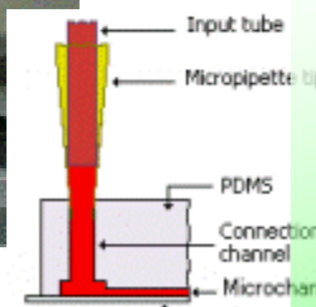
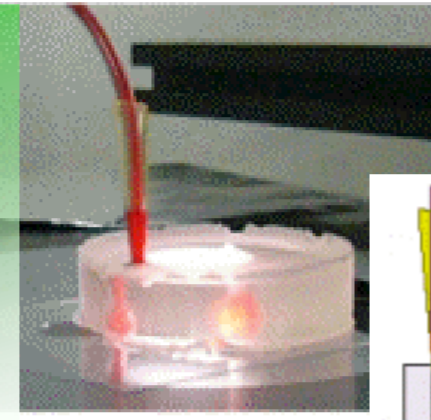


Introduction

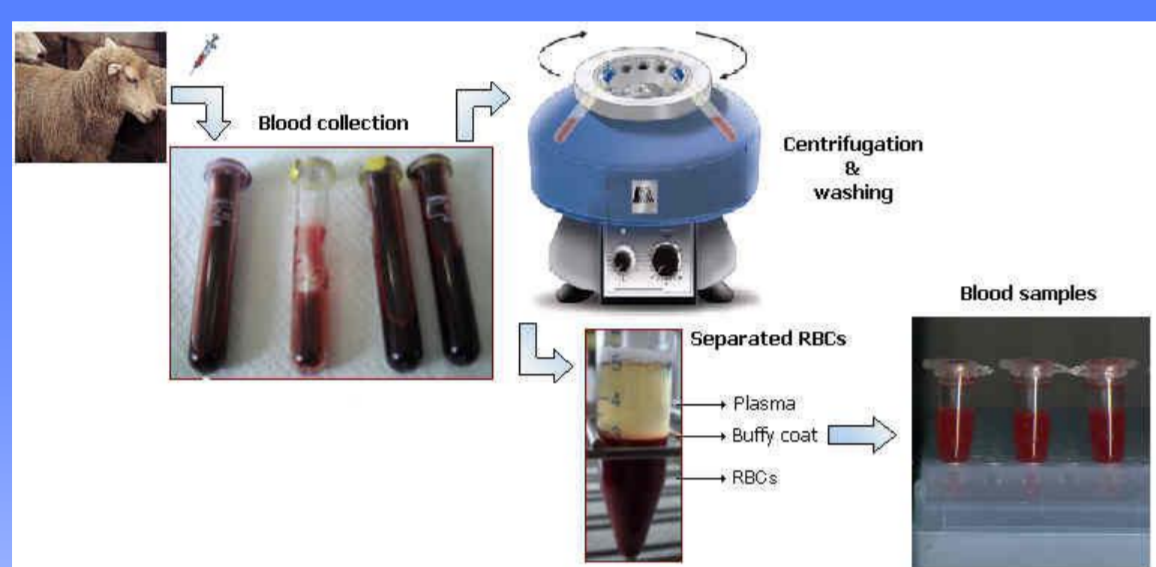
Currently, **biomedical microdevices** are becoming one of the most promising tools for the diagnostic and treatment of several diseases, such as diabetes, malaria and cancer. Hence, it is increasingly important to investigate the rheological behaviour of physiological fluids in microchannels in order to make use on the physics of microfluidics to either develop new lab-on-chip devices and to optimize the design of existent biomicrofluidics chips.



The main objective of this study is to **investigate the flow behaviour of two different physiological fluids frequently used in biomedical microdevices**. The working fluids used in this study were physiological saline (PS) and dextran 40 (Dx40) containing about 6% of sheep red blood cells (RBCs), respectively. By using a syringe pump and a camera it was possible to measure qualitatively the flow behaviour within a horizontal capillary.

Materials and methods

Blood samples preparation



The blood was collected from a healthy sheep, where heparin was added to prevent coagulation. The RBCs were separated and washed by centrifugation.

The washed RBCs were diluted with PS to make up the required RBCs concentration by volume.

The hematocrit (Hct) was about 6% (6Hct).

All blood samples were stored hermetical at 4°C until the experiment was performed at room temperature (18 to 20°C).

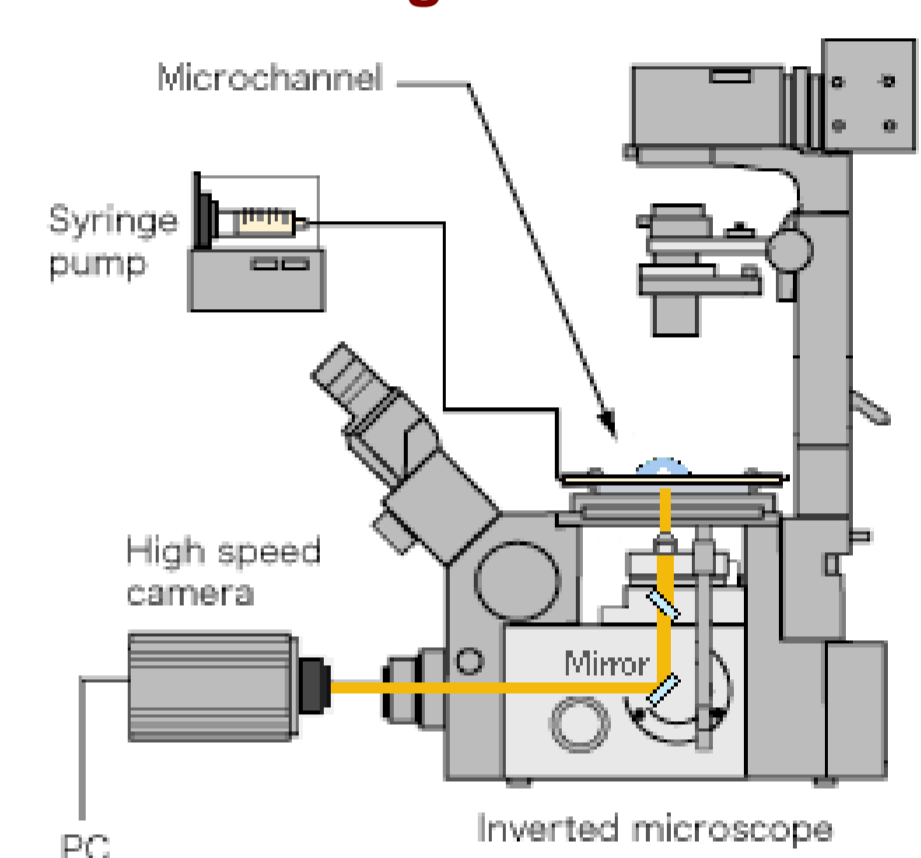
Experimental set-up

Experimental set-up for the dynamic sedimentation measurements



In this method the capillaries were placed horizontally on a slide glass and by using a syringe pump a pressure-driven flow was kept constant at 50 $\mu\text{l}/\text{min}$ which corresponds to a Reynolds ~ 0.9 (PS) ~ 0.3 (Dx40).

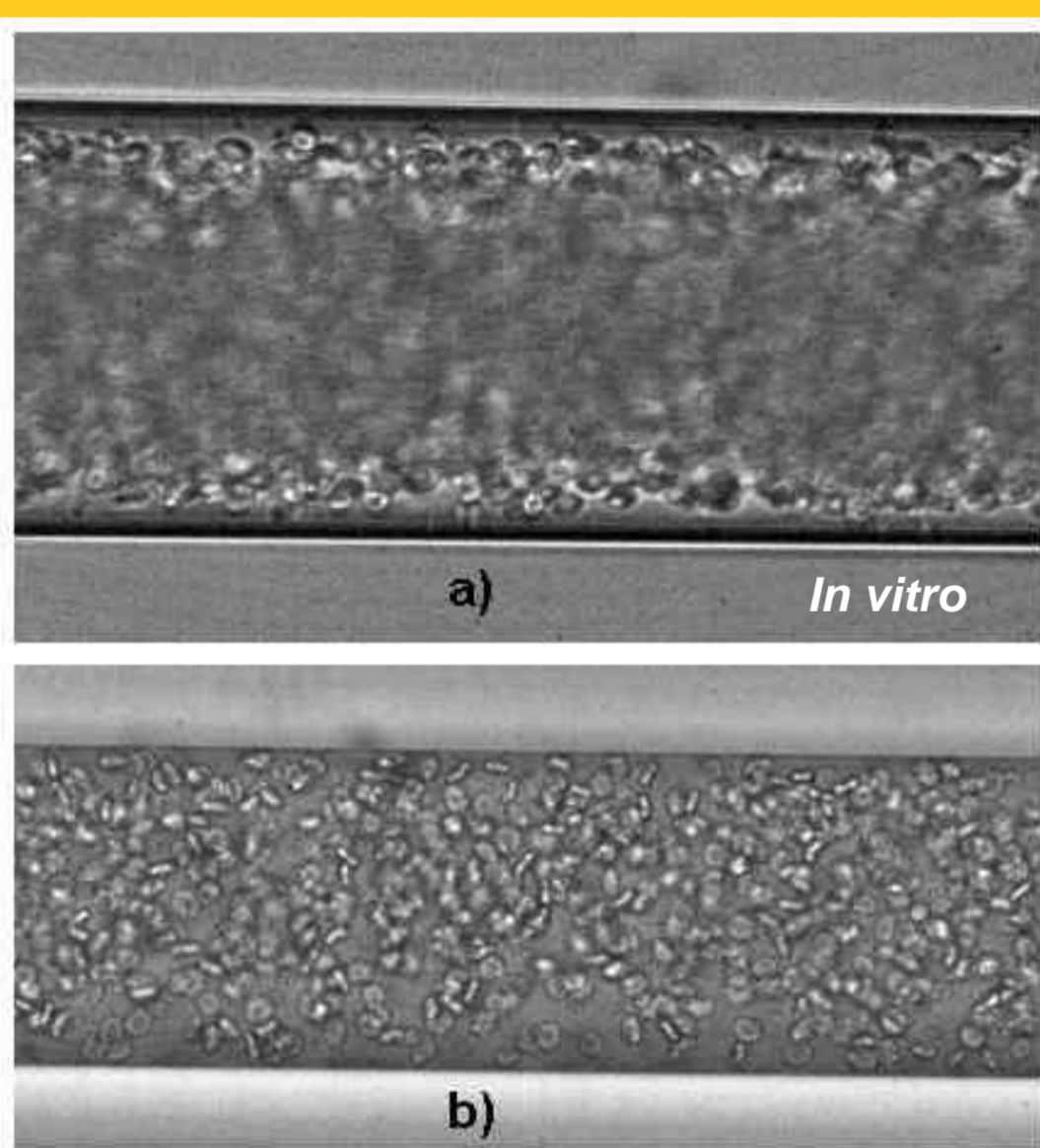
Experimental set-up for blood flow visualization in glass microchannels



Visualization of *in vitro* blood flow in glass microchannels by means of a high-speed video microscopy system.

Results and discussion

Flow visualization in glass microchannels

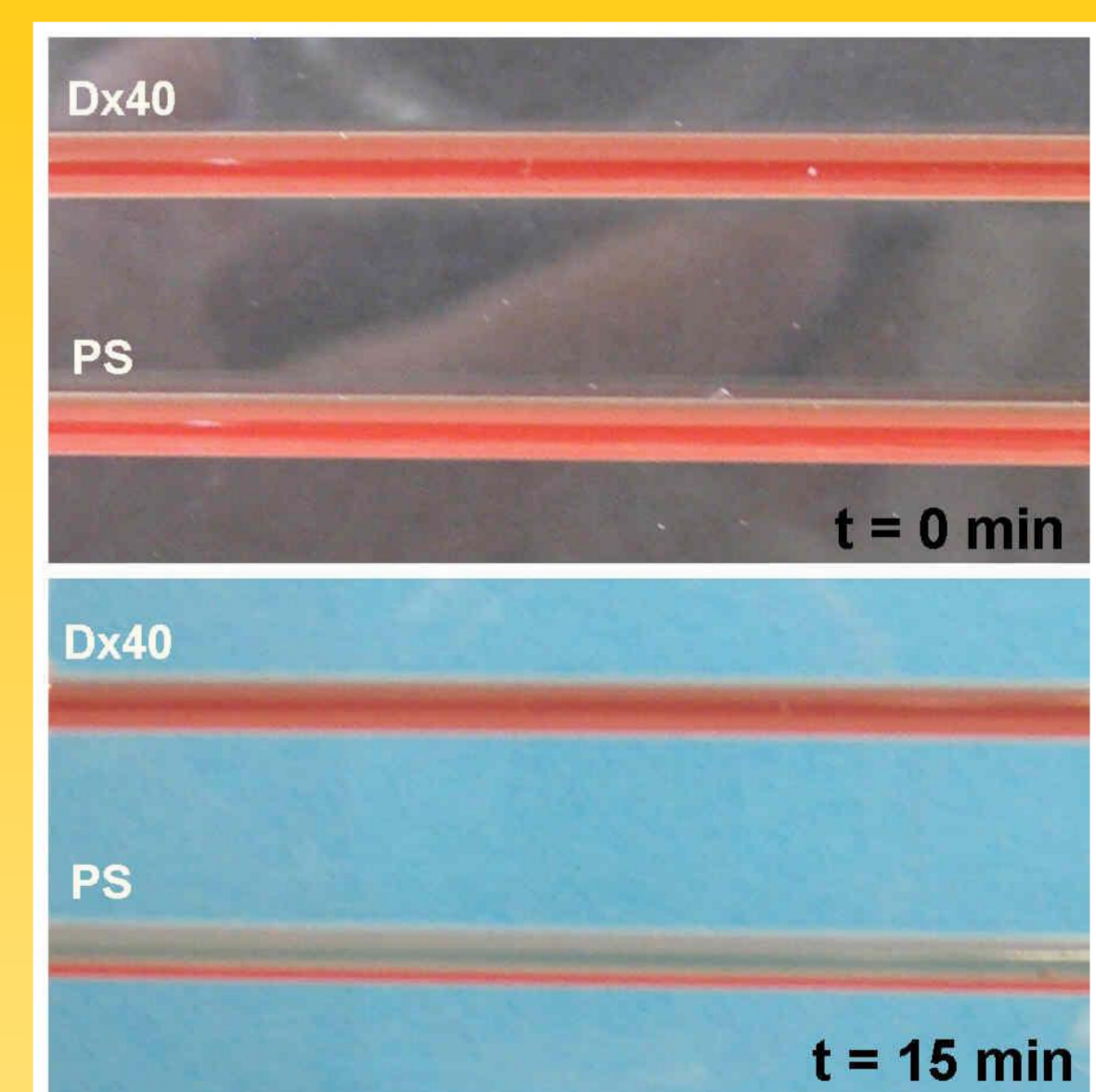


For the case of Dx40 there is formation of cell-free layer adjacent to the walls of microchannels. However, in the fluid with PS RBCs do not exhibit tendency to migrate into the microtube axis.



In vivo visualization shows a clear tendency for the formation of a plasma layer in microvessels. Hence, the present results indicate that *in vitro* blood containing Dx40 has a flow behaviour closer to the one observed *in vivo* microvessels.

Dynamic sedimentation measurements



Flow rates for both physiological saline (PS) and dextran 40 (Dx40), containing about 6% of sheep RBCs, was 10 $\mu\text{l}/\text{min}$.

Flow qualitative visualizations measurements in glass capillaries with diameters ≈ 1.2 mm, for 15 minutes.

For a period of 15 minutes the RBCs tend to settle down in the fluid with PS whereas using Dx40 no RBC sedimentation was observed.

Conclusion and future work

- Preliminary results indicate that *in vitro* blood containing Dx40 has a flow behaviour closer to the one observed *in vivo* microvessels. The *in vitro* blood containing PS did not show a clear formation of cell-free layer which might be due to the fast sedimentation of the RBCs.
- In the near future we plan to vary the flow rate and diameter to study the influence of these effects on the RBC sedimentation.