Hydroxychloride trace minerals improve growth performance and carcass in pigs: a meta-analysis

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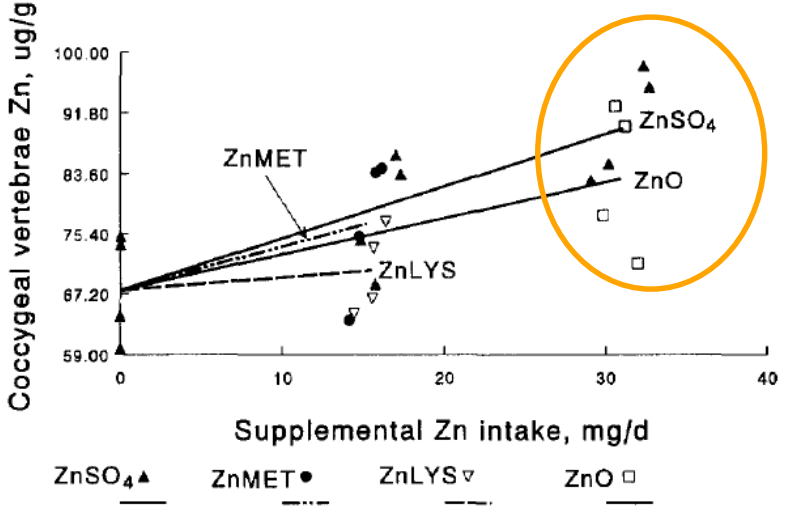
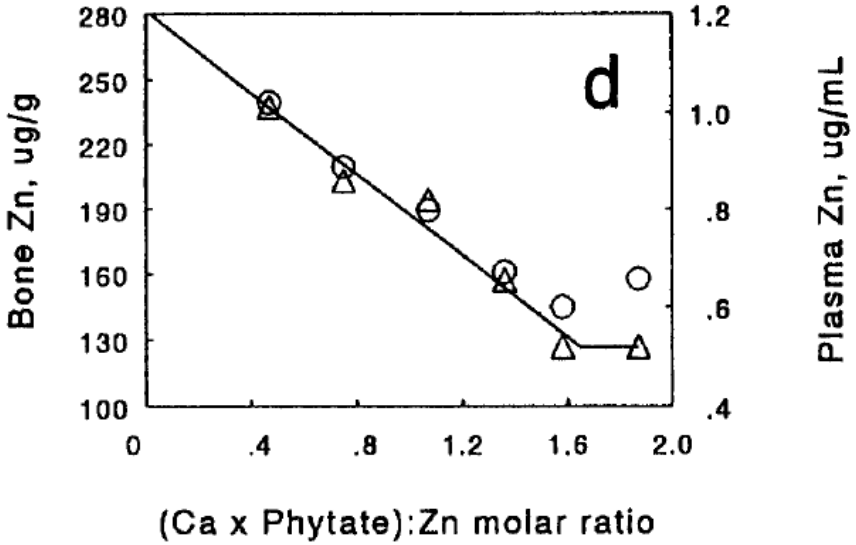
Zinc in pig nutrition

- Zinc is important for many enzymes, collagen and keratin formation and several immune functions (Richards et al., 2010)
- Dietary minerals and vitamins are essential for feed efficiency, weight gain and feed intake in finishing pigs (Edmonds and Arentson, 2001)
- To prevent problems due to deficiencies extra Zn is added to diets of pigs.
- In the EU a maximum of 120 ppm Zn and 25 ppm Cu are allowed in the complete feed for fattening pigs (EFSA, 2014)

Zinc availability

- At these low levels the source of Zn is important for availability
- Availability is also determined by solubility and interaction with other nutrients such as phytate and calcium

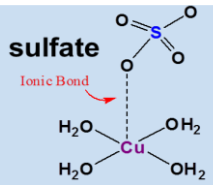
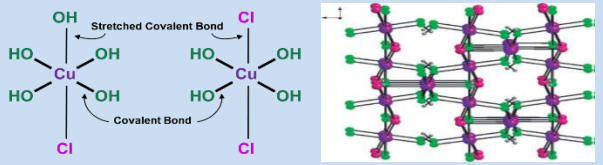




Wedekind et al. 1994. Bioavailability of zinc from inorganic and organic sources for pigs fed corn-soybean meal diets. J. Anim. Sci. 72:2681-2689.

Zinc sources

- Two different sources of trace minerals:

	Inorganic (ITM)	Hydroxychloride (HTM)
Structure		
Form	Sulfate, oxides	Crystalline structures
Bonds	Ionic bonds	Covalent bonds
Solubility	Very soluble (sulfate)	Soluble at pH<4
Reactivity	High reactivity	Low reactivity
Bioavailability	Low bioavailability	High bioavailability
Costs	Cheap	Relatively cheap (compared to organic TM)

Objective

Demonstrate the effect of hydroxychloride trace minerals (HTM) on the growth performance and carcass quality in grower-finisher pigs in different European conditions.

Several trials are combined into a meta-analysis to increase power, and draw an overall conclusion.

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Experimental set up

Currently in practice in the EU we supplement grower/finisher pig feeds with 15 ppm Cu and 80 ppm Zn (to EU max levels)

Treatments	Cu from $CuSO_4$ (ppm added)	Zn from $ZnSO_4$ (ppm added)	Cu from hydroxychloride* (ppm added)	Zn from hydroxychloride* (ppm added)
1 – ITM	15	80		
2 – HTM			15	80

* Hydroxychloride mineral sources: IntelliBond® C and IntelliBond® Z

Similar study set up in 6 different trials

Study locations

Multiple locations with a variety in:

- Environmental conditions
- Seasonal differences
- Management regimes
- Feed ingredients

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Statistics

- All raw data combined into one data set
- This data is analyzed in SAS:
  - MIXED model for continuous variables
  - GLIMMIX model for percentages using a beta distribution
- All models were corrected for within and between study variation
- In the analysis per feeding phase a repeated statement was included.

Meta-data grower/finisher pigs

Study	Facility	Country	Length of study	Starting age	Days in study per phase Phase 1 – phase 2 – phase 3
1	KU Leuven	Belgium	120 days	9.5 weeks (~19 kg)	36 – 71 – 120
2	IRTA	Spain	126 days	10 weeks (~27 kg)	42 – 84 – 126
3	SNiBA-UAB	Spain	105 days	9 weeks (~19 kg)	21 – 63 – 105
4	ILVO	Belgium	105-121 days	10 weeks (~26 kg)	35 – 70 – slaughter weight ~ 115kg
5	TH Bingen	Germany	90 days	10 weeks (~28 kg)	28 – 63 – 90
6	TH Bingen	Germany	91 days	10 weeks (~25 kg)	26 – 49 – 91

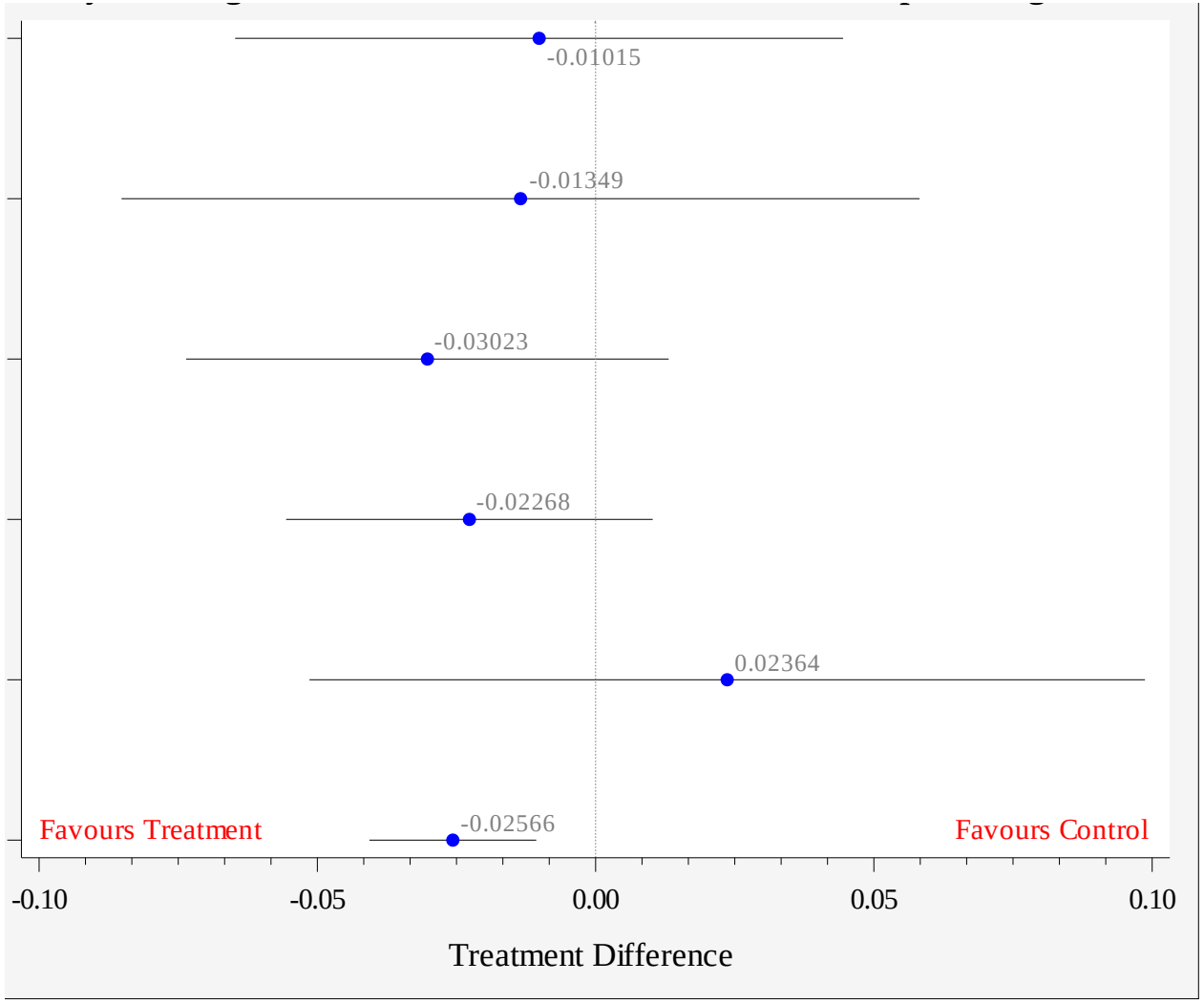
Meta-analysis overall study results - 80 ppm Zn

	BW (kg)	ADG (kg)	ADF (kg)	Gain:Feed	Carcass yield (%)	Back fat (mm)	Lean Meat (%)
ITM	107.81	0.789	1.981	0.399	74.42	11.60	61.31
HTM	107.96	0.797	1.980	0.404	74.44	11.25	61.91
Δ	0.149	0.0079	-0.0014	0.0053	0.020	-0.350	**0.600**
% difference	0.14	1.0	-0.7	1.3	0.03	-3.0	**1.0**
P-value	0.895	0.318	0.950	0.093	0.941	0.159	**0.001**

Δ = difference HTM - ITM
BW = body weight, ADG = average daily gain, ADF = average daily feed intake, FCR = feed conversion ratio, FE = feed efficiency
Carcass yield, Back fat, Lean meat: 5 studies included because of missing data.

Mortality: in general, mortality was very low. Therefore it was not included in the statistics.

Forest plot – Lean meat percentage



Overall difference is shown as the difference of the **log** LS means (ITM - HTM). The difference in the table is the actual difference.

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Meta-analysis per feeding phase - 80 ppm Zn

		ADG (kg)	ADFI (kg)	Gain:Feed
Phase 1	Δ	0.0020	0.0189	-0.0060
	% difference	0.1	2.5	-0.3
	P-value	0.876	0.385	0.386
Phase 2	Δ	-0.0063	-0.0141	0.0023
	% difference	-0.7	-0.7	0.6
	P-value	0.515	0.660	0.674
Phase 3	Δ	0.0290	0.0121	**0.0134**
	% difference	3.9	0.5	**3.9**
	P-value	0.065	0.761	**0.003**

Δ = difference HTM - ITM
ADG = average daily gain, ADFI = average daily feed intake, FCR = feed conversion ratio, FE = feed efficiency

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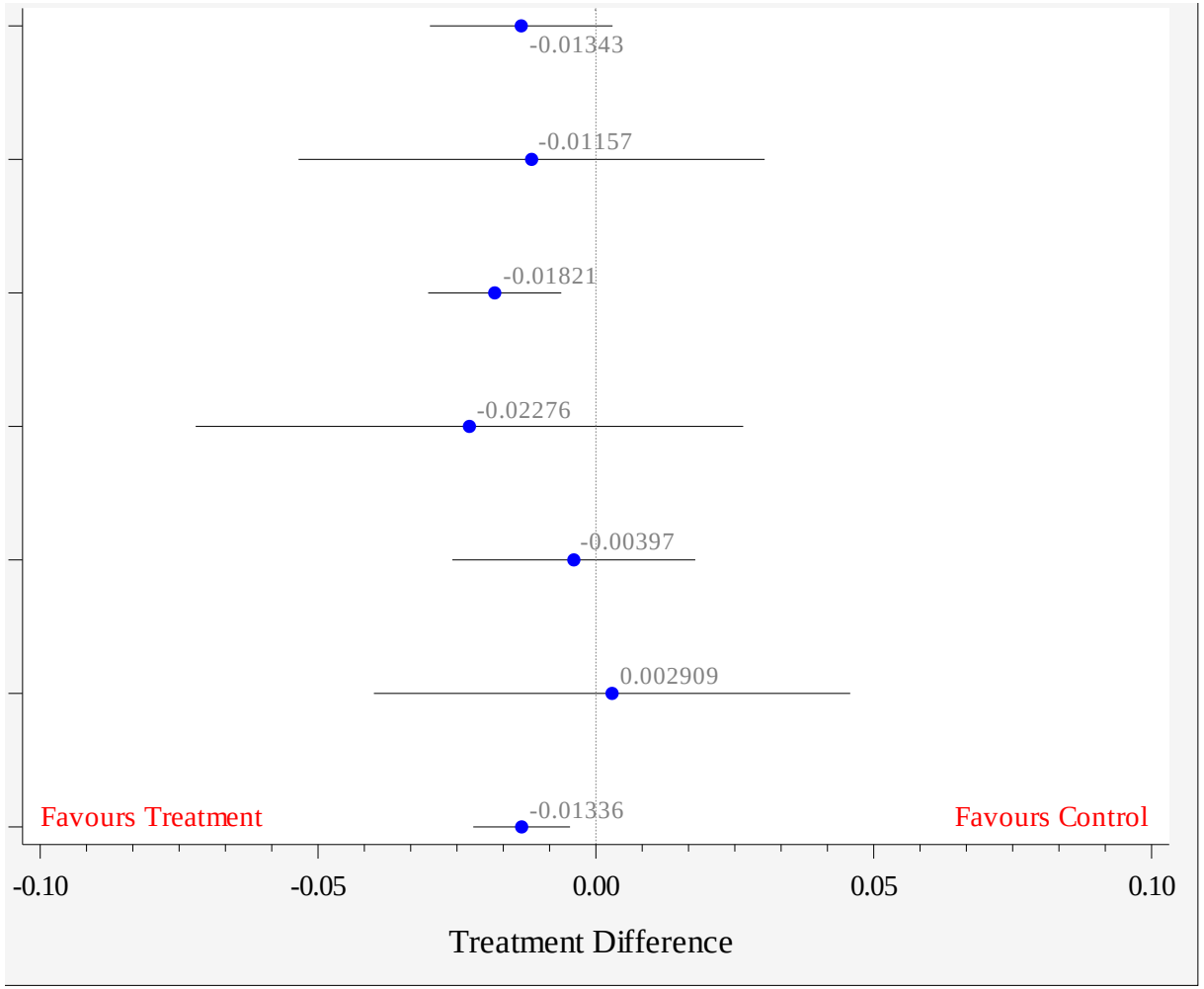
Forest plot – FE – phase 3 – 80 ppm



Overall difference is shown as the difference of the LS means (ITM - HTM).

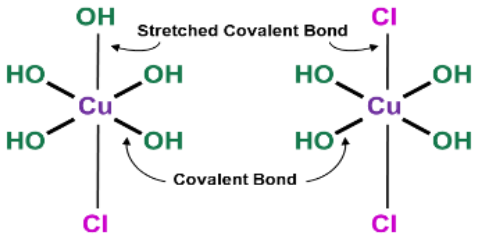
Conclusions

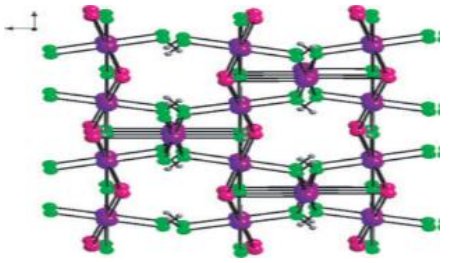
The overall study period:

- The **lean meat %** was 0.6% higher (P=0.0009) in HTM fed pigs compared to ITM fed pigs.
- **Gain:Feed** tended (P=0.0925) to be improved by 1.3% in HTM pigs.

Individual feeding phases:

- **Gain:Feed** was significantly improved (P=0.0031, 3.9%) in the HTM fed pigs in the final growing phase
- **ADG** tended to be improved (P=0.0625, 3.9%) in HTM fed pigs





Thank you for your attention

Hydroxychloride trace minerals did have an effect on growth performance, especially in the last feeding phase. Feeding hydroxychloride trace minerals results in an increased lean meat percentage and a trend for improved Gain:Feed.