

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



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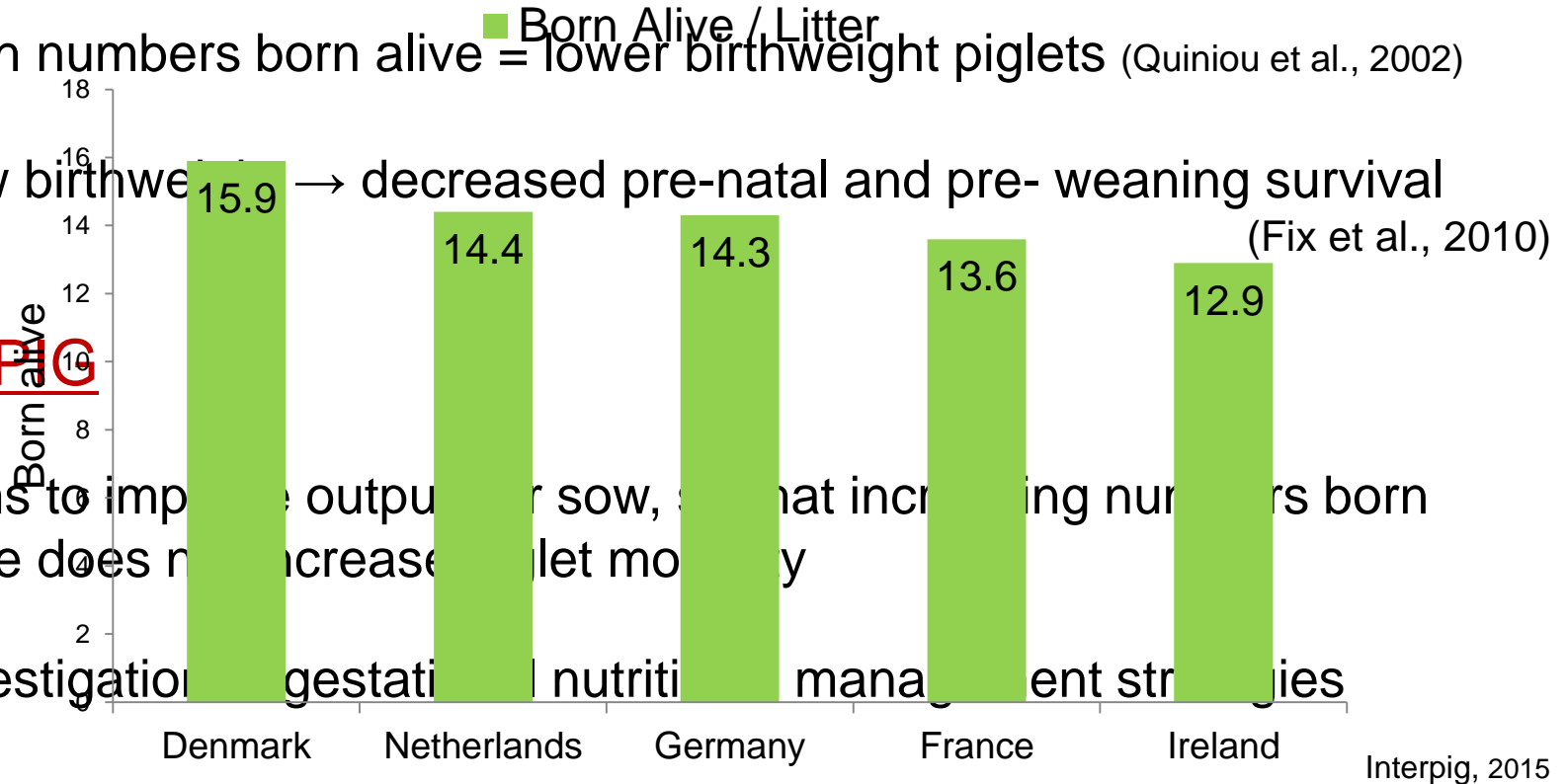
# Background



- 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

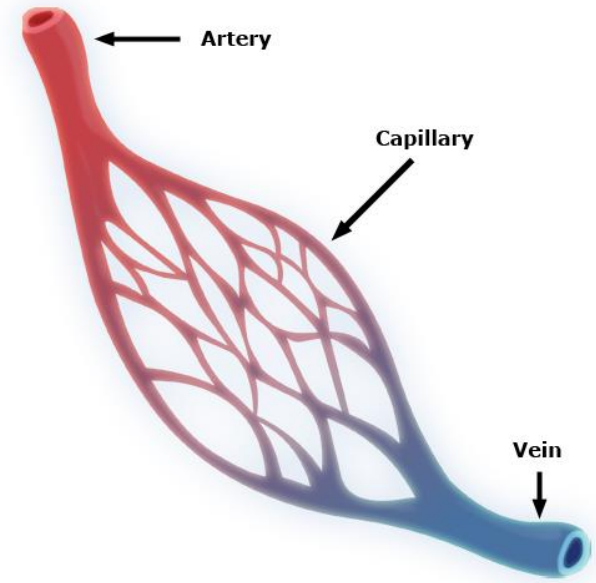
- Uterine crowding in early gestation
  - Competition for space, nutrients
  - Late implanting embryos affected
- Longer farrowing duration (Herpin et al., 1996)



## Consequences...

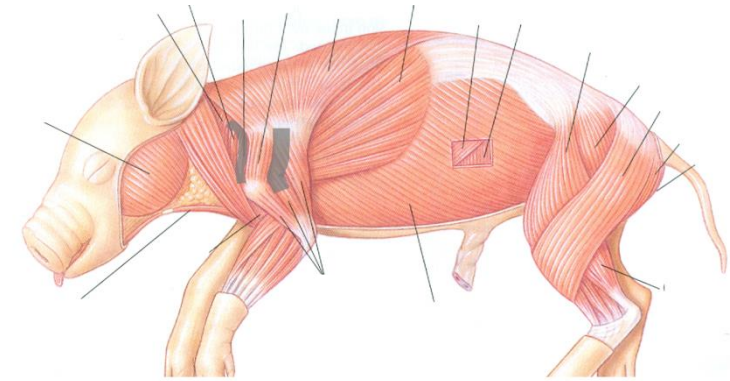
- Low birth weights (*SGA and IUGR*)
- Birth weight variation
- Hypoxia and reduced vitality (Herpin et al., 1996)
- Pre weaning mortality
- Poor lifetime performance (Berard et al., 2010; Quiniou et al., 2002)

# 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

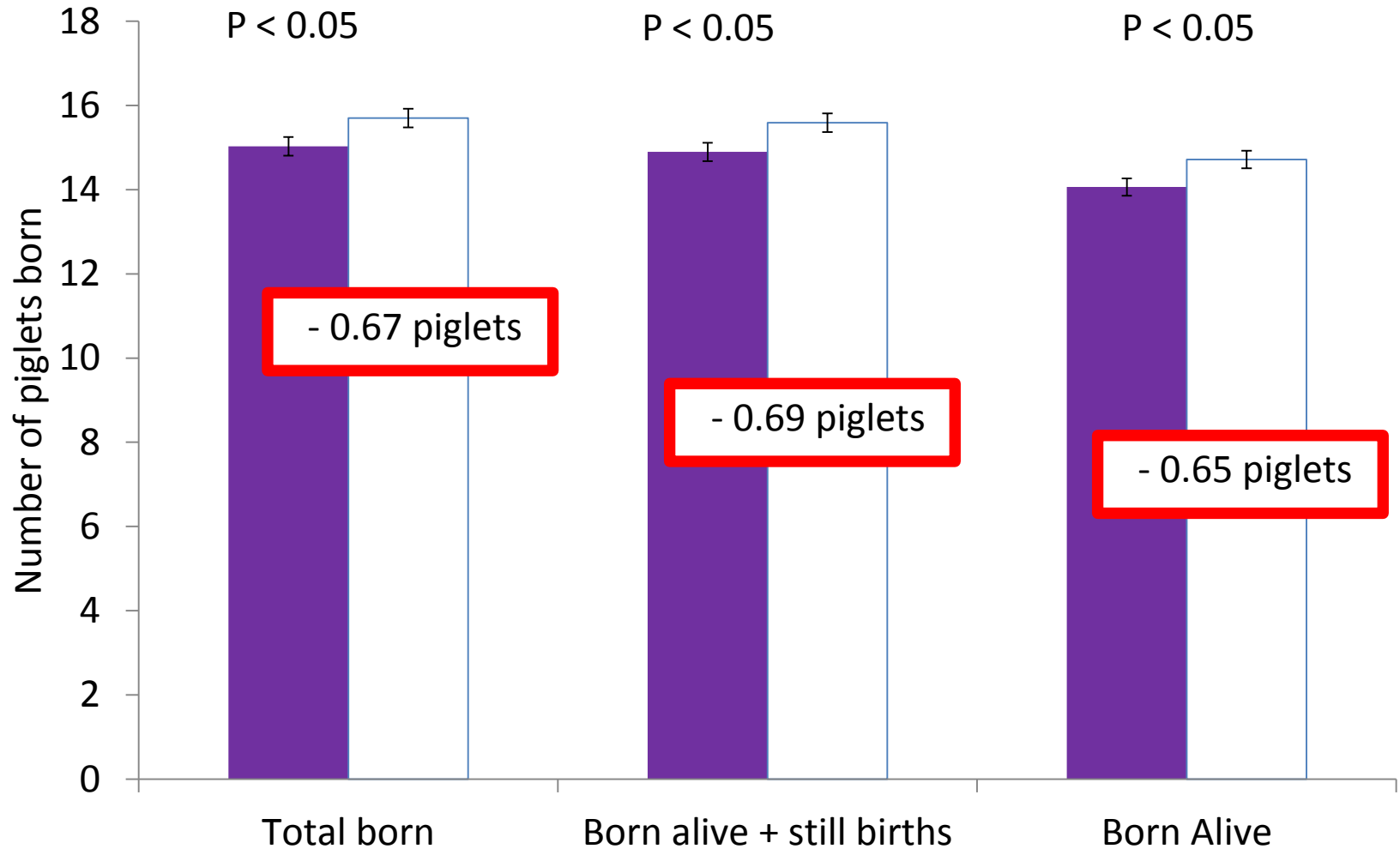
## Weaning weight

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

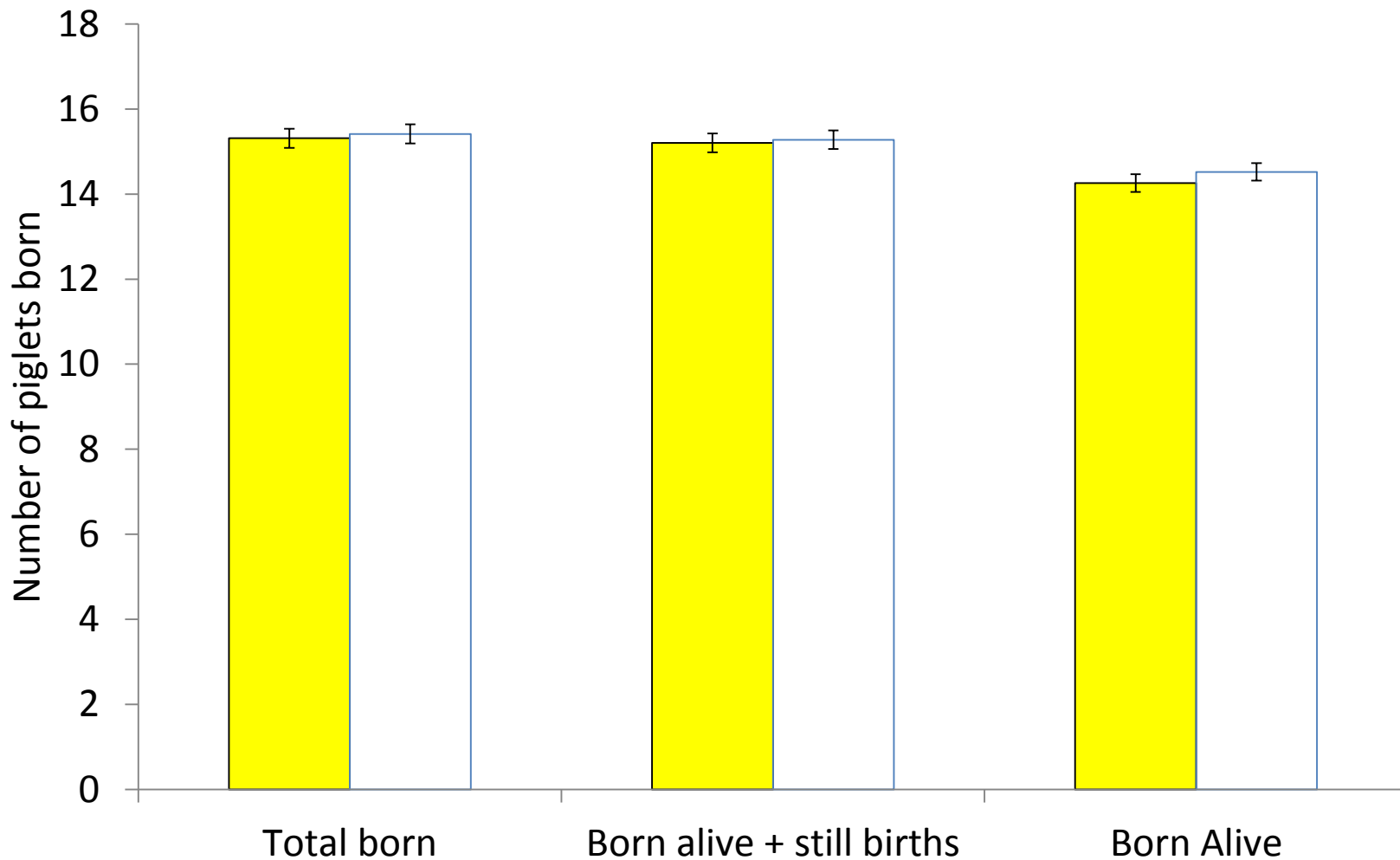
# Results and Discussion



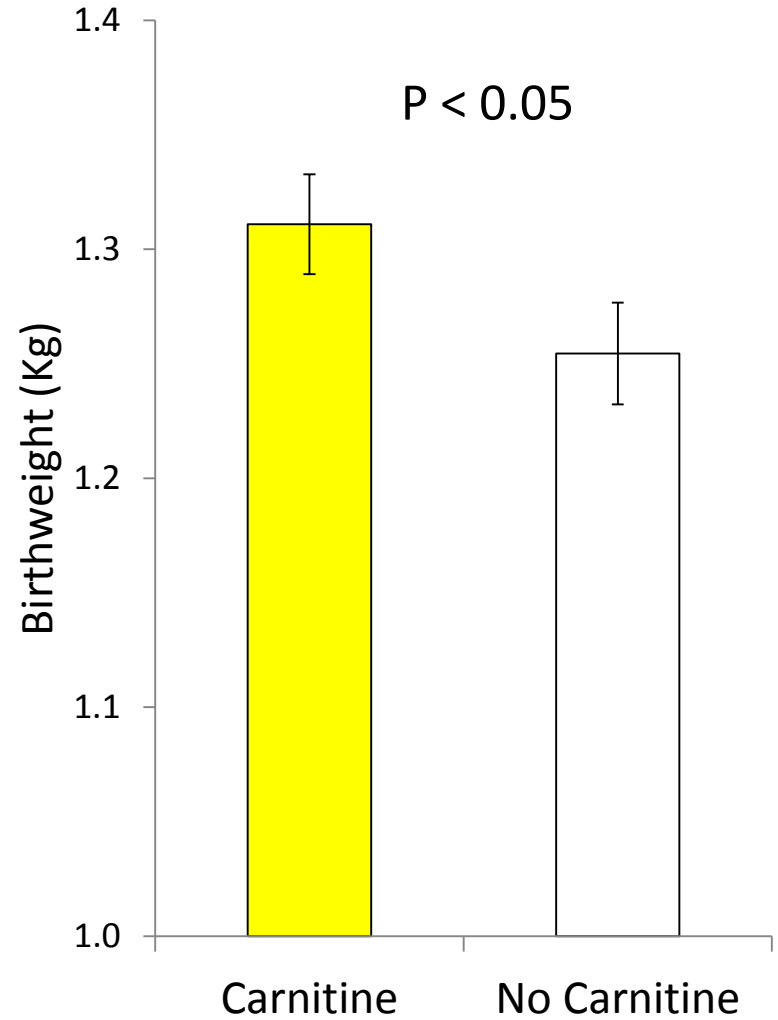
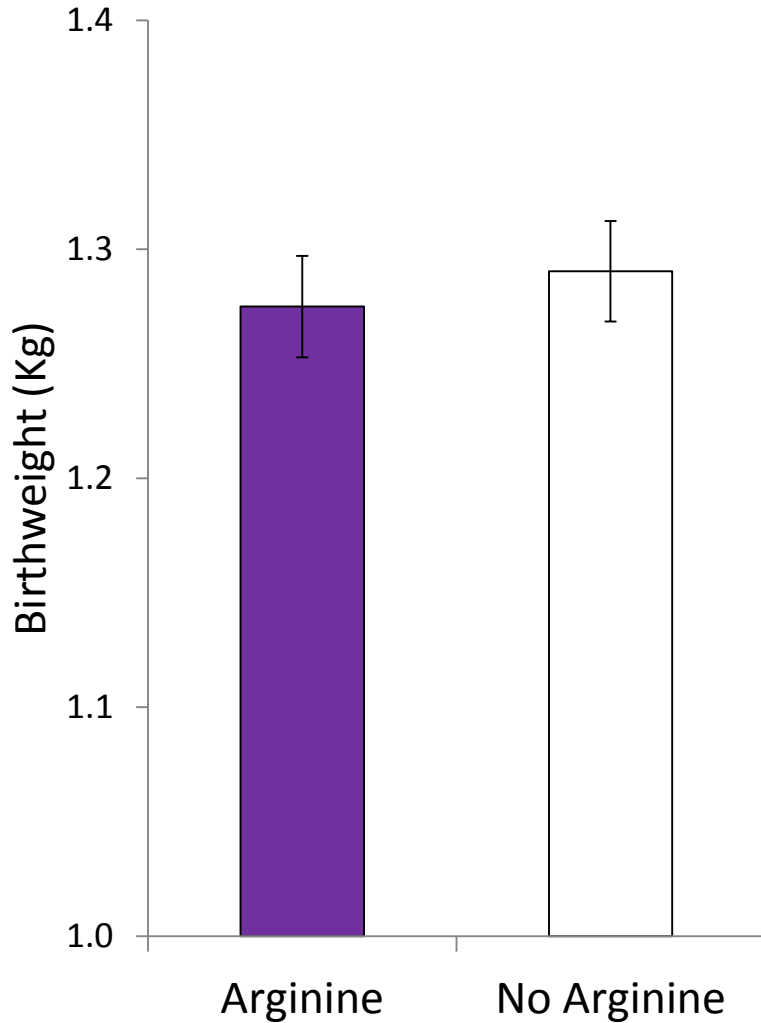
■ Arginine □ No arginine



■ Carnitine    □ No Carnitine

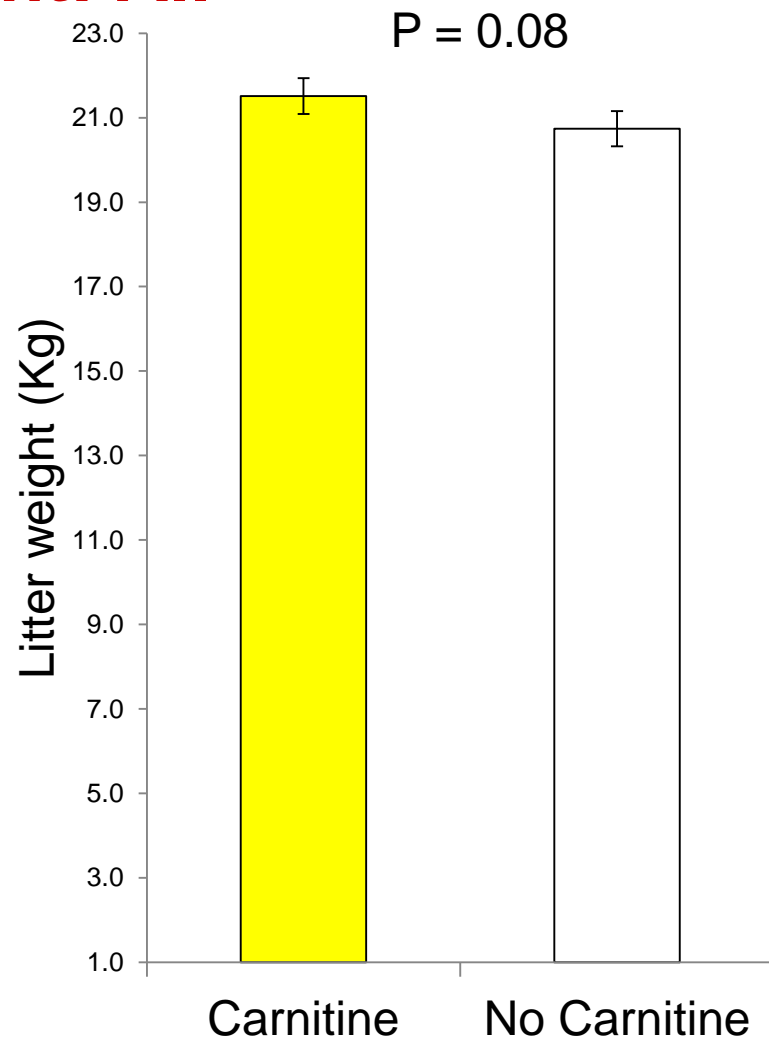
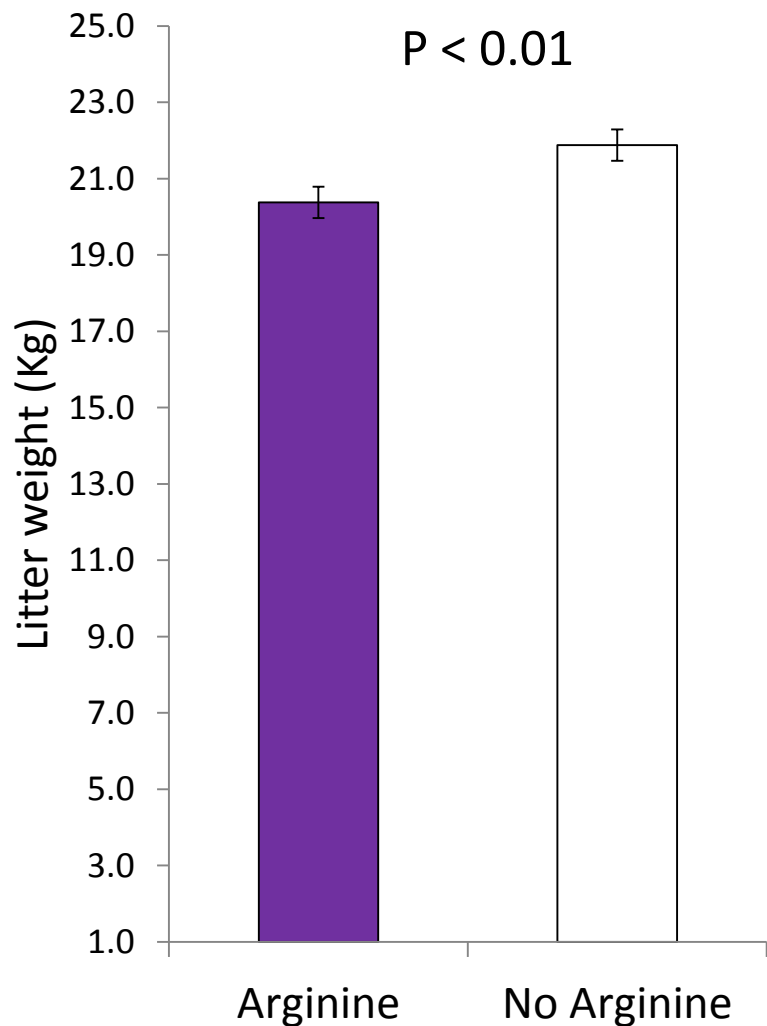


# Birthweight: All

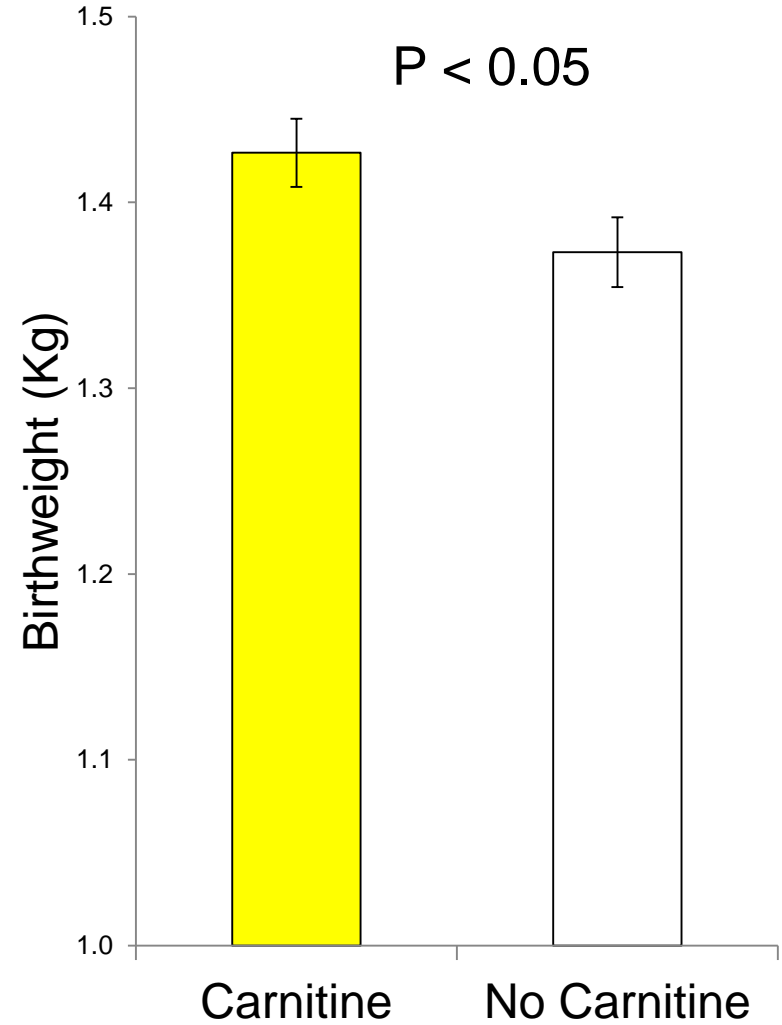
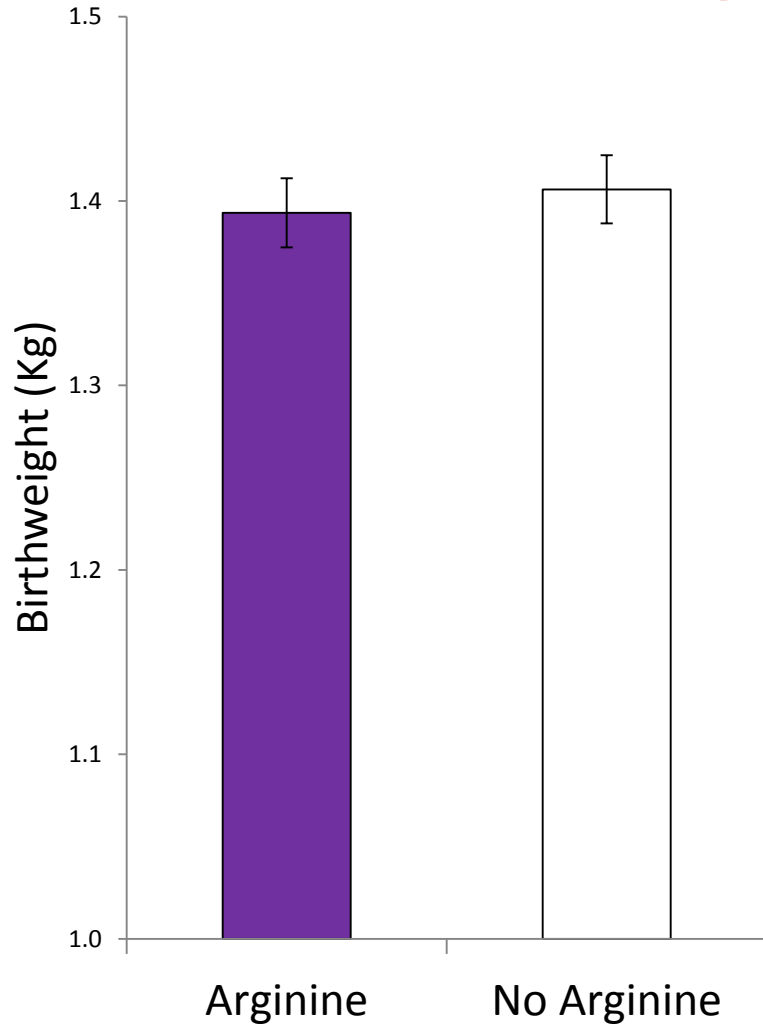




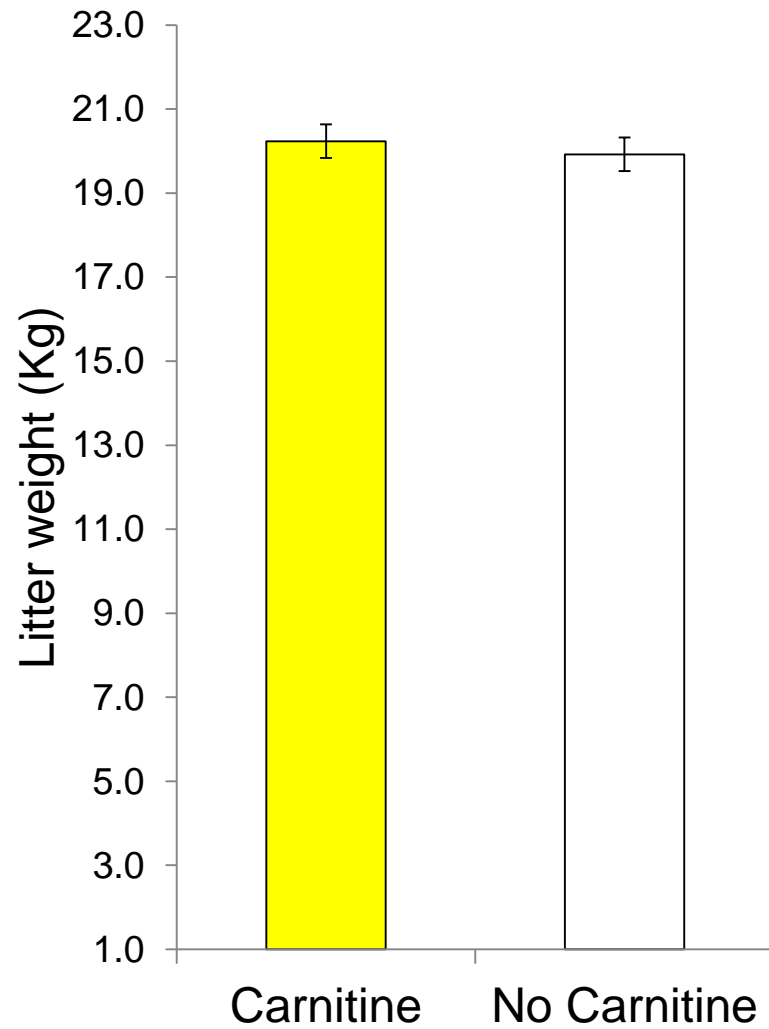
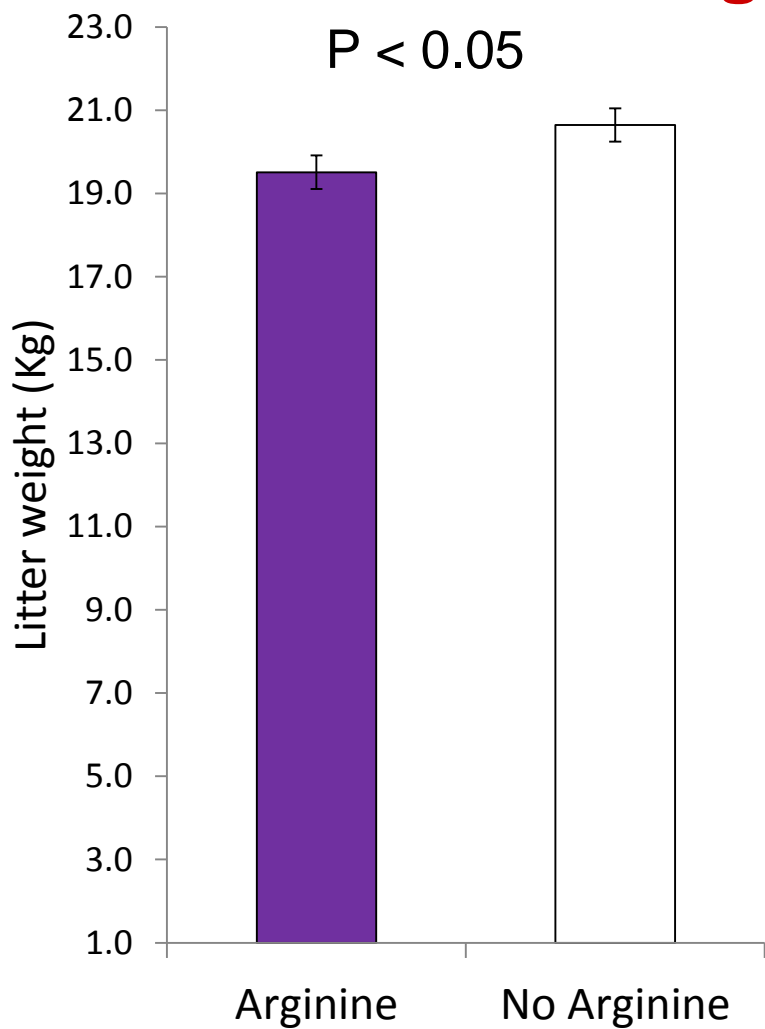
# Litter weight: All



# Birthweight: Live born

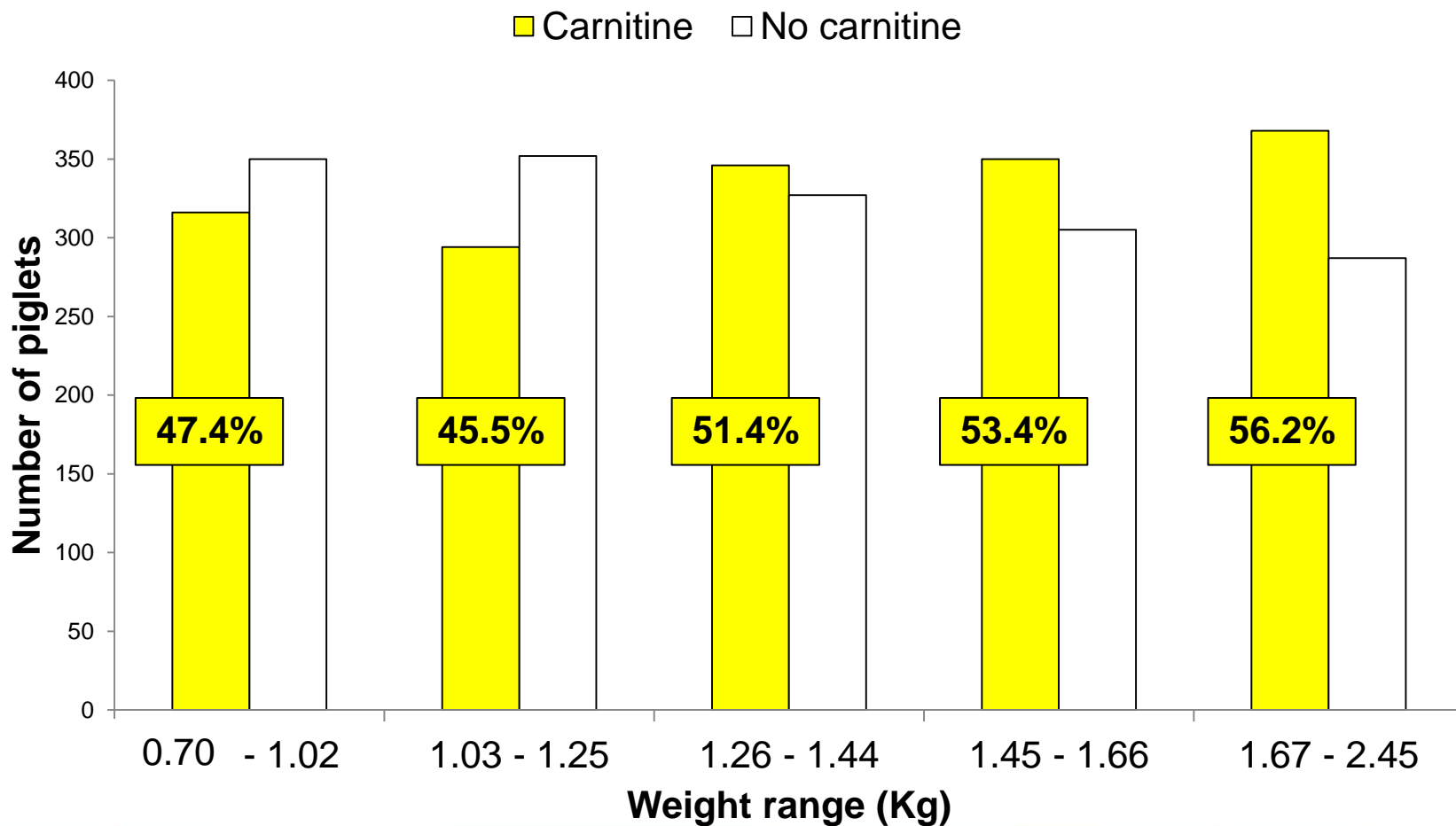


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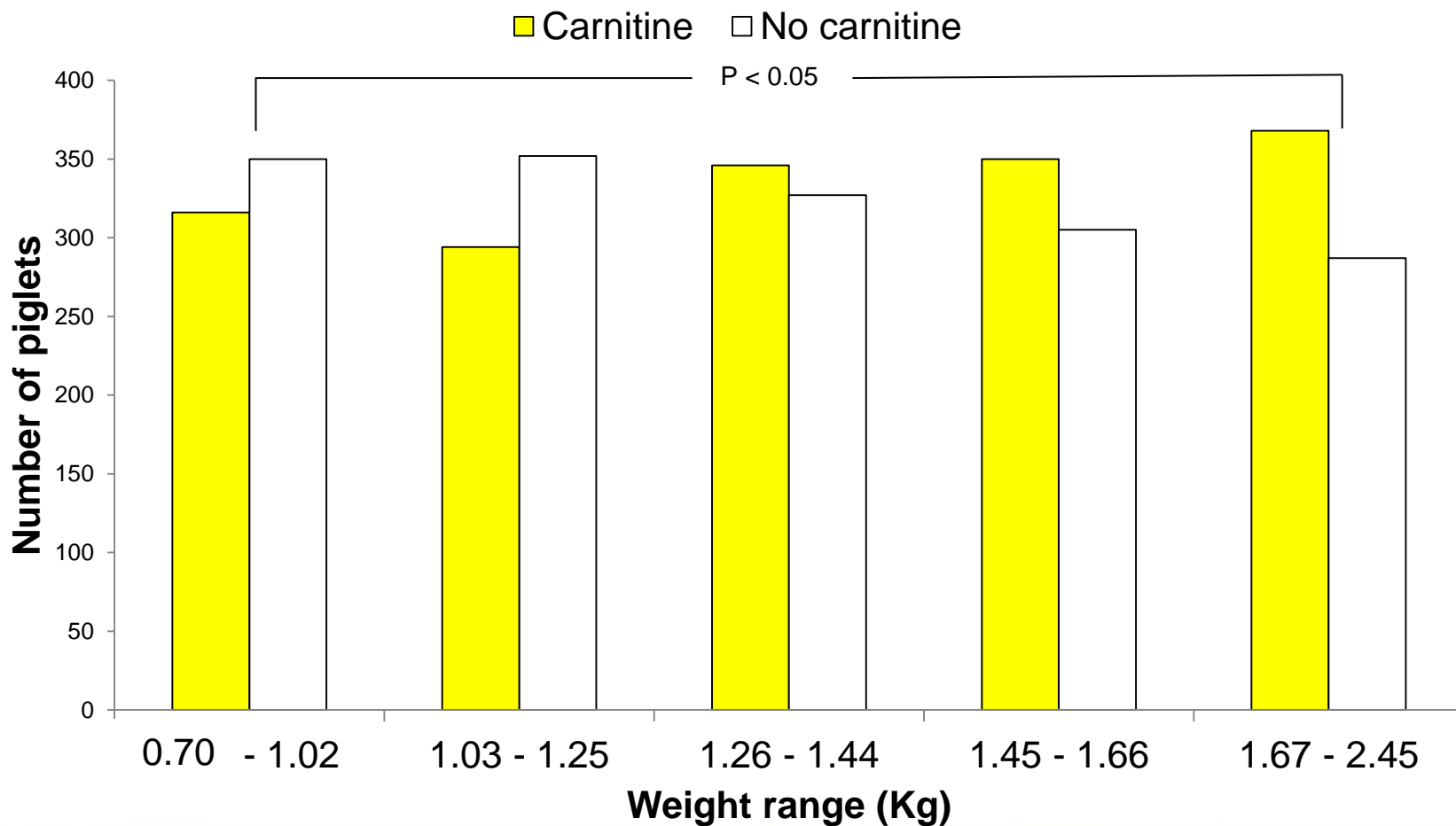


# Birthweight: By rank

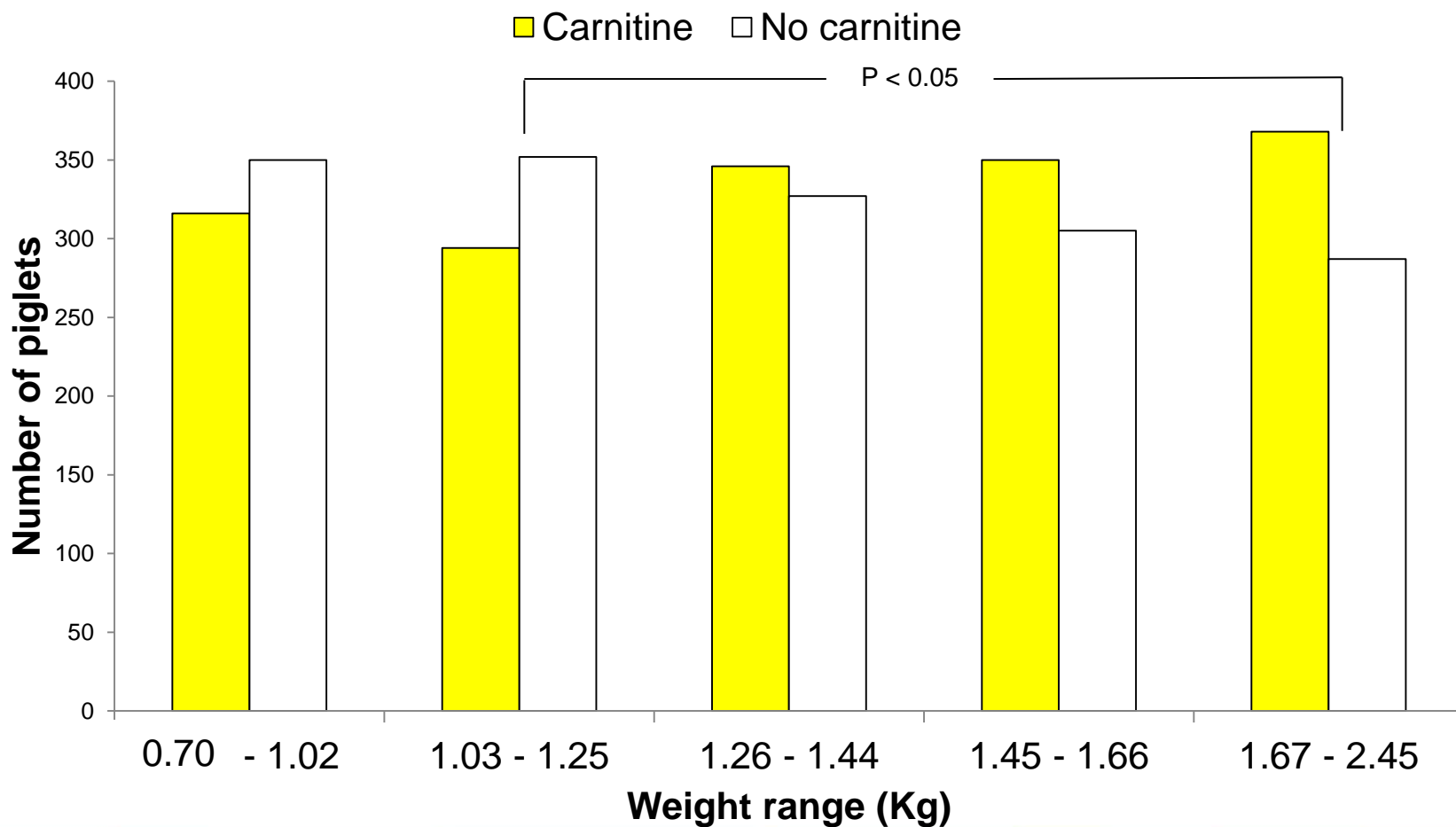
Effect of carnitine on proportion of piglets in each rank:  $P < 0.001$



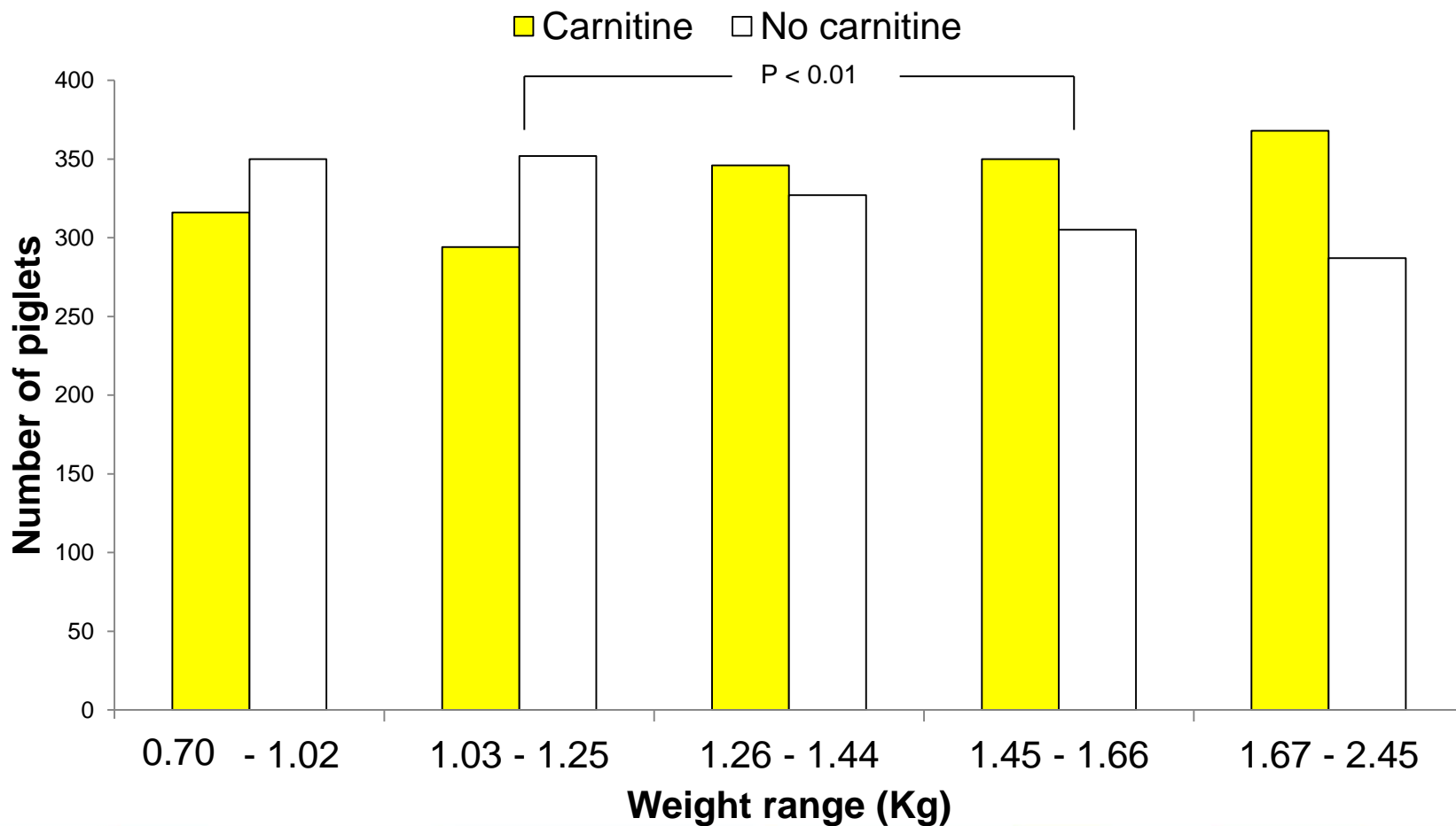
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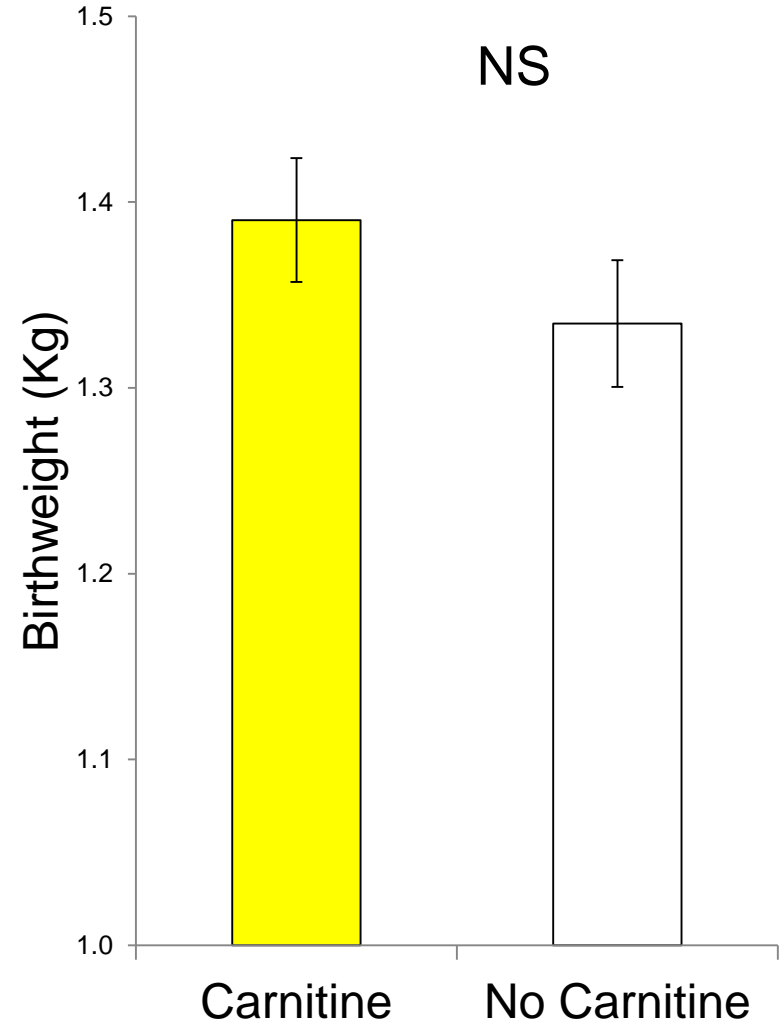
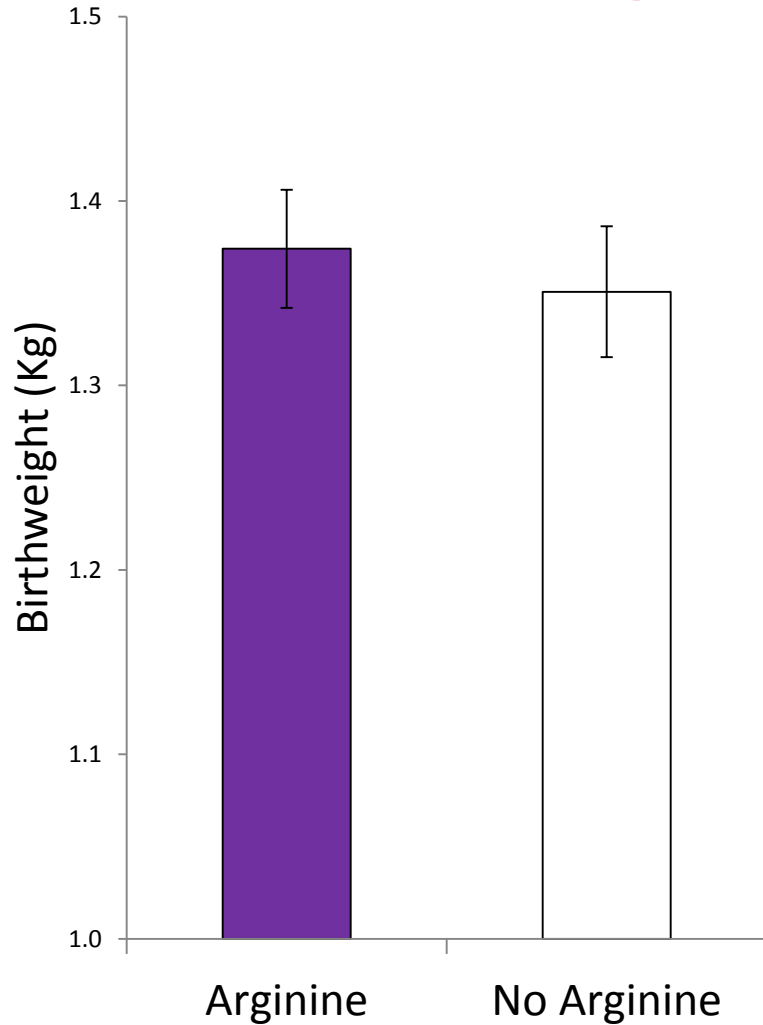
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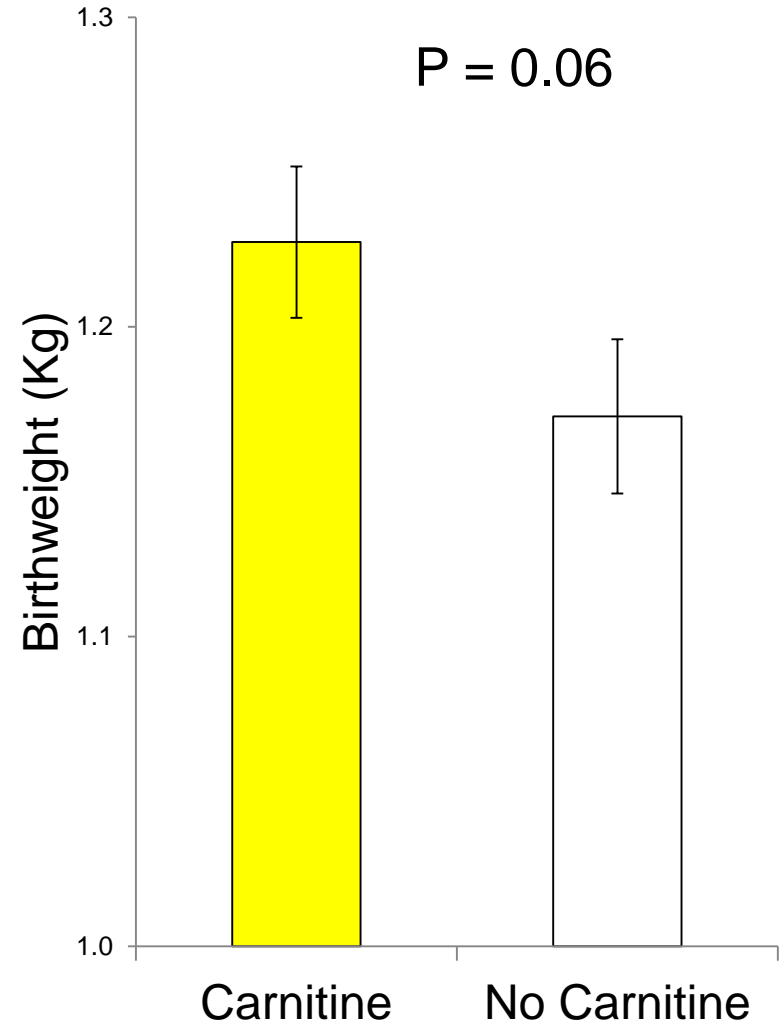
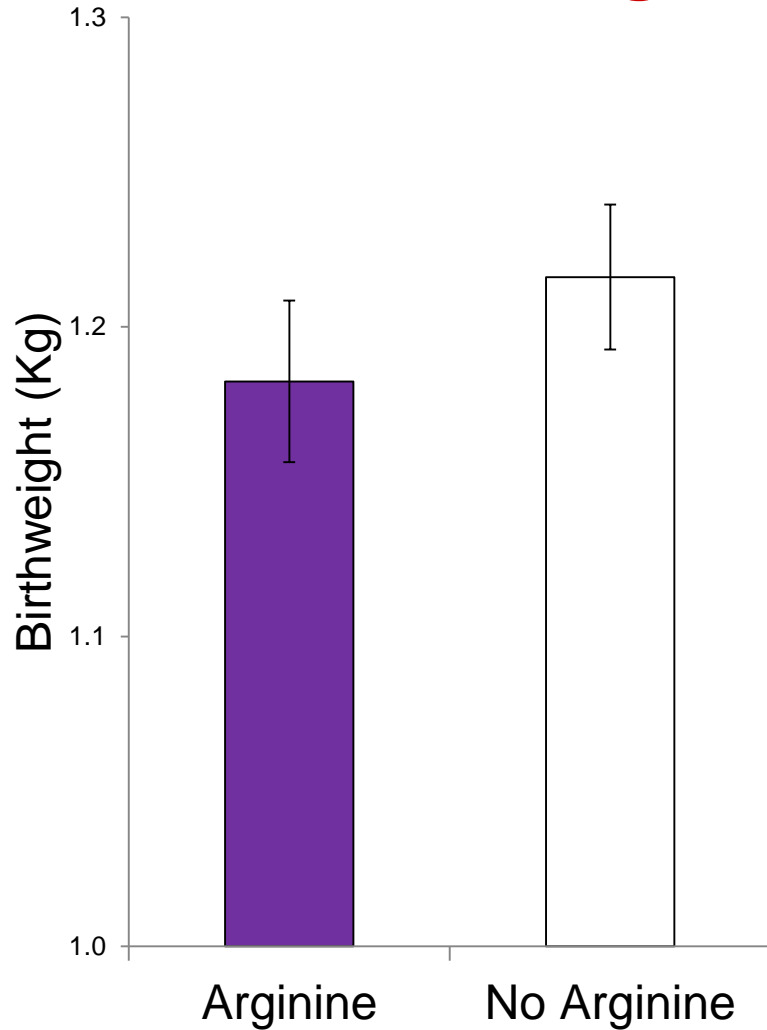


# Birthweight: $\leq 14$ total born



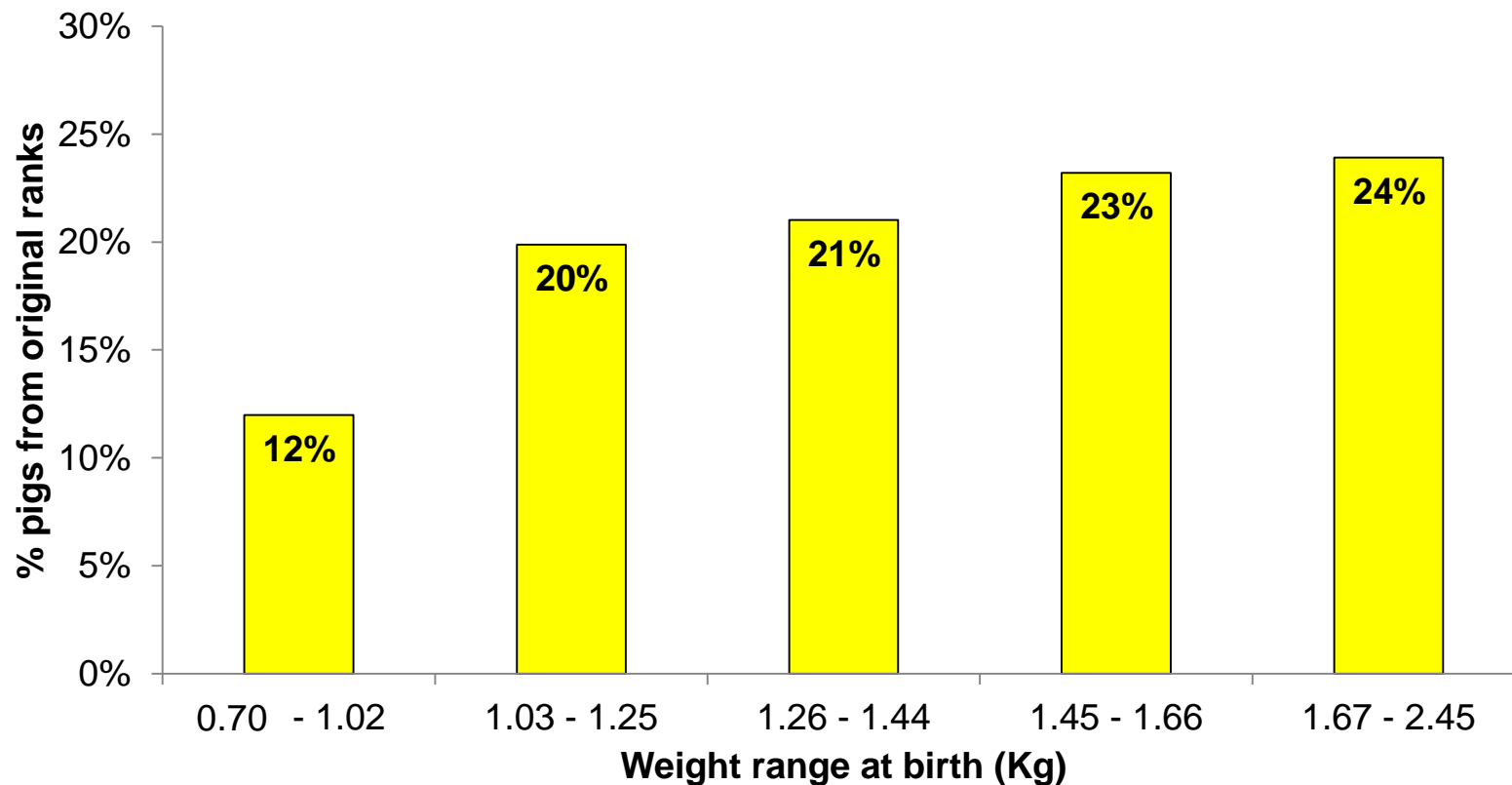


# Birthweight: > 14 total born

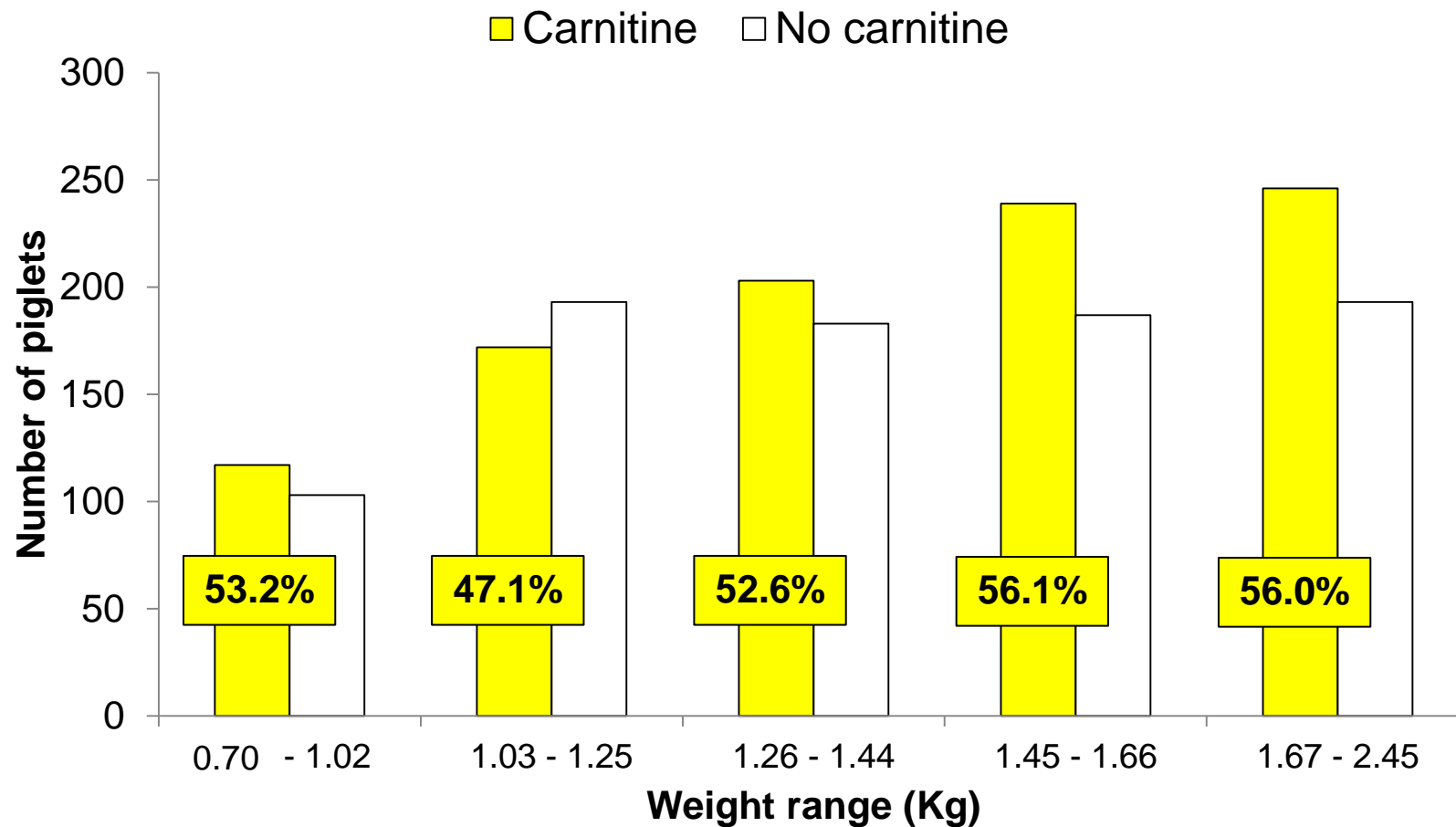


# Weaning weights

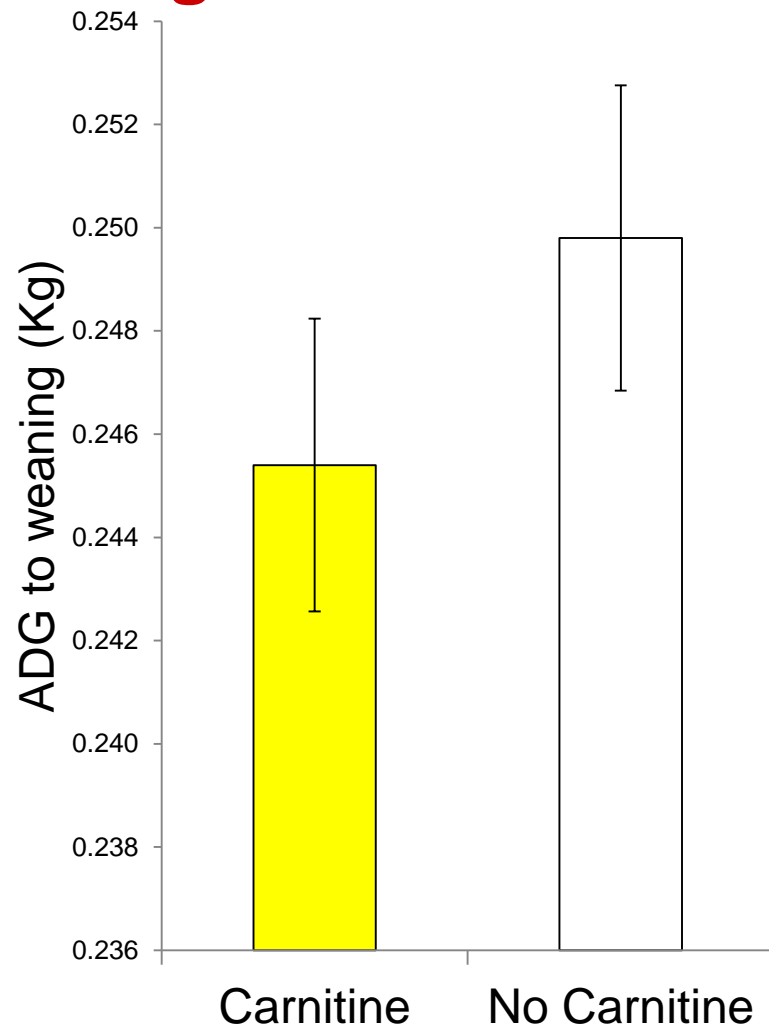
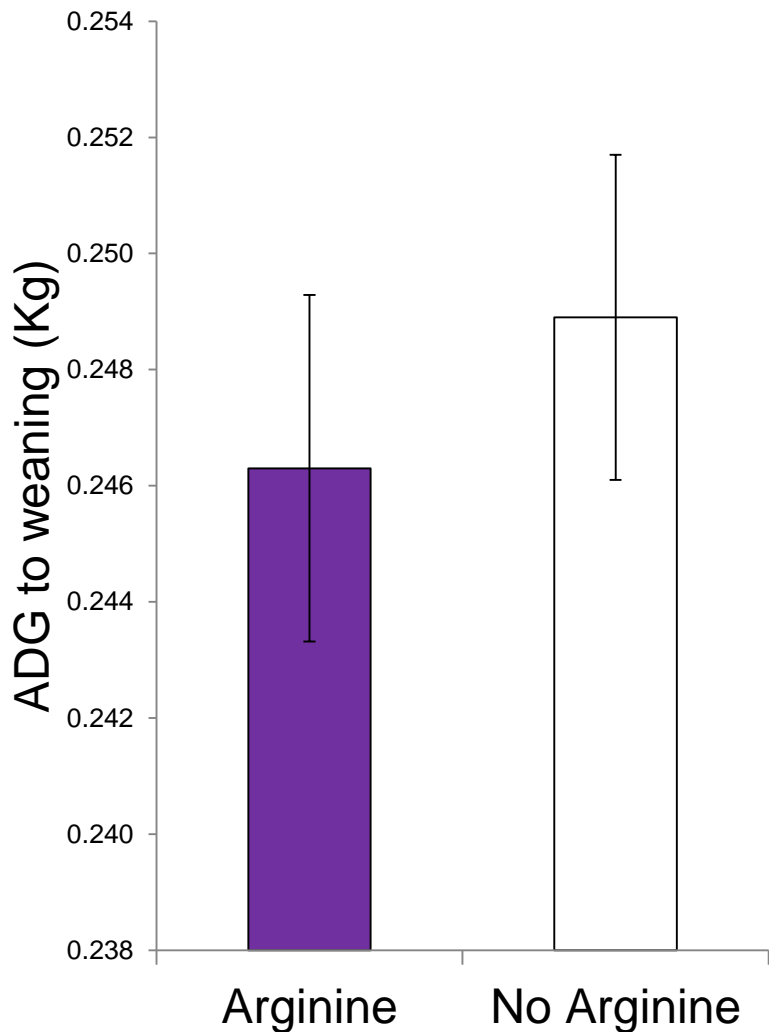
- 1836 piglets in dataset (v's 3295 total birthweights)



# Weaning weight: By rank



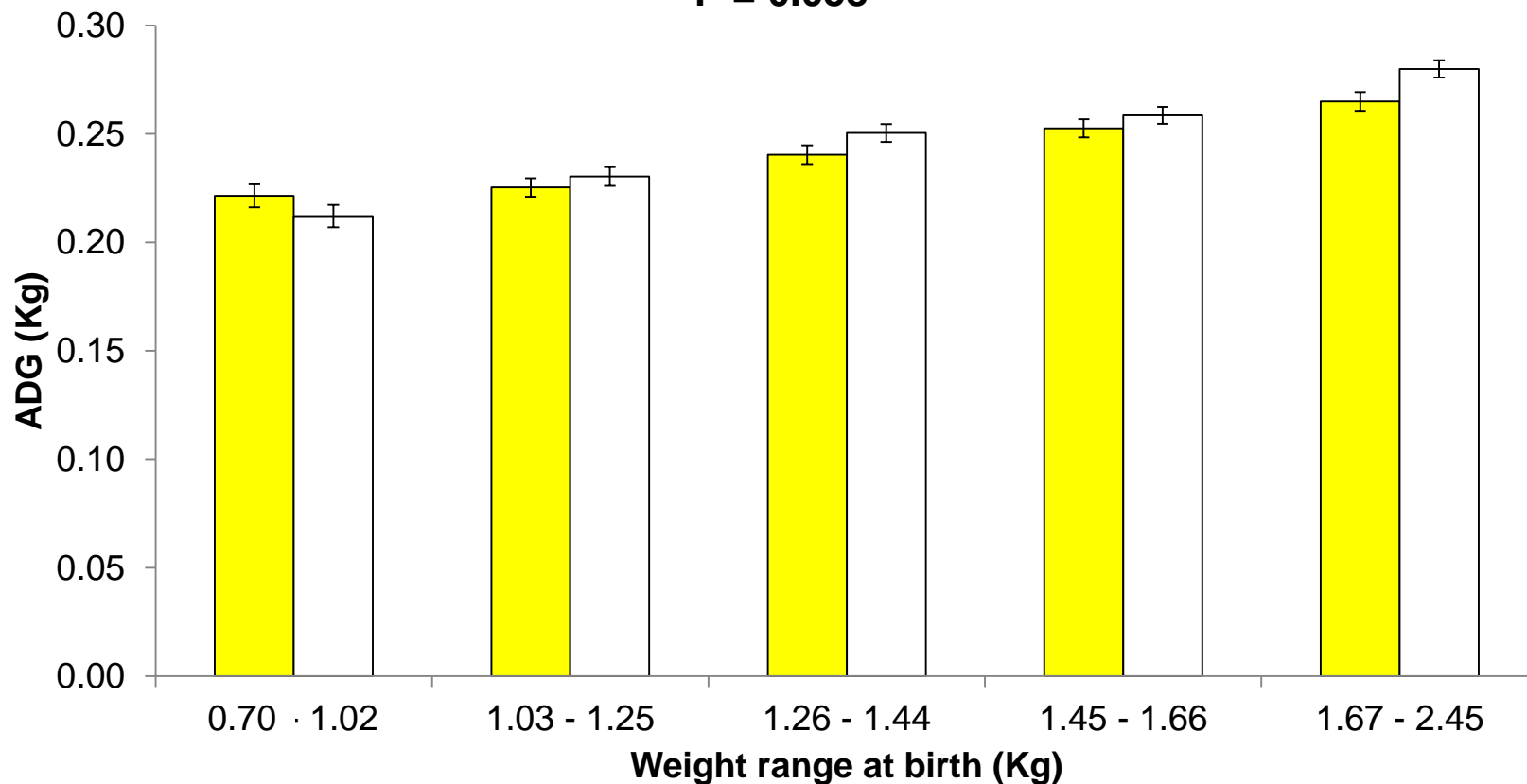
# ADG to Weaning



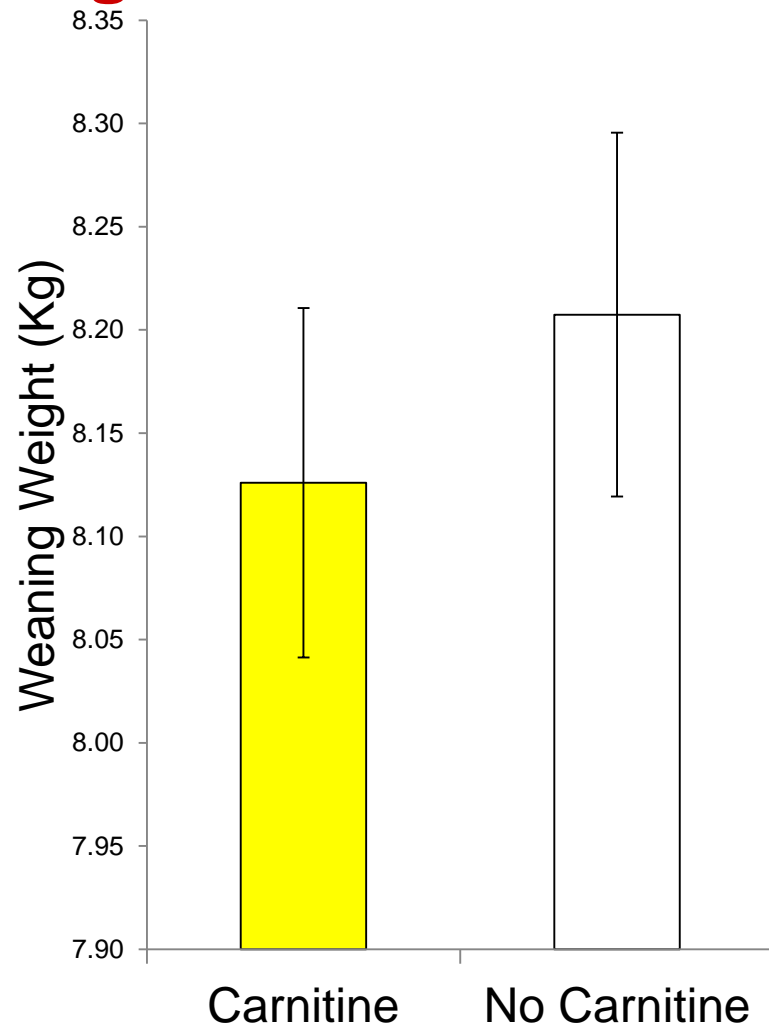
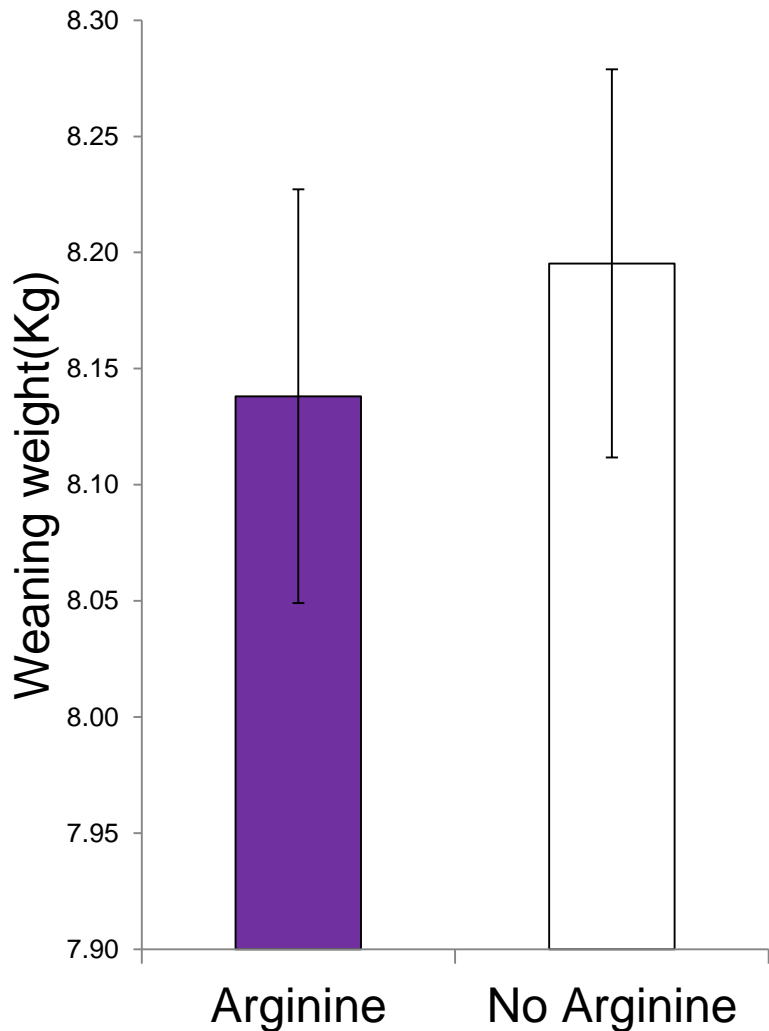
# ADG to Weaning

■ Carnitine   □ No Carnitine

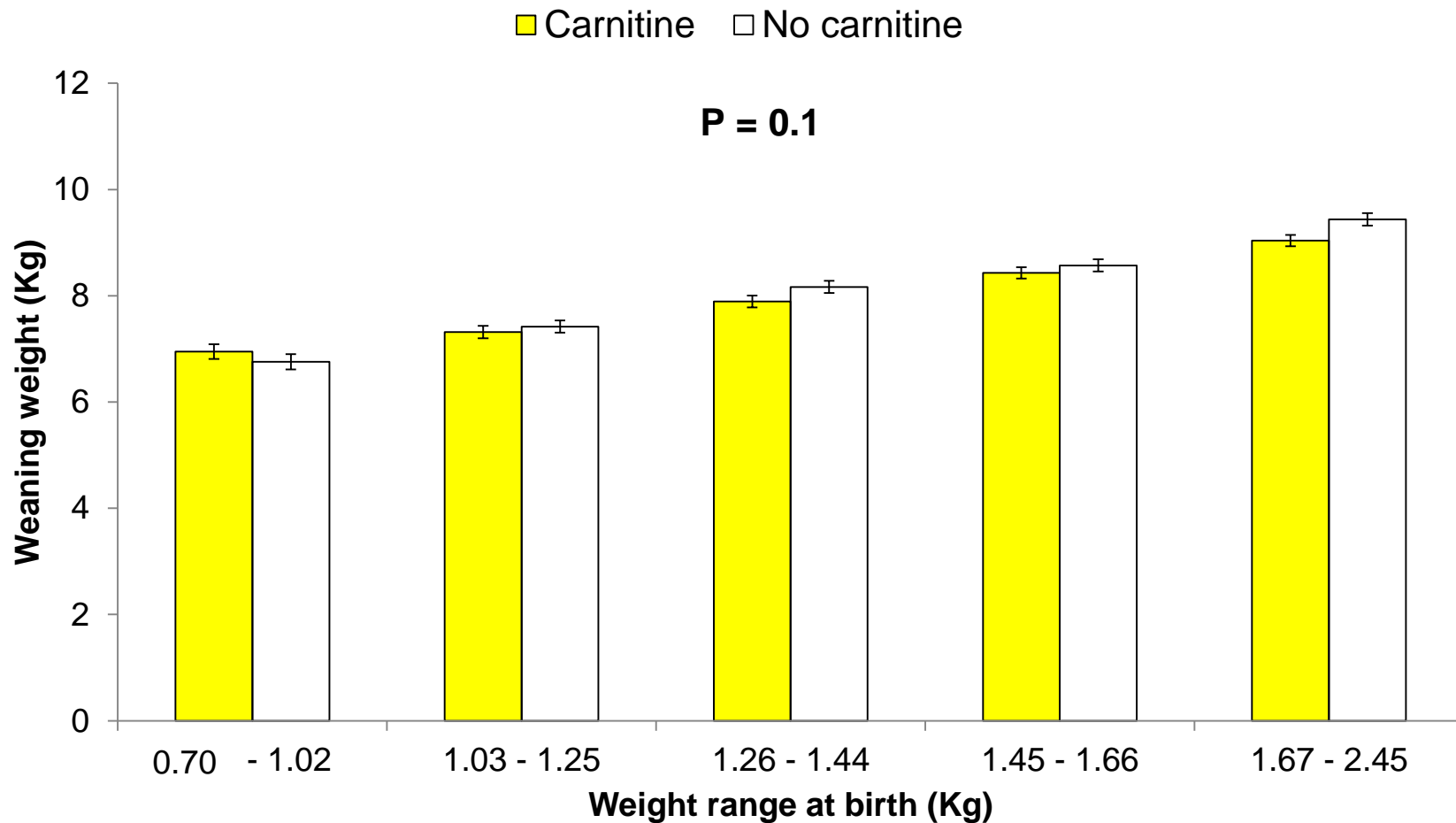
**P = 0.058**



# 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



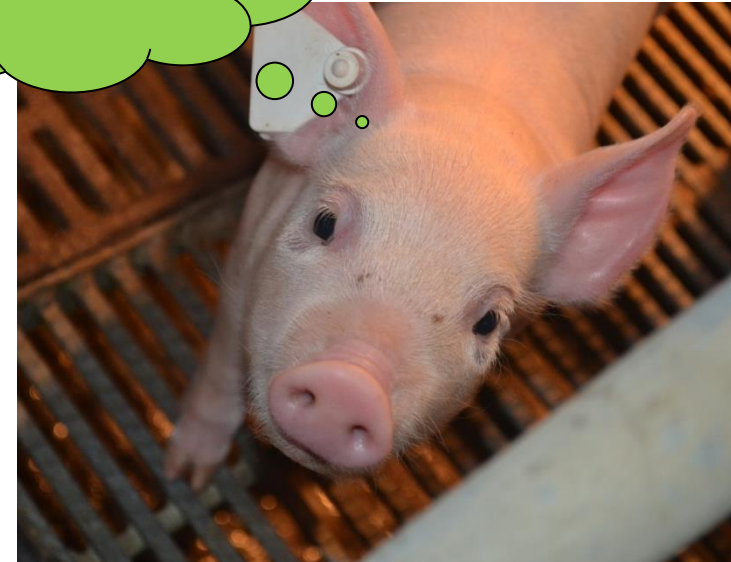
# Take home message

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