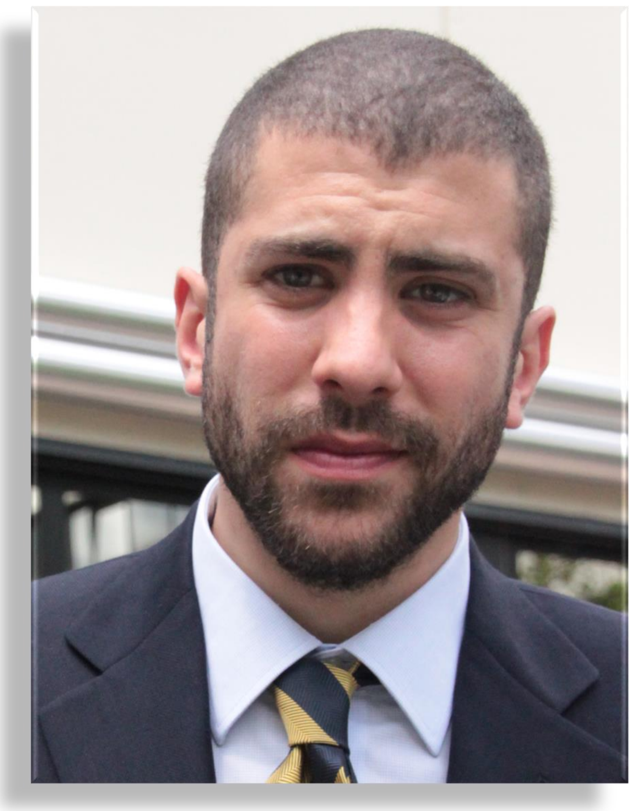
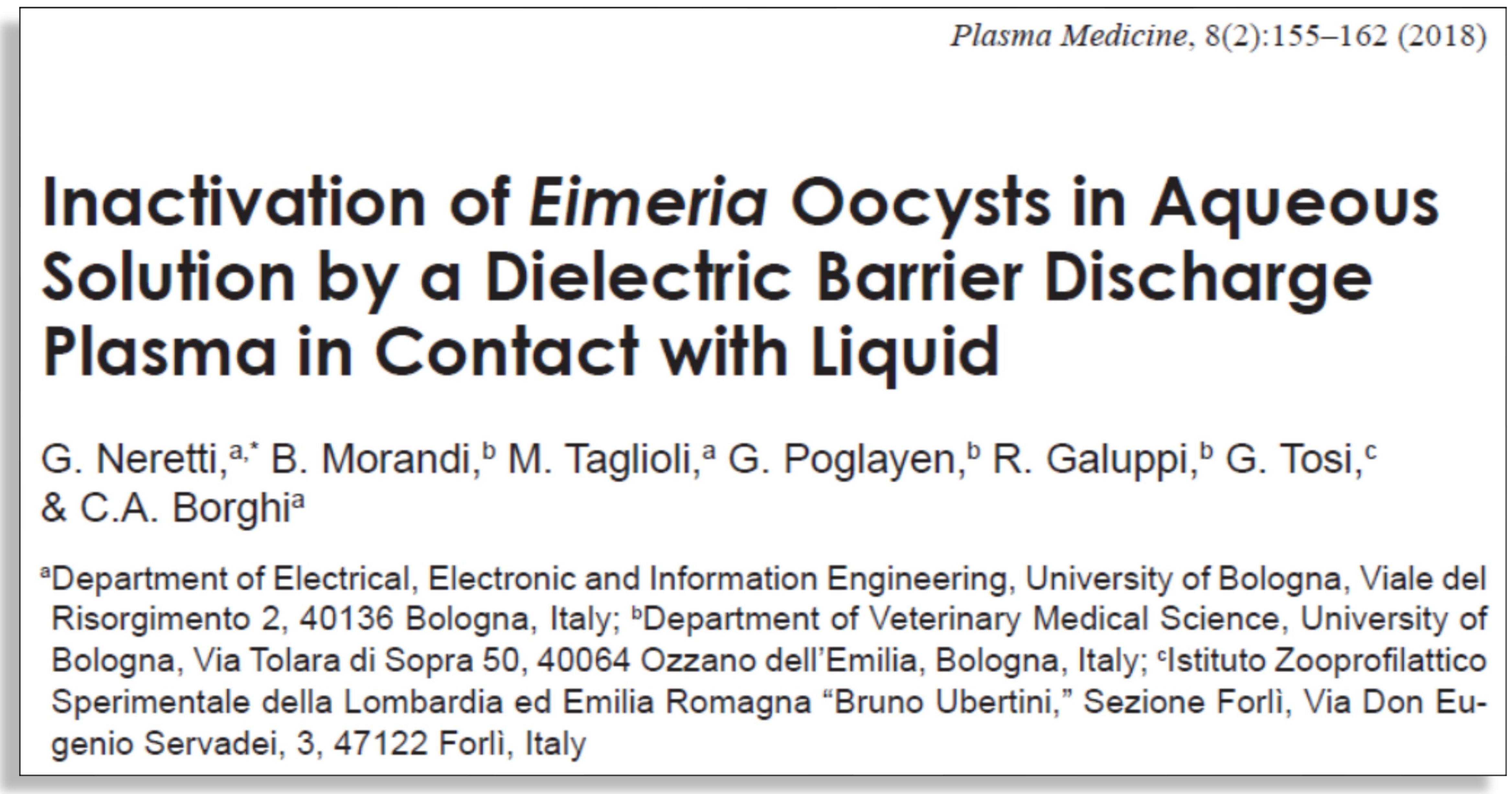
DIPARTIMENTO DI SCIENZE MEDICHE VETERINARIE
ALMA MATER STUDIORUM – UNIVERSITÀ DI BOLOGNA

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Inactivation of *Eimeria* Oocysts in Aqueous Solution by a Dielectric Barrier Discharge Plasma in Contact with Liquid

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1. Introduction

The study here presented describes a novel technique to inactivate coccidian oocysts in an aqueous solution. The technique consists of treating the contaminated liquid by using an atmospheric-pressure air dielectric barrier discharge (DBD) plasma in contact with it. Among human and animal diseases agents, parasites show much higher environmental resistance than the others. An example of parasitic element are coccidia, whose oocysts may last more than 600 days in soil. Coccidia are intracellular obligated protozoa, particularly feared in poultry and rabbit breeding.

Cold atmospheric-pressure plasmas have been widely investigated in the past two decades for biocidal purposes and they resulted useful for several pathogenic agents, such as *Aspergillus brasiliensis*, *Escherichia coli*, HSV-1, *Rhizoctonia solani*, *Cryptosporidium parvum* and others.

Several experiments with increasing treatment time were performed.

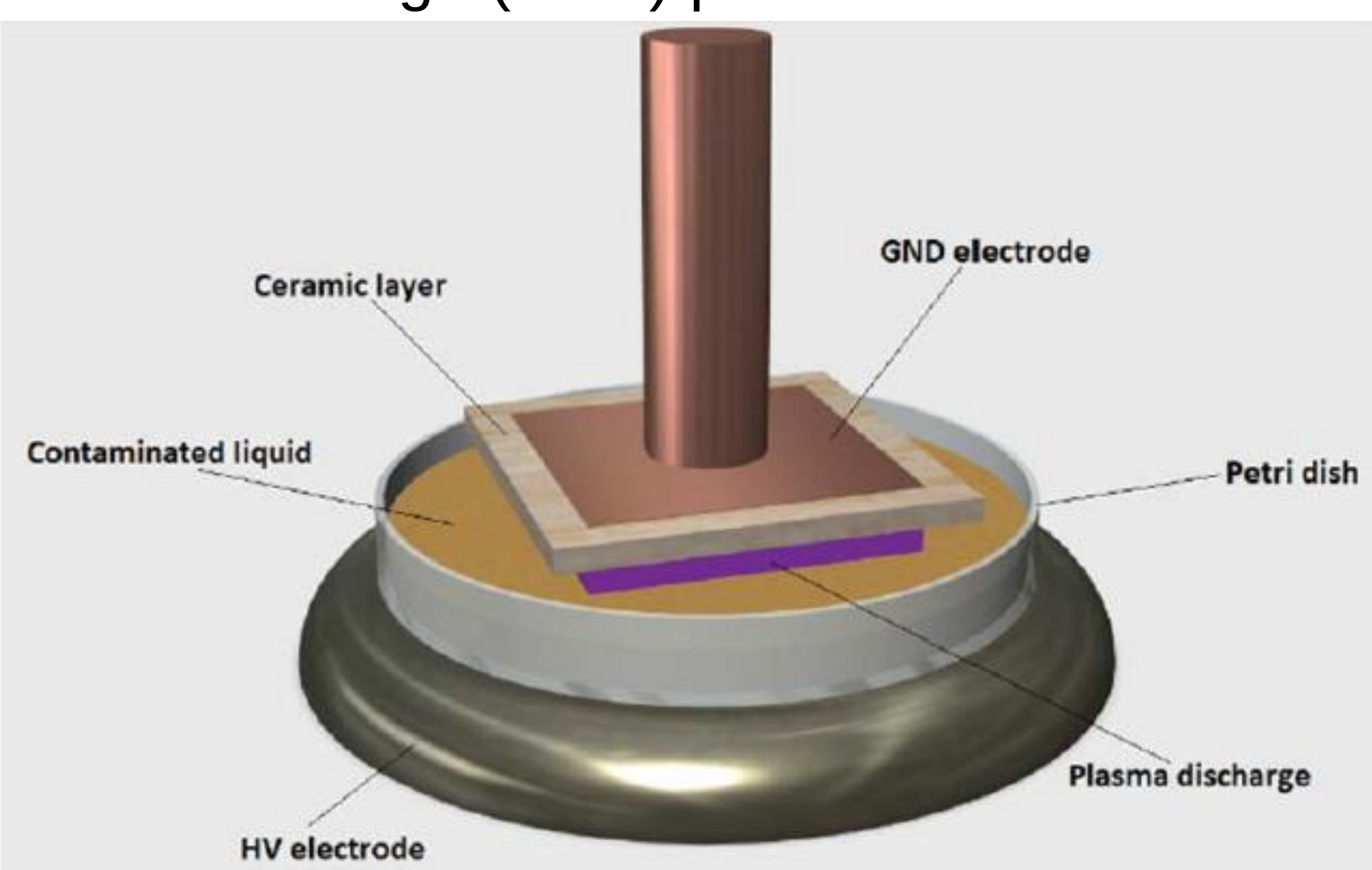

FIG. 1: Schematic of the DBD device

2. Materials & Methods

The coccidia *Eimeria necatrix*, *E. maxima* and *E. acervulina* were collected in poultry farms with clinical coccidiosis evidences. In order to apply the plasma discharge on the material, the engineering department tuned the device pictured in fig.1. The discharges were supplied by both sinusoidal and nanosecondpulsed (fig.2) voltage waveforms, keeping constant the average power, then transferred in labeled sporulation chambers to obtain the infectivity stage (fig. 3).

3. Results

Although the DBD device generates very different plasmas according to the supply voltage waveform, the number of survived and noninfectious oocysts after treatment does not seem to depend strongly on the discharge excitation waveform. The number of survived oocysts drops down by 40% in the first 4 minutes and about twice after 12 mins.

These results suggest the direct discharge role on the oocysts.

The O_3, OH, H_2O_2 generated in liquid by plasma are responsible for the parasite higher damage rate.

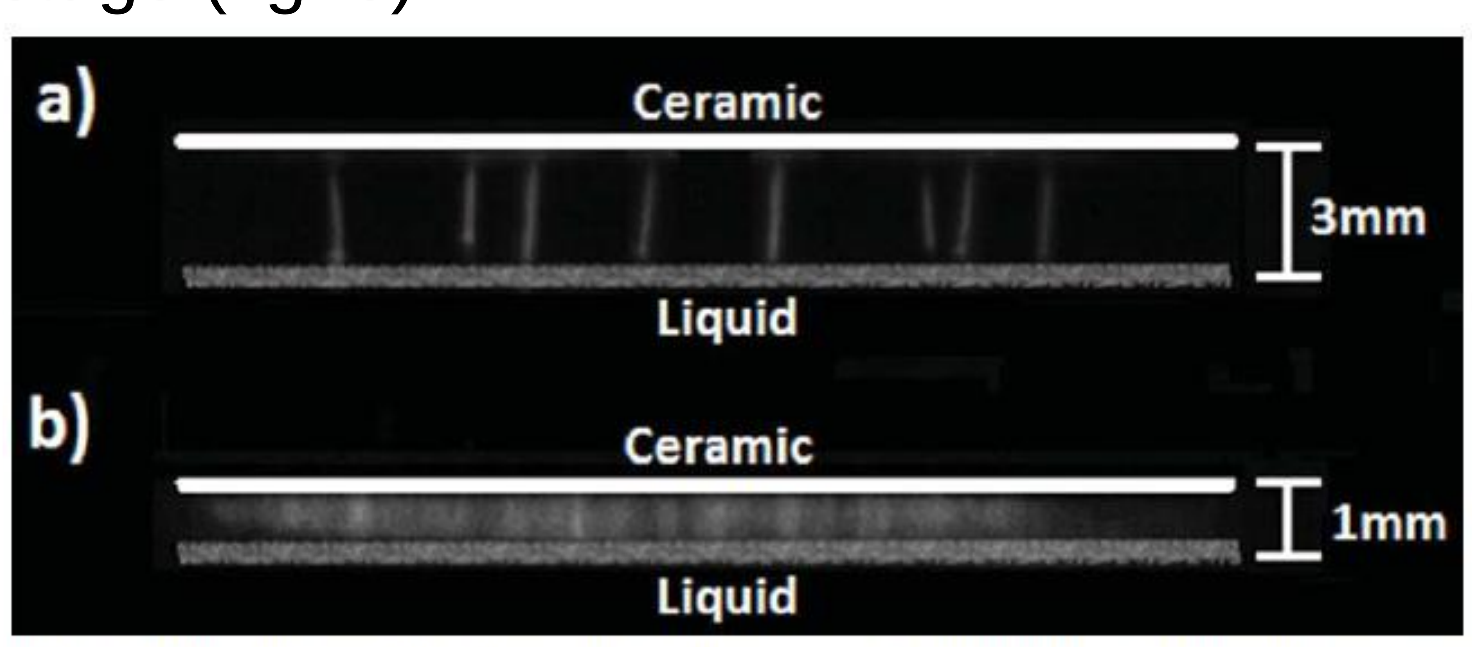

FIG. 2: iCCD pictures of the sinusoidal (a) and nanosecond-pulsed (b) DBD plasma. Exposure time 210 µs (a) and 1 µs (b)

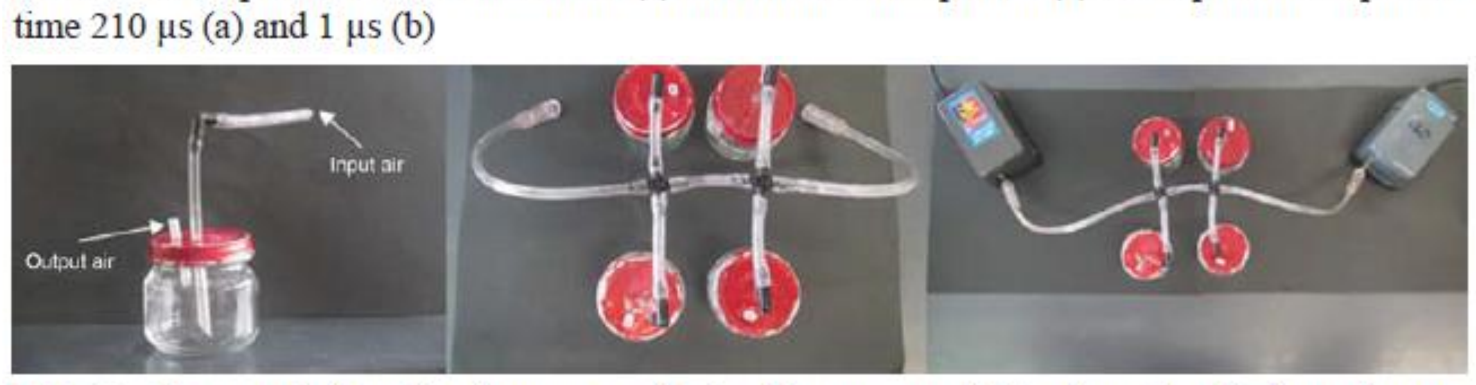

FIG. 3: The sporulation chambers were obtained by means of glass jars, in which continuous oxygenation of the biological samples was guaranteed by means of two aquarium pumps

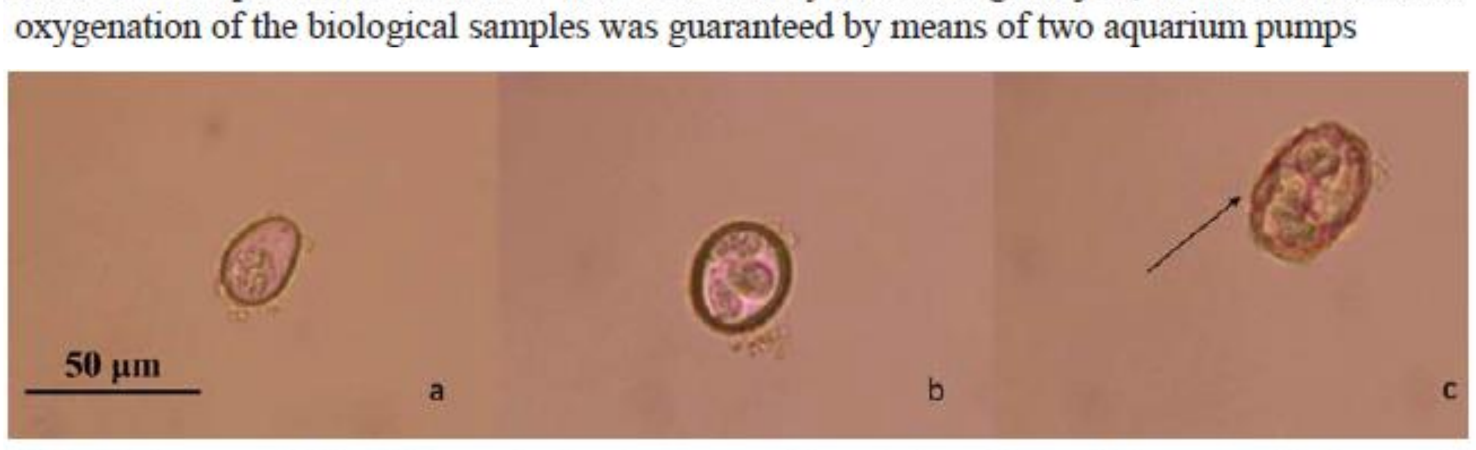

FIG. 4: Images obtained by optical microscope. The picture shows (a) unsporulated oocyst, consisting of a nucleated mass of protoplasm enclosed by a resistant wall; (b) sporulated oocyst, consisting of an outer wall enclosing four sporocysts each containing two sporozoites (infective stage) and (c) oocyst's wall posttreatment damage

4. Discussion & Conclusion

No significant differences in the use of the two sources were detected. Chi-squared tests on the plasma-treated coccidian compared with the control pointed out the stochastic warranty of nonrandomness efficacy. The inactivation results presented here are really encouraging, but some aspects related to the coccidian inactivation mechanism are still unclear and need more investigation. Further work is needed to optimize the treatments and develop more efficient plasma devices in order to reach our goal: use it in the field.

Tutor: Prof. Giovanni Poglayen