SEMINAL FRUCTOSE, CITRIC ACID AND PHOSPHATASE LEVELS AND THEIR RELATION TO THE SPERM COUNT IN MAN

V.S. JATHAR AND RASHMI HIRWE

Department of Chemistry, University of Bombay, University Campus, Kalina, Santacruz (East), Bombay—400 098

AND

SHANTA DESAI AND R.S. SATOSKAR

Department of Pharmacology, Topiwala National Medical College, Byculla, Bombay—400 008

Summary: Seminal fructose, citric acid and phosphatase levels were estimated in 60 normal adults and compared with 60 oligospermic and 24 azoospermic Indian subjects. In normal group, the seminal plasma fructose level and acid phosphatase activity showed a fall as the sperm count increased. As compared to normals, significantly higher mean values for fructose and acid phosphatase activity were observed in oligospermic and azoospermic groups. Seminal alkaline phosphatase activity did not show any relationship with sperm count. Similarity in changes observed in seminal fructose and acid phosphatase levels with respect to seminal citric acid content and sperm concentration suggests that both these parameters are probably regulated by similar physiological mechanism.

Key words: seminal fructose, seminal citric acid, seminal chemistry, seminal phosphatase activity

INTRODUCTION

Biochemistry of seminal plasma is still not clearly defined in oligo or azoospermic disorders. The significance of fructose in seminal plasma is still controversial (16). and so is true with the chemistry of proteins (7). In the present study, some of the biochemical parameters such as fructose, citric acid, acid and alkaline phosphatase activity were evaluated on the basis of sperm concentration and the relationships between these parameters were investigated.

MATERIALS AND METHODS

Out of the total 134 individuals studied, 50 subjects were normal volunteers with normal sperm count and sperm morphology. Sixty subjects with repeated sperm count of less than 6×10^6 sperms/*ml* were considered as having oligospermia while the remaining 24 individuals whose semen was free from sperms were classified as azoospermic.

The semen samples were collected in a clean, sterile glass container by masturbation, after observing abstinence for five days. Volume and viscocity were noted immediately. After allowing 30 minutes for liquification, total sperm count, motility and sperm morphology were studied by standard techniques (3, 18).

Seminal plasma was separated by centrifugation and the samples were preserved in the refrigerator at 4°C for biochemical estimations.

Fructose estimations were carried out by the circular paper chromatography method (17). Citric acid was estimated by the method of Murray and Orville (13). Acid and alkaline phosphatase activities were measured by Bodansky's method using sodium - β - glycero-phosphate as a substrate and the activity was expressed in terms of Bodansky's Unit (1). The phosphorus was measured by Fiske and Subbarow's method (5).

RESULTS

The mean values ± S.E. for various parameters studied are given in Table I. The mean values for fructose in oligospermic and azoospermic groups were significantly higher than the corresponding mean value observed in the normal subjects. Further, analysis of fructose values revealed that in normal volunteers, seminal palsma fructose levels decerased as the sperm count increased (Fig. 1).

TABLE I : Biochemical analysis of seminal plasma in fertile, sub-fertile and infertile Indian subjects.

Group & No.	*Fructose mg/100 ml*	*Citric acid mg/100 ml*	*Alkaline phosphatase B.U.%*	*Acid phosphatase B.U. × 10³%*
Normal (50)	381±17.4	657±80	52±3.9	228±9.3
Oligospermia (60)	467±19.4	681±55	40±3.6	278±5.7
Azoospermia (24)	588±25.4	606±63	43±3.4	319±14.3

Mean values with ± S.E.

The seminal plasma citric acid levels showed a positive co-relationship with sperm count ($P<0.05$). Further, in all the groups the citric acid values were inversely related to the corresponding fructose levels. Thus, the semen which had high fructose level usually showed low citric acid content (Fig. 2). Similar relationship was also observed between citric acid levels and semen acid phosphatase activity.

The mean alkaline phosphatase activity in normal, oligospermic and azoospermic groups showed no significant difference and the levels were not related to the sperm centrations. The seminal plasma acid phosphatase activity in normal group, however, showed an inverse correlation with sperm concentration (Fig. 3). Thus, higher sperm content was associated with lower acid phosphates activity. The highest mean value for acid phosphatase was noted in azoospermic patients (Table I).

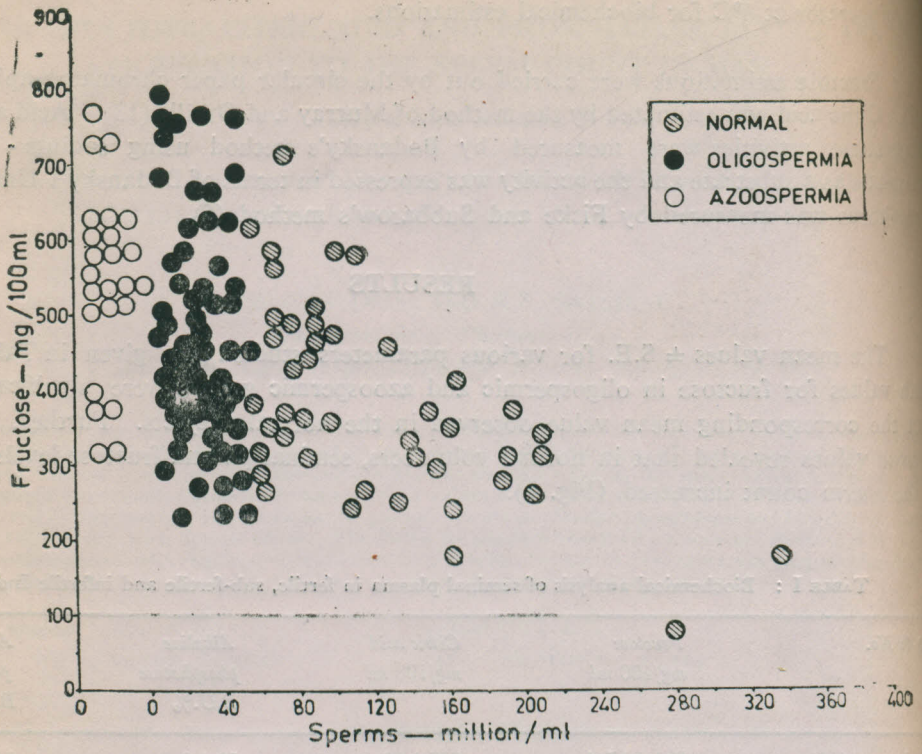

Fig. 1: Relationship between sperm concentration and the corresponding fructose levels in seminal plasma.

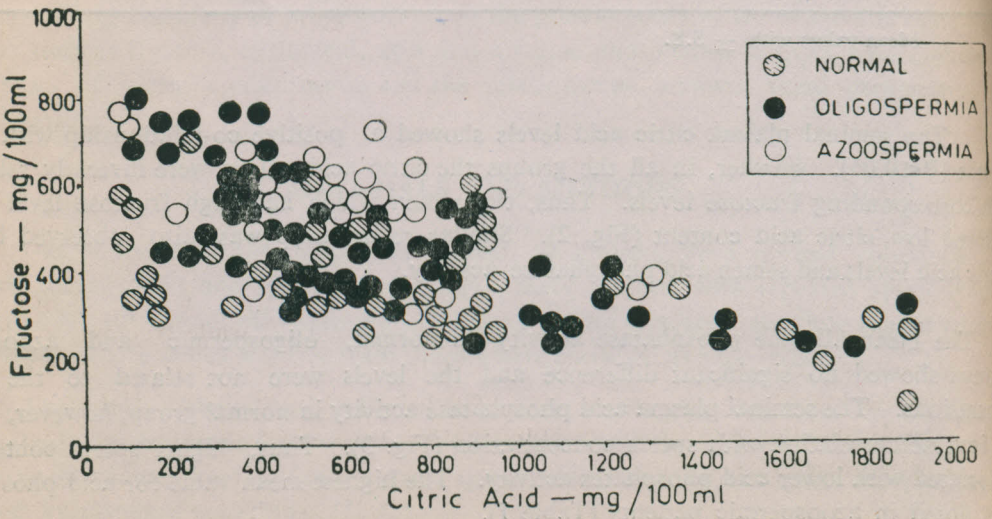

Fig. 2: Relationship between fructose and citric acid values in seminal plasma.

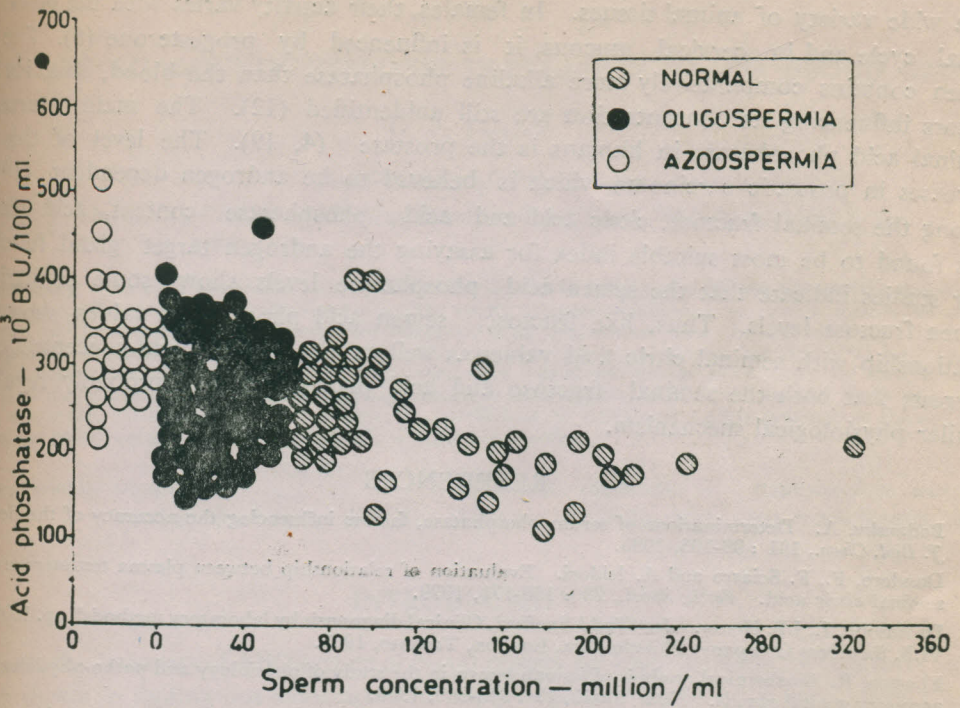

Fig. 3: Relationship between sperm concentration and acid phosphatase activity in seminal plasma.

DISCUSSION

The significance of fructose in seminal plasma is still a controversial subject (16). Some workers have observed no statistical relationship between fructose level and sperm concentration while others have demonstrated definite inverse relationship between these two parameters (9, 10, 11, 14). Further, a relationship was also observed between seminal fructose and androgen production (9). Our findings support the view that higher seminal fructose values are usually associated with low sperm concentration. Recently Phadke *et al.* (15) have observed that the fructose activity is related to germinal cell activity and it is usually highest in cases of germinal cell aplasia. In the present study, very high fructose values were observed in subjects with azoospermia. The seminal plasma ctiric acid content was inversely related to the fructose levels in both normal and abnormal groups. Citric acid in humans is believed to be secreted entirely by the prostate (2) wnile fructose probably comes from seminal vescicles (4, 9). However, like fructose some correlation between citric acid and plasma testosterone levels has been demonstrated though no correlation between citric acid levels and the motility of spermotozoa has been observed (4). The exact role of citric acid in semen is not known.

Alkaline phosphatase and acid phosphatases are specific enzymes which react on compounds containing monophosphate or diphosphate group. These enzymes are found

in a wide variety of animal tissues. In females, their activity varies with the phase of m strual cycle and in cervical mucous, it is influenced by progesterone (6). The hum semen contains comparatively more alkaline phosphatase than the blood, but its role a factors influencing its concentration are still unidentified (12). The main source of seminal acid phosphatase in humans is the prostate (4, 19). The level of this enzy increases in prostatic carcinoma which is believed to be androgen dependent (19). Fro among the seminal fructose, citric acid and acid phosphatase content, acid phospha was found to be most suitable index for assaying the androgen target gland function Our studies indicate that the semen acid phosphatase levels show some similarity wi semen fructose levels. Thus, like fructose, semen acid phosphatase values showed inver relationship with seminal citric acid values as well as the semen sperm concentration. T suggests that both the seminal fructose and acid phosphatase are probably regulated b similar physiological mechanism.

REFERENCES

1. Bodansky, A. Determinations of serum phosphatase, factors influencing the accuracy of the determinati *J. Biol. Chem.*, **101** : 93-103, 1933.
2. Dandero, F., F. Sciarra and A. Isidori. Evaluation of relationship between plasma testosterone and huma seminal citric acid. *Fertil. Steril.*, **23** : 168-171, 1979.
3. Davidsohn, I., J.B. Henry. In "Todd-Sanford, Clinical diagnonsis by laboratory methods" pp. 1204, 14th Ed W.B. Saunders Company, Philadelphia, London, Toranto, 1967.
4. Eliasson, R. Biochemical analysis of human semen in the study of physiology and patho-physiology of the m accessory genital glands. *Fertil. Steril.*, **19** : 345-349, 1968.
5. Fiske, C.H. and Y. Subbarow. The colorimetric determinations of phosphorus. *J. Biol. Chem.*, **66** : 375-3 1925.
6. Gregoire, A.T., O. Kandil and G. Beyer. The acid and alkaline phosphatase activity in human cervical mu of females using either a coil or combined therapy. *Fertil. Steril.*, **23** : 15-17, 1972.
7. Hirwe, R.B. In "Biochemical and vitamin studies in male infertility" A thesis submitted to the Universit Bombay, 1975.
8. Kent, J.R., M. Hill., F.J. Huix and E.J. Segre. Seminal acid phosphatase content in clinical bioassay of and gens and anti-androgens. *Clin. Phramacol. Ther.*, **13** : 205-211, 1972.
9. Mann, T. In "Biochemistry of semen and of the male reproductive tract" 2nd Edn., Mathuen, London,19
10. Mann, T. and U. Parsons. Effect of testicular hormone on the formation of seminal fructose. *Nature*, 16 294-298, 1947.
11. Moon, K.H. and R.G. Bunge. Observations on the biochemistry of human semen I, Fructose. *Fertil. Soc.* **79** : 186-188, 1968.
12. Moon, K.H. and R.G. Bunge. Observation on the biochemistry of human semen II, Alkaline phosphata *Fertil. Steril.*, **19** : 766-769, 1968.
13. Murray, S. and F.D. Orville. A rapid method for the determination of citric acid. *J.Biol. Chem.*, **175** : 8 855, 1968.
14. Nun, S., I Musacchio and J.A. Epstein. Variations in seminal plasma estimations from fertile, subfertile a vasectomized azoospermic man. *Fertil. Steril.*, **23** : 357-360, 1972.
15. Phadke, A.M., N.R. Samant and S.D. Deval. Significance of seminal fructose studies in male infertility. *Fert Steril.*, **24** : 894-702. 1973.
16. Schirren, C. Relation between fructose content of semen and fertility in man. *J. Reprod. Fertil.*, **5**:347-3 1963.
17. Sheth, A.R. and S.S. Rao. Fructose and fructolysis in human semen, determined chromotographically *Experientia.*, **15** : 314-315, 1959.
18. Williams, W.W. In "Sterility, the diagnostic survey of the infertile couple" pp. 13, 3rd Edn., Springfield, Mas chusetts, U.S.A,. 1964.
19. Yam, L.T. Clinical significance of the human acid phosphatase, *Am.J.Med.*, **56** : 604-615, 1974.