

## Recent Developments in Stallion Fertility – Co Enzyme Q10 Dr Peter Huntington

### Background

In comparison to other species, equine spermatozoa mainly use oxidative phosphorylation (OXPHOS) to generate ATP for energy production, and motility requires large amounts of energy to be produced. The rapid metabolic rate and increased mitochondrial activity facilitated by OXPHOS results in a high rate of reactive oxygen species (ROS) generation. The continued, unchecked production of these ROS will lead to oxidative stress and disturbances of cellular functions.

At low levels, ROS can damage DNA but fertilisation may still occur, however the conceptus has a higher risk of embryonic loss, abortion or foetal growth retardation. An inverse correlation has been found between the antioxidant status of stallion semen and DNA fragmentation of stallion sperm. At high levels, ROS lead to DNA, protein and membrane damage, with reduced motility and sperm viability. To combat ROS, the body uses its reserves of antioxidants and antioxidant reserves may be boosted by supplementation of antioxidant precursors eg selenium or antioxidants themselves. The selenium content of stallion sperm has been correlated with progressive motility and fertility rate.

In both natural service and AI situations, one of the goals is to extend the life span of the sperm, optimise motility and reduce sperm damage prior to fertilisation. For this reason, antioxidant supplementation of stallion diets, or the addition of antioxidants and energy substrates to semen extenders may increase fertility in some stallions.

One such antioxidant and energy substrate is CoEnzyme Q10 (CoQ10), whilst another antioxidant is Vitamin E (alpha tocopherol). Some recent reviews and research on CoQ10 in relation to fertility are listed below.

### Recent reviews and research

In human fertility, excess ROS and oxidative stress are associated with male infertility, related to impaired seminal plasma non-enzymatic antioxidant capacity. This has been linked with DNA damage as well as sperm damage, deformity and lower motility and longevity. CoQ10 can be measured in seminal plasma and its concentration correlates with sperm count and motility.

Oral supplementation led to significant increases in CoQ10 levels in plasma, sperm cells and seminal plasma along with increased sperm concentration and motility (Lafuente et al 2013). Studies have shown a correlation between sperm count and motility and an inverse correlation between the ROS hydrogen peroxide levels and abnormal sperm forms with CoQ10 levels in seminal fluid (Mancini and Balercia 2011).

Nadjarzadeh et al (2013) found that oral supplementation of CoQ10 to infertile men for 3 months. Increased seminal plasma concentration, antioxidant enzyme activity and normal sperm morphology.

### CoQ10 and Stallion Semen Preservation

Gibb & Aitken are leading male reproduction researchers at the University of Newcastle and published a review of recent developments in stallion semen preservation (Gibb and Aitken 2016). An extract of the text on CoEnzyme q10 on p33 is:

‘Given that mitochondrial metabolism is the source of the majority of ROS, a mitochondrial antioxidant that can also act as a regulator of mitochondrial bioenergetic functions may present the best option to reduce the downstream effects of ROS on sperm function and DNA integrity. One such tool for this purpose is CoQ10, which plays key roles in mitochondrial bioenergetics and in the scavenging of ROS.

The overwhelming majority of studies investigating the role of CoQ10 in male fertility have concentrated on its use as an oral supplement. Few publications exist in which CoQ10 has been investigated as a pro-survival factor during in vitro sperm storage. While CoQ10 has been shown to improve the motility of human spermatozoa in vitro, neither of the two published studies investigating the effect of CoQ10 supplementation during in vitro storage of stallion spermatozoa have revealed any beneficial effects, potentially due to very low CoQ10 concentrations or the use of skim milk-based extenders and chilled storage. In our laboratory, and at much higher concentrations, CoQ10 shows great potential as a pro-survival factor during the storage of stallion spermatozoa at ambient temperatures.’

## CoQ10 and Chilled or Frozen Semen

Bayly et al (2020) investigated the effect of oral CoQ10 supplementation for 30 days on semen parameters in stallions being collected for chilling or frozen semen. Horses with good semen quality were not helped, but supplementation led to increased motility and viability in 15 days in sub fertile horses. Positive effects continued for 30 days after supplementation ceased indicating a benefit for the life of spermatozoa.

Nogueria et al (2015) found that Coenzyme Q10 and  $\alpha$ -Tocopherol supplementation to a semen extender prevented the lipid peroxidation of cooled equine semen from fertile stallions. When seminal plasma is diluted and removed during chilling of equine semen. Addition of CoQ10 to an extender led to significantly higher motility in chilled semen kept for 72h, whilst both CoQ10 and  $\alpha$ -tocopherol led to reduced indicators of Oxidative Stress in chilled semen.

Canisso et al (2018) studied the effects of coenzyme Q10 on semen cryopreservation of stallions classified as having good or bad semen freezing ability. They found that addition of CoQ10 to centrifugation extender improves semen of bad semen freezing ability and that 75  $\mu$ mol/L of CoQ10 appears to be optimal dose for stallions with bad semen freezing ability. In contrast the sperm from stallions with good freezing ability did not benefit from addition of CoQ10.

Brazilian researchers (Lagares et al 2020) investigated the addition of various doses of CoQ10 to the semen extender used to freeze semen from fertile stallions. Although there was no significant difference in motility, the middle dose showed that CoQ10 can play a significant role as an antioxidant by significantly reducing the levels of free radicals and ROS in the sperm.

## References

- Bayly W (2020) Effects of CoQ10 supplementation on stallion semen parameters
- Canisso IF, Bendeira R, Scheeren V et al (2018) Effects of coenzyme Q10 on semen cryopreservation of stallions classified as having good or bad semen freezing ability. *Animal Repro Science* (2018) 192:107- 11 <https://doi.org/10.1016/j.anireprosci.2018.02.020>
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## KER Nano Q10 - Coenzyme Q10 Supplement for Horses

**Nano-Q10** is a highly bioavailable form of coenzyme Q10, also known as ubiquinone. Nano-Q10 features advanced nanotechnology to create a rapidly available and absorbed source of coenzyme Q that has been shown to be three times more bioavailable than powdered crystalline ubiquinone.

Coenzyme Q10 is involved in numerous reactions in the body, primarily the production of energy, and is found in highest concentrations in mitochondria, where its function is to carry protons and electrons, an essential process in the generation of adenosine triphosphate (ATP). ATP is the main energy currency used by all cells, including muscle cells. Coenzyme Q10 is also found in cell membranes, where it boosts cell integrity. Coenzyme Q10 is a powerful antioxidant, protecting cells from highly reactive chemicals called free radicals that can damage cells and their DNA. Besides providing direct antioxidant protection, it also improves the antioxidant potential of other antioxidants in the body, like vitamins C and E.

