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**Effects of zinc on human semen quality and sexual behaviour of  
male rats**

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## Abstract

The main aim of this study was to evaluate the effects of serum and seminal plasma zinc levels on semen quality of a subfertile male population. At the same time, effects of zinc on different aspects of male reproduction were studied.

The study was carried out as a prospective hospital and laboratory based study. Semen samples from 152 males were analyzed. Seminal plasma and serum levels of zinc, serum hormone levels, seminal plasma fructose and neutral  $\alpha$ -glucosidase levels of same males were also measured. Relationship between seminal plasma zinc and semen quality was observed using two markers; zinc concentration and total zinc per ejaculate (Total zinc). Effects of zinc on various functions of spermatozoa were studied *in-vitro* and, the effects on sexual competence of males were observed using a rat model.

Of the 152 semen samples 55 (36 %) were normozoospermic and 97 (64 %) were pathozoospermic. The mean (SD) serum and seminal plasma zinc concentrations of the population were 0.94  $\mu\text{g/ml}$  (0.36) and 121.87  $\mu\text{g/ml}$  (69.13) respectively. Seminal plasma total zinc was significantly low in samples with low volume and hyperviscosity compared to samples with normal volume and viscosity; 139.72  $\mu\text{g}$  (73.72) vs. 377.40  $\mu\text{g}$  (231.06),  $p < 0.01$  for volume and 220.06  $\mu\text{g}$  (144.09) vs. 336.34  $\mu\text{g}$  (236.33),  $p < 0.05$  for viscosity. Conversely significantly high amount of total zinc was found in low viability group compared to normal; 437.67  $\mu\text{g}$  (283.88) vs. 305.15  $\mu\text{g}$  (221.19),  $p < 0.05$ . Percentage of pathozoospermics and volume abnormalities were significantly higher in abnormal total seminal zinc group compared to normal (pathozoospermics, 27 % vs. 7.3 % and volume abnormalities, 55.3 % vs. 8.8 %,  $p < 0.05$ ). Mean zinc concentration was significantly high in Asthenozoospermics compared to normal motile group; 138.11  $\mu\text{g/ml}$  (83.92) vs. 110.69  $\mu\text{g/ml}$  (54.59),  $p < 0.05$ . Significantly positive correlations were found between total seminal plasma zinc and volume ( $r = 0.53$ ,  $p < 0.01$ ) as well as total sperm count ( $r = 0.21$ ,

$p < 0.05$ ), whereas correlation between seminal zinc and pH was inverse ( $r = -0.193$ ,  $p < 0.05$  for zinc concentration and  $r = -0.280$ ,  $p < 0.01$  for total zinc). In contrast serum zinc levels correlated positively with seminal plasma pH ( $r = 0.167$ ,  $p < 0.05$ ).

Gonadotropin levels were significantly high in azoospermics compared to normozoospermics; LH - 12.82 mIU/ml (11.82) vs. 5.90 mIU/ml (2.78), FSH - 19.69 mIU/ml (9.93) vs. 4.18 mIU/ml (2.78),  $p < 0.05$ . FSH level was inversely correlated with sperm concentration ( $r = -0.203$ ,  $p < 0.05$ ) and total sperm count ( $r = -0.206$ ,  $p < 0.05$ ). There was an inverse correlation between seminal plasma zinc concentration and serum PRL levels ( $r = -0.198$ ,  $p < 0.05$ ). Serum zinc concentration showed a negative correlation with serum T levels ( $r = -0.207$ ,  $p < 0.05$ ).

Both fructose concentrations and total fructose were significantly low in abnormal volume group compared to normal; 15.30  $\mu\text{mol/ml}$  (1.52) vs. 44.27  $\mu\text{mol/ml}$  (2.44) for fructose concentration and 19.06  $\mu\text{mol}$  (2.39) vs. 160.63  $\mu\text{mol}$  (16.0) for total fructose,  $p < 0.0001$ . Mean fructose concentration was significantly high in oligozoospermic group compared to normal; 45.33  $\mu\text{mol/ml}$  (5.02) vs. 35.07  $\mu\text{mol/ml}$  (2.39),  $p < 0.05$ . Total neutral  $\alpha$ -glucosidase activity was significantly low in low volume group compared to normal; 55.37 mU (8.79) vs. 140.93 mU (15.36),  $p < 0.0001$ . Seminal plasma total zinc positively correlated with total fructose ( $r = 0.378$ ,  $p < 0.001$ ), and NAG ( $r = 0.247$ ,  $p < 0.001$ ).

*In-vitro* incorporation of zinc,  $> 5.0 \mu\text{mol/ml}$  into the processed sperm samples and,  $> 10 \mu\text{mol/zinc}$  into unprocessed sperm samples, caused an impairment of the progressive motility of sperms. Incorporation of 1.2  $\mu\text{mol/ml}$  of zinc into sperm culture medium exerts a significantly beneficial effect on sperm recovery rate. The mean post wash sperm concentration showed an increase in the 1.2  $\mu\text{mol/ml}$  of zinc added group compared to the zinc devoid sample; 21.87 million/ml (6.61) vs. 18.34 million/ml (9.73),  $p < 0.05$ . The

percentage of hyperactivated sperm also increased in 1.2  $\mu\text{mol/ml}$  zinc added group compared to zinc devoid group; 46.70 % (3.80) vs. 38.83 % (3.56),  $p < 0.05$ .

In behavioural studies, supplementation of zinc (5 mg/day) for two weeks led to a prolonged ejaculatory latency; 711.6 Sec. (85.47) vs. 489.50 Sec. (67.66),  $p < 0.05$  and an increase in penile thrusting compared to controls; 52.80 Sec (11.28) vs. 26.50 Sec (6.17),  $p < 0.05$ . Similarly the PRL and T levels were significantly increased after the treatment period compared to hormone levels before the treatment; PRL - 7.22 ng/dl (3.68) vs. 2.90 ng/dl (0.34) and T - 8.21 ng/ml (6.09) vs. 2.39 ng/ml (1.79),  $p < 0.05$ .

In conclusion, this study revealed that zinc is beneficial in male reproduction in different aspects.

