TWO-STEP SCREENING PROCESS TO EVALUATE PRINTABILTY OF INKS FOR EXTRUSION-BASED BIOPRINTING

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One of the key bottlenecks of biofabrication are suitable ink materials. These materials need to meet various requirements and combine good printing properties with adequate cytocompatibility. Many scientists try to overcome this bottleneck by designing novel inks. Their approaches range from multimaterial inks to alternative crosslinking strategies. To encourage efficient application of new strategies, we developed a two-step assessment (Fig. 1) focusing on ink printability with extrusion-based bioprinters. The first step only requires a syringe, a nozzle and the material. We have shown that simple screening based on fiber formation and layer stacking properties was an efficient method to assess printability. In a second step, the materials were transferred to a rheometer and evaluated regarding their shear thinning and post-printing recovery properties. We demonstrated that mathematical modelling of the extrusion process can help gaining deeper understanding of the material behavior and enables better evaluation by estimating the conditions present in the nozzle. The data from the shear viscosity plot was fitted and the shear-rate, extrusion velocity, shear stress and residence time profiles for the conditions present in the nozzle during dispensing were calculated (Fig. 2). This approach enabled calculation of the mean shear rate that was used for the recovery tests. These investigations helped to estimate if a material will be printable with a given printer and how needle diameter changes, among other factors, influence the pressure suitable for printing, considering the velocity limits of the device. Furthermore, we demonstrated how these findings can help design bioinks.

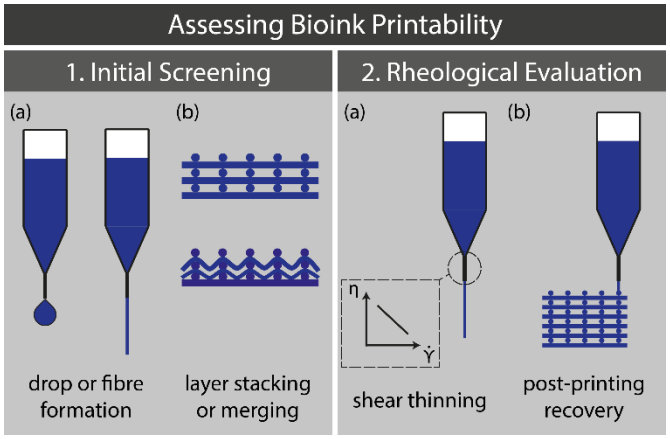

Figure 1 – Overview of the two-step screening process to assess printability of inks developed for extrusion-based bioprinting

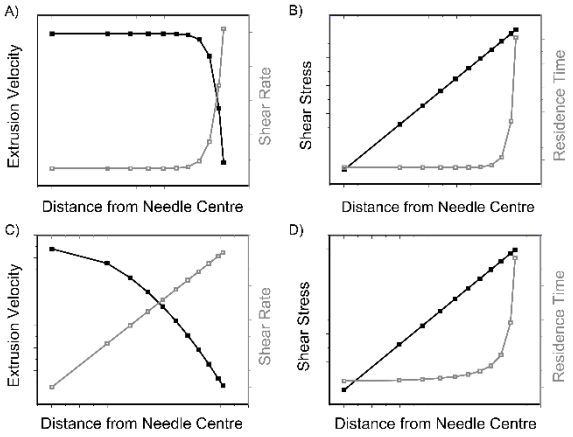

Figure 2 – A) and B) show profiles calculated from 25 wt% pluronics data, C) and D) shows profiles calculated for a Newtonian fluid