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Detection of Bioelectromagnetic Signals Transmitted Through the Exoskeleton of Living Land Snails

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Abstract

Background: Our previous reports have used a novel method for imaging bioelectromagnetic energy as electromagnetic fields (EMFs) emanating from plant and animal tissue The purpose of this study is to demonstrate that living land snails exhibit EMFs that can be transmitted through their exoskeleton and can be detected utilizing a mixture of fine iron particles and Prussian Blue Stain (PBS Fe2). Methods: Living intact land snails, 15 to 20 mm in length, were placed on glass slides, two drops of a PBS Fe2 solution were delivered under the snail's shell. After total evaporation the snails were removed and micro-photographs of areas under the snails were viewed via a video microscope. Results: EMFs were imaged as specific patterns of iron aggregates directly under the contact area of the shell and evaporated solution; whereas such iron aggregate patterns were not observed in the presence of empty shells. Conclusions: Living gastropods, such as small snails, emit bioelectromagnetic energy in the form of EMFs transmitted through their exoskeletons to be imaged as specific patterns of iron aggregation subsequent to evaporation. No similar patterns were seen when empty shells were substituted for the live snails.

Keywords

Biomagnetism, Electromagnetic Fields, Gastropods, Exoskeleton

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1. Introduction

A recent novel and simplified method for imaging the electromagnetic energy in living plants and animal tissues was developed in our laboratory [1]. It allows for detection and imaging of inherent bioelectromagnetic energy and electromagnetic fields (EMFs) from living tissues. The EMFs are visually imaged with the use of a nano-sized iron particle solution in conjunction with a specific Prussian Blue Stain (PBS Fe2) and recorded by microscopy. The aforementioned technique had been previously used to detect and image inherent EMFs from human hair follicles [2], rat whiskers [3] and plant tissue [4]. Living tissue metabolism through cell respiration involves the electron transport chain, which accounts for electrical current flow within cells and tissues thereby inducing EMF emissions. We propose that Gastropods such as land tree snails exhibit inherent EMFs that can be transmitted through their exoskeleton allowing for the detection of those EMFs by our imaging techniques [1].

2. Materials and Methods

During mid November in western Dade County, Florida USA, living land tree snails with a length ranging from15 to 20 mm and an average width of 7 mm were collected in a shaded area under an orange tree. The snails (n= 8) were placed on a clean glass slide 25 x 75 x 1mm, two drops of the PBS Fe2 solution were placed under the shell [see Figure 1].

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2.1. Preparation of the PBS Fe2 Solution [1]

A fine iron particle solution was prepared by mixing several grams of powdered iron filings (Edmond Scientific, Co., Tonawanda, NY) in 200 cc of deionized water (resistivity, 18.2 MΩ.cm). After standing for several hours the supernatant was carefully decanted for sizing of the iron nano-sized iron particles. The particle size and distribution of the nanoparticles from the supernatant was determined using dynamic light scattering (DLS) and the zeta potential using phase analysis light scattering by a Zeta potential analyzer (ZetaPALS, Brookhaven Instruments Corp, Holtsville, NY). For sizing, 1.5 ml of the solution in de-ionized water was scanned at 25°C and the values obtained in nanometers (nm). A similar aliquot of the fine iron particle solution was scanned for 25 runs at 25°C. for determining zeta potentials. Zeta potential values were displayed as millivolts (mV). A solution having diamagnetic properties was prepared by mixing aliquots as shown below:

One part of 2.5% Potassium Ferroyanide solution ($K_4Fe_2CN_6$) and one part of 2.5% HCl. Also added were two parts of the Fe 2000 solution. The composite solution is abbreviated throughout the manuscript as "PBS Fe2".

2.2. The Single Slide Preparation

To display the horizontal electromagnetic forces, two drops of the PBS Fe2 solution were placed on a clean glass slide (size 25 x 75 x 1mm).

Living small tree snails were centered on the slide. During the evaporation process the snails were observed slowly emerging from their shell. As soon as the tissue contacted the PBS Fe2 on the slide, the snails quickly retracted into their shell. No motion of the exoskeleton was observed. After total evaporation was achieved at room temperature (average time 6 hours) the snails were then carefully removed by tilting and lightly tapping the glass slide. The same procedure was repeated with empty exoskeletons of the same species collected from the site n= 8. The empty shells were rinsed inside and outside with squirts of distilled water, drained and then subjected to the same PBS Fe2 procedure. Microphotographs of both living and empty shells of the electromagnetic fields emissions were obtained at X4 and x10 magnification utilizing a video microscope (Celestron, LCD Digital Microscope II model # 44341 Torrance California, USA).

3. Results

After evaporation of the PBS Fe2 solution, Figure 2 shows the aggregated iron particles, which formed a branching pattern (arrows) that was recorded directing underneath the contact area of the snail shell (see, Figure 1).

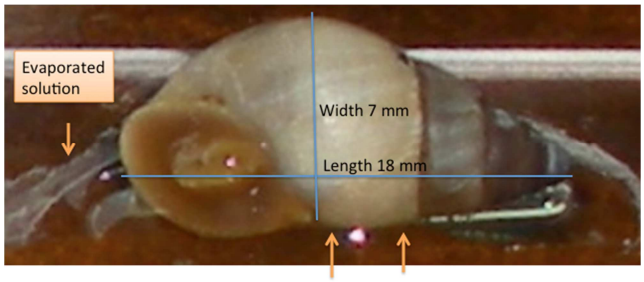

Figure 1. Demonstration of land snail mounted on slide. The Prussian Blue Stain solution is in the process of drying. Arrows indicate the area of maximum contact with the slide.

A similar example is shown in Figure 3. Note that the branching iron aggregates are somewhat obscured by the heavy aggregation of iron particles dispersed in the background.

In the control setting with no presence of the snail but only the empty shell, there were no recorded patterns of iron aggregates at the contact area but rather a uniformly dispersed field of fine iron particles (Figure 4).

4. Discussion

The Gastropod's exoskeleton consists of a combination of chitin and calcium carbonate (CaCO3) for hardness. Chitin is the major structural component in the exoskeleton of gastropods such as snails. Chitin and CaCO3 have been found to be polymers with conductive characteristics and as such to "contain a π-electron backbone responsible for their unusual electronic properties such as electrical conductivity, low energy optical transitions, low ionization potential and high electron affinity." [6, 7, 8]. Our findings suggest that the land snail within its shell emits EMFs which are transmitted through the shell and result in the pattern of branching iron particles in the PBS Fe2 solution upon evaporation (Figures 2, 3).

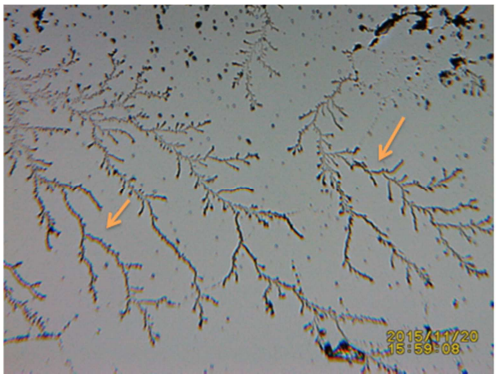

Figure 2. Microphotograph of EMF emissions which took the form of branching patterns of aggregated iron particles (arrows) recorded from underneath the area of maximum contact of the shell of a living snail after evaporation of the PBS Fe2 solution.

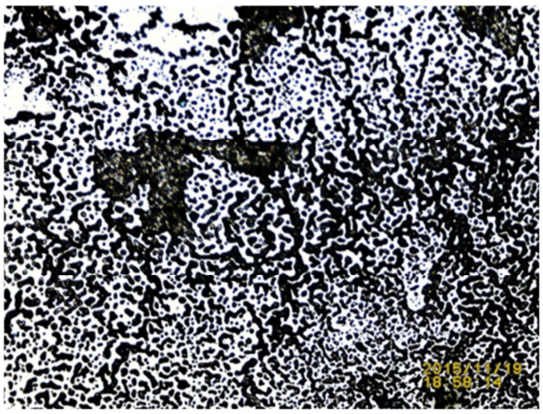

Figure 3. This microphotograph is also from the area underneath the mounted snail after evaporation of the PBS Fe2 solution. In this example the heavily aggregated iron particle in the branching pattern is somewhat obscured by the iron particles aggregates of the background.

These findings correspond with our recent studies showing that evaporation of crystalline solutions, e.g. potassium ferrocyanide in the PBS solution, can be affected by extraneous EMFs. Specifically, we showed that the EMF emitted by an ex-vivo human hair follicle or a small magnet fragment could induce iron aggregation incorporated into the crystals that formed with evaporation of the same PBS Fe2 solution used in the present study. When an inanimate, non magnetic wooden splinter was placed in the same solution, as a control, we observed finely dispersed iron aggregation similar to that shown in Figure 4 [9].

Figure 4. Microphotograph of the non-descript pattern of uniformly dispersed iron particles that were observed in the evaporated PBS Fe2 solution underneath an empty shell contacting the glass slide. The absence of any organized iron aggregate branching is evident.

Recently, bioluminescence was detected in seawater small snails [10], indicating that some snails can emit EMFs in the visible range of the electromagnetic spectrum.

5. Additional Ancillary Testing

Using the same technique as described above, living small tree snails were studied n=3. In contrast with the previous cohort, these animals were allowed to crawl at will on the slide surface containing the PBS Fe2 solution. Invariably, after an average of 3 attempts of sensing and retracting, the cautious snails slowly crawled out of the shells and proceeded to exit the glass slides boundaries. Interestingly, after evaporation of the PBS Fe2, branching iron aggregates were recorded (Figure 5). These imprints were interpreted to be a direct consequence of the snail's soft tissue metabolism induced EMFs.

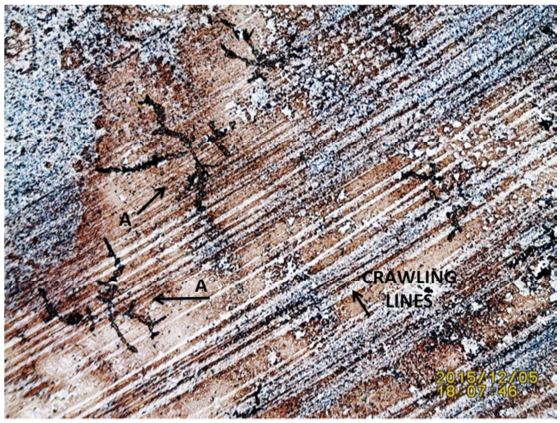

Figure 5. Microphotograph of EMFs emissions and crawling imprints of a small tree snail allowed crawling on a glass slide with drops of PBS Fe2.

A= Branching iron aggregates from Biomagnetism. Notice the trail lines recorded as a consequence of the snail's slow and continuous crawling.

6. Limitations

We have not tested other shelled animals to determine if they also emit EMFs and whether the iron aggregated pattern seen in the land snail is specific for this gastropod.

7. Conclusions

In the present study, living gastropods, such as small land snails, emit bioelectromagnetic energy in the form of EMFs transmitted through their exoskeletons to be imaged by their effect on crystallization subsequent to evaporation of fine iron particles in an iron staining solution. Ancillary testing showed that Bioelectromagnetic imprints of the metabolic process in the form of branching iron aggregates were also recorded as emitted by the snail's soft tissue directly on the glass slide. We conclude that the EMFs detected through the shell, as well as directly on the slides are being emitted by the snail's living tissue metabolism.

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