Temperature Dependence on Flow Property of Blood Based on Modified Herschel-Bulkley Equation

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We measured pig blood viscosity at several temperatures using a compact falling-needle rheometer, which has been developed to measure blood viscosity with high accuracy. We then used the modified Herschel-Bulkley equation (mHB equation), which we have already proposed for the apparent viscosity of blood, to organize the measured values. As a result, it was confirmed that pig blood viscosity can be approximated better than the Herschel-Bulkley model equation and the Casson model equation over a wide range of shear rates. In this study, we investigated the temperature dependence of blood viscosity. Pig blood was used to measure blood viscosity. A circulating thermostatic chamber was used to control the blood temperature, and viscosity measurements were performed after confirming that the target temperature had been reached. The dimensionless numbers (a, b, m, n) in the mHB equation were determined based on the conditions previously reported for 25 healthy male and female subjects (50 subjects in total), and the mHB equation was created for each temperature range. The analysis of flow characteristics confirmed the non-Newtonian (Casson fluid) behavior unique to blood. It was confirmed that the apparent viscosity of blood changes as the temperature changes, suggesting that the graph of the mHB equation moves parallel to the viscosity axis as the temperature changes. This study enables flow analysis of blood at arbitrary temperatures and may contribute to the analysis considering non-Newtonian flow by incorporating computational fluid dynamics (CFD).