# Citrate, zinc, magnesium and calcium levels of seminal plasma in the normospermic, Oligospermie and azospermic patients

**Erol KOÇ[1], Atilla GÖR[1], Orhan DEĞER[2], Abdullah SİVRİKAYA[1], Güner K. ÖZGÜR[1]**

Depts. of[1] Urology and[2] Biochemistry, Medical School of Karadeniz Technique University, TRABZON, TURKEY

*Citrate, zinc, magnesium and calcium levels of seminal plasma were measured in the fertile (normospermic) and infertile (oligo and azospermic) patients, to show the biochemical changes of the semen. 20 normospermic, 25 Oligospermie and 20 azospermic patients who were kept under control in the Urology Department, were evaluated. In the normospermic fertile group, the mean semen concentrations were as follows: citrate 5.79 ± 1.01 g/L, zinc 19.28 ± 2.43 mg/dl, magnesium 11.90 ± 2.43 mg/dl and calcium 27.20 ± 3.26 mg/dl. These values were significantly higher than that of the infertile oligo and azospermic group. The values of Oligospermie group were also significantly higher than that of the azospermic group. The measurement of citrate, zinc, magnesium and calcium levels which secreted in the high proportion by the prostate, should be considered in the detection of infertility. [Turk J Med Res 11(6): 282-285]*

**Key Words:** Seminal fluid, Citrate, Zinc, Magnesium, Calcium

The genital accessory glands have major roles in the male fertility. It is known that not only high levels of acid phosphatase, citric acid, zinc (ZN), magnesium (Mg) and calcium (Ca) exist in the prostate secretion, but the seminal vesicle secretion has a high fructose level as well(1).

Citrate is the major anion of the prostate secretion (75 mmol/L in semen, and 0.12 mmol/l in serum)(2). This anion directs the osmotic balance of the prostate. It is used as an indicator in testing the function of the prostate(3). Mowson and Fischer have proved that zinc (Zn) concentration is high in the human semen and originated from prostate. In human beings prostate is assumed as a tissue that has the highest Zn content(4).

Although, other glands in the male genital system have nearly the same magnesium concentration, the human prostate gland and seminal vesicle have high Mg content. ATP must form complex with Mg in order to maintain the required energy for the fertilization^).

Calcium is very important for the cell function. It exists in a high concentration in some body fluids. In the seminal plasma the calcium concentration is 3-4 'old high with respect to blood serum level. The calcium in semen is originated from semen(6). As a result of the pathologies in the accessory sex gland chemical changes take place and may effect the fertility as increasing or decreasing the secretion(l).

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**Correspondence:** Erol KOÇ
Dept. of Urology Medical School of Karadeniz Technique Univ. TRABZON, TURKEY

## MATERIALS AND METHODS

In this study, 20 normospermic, 25 infertil oligspermic and 20 azospermic patients were sampled.

The semen samples were collected into a steril petri disk by masturbation at the end of sexual diet which continued for 5 days. The specimen was used for semen culture, spermiogram. The rest of the semen was centrifugated at 3000 rpm for 10 minutes. In order to obtain the seminal plasma and kept at -20 °C in glass tubes, untill assayed. The citrate level at semen was detected by the enzymatic UV method(7) and the results were calculated as g/l. The Zn and Mg levels were detected by using Atomic Absorbtion Spectrophotometer in terms of mg/dl (8,9). Colorimetric method was used for the measurement of Ca level in mg/dl.

In Table 1 detailed information is given about the properties of study population.

## RESULTS

The seminal plasma citrate levels were shown in Table 2.

Tablo 1. The properities of the study population

| Group | Number of case | Age | Duration of marriage(year) | Number of children | Number of sperm | Volume of the semen | Semen pH | Number of leucocyte |
|---|---|---|---|---|---|---|---|---|
| Normos-permie | 20 | 30.0+6.44 | 9.0±5.93 | 2.4+1.35 | 68.8±5.49 | 3.22+0.33 | 7.44+0.19 | 4.0±0.81 |
| Oligos-permie | 25 | 29.0±3.70 | 5.4±3.17 | 0 | 23.2±7.44 | 3.51+0.44 | 7.44±0.15 | 4.5±1.00 |
| Azospermic | 20 | 31.3±4.57 | 7.0+3.97 | 0 | 0 | 2.92±0.57 | 7.67±0.18 | 4.1±1.13 |

Table2. The average semen citrate levels of normospermic, Oligospermie and azospermic patients (g/L)

| Group | X | ±SD | Range |
|---|---|---|---|
| Normospermie | 5.79 | 1.01 | 3.78 - 7.64 |
| Oligospermie | 3.90 | 1.10 | 2.07- 5.76 |
| Azospermic | 1.65 | 0.33 | 1.10-2.15 |

Table3. The average semen Zn levels of normospermic, Oligospermie and azospermic groups.

| Group | X | +SD | Range |
|---|---|---|---|
| Normospermie | 19.28 | 3.03 | 14.1-25.9 |
| Oligospermie | 10.30 | 2.52 | 6.8-15.3 |
| Azospermic | 5.70 | 1.35 | 3.5-8.2 |

In the normospermic group; the semen citrate levels were significantly higher than that of the oligospermic and azospermic groups ($p<0.01$). The average semen citrate level in the infertile oligospermic group was significantly higher with respect to the azospermic group ($p<0.01$).

The seminal plasma Zn levels were as in Table 3.

**A** statistically significant higher seminal plasma Zn levels were observed in normospermic group according to the other groups ($p<0.01$). However the oligospermic group had higher Zn level according to the azospermic group ($p<0:01$).

The Mg level in the seminal plasma of the normospermic, oligospermic and azospermic group were indicated in Table 4.

Significantly highest Mg level was observed in the normospermic group ($p<0.01$) and followed by the oligospermic group ($p<0.01$) among the study group.

Table 5 indicated the average seminal plasma Ca level within our study group.

The average semen calcium level was found to be significantly high within the normospermic population ($p<0.01$). The patients in the oligospermic group had significantly high Ca levels than azospermic group ($p<0.01$).

## DISCUSSION

The complete analysis of the ejaculate is consisted of spermiogram and biochemical analysis. Mann indicated that both the number of the sperm and physical - biochemical properties of the seminal liquid is important for the fertilization(10). Normal ejaculate is a heterogenous compound secreted from male genital system. For a succesfull fertilization the compound should be in normal ratios having proper physical and biochemical properties. By analysing the seminal plasma, activities of the accessory glands and the properties of the secretions could be validated.

In this study we tried to investigate the relationship with the citrate, zinc, magnesium and calcium levels and infertility.

The fertil normospermic seminal plasma citrate, zinc, Mg and Ca levels were compared with the previous studies in literature (Table 6).

In the malignant diseases of prostate, semen citrate level decreases(18). Therefore the reduced citrate level indicates the dysfunction of the prostate(19).

It was proved that in the prostatide the seminal plasma citrate level decrease therefore this anion can be used as a biochemical marker for the prostate function(20). Paz et al reported that the change in the citrate level among the azospermic patients and fertil normospermic group was insignificant. But in our study this alteration was found to be statistically significants 3). Azospermic patients had low cation concentration in semen so, it may also effect the citrate concentration in our study. Since this anion has a high affinity to the cations such as Ca, Mg, Zn. These metals form complexes with the anion. So the reduction in the level of these cations will cause the elevation of the citrate level(21).

The semen zinc levels of the infertile oligospermic and azospermic patients were found to be suitable with the results indicated in the literature. Mbizuo et al, reported that the zinc level in oligospermic patients was 5.06 ± 0.9 mg/dl, and in azospermic patients was 3.2 ± 0.6 mg/dl(22). Stankovich et al found the Zn level in infertil patients as 11.2 ± 0.06 mg/dl(23). Wood and his group showed that Zn level was 13.7±7.2 mg/dl in oligospermic patients and its level was lower than that of the azospermic patients(24). Although Skandhan et al had reported that the Zn level in the

Table 4. The average semen Mg levels (mg/dl)

| Group | X | ±SD | Range |
|---|---|---|---|
| Normospermic | 11.90 | 2.43 | 8.1 -16.9 |
| Oligospermie | 6.58 | 2.04 | 3.8-10.8 |
| Azospermic | 3.35 | 0.63 | 2.5-4.3 |

Table 5. The average semen Ca levels (mg/dl)

| Group | X | ±SD | Range |
|---|---|---|---|
| Normospermic | 27.20 | 3.26 | 22-32 |
| Oligospermie | 22.25 | 2.73 | 18.5-25.5 |
| Azospermic | 17.25 | 3.85 | 11 -23 |

Table 6. The comparison of semen citrate, Zn, Mg and Ca levels of fertil group (normospermic group) with the values in the literature.

| References | | Citrate | Zn | Mg | Ca |
|---|---|---|---|---|---|
| Coffey et al. | (11) | 0.96 - 14.3 | 5-23 | 11 | 28 |
| Kavanagh et al. | (12) | 6.45 ±1.50 | 15.7±5.2 | 10.7±2.9 | 29.6±8 |
| Paz et al | (13) | 5.28±0.21 | - | - | - |
| Uneyama et al | (14) | - | 12.4±5.4 | 7.9±3.3 | 24.5±7.9 |
| Grizard et al. | (15) | 5.95+0.54 | - | - | - |
| Bondani et al. | (16) | - | - | 11.4±4.3 | 32±12 |
| Arver et al | (6) | - | 13.1 ±7.8 | - | 22.8±10 |
| Saaranen et al | (17) | - | 14.1±7.2 | 10.4+4.9 | |
| Our results | | 5.79±1.01 | 19.28±3.03 | 11.9±2.43 | 27.7±3.26 |

fertil normospermic group was significantly higher than that of the oligospermic and azospermic groups, U meyama stated that the difference was insignificant among his study population (14,25).

In this study, it was found that the fertil normospermic group had significantly high Mg level than the others. Degerr et al showed that the infertile patients had significantly low levels of semen magnesium with respect to fertile men(26). Papadimas et al found a lower semen Mg level(27). Saaren and Tomokazu have proved that the reduction of semen Mg level was related with the reduction in the number of sperms(14,17). The recent studies showed that a significant difference in the Mg levels exist between the fertile and infertile groups(26), The cation concentration was not related with the number of sperm in the normospermic, oligospermic and azospermic groups(14,16).

The semen calcium level was found to be high in the fertil normospermic group. Gaffuri et al found the semen Ca level as 24.5 in oligospermic group and 12.3 mg/dl in azospermic group(16). Both results have a significant difference with respect to the control group. Bondani et al reported that the Ca in the normospermic fertile group have 32.4 mg/dl, and 29.8 mg/dl in the oligospermic group(16). Leon et al found Ca level as 25 mg/dl and in oligospermic group as 26 mg/dl, and in azospermic group as 20 mg/dl(28). The difference was found to be statistically insignificant within the groups.

The reduction in the cation concentration was related with the reduced quality of the semen(18). These elements are secreted from the prostate gland and their reduction indicate the dysfunction of the prostate (17).

The changes can be managed by using the exogen compounds in semen may affect the capacity el the fertilization of male germ cells(29). Therefore the mentioned divalent cations can regulate the fertilization. For this purpose, the therapies with Zn, Mg, Ca tried and good results weie obtained from the Zn therapy(29-31).

We concluded that sitrate-zinc or sitrate-magnesium levels are good paramètres in predicting the function of prostate.

**Normospermik, oligospermîk ve azospermik şahıslarda seminal plazma sitrat, çinko, magnezyum ve kalsiyum düzeyleri**

*Fertil (normospermi) ve infertil şahıslarda (oligospermi ve azospermi) semen biokimyasındaki değişiklikleri göstermek amacıyla seminal plazmada sitrat, çinko, magnezyum ve kalsiyum düzeyleri ölçülmüştür. Çalışmaya KTÜ. Tıp Fakültesi Üroloji Polikliniğine başvuran 20 normospermik fertil grupta ortalama semen sitrat konsantrasyonu 5.79H.01 g/L, çinko 19.28±3.03 mg/dl, magnezyum 11.90±2.43 mg/dl ve kalsiyum 27.20±3.26 mg/dl olarak tesbit edilmiştir. Bu değerler infertil oligospermik ve azospermik gruba göre anlamlı derecede yüksektir. Oligospermik grupta değerlerde azospermik gruba göre anlamlı derecede yüksek bulunmuştur. İnfertilitenin değerlendirilmesinde prostat tarafından yüksek oranda salgılanan sitrat çinko magnezyum ve kalsiyum düzeylerinin tayini de göz önünde tutulmalıdır. [TurkJMedRes 1993; 11(6): 282-285]*

## REFERENCES


1. Eliasson R, Molin L, Rajka G. Involvement of the prostate gland and seminal vesicles in urethritis with special reference to semen analysis. Andrologia 1970; 2:179.
2. Donald SC. The Biochemistry and physiology of the Prostate and seminal Vesicles. Campbell's Urology, WB Saunders Company 1986.
3. Cooper JF, Farid J. The role of citric acid in the physiology of the prostate. J Surg Res 1963; 3:112-21.
4. Mawson CA, Fischer MI. Zinc in aspermic human semen. Nature 1956; 177:190.
5. Lehninger AL. Principles of Biochemistry, North Publ, New York 1982:209-70.
6. Arver S, Sjôberg HE. Calcium fractions in seminal plazma and functional properties of human spermatozoa. Acta Physiol Scand 1982; 116:159-65.
7. Gavella M. A simple automated method for determination of citric acid levels in semen. Int J Androl 1983; 6:585-91.
8. Kunç S, Yùregir G, Necipoglu Z, ve ark.. Serumda Ca, Mg, Fe, Zn ve Cu'in atomik absorpsiyon spektroskopisi Ne analizi. Biyokimya Derg 1980; 4:20-32.
9. Perkin-Elmer Co. Analytical methods for atomic absorption spectrophotometry. Norwalk 1976.
10. Mann T. Secretory function of the prostate, seminal vesicle and other male accessory organs of reproduction. J Report Fertil 1974; 37:179-88.
11. Coffey DS. The biochemistry and physiology of the prostate and seminal vesicles. Campell's Urology, Saunders Co. Philadelphia 1986:1:253-90.
12. Kavanagh JP. Sodium, potassium, calcium, magnesium, zinc, citrate and chloride content of human prostatic and seminal fluid. J Reprod Fert 1985; 75:35-41,
13. Paz G, Sofer A, Karacier P. Human semen analysis. Seminal plasma and prostatic fluid composition and their interrelations with sperm quality. Int J Fertil 1977; 22:140.
14. Umeyama T, Ishikawa H, Takeshima H. A comparative study of seminal trace elements in fertile and infertile men. Fertil Steril 1986; 6:3
15. Grizard G, Janny L. Seminal biochemistry and sperm characteristics in infertile men with bacteria in ejaculate. Arch Androl 1985; 15:181-6.
16. Bondani A, Aspeitia E, Aznar R. Correlation between sperm motility and electrolyte composition of seminal fluid in normal and infertile men. Fertil Steril 1973:24:2
17. Saaranen M, Suistomaa U, Kantola M. Lead, magnesium, selenium and zinc in human seminal fluid. Comparison with semen parameters and fertility. Human Reproduction 1987:2(6):475-9.
18. Homonnai ZT, Matzkin H, Fainman N. The cation composition of the seminal plasma and prostatic fluid and its correlation to semen quality. Fertil Steril 1978:29(5)
19. Watterauer U. Recommended biochemical parameters for routine semen analysis. Urol Res 1986; 14:241-6.
20. Comharie FH, Vermeulen L. Study of the accuracy of physical and biochemical markes in semen to defect infectious dysfunction of the accessory sex glands. Journal of Andrology 1989:10(1).
21. Teaque NS, Boyarsky S, Gelnn JF. Interference of human spermatozoa mortility of Escherichia coli. Fertil. Steril 1971; 22:281-5.
22. Mbizuo MT, Nyazema NZ, Chimbira TH. Seminal plazma zinc levels in fertile and infertile men. Sam J 1987:71
23. Stankovic H, Mikac-Devic D. Zinc and copper in human semen. Clin Chim Acta 1976; 70(1):123-6.
24. Wood BJ, Lawrence DM, Mc Garrigle H. Similar zinc levels in seminal fluid from normospermic, oligospermic and azospermic men. Clin Chim Acta 1982; 123(3):329-32.
25. Skandhan KP, Skandhan S, Mehta YB. Semen electrolytes in normal and infertile subjects. Il. Zinc, Experientia 1978; 34(11):1476-77.
26. Deger O, Akkus L Semen magnesium levels in fertile and infertile subjects. Magnesium 1988; 7:6-8.
27. Papadimas J, Bontis J, Ikkos D. Seminal plazma zinc and magnesium in infertile men. Arch Androl 1983; 10:261-8.
28. Gershbein LL, Thielen DR. Enzymatic and electrolytic profiles of human semen. The Prostate 1988; 12:263-9.
29. Leake A, Chrisholm GD. Subcellular distribution of zinc in the benign, and malignant human prostate: Evidence for a direct zinc androgen interaction. Acta Endoc 1984; 105:281-8.
30. Elisson R, Lindholmer C. Magnesium in human seminal plazma. Investigative Urology 1972:9(4).
31. Takihara H, Cosentino JM, Cockett TK. Effect of lowdose androgen and zinc sulfate o.i sperm motility and seminal zinc levels in infertile men. Urology 1983:12(2):160-4.