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Variation of zinc release from phytate by phytase is dependent of the level of dietary Zn supplementation in pig : a meta-analysis

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Introduction

Zinc

Plays an important role
as cofactor of many
enzymes

**Low bioavailability of Zn
due to the interaction
with Phytic P¹**

Environmental impact of zinc

A zinc supplementation is used to reach the
requirement of the pig
Soil accumulation of zinc

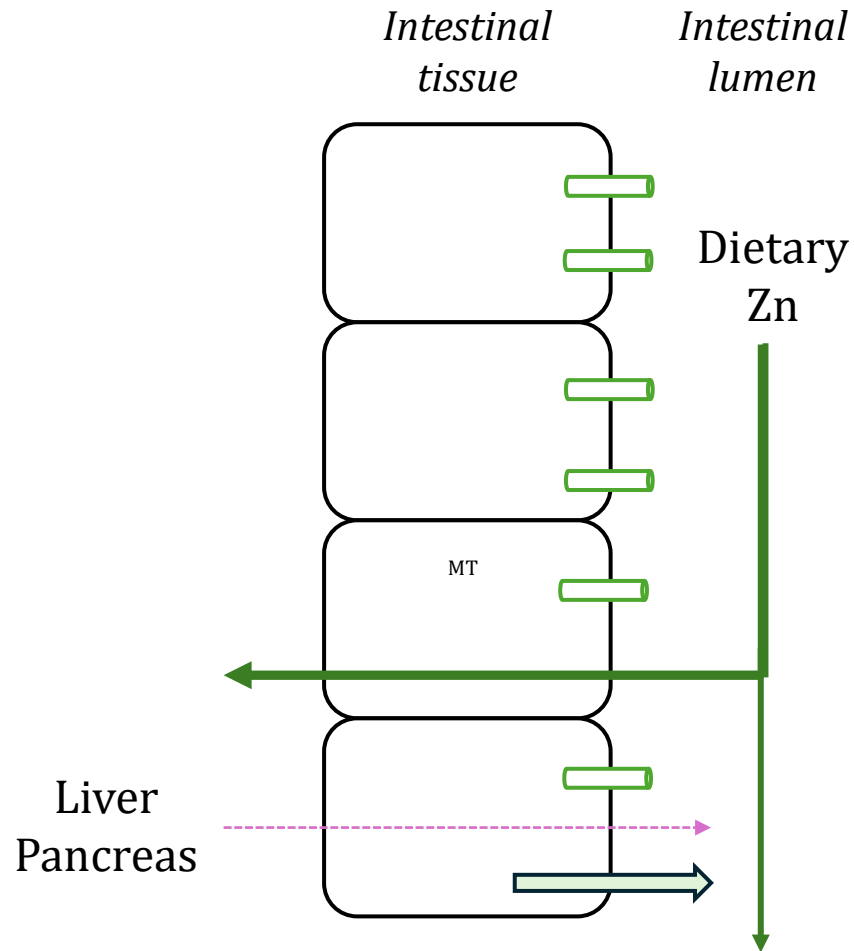
Solution

The breakdown of phytic acid by phytase can
improve the availability of zinc for absorption¹.

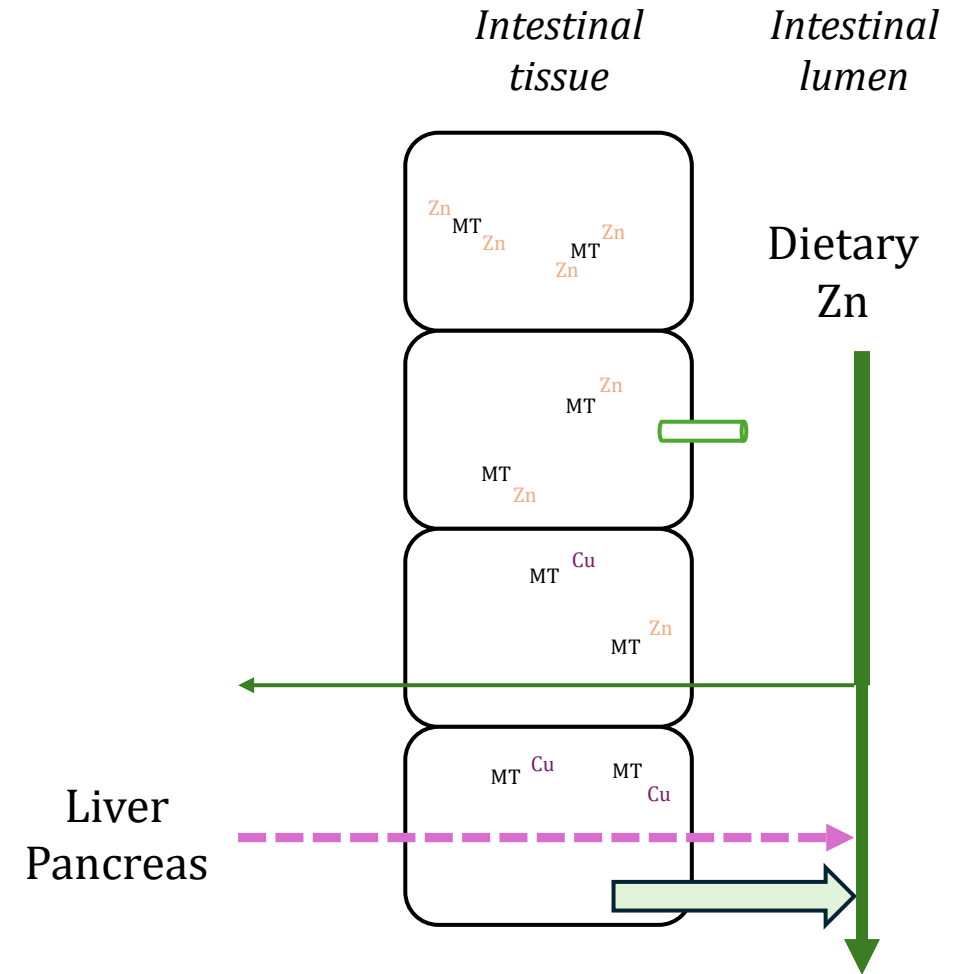
¹Schelgel et al., 2013;

Background : zinc metabolism is highly regulated

Dietary zinc deficiency

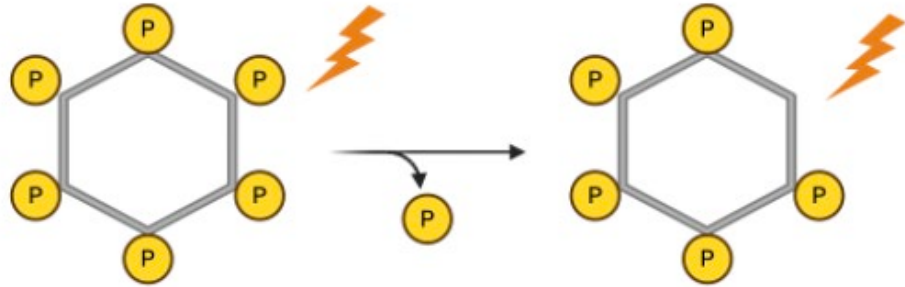


Dietary zinc oversupply



 ZIP4; MT : metallothionein

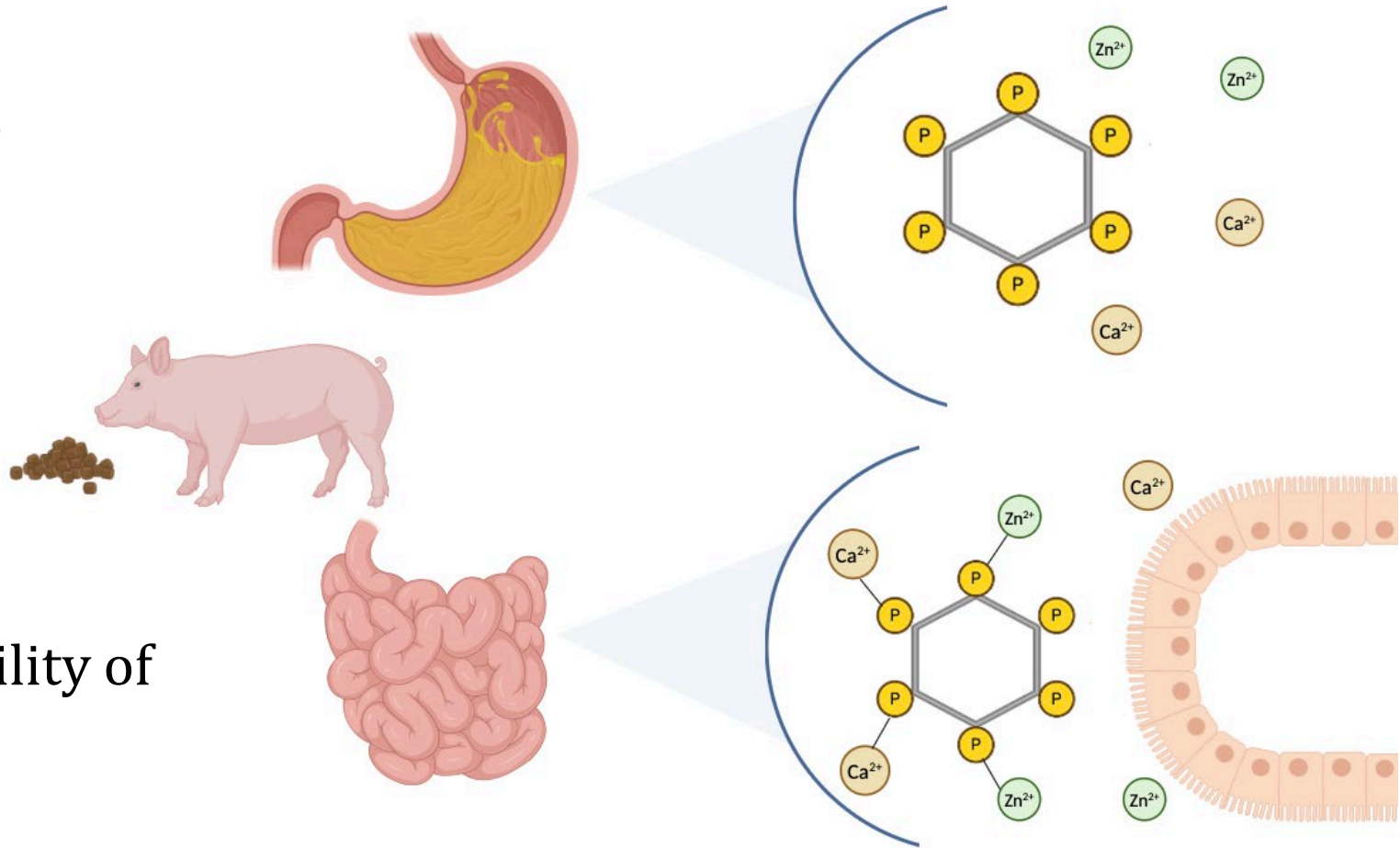
Background



P phytic degradation by
phytase

Hypothesis

The phytase improves the bioavailability of
zinc in smaller extent when zinc is
oversupplied



Materials and methods

Literature search :

“pig” , “phytase” and “zinc”

Criteria of inclusion:

1. Diet composition
2. Variation only of phytase or dietary zinc
3. Dietary supply over 250 mg/kg was removed

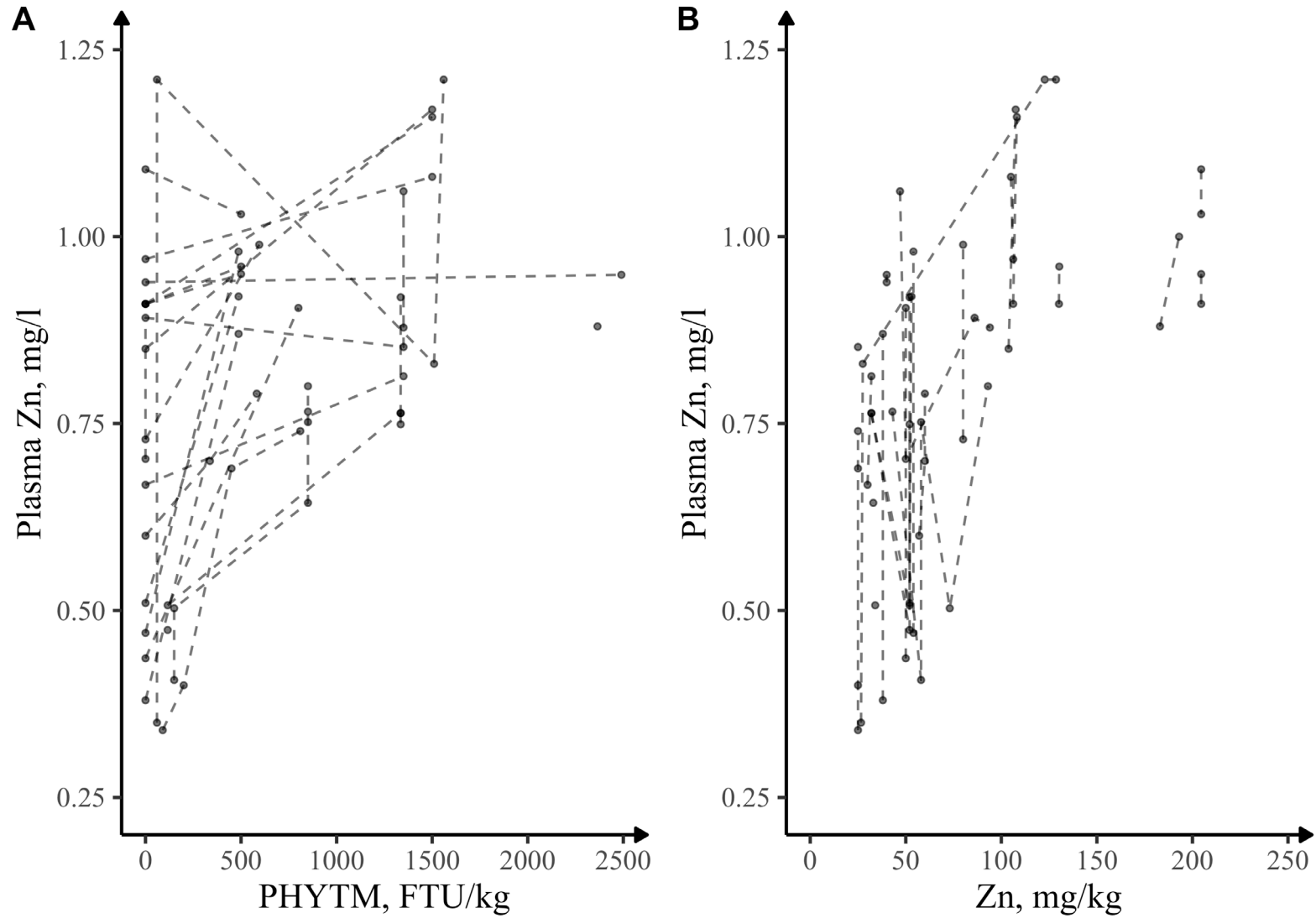
Materials and methods

$$Y_{ij} = \mu + s_i + b_k X_{ij} + b_2 Z_{ij} + b_3 Z_{ij}^2 + \alpha X_{ij} Z_{ij} + e_{ij}$$

The diagram illustrates the components of the mixed-effects model equation. Arrows point from descriptive labels below to the corresponding terms in the equation above:

- Plasma Zn, mg/L** points to Y_{ij} .
- Random effect of study** points to s_i .
- Phytase, 100 FTU/kg** points to X_{ij} .
- Zn, mg/kg** points to Z_{ij} .
- Interaction between phytase and zinc** points to the interaction term $\alpha X_{ij} Z_{ij}$.
- Error** points to the error term e_{ij} .

Meta-design

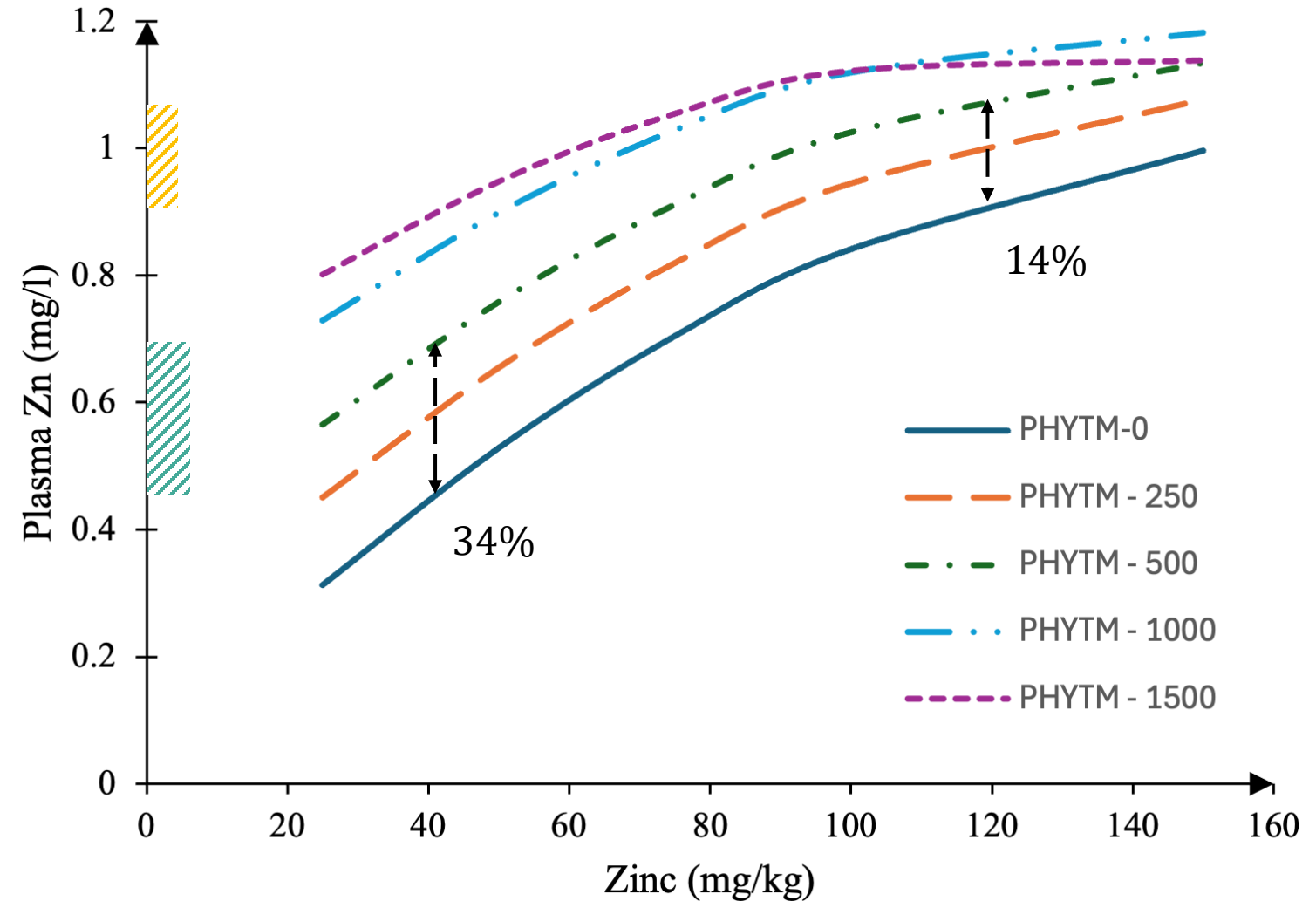


PHYTM : microbial phytase

Result : Plasma Zn is dependant of Zn and PHYTM

Plasma Zn (mg/l)	Coefficient	<i>P</i>
Constante	0.057	0.46
PHYTM	0.064	<0.001
PHYTM ²	-0.002	<0.001
Zinc	0.011	<0.001
Zinc ²	-0.0001	<0.001
Zinc x PHYTM	-0.0001	<0.001

$R_{adj}^2 = 0.82$; RMSE = 0.10 (mg/l)

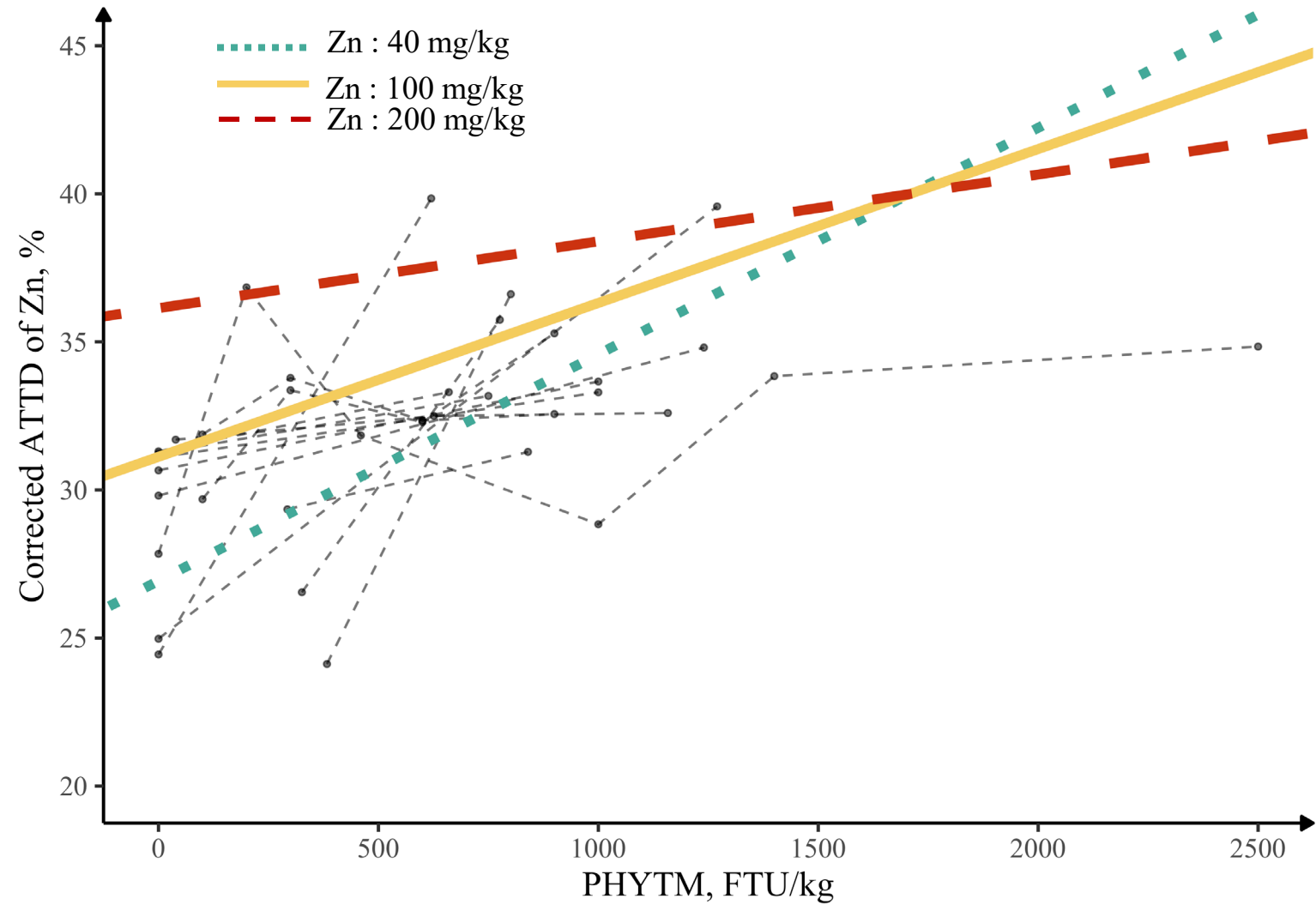


PHYTM = 100 FTU/kg

Result

ATTD of Zn, %	Coefficient	<i>P</i>
Constante	21.004	0.46
PHYTM	0.839	<0.001
Zinc	0.007	<0.001
Zinc x PHYTM	-0.0045	0.02

$R^2 = 0.89$; RMSE = 2.53



PHYTM = 100 FTU/kg

Discussion

- The quadratic response of plasma Zn to dietary Zn agrees with Schlegel et al., 2013
- Phytase hydrolyses phytic P avoiding the formation of Zn-phytic P complexes² in the digestive tract of pig and making more Zn available for absorption^{1,3}.
- Zn metabolism is regulated by its absorption and its endogenous secretion (biliary and pancreatic secretion). With phytase, Zn is more available for absorption, and the supplemental Zn absorption activate the regulation of Zn leading to less absorption and more endogenous secretion (negative interaction in the model)

¹Schlegel et al., 2013; ²Selle and Ravindran, 2008 ; ³Bikker et al., 2012

Conclusion

- Phytase and dietary Zn increase plasma Zn and ATTD of Zn
- Due to the metabolism of Zn, the effect of phytase is modulated as dietary Zn increase
- Numerous fluxes on Zn exist in the digestive tract of pig, and a mechanistic representation of the system is needed to better understand the variation of the absorption and the endogenous secretion in response to dietary Zn or phytase



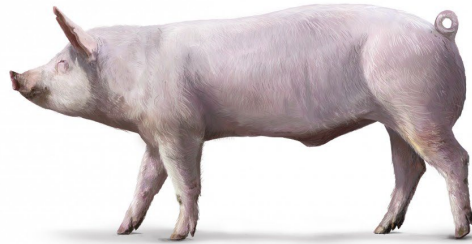
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Thank for your attention !



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