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SOD B® & Male Fertility Recovery

Male infertility is a major social concern, affecting 15% of all reproductive-aged couples. Male factors, including decreased semen quality, are responsible for 25% of these cases. Recent research of the role of Reactive Oxygen Species (ROS) in human infertility has received a great deal of interest from the scientists and medical practitioners. Excessive levels of ROS can negatively impact sperm quality and being responsible for male infertility. Superoxide Dismutase (SOD) has been demonstrated to be efficient in the management of male factor infertility.

Infertile men are under oxidative stress

Oxidative stress has been attributed to affect the fertility status and thus, has been studied extensively in recent years[1]. According to MEDLINE, the involvement of oxidative stress in male infertility has been largely reported in the scientific literature, with over 700 papers. Overall, studies have shown that 30% to 80% of unselected infertile patients have high levels of seminal ROS[2]. Superoxide anion ($O_2^{\bullet -}$), hydroxyl radical ($OH^{\bullet}$) and hydrogen peroxide (H_2O_2) are some of the major ROS present in seminal plasma (Figure 1).

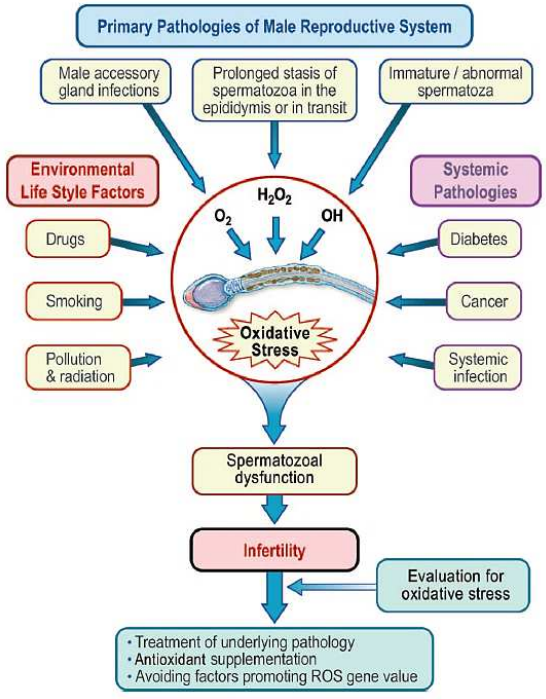

Figure 1: Factors contributing to oxidative stress-induced male infertility.

Infertile men & antioxidant defenses

In a system with high levels of oxidants, sperm quality will be altered. Conversely, a system with increased antioxidant capacity can keep the oxidants in balance, leading to improved sperm quality. While SOD, Catalase (CAT) and Glutathione Peroxidase (GPx), are found in high concentrations in the cytoplasm of most cells, sperm cells contain only minimal amounts of these critical ROS scavenging pathways[3]. Infertile patients exhibit lowered primary antioxidant defenses than fertile ones[4]. A restoration of SOD, CAT and GPx levels seems to be an efficient solution against infertility. These three major antioxidant enzymes work synergistically to inhibit the ROS production and prevent sperm oxidative damages (Figure 2).

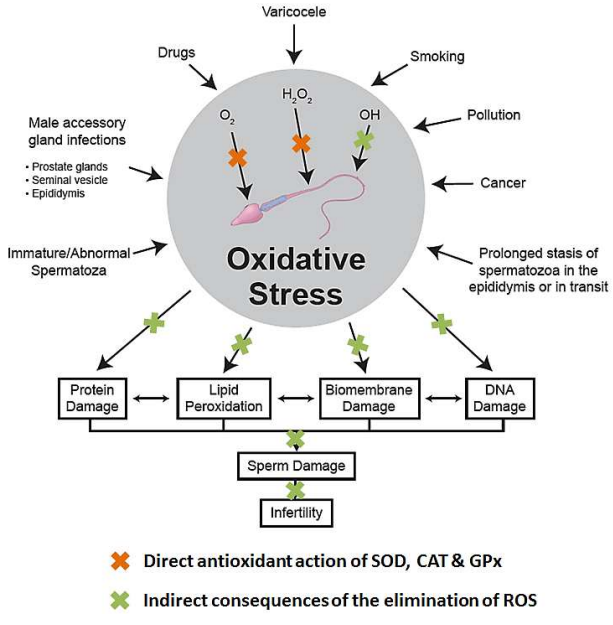

Figure 2: SOD mechanism of action in male fertility.

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SOD decreases sperm oxidative stress

In a model of cryopreserved spermatozoa, *in vitro*, SOD reduces sperm ROS production. The ROS generation is significantly reduced by the addition of SOD at concentrations of 150 and 300 IU/ml (Figure 3)[5].

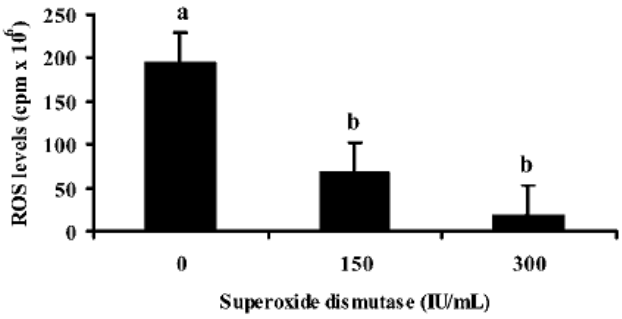

Figure 3: SOD antioxidant efficiency on seminal ROS production.

SOD increases sperm motility

A positive correlation between SOD activity and semen quality parameters, such as sperm concentration and motility, has been reported in several studies (Figure 4)[6].

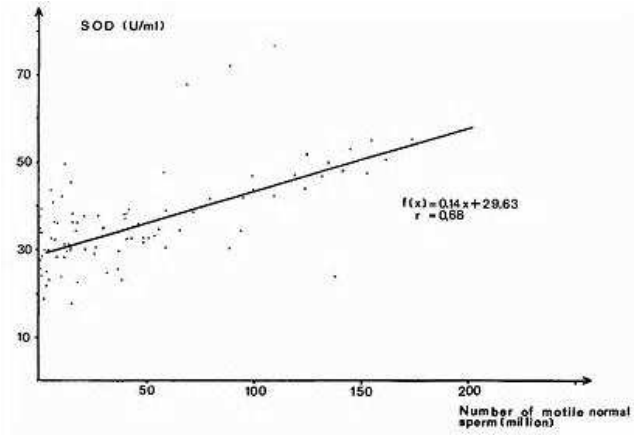

Figure 4: Correlation between SOD activity and the number of motile normal sperm.

The administration of SOD, respectively at 25 or 50 IU/ml, improves the mobility and viability of spermatozoa *in vitro*[7]. Further studies have confirmed that the addition of SOD (400 IU/ml) significantly increases the sperm motility thanks to the inhibition of lipid peroxidation[8].

SOD improves sperm viability

Studies have reported that the addition of both SOD (100 IU/ml) and catalase (100 IU/ml) improved significantly human sperm recovery in human semen samples (n= 25)[7]. These results have been confirmed on boar spermatozoa with a supplementation of SOD (at 150 and 200 UI/ml) and catalase (300 and 400 UI/ml)[5]. Because of their combined and simultaneous action on $O_2^{\bullet -}$ and H_2O_2, SOD and CAT contribute greatly to the prevention of sperm apoptosis.

SOD enables sperm-oocyte fusion

The addition of CAT (100 IU/ml), alone or in combination with SOD (100 IU/ml) improves sperm-oocyte fusion in an *in vitro* ROS generative model (Table 1)[9].

Treatment	Oocyte penetration (%)	Polyspermy (sperm per oocyte)
Control	98.8 ± 1.2	7.1 ± 0.9
XO	73.8 ± 10.8*	2.2 ± 1.0*
XO + CAT	100.0 ± 0.0	6.7 ± 1.5
XO + CAT + SOD	94.3 ± 3.9	4.2 ± 1.1

*$P = < 0.05$ compared with respect to control.
Number of replicates = 6.
XO: xanthine oxidase; SOD: superoxide dismutase; CAT: catalase.

Table 1: Influence of SOD & CAT on sperm-oocyte fusion.

Conclusion

ROS affect the quality and number of sperm reaching the ovum in the female reproductive tract. As the first line of antioxidant defenses, SOD has been demonstrated to:

- **decrease sperm ROS production**
- **increase sperm motility**
- **improve sperm viability**
- **favor sperm-oocyte fusion**

A restoration of its SOD endogenous levels is therefore an efficient solution to restore sperm functions.

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