Bioavailability of alternative zinc sources in piglets 0-3 weeks post weaning

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Background and objectives. Inorganic zinc oxide (ZnO) is the most abundant source of added zinc (Zn) to diets of pigs. However, the bioavailability of traditional inorganic ZnO in weaned piglets is estimated to be low and there are other sources of Zn (organic/processed inorganic forms) with potentially higher bioavailability. However, a range of feed components, such as phytate, dietary fiber, tannins, protein quantity and quality and presence of other divalent cations in the diet affect the bioavailability of Zn. This makes comparison of bioavailability of Zn from different Zn sources across studies difficult. The aim of this study was to determine biomarkers of Zn bioavailability (apparent total tract digestibility (ATTD) of Zn and plasma Zn status) following different Zn sources, their effect on performance and faecal consistency score in piglets 0-3 weeks after weaning.
Material and methods. Ninety-six female pigs weaned at 28 days of age (6.8±0.7 kg) were randomly assigned to eight dietary treatments d0-21 post-weaning; A standard weaner diet including 0.5% titanium dioxide as an indigestible marker plus 100 ppm of one of six Zn sources (ZnO and $ZnSO_4$ also in 1000 ppm) (Table 1). The standard diet contained approximately 50 ppm Zn when added Zn was not included.

Table 1. The eight dietary treatments, level and type of Zn added to the diet (n=12/treatment)

Treatment	1, 2	3, 4	5	6	7	8
Level, ppm	100, 1000	100, 1000	100	100	100	100
Type	Oxide	Sulfate	Glycinate	AA bound	Covalent	Micronized

The experiment was conducted in three blocks of 32 pigs/block. Pigs were housed individually with ad libitum access to feed and water. Body weight and feed intake was recorded and blood obtained for analysis of plasma Zn status, weekly. Faeces consistency was evaluated daily using a 4-scale visual scoring system (1, 2 = normal, 3, 4= diarrhoea) and at d14, ATTD of Zn was calculated based on analysis of a grab faecal sample.
Results. Treatment did not affect average daily feed intake d0-21 (P=0.17) ranging from 259 to 361 g/d. Average daily gain d0-21 was also unaffected by treatment (P=0.21) ranging from 201 to 306 g/d. The ATTD of Zn d14 was similar for ZnO and $ZnSO_4$ when provided at 1000 ppm (3.42 and 8.70, respectively). However, all diets with 100 ppm added Zn from different Zn sources, showed negative values of Zn ATTD (P<0.001), but only Zn-glycinate (Zn ATTD = -16.48) resulted in significantly lower Zn ATTD than amino acid (AA) bound (Zn ATTD = -0.55) and micronized Zn (Zn ATTD = -4.07), the other Zn sources were intermediate. Results on plasma Zn status are currently being produced in the laboratory and will be presented at the meeting. Generally, the frequency of diarrhoea was very low. The risk of a faecal consistency score considered as diarrhoea (score 3+4) was not influenced by treatment neither when considered separately in week 1, 2 or 3 (P=0.98, 0.83 or 0.14, respectively), nor across the entire experimental period d0-21 (P=0.56). From d0-21, the risk of diarrhoea ranged from 1.3% to 8.2%.
Discussion and conclusion. Negative ATTD values for Zn when 100 ppm Zn is added to the diet indicates that the endogenous loss of Zn at post-weaning d14 is greater than the dietary Zn supply. This again indicates that pigs are under supplied with Zn at d14 when 100 ppm is added to the diet and the degree of under-supply vary between Zn sources. Our own unpublished results from a Zn dose-response experiment in newly weaned pigs show that 150 ppm total Zn in the diet (added Zn as ZnO), is far from enough to cover the physiological requirement for Zn the first two weeks after weaning when feed intake, gain and plasma Zn status are the primary response parameters, supporting the present findings. However, more robust conclusions can be drawn when the results on plasma Zn status as another indicator of Zn bioavailability is available.