Effect of Presence of Drugs on Viscoelastic Properties and Melt Extrusion of Soluplus®, a Graft Copolymer
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Purpose
To study the effect of drug concentration on drug-polymer miscibility and extrudability of binary mixtures through melt extrusion, and to investigate the influence of processing temperature on the rheology of the drug-polymer mixtures.

Methods
Three poorly water-soluble drugs, carbamazepine (CBZ), itraconazole (ITZ) and ibuprofen (IBU) were mixed with Soluplus®, a graft polymer used as carrier. Torque analysis using a melt extruder was performed at various drug concentrations (0%, 10%, 20%, 30% w/w) and the effect of barrel temperature was studied. Rheology of the mixtures was studied by flow temperature ramp from 120°C to 200°C at 5°C/min. The products were characterized by DSC and powder XRD.

Results
The torque exerted on the twin screws decreased with the increase in drug concentration for all three drugs. The decrease in torque at different temperatures for IBU systems was the highest, followed by CBZ and ITZ. A lower viscosity was observed at all concentrations of CBZ (m.p. 191°C) than ITZ (m.p. 168°C) because of disruption of polymer structure due to miscibility of CBZ. The viscosity values for all three concentrations of IBU were lowest due to low melting point of the drug (76°C). Similar observations were made with the change in barrel temperature. The viscosity values for all concentrations of CBZ in Soluplus® lied between the range of 1000-10,000 Pa.s at 150°C, which was defined as an extrudable range. Rheology of polymer in presence of the drugs was done and the viscosity data was correlated with torque analysis.

Conclusion
The viscosity of binary mixtures decreased with the increase in drug concentration and increase in processing temperature. The miscibility and extrudability of drug-polymer mixtures were characterized by torque analysis during extrusion and viscosity measurements by rheology. These results led to the identification of optimal processing conditions for melt extrusion of crystalline and amorphous drugs.