Point of care detection of infectious pathogens using a portable microfluidic system

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Abstract

Point of care testing (POCT) represents important part of the diagnostics and subsequent treatment of patients. Diagnostic tests performed from the comfort of the patient's home with a smartphone readout enable diagnosis without the laboratory equipment and the presence of a specialized laboratory trained personnel. The tests are designed to be simple and thus allow the patient to do them themselves. They also have the potential for testing in medical facilities due to their small dimensions and lower economic demands than other classical diagnostic methods based on the PCR reaction. The importance of POC approaches increases during the pandemies, like in case of SARS-CoV-2.

In the present work, a microfluidic device, which uses RNA isolated by magnetic nanoparticles with a specifically modified surface, is developed. Magnetic nanoparticles represent a fast tool for obtaining the RNA of high quality, compatibility with other downstream RNA detection platforms and the possibility of miniaturizing into a chip. For RNA analysis, we have developed a sensitive reverse-transcription loop-mediated isothermal amplification (RT-LAMP) assay, which utilizes a fluorescence readout with sensitivity and specificity comparable to the RT-qPCR. Its advantage lies primarily in the isothermal profile of the reaction and a shorter time of the whole analysis. The fluorescent detector could be replaced by an electrochemical sensor, which could provide even higher sensitivity of the detection. The difference between both types of detection has been preliminary studied in this work.

This approach could be utilized as a universal tool for the detection of various pathogens in human and veterinary medicine. The biggest challenge is the diagnosis of neonatal sepsis due to the low weight of the birth child, small blood volume and insufficiently developed immune system. This approach could provide accelerate an accurate diagnosis, just right on the place of need and therefore treatment targeting within 40 minutes from a drop of the patient's blood.

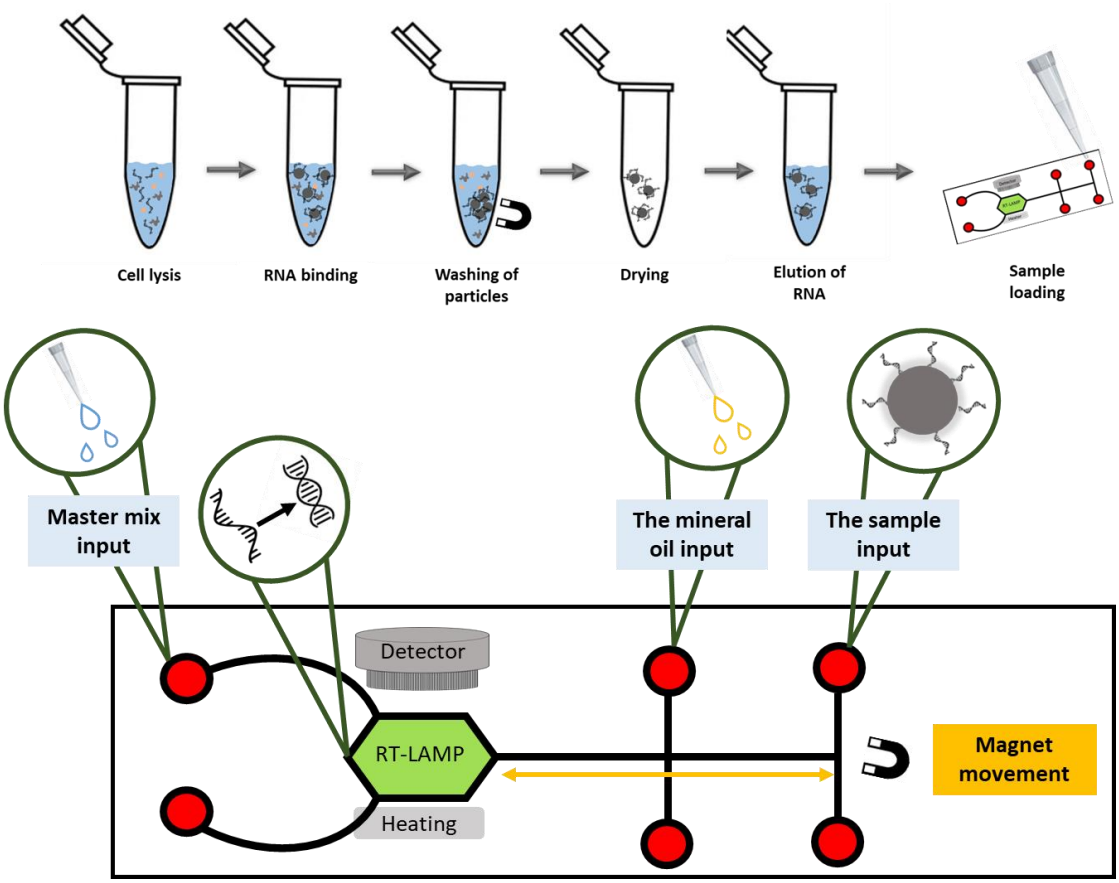

Figure 1: Scheme of the reaction