Whole blood viscosity and viscoelasticity in healthy dairy cows

Sandersen C., Dringenberg B., Vandeputte S., Sartelet A. , Amory H. Guyot H.,

It has recently been shown that bovine erythrocytes have a particular phospholipid composition, consisting largely of sphingomyelin and few or no phosphatidylcholine. The membrane composition is known to have a major impact on the erythrocytes membranes fluidity and deformity. Little information is known about the rheological behavior of bovine blood, although red blood cell deformity, whole blood viscosity, and viscolelasticity are influenced by numerous physiological, pathological and pharmacological conditions. The rheological properties of blood themselves influence shear stress in blood vessels and can be of importance in the understanding of pathological mechanism of certain diseases, like e.g. babesiosis or postparturient haemoglobinuria. The aim of the study was to measure whole blood viscosity and viscoelasticity of clinically healthy animals in order to establish reference values that can be compared to values obtained in sick animals in the future.

Ten healthy Holstein-Frisian cows were studied. Blood was sampled on EDTA vacutainer tubes. Packed cell volume, red blood cell count, and hemoglobin concentration were determined with a cell analyzer (Medonic CA50), total protein content was measured colorimetrically. Whole blood viscosity and viscoelasticity was measured at shear rates of 2.2, 12 and 62 s^{-1} using the Bioprofiler (LAT -Labor- und Analysen-Technik, Garbsen, Germany).

Measurements of viscosity revealed mean values (± S.D.) of 2.616 ± 0.288, 2.330 ± 0.272, and 2.433 ± 0.266 mPa s for the shear rates of 2.2, 12 and 62 s^{-1}, respectively. Measurements of viscoelasticity revealed mean values (± S.D.) of 5.410 ± 1.741, 4.903 ± 1.618, and 4.565 ± 1.566 mPa s for the shear rates of 2.2, 12 and 62 s^{-1}, respectively.

Results indicate that inter-animal variability was higher for blood viscoelasticity than for blood elasticity. There was no correlation between the red blood cell count, hemoglobin concentration, total protein concentration, temperature and the blood viscoelasticity, indicating that blood viscolelasticity is largely influenced by other factors. Nevertheless, this method seems to be relatively simple to perform and opens the possibility of serial examination of a large number of samples. Future studies should be carried out to investigate the different factors influencing rheological behavior of bovine blood.