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Rheologie

Flow properties of whole blood can be analyzed by characterizing the flow curves with the new LS 300 low shear rotational rheometer

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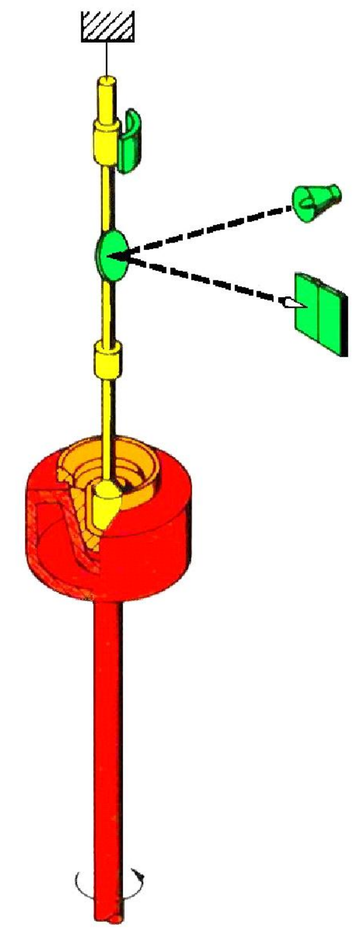
Introduction:

Determination of whole blood viscosity at a given shear velocity is an often used method. The whole blood viscosity plays a key role in the syndrome of hyperviscosity of the neonate, the wall shear stress and for determination of the limits of red blood cell transfusion. The new LS 300 (proRheo, Althengstett, Germany) with its analyzing software generates a flow curve, which allows foreseeing the flow of whole blood at various conditions.

Material and Methods:

Whole blood of 40 adults were used to determine flow curves, yield point and viscosity, the plasma viscosity (LS 300, proRheo; capillary tube plasma viscometer, Fresenius) and haematocrit. Ten adult samples were used to determine the effect of heparin and citrate compared to EDTA as anticoagulant. The effect of these anticoagulants on RBC geometry was analyzed with the micropipette technique in five adult blood samples.

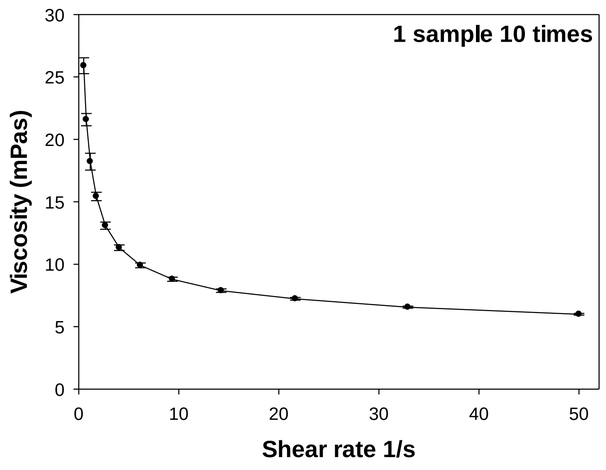
measuring unit

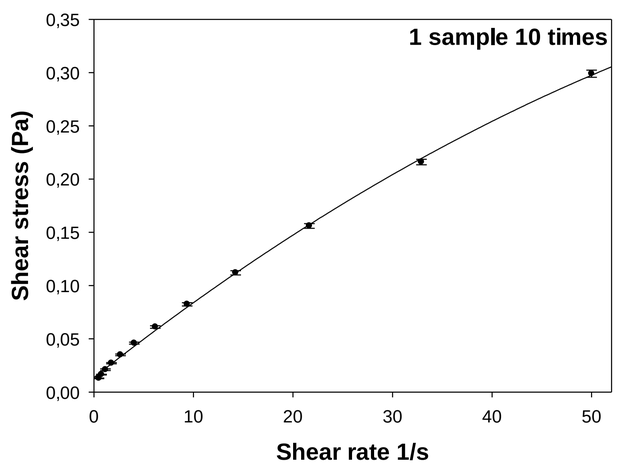


Operating principle

Results:

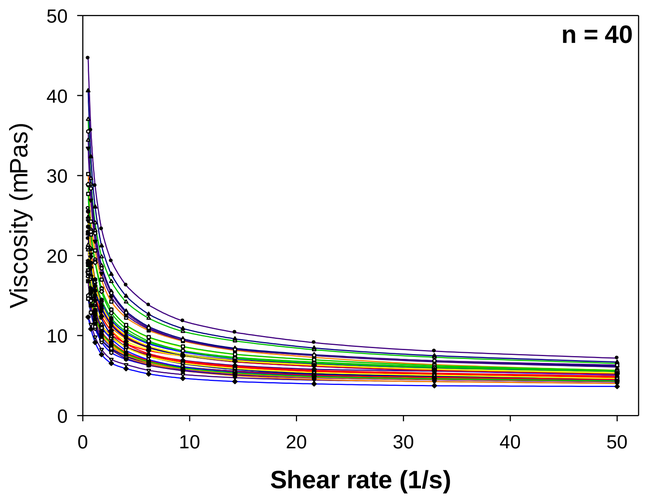
With the new LS 300 (proRheo, Althengstett, Germany) and its analyzing software an optimal approximation of this flow curve will be given with an accuracy of more than 99.5%. The flow curve can be defined by only two parameters: the yield point and the viscosity as per Casson method.

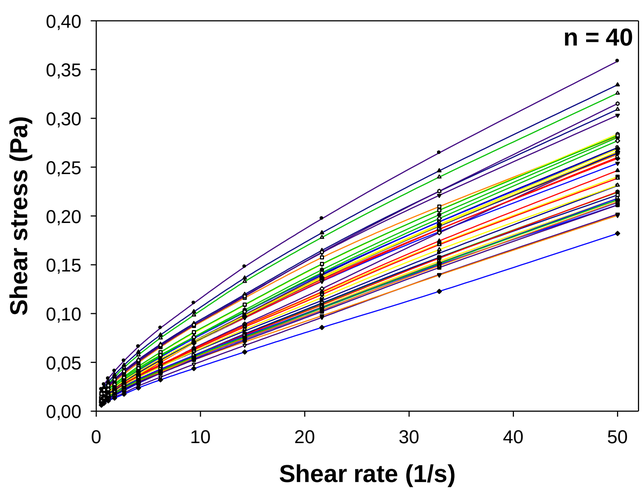


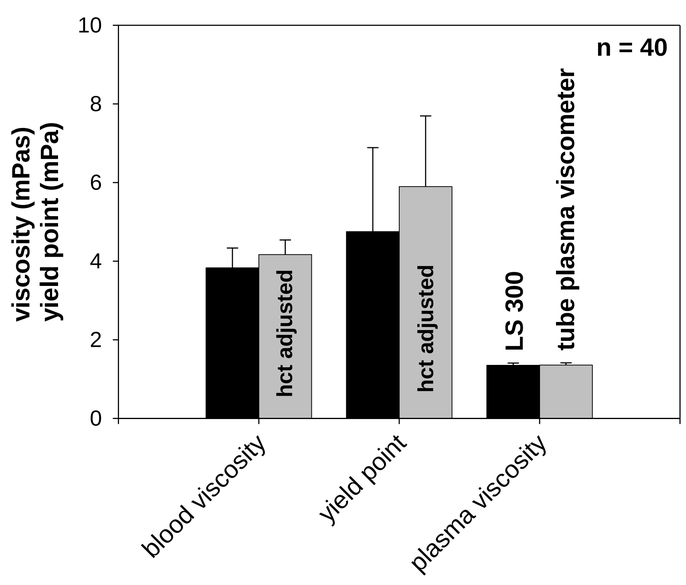


$$\tau = \sqrt{\tau_0} + \sqrt{\eta \dot{\gamma}}$$

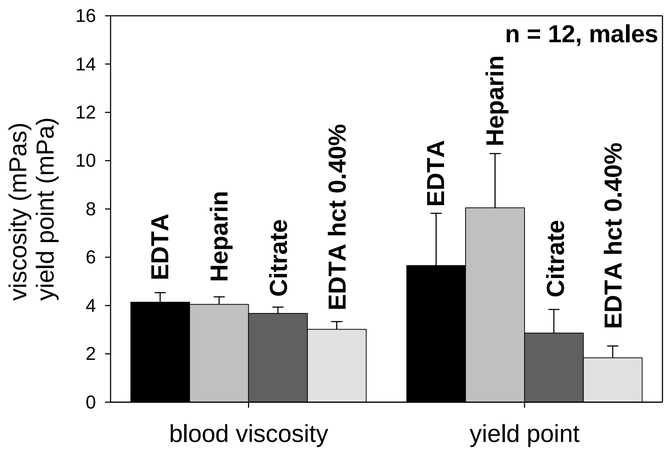
The whole blood viscosity was 3.831 mPas ± 0.503, the yield point was 4.75 mPa ± 2,14, and the plasma viscosity was 1.35 mPas ± 0.05 (37°C).

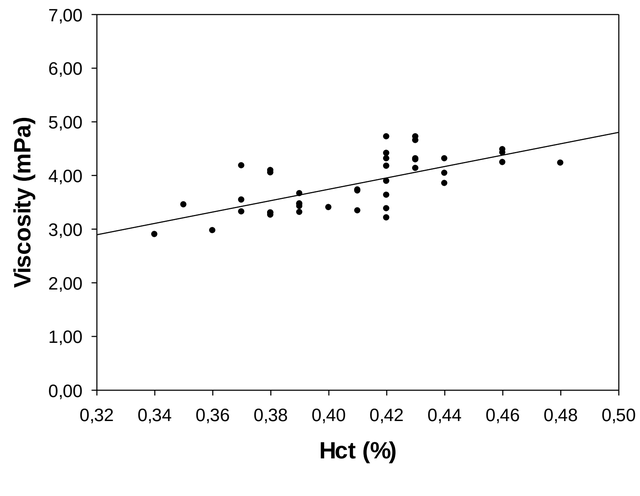


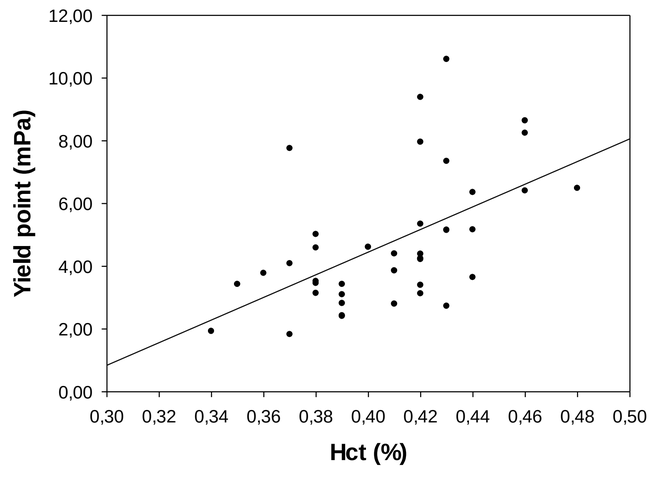




The geometrical parameters of RBC were not different due to various anticoagulants while the yield point was highest with heparin, followed by EDTA and citrate. Centrifugation for adjusting the haematocrit had a distinct effect on the yield point and viscosity. Since the haematocrit influences the flow behaviour of whole blood, an algorithm was developed to rule out this influence for the analyses (in a range of hct of 30 – 50%).







Conclusion:

The determination of the flow curves which can be characterized by the two parameters yield point and viscosity of whole blood is an important improvement for determination of blood flow at various flow conditions.