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Red blood cell deformability and aggregation: implications for omics analysis

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Blood is a complex fluid with non-Newtonian characteristics. It consists primarily of a concentrated suspension of deformable red blood cells (RBCs) [1] which tend to aggregate reversibly in microstructures, such as rouleaux; this tendency is a major contributor to the viscoelastic flow behavior of blood. Human blood mechanical response is strongly affected by RBC properties, such as volume fraction, deformability and aggregation [2]. In particular, the tendency of RBCs to form packed structures plays an important role in blood flow behavior, causing the increase of blood viscosity, especially at low shear rates. Currently, both research and clinical hemorheology is mostly based on steady shear measurements to obtain the apparent blood viscosity [3]. However, linear viscoelastic tests, such as oscillatory shear, can provide valuable information about blood microstructure, but few results are available in the literature. Recently, blood viscoelastic moduli have been investigated by passive microrheology [4], but the application of this technique to a heterogeneous material such as blood is questionable. Here, we present a systematic set of oscillatory shear measurements by conventional bulk rheology to evaluate storage and loss moduli of whole human blood. The rheological behavior of human blood was characterized both in physiological conditions and in RBC aggregating media. The latter ones were obtained by the addition of a polymer and by increasing the hematocrit above the normal physiological levels [5].

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Department

Dipartimento di Ingegneria Chimica, dei Materiali e della Produzione Industriale

Primary author(s) : Prof. TOMAIUOLO, GIOVANNA (Dipartimento di Ingegneria Chimica, dei Materiali e della Produzione Industriale, Università di Napoli Federico II); Prof. GUIDO, Stefano (Dipartimento di Ingegneria Chimica, dei Materiali e della Produzione Industriale, Università di Napoli Federico II)

Presenter(s) : Prof. TOMAIUOLO, GIOVANNA (Dipartimento di Ingegneria Chimica, dei Materiali e della Produzione Industriale, Università di Napoli Federico II)