Effects of Reactive Oxygen Species on Sperm Function, Lipid Peroxidation and DNA Fragmentation in Porcine Spermatozoa


1Institute of Reproductive Medicine and Population, Medical Research Center, Seoul National University, Seoul, Korea. 2Biomedical Research Center, Korea Advanced Institute of Science and Technology, Taejoen, Korea. 3Department of Animal Science Chung-Ang University, Ansung, Korea.

Spermatozoa are able to generate reactive oxygen species (ROS), such as superoxide anion (O_2^-), hydrogen peroxide (H_2O_2), hydroxyl radical (OH) under aerobic conditions (Alvarez et al., 1987). ROS have been associated with a reduction in sperm motility, decreased sperm-oocyte fusion capability and diminished fertility in vitro (Aitken et al., 1991; Iwasaki & Gagnon, 1992).

The objective of the present study was to evaluate the effects of the ROS generated with a xanthine and xanthine oxidase (X-XO) system on sperm function, the change of sperm characteristics, lipid peroxidation, and DNA fragmentation of porcine spermatozoa.

ROS were produced using a combination of 1000 μM xanthine (X) and 50 mU/ml xanthine oxidase (XO). The ROS scavengers: superoxide dismutase (SOD) (200 U/ml) and catalase (500 U/ml) were also tested. Spermatozoa were incubated for 2 hours in BWW medium with a combination of X-XO supplemented with or without ROS scavengers at 37°C under 5% CO_2 Incubator.

Sperm movement characteristics by CASA (computer-aided sperm analysis), HOST (hypoosmotic swelling test), ionophore induced acrosome reaction, the detection of malondialdehyde for lipid peroxidation and the percentage of DNA fragmentation using TdT-mediated nick end labelling (TUNEL) by flow cytometry, were determined after 2 hours incubation.

The action of reactive oxygen species on porcine spermatozoa resulted in a decreased capacity for ionophore-induced acrosome reaction, sperm motility and membrane integrity, an increase in the production of malondialdehyde and the percentage of sperm with DNA fragmentation. Catalase completely alleviated the toxic effects induced by the ROS in terms of sperm function and sperm characteristics, however SOD exhibited no capacity to reduce the toxic effects.

The ROS can induce significant damages to sperm function and characteristics. Useful ROS scavengers can minimised the defects in sperm function and the various damage to spermatozoa.


Email: byryu@unitel.co.kr