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A Novel and Simplified Method for Imaging the Electromagnetic Energy in Plant and Animal Tissues

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Abstract

Background: Previous studies have used highly sophisticated devices for measuring the electromagnetic fields (EMFs) of plants and from the heart and brain of man. The purpose of this communication is to introduce a simplified method whereby EMFs generated by plant and animal tissues could be visualized with optical and video microscopy. *Methods:* A solution containing aliquots of fine iron particles (average diameter, 2 microns) and a specific Prussian Blue stain for iron was applied between two glass slides to hold green leaves of the Mung bean plant. Freshly plucked human hairs were placed on a single slide. The follicle and shaft were covered with the same solution. *Results:* As a result of their intrinsic electron transport based metabolism these biologic entities emitted electromagnetic fields that were imaged by aggregated iron particles outlining the leaves or visualized as circulating aggregated iron particles around the hair follicles. *Conclusions:* This technique can provide a simplified imaging method to provide electromagnetic profiles for living systems in general.

Keywords

Iron Particles, Electromagnetic Energy, Photoelectrons, Human Hair, Plant Leaves, Optical Microscopy, Video Microscopy

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1. Introduction

In the first report of electromagnetic field (EMF) measurements made from the human heart, Baule and McFee [1] used two large coils placed over the chest, to cancel ambient magnetic interference. Better resolution and less noise was achieved by Cohen and his associates who recorded EMFs from the brain [2] and the heart [3, 4] using a superconducting quantum interference device (SQUID). A recent report from Corsini et al. [5] stated, "To our knowledge, no one has yet detected the electromagnetic field from a plant." These investigators made measurements with a sensitive atomic magnetometer on the flowering plant, Titan arum (Amorphophallus titanium). We hypothesize that all living matter maintains an intrinsic, electromagnetic homeostatic mechanism at quantum levels based on biochemical and biophysical processes. From sub-atomic and atomic interactions, there are ordered amplifications manifesting as metabolic activity to maintain homeostasis. Photon-phonon and photon-photon transductions, i.e., piezo-electricity and photoelectricty may be underlying mechanisms to explain bio-electromagnetic order and balanced function in living things. Utilizing the intrinsic paramagnetic properties of fine iron particles, and the imaging characteristics for iron by Prussian Blue stain, a solution was developed which could be applied to plant and animal tissues. Magnetic energy was detected and visualized by the stained, aggregated iron particles applied to the leaf of the Mung bean plant and the follicle and shaft of human hairs.

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2. Materials and Methods

2.1. Preparation of the Iron Containing Solution

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. After standing for several hours the supernatant was carefully decanted for sizing of the iron particles. The particle size and distribution of the particles 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). Using a transfer pipette, aliquots of the solution containing the iron particles (mean particle size, 2 microns) were combined with Prussian Blue Stain (PBS Fe 2, 2.5% potassium ferrocyanide and 2.5% hydrochloric acid).

2.2. The Glass Slide 'Sandwich' (SDW)

Seeds of the Genus and species, Vigna radiata were germinated in tap water for 2 weeks. Oklahoma City treated water contains 0.3 ppm, iron [6]. Mature green leaves were carefully cut from the plants. To avoid any metal contact with the leaves wooden applicator sticks were used to transfer the leaves to clean glass slides. Using a transfer pipette, several drops of a solution containing aliquots of the iron (mean particle size, 2 microns) and a solution of PBS Fe 2 was added to the leaves on the slide (n=6). A second slide was carefully placed covering the first to hold the leaves in place. This preparation will be referred to as the "sandwich" (SDW).

Similarly, leaves were prepared with deionized water as the applied solution (no iron or PBS Fe 2 solution) between slides which served as one control set (n=6). Another control set consisted of leaves immersed in formaldehyde for at least 48 hour, then prepared in a SDW containing the PBS Fe 2 solution (n=6).

These slides were allowed to stand until the liquid between the slides had essentially dried (at least 48 hours). The specimens were then examined under an optical microscope at 10X or 20X magnification. Microphotographs were made of examples from the experimental and each control group.

2.3. The Single Slide Preparation (SSP)

Human forearm hairs were plucked by forceps. Each hair was placed in the center of a standard glass slide. One or two drops of the PBS Fe 2 solution were placed to cover the follicle and adjacent shaft area with the liquid (n=6).

For controls, we immersed hairs in formaldehyde for 48 hours (n=5) and then proceeded to treat them as described above with the application of one or two drops of the PBS Fe 2 solution placed to cover the follicle and adjacent shaft area. The SSP was then viewed in the normal mode at X10 and/or 20X magnification with a video microscope (Celestron. LCD Digital Microscope II model #44341 Torrance California USA).

3. Results

1. Mung bean leaves.

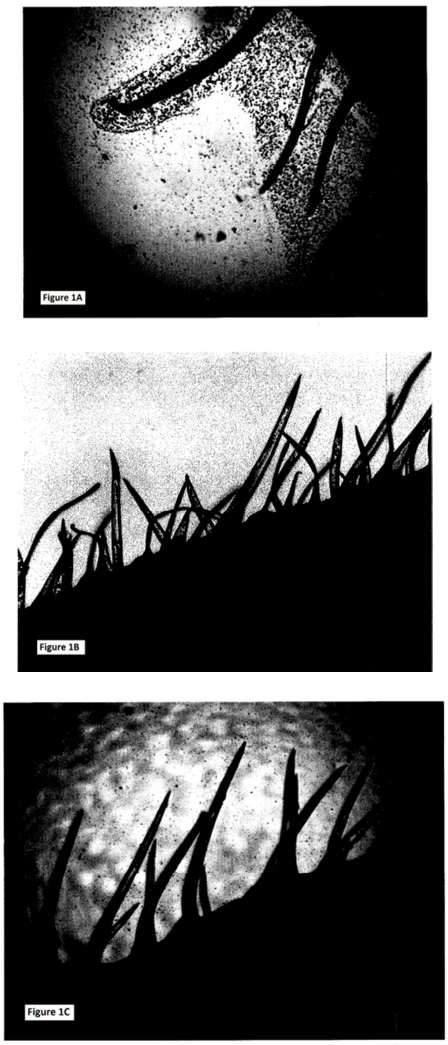

Figure 1. Panel A. Microphotograph of the leaf from a Mung bean plant (Vigna radiata). The leaf was placed between 2 glass slides containing a solution of Prussian Blue stain and fine iron particle. The leaf edge and hair cells known as trichomes are outlined by the aggregated iron particles. Panel B. Mung bean leaf edge and trichomes in a slide "sandwich" (SDW) containing deionized water. Panel C. Mung bean leaf after a 2 day immersion in formaldehyde. A small number of iron particle aggregates were scattered throughout the area. In contrast to panel A, no outlines of the leaf edge and trichomes were observed.

2. Human hairs. (see footnote[1], below)*

4. Discussion

4.1. Major Findings

Using fine iron particles (average diameter 2 microns) in a solution with a Prussian blue stain for iron applied to leaves of the Mung bean plant (Vigna radiata) and isolated human forearm hairs, we demonstrated putative images of the EMFs emanating from these plant and animal tissues. Specifically, iron particle aggregates outlined the leaf edges and trichomes in the leaves taken from the plants and treated with the PBS Fe 2 solution for 24-48 hours until the solution dried. In contrast, no similar images were obtained when leaves were studied after treatment with deionized water or when the same solution was applied to leaves immersed in formaldehyde for 24 hours (Figures 1A-C).

In regard to the human hairs, the characteristic movement of aggregated iron particles moving around the follicle (*see footnote, video 1) was not observed after prolonged immersion of the hairs in formaldehyde (*see footnote, video 2).

4.2. Background

A metabolic process common to plants (photosynthesis) and animals (cellular respiration) involves the electron transport chain. This process consists of electrons transferred along a series of electron donor and receptor compounds coupled to a proton, H+, gradient across cell membranes. The ensuing charge differential or voltage is used to drive energy production in the form of adenosine triphosphate (ATP). As inferred by Faraday's law, electron movement within cells will induce an electromagnetic field (EMF) emanating from both plant and animal cells acting as electrical conductors.

The findings of the present study confirms and extends our previous studies [6-8] and provides additional evidence for the use of fine iron particles in an iron staining solution as a simple method for imaging EMFs associated with plant and animal tissues. In particular we previously showed that these iron particles could be observed to stream around follicles of rat whiskers [8] as well as human hairs [7]. It should be noted that the limits of optical microscopy are well known to be on the order of $2X10^{-3}$ whereas, the particles we used were on the order of $2X10^{-6}$. We hypothesize that there are two factors that could account for the highly visible particles seen in our studies. The zeta potential is directly related to particle stability [9]. Zeta potential in the range of -100 to -60 mv indicate extreme to very good particle stability; whereas, zeta potential between -5 and +5 show strong agglomeration. Our fine iron particles measured -7mv indicating a strong aggregation tendency. Taken in combination with the effect of intrinsic electromagnetic fields generated by the metabolizing leaves and hair follicle, the iron particle aggregation would be further intensification. Both of these factors would allow particles sizes within the visual range of the optical microscopes we employed.

Other observations that require comment are: 1. The effect of heat which caused acceleration of the circulating iron aggregates around the hair follicle. We propose that this response was due to the acutely enhanced metabolic activity of the hair follicle under the influence of the applied heat. Our suggestion is supported by the finding that the same procedure carried out in the formaldehyde treated (supposedly dead hair) showed no such response to the same application of PBS Fe 2; 2. It was noted that in Figure 1C, iron particle aggregates were scattered throughout the field of view, albeit not heavily outlining the leaf edges as seen in figure 1A. We suggest that there may be some residual EMF activity within the leaves despite the formaldehyde treatment. Of interest this was not observed in the formaldehyde treatment of the hair follicle. Note that in the second video (*see footnote) not only was there no streaming of particles around the follicle, the rest of the field was devoid of iron particle aggregates. These findings may indicate that plant tissues are less susceptible to the toxic effects of formaldehyde than animal tissues. Our ongoing studies support this hypothesis.

4.3. Implications

A recent study used PBS to highlight the inclusions of iron in tissues after perfusion of neural structures in the heart with nanoparticles having an iron core [10]. Using fine iron particles, imaging of tissues, various organs ex vivo or organisms in 2 or 3 dimensions may be feasible based on the simple techniques described in the present study.

4.4. Limitations

It could be argued that the movement of particles as seen in our Mung bean leaf experiments could be due to surface tension induced by the leaf and not the response to any inherent electromagnetic properties of the leaves. However, there were no outlines of aggregated iron particles around the leaf edges or trichomes when SDW preparations of PBS FE 2

*1. The human hair experiments are shown as 2 videos which are available on request at: benjamin-scherlag@ouhsc.edu. In the early section of video 1 we show, in an SSP, iron aggregate particles moving slowly around the human hair follicle after application of PBS Fe2. At the 30 second mark of the video, we applied heat using a heat gun under the slide for several seconds. There was an immediate acceleration of the particles around the hair follicle. Removal of the heat restored the slow pace of circulating particles around the follicle. See text below for further discussion.
In video 2, after immersion of the hairs in formaldehyde for at least 48 hours, the PBS Fe 2 solution was applied as described previously. No aggregated iron particles were noted around the follicle or within the surrounding solution nor was there any movement in response to heat applied at the same time interval

included dead leaves after immersion in formaldehyde preservative for 1-2 days. The same surface tension argument can be proposed to explain the movement of the aggregated iron particles circulating around the hair follicles (*see footnote 1, video 1). However, when the hairs were immersed in formaldehyde and then established as an SSP containing PBS Fe 2 no particle circulation around the follicle was noted (*see footnote 1, video 2).

5. Conclusions

The finding of the present study supports our hypothesis that the intrinsic metabolic activity of the living leaves and hair contribute an EMF which not only attracts the fine, paramagnetic iron particles allowing static as well as streaming images reflecting the electromagnetic fields emanating from plant and animal tissues, respectively.

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