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TWO ASPECTS OF ZINC IN PIGLET FEEDING – AN ESSENTIAL NUTRIENT OR AN ENVIRONMENTAL FACTOR?

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AT WEANING

- Changes in feed
  - Sow's milk is replaced by solid feed (often fed dry)
  - Cereals, soybean ⇒ high phytate content
  - Reduced zinc availability
- Very limited feed intake ⇒ limited zinc intake
  - Damaged villus structure
    ⇒ reduced digestion and absorptive capacity
    ⇒ increased loss of water, salt (also zinc)
  - Inflammation of the intestine (*E. coli*)
- Diarrhea 5-6 days post-weaning
  - Treatment: antibiotic or high dietary zinc (2500 ppm)

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EXTRA ZINC ALLEVIATES DIARRHEA

- Undernourished children
  - Zinc supplementation reduces diarrhea incidence
- Piglets
  - 2500-3000 mg Zn/kg diet (mainly as ZnO) has been used for decades the first two weeks post-weaning to reduce diarrhea and improve performance
  - 2500-3000 mg Zn/kg diet is only needed during the first two weeks after weaning.

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WHY DOES HIGH DIETARY ZINC ALLEVIATE DIARRHEA?

- Hypothesis
  - Zinc has an antimicrobial effect in the gastrointestinal tract – reduction of *E. coli*
    - Studies show that 2500-3000 ppm zinc not always modifies the microbiota or may even increase *E. coli*
  - **Pigs develop diarrhea due to temporary or transient zinc deficiency after weaning**

HYPOTHESIS (2)

- Hypothesis
  - Pigs develop diarrhea due to temporary or transient zinc deficiency the first days after weaning
- Why
  - Low feed intake
  - Small labile zinc pool in the body

} Zinc deficiency

- Sufficient daily zinc supply is required – combination of feed intake and dietary zinc concentration

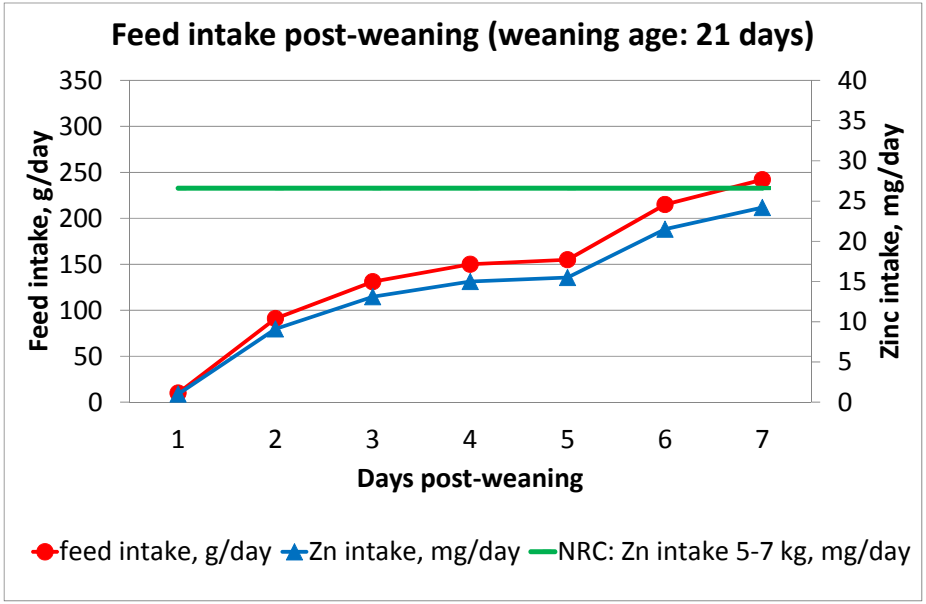
NRC RECOMMENDATIONS

- Amounts per kg diet
  - 100 mg Zn per kg diet

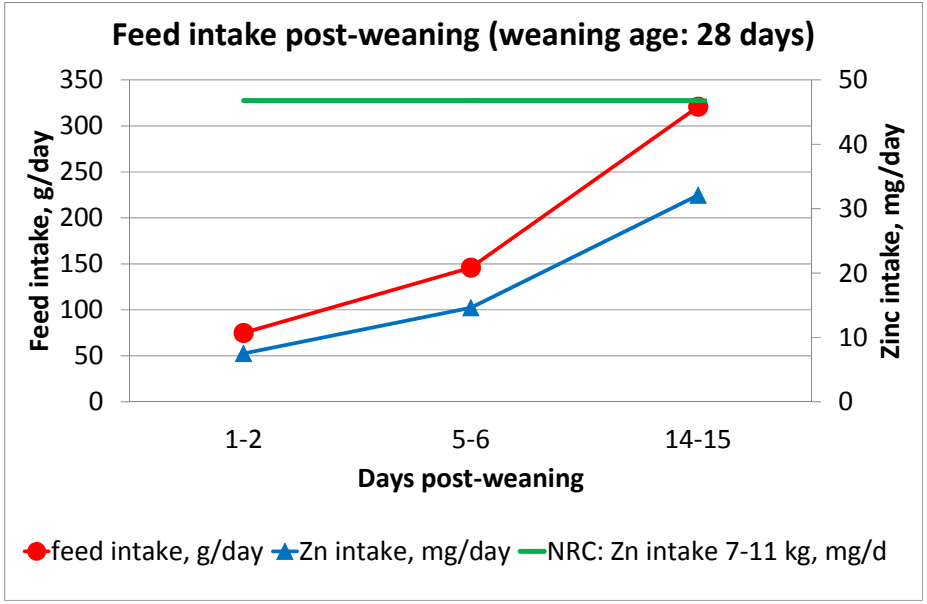
- Amounts per pig per day
  - 5-7 kg: 26.6 mg Zn/day
  - ⇒ with 100 mg Zn per kg diet, piglets must consume 266 g/day

  - 7-11 kg: 46.8 mg Zn/day
  - ⇒ with 100 mg Zn per kg diet, piglets must consume 468 g/day

INTAKE OF FEED AND ZINC AFTER WEANING



Bark et al. (1986)



Carlson (2003)

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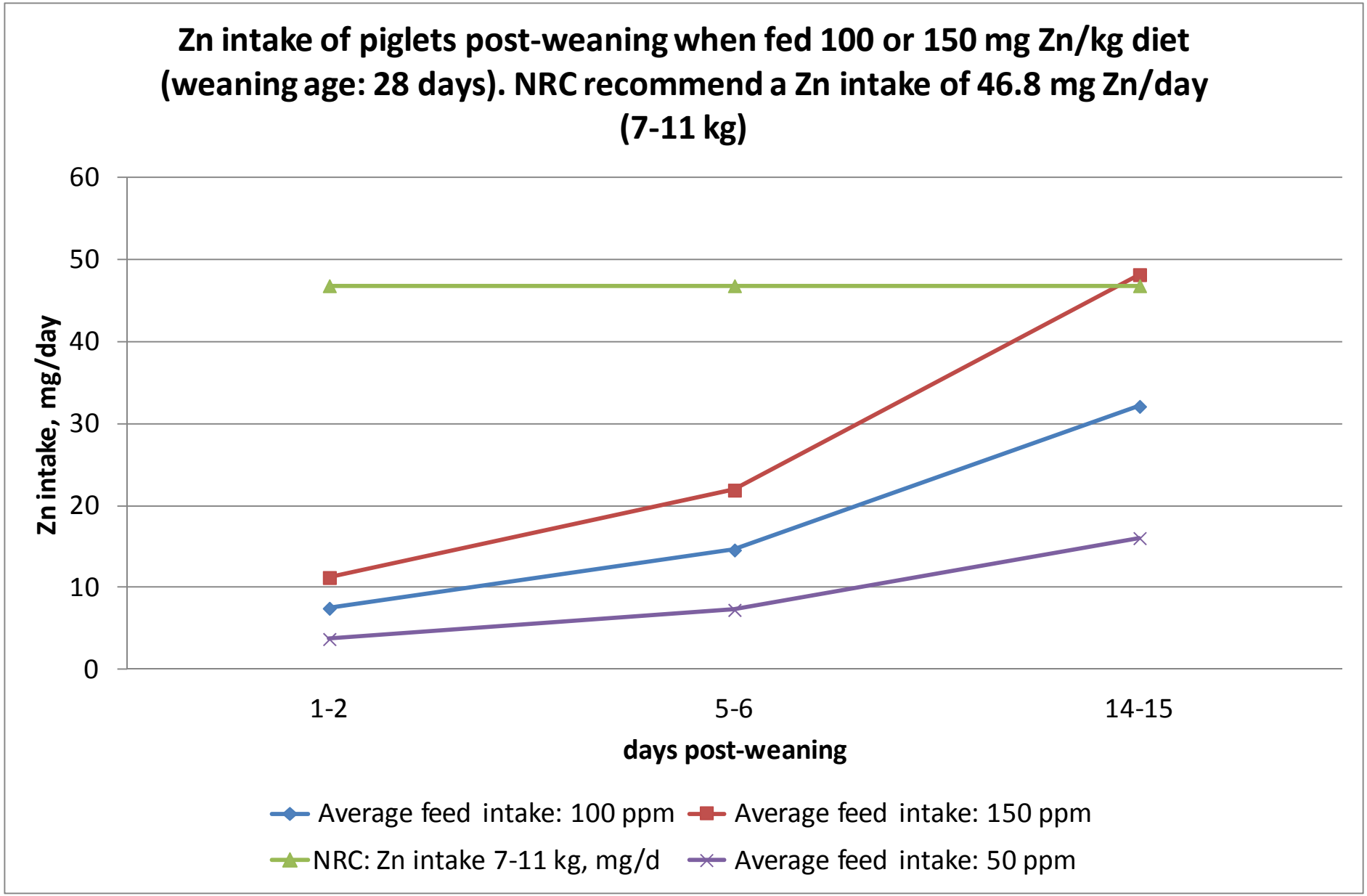

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STUDY - AIM

To associate the development in:

serum zinc status, occurrence of diarrhea, and performance of piglets fed different ZnO supply for 14 days followed by 100 ppm zinc

during 35 days after weaning for 21 days (all piglets)

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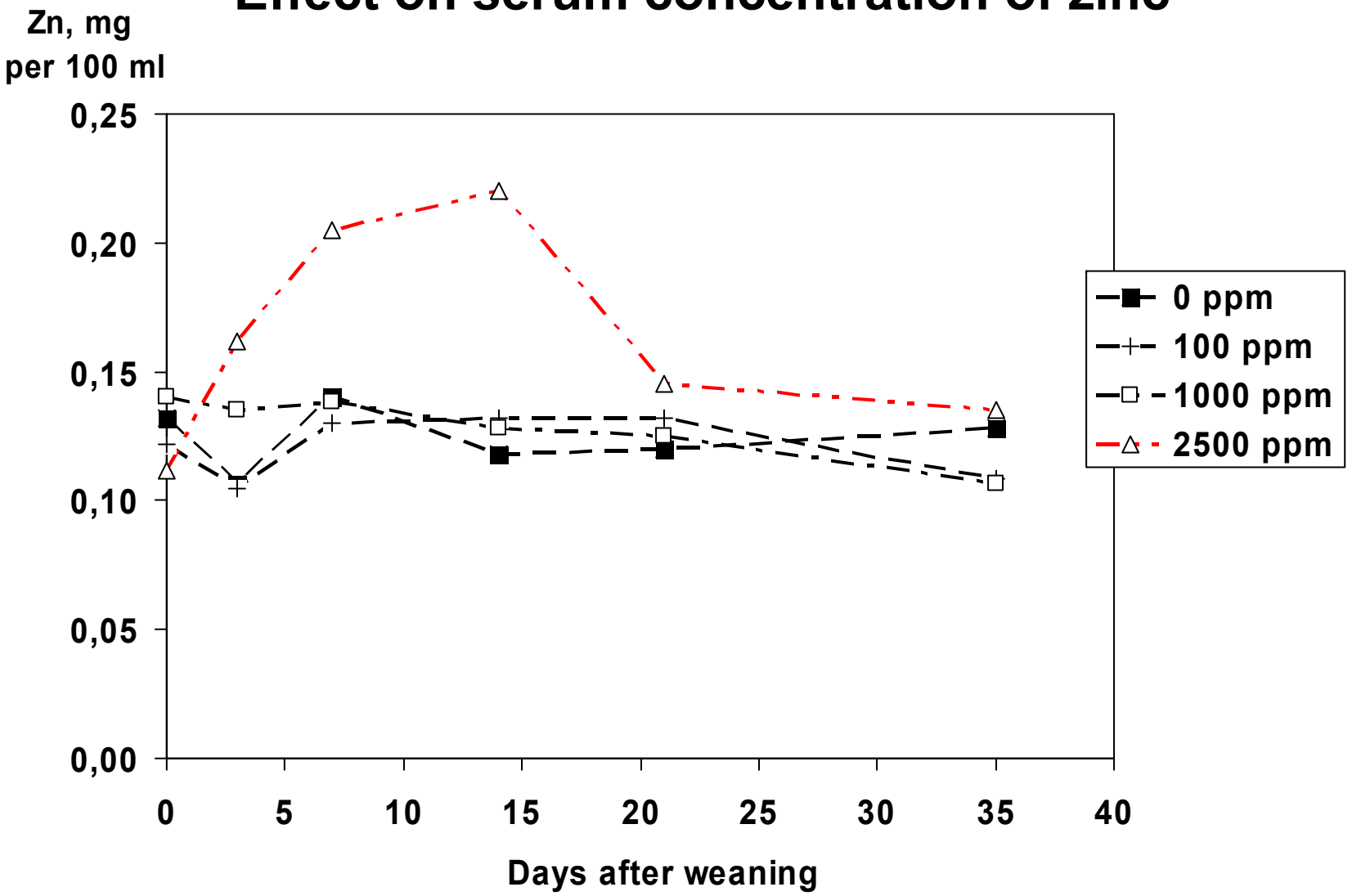
STUDY – RESULTS

	Dietary supply of ZnO, ppm			
	0	100	1000	2500
Average daily gain, g	326	322	338	371
Feed intake, kg/piglet (21 days)	11.1	11.4	11.6	12.2
Diarrhea, % of piglets	65	61	57	35

- Only 2500 ppm increases growth and feed intake and reduces diarrhea

Effect on serum concentration of zinc



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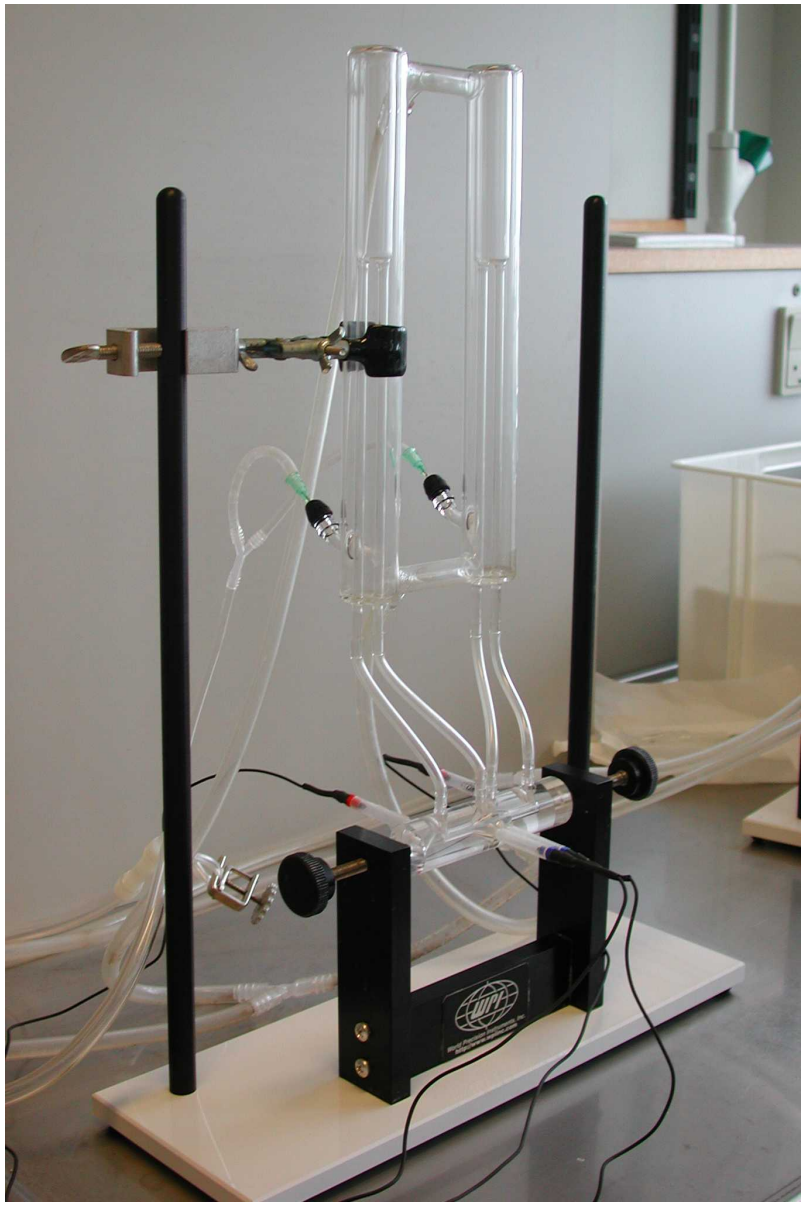
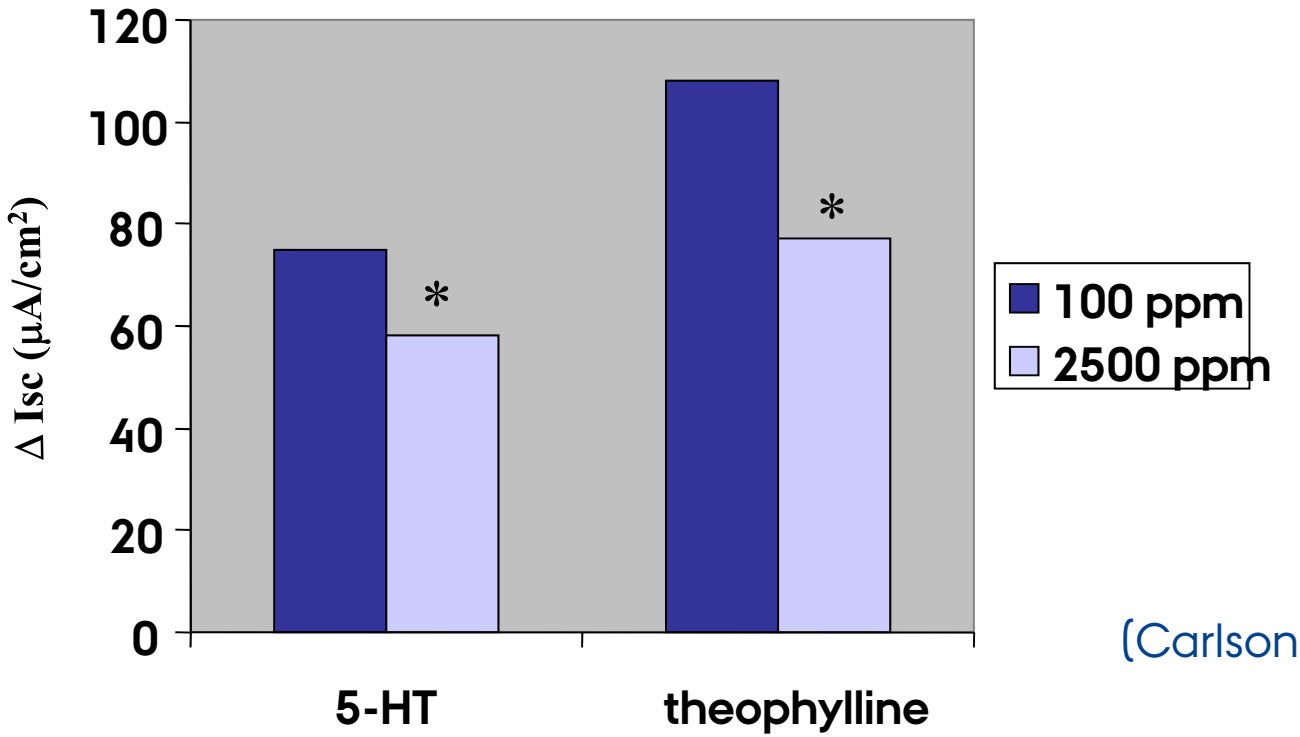
Ussing chamber studies:

- *ex vivo* function of epithelium (small intestine)
- kept alive for up to 3 h
- bathed in specific buffers and kept at 38° C
- exposed to challenging substances (mucosal, serosal or both sides)
- electrodes measure the short circuit current (ΔIsc) as a measure of ion transport across the epithelium (chloride)



CHLORIDE SECRETION *EX VIVO*



(Carlson et al., 2004)

› 2500 ppm dietary zinc reduces intestinal sensitivity to substances that induce chloride secretion (cf. diarrhea in live pigs)

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CONCLUSION

- Effect of high dietary zinc is a “nutrient effect”
  - Association: ↓diarrhea and ↑zinc concentration in serum (↑zinc status) and ↑growth
  - *Ex vivo* Ussing chamber studies: zinc must be present on the blood side (serosa) to reduce diarrhea symptoms (chloride secretion)
- High dietary zinc compensates for low feed intake/low zinc intake ⇒ avoid the development of zinc deficiency

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ZINC – NUTRIENT AND HEAVY METAL

- Zinc is a nutrient? ⇒ health/welfare (less diarrhea) ⇒ reduction in the use of medical treatments against diarrhea ⇒ reduced risk of resistance to antibiotics

- Environmental factor? ⇒ very limited feed intake with high zinc concentration (less than 14 days) ⇒ until feed intake is normalized ⇒ and zinc concentration is normal (transient zinc deficiency)

- Too cautious about the environmental impact of 14 d use of high zinc concentrations after weaning!

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ANNOUNCEMENT – WEDNESDAY AFTERNOON – SESSION 30

› Environmental optimisation of the pig production system:

- Identification of the most important factors
- Discussions on how to solve the problems in a holostic way to obtain sustainability
- Next steps
  - collaboration and future activities?
  - joint applications?
  - topics for the next EAAP meetings?
  - ???