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MAGNETIC LIQUID EFFECT ON PIGMENTS AND NUCLEIC ACIDS IN SUNFLOWER SEEDLINGS

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Abstract
The biological effects of low concentrations of magnetic fluid were studied on sunflower seedlings germinated in controlled laboratory conditions. Biocompatible magnetic fluid, based on magnetite stabilized with tetramethyl ammonium hydroxide, was supplied daily for five days to freshly germinated plantlets in aqueous solution (dilutions: 20-40-60-80-100 microl/l). Green tissue was used to extract chlorophylls, carotenes and nucleic acids in specific selective solvents. Shimadzu UV-VIS spectrophotometer was utilized to measure light extinction to the wavelengths required in the frame of Meyer-Berthenrath's and Spirin's methods. Possible biotechnological tool in plant growth conducting was presumed on the basis of biocompatible magnetic fluid.
Keywords: magnetic fluid, sunflower seedlings, pigments, nucleic acids

1. Introduction

The study was focused on the biochemical changes induced at the level of DNA and RNA acids by various concentrations of magnetic fluid in sunflower plantlets. Previous reports revealed plant and micoorganism sensitivity to magnetic fluid addition in the culture medium [1-4]. The possible application is related to plant growh in controleld laborator conditions in order to use magnetic fluids as biotechnological tool.

2. Method and samples

The magnetic fluid: The ferrophase was obtained by iron oxides precipitation from auto-catalytic reaction of ferrous ($FeSO_4$) and ferric salts ($FeCl_3$), in excess ammonia. Ferrophase stabilization was conducted by means of tetramethylammoniumhydroxide. Ferrofluid nanoparticles average diameter was of 9.27nm, the saturation magnetization of 2.4 kA/m and the ferrophase volume fraction in ferrofluid volume was of 1.5%. Seedlings of sunflower (with uniform genophond), freshly germinated in Petri dishes, were supplied daily with 1ml solution of magnetic fluid (20 microl/l to 100 microl/l).

Biological material: Plant growth was conducted in controlled conditions of temperature (24^0C), humidity (90%) and illumination (dark/light cycle 14h:10h), into a Angelantoni Scientifica climate room. After 12 days, the biochemical investigation was carried out.

Spectrophotometric assay: UV-VIS Shimadzu spectrophotometer, provided with quartz cells, was used to read the values of light extinction as required by standard methods. The contents of chlorophyll a, chlorophyll b and carotene pigments (Meyer-Berthenrath's method):

$$chla = \frac{12.3 \cdot E_{663} - 0.86 \cdot E_{645}}{1000 \cdot d \cdot w} \cdot V \text{ , } chlb = \frac{19.3 \cdot E_{645} - 3.6 \cdot E_{663}}{1000 \cdot d \cdot w} \cdot V \text{ , (1)}$$

$$t.c. = \frac{10 \cdot E_{472}}{2485 \cdot d \cdot w} \cdot V \text{ , (2)}$$

where: w - the fresh vegetal sample mass, V - the extract volume (in acetone 85%), E_λ - the light extinction to the wavelength λ, d - the quartz cell width.

DNA and RNA content were assessed accordingly to Spirin's method, based on the light extinction in the ultraviolet range, at 260 nm and 280 nm.

Statistical analysis Statistic significance was ensured by repeating three times the spectrophotometric investigation. Discussion was carried out considering the possible influences on the biosynthesis of chlorophyll a, chlorophyll b and carotenes.

3. Results and discussions

The magnetic liquid inhibited the biosynthesis of photosynthetic pigments for 40 and 60 microl/l, while for 80 and 100 microl/l a stimulatory effect was noticed.

Ferrofluid addition in the culture medium of the sunflower seedlings resulted in slight stimulation of photosynthesis efficiency for 40 microl/l as can be seen from the chlorophyll ratio. The total concentration of photosynthetic pigments was significantly diminished for 40 and 60 microl/l while for 80 microl/l an increase of this biochemical parameter was observed. Magnetic liquid effect on the biosynthesis of nucleic acids was an inhibitory one (up to 70% diminution), for all concentrations tested in the frame of this experiment. It seems that the most sensitive cellular structure is the cell nucleus where the genetic information is stored mainly at the level of the nucleic acids.

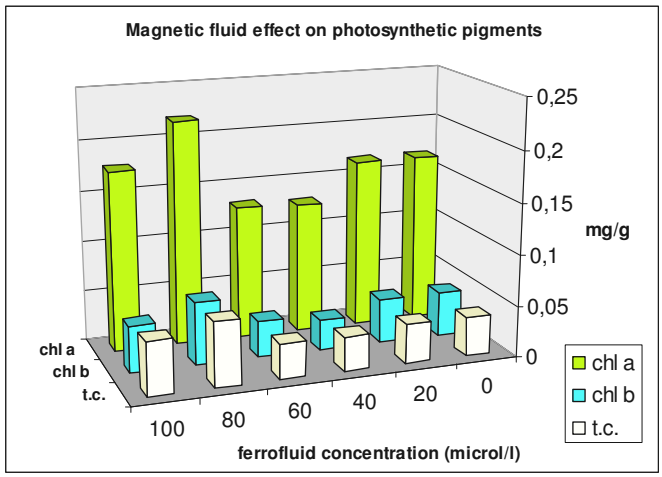

Fig. 1. The effect of magnetic fluid upon the photosynthetic pigments: chla, chlb, t.c.

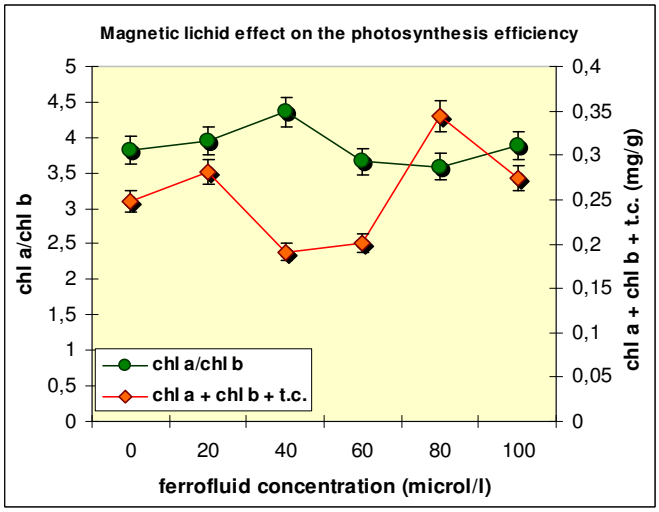

Fig. 2. The effect of magnetic fluid on the photosynthesis efficiency

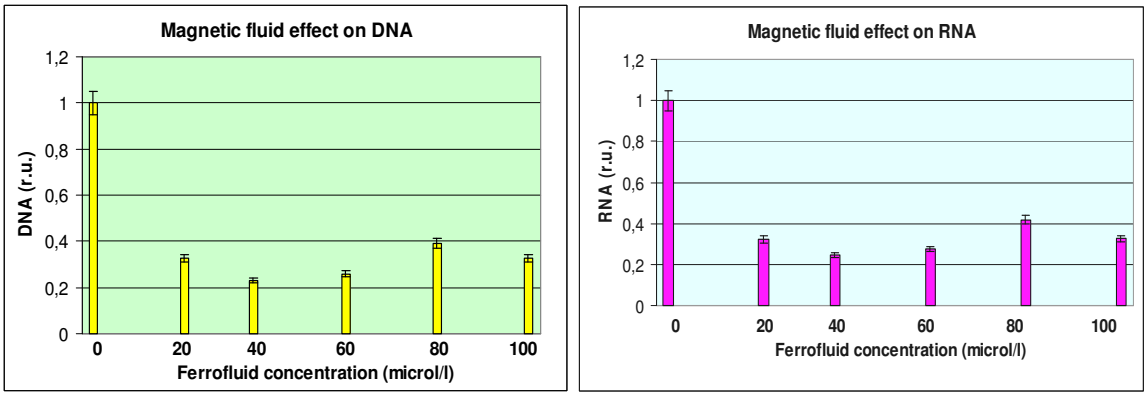

Fig. 3. The effect of magnetic fluid in various concentrations on DNA and RNA

Some molecular and cellular phenomena, that can be invoked for the interpretation of ferrofluid putative influence on the plant metabolism: the existance of an efficient mechanism of iron acquisition by graminaceous plants (resulting in the release of iron complex compounds called phyto-siderophores); we noticed that high concentrations can be toxic for the vegetal cell. The cooperation plants-microorganisms: plants may benefit from the presence of some growth stimulatory bacteria since, under iron-limited conditions, these microorganisms can produce bacterial-siderophores - that can be internalized by plant root cells. In other paper [4], we reported that relatively small ferrofluid concentrations may induce the increase of chlorophyll a level, the main photosynthesis pigment, as well that the nucleic acid level, but higher ferrofluid concentration may have severe disruptive effects such as the chlorophyll a level and the ratio chla/chlb. So, it seems that the various plant species exhibit various levels of sensitivity to magnetic fluid addition in their culture medium.

4. Conclusions

The magnetic fluid had mainly stimulatory effect on the chlorophyll a biosynthesis of sunflower seedlings, when relatively high concentration is used; slight stimulation of photosynthesis efficiency was also noticed for medium concentration of magnetic fluid. Inhibitory effect on the biosynthesis of nucleic acids was revealed for all concentrations of the magnetic fluid tested in this experimental study. So, the plant growth during their early ontogenetic stages, can be influenced by using magnetic fluid aliquots.

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