

Characterization of mechanical properties of Sodium Alginate raft Using Rheometer

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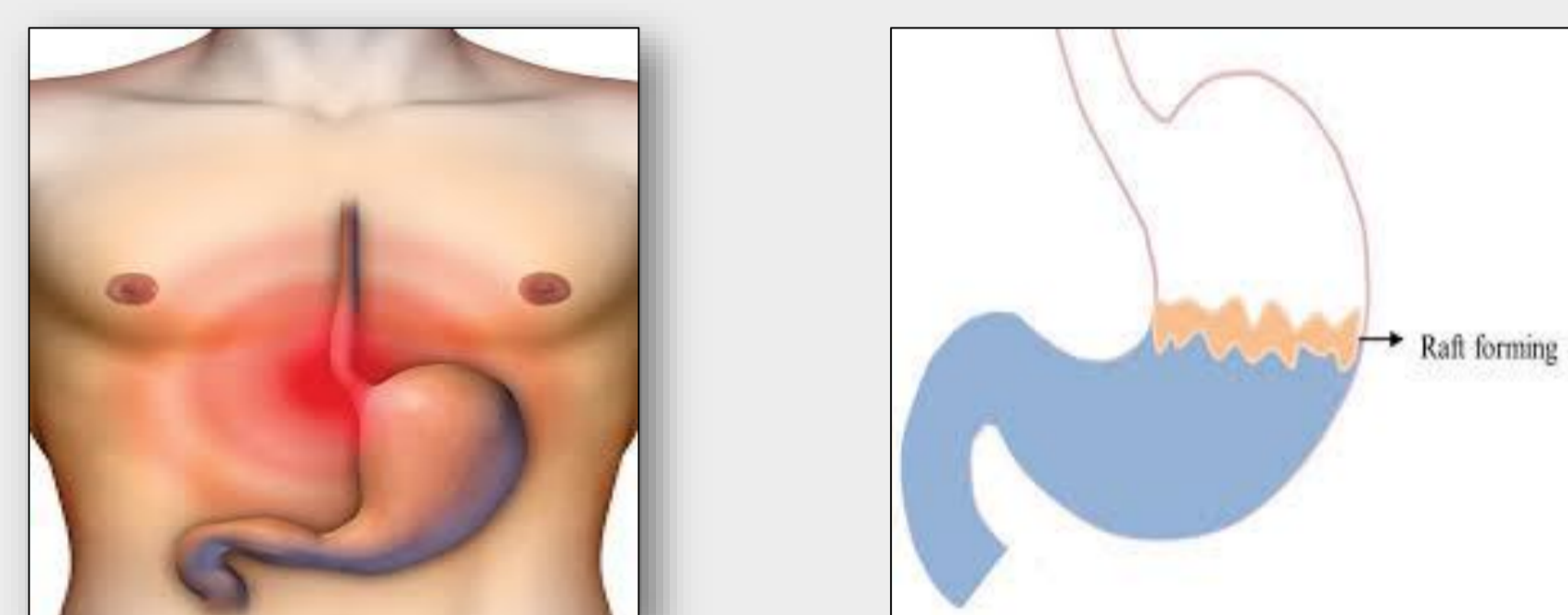
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PURPOSE

Alginate suspensions are used in the treatment of gastroesophageal reflux disease (GERD). These suspensions are formulated to provide relief from symptoms by forming a physical barrier on top of stomach contents in the form of gel or raft.



Literature review shows that rafts formed in the stomach encounter shear forces due to churning of stomach contents and gastric pressure which might drive the rafts into the lower esophagus. It is important to characterize the mechanical properties of alginate rafts by exposing rafts to the shear forces.

The study involved investigation of sodium alginate rafts for mechanical properties using rheometer [1].

OBJECTIVE(S)

To characterize the Sodium Alginate rafts formed from different formulations for rheological properties like overall strength, recoverability and viscosity.

METHOD(S)

Materials:

Two different formulations of Sodium Alginate suspension were prepared by in-house procedure

Equipment:

Discovery Hybrid Rheometer 3 (Make: TA Instruments, USA) with Peltier plate using 60 mm stainless steel parallel plate geometry was used.



Viscosity measurement:

Sample: Sodium Alginate Suspension
Temperature: 25°C
Shear rate: 0.1 to 500 1/s



Sample preparation - Raft formation:

- Acidic solution of acetic acid in water, pH 1.2 was prepared and maintained at temperature of 37°C in water bath.
- Sodium Alginate suspension (10 mL) was added to 150 mL acidic solution maintained at 37°C and allowed 30 minutes for raft formation
- The raft was isolated and removed the solution if any present in the raft
- Isolated raft was used for rheological studies



1) Oscillation Amplitude:

- To measure the strength of rafts formed

Temperature of Peltier plate: 37°C
Gap: 2500 µm
Equilibration time: 300 sec
Strain Sweep: 0.1 to 100 (%)
Angular Frequency: 10 rad/S

2) Two step strain sweep:

- To measure the recoverability of raft after applying higher strains

Temperature of Peltier plate: 37°C
Gap: 2500 µm; Equilibration time: 300 sec
Step-1
Strain Sweep: 0.1 to 100 (%)
Angular Frequency: 10 rad/S
Step-2
Strain Sweep: 100 to 0.1 (%)
Angular Frequency: 10 rad/S

RESULT(S)

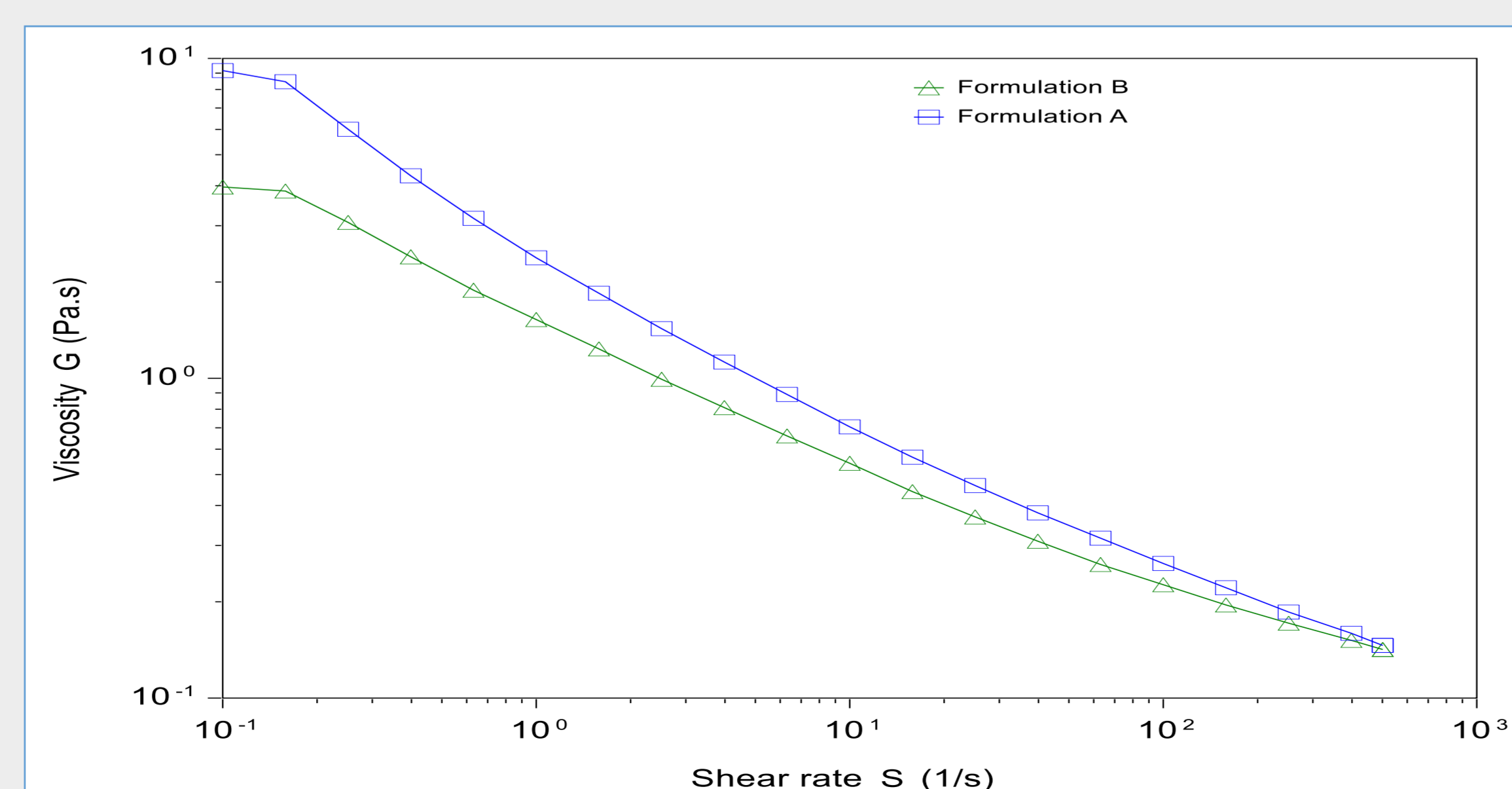


Figure: Overlay of viscosity curves

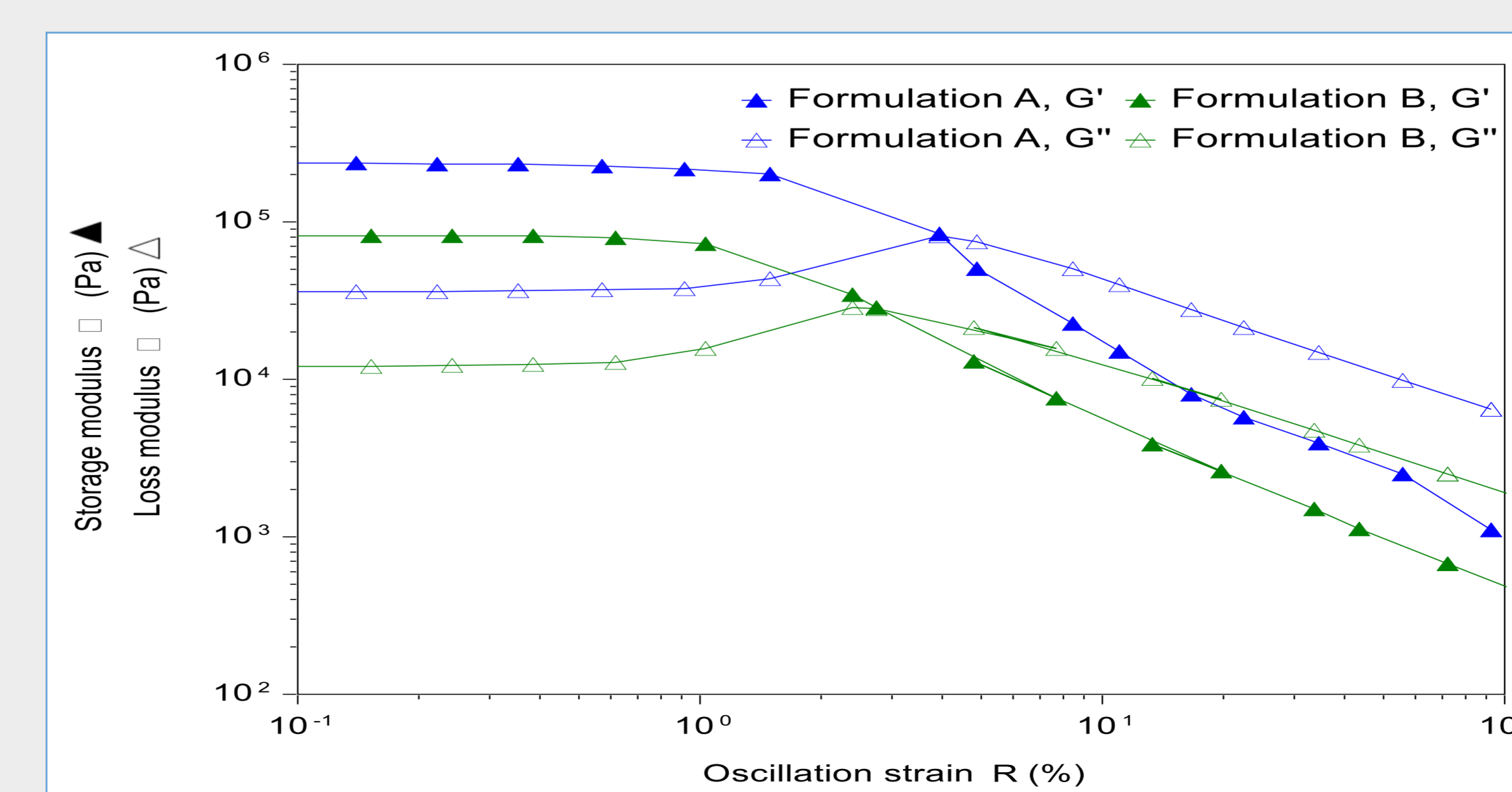
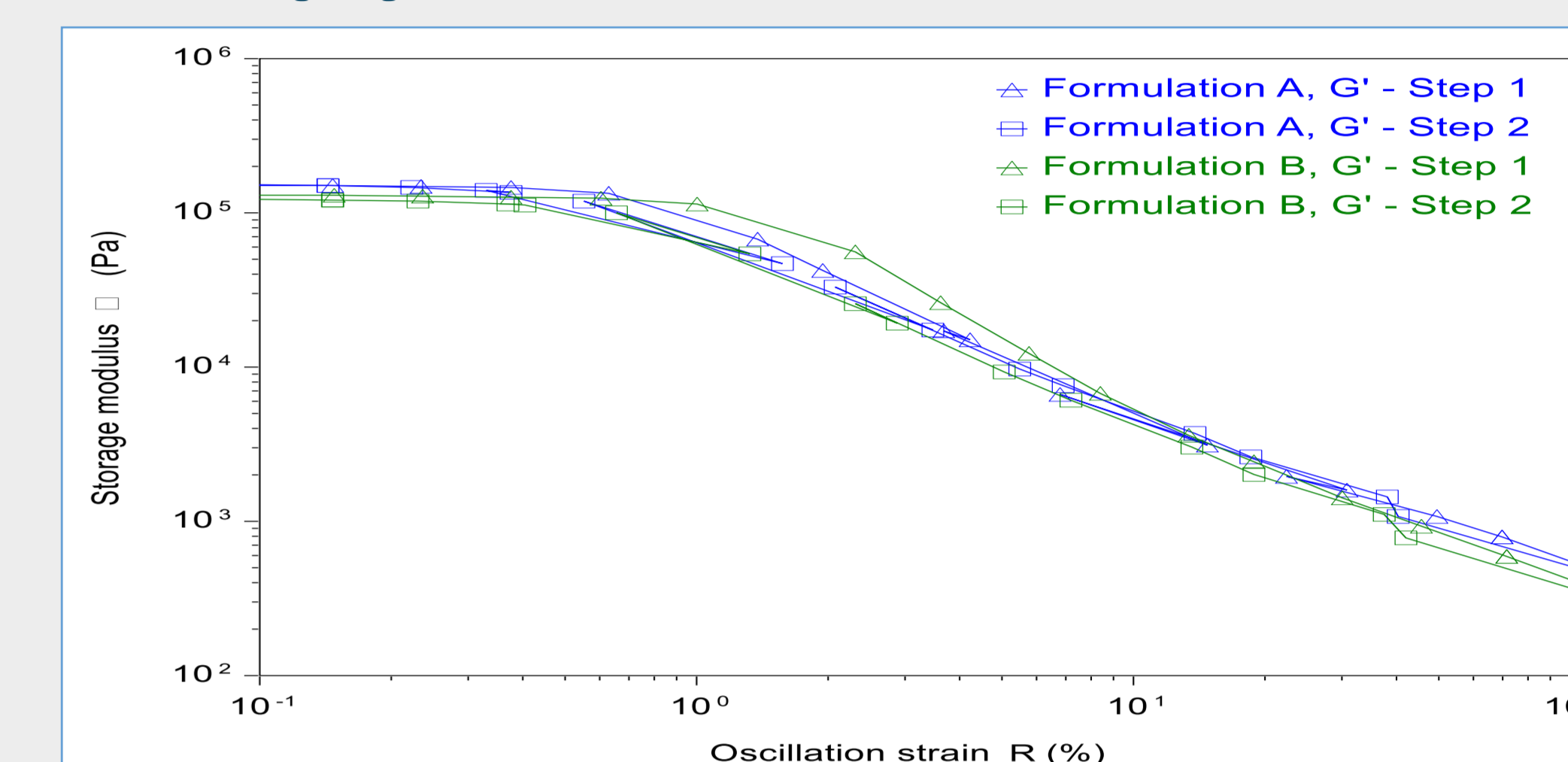


Figure: Overlay of Strain Sweep curves

RESULT(S)



Overlay of Storage moduli from increasing and decreasing strain sweep

Formulation	Viscosity (Pa. S) of suspension			Raft Strain @ 0.1%	
	Low shear (0.1 1/s)	Mid Shear (100 1/s)	High Shear (500 1/s)	Storage Modulus (G')	Loss Modulus (G'')
Formulation A	9.2	0.3	0.1	150593	23058
Formulation B	4.0	0.2	0.1	129424	19543

Formulation viscosity at different shear rates and Storage /Loss modulus of Raft

CONCLUSION(S)

- The viscosity of Sodium Alginate suspension formulations were measured by rheometer and both the formulations tested shown non-Newtonian, shear thinning behaviour with decrease in product viscosity as shear rate increases.
- Sodium Alginate rafts were prepared in acidic solution and the isolated rafts were tested for strength and recoverability by rheometer. Formulations has shown good elastic behaviour at lower strains and exhibited ability to recover after applying higher strain.

REFERENCE(S)

[1] B.M. Elliott et al., International Journal of Pharmaceutics, 457, (2013), 118-123

