VOLUME - 10, ISSUE - 09, SEPTEMBER - 2021 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra

Original Research Paper

Ayurveda

DETAILED STUDY ON HUMAN SEMEN AT GOLD MINE AND NON GOLD MINE AREAS

Prasad BS	Kaher's Shree Bmk Ayurved Mahavidyalaya Belagavi India
Skandhan KP*	Kaher's Shree Bmk Ayurved Mahavidyalaya Belagavi India. *Corresponding Author
Pawankumar G	Institute For Post Graduate Teaching And Research Gujarat Ayurveda University Jamnagar India
Mehra BL	Institute For Post Graduate Teaching And Research Gujarat Ayurveda University Jamnagar India
Singh G	Institute For Post Graduate Teaching And Research Gujarat Ayurveda University Jamnagar India

KEYWORDS :

INTRODUCTION

Semen gathered large attention in public health system as male infertility is a major issue in infertility studies which remain as a major concern since decades. An infertile couple remains under stress and they are psychologically very much disturbed. In certain societies, childlessness is considered as an insult to the couple, especially to female partner.

Male infertility is not uncommon, which is reported as 40-50 percentage[9]. On the basis of an ultrasound study, Lotti and Maggi[29] observed 7% of all men population are infertile. Atig et al.[3] opined primary cause of infertility as oxidative stress. More workers are trying to find out the different causes responsible for it[45,65,67]. Several studies from different parts of the world reported its alarming level as shown below.

Country	Male infertility (%)
Bangladesh[14]	29
France[88]	35
Israel[16]	28
Pakistan[10]	26
Singapore[39]	23
The United Kingdom[13]	30
West Germany[41]	28
India-Ahmedabad[58]	64
Ahmedabad[70]	76
Bengaluru[8]	35
Delhi[24]	84
Jamnagar[37]	75
Jamnagar[32]	45
Kolar[37]	42
Wardha[25]	65
Belagavi[12]	62

A possible reason for this condition is likely to that our present knowledge on male reproductive system is thirty years behind that of female[101,102]. Following these reports many workers engaged in finding details of male reproductive system and its secretion. We have contributed minute details of human epididymis[84].

Pollution present in environment may be a cause for decreasing testicular functions at places[2,4,15,26-28,33].

Study on semen from a gold mine area, Kolar and a non-gold mine area, Jamnagar was reported earlier[37]. This is followed by the present detailed evaluation of semen at these two places.

MATERIALS AND METHODS

Normal healthy subjects from Kolar (n=114) and Jamnagar (n=111) were preferred in this study. Their age varied from 25-45 years. Their semen samples were studied.

WHO[103] prescribed the criteria for normal semen.

Following instructions were given to volunteers,

1. to maintain an abstinence of 3-5 days prior to collection of sample[50,69,95,96]. The semen volume increases if it is allowed to remain in male system[23]. Thus we preferred to have a fixed time period of continence

2. to collect sample between at 8:00 am - 8:30 am. Fixed time is important considering the chronobiological changes taking place in body[5-7,82] and in the composition of semen during different timings of the day[95-98]

3. to collect sample onto a clean and sterile glass container provided from the laboratory[52]. Semen examination was done as per the prescribed procedure[103] and

4. to collect sample by masturbation[1], at a place close to laboratory. The sample submission in short time is important to prevent changes in it. Freund[20] opined that semen collected by a person by coitus interruptus or by masturbation was found to have equal in properties of semen. It may not be true as during coitus interruptus one or few drops of semen may be lost. It is also likely such sample may contain a portion of vaginal secretions and other cells. Considering these, we opted the collection of sample by masturbation.

Proper lighting in laboratory and on microscope was done throughout the study. This was in response to a report of Veena et al.[100] showing light has a direct effect on sperm motility.

Within 30 minutes after submission sample was studied[30]. During this time the semen coagulum liquefies. The Semen examination[1] included its 1) Total volume 2) Liquefaction time 3) pH 4) Viscosity 5) Chemical composition like fructose 6) Total Sperm Count 7) Percentage of Sperm motility and 8) Sperm morphology. In the present study on semen, keeping importance to its total sperm count (40mill/ml), percentage of sperm motility (60%)[1,17,21,59,99] and total semen volume was also chosen for elaborate analysis.

After completion of this we compiled the results of three major parameters of this study, Total semen volume, Total sperm count and Percentage of sperm motility.

Total sperm count was done as per the method given by

Cannon[11]. In man the daily output of spermatozoa was measured as 500 million[31].

Sperm motility evaluation is possible after liquefaction of semen. Sperm motility deteriorates as the time lapses. At 37°C sperm motility was studied by using prepared sample slide, which was studied using percentage system[19,20]. Majority of laboratories prefer this method[21].

RESULTS

pH and liquefaction time of all samples were within normal range[30].

According to the age of semen supplier's results of the present study is given in Table 1. Graphically results of Semen Volume (Fig 1), Total Sperm Count (Fig 2) and Percentage of Sperm Motility (Fig 3) are presented.

DISCUSSION

Semen study started when sperm was first time seen under lens by Antonie Van Leeuwenhoek in 1677 [30]. Semen study continued since then by several authors. Today semen study is important because this is one of the investigations advised for male partner when a couple reports to a doctor for infertility.

Semen report of a man shows whether he is fertile or infertile.

The structure of a spermatozoa was studied elaborately under electron microscope by several authors.

The seminal plasma secured large attention in which spermatozoa survive and do its function with the support of several organic and inorganic items present in it. Presence of WBC was established in 1986 [55]. In seminal plasma Protein [89], Glutathione [3], Cholesterol [90], Glucose and fructose[34], hormones FSH, LH, Testosterone and Prolactin[35] were all recorded.

Interestingly some authors carried out biochemical study of it. Several elements were studied by different groups of workers. This was important as a change in concentration of any of those elements may lead to immotility or death of spermatozoa. We observed different elements present in seminal plasma by using Emission Spectroscope [54], Direct Couple Plasma Emission Spectroscopy [63], Energy Dispersive X-ray analysis of Electron Microscope [78] and X-ray diffraction study [74].

Sodium, Potassium and Chloride sluggishly enter into sperm [42]. Some others are restricted its entry into spermatozoa, so remained in seminal plasma. We have reported the level of Sodium[44,57,61,66], Potassium[44,57,61,66], Calcium [44,66,92], Magnesium [44,66,73,92-98], Iron [44,79], Zinc [44,46,47,60,62,66,68,69], Copper [43,44,53,56,62,64,69,85,91], Cadmium [68,72], Nickel [44,72], Chromium[44,72], Manganese[44,72], Lead [44,72], Aluminium[44], Barium[44], Cerium[44], Cobalt[44] ,Gallium[44], Molybdenum[44], Strontium[44] and Titanium[44].

Gold in semen was discovered in 1981[48]. Gold present in food may be entering blood and into semen. We observed gold as an important element for sperm quality and its motility [44,75,86]. Gold is recognized as an important element in semen for its function. Level of gold in semen of Normal, Oligozoospermia, Aesthenozoospermia, Oligo Aesthenozoospermia and Azoospermia samples were reported[37,38,40,44,46-49,51,76,77,83].

The source of gold in semen is shown by employing animal experiments [71,81,82,87]. Gold was detected in male reproductive organs of Frog[87], Rat[81,82] and Guinea pig[81]. Our interest in this area made to understand gold is present in reproductive system of female frog [80].

The present severe study was conducted at two places, Kolar in the Province of Karnataka which is the major gold mine area of this country and Jamnagar in the Province of Gujarat, a far away place from any gold mine area.

The soil chemistry gives the picture that gold is present more in the soil of Kolar region than non-gold mine places. The element gold like other elements enters the body through intake of water as well as food. Through blood it reaches semen. No study is done to find out the level of gold in food items and blood of people of Kolar. Gold is one of the likely elements promoting spermatogenesis as well as increase in sperm motility.

Level of gold in Suvarna Bhasma (Gold Ash) was reported[36]. Experimentally it was shown that Gold Ash ("Suvarna Bhasma"), an Ayurvedic preparation, prescribed in Ayurveda for male infertile men, "Suvarna bhasma"(Gold ash) [36], leading to increase in sperm motility [22,83].

Immediately after ejaculation semen remains in coagulum. This is liquefied in a short period of time. Using the split ejaculation technique, Eliasson and Lindholmer[18] reported secretion of seminal vesicle as responsible for forming coagulum. It is accepted total sperm count as an essential parameter for semen analysis. We have reported existing interdependance between sperm count and percentage of motility [59]. In the present study we have also studied sperm morphology which was normal in all cases.

In the present study, looking into Table 1 and Fig 1, it is seen semen volume was more in Kolar in all age groups when compared to that of Jamnagar. In comparison to that of Kolar region, semen reports from Jamnagar showed inferior in quality of Total Sperm Count and Percentage of Sperm Motility (Table 1). Pollution causes damage to male fertility. Jamnagar is an industrial area. Air and water pollution of this place are recorded. Different heavy metals are present in air. Comparing reports from both regions, Total semen volume, Total sperm count and Percentage of sperm motility are presented (Table 1). The semen was higher in quality from gold mine area than from non-gold mine area (Table 1). The total study showed semen collected from Kolar was better in quality than that from Jamnagar in terms of Semen volume (Fig 1), Total sperm count(Fig 2) and Percentage of sperm motility(Fig 3;Table 1).

In conclusion the semen from normal men of Kolar is better in quality when compared to semen samples from normal men of Jamnagar. It may be concluded that the element gold is present in soil in Kolar and which enters the semen is the likely reason for the better quality of semen with increase in Semen Volume, Sperm Count and better Percentage of Sperm Motility.

Table 1. Semen reports shown according to age

Age (in years)	**Area 1** (n=114)			**Area 2** (n=111)		
	Volume (in ml)	Total sperm count (mill/ml)	Sperm Motility (%)	Volume (in ml)	Total Sperm Count (mill/ml)	Sperm Motility (%)
20-25	3.5	98.9	72	2.2	53.8	60.6
26-30	3.5	92.5	71	2.7	51.5	61.2
31-35	3.4	93.4	70	2.7	51.1	61.0
36-40	3.3	96.8	74	2.2	58.3	62.00
40-45	3	140.0	90	2.0	60.3	63.5
Average	3.34	104.4	81.14	2.75	55.0	61.62

Area 1. Kolar (Gold Mine Area); **Area 2.** Jamnagar (Non-Gold Mine Area)

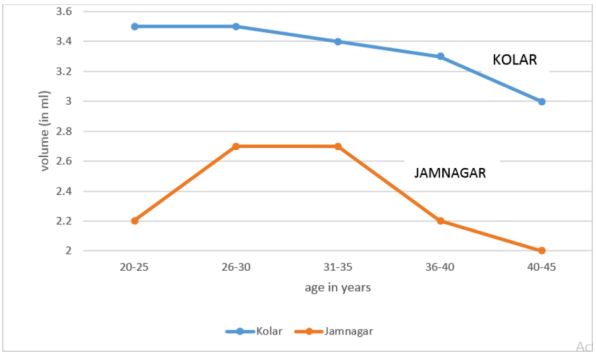

Fig 1: Semen Volume seen in this study

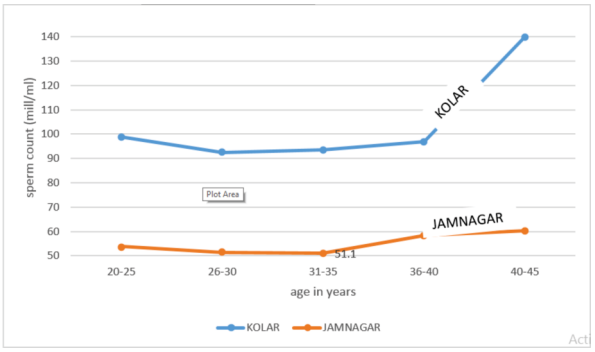

Fig 2: Total Sperm Count (mill/ml) seen in this Study

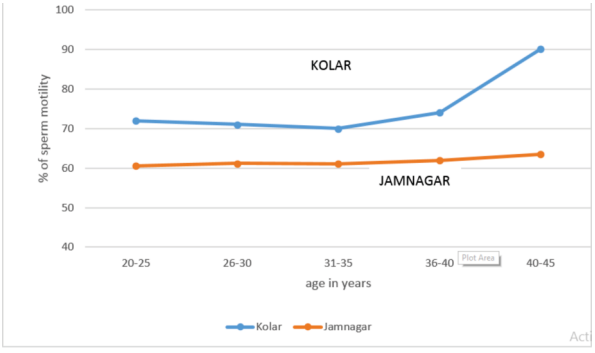

Fig 3: Percentage of Sperm motility seen in this study

REFERENCES

1. Amelar RD, Dubin L: Semen analysis. In Amelar RD, Dubin L and Walsh PC (Editors): Male infertility, Philadelphia, WB Saunders Company,1977
2. Assennato G, Paci C, Baser ME, Molinini R, Candela RG, Altamura BM, Giorgino R. Sperm count suppression without ndocrine dysfunction in lead exposed men. Arch Environ Health 42:124-7, 1987
3. Atig F, Raffa M, Habib BA, Kerkeni A, Saad A, Ajina M. Impact of seminal trace element and glutathione levels on semen quality of Tunisian infertile men. BMC Urol 12:6-10, 2012
4. Babalola OO, Babajide SO,. Selected heavy metals and electrolyte levels in blood of workers and residents of industrial communitites. African J Bio Chem Rese 3:37-40, 2009
5. Bhattacharya RD: Histochemistry of circadian changes of some lysosomal enzymes in rat liver. Acta Histochemica 16: 189-194, 1976
6. Bhattacharya RD: Circadian rhythmic aspects of urinary zinc excretion in presumably healthy subjects. Panminerva Med 21: 201-203, 1979a
7. Bhattacharya RD: Circadian rhythm of urinary electrolytes from homogeneous subjects with vegetarian food habits. Chronobiologia 6:79, 1979b
8. Biradar KD. Male factor in infertility: study from a tertiary care hospital. Int J Reprod, Contra, Obstet Gynecol 5:2022-2025, 2017
9. Brugh VM, Lipshultz LI. Male factor infertility. Med Clin North Ame 88:367-385, 2004
10. Butt F, Akram N. Semen analysis parameters: experience and insight into male infertility at a tertiary care hospital in Punjab. J Pak Med Assoc 63: 558-562, 2013
11. Cannon DC: Examination of seminal fluid. In Davidsohn I and Henry JB: Clinical diagnosis by laboratory methods, New Delhi, The Macmillan Company of India Limited, 1977
12. Chaitrali G, Santrupti K, Niranjan K, Skandhan KP, Sukumar N. Male infertility rate: A Retrospective Study. Int J Infertile Fetal Med 10:1-3,2019
13. Chandley AC. Cytogenetics of infertile men. In: Hafez ESE (editor) Human semen and fertility regulation in Men. Saint Louis. The CV Mosby company pp 419-428, 1976
14. Chowdhury TA, Hanam SO, Akhter N. Profile of 350 couples attending the infertility clinic at PG hospital In: Contributors conference, Dacca, Dec 13 1980. Dacca: Bangladesh Fertility Research Programme; 1981. p.85
15. Danadevi K, Rozati R, Reddy PP, Grover P. Semen quality of Indian welders occupationally exposed to nickel and chromium. Reprod Toxical 17:451-6, 2003
16. Dor J, Homburg R, Rabau E. An evaluation of etiologic factors and therapy in 665 infertile couples. Fertil Steril 28:718-722, 1977
17. Eliasson R. Accessory glands and seminal plasma with special reference to infertility as a model for studies on induction of sterility in the male. J Reprod Fertil 24:163-174, 1976
18. Eliasson R and Lindholmer C: Functions of male accessory genital organs. In Hafez E.S.E.(Editor): Human semen and fertility regulation in men. Saint Louis, The CV Mosby company, 1976
19. Freund M: Semen analysis. Clinical and research studies. In Behrman SJ and Kistner RW (Editors): Progress in infertility, Boston, Little Brown & Co., 1968a
20. Freund M: Performance and interpretation of semen analysis. In Roland M (Editor): Management of the infertile coupe, Springfield, Charles C. Thomas, 1968b
21. Freund M, Peterson RM. Semen Evaluation and Fertility. In: Hafez E.S.E Human Semen and Fertility Regulation in Men. Saint Louis, CV Mosby Company, 1976
22. Godatwar PP,Prasad BS, Skandhan KP, Mehra BL, Singh G. Effect of Ayurvedic Medicines "Suvarna bhasma"(gold ash) and atmaguprachurna in normozoospermic infertile patient. Int J Sci Res 9:42-43, 2020
23. Hudson B, Burger HG: The physiology and function of the testes. In Shearman RP (Editor): Human reproductive physiology, Oxford, Blackwell Publications, 1972
24. Jairajpuri ZS, Rana S, Ali MA. Patterns of semen analysis: Experience of a laboratory catering to semi urban population of Delhi. Bangladesh J Med Sci 16:314-319, 2017
25. Kumar N, Choudhan AR, Singh AK. Prevalence of male factor infertility in last ten years at a rural tertiary care centre of central India. A retrospective analysis. Indian J Obstet Gynaecol Res 2:132-136, 2015
26. Lancranjan I, PopescuHI, Gavanescu O, Klepsch I, Srbanescu M. Reproductive ability of workmen occupationally exposed to lead. Arch Health 30:396-401, 1975
27. Lerda D. Study of sperm characteristics in persons occupationally exposed to lead. Am J Ind Med 22:567-71, 1992
28. Li H, Chen , Li S, Yao W, Li L, Shi X, Wang L,Castranova V, Vallyathan V, Ernst E, Chen C. Effect of Cr(VI) exposure on sperm quality: human and animal studies . Ann Occup Hyg 45:50511, 2001
29. Lotti F, Maggi M. Ultra sound of the male genital tract in relation to male reproductive health. Hum Reprod Update 21:56-83, 2014
30. Mann T. The biochemistry of semen and of the male reproductive tract. London. Methuen and Company Ltd,1964
31. Mann T and Mann CL. Male Reproductive Function and Semen. Springer-Verlag. Berlin Heidelberg New York, 1981
32. Mehra BL, Skandhan KP, Prasad BS, Pawankumar G, Sing G, Jaya V. Male Infertility rate: a retrospective study. Urologia 85:22-4, 2018
33. Moran-Martinez J, Carranza- Rosakes P, Morales- Vallarta M, A Heredia-Rojas J, Bassol-Mayaoitia S, Denys Betancourt-Martinez N, M Cerda-Flores R. Chronic environmental exposure to lead affects semen quality in a Mexican men population. Iran J Reprod Med 11:267-74, 2013
34. Patel SM, Skandhan KP, Mehta YB. Seminal plasma fructose and glucose in normal and pathological conditions. Acta Eur Fertil (Padua, Italy)19:329-332, 1988
35. Patel GH,Mazumdar BN,Skandhan KP, Panchal HB,Balar DB,Shukla SN.Serum and seminal plasma FSH, LH. Testosterone and prolactin in normal subjects in relation to their sperm counts. Gujarat Cancer Res Bull 3: 68-81, 1996
36. Prasad BS, Skandhan KP, Singh G. Analytical study of "Suvarna Bhasma (gold Ash),an ayurvedic Medicine.Int J Drug Develop Technol (New Delhi, India) 1:99-101. , 2011a
37. Prasad BS, Skandhan KP, Sing G. Human semen study around and away from gold mine area. Urologia 78:293-296, 2011b
38. Prasad BS, Skandhan KP, Pawankumar G, Mehra BL, Singh G.Level of gold in semen at gold mine and non-gold mine area. Global J Res Anal. 10:12-14,2021
39. Ratnam SS, Chew PCT, Tsakok M. Experience of a comprehensive infertility clinic in the Department of Obstetrics and Gynecology, University of Singapore. Singp med J 17:157-159, 1976
40. Sahab Khan P, Skandhan KP, Ajesh K, Siraj MVP. Gold in human semen around and away from a gold deposit area. Biol Trace Elem Res 142:302-308,2011
41. Semm K, Brandl E, Mettler L. Vaccum insemenation cap. In: Hafez ESE (EDITOR) Human semen and fertility regulation in Men. Saint Louis. The CV Mosby company.pp. 439-441, 1976
42. Setchell BP, Waites GMH: The blood testis barrier. In Greep RO and Astwood, EB (Editors): Male reproductive system, Hand book of physiology, Section 7, Endocrinology, Washington DC, American Physiology Society, 1975, Volume 5.
43. Shaji G, Skandhan KP.Copper in human seminal plasma. Panminerva Med (Torino, Italy)33:35-36,1991
44. Sivapriya N, Pandiyan N, Skandhan KP and Manasa N. Level of elements in normal human seminal plasma: A Study and Review. Int J Life Sci Pharma Res 10: 138-144, 2020
45. Skandhan KP. Evaluation of infertility due to semen antigencity and certain techniques adopted for its detection. Panminerva Med21:191-196, 1979
46. Skandhan KP.Zinc in normal human seminal plasma. Andrologia (Hamburg, West Germany)13:346 -351,1981a
47. Skandhan KP.Importance of zinc in the semen quality of different fractions of split ejaculate. Infertility(NewYork,USA)4:67-81,1981b
48. Skandhan KP. Gold in human semen. Andrologia 13:78-81,1981c
49. Skandhan KP. Gold in seminal plasma of normal and pathological specimens. Israel J Med Sci 17:769-770,1981d
50. Skandhan KP. Can increase in frequency of ejaculation promote spermatogenesis? Med Hypo 30:81-2, 1989
51. Skandhan KP. Presence of gold in semen.Ind J Physiol Pharmacol 34: 287 - 288,1990
52. Skandhan KP. A new glass device for the collection of semen sample. Urologia

58:271 -273,1991
53. Skandhan KP. Review on copper in male reproduction and contraception. Rev Fr Gynecol Obstet 87:594-8, 1992
54. Skandhan KP, Abraham KC. Presence of several elements in normal and pathological human semen samples and its origin. Andrologia 16:587-8, 1984
55. Skandhan KP, Gusani PH.Total leucocytes in human semen of normal and pathological origin. Invest Clinic 26:225 -229,1986
56. Skandhan KP, Mazumdar BN.Semen copper in normal and infertile subjects. Experientia (Basel, Switzerland)35:876 - 877,1979
57. Skandhan KP, Mazumdar BN. Correlation of sodium and potassium n human seminal plasma with fertilizing capacity of normal and infertile subjects. Andrologia 13:147-154, 1981
58. Skandhan KP, Mazumdar BN. High incidence of male involuntary infertility. Infertility 5:167-74, 1982
59. Skandhan KP, Mazumdar BN. Interdependance of count and motility of spermatozoa. Acta Eur Fertil 13:49-54, 1983
60. Skandhan KP, Mazumdar BN. Le zinc dans le plasma seminal (Zinc in seminal fluid). Revue Franc Obstet Gynecol 80:891-898,1985a
61. Skandhan KP, Mazumdar BN. The relation between sodium and potassium in seminal plasma and the essentiality of these elements for sperm motility. Urologia 52:413-420,1985b
62. Skandhan KP, Mazumdar BN.Zinc and copper in normal and pathological seminal plasma: an analytical study. Urologia 53:200 -208,1986a
63. Skandhan KP, Pandya CB. Direct Couple plasma Emission Spectroscopic study on human seminal plasma. Adv Cont Dely Syst 2:256-7, 1986b
64. Skandhan KP, Skandhan S. Seminal plasma copper in fertile subjects and infertile patients. Adv Contr Dely Syst 3:23 -236,1987
65. Skandhan KP, Agrawat HH, Joshi JR, Roy PR, Achar VS. Report on study of immunological aspects of sterility .J Obstet Gynecol India (Bombay, India) 26: 230 - 233,1976
66. Skandhan KP, MehtaYB, Chary TM, Achar MV. Semen electrolytes in normal and infertility cases. I. Sodium, potassium, calcium and magnesium. J Obstet Gynecol India (Bombay,India) 28: 278-285,1978
67. Skandhan S, Skandhan KP, Bhatt AC. Immunogenic agglutination and immobilization of spermatozoa. Gynecologie(Paris, France) 32: 351 - 353,1981
68. Skandhan KP, Pandya CB, Skandhan S. Concentration of zinc, copper and cadmium in seminal plasma after prolonged storage in different containers. Z Med Lab Diag (Tenn Stedt., East Germany)25 :43-46,1984
69. Skandhan KP, Skandhan S, Pandya CV, Shah RC. Daily Ejaculates Zinc and Copper in Seminal plasma necessity for abstinence prior to semen collection. Infertility 8:279-291,1985
70. Skandhan KP, Patel IA, Mehta YB. Rate of involuntary infertility among male partners. Ital J Med 2:71-8, 1986
71. Skandhan KP, Skandhan S, Mehta YB, Roy PB.Histological demonstration of gold in male genital system of rat. Urologia (Doson, Italy) 59:75-76,1992
72. Skandhan KP, Makada MT,Avni S.Levels of cadmium, chromium, nickel, manganese and lead in normal and pathological human seminal plasma.Urologia (Doson, Italy) 72: 461-464, 2005
73. Skandhan KP, Jiyo CS, Amith S. Different Electrolytes and metals in human seminal Plasma. Gazetta Medica Italia166: 181-186, 2007
74. Skandhan KP, Amith S, Avni KPS. X-ray diffraction study on human male reproductive tract and semen. Urologia 76:198-202, 2009a
75. Skandhan KP, Singh G, Prasad BS, Thakur AB, Godatwar PR, Rao N, Pandhya AR. Veracity of "Suvarna Bhasma" [Gold Ash]. An indigenous ayurvedic preparation, as a therapeutic agent for male infertility. J Ayur 3:83-6, 2009b
76. Skandhan KP, Sumangala B, Mehta YB, Roy PB, Amith S, Avni KPS. Level of gold in normal and pathological semen. Urologia 77:254-256,2010a
77. Skandhan KP, Sumangala B, Sahab Khan P, Amith S, Avni KPS. About gold in human semen. Int J Ayur Res (New Delhi, India) 1:220-221, 2010b
78. Skandhan KP, Sumangala B, Amith S, Avni KPS. Electron Microscopic (Energy Dispensible X Ray Analysis) study on human male reproductive organs and semen. Biol Trace Elem Res 141:91-95, 2011
79. Skandhan KP, Mazumdar BN, Sumangala B. Study into iron content in seminal plasma of normal and infertile subjects. Urologia (Doson, Italy) 79:54-57, 2012
80. Skandhan KP, Valsa J, Gusani PH, Sumangala B, Dinesh KS. Level of gold in female reproductive organs of frog. Indian J Animal Repro (Srinagar, India) 34:37-38, 2013
81. Skandhan KP,Valsa J,Sumangala B,Jaya V.Gold in male reproductive tract of rat and guinea pig.J Adv Res Med Sci 7:21-25,2015
82. Skandhan KP, Valsa J,Sumangala B, Jaya V. Gold in the male reproductive tract of rat: A chronobiological study. J Med Allied Sci (Hyderabad, India) 6:52-55, 2016
83. Skandhan KP, Nampoodiri E, Rao N, Prasad BS, Singh G. Effect of "suvarna bhasma" (gold ash) , an indigenous Ayurvedic preparation, on human sperm motility. J Sex Med (USA) 2:1009-1013,2017a
84. Skandhan KP, Soni A, Joshi AK, Avni KPS, Gupta BD. Human Epididymis: Structural pattern, total length and inner surface area. Urologia 84:215-217,2017b
85. Skandhan KP, Valsa J, Sumangala B, Jaya V. Level of copper in human split ejaculate. Urologia 84:51–54, 2017c
86. Skandhan KP, Valsa J, Sumangala B, Avni KPS, Jaya V. Gold in semen: Level in seminal plasma and spermatozoa of normal and infertile patients. Alexandria J Med (Alexandria, Egypt) 53: 31–33, 2017d
87. Skandhan KP, Valsa J, Sumangala B, Jaya V. Gold in reproductive tract of frog (Rana tigrina): A chronobiological study. Bio Rhythm Res 52:167-170, 2021 (Online 2019)
88. Soutoul JH, Burger C, Homasson N. Marital sterility and etiological study and therapeutics results. Rev Fr Gynecol Obstet 71:79-89, 1976
89. Valsa C, Skandhan KP, Gusani PH, Mehta YB. The level of protein in normal and pathological seminal plasma. Z Med Lab Diag 29:103-106,1988
90. Valsa J,Skandhan KP, UmarvanshiV. Cholestrol in normal and pathological seminal plasma. Panminerva Med 34:160-162,1992
91. Valsa J, Gusani PH, Skandhan KP, Modi HT. Copper in daily and split ejaculates. J Reprod Med (Los Angles, USA)39:725 -728, 1994
92. Valsa J, Skandhan KP, Avni KPS, Amith S. Calcium and magnesium in male reproductive system and its secretion. part II. Within subject variability in human seminal plasma and spermatozoa. Urologia 75 : 94- 96, 2007
93. Valsa J, Skandhan KP, Sahab Khan P, Sumangala B, Gondalia M. Split ejaculation study: semen parameters and calcium and magnesium in seminal plasma. Cent Eur J Urol (Spain) 216-218, 2012a
94. Valsa J, Skandhan KP,Sumangala B, SahabKhan P, Amith S. Effect of prolonged storage of seminal plasma on level of calcium and magnesium.J Clin Lab Anal (France) 26:315-316, 2012b
95. Valsa J, Skandhan KP, Gusani PH, SahabKhan P, Amith S. Quality of 4 – hourly ejaculations – levels of calcium and magnesium. Andrologia (Hamberg, Germany) 45:10-17,2013a
96. Valsa J, Skandhan KP, Gusani PH, Sahab Khan P, Amith S, Gondalia M. Effect of daily ejaculation on semen quality and calcium and magnesium in semen. Andrologia (Hamberg,Germany) 19: 1-6, 2013b
97. Valsa J, Skandhan KP, Sumangala B, Amith S, Avni KPS. Effect of different timings of the day on semen and calcium and magnesium in it. Urologia (Doson, Italy) 83:207-210, 2016a
98. Valsa J, Skandhan KP, Sumangala B, Jaya V. Time bound changes (in 24 hour) in human sperm motility and level of calcium and magnesium in seminal plasma. Alexandria J Med (Alexandria, Egypt) 52:235-241, 2016b
99. Van Zyl JA, Mankveld R, Relief AE, Van Niekerk WA: Oligozoospermia. In Hafez ESE (Editor): Human semen and fertility regulation in men, Saint Louis, The CV Mosby Company, 1976
100. Veena K, Skandhan KP, Siraj MVP, Amith S. Effect of visible light on human sperm motility. Urologia (Doson, Italy) 79: 1-5, 2012
101. Weyer RA. Male Contraception: will get it? Do we want it? Savvy 3:62-4, 1980
102. World Health Organization. Technical Reprt Series NO: 582. The Epidemology of Infertility. Switzerland;1975
103. World Health Organization. WHO Laboratory manual for Examination of Human Semen and Sperm Cervical Mucus Interaction, London, Cambridge University Press, 1992