

L-Arginine and L-Carnitine in gestating sow diets to optimise output and piglet growth.



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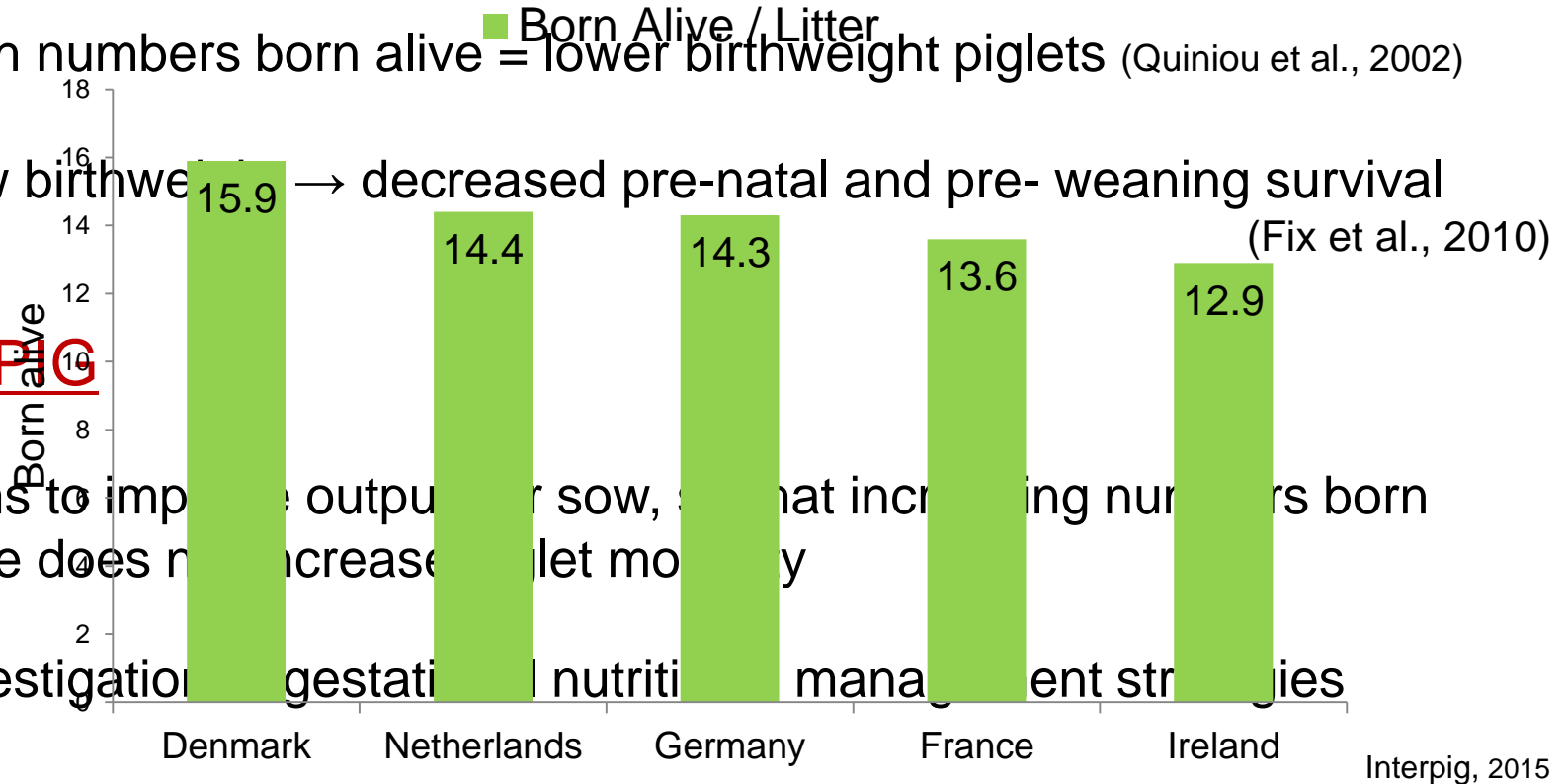
Background



- No piglets born alive relatively low in Ireland
- High numbers born alive = lower birthweight piglets (Quiniou et al., 2002)
- Low birthweight → decreased pre-natal and pre-weaning survival (Fix et al., 2010)

OPTIPIG

- Aims to improve output per sow, so that increasing numbers born alive does not increase piglet mortality
- Investigation of gestational nutrition management strategies



Effects of large litters

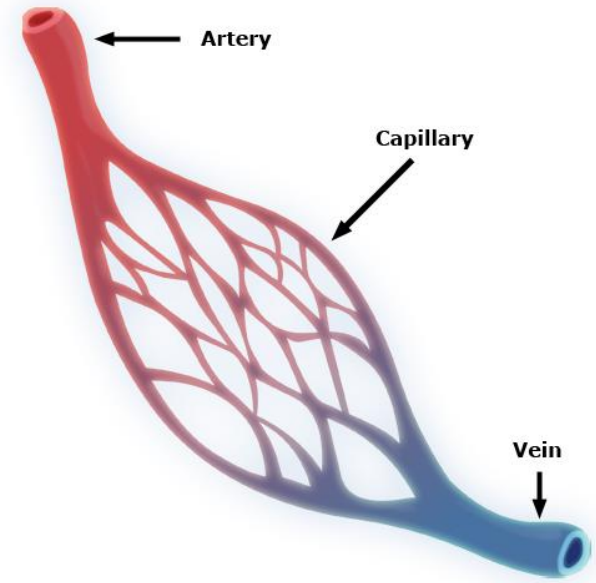
- Uterine crowding in early gestation
 - Competition for space, nutrients
 - Late implanting embryos affected
- Longer farrowing duration (Herpin et al., 1996)



Consequences...

- Low birth weights (*SGA and IUGR*)
- Birth weight variation
- Hypoxia and reduced vitality (Herpin et al., 1996)
- Pre weaning mortality
- Poor lifetime performance (Berard et al., 2010; Quiniou et al., 2002)

Arginine

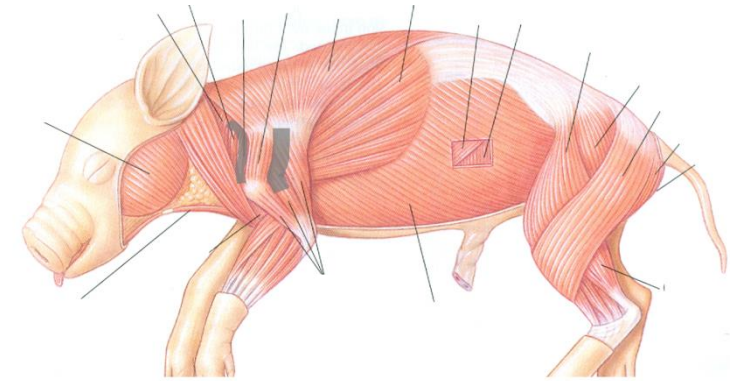


- Precursor for NO and polyamines
 - Placental angiogenesis
 - Embryogenesis
 - Blood flow between placenta and uterus
 - Placental and foetal growth (Wu et al., 2006)

- ↑ oxygen and nutrient flow to the foetus

- Effects in lowly-prolific sows
 - Wu et al. (2012), 10.65 - 11.12 total born: + birth weight (*d90 – farrow*)
 - Che et al. (2013), 11.24 - 12.33 total born: + born alive (*d30 – d114*)
 - Gao et. al (2012), 12.46 – 13.77 total born: + birth weight, born alive, - weight variation (*d22 – d114*)

Carnitine



- Composed of lysine and methionine
 - Hypothesised to
 - ↑ IGF1 and IGF2 in the mother (Birkenfield et al., 2006; Musser et al., 1999, Doberenz et al., 2006)
 - Could enhance muscle fibre development (Musser et al., 1999, 2001)
 - Increased insulin + IGF1 at time of secondary muscle fibre development
 - Regulate transport of fatty acids across mitochondrial membrane
- (Birkenfield et al., 2006)
- Effects in lowly-prolific sows
 - Musser et al. (1999): 11.28 – 11.11 total born: + birth weight, litter weight, sow back-fat (*d5 – 112*)
 - Eder et al. (2001): 12.0 - 12.4 total born: + birth weight, - non-viable piglets (*mating – farrow, gilts + sows*)
 - Birkenfield et al (2006): 10.6 – 11.4 total born: + birth weight (*b4 insemination – farrow, gilts*)

Hypothesis

Supplementation of highly prolific gestating sows with arginine and carnitine would

- *Increase numbers of piglets born alive*
- *Increase piglet birth weight*
- *Increase weaning weight*

and the effects would be additive

Experimental design

- 1,000 sow commercial integrated unit
- 2 × 2 factorial design
- 429 sows
- Blocking: breed, parity, backfat, born alive

		Carnitine (0.125g/day)	
		Yes	No
Arginine (25g /day)	Yes	106	110
	No	107	109

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Timeline

- Start: 9 Feb 2015
- Reps created every 2 weeks
- 16 Reps: \approx 28 sows/rep (429 sows)
- Service: Backfat and blocking
- Treatments applied: d28– farrowing
- Last weaning Feb 16



Measurements

Sows

- Backfat (service, farrowing, weaning)
- Total born, born alive, and dead

Piglets

- Tagged and weighed at birth ($n = 216$ litters)
- Weighed at weaning
- Birth and weaning sow recorded



Statistics

- Experimental unit: Sow
- Random effect: block

Numbers born

- Fixed effects: Arginine|Carnitine, rep

Birth weight

- Fixed effects: Arginine|Carnitine|prolific, sex, alive, rep
- Fishers exact test

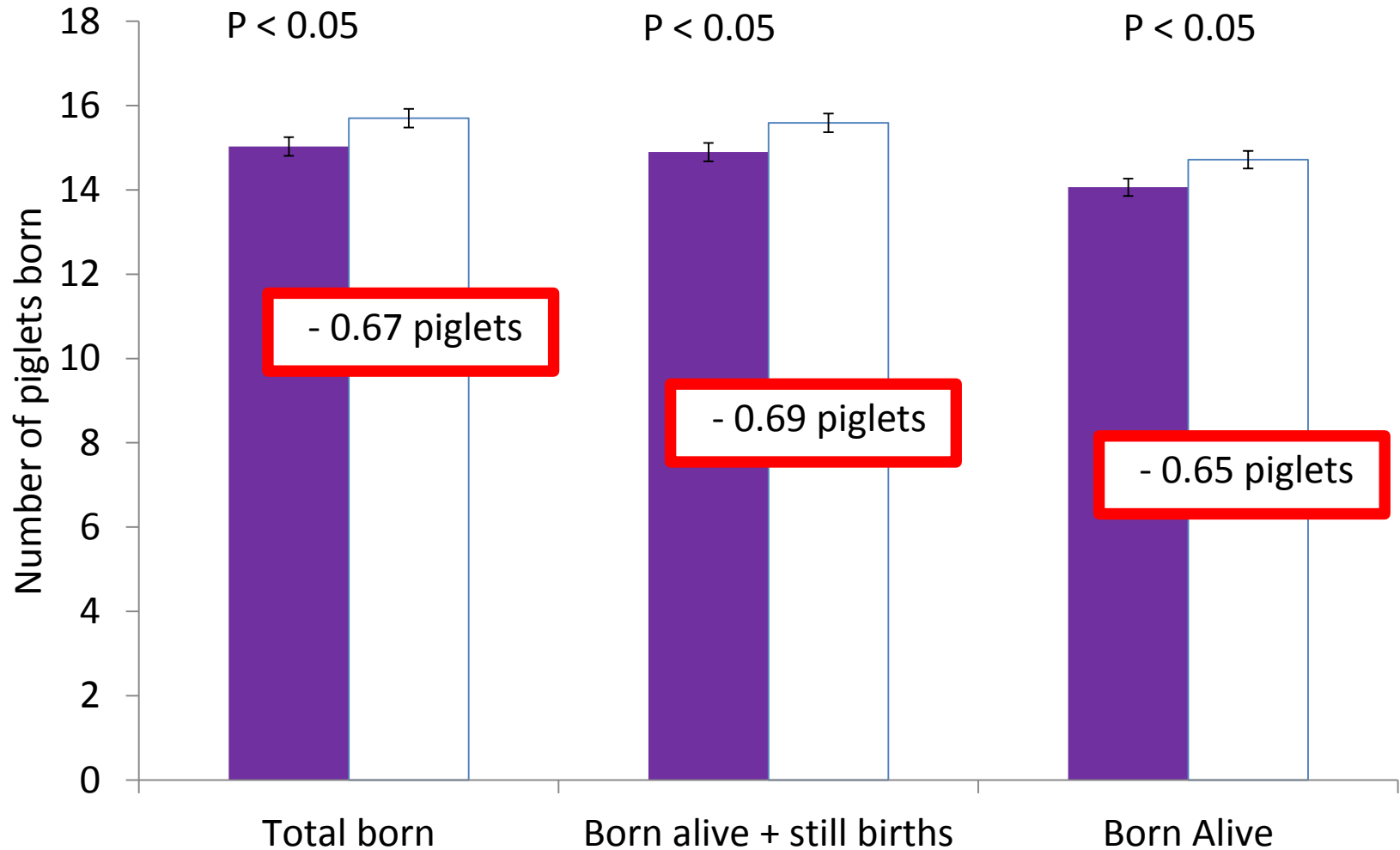
Weaning weight

- Fixed effects: Arginine|Carnitine|birthweight rank, sex, rep

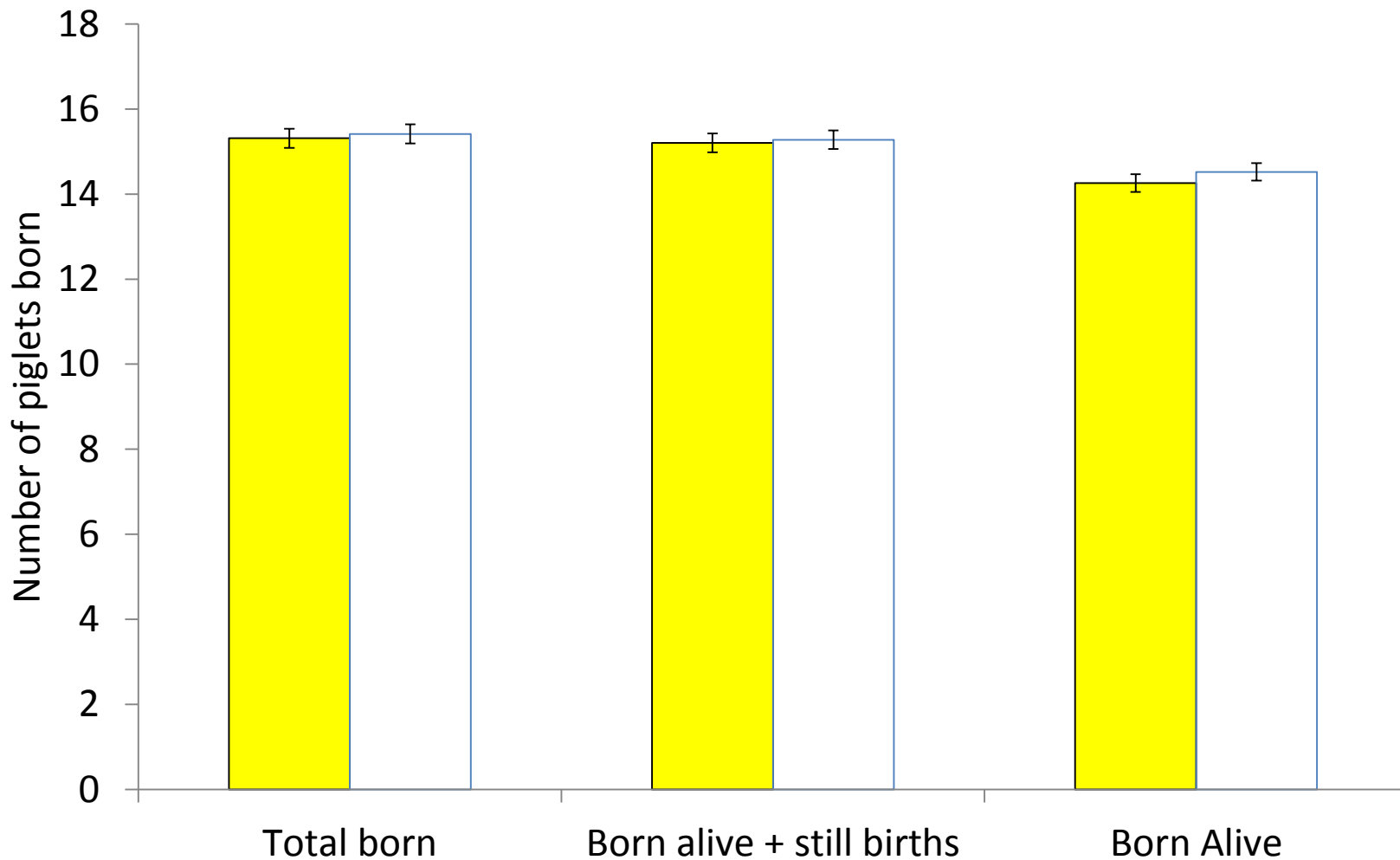
Results and Discussion



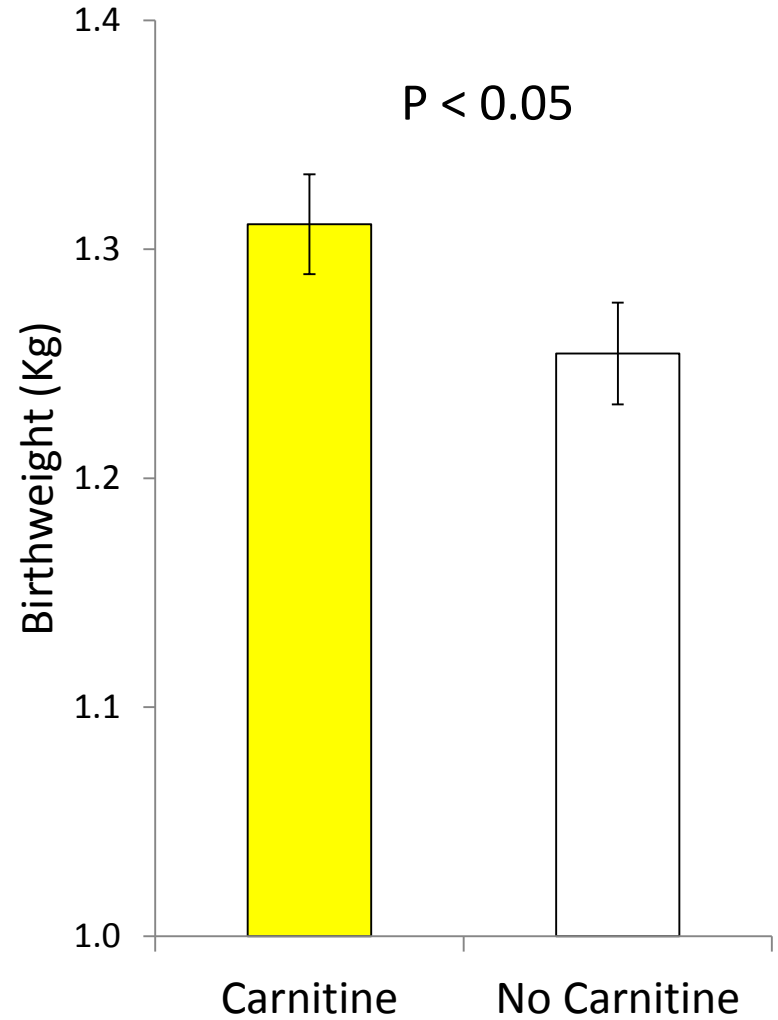
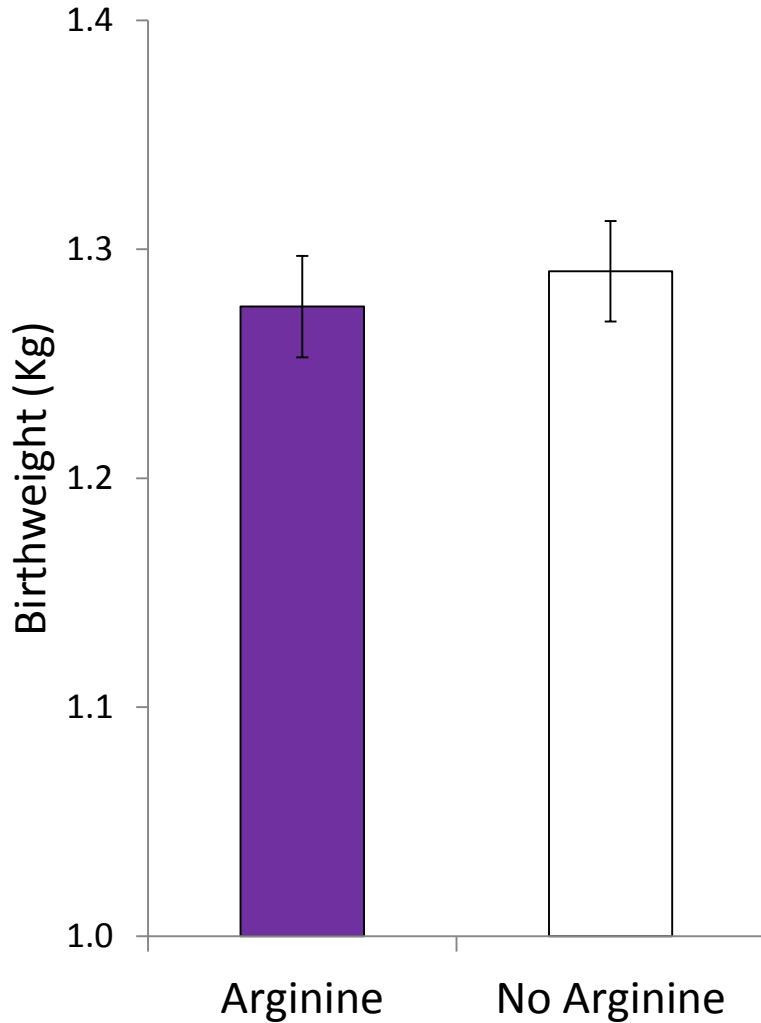
■ Arginine □ No arginine



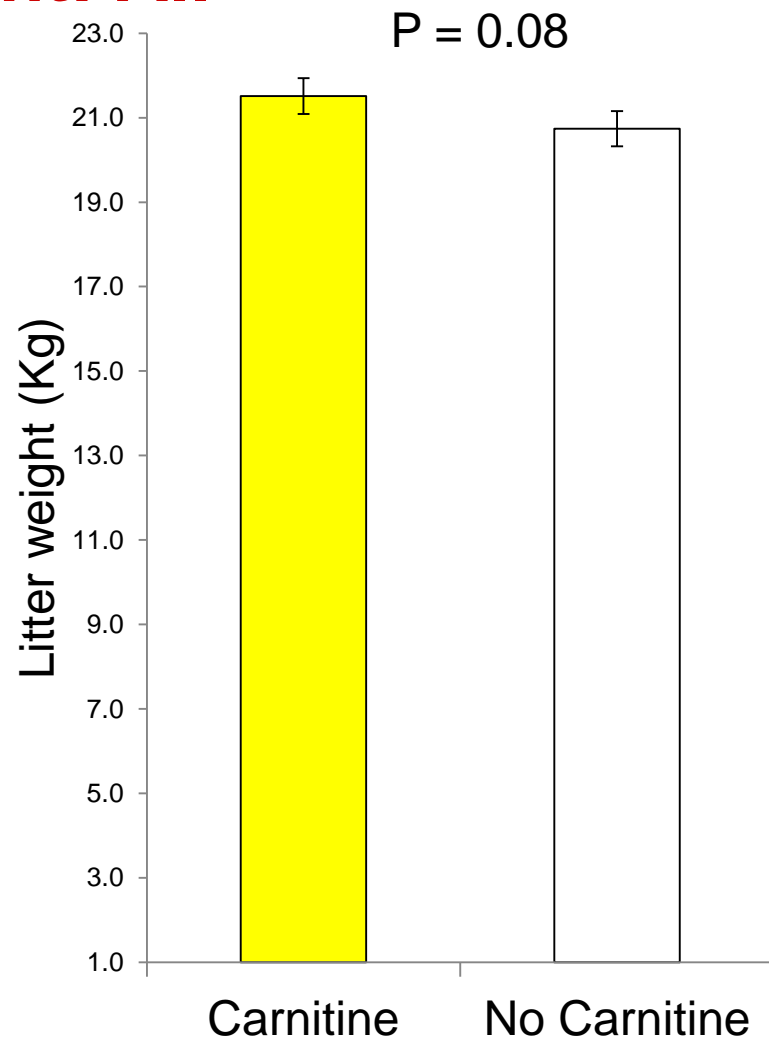
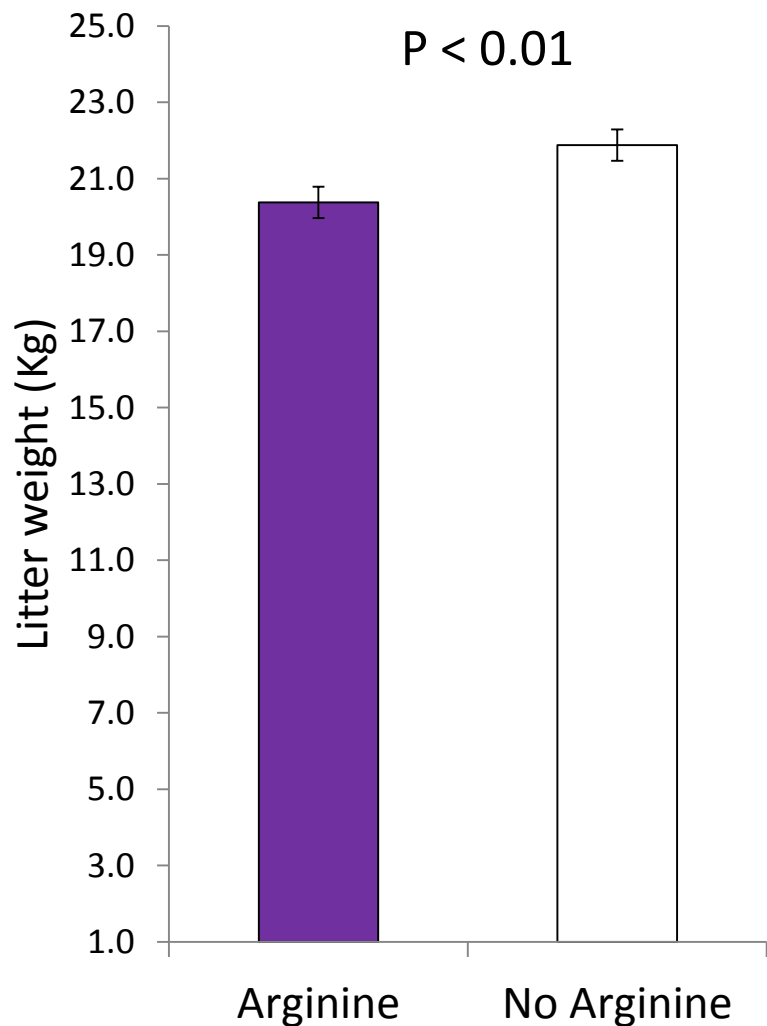
■ Carnitine □ No Carnitine



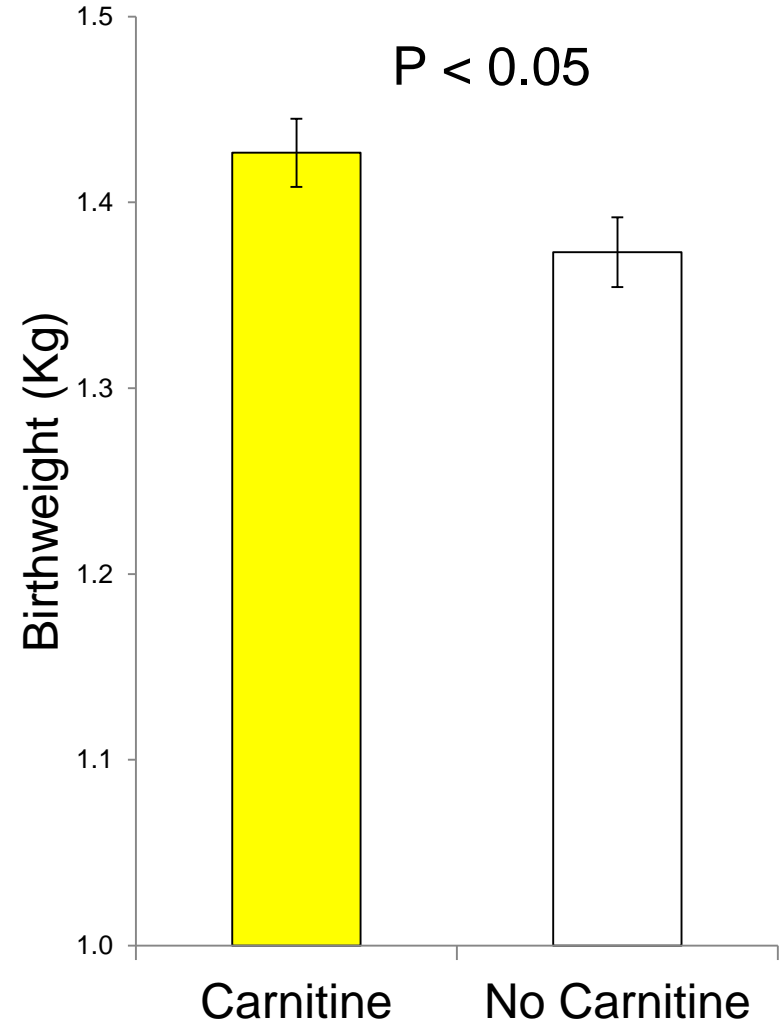
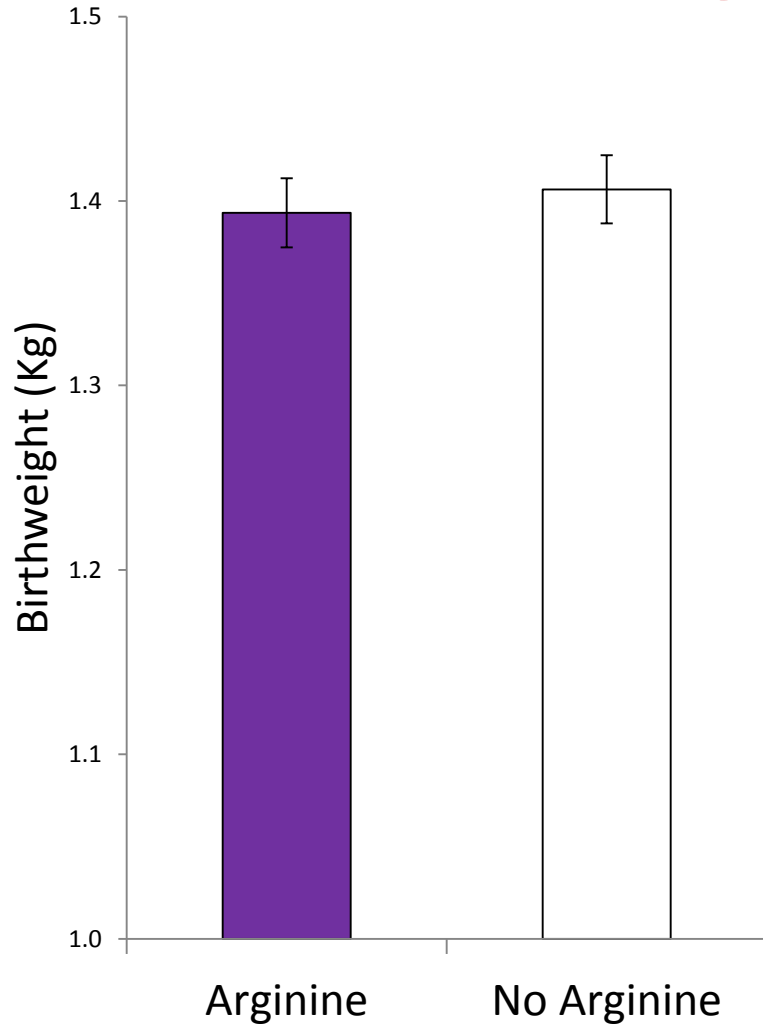
Birthweight: All



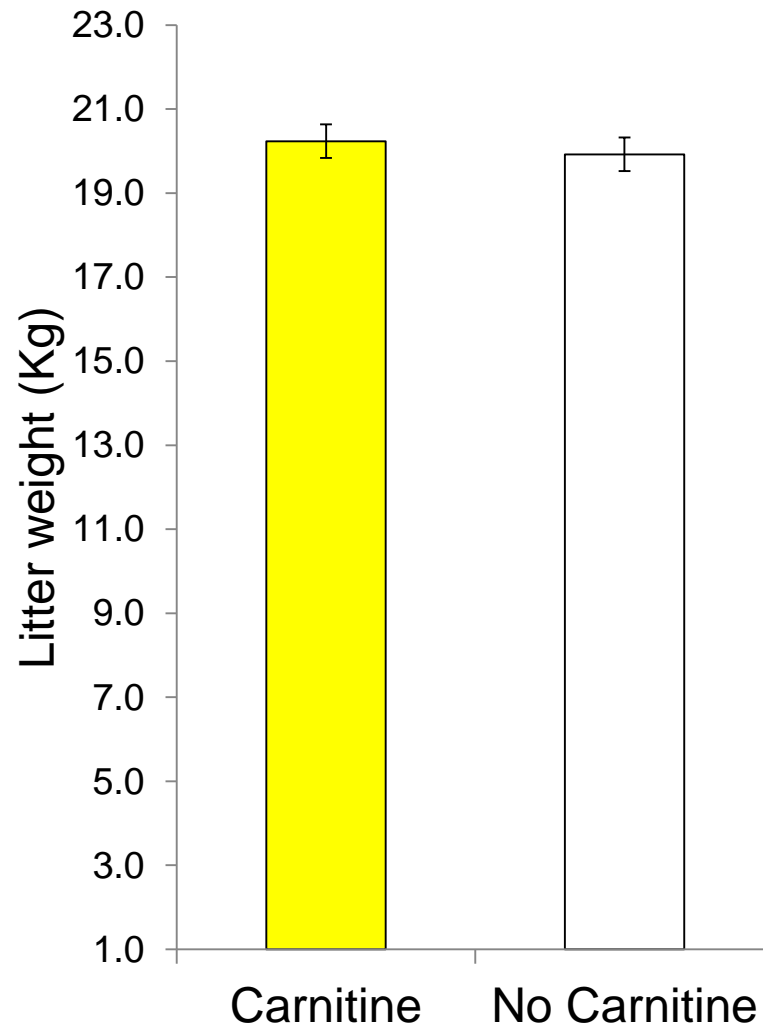
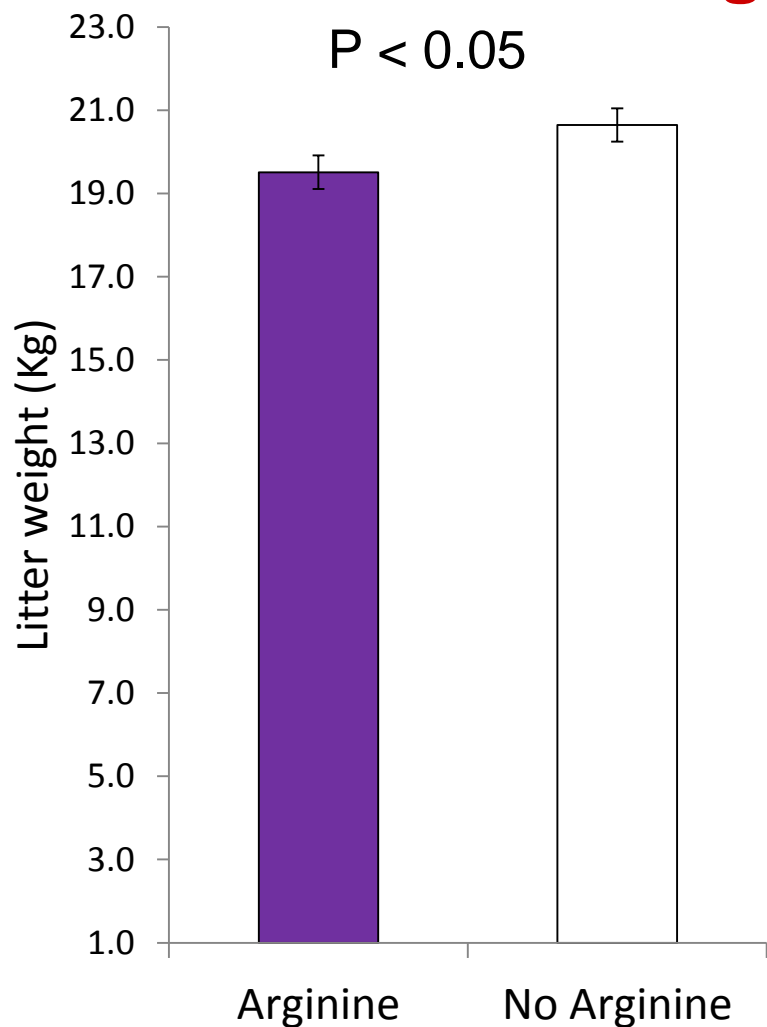
Litter weight: All



Birthweight: Live born

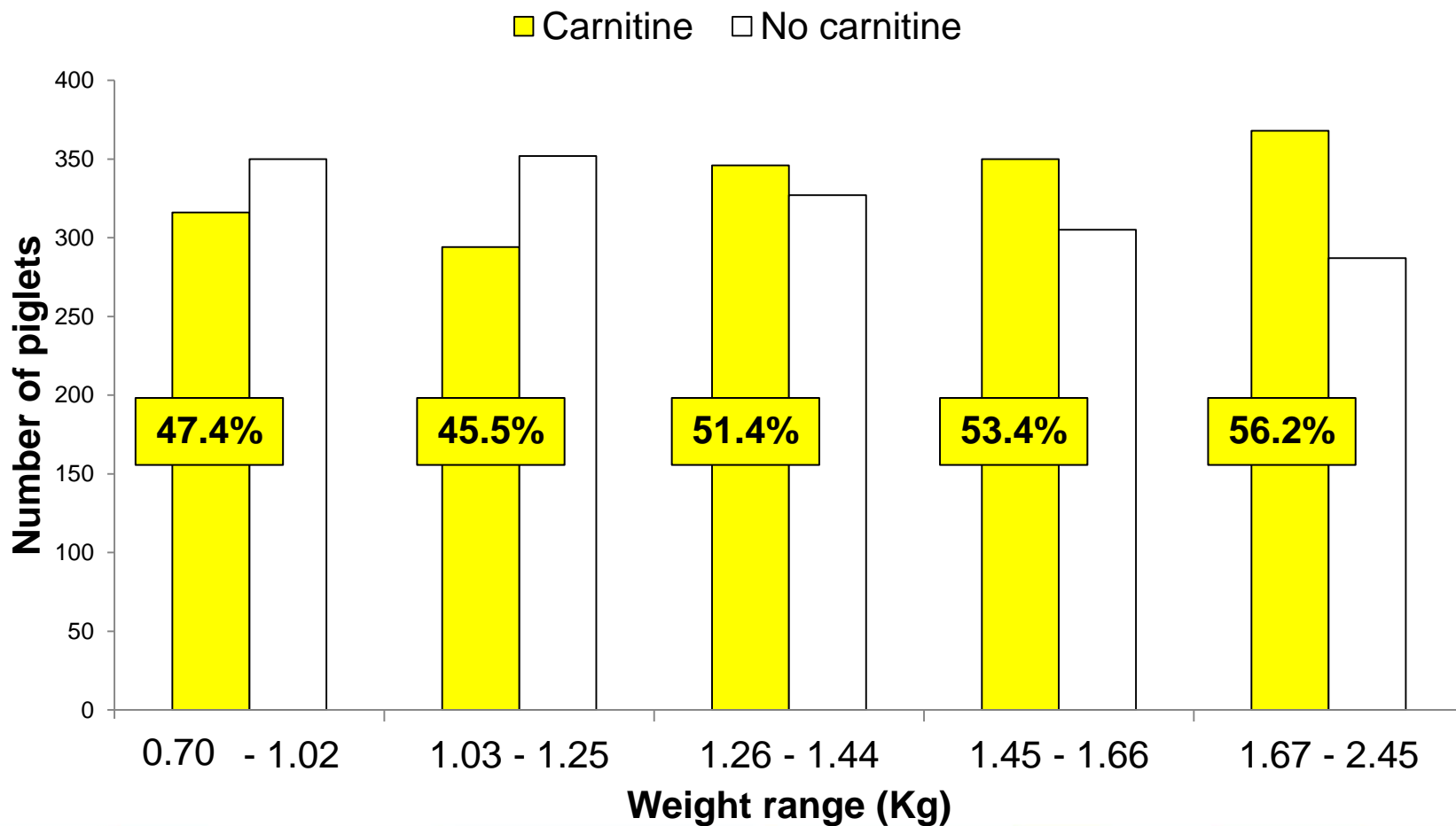


Litter weight: Live born

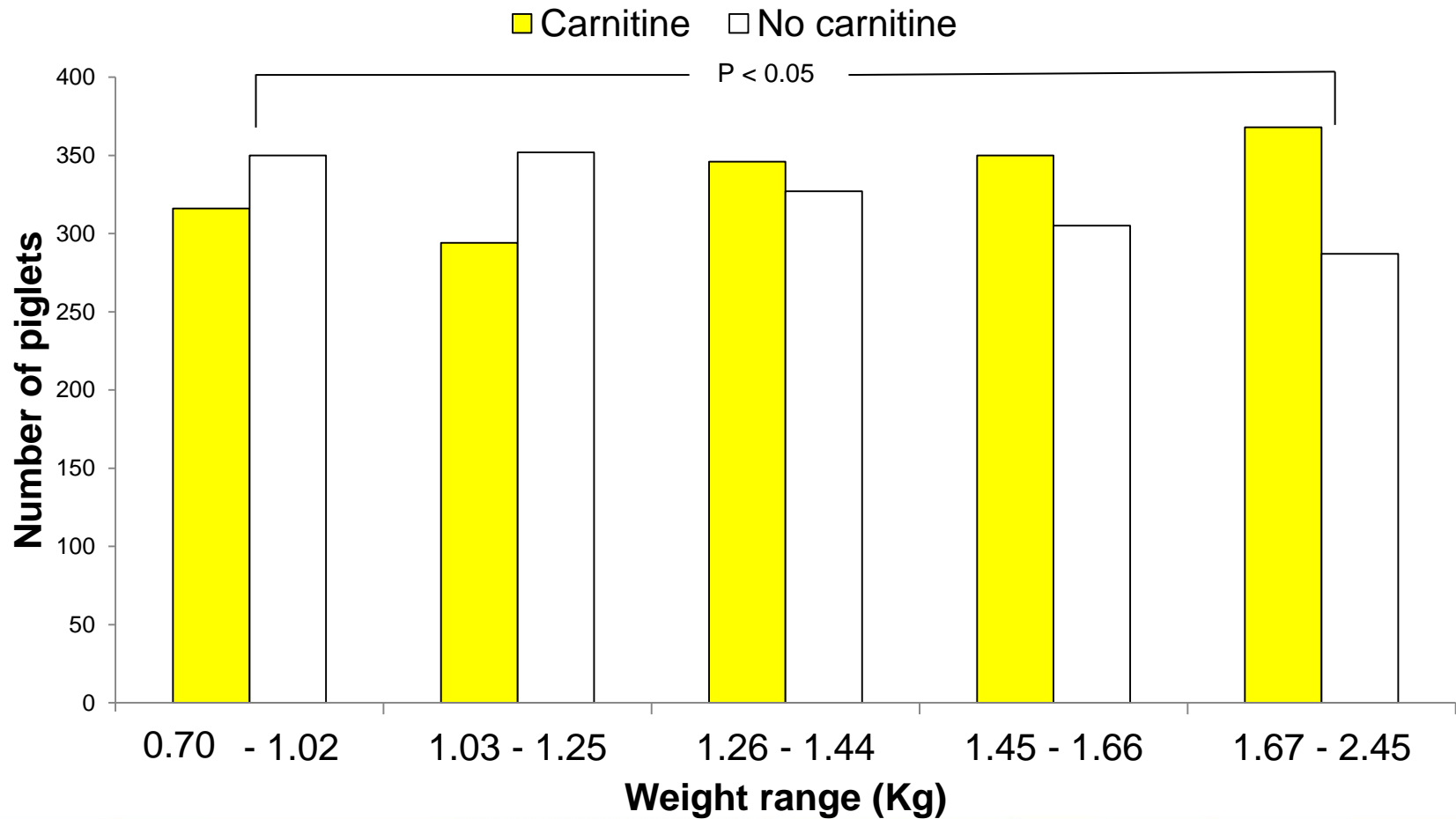


Birthweight: By rank

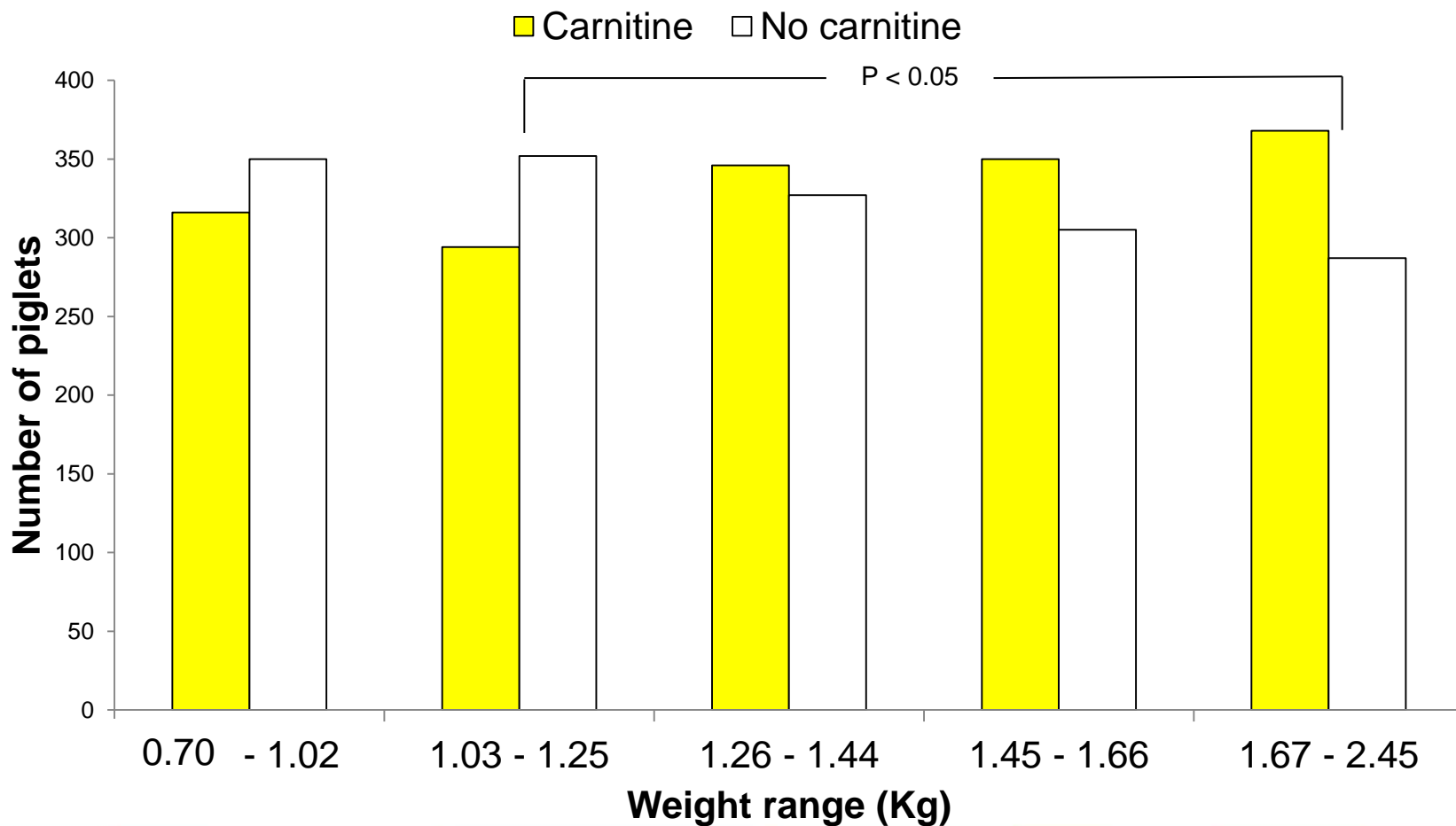
Effect of carnitine on proportion of piglets in each rank: $P < 0.001$



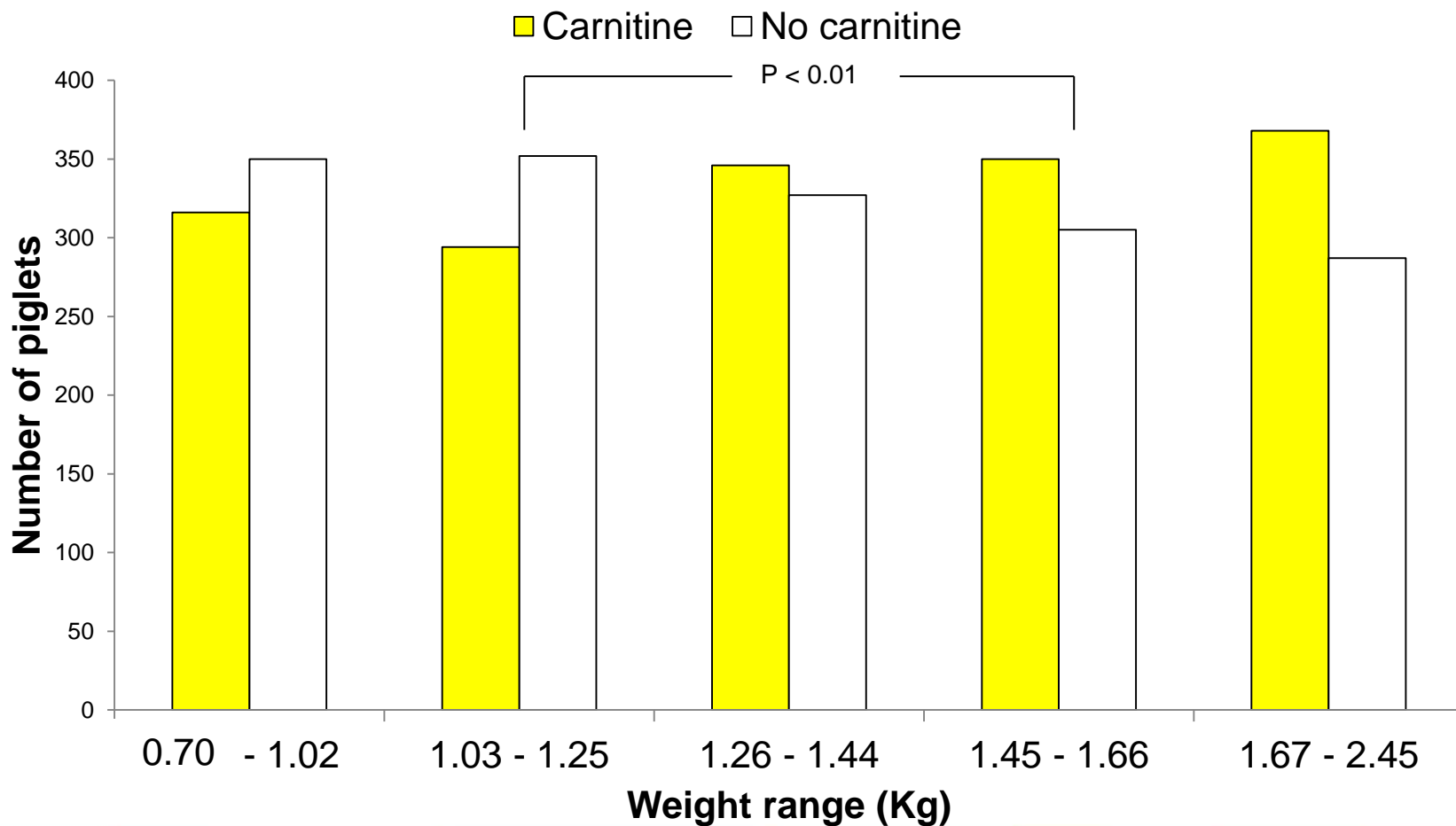
Birthweight: By rank



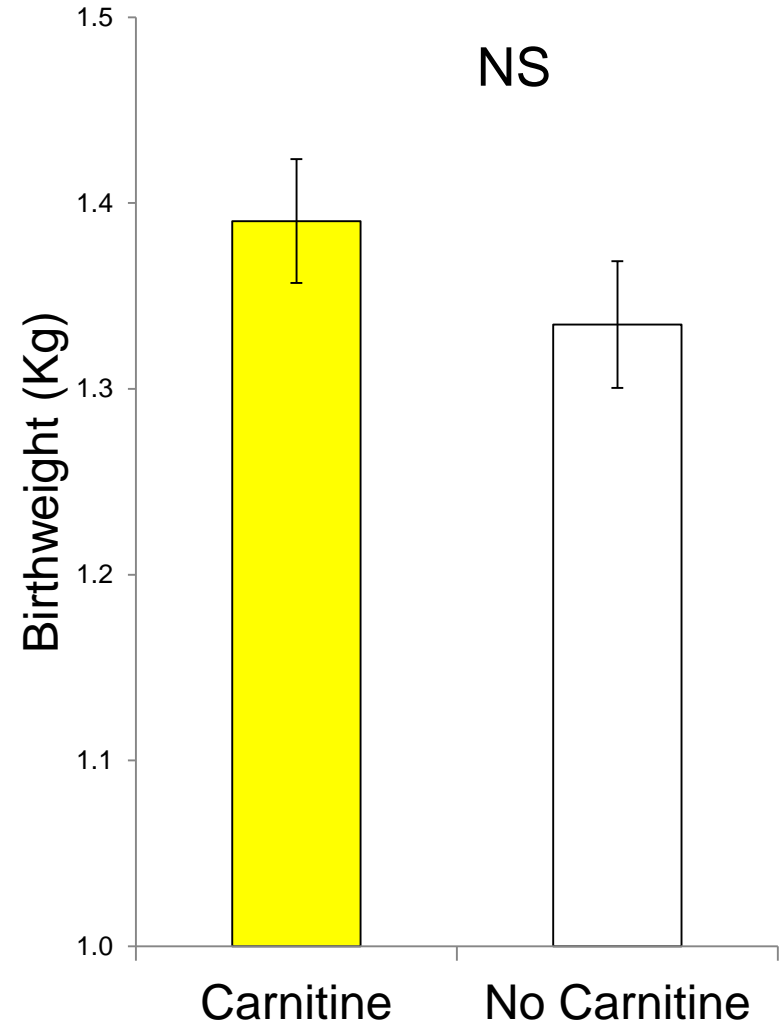
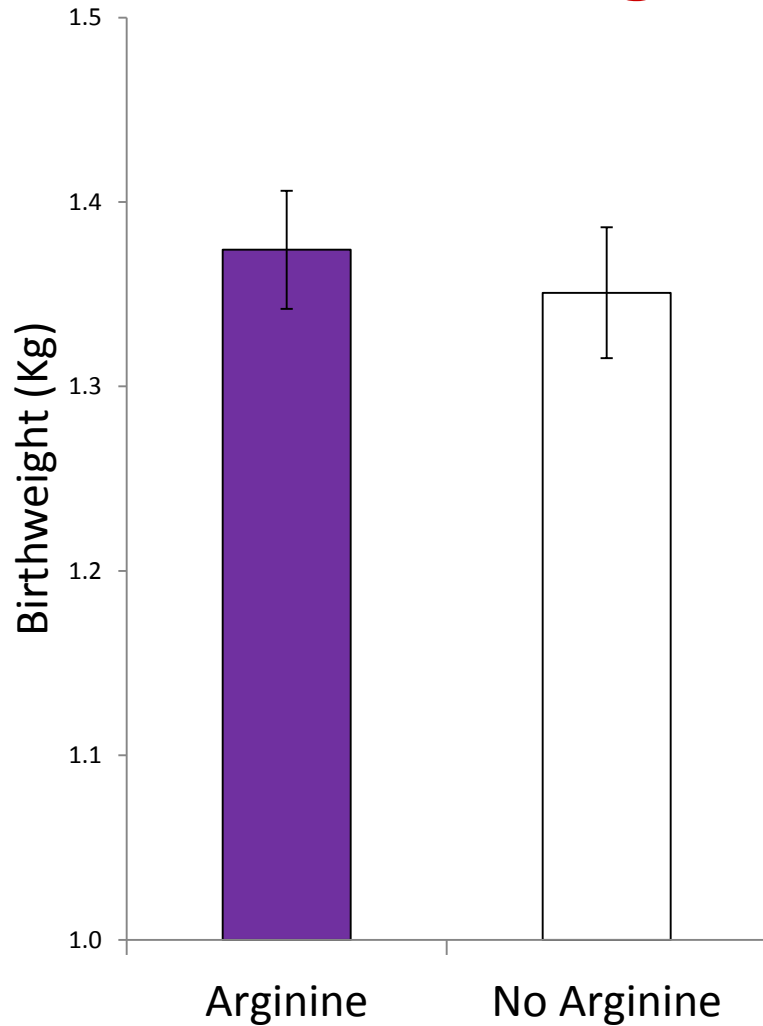
Birthweight: By rank



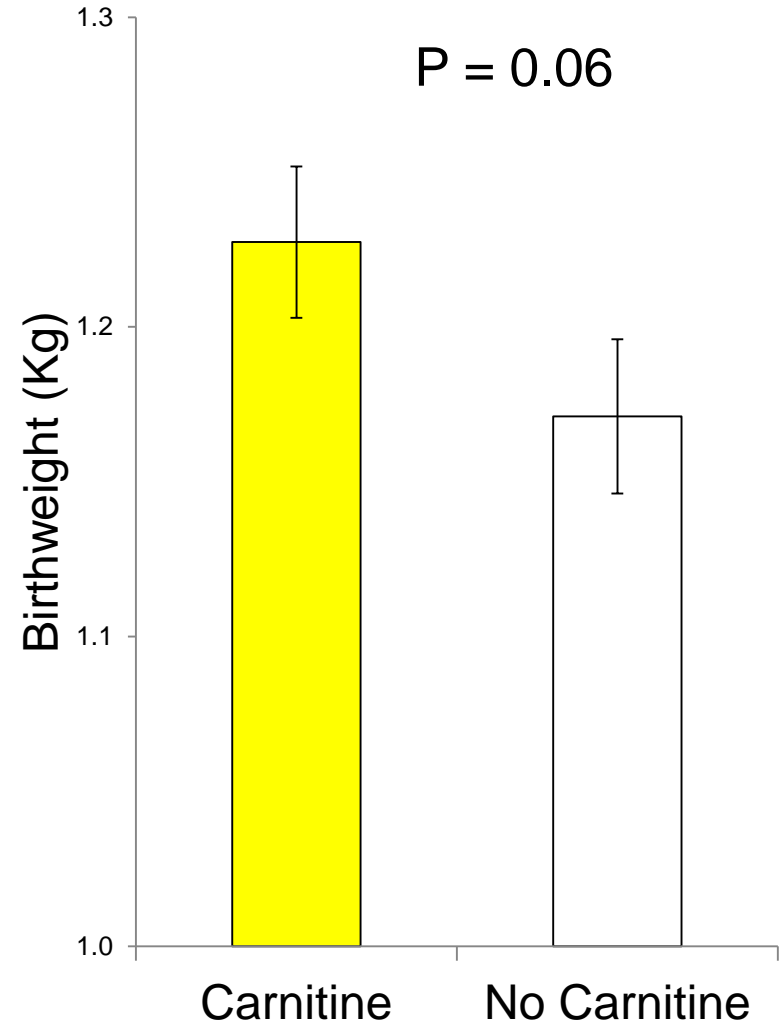
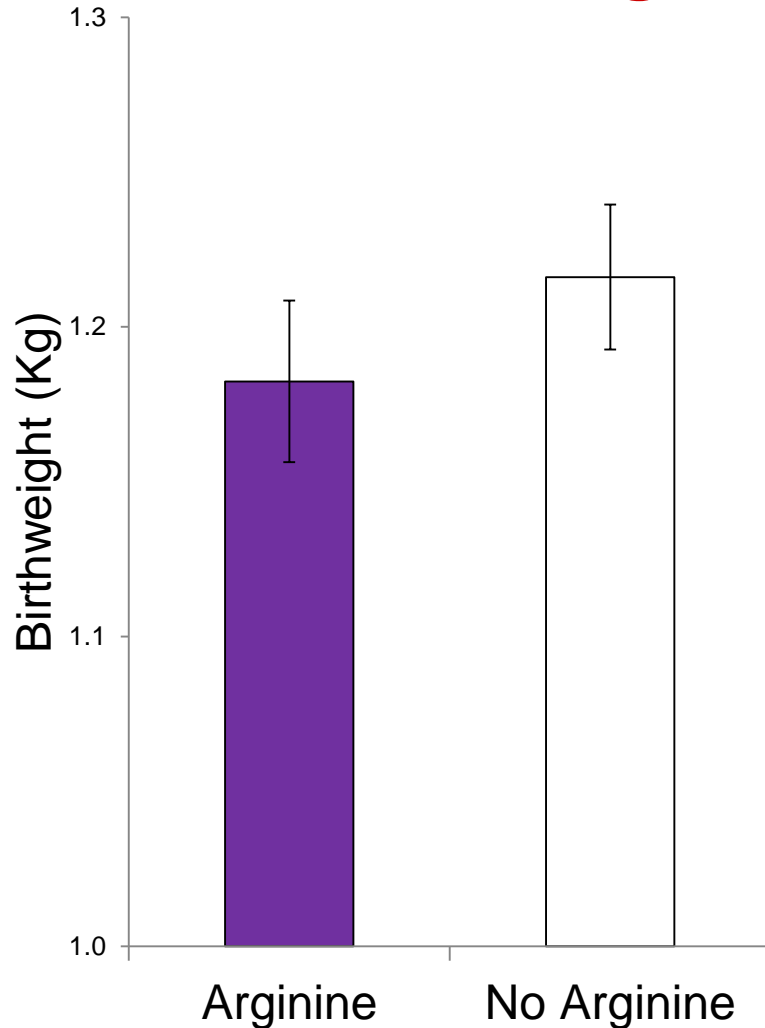
Birthweight: By rank



Birthweight: ≤ 14 total born

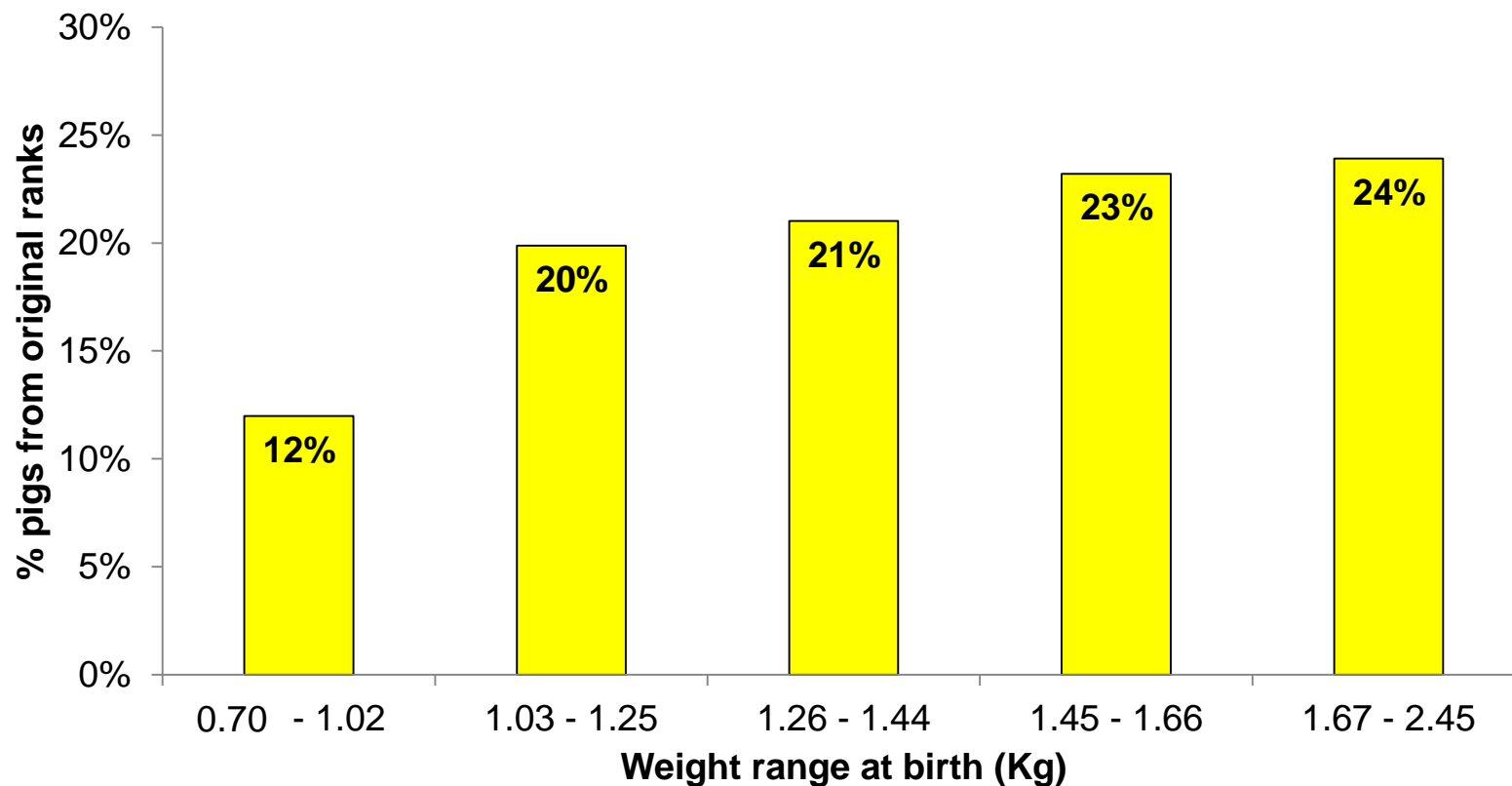


Birthweight: > 14 total born

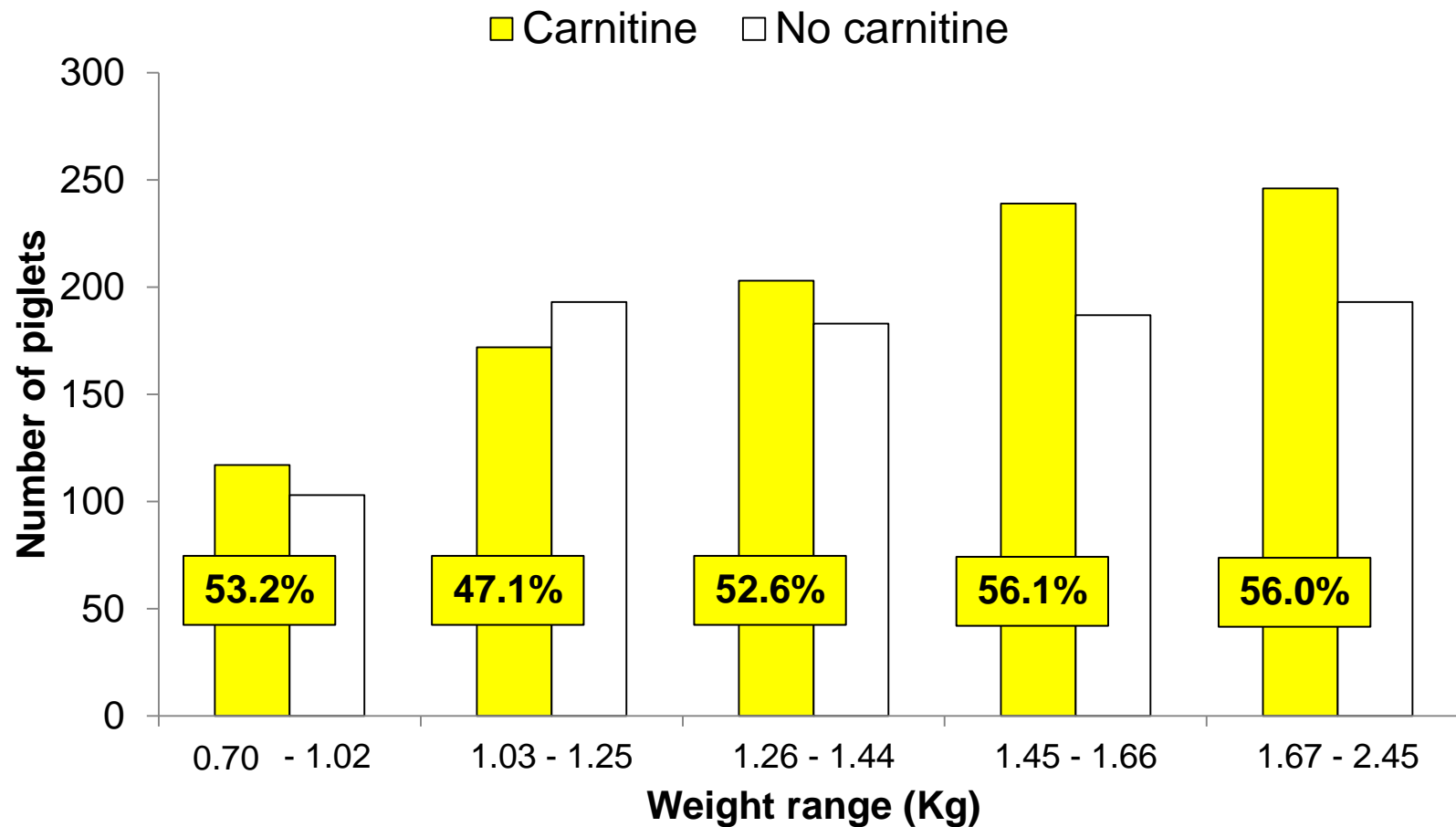


Weaning weights

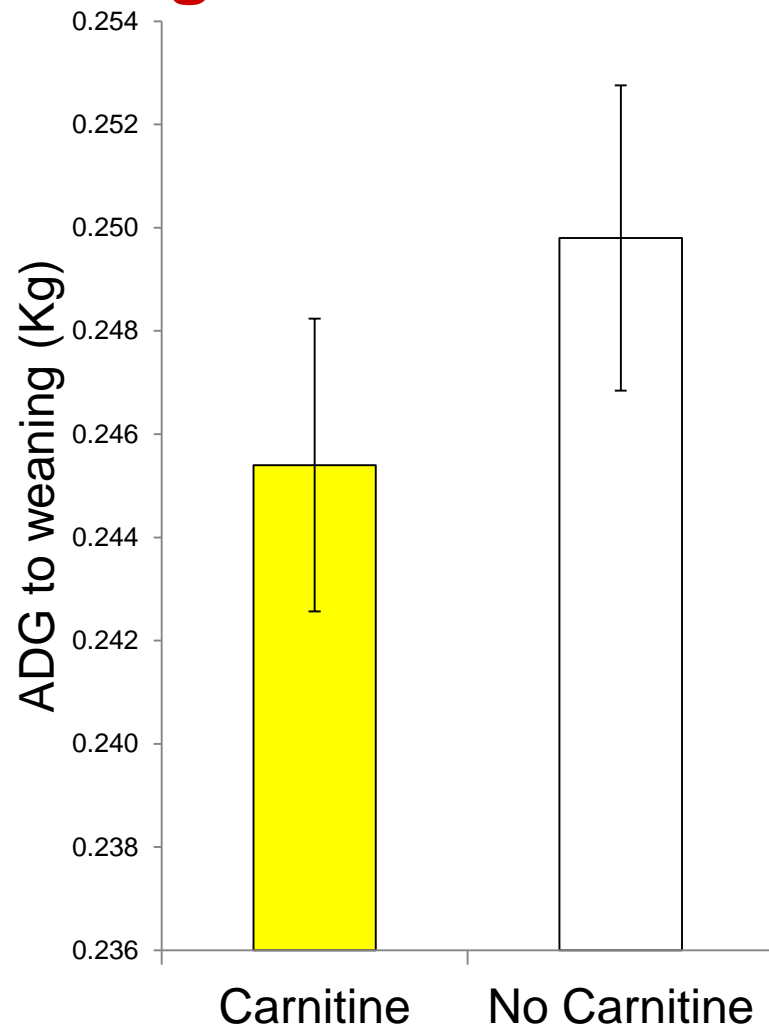
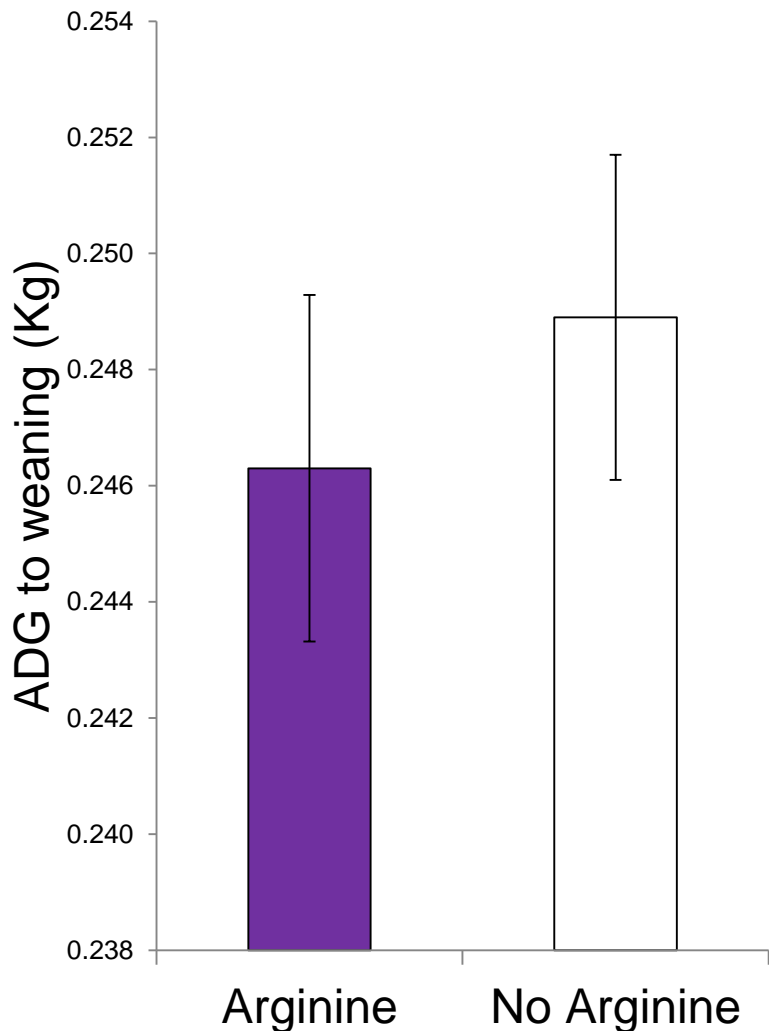
- 1836 piglets in dataset (v's 3295 total birthweights)



Weaning weight: By rank



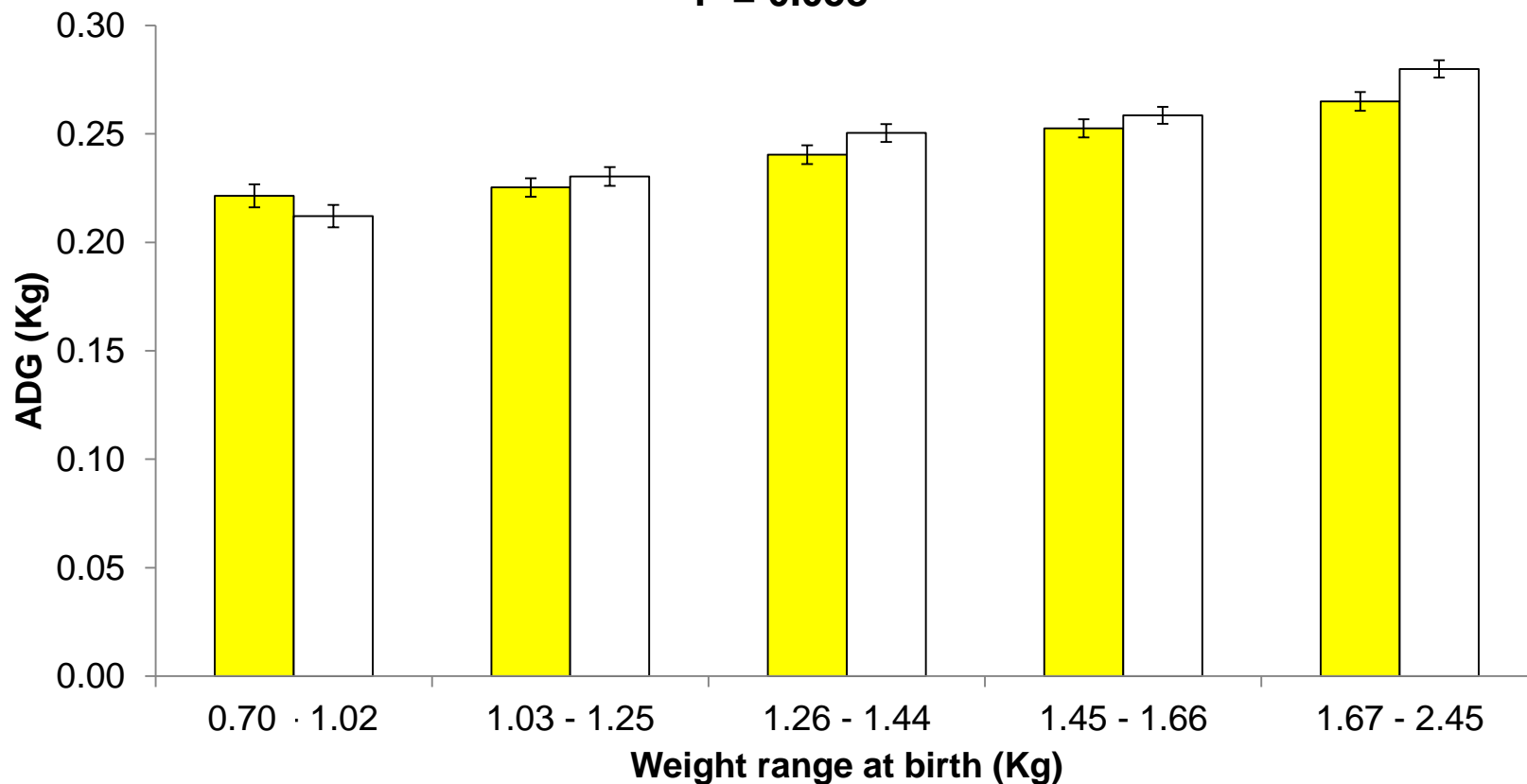
ADG to Weaning



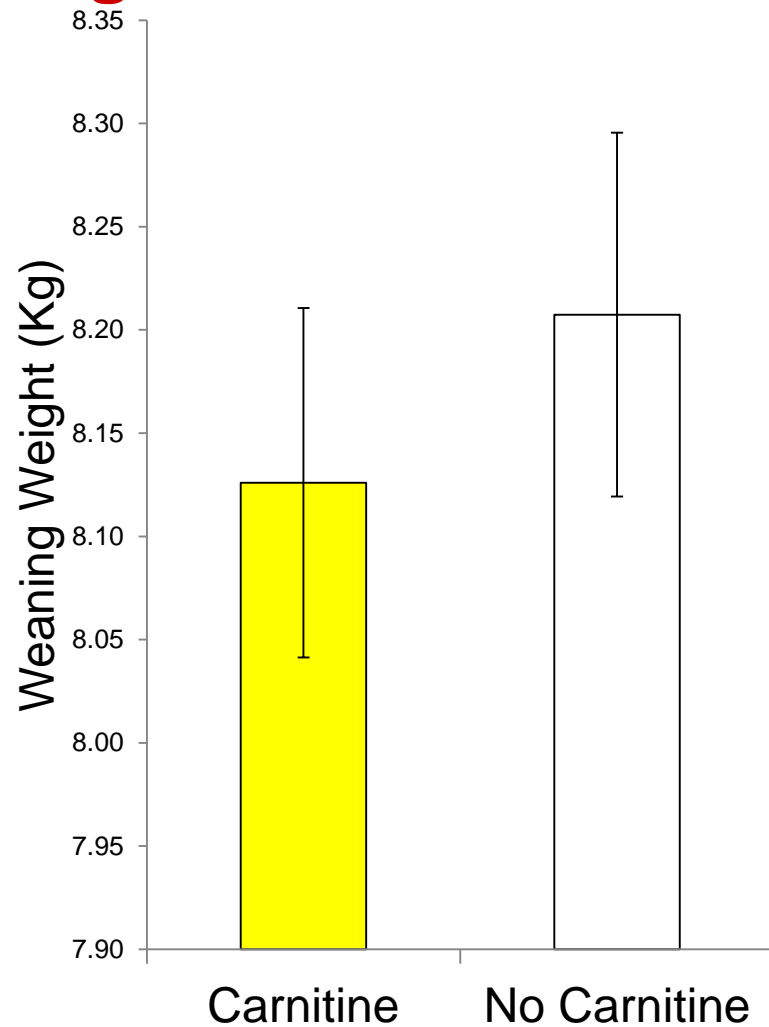
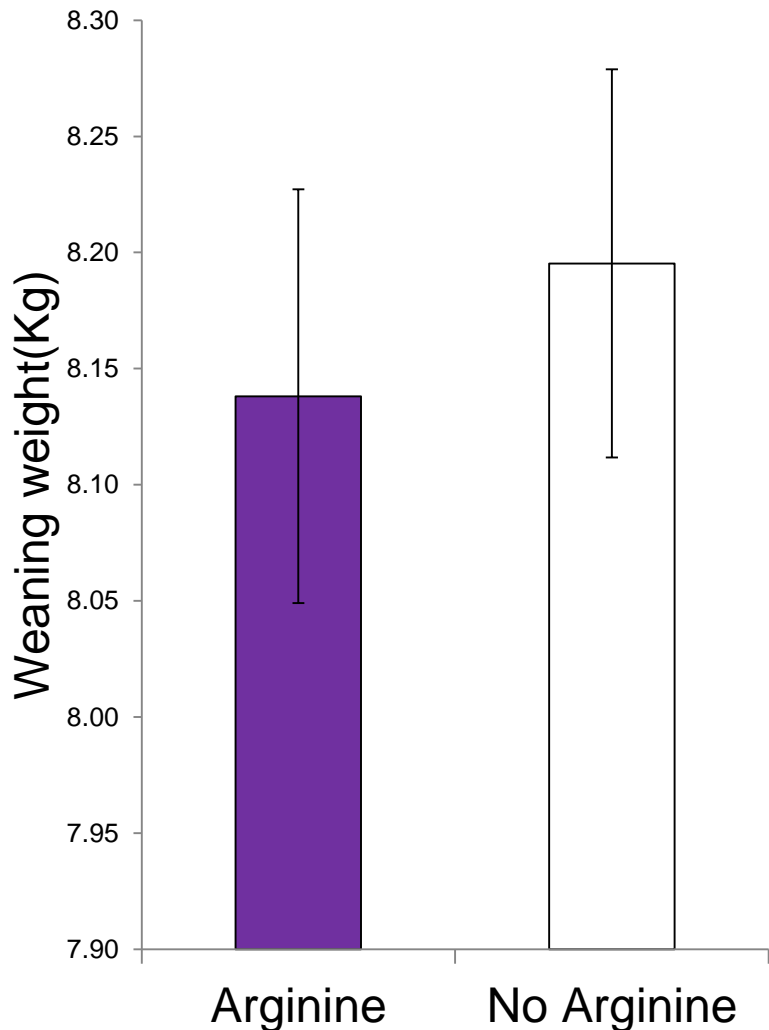
ADG to Weaning

■ Carnitine □ No Carnitine

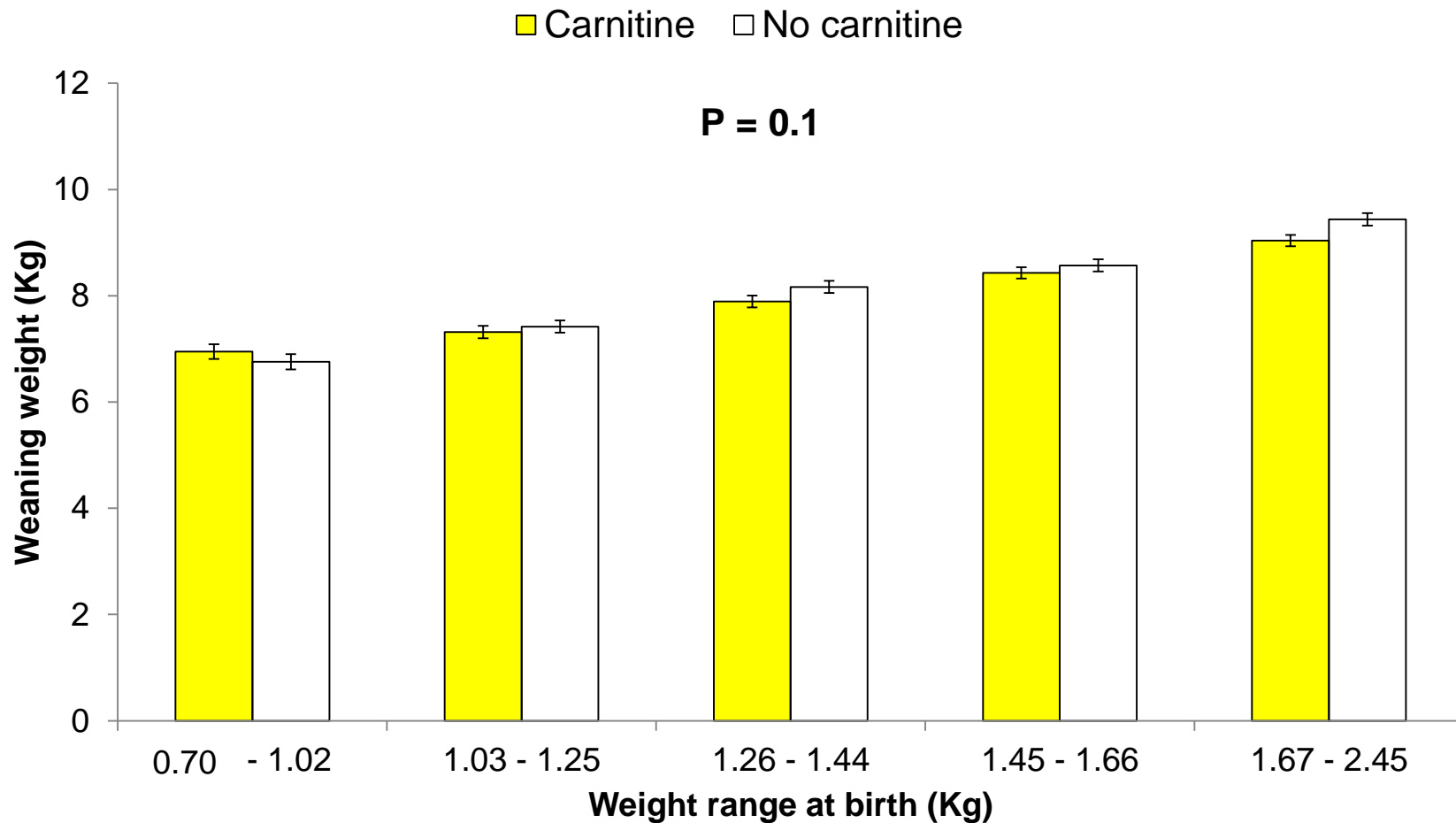
P = 0.058



Weaning weight



Weaning weight



Implications at birth

Arginine

- Did not appear to have any effect

Carnitine

- Overall birthweight ↑ by approx 57g
- ↑ carnitine piglets in higher ranks
- Tended to be significant for larger litters



Carnitine supplementation could be beneficial for highly prolific sows



Implications at weaning

Arginine

- Did not appear to have any effect

Carnitine

- No effect on weaning weight or ADG
- ↑ % of carnitine piglets at weaning than at birth, including lowest rank
- Interaction between carnitine and rank implies smaller piglets at birth benefit more than larger



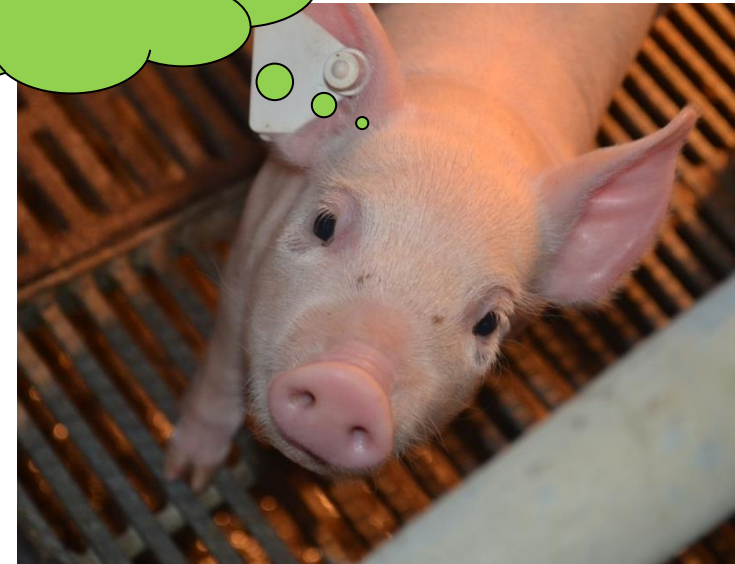
Take home message

Supplementation of highly prolific sows with carnitine during gestation increases piglet birth weight, and may improve survival and growth of small piglets to weaning



Questions ?

THANK YOU



Scharragh farm

Technicians: Emer McCrum and Oliver Clear

Research Assistants: Phoebe, Flavie, Julie and Katie