine and xylanase have additive effects on daily gain in gilts fed 80% ad libitum (2.7 kg/d)



Dunshea (unpublished)

Immunization against GnRF and physical castration reduce aggression



Cronin *et al.* (2003)

Table 1 *Average fixed effects of immunization against GnRF (immunized males – entire males) from meta-analyses of data from peer reviewed studies (n = 19) with group-housed pigs* [a, b, c]

Trait	Effect	s.e.d.	95% confidence interval	*P*-value	# studies
ADG (g/d)	119	8.9	(102, 136)	<0.001	17
ADFI (g/d)	429	26.8	(376, 482)	<0.001	12
FCR	0.11	0.02	(0.07, 0.15)	<0.001	14
Live weight (kg)	2.96	0.43	(2.12, 3.80)	<0.001	16
Carcass weight (kg) [d]	2.09	0.35	(1.38, 2.94)	<0.001	17
Dressing percentage	-0.29	0.12	(-0.51, -0.07)	<0.001	11
Back fat (mm)	1.53	0.18	(1.16, 1. 89)	<0.001	14

ADG = average daily gain; ADFI = average daily feed intake; FCR = feed conversion ratio.

Dunshea *et al.* (2013)

Dietary neuroleptics

- Dietary tryptophan has been shown to increase brain serotonin, decrease aggression and improve meat quality
- Bromide has been used as a sedative and anti-epileptic in humans and was common in the mid 20th century (Bromo-Seltzer was a common over-the-counter remedy in the 1930s and 1940s).
- Bromide tea was widespread in WW1 and WW2 as it was believed to reduce the sexual desire of servicemen.
- Dietary neuroleptics may provide a dietary means of reducing sexual and aggressive activities and increasing growth performance

Dietary neuroleptics can increase carcass weight and dressing rate in males

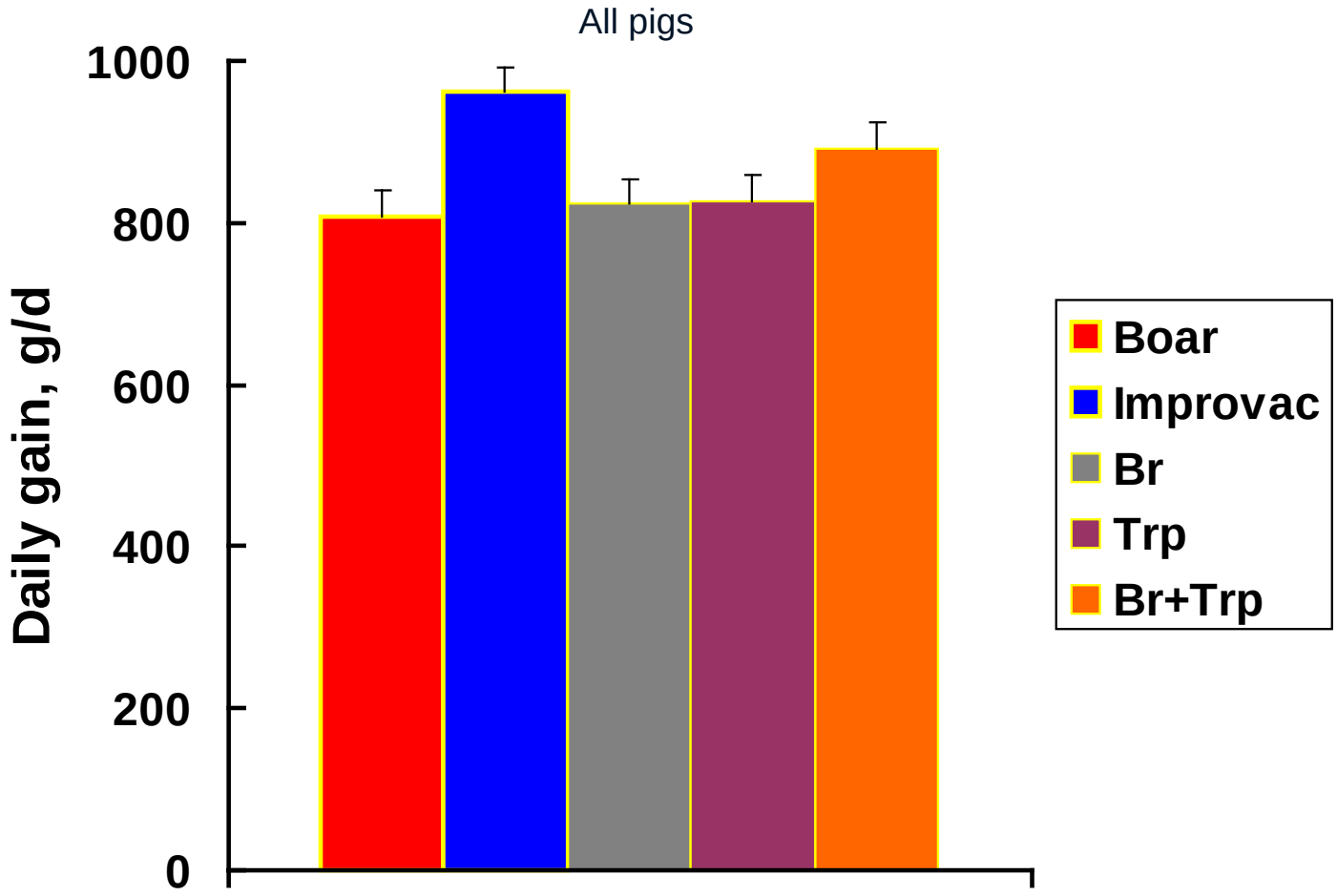
Table 1. Effect of sex and dietary additives over the finisher phase between 17 and 22 weeks of age on final weight and carcass characteristics at slaughter (after McCauley at al. 2003a and unpublished)[A]

	Boars				Anti-			
	Control	Mg	Br	Trp	GnRF	Barrow	LSD[B]	P-value
Final weight (kg)	93.7[a]	95.2[a]	97.9[ab]	94.1[a]	99.8[b]	99.3[b]	4.66	0.04
Carcass weight (kg)	69.0[a]	71.3[ab]	74.1[b]	71.0[ab]	73.7[b]	76.8[b]	4.62	0.05
Dressing (g/kg)	751[a]	761[b]	761[b]	760[b]	755[a]	773[c]	8.7	0.009
P2 back fat (mm)	10.6[a]	11.0[a]	11.1[a]	10.3[a]	11.7[a]	15.6[b]	1.36	<0.001

[A] Anti-GnRF injections were given at 13 and 17 weeks of age.
[B] Least significant difference (P=0.05) between treatment groups.

Dietary neuroleptics and immunization against GnRF can increase daily gain in entire males

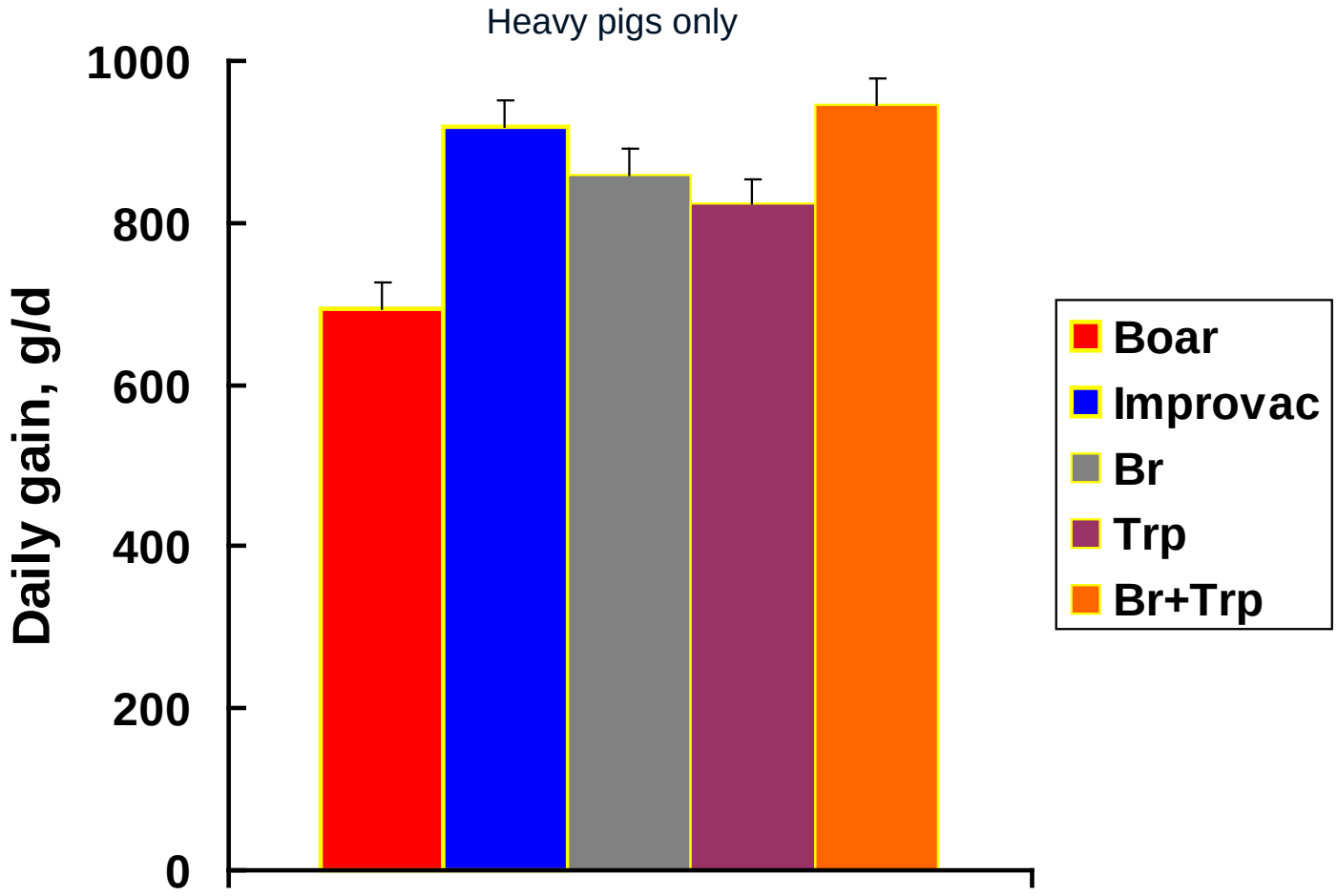
Growth performance: 17 - 22 weeks



Dunshea *et al.* (unpublished)

Dietary neuroleptics and immunization against GnRF can increase daily gain in heavy entire males

Growth performance: 17 - 22 weeks



Dunshea *et al.* (unpublished)

Conclusion

- Physical castration of male pigs results in reduced feed efficiency and lean deposition and excess deposition of fat
- Performance of group-housed entire males over the late finishing period is less than potential, possibly because of aggressive and sexual behaviours
- Modern improved entire male pigs are generally constrained by energy (and possibly other nutrient) intake under commercial conditions
- Management and nutritional strategies (eg. betaine, enzymes) that maximise energy intake or energy availability can overcome some constraints under commercial conditions
- Dietary neuroleptics and immunization against GnRF may provide means of reducing sexual and aggressive activities and increasing growth performance