GENERATIONAL NUTRITION™

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As a proportion of total pregnancy loss, embryonic loss in the first month of gestation is the single greatest contributor (Reese, 2020). Consequently, strategies to decrease embryonic loss have the greatest potential to improve overall reproductive success.

There is no doubt that overall nutrition is crucial for helping maximise reproductive performance. Considering that reproduction is the single biggest influencer of beef herd profitability, it is logical that nutritional strategies focused on reproduction can have substantial impacts on the economic sustainability of the operation. Volumes have been written about the importance of proper body condition and macronutrient concentrations like protein, calcium, and phosphorus for reproductive performance and foetal programming impacts. However, trace mineral nutrition often gets overlooked, despite the profound impact these nutrients can have on supporting reproductive performance and fueling Generational Nutrition™ – the impact of maternal trace mineral nutrition on offspring health and performance. Increasingly, research is revealing that while trace mineral concentrations are important, the chemical form of these minerals is equally important. Moreover, it is increasingly evident that trace mineral nutrition is far more effective when administered in the diet versus administered by injection.

RESEARCH INTO REPRODUCTION SUCCESS

For decades, beef producers have included zinc (Zn), manganese (Mn), and copper (Cu) amino acid complexes in their herd nutrition programme, along with cobalt glucoheptonate. Including these trace mineral complexes in herd nutrition in the months between calving and breeding was based on research showing improvements in conception and pregnancy rates that often exceeded 20% compared to control diets providing inorganic trace minerals (Stanton, 2000; Burnett, 2016). Inorganic minerals include oxides, sulfates, and hydroxychlorides. In multi-year studies (Arthington, 2004), reducing calving interval by 16 days was a benefit of feeding trace mineral complexes that was hard to ignore.

Since that foundational data was published, researchers have increasingly sought to determine the underlying factors that led to those broad reproductive improvements. Recalling the immense contribution of early embryonic survival to overall pregnancy success, that was a logical phase on which to focus. Researchers at the University of Tennessee in the USA looked specifically at the unfertilised oocyte and the first week of development using an *in vitro* model (Dantas, 2019). Pregnant Angus cows grazing pastures in the heat of summer were provided either an inorganic free-choice mineral or a similar mineral containing amino acid complexes (Zn, Mn, Cu) and cobalt glucoheptonate. After nearly 100 days on treatment minerals, oocyte pickup was performed by aspirating dominant follicles and the collected oocytes were evaluated. Cows fed complexed trace minerals generated more culturable oocytes. Following fertilisation of the culturable oocytes and a seven-day incubation period, a greater number of transferable and freezable embryos were also quantified from cows fed complexed minerals. The findings revealed that improving trace mineral nutrition impacted reproduction prior to fertilisation and resulted in a more viable blastocyst-stage embryo.

It was an exciting realisation that feeding complexed trace minerals can impact reproduction as early as the seven-day embryo

and even pre-fertilisation. However, the first one to two months of pregnancy are still crucial for overall pregnancy success. Therefore, a trial was completed at South Dakota State University in the USA to investigate trace mineral nutrition in developing heifers (Perry, 2021). The study compared inorganic versus complexed trace minerals (Zn, Mn, Cu, Co) in a complete mixed ration. Weaned heifers were started on treatment at approximately eight months of age, artificially inseminated at 15 months, and finished dietary treatments after a 60-day pregnancy confirmation at 17 months old. Heifers fed complexed trace minerals had greater early embryonic survival and thus, pregnancy retention. From day 17 to day 60 post-insemination, heifers fed complexed trace minerals retained 73% of pregnancies, compared to only 62% for heifers fed inorganic minerals. The difference in pregnancy retention was notable as early as day 28 after insemination.

Collectively, these data help explain the reproduction improvements observed in earlier work. Feeding amino acid complexes (Zn, Mn, Cu) and cobalt glucoheptonate improve unfertilised oocyte quality, early embryo quality, and embryonic survival in the first two months after insemination. In short, improving trace mineral nutrition prior to the breeding season has significant impacts on reproduction during the crucial early pregnancy where pregnancy loss is typically greatest. Helping cows and heifers retain early pregnancies leads to greater overall pregnancy success and an increase in the percentage of calves born.

THE IMPORTANCE OF GENERATIONAL NUTRITION™

Once pregnant, the importance of trace mineral nutrition is not diminished but instead amplified by the potential of Generational Nutrition™. Previous research has demonstrated that providing complexed trace minerals to cows during pregnancy can have substantial impacts on calf growth and lifetime health. Researchers at Oregon State University in the USA found that when cows were fed complexed trace minerals during gestation, they ultimately weaned 13 kg heavier calves than calves from cows fed inorganic trace minerals (Marques, 2016). Compared to calves born to cows fed a supplement devoid of Zn, Mn, Cu, and Co, the weight advantage of the complexed mineral calves was even greater at 24 kg! Moreover, calves born to cows fed complexed trace minerals were healthier through the feedlot phase, with less than half the incidence of respiratory disease as the other calf groups despite no difference in nutrition post-parturition.

Following that work, the most often asked question was what advantage the heifer offspring might possess if their dams were fed complexed trace minerals during gestation? Researchers at Texas A&M sought to answer that very question, feeding cows a supplement with either amino acid complexed trace minerals (Zn, Mn, Cu) and cobalt glucoheptonate, or inorganic forms of the minerals (Harvey, 2021). Compared to the inorganic mineral treatment, when cows were fed complexed trace minerals during gestation, their daughters reached puberty 19 days earlier – nearly a full oestrus cycle. Considering the evidence that earlier puberty and more cycles prior to the breeding season leads to greater first breeding season success, the prospect of earlier puberty is substantial. The result is especially intriguing since the earlier puberty occurred without a bodyweight advantage, meaning heifers hit earlier puberty without simply being heavier as is traditionally assumed.

THE BENEFITS OF PROVIDING COMPLEXED TRACE MINERALS

The need for trace mineral supplementation in the cow herd cannot be overstated and the impacts are amplified when producers upgrade from inorganic minerals to amino acid complexes (Zn, Mn, Cu) and cobalt glucoheptonate. Considering that the greatest proportion of total pregnancy loss occurs in the first month post-insemination, preparing females nutritionally must start months in advance and continue throughout the breeding season to improve pregnancy retention and overall pregnancy success. This idea is easy to digest since producers can provide complexed trace minerals throughout pregnancy to capture benefits from Generational Nutrition™ on calf performance while also preparing the cow for the subsequent breeding season.

Dr Jason Russell grew up on a beef seedstock operation in Wisconsin, in the USA. He earned a master's degree in animal science from the University of Missouri and a PhD in nutritional science from Iowa State University. As part of Zinpro's technical team, Dr Russell provides beef technical services throughout North America and International markets, including in South Africa through Zinpro's local partner, Chemuniqué. He also remains actively involved in the nutrition, marketing, and breeding decisions for his family's cattle operation. Please contact Wiaan Faber at wiaan@chemunique.co.za for any questions relating to this article.