

The viscoelastic behavior of normospermic and infertility-diagnosed human semen samples

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Introduction: Viscosity of human semen, though acknowledged as important in fertility assessment, are typically evaluated using measures that consist in allowing a semen sample aspirated in a pipette to freely fall by gravity. According to the World Health Organization guidelines, a sample is considered to have normal viscosity if it exits the pipette as discrete droplets. Conversely, if a liquid thread forms at the pipette tip—particularly when the thread length reaches > 2 cm—the sample is classified as hyperviscous. However, this measurement could be influenced by a combination of factors, including not only viscosity but also elasticity and surface tension.

Aims: The aim of this work is to provide the first quantitative experimental measurements of human semen, including both normospermic and infertility-diagnosed samples by sing oscillatory shear rheometry.

Material and methods

88 human semen samples collected during routine tests at the Sterility Center of the Medical School of the University of Naples Federico II and classified as normospermic (25) or abnormal (63) according to WHO criteria (WHO labaratory manual for the processing of human semen 2021) were included in the study.

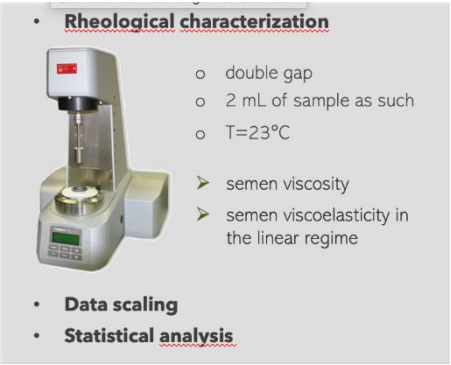


Figure 1: rheological characterization

Results

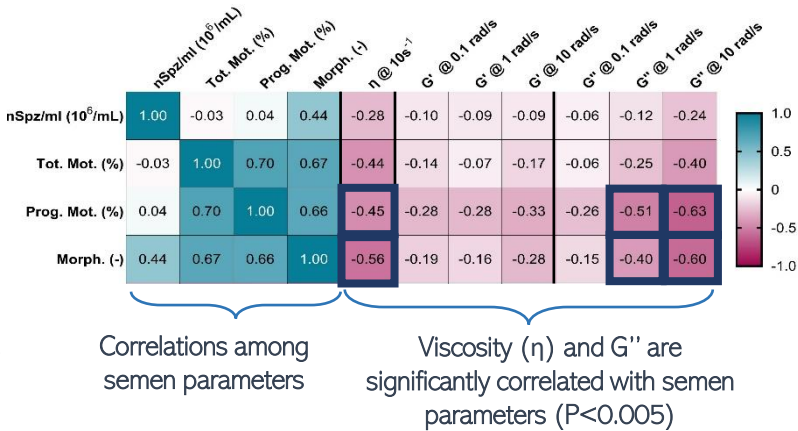
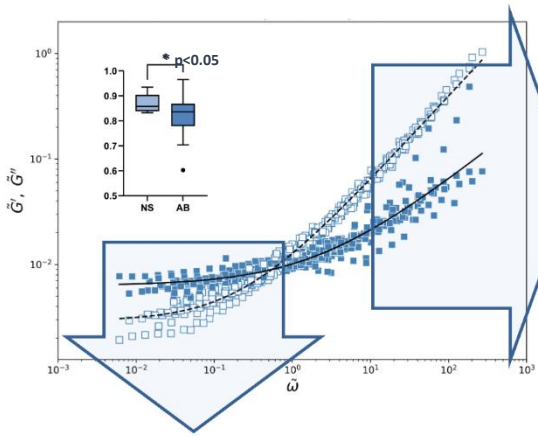


Figure 2: Correlation between semen parameters and viscosity

Results



- The response is dominated by the elastic component, associated with stable molecular structures, similar across samples
- An effective distinction between normospermic and abnormal samples is not favorable

($\omega \sim$ spermatozoa flagellar beating)
The predominant viscous response may enable discrimination between normospermic and abnormal samples due to different:

- interactions among seminal proteins
- efficiency of PSA-driven semen liquefaction
- presence of inflammatory cells/debris/crystals/cellular aggregates

1. Human semen, bot normospermic and abnormal, behaves as a viscoelastic fluid (weak gel) after liquefaction
2. At high frequencies G'' negatively correlates with sperm morphology and motility
3. At high frequencies, normospermic and abnormal samples are statistically different

Conclusion: Our findings could lead to the definition of a quantitative index of semen viscoelasticity to be used in semen clinical assessment

Open issues

- Molecular basis of semen viscoelasticity
- Role played by cells
- Effect of viscoelasticity on sperm motility

References

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