Potential use of peroxiredoxins to improve the quality of cryopreserved bull semen

Semen cryopreservation is a highly important tool in the artificial reproductive technologies of livestock breeding. Although the cryopreservation techniques are being constantly improved, the side effects which negatively influence the post-thaw quality of semen have not been entirely eliminated.

Growing evidence suggests that oxidative stress accompanying the freezing-thawing process is the main cause of the decrease of motility and non-physiological sperm cryocapacitation (Fig1A). Numerous ineffective attempts have been made to eliminate the adverse effect of oxidative stress, including supplementation of the diluents with the diverse antioxidant compounds. The reason why it did not fully achieve the expected quality improvement of the cryopreserved semen is most likely the fact that scavenging free radicals may disturb the redox balance in spermatozoa leading to disturbances of motility, capacitation and fertilization (Fig1B). For this reason there is a need for a different solution to reduce the oxidative stress generated during cryopreservation.The potential candidates would be the enzymes from the peroxiredoxin group (PRDXs), which have a unique feature of acting both as antioxidants and redox signal transmitters (Fig1C).The results of such an innovative experiment might in future contribute to preventing the unfavorable process of cryocapacitation in cryopreserved bull semen. The results of such an innovative experiment might in future contribute to preventing the unfavorable process of cryocapacitation in cryopreserved semen of bulls and other mammals.

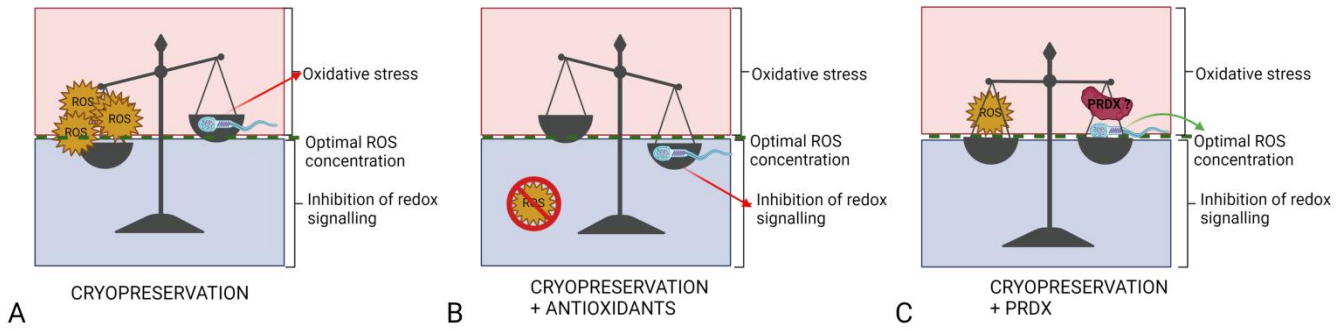

Fig.1. The effect of semen cryopreservation (A) the effect of semen cryopreservation with the addition of antioxidants to the diluent (B) the potential effect of semen cryopreservation with the addition of PRDXs (C).

The research hypothesis presumes that introducing PRDXs into sperm prior to the cryopreservation process will improve the quality of cryopreserved semen by reducing oxidative stress and capacitation-like changes. Furthermore, the research hypothesis presumes that sperm PRDXs act to prevent harmful lipid peroxidation and protein oxidation through antioxidant activity and at the same time ensure the correct redox status through the activity of the redox transmitter.

To verify the research hypothesis Several specific aims were developed: (1) to gain knowledge about the molecular mechanisms underlying the varied susceptibility of a bull's sperm to cryogenic damage; (2) to select PRDXs isoforms that play an important role in the resistance of sperm to cryogenic damage; (3) to verify changes in the suitability of semen for freezing due to the extracellular and intracellular introduction of selected PRDXs isoforms.