

SHORT REPORT

Open Access

# Elevated dietary zinc oxide levels do not have a substantial effect on porcine reproductive and respiratory syndrome virus (PPRSV) vaccination and infection

Weidong Chai<sup>1</sup>, Zhenya Wang<sup>1</sup>, Pawel Janczyk<sup>2</sup>, Sven Twardziok<sup>3</sup>, Ulrike Blohm<sup>4</sup>, Nikolaus Osterrieder<sup>1</sup> and Michael Burwinkel<sup>1\*</sup>

## Abstract

**Background:** Porcine reproductive and respiratory syndrome virus (PPRSV) is one of the most important infectious agents for the swine industry worldwide. Zinc (Zn) salts, which are widely used as a dietary supplement in swine nutrition, have shown antiviral effects *in vitro* as well as *in vivo*. The purpose of this study was to determine the influence of dietary zinc oxide supplementation on vaccination and challenge infection with PPRSV.

**Findings:** The clinical course of PRRS and the success of vaccination with an experimental inactivated vaccine were compared between animals receiving a conventional diet (50 ppm Zn, control group) and diets supplemented with Zn oxide (ZnO) at final Zn concentrations of 150 or 2,500 ppm. Pigs receiving higher dietary Zn levels showed a tendency towards higher neutralizing antibody levels after infection, while dietary Zn levels did not substantially influence the number of antiviral IFN-gamma secreting cells (IFN-gamma-SC) or percentages of blood immune cell subsets after infection. Finally, feeding higher dietary Zn levels reduced neither clinical symptoms nor viral loads.

**Conclusions:** Our results suggest that higher levels of dietary ZnO do not have the potential to stimulate or modulate systemic immune responses after vaccination and heterologous PPRSV infection to an extent that could improve the clinical and virological outcome.

**Keywords:** PPRSV, Inactivated vaccine, Dietary zinc oxide

## Findings

### Introduction

Porcine reproductive and respiratory syndrome (PPRS) is one of the most significant swine diseases worldwide [1]. Efficient PRRS virus (PPRSV) vaccines would be invaluable in minimizing the clinical and economic impact of PPRSV infections, but currently safe and effective vaccines which protect against a wide variety of strains are not available [2].

Zinc (Zn) ion salts exhibit a broad-spectrum antiviral activity against a variety of viruses *in vitro*, including the animal viruses equine arteritis virus and transmissible

gastroenteritis virus [3,4]. In the European Union standard dietary Zn levels in feedingstuffs are limited to 150 ppm due to environmental reasons. However, in other countries high levels of in-feed Zn oxide (ZnO, 2,000-3,000 ppm) may be added to the diet of pigs during a restricted period following weaning to prevent post-weaning diarrhea [5] as high levels of ZnO have been proven to conserve the intestinal flora during the critical period following the change of diet that place at weaning [6]. Despite this effect, the exact mechanisms of ZnO action remain uncertain, and the local or systemic effects of ZnO against specific viral pathogens also remain largely unknown.

We evaluated the systemic effects of different Zn levels added to a conventional diet containing 50 ppm Zn (Zn<sup>low</sup>, control group) against PPRSV. Two other groups were fed the diet supplemented with ZnO at final

\* Correspondence: burwinkel@rki.de

<sup>1</sup>Institut für Virologie, Freie Universität Berlin, Robert-von-Ostertag-Str. 7-13, 14163 Berlin, Germany

Full list of author information is available at the end of the article