Electronic Supplementary Information (ESI)

Development and Characterization of a Dextran/$CaCl_2$ Based Blood Mimicking Fluid: A Comparative Study of Rheological and Mechanical Properties in Artificial Erythrocyte Suspensions

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S1 Swelling Behavior

The P(SA-Am) hydrogel was prepared according to the described protocol. To ensure polymerization the hydrogel was kept in the polymerization beaker for 30 min. The hydrogel was then cut into small pieces and their initial weight was measured. The hydrogel pieces were then immersed in the three artificial plasma phases and measured at different times (see Figure S1). The relative swelling coefficient was calculated as follows:

$$Swelling\ coefficient = \frac{M_t - M_0}{M_0}$$

Where M_t (in g) is the weight at the measured time and M_0 (in g) is the weight directly after fabrication. The swelling coefficient over time is visualized in Figure S1.

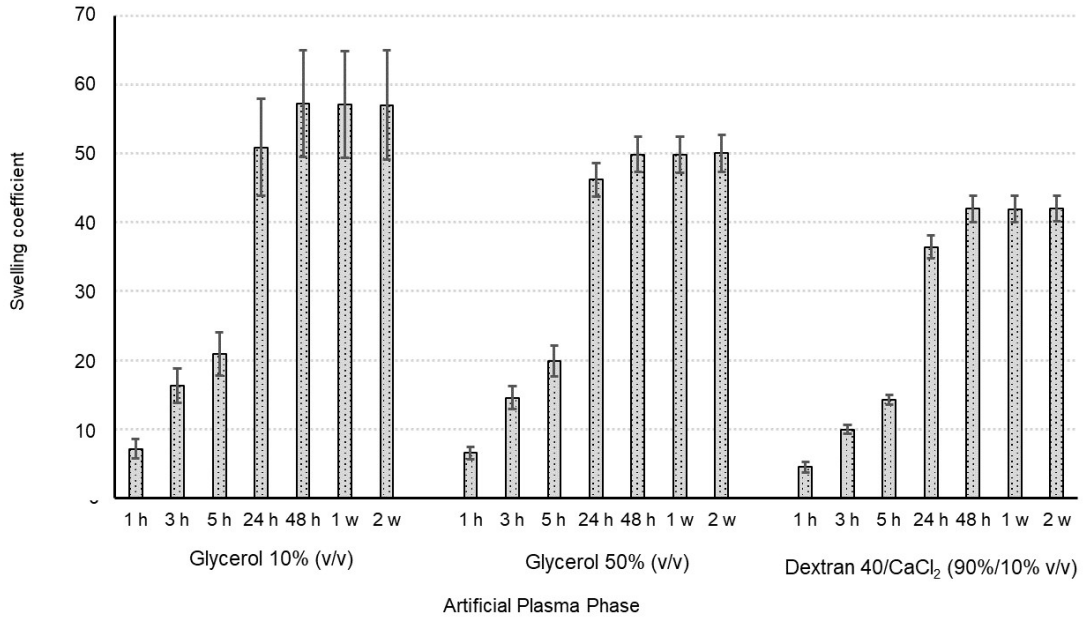

Fig. S1: Relative swelling coefficient at different time points. Hydrogel samples were submerged into the three artificial plasma phases.

The hydrogel samples reached the equilibrium swelling point 48 hours after production. Thereafter the swelling coefficient remained constant. The samples immersed in the 10% (v/v) Glycerol reached the highest swelling coefficient of 58, while the samples immersed in the 50% (v/v) Glycerol concentration reached a swelling

coefficient of 50. The hydrogel swelling was lowest for the particles in the dextran 40/CaCl2 solution, reaching a maximum swelling coefficient of 42.

S2 Density Measurements

Density of the artificial plasma phases and the swollen hydrogel were compared by using the volumetric swelling ratio method. For this, the density of the artificial plasma phases was determined using a densitometer (Anton Paar, Switzerland). The respective density values for the three plasma phases were 1.0205 g/cm^3 for Glycerol 10% (v/v), 1.1092 g/cm^3 for Glycerol 50% (v/v) and 0.9992 g/cm^3 for Dextran 40/$CaCl_2$, respectively.
To determine the hydrogel density, the hydrogel was fabricated and cut into smaller samples. The samples were weight directly after production, then submerged into the respective plasma phases. After 48h of swelling time the samples were weight again and the absorbed mass was calculated using:

$$m_a = m_s - m_d$$

Where m_a is the absorbed mass (in g), m_s the mass of the swollen hydrogel (in g) and m_d the mass of the dry hydrogel. Additionally, the volume (V_s) of the hydrogel was measured. The density of the swollen hydrogel was calculated using:

$$\rho_s = \frac{m_s}{V_s}$$

The calculated densities for the hydrogel swollen in the three respective plasma phases are 1.08583 g/cm^3 for the hydrogel swollen in Glycerol 10% (v/v), 1.1977 g/cm^3 for the hydrogel swollen in Glycerol 50% (v/v) and 1.0781 g/cm^3 for the hydrogel swollen in Dextran 40/$CaCl_2$. With this the density differences between plasma phase and swollen hydrogel could be determined. They where 0.0653, 0.0885 and 0.079 for Glycerol 10% (v/v), Glycerol 50% (v/v) and Dextran 40/$CaCl_2$, respectively.

With this the sedimentation velocity for quiescent conditions can be calculated, using the Stokes Law:

$$v_s = \frac{2(\rho_p - \rho_f)gr^2}{\eta}$$

Where v_s is the sedimentation velocity (in mm/s), ρ_p and ρ_f the densities of the microparticles and suspending medium (in g/cm^3), respectively, g is the gravitational acceleration, r the particle radius (in µm) and η the dynamic viscosity of the suspending medium (in Pas). The calculated sedimentation velocities were 0.0451 mm/s for Dextran 40/$CaCl_2$, 0.232 mm/s for Glycerol 10% (v/v), and 0.218 mm/s for the Glycerol 50% (v/v) solution.

S2 Elasticity Curves

The force-indentation curves of particle approach and withdrawal were plotted for all three blood mimicking fluids (BMF) as well as the positive porcine erythrocyte control. All BMF's show similar force curves for approach and withdrawal indicating an elastic material response.
The positive control shows a steep increase in force with increasing indentation at the beginning of the measurement. The force slope decreases with increasing indentation.
Similar behavior is recorded for the artificial erythrocytes in Glycerol 50% (v/v) solution, displaying initially a steep increase in force with only little particle indentation.
The Dextran 40/$CaCl_2$ and Glycerol 10% (v/v) both display an almost linear increase in particle indentation with increasing force. The artificial erythrocytes within the Glycerol 10% (v/v) solution are more flexible compared to the artificial erythrocytes within the Dextran 40/$CaCl_2$ solution reaching a maximum particle indentation of 4.4 µm and 2.1 µm, respectively.

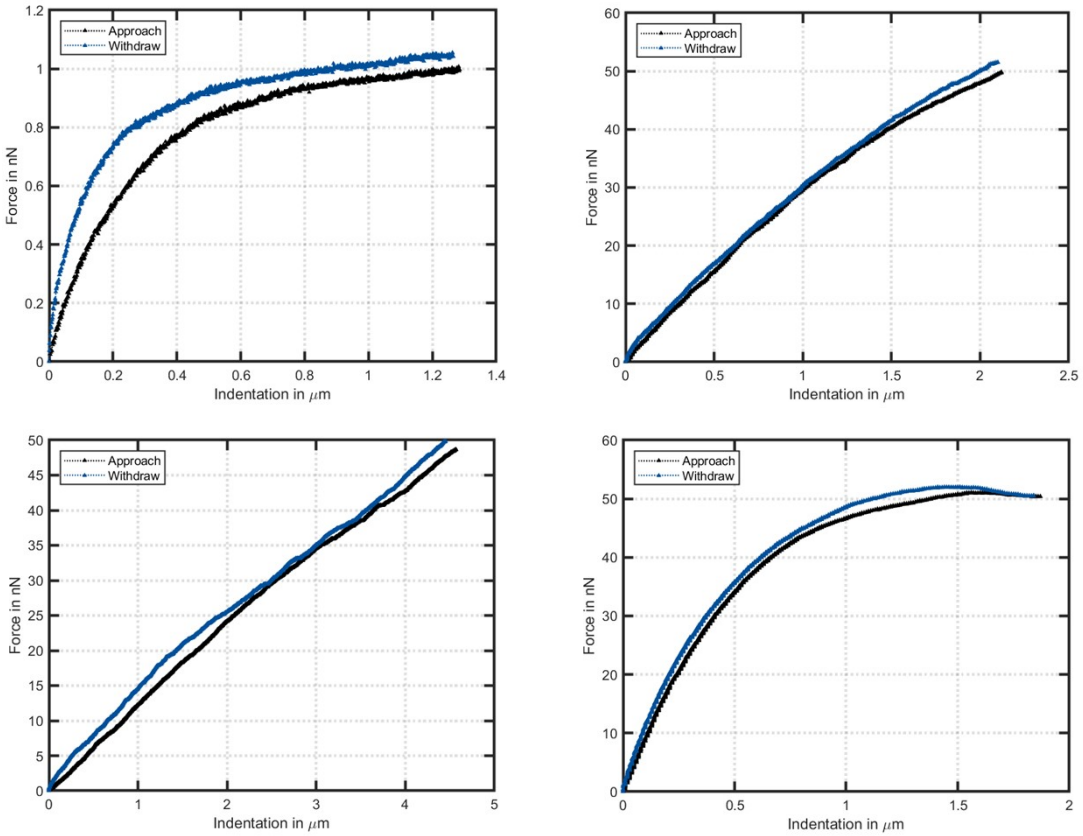

Fig. S2: Exemplary Force – Indentation curves of particle approach and withdrawal for the three BMF's and porcine erythrocytes (positive control). Force-Indentation curve of porcine erythrocytes (upper left). Force-Indentation curve of artificial erythrocytes in Dextran 40/$CaCl_2$ (upper right), in Glycerol 10% (v/v) (lower left) and in Glycerol 50% (v/v) (lower right). The maximum force and the maximum particle indentations were recorded.