

***Trypanosoma cruzi* quantitative chemotaxis characterization by Optical Tweezers**

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One of the fundamental goals in parasitology is the fully understanding of parasite-host cell interactions. This is still more important when it comes to non-curable diseases, like Chagas disease caused by *Trypanosoma cruzi*. In this work, we propose a methodology to study microorganisms chemotaxis in real time using an Optical Tweezers system. Quantitative measurements of taxis, mainly chemotaxis, are essential to elucidate the infection process. For a better understanding of chemotaxis it is necessary to know not only the sense and direction of the parasite's force but also its intensity. Optical Tweezers allowed real time measurements of the force vectors, strength and direction, of living parasites under chemical or other kinds of gradients. This seems to be the ideal tool to perform observations of taxis response of cells and microorganisms with high sensitivity to capture instantaneous responses to a given stimulus. We applied this methodology to investigate the *T. cruzi* under distinct situations: the parasite alone and in the presence of its insect-vector *Rhodnius prolixus*. A quadrant detector allowed us to measure the sense and direction of the forces.

The propulsion forces of the flagellum of the protozoan was measured with an optical tweezers by using a polystyrene bead, connected to the parasite, as a force transducer. We assume a geometrical optics model to calibrate the force as a function of the bead displacement from the equilibrium position. The displacement of the bead due to the parasite's flagellum propulsion was then measured to determine the numerical values for the optical force and, consequently, for the force of the parasite. Previous calibration of this procedure against hydrodynamic force showed good results [1].

By trapping and moving *T. cruzi* to the vicinities of midgut cells we observed a change of behavior of the parasite. It projects its flagellum towards the cell as show in figure 1. This clearly shows how the microorganism (inside the yellow circle) can sense the presence of others cells and respond to it. This behavior contrasts with its behavior more than 50 μm away from the midgut cells where it just shows an erratic without any preferred direction movement. This is confirmed by quantitative measurements of chemotaxis.

References

- [1] Fontes, A., Giorgio, S., de Castro Jr., A. B., Neto, V. M., Pozzo, L. Y., Marques, G. P., Barbosa, L. C., Cesar, C. L., 2005. “Determination of femtonewton forces and fluid viscosity using optical tweezers: application to *Leishmania amazonensis*.” Proceedings of SPIE 5699, 419–425.



Fig 1. Optically trapped *T. cruzi* trapped and moved closer to the intestine cell.