RheoSense
Simply Precise™

Automated Screening: BSA Viscosity Versus Concentration and Temperature

Bovine Serum Albumin (BSA) is a globular protein found in cow blood serum. Serum albumin is produced by the liver and is essential to ensure proper distribution of body fluids among blood vessels and tissues. As a low-cost, stable, and readily available protein, BSA is widely used as a protein concentration standard. BSA applications include:

- Microbial and cell culture
- Enzyme stabilization during DNA digestion
- Immunohistochemistry

In this application note, we examine the effect of concentration on the viscosity of BSA in distilled Water and PBS solutions.

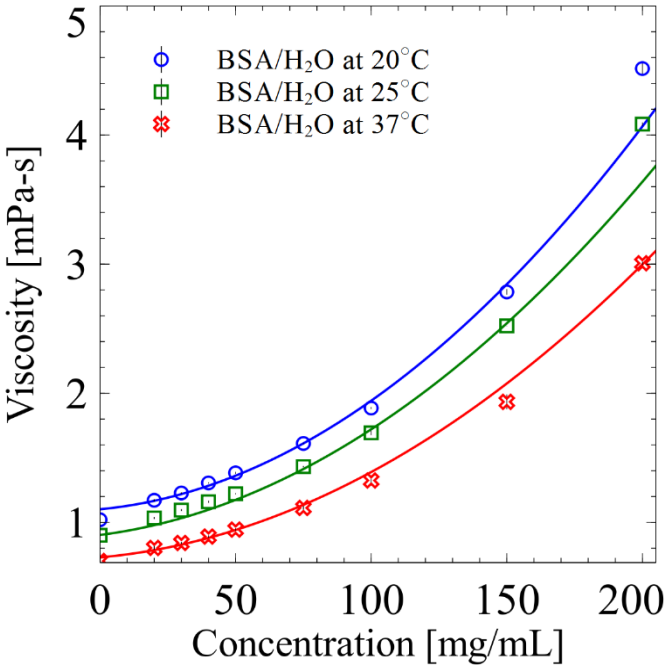
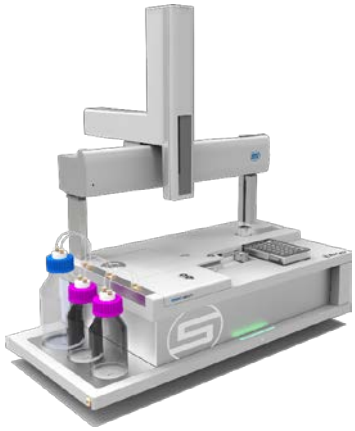


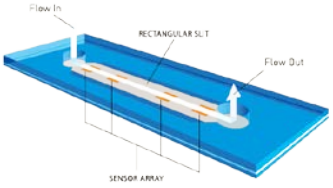
Figure 1. Viscosity as a function of concentration and temperature for solutions of BSA in water. Solid lines correspond to second order polynomial fits (See Table 1 for coefficients).



VROC® initium offers unattended shear viscosity measurements with the smallest sample volume requirement in the market and a wide dynamic operation range. High accuracy and repeatability makes it ideal for R&D and QC screening applications.

- Automated sample loading and cleaning
- 40 vial rack and 96 well plate compatible
- Smallest sample volume (10 µL)
- Accuracy: 2% of reading
- Repeatability: 0.5% of reading
- Shear Viscosity range: 0.2 – 1,000 mPa-s
- Shear Rate range: 0.5 -80,000 s^{-1}
- Temperature control: 4-70°C

VROC® Technology and Principle of Operation



RheoSense's *Viscometer-Rheometer-on-a-Chip* (VROC®) combines microfluidic and MEMS technology to measure viscosity. As the test fluid is pumped through the channel at a controlled shear rate the MEMS pressure sensor array captures the pressure drop, which is proportional to the shear stress at the wall. The viscosity of the test fluid is obtained as the ratio of shear stress to shear rate.

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Experimental

Samples and Test Set-Up: The samples in this study were prepared by diluting pharmaceutical grade BSA (Sigma Aldrich) in distilled Water and Phosphate-Buffered-Saline solution (PBS).

All measurements were performed using a VROC® initium unit equipped with an A05 (50 µm) chip. Solutions were automatically loaded into a 100 µL syringe using the system's XYZ autosampler. Tests were conducted at 20, 25 and 37°C, with a temperature stability of ±0.07°C.

Results

Figure 1 shows the **viscosity dependence on concentration** of the different BSA/H_2O solutions. Following the Huggins equation [1], second order polynomials have been used to fit each set of results. A summary of the coefficients is given in Table 1.

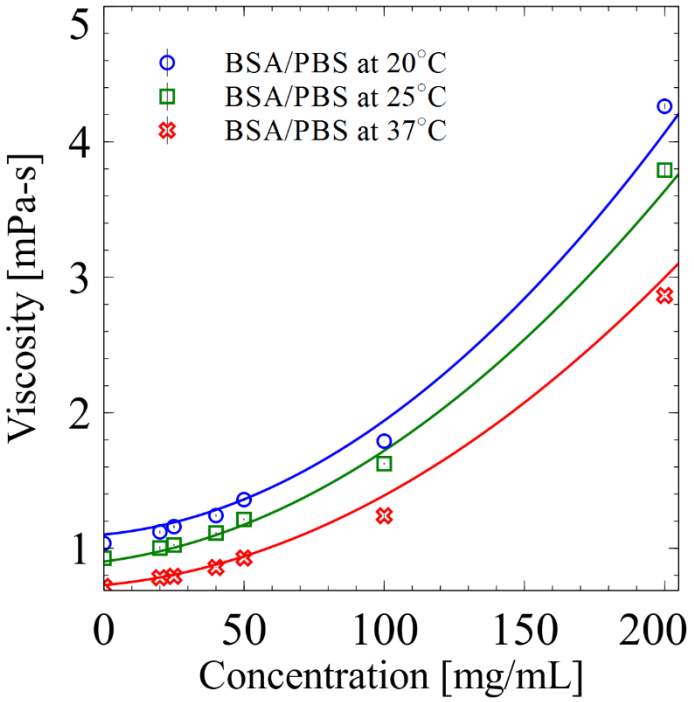

Figure 2. Viscosity as a function of concentration and temperature for solutions of BSA in PBS. Solid lines correspond to second order polynomial fits (See Table 1 for coefficients).

Figure 2 shows the **viscosity dependence on concentration** of the different BSA/PBS solutions. Note that each data set presented in Figures 1 and 2 corresponds to the average of 3 runs where the standard deviation was below 0.5% of the reading. This study summarized the results for 16 different solutions at 3 temperatures with 3 repeats. That is 144 unattended viscosity measurements in less than 8 hours!

Table1.Second order polynomial coefficients $\eta = a + b\,x + c\,x^2$

Sample	T [°C]	a	b	c
BSA in water	20	1.1	0.002	6.4×10^{-5}
	25	0.9	0.003	5.5×10^{-5}
	37	0.7	0.002	4.7×10^{-5}
BSA in PBS	20	1.1	0.002	6.4×10^{-5}
	25	0.9	0.002	5.4×10^{-5}
	37	0.7	0.002	4.7×10^{-5}

Based on the second order polynomial coefficients presented in Table 1, we can conclude that the viscosity vs concentration profiles for BSA/water and BSA/PBS are very similar and almost independent of buffer solution. However, we do observe a significant differentiation at high concentrations (i.e. for a concentration of 200 mg/mL at 25°C the viscosity of the two types of solutions differs by almost 0.3 mPa-s, or 7.3%). Most viscometry methods lack the repeatability required to characterize these small, but important, variations in viscosity due to change in the protein structure in different buffer solutions [2].

Glass capillary viscometers are conventionally used for precise viscosity measurements, but their operation is laborious and time consuming. VROC® initium's exceptional precision and straightforward operation make it ideal for unattended testing of large batches of samples and formulations.

Conclusion

Measurements of viscosity as a function of concentration of BSA in two different buffers have been presented. These results demonstrate the superior capabilities of VROC® powered systems, with faster data acquisition and higher accuracy:

- VROC® initum enables highly accurate dynamic viscosity measurements.
- Our high throughput measurement system allows for unattended testing of a complete 40 vial rack overnight and a 96 well plate in a day.
- An additional advantage of VROC® initium over other viscometers is that sample loading, testing, and cleaning is fully automated. This not only allows for more in-depth viscometry studies, but also results in hands-off testing and additional time savings.

Remember, VROC® initium will make your viscosity measurements hands free, worry free, and Simply Precise™.

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Bibliography

[1] M. A. Masuelli and M. G. Sansone, "Hydrodynamic Properties of Gelatin - Studies from Intrinsic Viscosity Measurements," Products and Applications of Biopolymers, 2012.

[2] http://www.rheosense.com/application/viscosity-of-l-arginine

For more information about VROC® initium check out our product webinars: http://www.rheosense.com/viscosity-webinars

Contact Information

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