Physical-chemical properties of zinc oxide in enhancing piglet health and growth

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OBJECTIVES

Recent research has shown that the **physicochemical properties of ZnO** significantly influence both its **bioavailability** in animals and its **antibacterial activity** (Cardoso et al., 2021; Vahjen et al., 2012).

→ To characterize *in vitro* the physical properties of two ZnO sources and its antibacterial properties.

→ To assess their physiological impact *in vivo* by feeding them to piglets for 25 days.

MATERIAL AND METHODS

SOURCES:

-Potentiated ZnO (**pZnO**; HiZox®)
-Activated ZnO (**aZnO**)

IN VITRO

-Particle size, specific surface area (SSA), density.

-Antibacterial on *E. coli* ETEC F18
-Growth media incubated during 8h (room temperature and pH 6.7)
-Turbidity every hour over 8h (OD690)

IN VIVO

-Design: 561 piglets, 4 treatments,
-150 ppm Zn from **pZnO** or **aZnO**
-With or without essential oils and organic acids
-25-day study

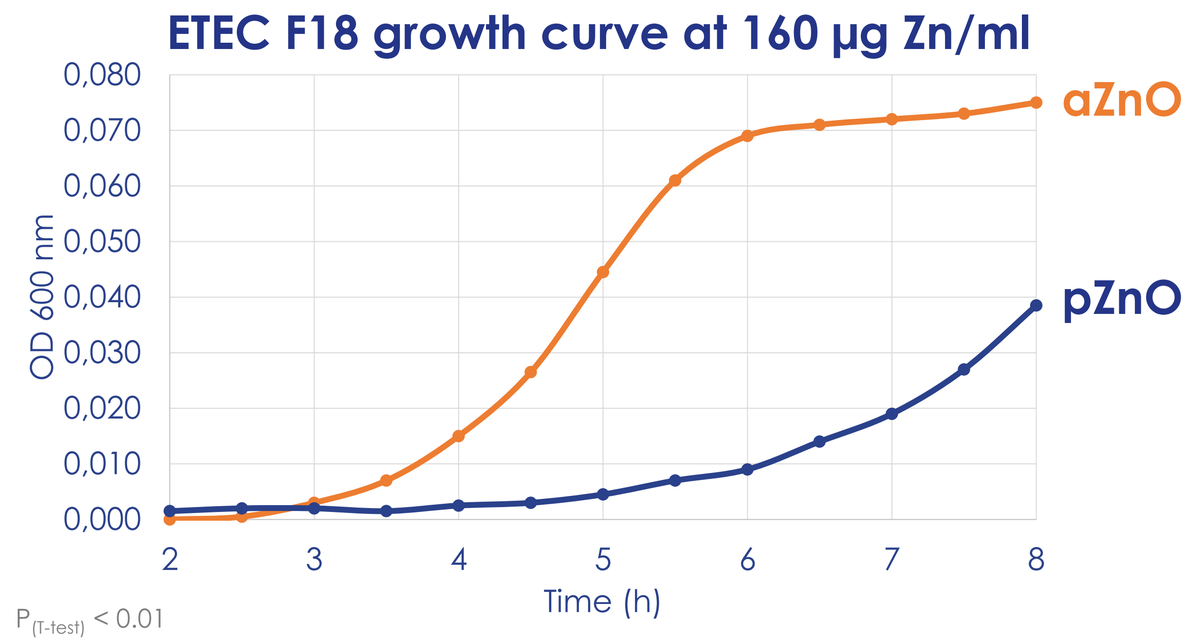
STATISTICAL ANALYSIS

-Antibacterial activity: unpaired t-test.
-Performance: ANOVA (effect of Zn source, additional additives, and interaction).

RESULTS AND DISCUSSION

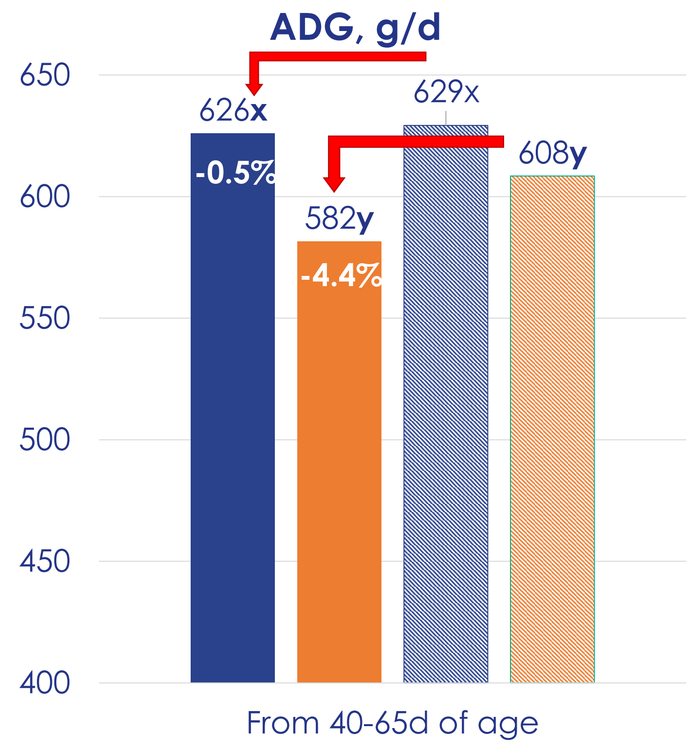
In vitro results showed important differences on the median particle size (**pZnO** = 126 µm and **aZnO** = 16 µm) and bulk density (**pZnO** = 1 g/mL; **aZnO** = 2 g/mL). **aZnO** was characterized as a very poor flow characteristic (Hausner ratio 1.52), while **pZnO** was characterized as excellent flowability (Hausner ratio of 1.08). For SSA: 45 m2/g for **pZnO** and 0.04 m2/g **aZnO**, showing that the surface to be in contact with bacteria is more than 1000-fold higher in **pZnO**.

In vitro efficiency showed that after 3h, ETEC F18 starts to grow in the media with **aZnO**, while in the media with **pZnO** it started to grow after 5h ($P<0.01$). These results can be linked to the differences in SSA, and have been observed in previous trials (Vahjen et al., 2012; Trevisi et al., 2014).

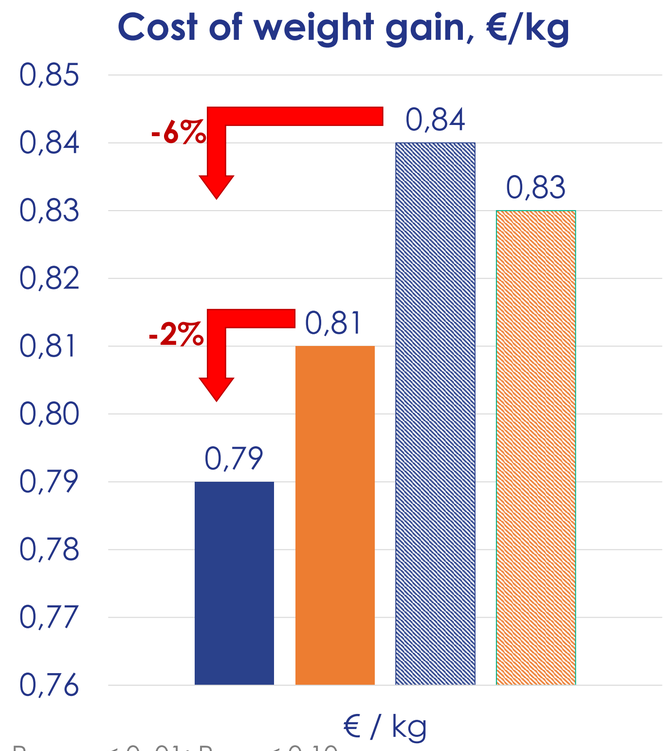


$P_{(T\text{-test})} < 0.01$

In vivo showed that piglets fed **pZnO** tended to achieve higher ADG than those fed **aZnO**, regardless of whether feed additives were included. The cost of weight gain was reduced by 6% within **pZnO** treatments and by 2% compared with **aZnO**.



$P_{source} = 0.10$; $P_{Block} < 0.01$



$P_{additive} < 0.01$; $P_{Block} < 0.10$

CONCLUSION

When no additional feed additives are used, piglets receiving aZnO exhibited reduced performance, whereas those supplemented with **pZnO** demonstrated a performance decline of less than 1%, indicating superior resilience associated with **pZnO**. This source can be effectively supplemented in starter diets, either alone or in combination with other additives, and tends to improve daily gain in piglets compared to aZnO.