# PREVENTION OF POST WEANING DIARRHOEA IN PIGLETS - REVIEW

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## Abstract

High doses of antibiotics and ZnO for growth promotion and diseases prevention in animals contributed to the antibiotic resistance. Antibiotics as growth promoters were banned by the European Parliament in 2003. In June 2022, the use of therapeutic doses of zinc oxide (ZnO) in compound feed for piglets will be banned. Post-weaning diarrhoea of piglets is caused by E. coli bacteria and is a big problem for many breeds. The solution of post weaning diarrhoea is not just about nutrition measures. The problem needs to be looked at comprehensively. The solution must also include hygienic measures to reduce the stress on the piglets as much as possible and to increase their resilience. The article is a review of possible nutritional intervention.

**Key words**: Piglet; weaning; diarrhoea; nutrition

High levels of pig performance have been achieved and maintained using antibiotic growth promoters and zinc oxide in piglets. The routine use of antibiotics has led to the antibiotic resistance of microorganisms, not only in animals but also in humans (Várnagy, 2020). Antibiotics as growth promoters were banned by the European Parliament in 2003 (Regulation (EC) No 1831/2003 of the European Parliament and of the Council of 22 September 2003 on additives for use in animal nutrition). Consumers' interest in food produced in so-called antibiotic-free plants has also contributed to reducing the use of antibiotics in animal nutrition. The feed industry was faced with the question of how to replace antibiotics. Subsequently, the consumption of zinc oxide, which was used as a preventive measure against diarrhea in piglets, increased sharply. In June 2022, the use of therapeutic doses of zinc oxide (ZnO) in compound feed for piglets will be banned. The use of ZnO had a number of positive effects, but also a large spectrum of negative ones (Figure 1). Zinc as a trace element will not be completely excluded from compound feed, as it is important for the proper growth of piglets. Zinc is a component of enzymes, is important for a wide range of metabolic processes in the body and is therefore irreplaceable. Zinc is considered essential for cell division and synthesis of DNA and protein synthesis. Besides, zinc is not widely stored in the body and requires a continuous supply along with the diet specially in pigs as pig diets are mainly composed of cereals, which contain high amounts of phytase (Borah and Paul, 2018). Zinc in the form of ZnO is very poorly used by the body, the excess is excreted in the faeces into the soil and water and burdens the environment. In 2017, the European Medicines Agency (EMA) decided that the negatives of using therapeutic doses of ZnO outweighed the positives (prevention of diarrhoea in piglets). It has been found that high doses of ZnO increase the proportion of multidrug resistant E. coli and salmonella, the two most important pathogens in pig farming. It has also been found that excess zinc accumulates in the liver, pancreas and blood serum and reduces the proportion of lactobacilli in the intestinal microflora. This led to the aforementioned ban on the use of ZnO in high doses in piglets (Barbosa et al., 2019).

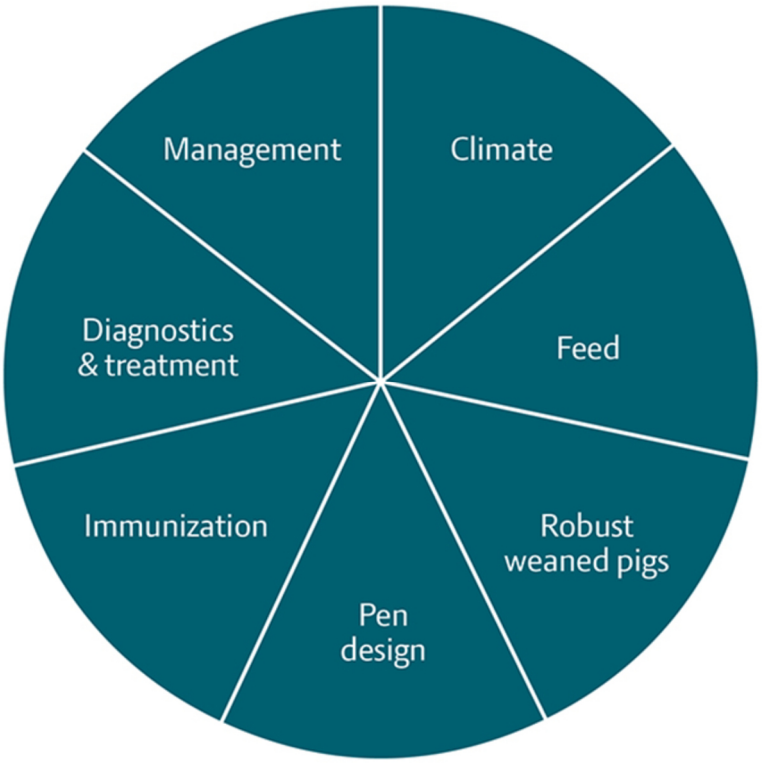
***Figure 1. Positive and negative effects of ZnO*** (Source: Várnagy, 2020)

| Negative effects of ZnO | Positive effects of ZnO |
|---|---|
| Increases the occurrence of antibiotic resistance (Vahjen *et al.*, 2015) | Morphology changes in the large intestine leading to better mucose production and thus immune response (Liu *et al.*, 2014) |
| Encourages the selection of multi resistant E. coli strains (Bednorz *et al.*, 2013) | Boost in production performance due to improved mucose secretion and immune respones (Liu *et al.*, 2014) |
| Decreases the absorption of macro- and micro elements (Sandström, 2001) | ZnO compensates for any weaknesses of technology, management, animal health and feed |
| Decreases the effectiveness of phytase (Lizardo, 2004) | Can be the most cost effective solution |
| Decreases the effectiveness of organic acids (Mavromichalis, 2014) | |
| Heavy metal effect on the environment (Dourmad and Jondreville, 2007) | |

**Post weaning diarrhoea**

Post-weaning diarrhoea of piglets is caused by E. coli bacteria and is a big problem for many breeds. This is a global problem, not limited to certain regions or states (Cho et al., 2012). During weaning, piglets are exposed to several stressful situations, whether nutritional or social. According to the valid legislation, piglets can be weaned at the age of 21 days at the earliest, standardly they are weaned at the age of 28 days (with the exception of organic farms). If weaned at a physiological time, it would be much later, the piglets would have a digestive tract developed and populated with the right microflora (Jensen et al., 1992). However, weaning at the age of one month represents a significant stress, which has negative effects. The pig does not receive food, the digestive tract is emptied, water intake is reduced, the intestinal microflora begins to change, and pathogenic bacteria causing diarrhoea begin to predominate. From a nutritional point of view, this period is demanding and the piglets must be properly prepared for weaning. Piglets suffering from post-weaning diarrhoea do not eat, are severely dehydrated (Williams, 2003; Lalles et al., 2007). Approximately 50% of weaned pigs consume their first feed within 24-h post-weaning, in approximately 10% weaning anorexia persists for up to 48 h (Brooks et al., 2001). ZnO in doses of 2500 - 3000 ppm has been used as a prevention since the 1990s. However, additional measures in farms are an essential part (Figure 2).

***Figure 2. Factors influencing a successful weaning of piglets*** (Source: Shooter, 2020)




The solution of post weaning diarrhoea is not just about nutrition measures. The problem needs to be looked at comprehensively. The solution must also include hygienic measures to reduce the stress on the piglets as much as possible and to increase their resilience. Any measures cannot be effective if they are carried out on piglets that have been experiencing problems since the suckling period. The basis is a healthy and vital piglet, which was properly treated after birth and received the colostrum necessary to gain immunity. Maternal hygiene is also important, the pen must be clean and disinfected before the sow arrives at the farrowing house, and the surfaces must be dry. Newborn piglets need to be dried and treated (preferably with disposable wipes). The newborn piglet does not have a fully developed thermoregulatory, immune and digestive system and has insufficient hematopoiesis. It therefore needs to ensure optimal temperature, intake of colostrum antibodies, sufficient energy, iron supplementation (Smola et al., 2015).

In terms of technology at farrowing stables, the most common farrowing pens are with restricted movement of the sow. Although alternative housing methods are currently being promoted, several days after the birth of piglets losses most often occur. Barriers that slow down the sow lying down reduce piglet losses by up to 0.8 per litter. All pen designs must comply with the minimum standards for animal protection and welfare by the legislation. Piglets must have access to water. The feeders must be regularly cleaned of forage and faeces (Rozkot, 2021; Rozkot, 2020; Smoal et al., 2015).

**Nutritional intervention**

Plant extracts have come to the interest with the ban on the use of antibiotics since 2006. The effects are mainly in the area of support of feed intake, digestibility of nutrients, support of beneficial microbiome in the digestive tract and also support of the animals' immune system. These extracts are often used in traditional

medicine, where their effects are known, and then their use has been transferred to the field of animal nutrition (Lei et al., 2018; Namkung et al., 2004). Examples are cinnamon (*Ramulus cinnamomi*), star anise (*Illicium verum*), *Bidens pilosa*, *Urena lobata*, *Pseuderanthemum palatiferum* (Matysiak et al., 2012). The plants come from tropical and subtropical regions of Asia. The phytochemical active substances in these plants are tannins, saponins, phenols, alkaloids and glycosides, which have antibacterial and antioxidant effects. The flavonoids contained in the lobed dental support liver function, showing high activity against *Bacillus cereus* and *E. coli*. *P. palatiferum* leaves have anti-diarrheal effects in piglets, cinnamon and star anise inhibit the replication of some viruses (Alikwe et al.,2014; Patra et al., 2020; Babu et al., 2016). Studies have also shown the effect of carvacrol on Salmonella bacteria. Carvacrol is a substance contained in oregano and thyme. This substance has a beneficial effect on the development of intestinal microflora, ie. that it increases the ratio between lactobacilli and enterobacteria, reduces the growth of coliform bacteria. Allicin (garlic extract) also protects intestinal cells from *E. coli*. In addition, garlic contains other active substances that reduce the activity of viruses and some fungi, improve feed intake and utilization and increase piglet weight gain. The literature also mentions the joint use of garlic and cinnamon extracts to increase piglet feed intake, increase growth and reduce piglet mortality (Michiels, 2010; Pellikaan et al., 2010; Si et al., 2006; Tatara et al., 2008) .Another option of post weaning diarrhoea reduction is the acidification of feed mixtures using organic acids. Organic acids with a short to medium chain, such as the citric, propionic, lactic and fumaric acids, are used in piglet feed in higher doses. They have bactericidal and bacteriostatic effects and offer the benefit of low cost. The aim is to reduce the pH in the stomach to an optimal level and thus ensure the digestion of fiber, which would become a ground for pathogenic microorganisms in the intestines. The advantage of acidifying of the digestive tract lies in the inhibition of undesirable microorganisms and the stabilization of the composition of the intestinal microflora. Furthermore, acidification ensures better digestibility of proteins (Tsiloyiannis et al., 2001).

Humic substances are natural organic compounds created by chemical and biological decomposition of organic matter and by synthetic activities of microorganisms. Humic substances include humic acids, fulvic acids and humin. People used humic substances as medicines already back in early days. Their medical effects are due to humic acids. In recent years, research has intensified on utilisation of these substances in various areas of life – in industry, agriculture and both human and veterinary medicine. In agriculture, they are used as natural growth promoters. They show antimicrobial properties, inhibiting growth of certain harmful microorganisms in the digestive tract. They create a protective film on the surface of the digestive tract, preventing infection and toxins from invading the organism. Humic acids are effective in treating multifactorial disorders, such as gastroenteritis, diarrhoea and metabolic disorders. Adding these substances to feed stabilises the intestinal flora and pH in the digestive tract (Ji et al., 2006).

The use of probiotics (such as Lactobacillus, Streptococcus, Enterococcus, Lactococcus, Bifidobacterium, Bacillus, microscopic fungi Saccharomyces cerevisiae and many others) and prebiotics in compound feeds is also an effective measure in the fight against weaned piglets (Maré, 2009). Probiotic microorganisms are able to survive in the acidic environment of the stomach and displace the proportion of pathogenic microorganisms in the intestine. The most important prebiotics for livestock are non-starch oligosacharides, such as fructo-oligosaccharides and galacto-oligosaccharides (Estienne et al., 2005).

Another nutritional intervention is to reduce the protein content of the compound feed. Excess protein (more than 20% of nitrogenous substances) is related to the occurrence of diarrhea, indigestible proteins remain in the digestive tract longer and thanks to them pathogenic microorganisms begin to multiply. It is important to maintain the level of the limiting amino acid lysine in the feed mixture. Reducing protein content in the feed ration (the so-called low-protein diet) is recommended as contributing to both the piglet's health (better growth, lower incidence of diarrhoea) and environment (less nitrogen excreted). Piglets which intake such diet (less than 21% protein) are less prone to infection with *E. coli*. Protein content, however, cannot be reduced below a certain threshold (the recommended threshold is 17%), unless valine and isoleucine amino acids are supplemented (Heo et al., 2008). The reduction of protein level under 17% causes a decrease of average daily weight gain (Várnagy, 2020).

## Conclusion

Many factors play a role in the prevention of post weaning diarrhea, nutrition remains one of the most important. According to previous studies, it will not be possible to replace ZnO with only one alternative, it will be necessary to use a combination of several measures, such as reducing the protein content in the feed mixture at the same time as additives. No nutrition measure can work if the principles of hygiene, animal care, prevention and husbandry management are not followed.

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