

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

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Reg. No. FGS/05/02/07/2004/01

Thesis submitted in fulfilment of the requirements for the Degree of

Master of Philosophy

March 2008

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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 α - 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.

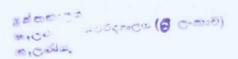
Of the 152 semen samples 55 (36 %) were normozoospermic and 97 (64 %) were pathozoospermic. The mean (SD) serum and seminal plasma zinc concentrations of the population were 0.94 µg/ml (0.36) and 121.87 µg/ml (69.13) respectively. Seminal plasma total zinc was significantly low in samples with low volume and hyperviscosity compared to samples with normal volume and viscosity; 139.72 µg (73.72) vs. 377.40 µg (231.06), p < 0.01 for volume and 220.06 µg (144.09) vs. 336.34 µg (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 µg (283.88) vs. 305.15 µg (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 µg/ml (83.92) vs. 110.69 11 µg/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 μ mol/ml (1.52) vs. 44.27 μ mol/ml (2.44) for fructose concentration and 19.06 μ mol (2.39) vs. 160.63 μ mol (16.0) for total fructose, p < 0.0001. Mean fructose concentration was significantly high in oligozoospermic group compared to normal; 45.33 μ mol/ml (5.02) vs. 35.07 μ mol/ml (2.39), p < 0.05. Total neutral α - 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 μmol/ml into the processed sperm samples and, > 10 μmol/zinc into unprocessed sperm samples, caused an impairment of the progressive motility of sperms. Incorporation of 1.2 μmol/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 μmol/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 μ 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.

