REVIEW PAPER

Integrative Understanding of Semen Analysis with An Ayurvedic Perspective

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ABSTRACT

Background

Male infertility contributes significantly to global reproductive health problems and is implicated either independently or in combination in nearly half of infertile couples. Semen analysis remains the cornerstone investigation for evaluating male fertility; however, conventional laboratory parameters often fail to provide a holistic understanding of reproductive dysfunction. *Ayurveda* describes male reproductive assessment through the concepts of *Retas Pareeksha*, *Shukra Dhatu*, and *Shukra Dushti*, which demonstrate remarkable parallels with modern semen analysis parameters.

Objective

To comprehensively understand modern semen analysis parameters and correlate them with *Ayurvedic* concepts of *Retas Pareeksha*, *Shuddha Shukra*, and *Shukra Dushti* described in classical *Ayurvedic* literature.

Methods

A narrative review was conducted using classical Ayurvedic texts including *Charaka Samhita*, *Sushruta Samhita*, *Ashtanga* Sangraha, and *Ashtanga Hridaya*, along with contemporary literature from WHO laboratory manuals, peer-reviewed journals, and modern andrology references. Classical descriptions of semen characteristics and pathological conditions were critically compared with modern semen analysis parameters including semen volume, viscosity, liquefaction, pH, sperm concentration, motility, vitality, morphology, and infective changes.

Results

The review demonstrated significant correlations between Ayurvedic descriptions of *Shuddha Shukra* and modern semen parameters. Classical parameters such as *Bahu*, *Bahalam*, *Snigdha*, *Picchila*, *Madhura*, and *Shweta-Spatika Sannibha* correspond closely with sperm count, semen volume, viscosity, biochemical composition, pH balance, and semen appearance respectively. Various forms of *Shukra Dushti* showed strong similarities with pathological semen abnormalities. *Vataja Shukra Dushti* correlated with oligospermia, azoospermia, and teratozoospermia; *Pittaja Dushti* with pyospermia and inflammatory conditions; and *Kaphaja* Dushti with hyper viscosity, sperm aggregation, and asthenozoospermia. *Ayurvedic Doshic* interpretations provided a broader pathophysiological understanding of male infertility beyond conventional semen analysis.

Conclusion

Retas Pareeksha represents a systematic and clinically relevant *Ayurvedic* approach for assessing male reproductive health. The substantial similarities between *Ayurvedic* semen assessment and contemporary semen analysis suggest that ancient *Ayurvedic* scholars possessed advanced understanding regarding reproductive physiology and pathology. Integrating *Ayurvedic* concepts with modern semen analysis and advanced sperm function tests may provide a more comprehensive framework for evaluating and managing male infertility. Further interdisciplinary clinical research is required to standardize *Ayurvedic* semen assessment methods and validate their relevance in evidence-based reproductive medicine.

Keywords: *Male infertility; Semen analysis; Retas Pareeksha; Shukra Dhatu; Shukra Dushti; Ayurveda; Andrology; WHO semen analysis; Shuddha Shukra; Klaibya; Integrative medicine; Reproductive health*.

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INTRODUCTION

Fertility defines the rate of reproduction and ability to propagate generations, though it has been declining globally for the last two centuries[1].

Fertility rate measures the number of offspring that can be produced during the life span, and fecundity measures the biological potential of the number of offspring that can be obtained during a lifetime[2].

In either case, it is determined by the proper functioning of the reproductive system, its anatomy and the physiology of organs, glands, ducts, and testicles/ovaries[3].

Semen analysis is a laboratory test performed to evaluate male fertility. Infertility is referred to as the inability to conceive even after 1 year of unprotected sexual intercourse. About 15% of couples of reproductive age experience infertility. The assessment of male infertility involves a comprehensive evaluation, including a detailed medical and sexual history, a thorough physical examination, and semen analyses. The male factor significantly contributes to about 30% of infertility cases and it is contributing factor in about half of cases[4,5,6].

The Semen analysis is the cornerstone investigation in male infertility. *Ayurveda* describes semen evaluation through *Retas Pareeksha*[7].

The semen is a fluid conglomerate consisting of two major components: the cellular fraction, consisting of spermatozoa, migrating leucocytes, immature germ cells, and epithelial cells and the acellular fraction consisting of seminal plasma and extracellular vesicles, epididymosomes and prostasome. Human semen consists of approximately 2–5% spermatozoa and 98–95% seminal plasma, has a minimum volume of 2 mL, a pH of 7.2–8.0 and contains 200–500 million spermatozoa[8].

SPECIMEN COLLECTION METHODS AND PROCESS

Seminal samples can be collected through masturbation practices carried out either in the patient's private setting or in a designated area close to the diagnostic lab. Specimen collection should ideally take place following at least 3 to 7 days of complete sexual abstinence[9]. Appropriate pre-analytical instructions should be provided to ensure adequate collection of seminal specimens. Any loss or incomplete collection of the specimen should be notified at the point of specimen submission. Considering the variable nature of seminal characteristics, it is advisable to collect two to three samples over different periods for accurate semen analysis[10].

The specimen must be collected in a clean and sterile wide-mouthed bottle made of sperm-friendly materials. The specimen should be kept in temperatures ranging between 20 °C and 37 °C. In instances where masturbation cannot be conducted, the collection of samples can be achieved through non-spermatotoxic condoms during coitus. Nonetheless, latex condoms are prohibited since they have substances that may negatively affect the viability and mobility of the sperm[11].

After collection, the specimen should be taken to the laboratory within an hour to avoid adverse effects on sperm quality associated with dehydration and temperature changes. Laboratory guidelines on safety precautions should be strictly adhered to during specimen collection and handling. Semen analysis should be carried out according to established procedures, including those stipulated in the WHO laboratory manual for processing human semen[12]. Besides, laboratories should conduct quality control measures internally and externally to guarantee the accuracy, precision, and reproducibility of the analysis[13].

General Considerations according to the 6th Edition of the WHO Manual for the Semen Analysis

Semen examinations categorised into 3 categories[14]:

Basic examination

Extended examination

Advanced examination

BASIC EXAMINATION:

It is also termed as the Standard test, which comprises fundamental parameters that every laboratory analysing Human semen is expected to perform. These procedures are designed to ensure high reliability and practical applicability in a routine laboratory setup. By adopting these standardized protocols gives an accurate diagnostic evaluation and contributes to the advancements in male reproductive health, according to the WHO[15].

The parameters in the basic examination are classified as[16]:

Macroscopic Examination: Evaluation of liquefaction time, volume, odour,appearance, Colour & pH.

Microscopic examination: Evaluation of Sperm concentration, total sperm count, sperm motility & vitality.

Morphological examination: Assessment of sperm anatomical abnormalities.

VOLUME:

According to the 6th edition of the laboratory manual by WHO, the normal reference range for seminal volume is 1.3-1.5ML. Any deviation in this range corresponds to a physiological or pathological condition that affects male reproduction[17].

Aspermia**:** It is described as the "Absence of semen ejection through the urethral meatus(S2EART). This condition can be categorised into Anejaculation, where there is an absence of semen emission and expulsion, or retrograde ejaculation, wherein there is redirection of the semen into the urinary bladder instead of emerging from the penis; during this, orgasm ability remains intact[18, 19].

The causes of these conditions include: spinal cord injury, congenital defects such as spina bifida, and other neurologic dysplasia of the lower spinal cord secondary to multiple sclerosis, Parkinson's disease, or diabetes. Additionally, psychological issues, including stress and anxiety, and also anatomical changes such as obstruction in the ejaculatory duct, pelvic surgery, and pelvic trauma, may also be responsible for anejaculation[20, 21].

Retrograde ejaculation is further defined or classified as complete, with no antegrade fraction, or incomplete, with minimal antegrade fraction[22].

Hypospermia is referred to when the semen volume is less <1.4 mL in at least two separately analysed semen samples[23]. This condition can be found independently or in association with other sperm abnormalities, such as oligospermia, asthenozospermia, or teratozospermia[24].

Factors responsible for hypospermia are Lack or insufficient sexual abstinence before the semen collection[24], and incomplete retrograde ejaculation can cause partial antegrade ejaculation[24]. Conditions like Hormonal imbalance, such as hypogonadism, which decreases circulating levels of testicular androgens and leads to quantitative and qualitative alterations of multiple components of male ejaculate, lead to hypospermia[24].

In addition, hyperprolactinemia caused by prolactin-secreting tumours or medications, such as spironolactone, cimetidine, antipsychotic agents, and ketoconazole, can lower androgen levels and result in hypospermia[24]. In patients with cystic fibrosis, absence of the vas deferens bilateral or unilateral can be seen; obstructive anomalies such as prostatic cysts or post-surgical stenosis could be associated with hypospermia[24].

Hyperspermia is the condition in which volume of semen is >6.3ml. Where production of excessive seminal fluid during intercourse may decrease chances of successful fertilisation by impairing the availability of spermatozoa due to the dilution of the semen.

MACROSCOPIC EXAMINATION[23]

The macroscopic examination includes evaluation of coagulum formation, liquefaction, volume, viscosity, appearance, and pH. If microbiology cultures are needed, the specimen must be treated aseptically and plated immediately after volume is assessed.

Table 1: Appearance and Colour of Semen

PARAMETER	DESCRIPTION	CAUSES
Normal appearance	Creamy, grey, opalescent, or off-white	Due to prostatic and seminal vesicle secretions rather than spermatozoa[23, 26].
Age-related yellowing	Mild, progressive yellow discolouration	Because of the accumulation of lipofuscin granules from degenerated epithelial cells, prolonged abstinence[23, 26, 27, 28].
Opacity variation	Variable opacity	Influenced by age, diet, abstinence, medications, and infection[23].
Drug-induced discolouration (orange)	Orange-tinted semen	Associated with rifampicin therapy[29].
Yellow semen (pathological)	Marked yellow discolouration	Infections like orchitis or prostatitis; pyospermia/ leukocytospermia[23, 30, 31, 32].
Yellow semen (systemic cause)	Yellow coloration	Hyperbilirubinemia (jaundice)[23].
Red or pink semen	Pink to red discolouration	Hematospermia (most common), dietary factors (e.g., beet ingestion), certain medication[33].
Dark brown/black semen (old blood)	Dark discoloration	Presence of old blood[34, 35, 36].
Dark semen (infectious cause)	Brown or black semen	Schistosomiasis[34, 35, 36].
Abnormal brown semen with odour	Non-viscous brown semen with foul odour	Reported in prolonged abstinence [34, 35, 36].
Dark semen (non-infectious causes)	Darkened semen	Spinal cord injury, heavy metal toxicity, and uric acid crystal deposition[34, 35, 36].

LIQUEFACTION

The Semen liquefaction is defined as the process of converting coagulated or gel-like semen to a watery consistency due to the proteolytic enzymes produced from the seminal vesicles & prostatic secretions[37].

It is important for liquefaction in the female reproductive tract because it enhances sperm motility for transport to the fallopian tubes for fertilisation with the ovum[37].

Normal liquefaction range: 15-30minutes at room temperature[23].

Delayed liquefaction is abnormal, where semen does not begin to liquify after 30 minutes; in that case, the specimen could be incubated at 37 °C for another 30 minutes[23].

Non-Liquefaction is referred as liquefaction that is not complete after 60 minutes of reaching 37 °C[23].

The pathogenesis behind non-liquefaction is unclear, but it might be influenced by seminal proteins such as semenogelin from the seminal vesicles & liquefaction factor from the prostate gland. Along with Increased levels of semenogelin and decreased levels of proteases and plasminogen activators, such as urokinase and chymotrypsin, are linked with non-liquefaction, along with seminal vesiculitis, a lack of trace elements, and congenital prostatic deficiencies[38, 39].

In some cases, the coagulum liquefies too quickly, shortly after ejaculation, which might be linked to oligospermia, hyperactive enzymatic breakdown, so it is not detected in the laboratory[23].

VISCOSITY

Hyper Viscosity of semen is assessed with the help of a wide -bore pipette for aspiration of the liquefied semen, to dispense a drop by gravity & measuring the thread length[40]. Normal liquefied semen should fall drop by drop. If the thread measures >2cm long, considered to be abnormal[23].

Hyper viscosity of semen is seen in 12-29% of men. After ejaculation, semen coagulates and then gradually liquefies; this process is hampered in conditions like infection, inflammation, male sex gland dysfunction, or cases of male infertility[40]. This condition may lead to infertility by causing impairment in normal sperm movement[40]. In case of infection or inflammation, increased numbers of seminal leukocytes may result in clumping of motile sperm, decreasing acrosomal functionality and resulting in altered morphology[41].

Small gelatinous clumps are occasionally seen in fertile men, whereas Large gelatinous clumps of semen have been observed in association with infertility and clumps are composed of free-moving spermatozoa in large number[42].

ODOUR

Table 2: Odour of Semen

Parameter	Cause
Normal odour	Due to alkaline amines produced by the prostate gland[43].
Foul or fishy odour	Sexually transmitted infections, prostatitis[43].
Pungent or foul odour	Contaminated collection container, infections (e.g., trichomoniasis, gonorrhoea), prolonged abstinence, urine contamination[44].
Sweet odour	It might be associated with diabetes mellitus[44].
Ammonia-like odour	Suggestive of Dehydration[44].
Absent odour	Possible prostatic dysfunction or ductal obstruction
Perception variability	Differences in individual olfactory sensitivity[43].

pH:

The normal semen pH falls in the range of 7.2-7.8, according to current WHO guidelines, and is controlled by a complex buffer system composed of inorganic ions, organic acids, and proteins[45].

The pH is mainly formed by the acidic secretions of the prostate gland and the alkaline secretions of the seminal vesicles, which provide the semen with a high buffering capacity [46, 47].

After ejaculation, semen pH increases during the course of time as natural buffers are lost due to the effect of environmental carbon dioxide[48].

If Semen pH <7.2 is considered acidic, suggestive of a congenital absence of the bilateral vas deferens or blockage of the seminal vesicles, also due to urine contamination by WHO[46, 48].

Then semen pH>8.0 is alkaline, suggestive of infections, inflammatory conditions, and ageing[49, 48].

Studies show that resuspending healthy sperm in acidic solutions reduces sperm motility and capacitation compared to non-acidic samples, which may indicate a role of the vaginal microenvironment on sperm activity[47].

MICROSCOPIC EXAMINATION

The microscopic evaluation comprises key parameters like an assessment of semen quality, motility, vitality, sperm concentration, total sperm count, morphology, and round cells[44].

SPERM CLUMPING[23]

The sperm clumping is an important criterion needs to be assessed under microscopic evaluation. It is essential to differentiate between the 2 types of sperm clumping, namely sperm aggregation and sperm agglutination, which are usually confused with each other.

SPERM AGGREGATION

The sperm aggregation is referred as the “adherence together of either immotile sperms to each other or in some cases motile spermatozoa with non-sperm components like mucus strands, epithelial cells, leucocytes or cellular debris. This is termed as non-specific aggregation caused by contamination, infections or faulty sample handling[49].

The adherence either of immotile sperms to each other or of motile spermatozoa to mucus threads, non-sperm cells or debris is defined as non-specific aggregation[49].

SPERM AGGLUTINATION

The sperm agglutination is defined as the specific attachment of motile spermatozoa to each other, head-to-head, tail-to-tail or in a mixed way[49].

The spermatozoa involved in agglutination motility are often vigorous, with a frantic shaking motion, but sometimes the spermatozoa are so agglutinated that their motion is limited[49].

Agglutination should not be confused with non-specific aggregation of spermatozoa; any type of agglutination signifies anti-sperm antibodies, is associated with immunologic infertility (Escherichia coli can colonise the prostate and induce production of IgA, which may cause agglutination of sperm) and infection, and therefore it is significant, which requires further immunological assay[44].

Table 3: Agglutination of semen[23].

Parts Involved	1. Isolated (<10 sperm/agglutinate; many free sperm)	2. Moderate (10–50 sperm/agglutinate; free sperm present)	3. Large (>50 sperm/agglutinate; some sperm still free)	4. Gross (all sperm agglutinated; agglutinates interconnected)
A. Head-to-head	Small clusters of sperm are attached head-to-head; the majority are free	Noticeable head-to-head clusters; free sperm still visible	Large head-to-head aggregates; fewer free sperm	Extensive head-to-head agglutination; clusters interconnected
B. Tail-to-tail (heads free and moving clearly)	Few sperm joined tail-to-tail; heads remain motile and free	Increased tail-to-tail grouping; heads still free	Large tail clusters; some free sperm heads visible	Dense tail-to-tail agglutination; interconnected masses
C. Tail-tip-to-tail-tip	Minimal tail-tip attachments; mostly free sperm	Moderate tail-tip clustering	Larger tail-tip aggregates; reduced free sperm	Extensive tail-tip agglutination forming networks
D. Mixed (head-to-head and tail-to-tail)	Small mixed clusters; most sperm free	Moderate mixed agglutinates; free sperm present	Large mixed aggregates; limited free sperm	Extensive mixed agglutination; interconnected clusters
E. Tangle (heads and tails ensnared; heads not clearly distinguishable)	Early tangling; most sperm are still distinguishable	Increased entanglement; partial loss of structure	Large tangled masses; few free sperm	Severe entanglement; dense interconnected networks

MOTILITY

Sperm motility can be explained as the percentage of motile sperm cells present in a sperm sample and also the nature of their movemen[50]. As per the standard references, total sperm motility usually ranges between 40-43% and immotile (IM) sperm cells account for around 19-20%[23].

Evaluation of motility needs to be done at an early stage as possible and ideally within 30 min after ejaculation and not exceeding 1 hour after collecting the sample as sperm motility is very sensitive to the changes in time and temperature[51].

line with the 6th edition of WHO Laboratory manual, there are three primary classes of sperm motility[52-62]. Progressive sperm motility (PR), non-progressive motility (NP) and immotile (IM).

Progressive sperm motility (PR) is described as sperm cells that show active motion and movement forward, either in a straight line or in large circles. Rapid progressive sperm cells will have velocities of ≥25 µm/s, while slowly progressive sperm cells have velocities of 5-<25 µm/s[52-62].

Non-progressive sperm motility (NP) involves the sperm cells that show active flagellar motion without any movement forward having their displacement of <5 µm (about a head length). On the other hand, immotile sperm cells (IM) lack movement of the tail[52-62].

From the clinical evidence gathered from manual observation and computer-assisted sperm analysis (CASA), it is clear that progressively motile sperm cells are very crucial, especially the ones that show rapid progression since they are highly correlated with fertilizing ability[52-62]. When the sperm progressive motility is significantly low or completely absent, motility index will be very low (1-1.1).

VITALITY

Sperm vitality describes the fraction of live spermatozoa in a semen sample. The viability of sperm cells is determined by assessing their plasma membrane integrity[63]. The WHO criteria for sperm vitality range around 50–63% viable spermatozoa[23].

Vitality evaluation can be conducted in all cases. However, in those cases where sperm motility is higher than 40%, evaluation of sperm vitality is unnecessary. Sperm vitality evaluation is crucial in samples where the percentage of motile sperm is low. It allows to differentiate between live and non-viable immotile sperm. A relatively high fraction of non-motile yet alive sperm cells indicate problems with the flagellum[64, 65]. At the same time, dead sperm cells may

indicate epididymitis or immunological response to infections[66, 67].

The method that is most commonly used to assess sperm vitality is dye exclusion. Live spermatozoa, possessing intact membranes, exclude vital stains, while dead spermatozoa include the stain. Eosin Y can be used individually or in conjunction with nigrosin, which will create a darker background, making evaluation easier. Bright-field microscopic examination shows white spermatozoa with unstained heads (they are alive) and red/pink sperm cells with coloured heads (they are dead). Staining of the head area even minimally suggests sperm death. On the other hand, a spermatozoon with the head unstained and a stained neck membrane is considered viable because of "leakage"[23].

In order to evaluate viability quantitatively, the percentage of viable sperm cells can be calculated using individual spermatozoa. This test needs to be done in duplicate. Two different slides should be used; one is stained with eosin/nigrosin, and another one is unstained. For each slide, the result should be averaged. Like the evaluation of motility, this test should be repeated if the result does not correspond to the 95% confidence limit[23].

SPERM CONCENTRATION

The sperm Concentration referred to the number of spermatozoa per millilitre of semen; the normal range is >16million spermatozoa/ml. Sperm count is NOT the same as sperm concentration; the total sperm count is the total number of spermatozoa in the entire ejaculate (concentration X semen volume). Although alternate methods of evaluation for semen concentration are available, including the Makler chamber (MidAtlantic Diagnostics, Mt. Laurel, NJ) and the disposable Cell-Vu chambers (Fisher Scientific, Pittsburgh, PA)[68].

Recent studies suggest that semen concentrations are declining[69-71]. The hemacytometer remains the gold standard.

TOTAL SPERM COUNT

The total sperm count defined as the total number of sperm cells found in the entire semen specimen and is evaluated by calculating the product of sperm concentration and semen volume[72]. The reference range for total sperm count is roughly estimated at 35–40 × 10^6 sperm cells per ejaculation[23].

A low total sperm count implies oligozoospermia and may signify poor potential for fertility. Absence of sperm cells in wet preparations on repeat is suggestive of azoospermia. It is necessary to note that azoospermia is only a descriptive term used for a laboratory finding and does not constitute the diagnostic or therapeutic basis. To confirm the absence of sperm cells, one needs to rule out their presence in the sediment after the centrifugation of semen specimens[73-75].

Other than the total sperm count, the total motile sperm count is one of the parameters derived from semen analysis and is routinely ordered in clinical practice. The total motile sperm count (TMSC) refers to the total number of motile spermatozoa in the entire semen specimen.

Table 4: Different nomenclature of semen[23].

MORPHOLOGY

Sperm morphology is used to define the anatomical deformity of spermatozoa in addition to their structure.76 According to the World Health Organisation, the lower reference limit for normal sperm form is about 3.9-4% as defined using strict criteria[23].

CLASSIFICATION OF SPERM MORPHOLOGY[23]

Table 5: Morphology of semen[23].

Nomenclature	Definition (WHO 6th Edition)
Azoospermia	Complete absence of spermatozoa in the ejaculate, confirmed after centrifugation
Oligozoospermia	Sperm concentration <16 × 10^6 spermatozoa/mL
Severe oligozoospermia	Sperm concentration <5 × 10^6 spermatozoa/mL
Asthenozoospermia	Reduced sperm motility, with total motility <42% and/or progressive motility (PR) <30%
Teratozoospermia	<4% spermatozoa with normal morphology (strict criteria)
Oligoasthenozoospermia	Reduced sperm concentration (<16 × 10^6/mL) and reduced motility (<42%)
Oligoteratozoospermia	Reduced sperm concentration (<16 × 10^6/mL) and abnormal morphology (<4% normal forms)
Asthenoteratozoospermia	Reduced motility (<42%) and abnormal morphology (<4% normal forms)
Oligoasthenoteratozoospermia (OAT)	Combination of low sperm concentration (<16 × 10^6/mL), reduced motility (<42%), and abnormal morphology (<4% normal forms)
Severe OAT	Sperm concentration <5 × 10^6/mL, progressive motility <32%, and <4% normal morphology
Normozoospermia	All semen parameters within WHO reference limits (≥16 × 10^6/mL concentration, ≥42% total motility, ≥30% progressive motility, ≥4% normal morphology)

STRUCTURE	NORMAL (TYPICAL) APPEARANCE	ABNORMAL FEATURES
Head	Smooth surface, well-proportioned contour, and elliptical shape. The acrosomal cap must cover 40–70% of the head surface. It must be free of large vacuoles, with up to two small vacuoles, none exceeding one-fifth of the head surface. Post-acrosomal part must be without vacuoles.	Abnormal distribution of the acrosome (<40% or >70%); abnormal length/width ratio (<1.5 = round head or >2 = elongated head); abnormal shapes like pyriform, amorphous, asymmetrical, non-oval heads; large vacuoles or vacuoles occupying >20% of the head surface or in post-acrosomal part; double heads; and combination defects.
Midpiece (Neck)	Slim, normally shaped, and similar in length to the head. The longitudinal axis of the midpiece must coincide with that of the head.	Deformed form; abnormally narrow or thick; asymmetrical or uncoordinated connection with the head; kinked midpiece; and combined defects
Tail (Principal piece)	Consistent in diameter throughout its length, narrower than the midpiece, and roughly 45 µm in length (about ten times the head length). It can be slightly curved but not sharply bent.	Sharp angles; hairpin-like curvature; looping; short tail; damaged tail; uneven thickness; multiple tails; and other anomalies
Cytoplasmic residue	Tiny amounts of cytoplasm may remain in the form of droplets, less than one-third of the head volume.	Large amounts of cytoplasm exceeding one-third of the head volume, indicating immature spermatozoa.

There are four groups of defects within the abnormal[23]:
(1) head; (2) neck/midpiece; (3) tail; and (4) cytoplasmic droplets.

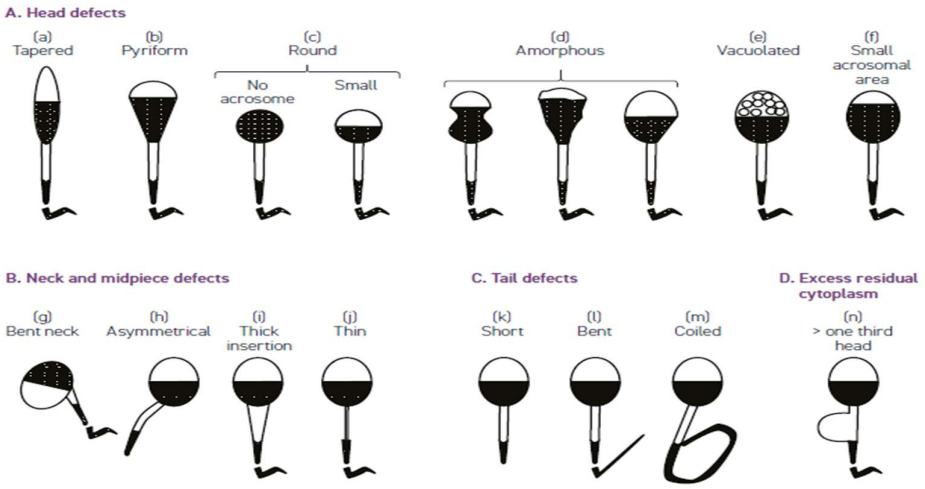

Figure 1: Morphological defects of semen[23].

Round cells[77].
Round cells may be either leukocytes or sperm precursors. The total number of round cells should not exceed 5 × 10^6/mL of semen. If more than 5 × 10^6 round cells/mL are found, staining is indicated to determine whether the cells are leukocytes or sperm precursors.

EXTENDED SEMEN EXAMINATION[78]
The process of extended semen analysis is characterised by the performance of several other investigations that are not necessarily needed during routine semen analysis tests. These tests provide an insight into the quality of sperms in

terms of genetic composition, chromatin integrity, and sperm DNA fragmentation (SDF).

Tests included:

Sperm genetic analysis (chromosomal abnormalities, gene mutations)
Chromatin structure assessment
Sperm DNA fragmentation (SDF)
Leukocyte analysis
Antisperm antibody testing
Immature germ cell evaluation
Indices of multiple sperm defects
Biochemical markers of accessory gland function

Advanced semen examination[78]

Advanced semen analysis comprises sophisticated procedures that are designed to evaluate sperm physiology from a cellular and molecular perspective. Conventional semen analysis, which assesses sperm parameters such as morphology, motility, and concentration, is usually successful in identifying abnormalities. There are instances where a man has all good sperm parameters, yet he suffers from infertility problems arising from some defects in his sperm.

Tests included:

Oxidative stress (OS) assessment
Chromatin integrity testing
Acrosome reaction evaluation
Transmembrane ion flux and transport studies
Computer-assisted semen analysis (CASA) for detailed motility assessment

AYURVEDIC UNDERSTANDING OF *RETAS PAREEKSHA*

INTRODUCTION

Acharya Charaka has quoted that "*Swasthasya Swasthya Rakshanam Aaturasya Vikaraprashamanam*" – *Prayojana* of *Ayurveda* is to maintain the health of a healthy person and cure the disease of a patient[79].

Arogya being *Moola* to achieve four *Purushartha* i.e. *Dharma*, *Artha*, *Kama* and *Moksha*. The concept of *Kama* in this concept can be understood as recreational aspects like pleasure which are equally important to its procreation aspects. So *Kama* also play important role in *Arogya*[80].

According to *Ayurveda* there are seven *Dhatus* , these are *Rasa*, *Rakta*, *Mamsa*, *Meda*, *Asthi*, *Majja* and *Shukra*. As *Shukra Dhatu* is the *Saramsha* of *Dhatu Parinama*. *Acharya Charaka* had mentioned *Shukra* is responsible for the formation of *Garbha* and also, *Shukra Kshaya* leads to sexual diseases in the form of infertility[81].

The various terms have been described in the literature pertaining to the *Shukra* but most appropriate word is to being used by *Acharya Charaka* while describing the *Garbhavakranti* in *Charak Samhita Shareerasthana*, chapter three/3 – i.e.-*Retas* is defined as male reproductive part responsible for the formation of *Garbha*.

This has been reported that the men suffering with sexual problems have low self-esteem, depressed and decreased quality of life[82].

Ayurveda gives prime importance to maintain good health as well as happiness. For happiness and harmony of life it is necessary to achieve all the goals of life. Creation and recreation are basic design of nature; hence progeny is essential to fulfil the aim of human life[82].

According to *Ayurveda* factors responsible for formation of *Garbha* is *Ritu*, *Kshetra* , *Ambu*, *Bija*. *Bija Bhaga* applies to both in male *Retas* and in female *Shonitha*, so any abnormality in any of the above said four factors leads to the infertility[83].

Ayurveda had explained *Klaibya*[84], *Napunsaka* and *Shukra*[85] *Dhatu Dosha* concepts which affecting to male infertility. For the assessment of morbidities in *Shukra Dhatu*, the *Retas Pareeksha*[86] is being used in world most ancient and rational system i.e. *Ayurveda*, described in *Charaka Samhita*.

At present, the introductory description in various *Ayurveda* classics (*Charaka Samhita*, *Sushruta Samhita*, *Ashtanga Sangraha*, etc.) is the only source for practice of andrology through *Ayurveda*[87].

Table 6. Features of *Shuddha Shukra* according to various *Acharya*[88]

Acharya Charaka	*Acharya Laghu Vagbhata*	*Acharya Sushruta*
Bahalam + Bahu	*Bahalam + Bahu*	*Dravam*
Sweta	*Shukla*	*Taila*
Madhura	*Madhura*	*Ksoudra nibham*
Snigdham	*Snigdham*	*Madhura*
Guru/Ghanam	*Guru*	*Snigdham*
Spatika sannibham		*Spatikabham*
Avisram		*Madhu Gandhi*
Avidahi		
Picchila		

Table 7. Classification of *Shukra Dushti*[89-92]

Acharya Charaka	*Acharya Sushruta*	*Acharya Vruddha Vagbhata*	*Acharya Laghu Vagbhata*
Phenila	*Vataja*	*Vataja*	*Vataja*
Tanu	*Pittaja*	*Pittaja*	*Pittaja*
Ruksha	*Slesmaja*	*Slesmaja*	*Slesmaja*
Vivarna	*Kunapa*	*Kunapa Gandhi*	*Kunapa*
Pooti	*Granthi*	*Granthi*	*Granthi*
Picchila	*Pootipuya*	*Pootipuya*	*Pootipuya*

Anyadhatu samsrusta	*Ksheena*	*Ksheena*	*Ksheena*
Avasadi	*Mutrapureesha retasah*	*Mutrapureesha retasah + Abeeja*	*Malahvayam yaha cha dvidha*

Table 8. Relation of *Shuddha Shukra Guna* with semen quality[93]

Shuddha Shukra Guna	Semen quality correlation
Snigdha	Mucoid consistency of semen
Ghana	Specific gravity
Picchila/Ghrita-Makshika-Tailabham	Viscosity of semen for ejaculation
Madhuram	Fructose and carbohydrate components of semen
Avidahi	Slight alkaline nature (optimum pH) for motility of sperms
Sweta-Spatika Sannibham	Milky white colour of semen
Bahalam	Volume of semen
Bahu	Sperm count

Table 9. Lakshanas (features) of vitiated Shukra[94-97]

Type of Shukra Dushti	*Dominant Dosha*	*Characteristic features*
Vataja Shukra Dushti	*Vata*	*Ruksha (non-unctuous), Phena (frothy), Shyava (whitish black), Aruna/Krishna varna, Alpa quantity, Vicchinna (broken), Rujam/Toda (pain), Chirat (delayed ejaculation), Krucchrena pravartana (ejaculation with difficulty)*
Pittaja Shukra Dushti	*Pitta*	*Ushna (hot), Visra gandha (foul smell), Peeta/Neela varna (yellowish/bluish discoloration), Daha (burning sensation during ejaculation)*
Shleshmaja Shukra Dushti	*Kapha*	*Snigdha, Pandu/Shukla varna (whitish), Picchila (slimy), Prabhuta (increased quantity), Vibaddha (obstructive), Kandu (itching), associated with Majja*
Kunapa Gandhi / Anyadhatu Samsrushta Shukra Dushti	*Rakta*	*Dead body odour, ejaculated in profuse quantity*
Granthi / Avasadi Shukra Dushti	*Kapha-Vata*	*Resembles Grathita (clot form), sinks in water, ejaculation with difficulty*
Putipoya Shukra Dushti	*Rakta-Pitta*	*Pus-like appearance*
Ksheena Shukra Dushti	*Vata-Pitta*	*Dourbalya, Mukhashosha, Pandutva, Shrama, Klaibya, Shukra avisarga, Medravrushana vedana, Ashakti in maithuna*
Malahvaya / Mutrapureeshaja Shukra Dushti	*Tridosha*	*Possesses odour of mutra and pureesha*

There are few research articles describing retas pareeksha in comparison with parameters of semen analysis. Those are as follows:

Table 10. Grading of *Picchilata* based on thread formation[98]

Grade	Reference	Length of thread formed
0	*Apicchila*	No thread formation
1	*Tailabha*	0.5–1 cm
2	*Grutabha*	1–1.5 cm
3	*Madhubha*	1.5–2 cm
4	*Atipicchila*	More than 2 cm

Table 11. Varna (colour) of Shukra according to Dosha involvement[98]

Dosha	*Varna*	Meaning
Vata	*Aruna Varna*	Reddish brown
Vata	*Krishna Varna*	Black
Pitta	*Peeta Varna*	Yellow
Pitta	*Neela Varna*	Blue/green/black
Kapha	*Shukla Varna*	Whitish

Table 12. Gandha (odour) of Shukra according to Dosha Dushti[98]

Dosha	*Gandha*	Meaning
Pitta	*Puti*	Foul smelling
Kapha	*Visra*	Smell of raw meat
Normal	*Madhu*	Smells like honey

Table 13. Relation between sperm/semen abnormalities with *Shukra Dushti*[93]

SEMEN ABNORMALITY	CORRESPONDING *SHUKRA DUSHTI*
Aspermia	*Nashtashukra*
Hypospermia	*Alparetas*
Haematospermia	*Kunapagandhi*
Pyospermia	*Pootipuya*
Oligospermia	*Ksheena Shukra*
Azoospermia	*Abeeja Shukra dushti*
Asthenozoospermia	*Kapha Vataja Shukra dushti (Granthi)*
Teratozoospermia	*Vata pradhana sannipataja Shukra dushti*
Necrozoospermia	*Ashukra*

Table 14. *Doshic* involvement in pathological semen conditions[93]

Sl. No	Condition	Ayurvedic diagnosis	Predominant *Dosha*
1	Oligospermia	*Tanu*	*Vata*
2	Pyospermia	*Puti*	*Pitta*
3	Agglutination	*Gratita*	*Kapha*
4	High viscosity	*Granthibhoota*	*Kapha*
5	Necrozoospermia	*Avasaadi*	*Vata*
6	Hypospermia	*Alpa*	*Vata*
7	Hyperspermia	*Bahu*	*Kapha*
8	Asthenospermia	—	Vata

Table 15. Relation between semen abnormalities and laboratory findings[93]

Type of *Shukra Dushti*	Macroscopic findings	Microscopic findings
Vataja Shukra Dushti	Liquefies within 5 minutes, increased pH (>6.3)	Azoospermia, oligozoospermia, teratozoospermia
Pittaja Shukra Dushti	Yellowish colour, foul smell	Pyospermia, teratospermia
Kaphaja Shukra Dushti	Hyperviscous, sample sinks to bottom, does not mix in water	Asthenospermia, teratozoospermia
Kunapa Shukra Dushti	Reddish colour/blood mixed, foul smell	RBCs, necrozoospermia
Pootipuya Shukra Dushti	Foul smell, colour change	Pyospermia
Granthibhoota Shukra Dushti	Agglutination	Asthenospermia (aggregation of sperm cells)
Malahva Shukra Dushti	Smell of mutra or pureesha	Presence of E. coli
Anyadhatu Samsrushta Shukra Dushti	Blood mixed	Immature sperm cells, crystals, RBCs

Table 16: Accoding to different acharya *Klaibya* classification[99-102]

Charaka Samhita	***Sushruta Samhita***	***Bhavaprakasha***	***Bhaishajya Ratnavali***
1. Beejopaghatja Klaibya	*1. Manasa klaibya*	*1. Manasa klaibya*	*1. Manasa klaibya*
2. Dhwajabhangaja Klaibya	*2. Saumyadhatu kshaya (Aharaja) klaibya*	*2. Pitta nimitta klaibya*	*2. Pittaja klaibya*
3. Jaraja Klaibya	*3. Shukrakshayaja klaibya*	*3. Shukrakshayaja klaibya*	*3. Shukra kshayaja klaibya*
4. Shukra Kshayaja Klaibya	*4. Marma Chedaja klaibya*	*4. Medrarogaja klaibya*	*4. Medrarogaja klaibya*
	5. Sahaja klaibya	*5. Marma Chedaja klaibya*	*5. Upagataja klaibya*
	6. Bhramacharyaja klaibya (kharashukra nimmitta)	*6. Shukrastambha nimmittaka*	*6. Shukra sthambha nimittaja klaibya*
		7. Sahaja klaibya	*7. Sahaja klaibya*

DISCUSSION

Male infertility has emerged as a significant global reproductive health concern, contributing to nearly half of infertility cases among couples. Although modern semen analysis remains the cornerstone for the evaluation of male fertility, conventional laboratory parameters alone often fail to explain the functional and qualitative defects associated with infertility. In this context, *Ayurveda* provides a holistic and individualised understanding of male reproductive health through the concepts of *Shukra Dhatu*, *Retas*, *Klaibya*, and *Shukra Dushti*.

The present review highlights the remarkable parallels between *Ayurvedic* descriptions of *Retas Pareeksha* and modern semen analysis parameters. Classical *Ayurvedic* texts such as *Charaka Samhita*, *Sushruta Samhita*, *Ashtanga Sangraha*, and *Ashtanga Hridaya* have described the characteristics of *Shuddha Shukra* with considerable observational accuracy. Features such as *Bahu*, *Bahalam*, *Snigdha*, *Picchila*, *Madhura*, and *Sweta-Spatika Sannibha* demonstrate close resemblance to contemporary parameters including semen volume, sperm concentration, viscosity, pH balance, colour, and liquefaction properties.

Among these, *Bahu* has a strong correlation with sperm count, while *Bahalam* corresponds to semen volume. *Snigdha* and *Picchila* reflect the viscoelastic and mucoid nature of semen essential for sperm transport and ejaculation. *Madhura* may indicate the nutritive biochemical composition of semen, particularly fructose and carbohydrate content, which are crucial for sperm metabolism and motility. Likewise, *Avidahi* reflects the mildly alkaline pH necessary for optimal sperm survival and fertilizing capacity.

The concept of *Shukra Dushti* described by Acharyas demonstrates significant diagnostic relevance in understanding pathological semen conditions. *Vataja Shukra Dushti*, characterized by *Ruksha*, *Phena*, *Alpa Retas*, and delayed ejaculation, closely resembles oligospermia, azoospermia, and teratozoospermia observed in modern andrology. Pittaja *Dushti*, associated with discoloration, foul smell, and burning sensation, correlates with inflammatory and infective semen abnormalities such as pyospermia. *Kaphaja Dushti*, exhibiting *Picchila* and granthi characteristics, corresponds with hyperviscosity, sperm agglutination, and asthenozoospermia.

Similarly, conditions such as *Kunapa Gandhi* and *Pootipuya Shukra Dushti* resemble hematospermia and pyospermia respectively, while *Ksheena* Shukra reflects oligospermia and reduced reproductive potential. These correlations suggest that Ayurvedic observations were not merely descriptive but represented clinically relevant reproductive abnormalities identifiable even today through laboratory methods.

An important contribution of *Ayurveda* lies in its *Doshic* interpretation of semen pathology. The predominance of *Vata* appears to influence sperm quantity and motility, *Pitta* affects inflammatory and infective changes, whereas *Kapha* contributes to viscosity, aggregation, and obstructive conditions. This *Doshic* understanding may provide a broader pathophysiological framework for individualized diagnosis and management of male infertility.

The article also emphasizes the importance of integrating ancient *Ayurvedic* semen examination methods with contemporary laboratory techniques. Modern diagnostic tools such as sperm DNA fragmentation assays, oxidative stress evaluation, chromatin integrity assessment, CASA analysis, and antisperm antibody testing may complement Ayurvedic clinical assessment and enhance understanding of unexplained male infertility.

Furthermore, the classical classifications of *Klaibya* described by various *Acharyas* indicate that *Ayurveda* recognized psychological, congenital, traumatic, nutritional, and functional causes of sexual dysfunction centuries ago. This reflects the multidimensional and biopsychosocial approach of Ayurveda toward male reproductive disorders.

Despite these correlations, limitations remain in standardizing Ayurvedic semen examination parameters for contemporary clinical research. Variability in interpretation, lack of universally validated grading systems, and insufficient evidence-based clinical trials continue to restrict wider scientific acceptance. Therefore, future interdisciplinary studies integrating Ayurveda with modern reproductive medicine are necessary to validate these traditional concepts using objective laboratory and molecular parameters.

CONCLUSION

Retas Pareeksha described in *Ayurveda* represents a systematic and clinically relevant approach for the assessment of male reproductive health. The classical descriptions of *Shuddha Shukra* and *Shukra Dushti* exhibit substantial correlation with modern semen analysis parameters such as semen volume, viscosity, sperm concentration, motility, morphology, pH, and infective changes.

Ayurvedic concepts including *Vataja*, *Pittaja*, and *Kaphaja Shukra Dushti* provide a unique *Doshic* interpretation of semen abnormalities and male infertility. These observations demonstrate that ancient *Ayurvedic* scholars possessed advanced understanding regarding reproductive physiology and pathology long before the development of modern andrology.

The integration of *Ayurvedic Retas Pareeksha* with contemporary semen analysis and advanced sperm function tests may provide a more comprehensive and holistic framework for evaluating male infertility. Such an integrative approach may improve early diagnosis, individualized treatment planning, and reproductive outcomes.

Further scientific validation through multidisciplinary clinical and experimental studies is essential to standardize *Ayurvedic* semen assessment methods and establish their evidence-based relevance in modern reproductive medicine.

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