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Action of Low Intensity Electric Current on UNI and Pluricellular Organisms

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Abstract:- One of the objectives of the work was to verify the effects of electricity on protozoa and mosquito larvae in water. The results demonstrated the occurrence of paramecium death in lettuce cultures exposed to both high tension and low intensity treatment, as well as low tension treatment, and the lack of effect of these methods on the multiplication of mosquito larvae in standing water. Regarding the aspects of the cultures, transparency of the water of the one that received high voltage treatment was observed. Two phases were formed in which it received low voltage. The water of the control group was cloudy. Another objective was to verify the influence of high voltage electricity on bacterial activity in three samples of raw milk. The methylene blue reductase test was used for the visual verification of discoloration due to the proliferation of bacteria. It was found that the treated group had less discoloration when compared to the control group, which is suggestive that the method decreased the bacterial load. Further research can be carried out with the aim of ascertaining the effect of electricity on several single-celled organisms, including viruses and in particular COVID - 19.

Keywords:- *Electricity; Death, Pathogens; Single-Cell, Voltage.*

I. INTRODUCTION

For decades, controlled electrical current has been used in conjunction with biology, medicine and functional rehabilitation. Gel electrophoresis and recombinant DNA technology are examples of applications in the biological field.

Simple experiments were carried out on water solutions with protozoa and milk with bacteria, to demonstrate the destructive effect of electricity on them.

The research had as one of the objectives to verify the occurrence of death of protozoa and mosquito larvae through the electric current and the occurrence of the inhibition of the multiplication of mosquitoes in containers that received low current intensity in an uninterrupted manner. With the application of continuous oralternatingelectriccurrent, with a low or high voltage respectively, there is the possibility of death or inhibition of the proliferation of microorganisms.

Another objective was to verify the occurrence of bactericidal effect in raw cow's milk after the application of electric current, using the blue methylene reductase test (TRAM). QThe faster the time to discolor the dye from blue to white, the greater the number of existing microbes (ERNANI, 2009). As the bacterial population grows, there is a loss of color in the mixture, which indicates bacterial activity. The test result is given in hours; the shorter the time for the reagent to lose its color, the greater the reduction caused by the bacteria.The objectives of this work were to demonstrate the influence of controlled electricity, of low intensity, on tumor somatic cells, bacteria, protozoa and viruses. Special attention was paid to the latter, as the current world scenario is a pandemic caused by the SARS-CoV-2 virus, with a high transmission rate and a worrying lethality rate and several sequelae.

Both bibliographic surveys and results of simple tests on bacteria and protozoa were used. The synthesis of a methodology was proposed for the viral quantification of SARS-CoV-2 in culture media, before and after the experimental treatment with electric current.

II. THEORETICAL AND PRACTICAL REFERENCES

1.1Action of electricity on tumor cells

Felippe Júnior (2004) states that generally the membrane fluidity is much higher in tumor cells than in normal cells, this causes cancer cells to become more susceptible to oxidants, dying with a slight increase in cell oxidation,

The continuous electric current can cause necrosis and apoptosis in the cells nearby and those that come in contact with the electrodes. In addition, free radicals are formed, which, when bound to the enzyme ribonucleotide reductase - a participant in tumor cell replication - deactivate it.

A concentration of molecules and substances would be obtained at a specific point in the tumor with the application of electrical current. The following effects could be expected: the deactivation of the active sites of the enzyme ribonucleotide reductase, according to Kulshreshtha (1997, apud SOUZA, 2009) and the small concentration of compounds resulting from electrolysis responsible for necrosis, cell apoptosis and decreased mitotic proliferation of cancer cells, according to Furtado (2005, apud SOUZA, 2009).

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1.2Electricity's action on bacteria

A research at the Oswaldo Cruz Institute was carried out to verify the effects of electricity on water contaminated with microorganisms. In this, different protocols, electrodes and varied results were used for different types of species and groups (OLIVEIRA, 1962). In the work of OTENIO et al. (2008), the bactericidal effect promoted by electrolysis was verified with the use of direct current in5 to10 minutes in untreated water. The author, based on the results, concluded that the electrolytic treatment proved to be effective in eliminating heterotrophic bacteria and total and fecal coliforms from raw water, which may result, in practice, in an economy in terms of chemicalsubstances, like chlorine.

In a simple test, carried out by the author, The results showed a decrease in bacterial activity in the treated repetitions of sample 1, as demonstrated by the discoloration of milk mixed with methylene blue at a different intensity compared to the control group. In this, 12V input voltage was used, promoted by a source with an intensity of up to 1000 mA, and time of 10 minutes and 10 seconds. The samples treated for 5 minutes had no variation in the intensity of discoloration when compared to the control group, thus showing that there was no reduction in bacterial activity. In addition, the modality of electric current can also play a relevant role, and the association of continuous electric current - pulsatile and alternating current, both of high voltage, determines the decrease in theloadofbacteria.

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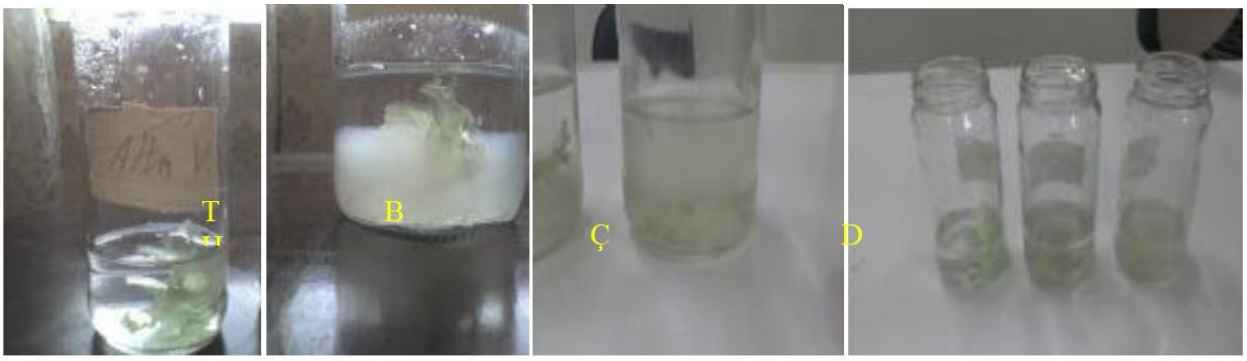
1.3Electricity's action on protozoa

1.3.1 Cultureofprotozoa

In experimental treatments carried out by the author, the following results were obtained:

The control group showed larvae and parameciums of small size with preserved motility. The other two samples, each from a representative of the experimental group, showed larvae and parameciums without motility. It is suggestive that the lack of motility of these organisms was due to the death caused by the low amperage electric current, both applied at high voltage once a day, and at low voltage continuously. Regarding the aspects of the cultures (FIGURE D), transparency of the water of the culture that received high voltage treatment was observed (FIGURE 1 A). Two phases were formed in which it received low voltage (FIGURE 1B). The water of the culture of the control group became cloudy (FIGURE 1 C).

The analysis with AgNO2 showed the formation of salts, which did not have a detailed chemical composition due to the formation in small quantities of the substances.



Figures 1A - Aspect of the culture submitted to high voltage; there was no formation of precipitates and the water remained transparent. B: aspect of the crop subjected to low voltage direct current, uninterrupted; note the formation of two phases, the superficial one being transparent and the lower one having an opaque and crystalline aspect. D: culture that has not received electrical treatment; the aspect was of turbidityofthewater.

1.4Electricity action on viruses

There is a possibility that the experimental treatment reported in the present research inactivates some types of viruses. There are reports of research involving electric current, electromagnetic waves in the microwave range and ions for virus inactivation. Certain combinations of electrolytes and a low pH can exert a more effective inactivation of the virus than other combinations and that their effects are specific to the virus (Nishide, 2011). According to Roohandeh (2011), two viruses were completely inactivated by 200 microA DC in 10 minutes (current density = 20 microA / mm2), while this amount of DC did not show significant changes in the viability of Vero cells. The degree of inactivation of HSV -1 and AdV-5 was 5 and 4 log per mL, respectively. Further studies are needed to investigate the mechanism of inactivation by this method.

With the results obtained, it is suggested that the medium-high voltage equipment, in this continuous form, be used in viruses, especially the one that causes Covid-19. If there is a decrease in viral load, the treatment with controlled electric current could be used as an adjunct to treatments until an effective mediation or vaccine can be commercialized and / or distributed. It would be possible for the mortality rate to decline. It is emphasized that this treatment must be carried out when others are used and do not have the expected effect, or else, cause serious side effects. It is suggestive that first tests were performed in vitro andonanimals.

The 9 Volt battery, with low amperage, can supply voltage to the interior of biological tissues. The same happens when medium voltage pulsed current is applied - 50 to 200 Volts. In theory, the higher the voltage, the greater the possibility of electric current penetrating into the body.

In a test with chicken farm fabrics, the tension between the inner face of a piece of thigh and the surrounding skin was some microV, both in the treatment with the 9 V battery and in the one provided by the media equipment - high voltage.

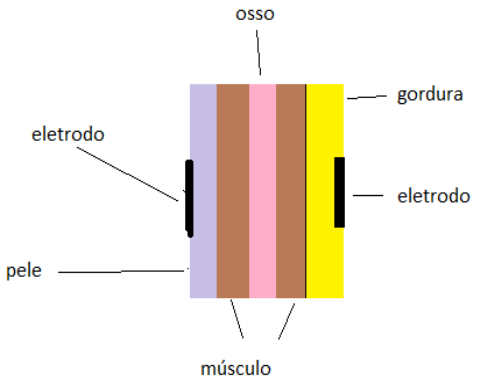


Figure 2. Representation of biological tissues that received controlled electric current
Source: own authorship

However, effects of apoptosis and muscle necrosis were observed with the use of this form of current, with low voltage - which can, on the other hand, be considered beneficial for the treatment of tumors.

III. ELECTRICAL CIRCUITS USED AND SUGGESTED

3. 1 direct current circuit:

It must be supplied by batteries with a voltage of up to 9 volts and electrical current, in amperes, not exceeding 1000 mA (milliamps). This type of current tends to form free radicals, electrons and ions, which can be highly reactive on single-cell pathogens and viruses. In order to avoid apotheosis and necrosis in the tissue area close to the electrodes, it is recommended to invert the polarity every 2min30secs.

3.2 Medium to high voltage alternating current circuit - 50 to 200 volts:

Theoretically, it tends to penetrate the organism more deeply, acting, albeit in a minimal way, on pathogens present in organs. The advantage is that, by producing alternating current, few ions, electrons and free radicals are formed, which would decrease the possibility or intensity of the resulting inflammatory process. In contrast, there would be less viruses involved and perhaps inactivated by these electrons, ions and free radicals. The intensity of the electric current must beadjustable.

3.3 Rectified electric current circuit: medium to high voltage - 50 to 200 volts:

It should be rectified so that more ions, electrons and free radicals are formed. In order to avoid apotheosis and necrosis in the tissue area close to the electrodes, it is recommended to invert the polarity every 2min30secs. As it has a higher tension than the treatment directly promoted by batteries, the tendency is to act on deeper layers of the body, even if in a tenuous way. The intensity of the electric current must beadjustable.

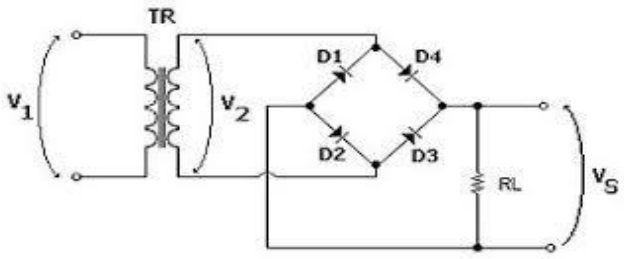


Figure 3. Full wave rectifier, represented by the diodes.
Source: Wikipedia

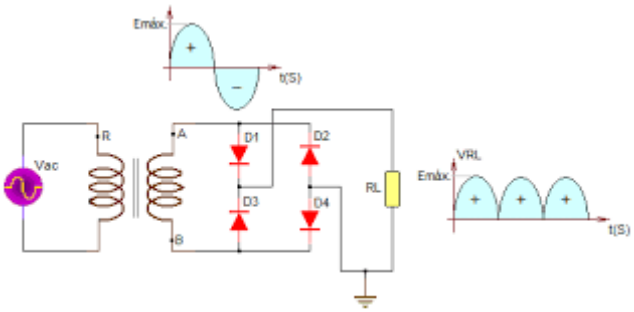


Figure 4. Full wave rectifier with center tape
Source: Teixeira, 2020

IV. ELECTRICAL PARAMETERS FOR EXPERIMENTAL TREATMENTS

4.1 Potentiometer for intensity control

In medium - high voltage circuits, a linear potentiometer can be coupled to the output (s).

4.2 Example of calculating the current that can be used in cultures with viruses

Output voltage of medium voltage equipment: 50 to 200 V
Tissue strength: 10,000 ohms
Ideal voltage for experimental treatment: 5 to 20 microV

Optimal tension = output tension / tissue resistance

In this example, it can be seen that the calculation performed provides the parameters for establishing the ideal tension to be applied directly to the cultures - as they do not have the tissue resistance of a vertebrate organism.

V. IN VITRO TREATMENT OF VIRUSES

The low intensity electric current can be used in culture media. Titration should be carried out to quantify cultures on plates before and after receiving electrical treatment.

VI. IN VIVO TREATMENT OF VIRUSES

In vivo treatment after confirming the decrease in viral load in tests performed in vitro is suggestive. An improvement in symptoms faster than usual would suggest the effectiveness of the treatment. Antibody screening could also be performed; however, it is not considered totally effective in predicting the decrease in viral load, as the tendency is the same to vary with time according to each person affected by the virus.

VII. METHODOLOGY (SUGGESTED FOR TREATMENT ON VIRUSES)

7.1 Electrical Treatment

The electrical treatment should be carried out in three parts, in order to verify which is the most effective and also which has the least side effects.

Low intensity electric current provided by batteries and the medium to high intensity rectified current can be used for 20 min. Every 5 minutes the polarity must be reversed - in order to reduce the possibility of adverse effects such as an increase in the inflammatory process.

7.2 Viral quantification

According to CANDEIAS (1996), viral quantification can occur through viral assays or quantitative assays:

- In cell culture, the titer is expressed in 50% of the infectious dose of the tissue culture (TDCID50); when the embryonated egg is used the titer is expressed in 50% of the infectious dose for the egg (EID50).
- The identification of a viral isolate is based on the cytopathic effect (ECP), changes that occur in the level of the embryonic egg or the signs of infection in inoculated laboratory animals, such as mice.
- In quantitative tests, the number of viral particles in the inoculum is determined, whether they are infectious or non-infectious. There are several types of quantitative testing, in both cases; however, the plaque test, which only quantifies infectious particles, and electromicroscopy, which quantifies both non - infectious and infectious particles, are used more frequently.
- The infectivity titer is expressed by the number of plaque-forming units per milliliter (pfu / ml) and is calculated by multiplying the average number of plaques counted by the reciprocal of the dilution and the reciprocal of the inoculated volume, in milliliters.
- For the titration of viruses in cell culture, the cell culture content that demonstrated viral multiplication is removed and centrifuged at 2000 RPM for ten minutes, after which the supernatant is distributed in aliquots that are placed at -70 degrees, one of these plots is diluted from 10 ^ -1 to 10 ^ 7 in MEM with 2% of fetal bovine serum, inoculating, in duplicate, 0.1 ml of each dilution, per cell culture tube. Inoculated cultures are examined daily for two weeks, recording the ECP. The calculation of the title is done using the Reed-Muench method, accordingtotheexample:

The 50% point, between the 10 ^ -4 and 10 ^ -5 dilutions, is calculated as follows:

$$\frac{\text{Infectivityabove 50\% = 83-50 = 0.7}}{\text{= proportionaldistance}}$$

(infectivity above 50%) - (infectivity below 50%) = 50-40

VIII. HYPOTHESIS

In theory, the effects would be the death of bacteria and protozoa and the inactivation of viruses. According to the literature and also with the result of practical experiments, tumor cells, bacteria, protozoa and viruses can be "destructive alterations" through the use of low intensity electric current.

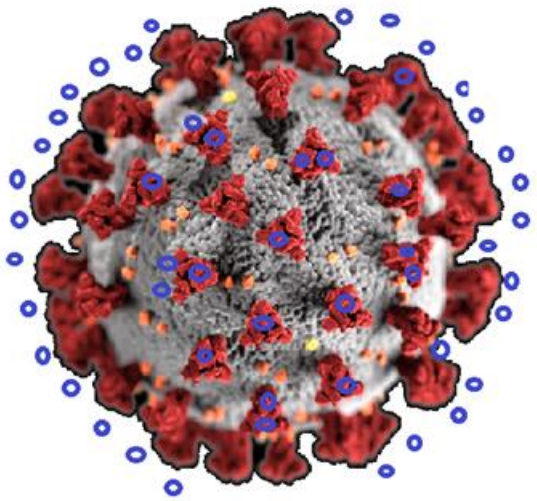


Figure 5. Possible SARS-CoV-2 virus surrounded by ions and electrons from low intensity electric current
Source: adapted from public domain illustration

IX. DISCUSSION

In view of the current scenario of the pandemic caused by SARS-Cov-2, any research that aims to reduce viral load, decrease the harmful effects caused by the virus and establish immunity through vaccines could be considered relevant. Until all individuals are immunized by these, it is essential to establish protocols that alleviate human injury, even if in a palliative andnotdefinitiveway.

It is suggested to carry out treatment with low intensity electric current instead of radiofrequency because, for the action on ions and electrons inside the body, the latter would demand great power and possible harmful effects on DNA. In the first method, electric current would be delivered through aluminum foil, which should cover as much of the patient 's body area as unresponsive to drug treatment as possible - in the acute phase of the disease.

Culture tests are very useful for verifying the occurrence of viral load variation.

X. CONCLUSION

Low-intensity electrical currents have deleterious effects on some types of bacteria, protozoa, viruses and tumor cells.

Further research can be carried out in vitro and in vitro to verify the therapeutic reach of these currents on different species and cell and viral types.

At the present time, the possible effect of decreasing viral load in patients affected by COVID - 19 could bring immeasurable beneficial effects to critically ill patients who are not responsive to drug treatments and intensive hospital care.

However, in order to verify if such effects would really occur, specialized virus research centers would have to carry out specific tests with one or more protocols of electric current - with financial support from people, entities, institutions or governments.

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