

The main goal of this experiment was to determine the effects of Mn^{2+} , Zn^{2+} or Cu^{2+} -nanosuccinate added to semen extender on ram semen characteristics and activity of antioxidant enzymes after thawing. This study utilized six clinically healthy Texel rams aged 2-4 years during seasonal anestrus (April-May). Ejaculates (n=36; 6 per ram) collected into an artificial vagina were evaluated for volume, sperm concentration and motility, and then divided into isovolumetric control and experimental fractions (n=10 per ejaculate). Control semen was diluted with lactose-yolk-tris-citrate-glycerin medium (LYTCGM) and nanosuccinates (Mn^{2+} - and Zn^{2+} -nanosuccinate: 2.5, 5.0 and 7.5 $\mu\text{g/l}$; Cu^{2+} -nanosuccinate: 1.25, 2.5 and 3.75 $\mu\text{g/l}$) were added to LYTCGM in experimental semen samples. Extended semen was loaded into 0.25-ml straws (8×10^7 spermatozoa/ml), equilibrated for 2.5 h and then frozen in liquid nitrogen. Post-thaw sperm motility was determined with Computer Assisted Semen Analysis (CASA) and the activity of antioxidant enzymes (superoxide dismutase (SOD), glutathione peroxidase (GPX) and catalase (CAT)) was measured with a spectrophotometric technique. The addition of an intermediate dose of Mn^{2+} - and Zn^{2+} -nanosuccinate to LYTCGM was associated with a significant increase in ram sperm progressive motility, and the lowest and intermediate dose of both nanosuccinates improved sperm motion kinetics/velocity parameters. Moreover, Mn^{2+} - and Zn^{2+} -nanosuccinates at a dose of 5.0 $\mu\text{g/l}$, consistently decreased ($P<0.05$) SOD activity and boosted ($P<0.05$) GPX and CAT activity in ram semen samples after thawing. Alternatively, the addition of Cu^{2+} -nanosuccinate to LYTCGM (highest dose) significantly reduced the post-thaw progressive motility and velocity of ram spermatozoa and increased the percentage of sperm with acrosomal/head defects. Furthermore, Cu^{2+} -nanosuccinate supplementation significantly increased SOD activity and depressed CAT (highest dose) and GPX (all doses) activity. In summary, the addition of Mn^{2+} - and Zn^{2+} -nanosuccinate to semen extender appeared to have beneficial effects on sperm motility/motion kinetics and structural integrity, whereas Cu^{2+} -nanosuccinate mainly had debilitating effects on the post-thaw semen characteristics in rams.