Managing oxidative stress in sows for better returns

Increased oxidative stress can quietly eat away at returns in sow production, as it is a factor that impairs milk production, reproductive performance and longevity of the sow. Indirectly it will also negatively impact the health and growth of nursing piglets.

by Gwendolyn Jones,
Anco Animal Nutrition Competence,
www.anco.net

The problem gets exacerbated in hyper-prolific sows and by challenges such as heat, mycotoxins and obesity. The ability to measure oxidative stress efficiently and knowing how to develop effective strategies to help prevent excessive oxidative stress in sows will go a long way towards supporting high returns on sow farms.

Oxidative stress explained

Oxidative stress describes an imbalance between the production of reactive oxygen species (ROS) in the pig and the ability of the pig's antioxidant defence mechanisms to neutralise them. Accumulation of ROS results in oxidative damage to lipids, proteins and DNA in cells and consequently tissue damage.

It can also induce damage in the intestinal tissue, compromise gut integrity in pigs and leads to an increase in inflammatory responses. Therefore, oxidative stress has been associated with impaired health status and reduced energy available for productive purposes.

For instance, under oxidative stress and inflammation 30% of the performance drop is explained by the catabolism and feed conversion needed to manage inflammation.

When are sows most vulnerable to oxidative stress?

The findings of previous studies showed that oxidative stress levels increased during late gestation and lactation. This was associated with sows being under severe catabolic status during late gestation and lactation. Catabolic conditions increase the production of reactive oxygen species.

Lymphocyte DNA damage was significantly increased during late gestation compared to day 30 of pregnancy. Changes in concentrations of lipid and protein peroxidation products indicate that during the periparturient period, especially around farrowing and the first week of lactation, the oxidative/antioxidative balance is disturbed, which leads to oxidative stress.

Extended catabolic condition during lactation can be a cause of further oxidative stress negatively affecting productivity and longevity of sows.

Factors increasing oxidative stress

External factors such as environmental stressors and social stress can lead to increased oxidative stress in sows. Studies have reported that sows showed increased oxidative stress by increased lipid peroxidation, protein oxidation and oxidative DNA damage in a hot environment under heat stress, compared with sows in a thermal-neutral environment.

Oxidative stress indicators in the hot environment were negatively correlated with the number of piglets at birth and weaning, as well as litter weight gain. Reduced litter size of sows under heat stress could be due to increased oxidative stress during the period of embryonic implantation causing increased embryonic death.

Feed quality is another important factor affecting levels of oxidative stress. For example, mycotoxins can play a role even at low to moderate levels of contamination.

A factor that is less well known is sow body condition. Recent studies have shown that higher backfat thickness in sows is associated with enhanced oxidative stress, increased expression of pro-inflammatory cytokines and inhibited a healthy placenta development relative to sows with moderate backfat thickness.

Levels of ROS and malondialdehyde (MDA), a lipid peroxidation marker, were increased in the placenta of sows with increased backfat thickness (Fig. 1).

This may also affect foetal development, as lipid oxidation can influence placental development, lipid metabolism and transport. The above stresses the importance of closely controlling body condition in sows.

Advances in measuring oxidative stress

The intensity of oxidative stress can be monitored with several biomarkers including antioxidative enzymes and non-enzymatic antioxidants, as well as end products or intermediates of peroxidative processes of lipids and proteins. Up until very recently biomarkers for oxidative stress have been measured in serum/plasma samples of pigs.

Anyone that has taken blood samples from pigs knows that it can be very stressful to the pig and it is unknown how this may impact on levels of the different oxidant biomarkers. More recent studies evaluated the possibility of measuring oxidative stress biomarkers in the saliva of pigs.

Saliva as material to evaluate stress conditions has several advantages over blood in pigs, since collecting saliva is easy,

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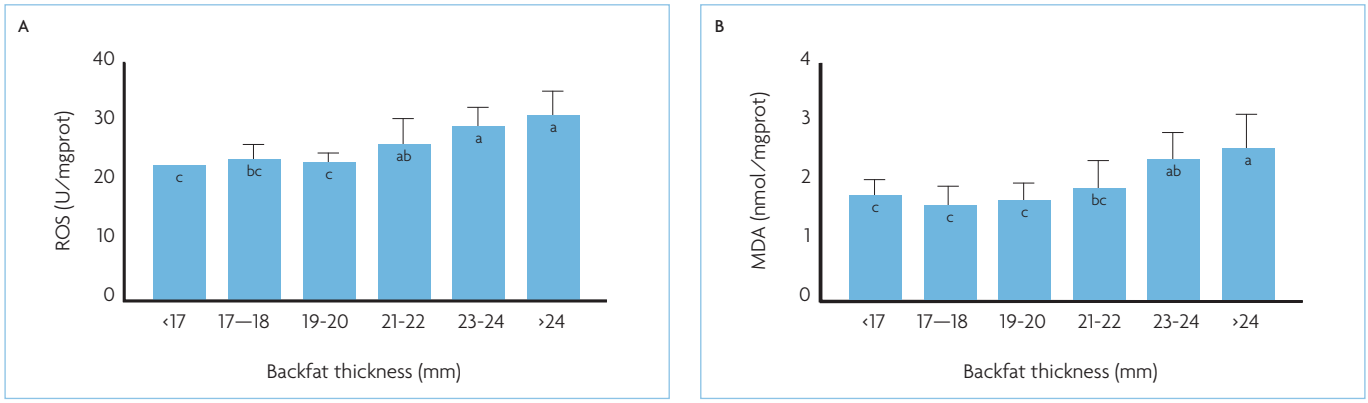

Fig. 1. Antioxidant status in placenta of different backfat thickness in sows. A) Placental reactive ROS level in response to different backfat thickness in sows. B) Placental reactive MDA level in response to different backfat thickness (Zhou et al, 2019).

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non-invasive and leads to minimal discomfort in the animal. It therefore represents an ideal sample in pigs and makes salivary markers very attractive.

The findings of the study confirmed that salivary biomarkers for oxidative stress are valid and reliable.

On top of that, the salivary biomarkers showed significant changes in a situation of oxidative stress such as lactation in sows. This means that future trials designed to measure oxidative stress in pigs would be a lot easier to conduct if salivary biomarkers are used.

Feed for antioxidative capacity

A better understanding of the factors causing oxidative stress and improved capabilities of measuring it in sows is paving the way for producers to take control of oxidative stress more actively to minimise the impact on the sow. Feed additives that have proven capabilities for antioxidant capacity can help to support the antioxidative capacity of sows.

Formulating diets accordingly, particularly for production phases where the sow is more vulnerable to oxidative stress can thus prevent excessive oxidative stress in sows.

Many herbs and spices contain high levels of components with strong antioxidative power, such as alkaloids and polyphenolic compounds, including different types of phenolic terpenes, phenolic acids and flavonoids.

New research methodologies are increasing the understanding of how bioactive substances from herbs and spices work alone and in concert at the cellular level in animals.

This is helping companies working in this field to design products and efficacy trials to maximise the potential benefits from these substances in animal nutrition. ■