Development of a Simulated Blood-Like Solution for Medical experiments

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Abstract

Real human blood presents several challenges that hinder long-term and large-scale studies, such as rapid degradation and clotting of real blood, which restricts its usability and necessitates frequent procurement of fresh supplies and complex storage solutions. This study develops a stable, long-lasting blood-mimicking fluid (BMF) to replicate human blood. This BMF has been synthesized from Agar-Agar ($C_{12}H_{18}O_9$), Iron(II) Tetraphenylporphyrin ($C_{44}H_{28}ClFeN_4$), Ringer's solution, and red food color ($C_{20}H_6I_4Na_2O_5$). The microstructure and size of the particles inside the BMF have been studied using a field effect scanning electron microscope (FESEM). Additionally, the dynamic light scattering (DLS) method has been employed to analyze the particle distribution in BMF at various solution concentrations. The other physical and chemical properties of the studied BMF, such as pH, density, viscosity, glucose level, particle size, and conductance were measured. The synthesized BMF shows a viscosity of 3.24 mPa·s, density of 1.013 g/cm³, and average particle size of ~1.4–2.0 µm, closely resembling real blood. Moreover, the BMF demonstrates the conductivity of 3.56 mS/cm and does not show phase separation, confirming its hydrophilic behavior. In addition, a 24-hour circulation test confirmed its stability, making it suitable for biomedical device testing, especially in diagnostics and hemodynamic studies.

Keywords: Ringer's solution, Microstructure, density, viscosity, Flow test.