Zinc and iron chelates in sows
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INTRODUCTION

An adequate formulation in trace minerals begins with the correct determination of the requirements. Physiological status like gestation and lactation are really important phases during which requirements of trace mineral increase above maintenance.

Another important factor is the bioavailability of the source employed. Bioavailability is determined by the chemical structure of the mineral and composition of the diet. In terms of chemical structure we can find two main groups, inorganic sources of minerals such as oxides or sulphates and organic trace minerals (OTM) in which minerals are bond with an organic molecule like methionine, glycine or peptides.

The presence in the diet of the specific nutrients like phytates could reduce the absorption, because phytic acid reacts with minerals, forming insoluble salts with a drastical reduction in the bioavailability of the minerals. The use of OTM where mineral are bond to organic molecules prevents the reaction with phytates and maintains maximum bioavailability for the minerals.

Other components like organic acids present in the diet could also interact with minerals, forming a specific complex and could increase the absorption of the mineral.

OTM is a good choice to reduce the security margin in the mineral inclusion, reducing excretion of the minerals.

ZINC DURING GESTATION AND LACTATION

Requirements are determined by the physiological status and sows in these periods have high level of zinc requirements. Zinc is an essential nutrient for sows and deficiencies in this period could result in abnormal development of the fetuses and the skeleton in the piglets. It could also could be related with a slow growth or dermatitis (Becker and Ammerman 1955; Shelton et al 2005).

To study the effect in pregnant sows, a trial was conducted by Norel with 236 animals. A control group received a diet with zinc concentration according to NRC and the treatment group was fed with the same diet, supplemented with 200 ppm of zinc in form of Biomet zinc (zinc methionine) during whole gestation and lactation.

Piglets were weighted after parturition and at weaning. The results showed a higher number of weaned piglets in treatment group and also heavier animals than in control group, table 1.

<table>
<thead>
<tr>
<th>CFU/g of feed before pelleting</th>
<th>Control</th>
<th>Biomet Zinc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piglets born</td>
<td>9.40</td>
<td>9.52</td>
</tr>
<tr>
<td>Born alive</td>
<td>9.02</td>
<td>9.25</td>
</tr>
<tr>
<td>Birth weight (kg)</td>
<td>1.39</td>
<td>1.42</td>
</tr>
<tr>
<td>Piglets Weaned</td>
<td>8.42x</td>
<td>8.84y</td>
</tr>
<tr>
<td>Weaning weight (kg)</td>
<td>6.50x</td>
<td>6.90y</td>
</tr>
</tbody>
</table>

Table 1.- Effects of addition of Biomet zinc in sows diet
x,y,p<0.1
Similar results were obtained by Payne et al. in 2006 when sows were supplemented with 100 ppm of organic zinc. A higher litter weight at birth and more weaned piglets per sow were obtained when sows were supplemented with OTM.

Numerical productivity, determined by number of weaned piglets per productive sow per year, has been increased year by year in farms. In Spain, in 2011, this parameter increased by 2.31% with an average of 26.12 piglets weaned per sow (Spanish report for swine production for year 2011). The increase of productivity with hyper prolific sows, together with a higher growth and development of the piglets, increases the requirement of zinc in piglets and the inclusion levels for gestating and lactating sows must be reviewed for the actual productivity.

**IRON DURING GESTATION AND LACTATION**

The use of iron for piglets as a therapeutic additive is well known for many years. The first documents that show the use of iron in piglets are dated by 1500 BC. In 1891, Braasch was the first author to describe anaemia in piglets born in confinement conditions.

There are many factors that predispose piglet to suffer anaemia, but the most important parameter is the low iron content in the milk of the sows (1 mg/l), much lower than other mammal’s species. Iron reservoirs of the piglets are also lower than other mammals, above 50 mg/piglet and only can cover the requirement for three or four days after birth.

These low levels of iron ingested by the piglets, together with the fast development and growth, make necessary an external supply of iron for piglets born in confinement. Requirement for piglet in the first 3-4 days are between 7 and 16 mg/day (NRC1998) and milk only supplies about 10% of this amount.

A common practice is to use iron dextran during the first days of life to avoid anaemia, but some other measures help to increase the level of iron in the milk of the sows. Different papers showed a higher concentration of iron in milk when organic source of iron were supplemented in comparison with inorganic sources (Paul et al 1978, Wei 2005).

Another way to prevent iron deficiency is to increase the deposition of iron in the piglet. Brady et al 1978, of Michigan University ran a trial with 20 sows. The treatment group was supplemented with 8.5 g of iron methionine (0.85 grams of iron) per day during 4 weeks before farrowing. One week before farrowing the supply was increased to 17 grams (1.7 gram of iron). After parturition one piglet per litter were killed for analysis and the authors found a tendency to accumulate higher levels of iron in the liver (208 vs. 155 mg/kg) and spleen (114 vs. 105) in piglets from sows fed with iron methionine.

The use of iron methionine also increases the iron level in the milk of the sow and improves the iron deposit in piglets at birth.

**LAMENESS IN SOWS**

Another very important point related with the mineral nutrition is the lameness in the sows. Lameness is a multifactorial problem with genetic, mechanical, chemical and biological processes involved. Lameness is a major production disease of pigs. This represents a big threat to the sustainability of current pig production methods, not only because it represents a serious welfare problem, but also because it has a detrimental impact on profitability.
Lameness associated with painful joint lesions has been identified as a welfare challenge for confined sows (Elmore et al., 2010). Lameness, or feet and leg problems, was ranked as the third greatest reason for culling sows, comprising 15% of the culls marketed in the United States (Schenk et al., 2010). Feet and leg problems were identified as the most common involuntary reason for culling sows (Stalder et al., 2004) and also have been associated with several variables that result in poor reproductive performance, including decreased litter size, poor performance, and decreased sow longevity (Engblom et al., 2008; Anilet al., 2009; Quinn 2013).

Good mineral nutrition is a really important factor in the development of the hoof structure and especially zinc supply, because it is the most important mineral involved in the keratinization process. Research of Minnesota University shows that the use of organic trace minerals reduced total claw lesion scores and resulted in a lower proportion of lame sows compared to sows fed inorganic trace minerals. Correct zinc intake along with good management are the most important points to consider for lameness prevention.

CONCLUSIONS

The improvement of sows' productivity and the faster growth of the piglets increase the requirements for trace minerals during gestation and lactation. Supplementation with organic trace minerals like methioninates or glycinites increase the bioavailability and result in a better performance in sow and piglets. Diets supplemented with organic zinc and iron increase the number of piglets at birth and the weight of weaned piglets.

Good mineral nutrition is one of the key factors to reduce prevalence for the major production diseases and one of the most important factors helping to reduce the culling of sows.