Influence of phytate and phytase on native and supplemented zinc bioavailability in piglets

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Zinc (Zn) is an essential trace element, a heavy metal and a non-renewable resource. Phytate is identified as the major dietary factor affecting Zn bioavailability in monogastrics, as phytate-zinc complexes are insoluble. Data from 5 experiments (31 observations) on weaning piglets, published between 2002 and 2010 were used to evaluate the interactions between phytate, phytase and Zn on Zn bioavailability. A GLM procedure was conducted using bone Zn content as dependent variable and dietary native Zn (Znn), added Zn sulfate (Znadd), Znadd^2 and non-hydrolyzed phytic P (PPhytNH) as independent variables. PPhytNH is a new variable and represents the residual phytic phosphorus (P) fraction remaining intact after hydrolysis by mainly vegetal and microbial phytase. It represents the difference between dietary phytic P and the quantity of released P. Bone Zn responded linearly to PPhytNH in non supplemented Zn diets (bone Zn = 91.7 ($P<0.001$) – 36.1 ($P=0.001$) * PPhytNH, $R^2=0.81$, RSE=7.24). Results from the meta-analysis ($R^2=0.92$; RSE=5.86) indicate that the positive effect on bone Zn from Znn ($P<0.001$) was clearly reduced by the interaction of PPhytNH ($P<0.001$). However, PPhytNH did not interact with Znadd ($P>0.10$). Znadd increased bone Zn linearly ($P<0.001$) and quadratically ($P<0.001$). The quadratic effect is probably due to the plateau of bone Zn with increasing dietary Zn. The present meta-analysis confirms that 1) neither phytic P nor phytase influences the bioavailability of supplemented Zn; 2) the release of Zn by phytase is proportional to the release of P; 3) microbial phytase offers an important possibility in adding value to native Zn. This model allows a quantification of the phytate antagonism on Zn bioavailability and could be used to review dietary Zn recommendations in pigs.