

THE NUTRITION OF WEANED PIGLETS - REVIEW

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Abstract

The recent years have seen a major development in the reproductive performance of pigs. With sows bearing more piglets per litter, the birth weight of piglets has decreased. Piglets need more care and treatment in the first days of their lives. This period is crucial for subsequent stages of a piglet's life, both in terms of its growth and health. After overcoming the first weeks of their lives, piglets are weaned. This is a critical period in a piglet's life, as it imposes not only a nutritional stress, but also a social stress induced by separation from the sow, a change of environment and a change of social hierarchy in the newly established groups of animals. After weaning, the feed ration changes, frequently bringing about changes in the piglet's digestive tract, digestive disorders and diarrhoea. After weaning, piglets may experience temporary anorexia, stop eating or become more prone to intestinal infections. In addition, weaning also causes a change in the intestinal flora. If piglets are to enter rearing in optimal health condition, two basic tasks must be addressed: providing feed intake and avoiding piglet diarrhoea.

To gain a better understanding of the problem, we need to take a closer look at how piglets are nourished in this critical period. It is well known that piglets need a high-quality diet in the weaning period. But what does a high-quality diet mean? Nowadays, the nutrition of weaned piglets is studied by many specialist centres all around the world, including research institutes and universities as well as companies specialising in animal nutrition. If we want to feed an animal properly, we must first understand its nutritional needs, the physiological processes in its organism and the behaviour linked to feed intake. We also need to understand that it is not about precisely formulating the animal's needs, but rather about processing, transporting and storing the feed, which brings about certain risks.

Key Words: Piglet, feed, weaning

The piglets cannot reach their maximum growth potential after weaning, because they have to face a number of obstacles, such as separation from their mother, establishing new animal groups (social stress), immunological stress, new method of feeding (Weary et al., 2008). Therefore, the growth potential of piglets remains unexploited. It is generally known that most problems arise with piglets that have not learned to eat sufficient amount of feed by the time of weaning. However, not only do piglets need to learn to eat enough feed, but also – unlike in the period when they sucked breast milk – to tell when to eat and differentiate between hunger and thirst. They have to learn to satisfy these two sensations from two sources: water and dry feed. Sufficient amount of feed consumed in the first week after weaning affects the live weight of the piglets at the end of the 4th week after weaning. Specifically, increasing the feed intake in the first week by 0.1 kg/day rises the piglet's weight at the end of the four-week period after weaning by 1.5 kg. Consuming 150–200 g of feed per day in the first week after weaning is deemed sufficient (Mavromichalis, 2019).

In terms of amino acid content, the most important is the lysine essential amino acid. It is also necessary to monitor the levels of methionine, threonine, tryptophan, isoleucine and valine. Adding glutamine to compound feeds for piglets is important to maintain a good health of the gut. The recommended content of amino acids is based on determining the content of lysine in the so-called ideal protein. 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).

Since the digestive tract of a piglet is adapted to digesting milk sugar up to the age of three weeks, the pre-starter compound contains a milk component in order to ensure a smooth transition from milk diet to the dry compound and

avoid stressing the piglet's enzymatic system. Research shows that during the first few weeks after weaning, feed intake and growth depend on the content of lactose in the feed (Mahan et al. 2004, Pierce et al., 2005). In excessive quantities, however, lactose causes piglet diarrhoea. Adding 10–20% of whey powder to compound feed improves piglets' growth by 15–30%. For piglets weighing more than 12–15 kg, adding lactose to support growth ability is pointless since their digestion is already adapted to another type of feed.

Vitamins and minerals are essential components of the feed. After birth, the piglets are deficient in iron, since iron is not transported across the placenta to the foetus during prenatal development and the iron content in the sow's milk is low. Therefore, piglets must be supplemented with iron after birth. If they are not, they may become less resistant to diseases and negative environmental influences as well as more sensitive to *E. coli* endotoxins. The newborn pig contains approximately 50mg of Fe at birth. The neonatal pig has been determined to have a requirement of 7-16mg of Fe/day for normal growth (Venn et al 1977). Due to minimal concentration of Fe in sows milk (1mg/l), neonatal pigs reared in confinement require supplementation Fe in order to overcome the susceptibility to anaemia (Brady et al., 1978). For piglets up to one week before weaning, the maximum amount of iron is 250 mg/day. The most discussed mineral in piglet nutrition is zinc. Zinc participates in cell division and formation of cartilages and bones. Consequently, its lack causes growth retardation, dermatitis, and impairment of reproductive functions in both sows and boars. Zinc also participates in processes linked to production of creatin. The requirements for the quantity of zinc in the feed ration are high in piglets and decrease with age (Manzanilla, 2019). A deficiency is more noticeable in pigs that are on a high-calcium diet. Since zinc displays antibacterial effects, it is widely used in pig farming to reduce incidence of diarrhoeal diseases, which are a frequent cause of losses of reared piglets. In the 1990s, it was discovered that zinc doses of 2000–3000 ppm in the form of an oxide or sulphate improve performance, and zinc dioxide started to be used as a supplement to support growth of young pigs. Since low utilisation rate of the conventionally administered zinc dioxide leads to significant excretion of zinc with subsequent negative

influence on the environment, legal restrictions will be imposed on the doses of zinc that may be used in feeds for livestock in 2022 (Poulsen, 1998; Bělková et al., 2018).

So how can we ensure that piglets intake a sufficient amount of feed? We have already addressed feed quality, but we should not forget about the necessity to comply with principles of hygiene and to ensure optimal environmental conditions. Piglets must learn to eat feed as soon as possible (Dybkaer et al., 2006). Usually, compounds start to be administered to piglets by one week of age. The piglets are administered a small amount of the pre-starter compound in their feeding bowls. They gradually get used to the new type of feed, which initially does not serve as a compensation for milk deficiency. It is advisable to make the compound as appetising as possible, e.g. by using heat treatment or flavourings (Bělková a Václavková, 2017)

When getting piglets used to compound feed, several principles must be followed to ensure that they get accustomed successfully and are able to eat enough feed when weaned.

- Feeders for the compound must be kept clean.
- The compound in the feeders must be changed for a fresh one every day.
- Feeders should not be overloaded with pre-starter and must be cleaned from faeces and urine daily. Feeders with a fermenting or mouldy content pose a risk of diarrhoeal diseases.
- Piglets must have access to drinking water using a bowl or drinking trough for sucking piglets.
- Feed must be stored in a cool place and the packaging must be closed after withdrawal of the feed to avoid contamination with the smell from the sty.
- The feeder for the pre-starter must be placed outside the reach of the sow in the pen. It should not be placed in a corner or in the vicinity of a drinking trough or a heat source (lamps, radiators) (Smola et al., 2015)

Insufficient intake of compound feed and starvation after weaning weakens the piglet and causes inflammation of the digestive tract. A piglet is very prone to infections. Since feed is the easiest way to influence the flora of the digestive tract, such conditions are prevented by various adjustments to compound feeds. One option, as

already mentioned, is to lower the protein content of the feed and balance the levels of amino acids. Other options include using prebiotics and probiotics, enzymes, acidifiers, herbal extracts, essential oils etc. Let us take a closer look at some of the options (Estienne et al., 2005; Maré, 2009).

Perhaps the most commonly used one is zinc dioxide, which serves as a substitute for antibiotics in preventing piglets' diarrhoea. Since its use will be restricted as of 2022, attention has focused on other substances. 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).

Another group of substances which can be used to improve piglets' health is herbal extracts (Lange et al., 2010; Durmic and Blache, 2012). Many of them have a several-thousand-year-old tradition in China, but also in Mesopotamia, Egypt, India, Greece and South America, where they have been utilised for medical purposes. The effects of herbal extracts depend on the dosage. While an insufficient dose has no effect, some can be toxic if overdosed. Essential oils are an important group of natural substances. These are extracts which are obtained by steam distillation and have a strong aroma and taste, so they are dosed in very small amounts. If they were not, they could negatively affect the intestinal flora, cause allergies or lower feed intake. Essential oils are hydrophobic and are quickly absorbed when ingested, inhaled or applied subcutaneously. In piglets, for instance, most of them get absorbed

from the stomach within 2 hours after feed intake. This is why they must be protected against early absorption and are processed into microcapsules that resist the digestive processes of the stomach and only get absorbed in the duodenum. A wide range of secondary metabolites of herbs can act against physiological and environmental stressors and pathogenic microorganisms. Studies have shown effect of limonene a cinnamaldehyde on *E. coli* bacteria and effect of carvacrol and eugenol on *Salmonella* bacteria (Michiels, 2010; Pellikaan et al., 2010). Cinnamaldehyde is a substance contained in cinnamon bark. Carvacrol is a substance contained in oregano and thyme. This substance has a positive effect on development of the intestinal flora, increasing the ratio of lactobacilli to enterobacteria and reducing the growth of coliform bacteria (Si et al., 2006). Similarly, allicin (garlic extract) protects the intestinal cells against *E. coli*. Garlic also contains other active substances that restrict the activity of viruses and some fungi, improve the intake and utilisation of feed and increase piglets' weight gain (Tatara et al., 2008). Literature also suggests that garlic and cinnamon extracts can be used together to increase piglets' food intake, increase gain and reduce piglet mortality. After antibiotic growth promoters have been banned in the EU, attention focused on extracts from medicinal plants as an alternative to the illegal preparations. Certain medicinal plants have long been known to stimulate appetite, regulate metabolism and have antioxidative effects. These effects have been researched in plants such as the fish mint (*Houttuynia cordata*) and the common dandelion (*Taraxacum officinale*). An extract from the common dandelion root, which contains many polyphenols and glycosides, can be used as a prebiotic (Yan et al., 2011). Research has also focused on an extract from the Japanese honeysuckle plant.

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 effects of organic acids are reflected in reduction of the number of coliform bacteria and increase in the number of beneficial lactobacilli (Tsiloyiannis et al., 2001).

Prebiotics are indigestible components of feed that support growth and activity of the intestinal flora, especially of bacteria from the *Lactobacillus* and *Bifidobacterium* genera, thus

improving the animal's health. They are usually hard-to-digest or indigestible oligosaccharides, which become a substrate for beneficial microorganisms in the large intestine. The most important prebiotics for livestock are non-starch oligosaccharides, such as fructo-oligosaccharides and galacto-oligosaccharides (Estienne et al., 2005).

Probiotics are live microorganisms that successfully colonise the animal's digestive tract upon oral administration (in a sufficient dose), thus maintaining or improving the natural flora, defending the digestive tract against colonisation by pathogenic microorganisms and ensuring optimal utilisation of feed. The most commonly used probiotic microorganisms are the *Lactobacillus*, *Bifidobacterium*, *Enterococcus*, *Streptococcus* and *Saccharomyces* bacteria (Maré, 2009).

Conclusion

All the measures that a farmer undertakes in piglet breeding in the period from birth to weaning are aimed at reaching an optimal weaning weight of the piglets and securing a sufficient intake of compound feed at the time of weaning. Piglets that have been well-prepared for weaning handle this period better and reach good gains after weaning. During this critical period, every breeding and feeding principle must be observed in order to minimise diarrhoeal episodes in the piglets. Adhering to all hygiene and organisational practices is a prerequisite for producing healthy and thriving piglets as well as reaching other breeding achievements.

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