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JOURNAL ARTICLE

The impact of reactive oxygen species on bovine sperm fertilizing ability and oocyte maturation

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The objective of this study was to examine the effects of reactive oxygen species (ROS) on bovine sperm function and on the developmental competence of in vitro-matured bovine oocytes. In a first series of experiments, spermatozoa were exposed to ROS generated through the use of the hypoxanthine-xanthine oxidase system +/- catalase prior to the conduct of in vitro fertilization (IVF). Reactive oxygen species exposure reduced significantly ($P < 0.001$) the rates of oocyte penetration (control: 56% +/- 4 SEM; ROS: 16 +/- 2-23% +/- 7 SEM), and this effect was reversed by adding catalase (ROS+catalase: 67% +/- 0.3 SEM). During IVF, addition of superoxide dismutase (SOD: 1, 10, or 100 U/ml) had no effect on penetration rates. However, increasing concentrations of catalase (0.1 or 1 mg/ml) reduced these rates significantly (control: 70% +/- 3 SEM; treated: 45% +/- 5 and 1% +/- 1 SEM; $P < 0.001$). In a second series of experiments, when oocytes were matured in vitro in the presence of exogenous antioxidants (SOD: 10, 100, or 1000 U/ml; beta-mercaptoethanol: 0.01, 0.1, or 0.5 mM; ascorbic acid: 0.05 mg/ml), the developmental competence of the oocytes after IVF was not significantly improved. On the other hand, presumed production of ROS using the hypoxanthine-xanthine system at the beginning of the in vitro maturation period did improve subsequent developmental competence of the oocytes under some conditions and when catalase was present (control: 14% +/- 4 SEM and treated: 23% +/- 9 and 27% +/- 8 SEM; $P < 0.05$). These observations demonstrate that ROS may be beneficial to gamete function under specific conditions.

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