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Sub Magnetic Environmental Biology based on Data Mining Algorithm

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Abstract: With the development of manned space technology, the scope of human activities has expanded rapidly, and astronauts will stay in space longer and longer. Space is an extreme environment, including microgravity, cosmic radiation and sub magnetic field. There have been many reports on the effects of microgravity and cosmic rays on human body, but there are few studies on the effects of sub magnetic field on life. This paper will study and analyze the biological effect (BE) of sub magnetic environment based on data mining algorithm(DMA). Taking Chlorella as the research object, the sub magnetic field of algal cells is processed by using data mining technology, and the effects of sub magnetic field on the cell cycle and algal cell activity of Chlamydomonas reinhardtii(CR) mediated by blue light are explored. The results of the combined action of sub magnetic field and organism constitute the BE of magnetic field. Among them, the different sources of magnetic field, the size and direction of field strength, the action time, as well as the species and sensitivity of organism itself, the action position and other factors will affect the biological magnetic BE, which initially provides a reference basis for the possible BE of green algae in the process of sub magnetic field culture.

1. Introduction

The geomagnetic field plays an important role in human production and life as well as other life activities. Because of the existence of the geomagnetic field, the earth's surface is protected from the direct damage of cosmic radiation. At the same time, after nearly a century of research, human beings have a more accurate understanding of the impact of external magnetic fields, whether static or dynamic, on life on earth. The geomagnetic field itself belongs to a static weak magnetic field. How does the extremely weak magnetic field or even a completely zero magnetic space affect life? That is, if the geomagnetic field disappears, will life on the earth's surface be affected? This is also of great significance for the study of the BEs of the geomagnetic field itself.

Many scholars at home and abroad have studied and analyzed the BEs of sub magnetic

environment based on DMA. Maity s s et al. Studied the effect of three week sub magnetic field treatment on barley seedlings. They provided a 10NT environment with Helmholtz coil. After barley seedlings were treated in this environment for 3 weeks, the dry and wet weights of buds and roots were significantly smaller than those of geomagnetic control group, and the number of third leaves was significantly reduced. It shows that the sub magnetic field treatment delays the opening and growth of plant tissues and organs [1]. Inaniwa t et al. Observed the changes of meristem cell ultrastructure and Dian balance of pea root under extremely low magnetic field environment. The results showed that lipid accumulation was obvious in meristem, vacuoles appeared, ferritin decreased, mitochondrial volume increased, cristae area decreased, and intracellular calcium overload [2]. Barreto a confirmed in three plants: pea, flax and lentil that weak magnetic field will reduce plant growth and development, which is closely related to the effect of magnetic field on cell division [3].

Based on the DMA, this paper studies the BEs of the sub magnetic environment. Taking Chlorella as the research object, the biological magnetoBEs are introduced into the culture process of Chlorella, and the sub magnetic algae are used for treatment, which provides a way for the physical enhancement of bio oil accumulation. At the same time, in order to study whether cryptochrome under blue light acts as a magnetic sensor in green algae to respond to the magnetic field and then affect other life activities, CR, a model organism, is treated with a sub magnetic field mediated by blue light, and the changes of carbonic anhydrase and its gene expression in photosynthesis in the magnetic field are further studied, It preliminarily provides a reference basis for the possible BEs of green algae in the process of sub magnetic field culture [4-5].

2. Data Mining Technology and BEs of Sub Magnetic Environment

2.1 Data Mining Technology

For a practical application scenario of data mining technology, DMA is only one of the important links. In order to mine effective information in a data set, we need to follow a relatively standardized process, so as to mine useful information in limited time and limited data sources efficiently and quickly. The processing process of general data mining technology is shown in Figure 1 [6].

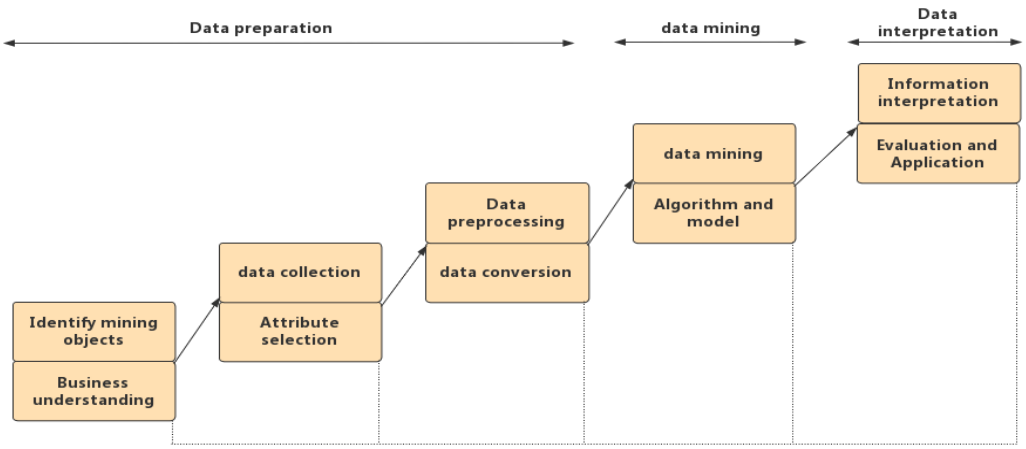

Figure 1.Data mining technology processing process

The general process of data mining includes determining the analysis object, collecting the original data, preprocessing, mining implementation and information interpretation. Determining the analysis object means to define a clear analysis object and purpose. Although the final effect of data mining is difficult to predict, the problems to be solved are indeed predictable and directional. Therefore, it is necessary to use a relatively thorough knowledge of relevant business fields as a priori information; The process of data collection is to provide the most original data for data mining. Selecting input data for a specific field requires the participation of scholars in that field; Preprocessing is mainly to remove erroneous data and transform. To find and remove outliers, we need to find more important features and reduce the burden of data mining steps. Sometimes, we need to realize the transformation between high-dimensional and low-dimensional [7-8].

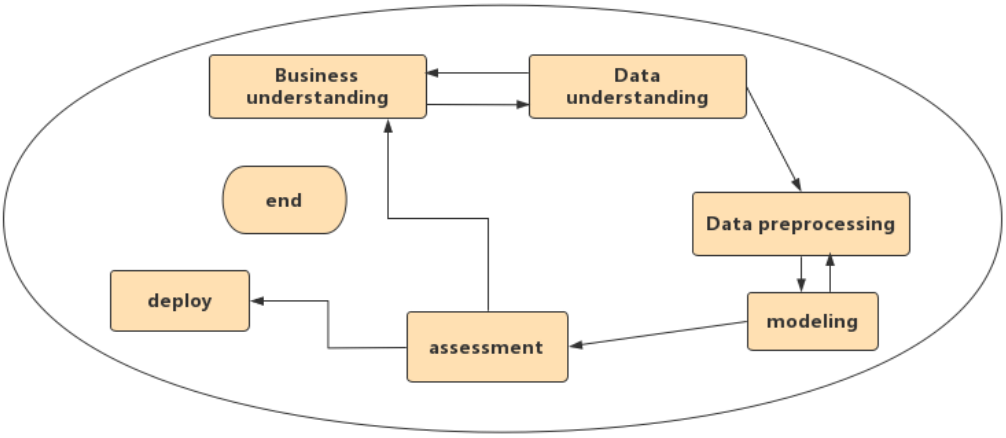

Figure 2.Data mining process

2.2 Analysis of BEs of Sub Magnetic Environment

2.2.1 Effect of sub magnetic field on microorganisms

The sub magnetic field is a magnetic field environment whose magnetic field intensity is far lower than the average intensity of the geomagnetic field. Different terms are used in different literatures to describe the sub magnetic field environment [9]. Reports on the effects of sub magnetic fields on microorganisms mainly focus on magnetotactic bacteria and drug resistance of common bacteria. After sub magnetic field treatment, the average size of magnetotactic bacteria AMB-1 magnetosomes increased, and the proportion of large magnetosomes increased, and the expression of magnetosome related proteins Mms6 and mmsl3 transcription levels changed [10-11]. In addition, the resting growth of the bacteria was inhibited in the sub magnetic field; The magnetic properties of cells in exponential growth period were significantly higher than those in geomagnetic control group]; Under short-term sub magnetic field treatment, the growth rate of E. coli in exponential growth period will slow down; Sub magnetic field treatment can enhance the resistance of Pseudomonas strains to ampicillin and tetracycline; And enhance the resistance of Enterobacteriaceae strains to ampicillin, kanamycin and pyridine carboxylase. The sub magnetic field not only affects bacteria, but also fungi; Two kinds of weak magnetic fields with different intensities can promote the production of red yeast invertase and ultimately increase the production of products [12-13].

2.2.2 Effect of sub magnetic field on animals

The impact of sub magnetic field on animals is the focus of this paper. The existing literature reports mainly focus on the impact on animal embryonic development, individual behavior, tissues, organs and cells.

In nature, there are many creatures that are very "sensitive" to the magnetic field. These creatures can more sensitively feel the magnetic field and use it. This is mainly because these organisms have a special substance, micro ferromagnetic particles, which should be one of the most important mechanisms of biomagnetic response [14]. In addition to micro ferromagnetic particles, metal ions are the most likely factors to directly respond to the magnetic field, especially the three magnetic metals, iron, manganese and chromium. When the magnetic field is shielded, metal ions may also have varying degrees of impact on the body due to metabolic disorders [15].

Sub magnetic field treatment can affect the activity of monoamine oxidase in visceral tissue and blood of guinea pigs. The sub magnetic field treatment will reduce the activities of aspartate aminotransferase and glycine aminotransferase in human serum. The sub magnetic field treatment can affect the activity of SOD enzyme. This result has been verified in both in vivo and in vitro experiments. It can be inferred that some proteases may also be important molecules of biological magnetic response, and the magnetic field may affect the activity of some proteases by affecting the conformation of proteins [16-17]. Hormone is an important regulatory factor in organism, and the disorder of hormone metabolism will have an important impact on life activities. After sub magnetic field treatment, the norepinephrine level in the brain stem of golden hamsters decreased significantly. Norepinephrine can recover the chicken long-term memory damage caused by sub magnetic field. Epinephrine and norepinephrine are secreted by chromaffin cells. Chromium salt oxidation combines with polymerized catecholamine to form a brown color, which exists in cells that will secrete norepinephrine. The magnetic field may directly affect chromate or grid protein, affect the function of grid cells, and then affect the secretion of norepinephrine. It is speculated that chromaffin cells may be an important magnetic response cell, and the magnetic field affects the basic metabolic level of organisms by interfering with the secretion of norepinephrine and epinephrine [18].

3. DMA

Suppose that the sample data set is expressed as G (x), where n is the number of samples, the input data xlhn is n-dimensional, and the output data flhn corresponds to the input data XL. Assume that the linear regression function is:

$$g(x) = w^K x + c \quad (1)$$

Where W, CH, W are normal vectors. The loss function is as follows:

$$\left| f - g(x) \right|_\gamma = \begin{cases} 0, if \left| f - g(x) \right| \le \gamma \\ \left| f - g(x) \right| - \gamma, otherwise \end{cases} \quad (2)$$

Lagrange dual function is applied to W, C, δ,δ* If the derivative is equal to zero, this dual problem can be transformed into a convex quadratic programming problem:

$$\max_{\sigma,\sigma^*} J_D(\sigma,\sigma^*) = -\frac{1}{2}\sum_{l,j=1}^{N}(\sigma_i - \sigma_i^*)(\sigma_l - \sigma_l^*)x_i^K x_l \quad (3)$$

The final target fitting regression function is expressed as:

$$g(x)=\sum_{i=1}^{N}(\sigma_i-\sigma_i^*)x_i^K x+c \quad (4)$$

Through deduction, it can be seen that the number of support vectors in SVM is limited, which is the input samples Xi corresponding to non-zero; Only the input vector that meets this condition can contribute to the SVM model, which is the sparsity of the solution of SVM.

4. Test and Analysis of BEs of Sub Magnetic Environment based on DMA

4.1 Experimental Method

4.1.1 Preservation of Chlorella pyrenoidosa species

Preparation of plates: prepare se solid medium, sterilize at 121 ℃ for 20 minutes, add amp solution (the final working concentration is 100 μ g/ml), mix well and prepare plates. Plate preservation method, take 15 samples respectively with a pipette gun μ L dilution ratio is 2.5 × 103 5 × 103 1 × 104. After coating, the plate was inverted at about 23 ℃, the light intensity was about 4000 lux, and the light dark ratio was 12 h:12 h. The plate was cultured in a light incubator for about a week until a single algal colony grew on the plate. Sealed and stored at room temperature and dark light.

4.1.2 Sub magnetic field treatment of algal cells

Cultivate the algal liquid in a 2L triangular flask to the early stage of logarithmic growth period, shake the algal liquid in a sterile environment and sub pack it into a 100ml triangular flask. Each bottle contains 50ml algal liquid, which is treated with a sub magnetic field with different magnetic induction intensity for 1H. With no magnetic field treatment as a reference, each magnetic field gradient is made into three horizontal lines, with a total of four magnetic field gradients. The length gradient of the sub magnetic field magnet rod is 100cm, 70cm, 40cm, 10cm, and the corresponding magnetic induction intensity is 7mt, 10MT, 25mt, 120mt. After treatment, put it into the light incubator for static cultivation.

Cultivate the algal liquid in a 2L triangular flask to the early stage of logarithmic growth period, shake the algal liquid in a sterile environment and sub pack it into a 100ml triangular flask. Each bottle contains 50ml algal liquid, which is treated with a sub magnetic field with different magnetic induction intensity for 1H. With no magnetic field treatment as a reference, each magnetic field gradient is made into three horizontal lines, with a total of four magnetic field gradients. The length gradient of sub magnetic field magnet rod is 100cm, 70cm, 40cm, 10cm. The triangular flask is changed by machine and shaken for 3 to 4 times. After 10 days of culture, the growth and fat content of each algae are measured.

4.1.3 Sub magnetic treatment of CR

Take six 100ml triangular flasks, prepare 25ml fresh tap medium, and sterilize it; Fix the Yading strong magnetic biochemical treatment instrument on the super clean workbench, wipe it with 75% alcohol, and irradiate it with UV lamp for 15 minutes for sterilization; Dilute the synchronized CR twice to each triangle bottle, that is, add 25ml synchronized algae liquid to each triangle bottle

containing 25ml. In order to avoid the impact of other environmental factors such as miscellaneous bacteria on the experimental system, all operations are aseptic in the ultra clean table; Fix the blue LED lighting device in the super clean table and adjust its light intensity to 280lux. Adjust the culture temperature to 23 ±2 ℃; CR was statically treated with sub magnetic fields with different magnetic induction intensities for 24 hours. Taking no magnetic field treatment as a reference, three parallel magnetic field gradients were made for each magnetic field gradient, with a total of three magnetic field gradients, and the magnetic induction intensities were 100MT, 200MT and 300mt respectively. Prepare the main mixture as shown in Table 1.

Table 1.Reaction system of Real-Time PCR

Reaction system components	Concentration	Volume (μL)
SybrGreen qPCR Master Mix	2X	12.5
F (10uM)	10μM	0.5
Primer R (10uM)	10μM	0.5
ddH20	-	9.5
Primer (cDNA)	-	2
Total	-	25μl

4.2 Experimental Results

4.2.1 Effect of sub magnetic treatment mediated by blue light on cell cycle of CR

Using blue light as the light source, the light intensity was 280lux, and the temperature was 23 ℃, the CR (cc125) synchronized with the cell cycle was magnetized for 24 hours under the sub magnetic field gradient of 100MT, 200MT, and 300mt, respectively. At the same time, the algae treated under the condition of 280lux blue light and no magnetic field were used as the control group. The cell density of CR was counted in the magnetic field group and the control group before (0h) and after (9h, 12h, 13h, 14h, 15h, 16h, 20h, 24h) magnetic field treatment. In addition, count the spore sac percentage of Chlamydomonas in the magnetic field group and the control group after magnetic field treatment, and the results are shown in Figure 3.

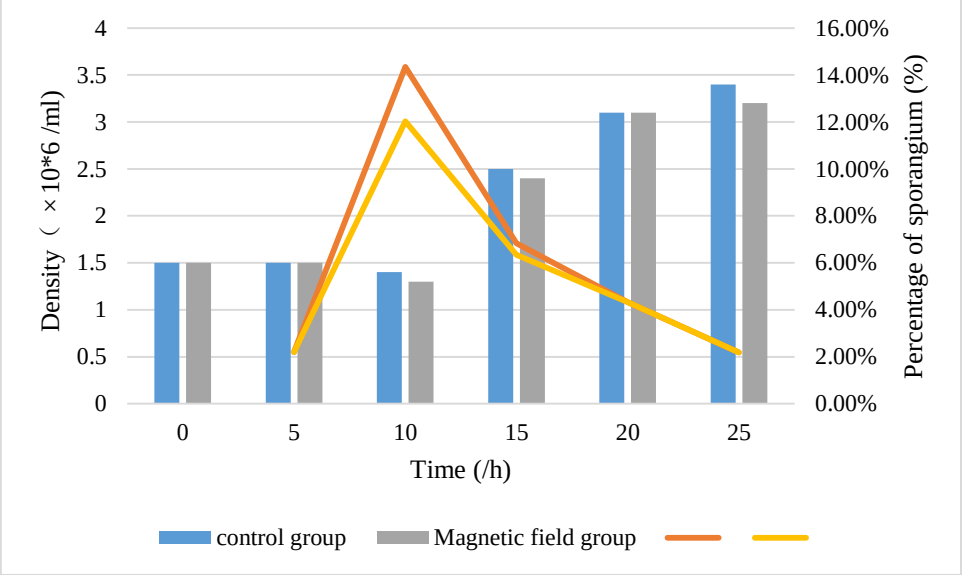

Figure 3.Cell density and sporangium of C. reinhardtii in 100mT constant magnetic field

Figure 3 shows the growth density of Chlamydomonas and the response of sporangium to 100MT sub magnetic field. Chlamydomonas after cell cycle synchronization was cultured for 24h under the condition of blue light mediated and magnetic field intensity of 100MT. At 12h, the percentage of sporangium in cells was the highest, and Chlamydomonas cells began to undergo a large-scale asexual fission stage. At this time, the sporangium content of the magnetic field group was slightly higher than that of the control group, but the whole statistical results showed that the single factor significance analysis of the number of cells and sporangium in the magnetic field group and the control group showed that under the condition of 100MT magnetic field, compared with the control group, the cell density and sporangium percentage of the algae strain in the magnetic field group did not show significant differences in response to the magnetic field at all times.

4.2.2 Effect of sub magnetic field treatment mediated by blue light on the activity of CR cells

It can be seen from the above experiments that when CR was treated with magnetic field for 15h after cell cycle synchronization, the sporangium content of CR reached the lowest point in the cell cycle. At this time, it was observed from the microscope that the sporangium of CR began to rupture, a large number of daughter cells began to release, and the cell density showed a maximum growth trend, and then the cell density began to grow slowly and even stabilized, It can be seen that 15h is a node where a large number of neutron cells are released in the cell cycle. Therefore, under the same conditions as the above treatment, MTS colorimetry was used to measure the cell activity before (0h) and 15h and 24h after magnetic field treatment, so as to explore whether the cell activity of CR responds to the magnetic field at several key time points of the cell cycle. The results are as follows:

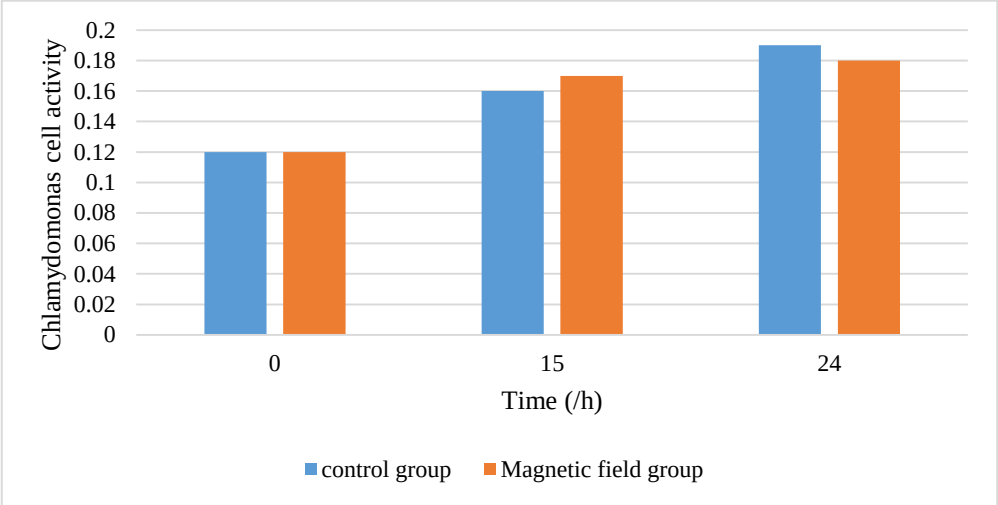

Figure 4.Cell activity of C. reinhardtii in 100mT constant magnetic field

Figure 4 shows the response of Chlamydomonas cell activity under 100MT sub magnetic treatment. The experimental results were analyzed by single factor significance on the cell activity of the magnetic field group and the control group. The results showed that under the blue light of 280lux, the magnetic field of 100MT had no significant effect on the cell activity of CR strains. The cell activity of CR was measured before treatment (0h) and 15h and 24h after magnetic field treatment. The experimental results were analyzed by single factor significance on the cell activity of the magnetic field group and the control group. The results showed that 300mt magnetic field had no significant effect on the cell activity of Chlamydomonas Chlamydomonas (cc125) strain mediated by 280lux blue light.

5. Conclusions

In this paper, the BE of sub magnetic environment based on DMA is studied, and good results are achieved: the results of the joint action of sub magnetic field and organism constitute the BE of magnetic field, in which the different sources of magnetic field, the size and direction of field strength, the action time, as well as the species and sensitivity of biological organism itself, the action position and other factors will affect the biological magnetic BE. In addition, organism is a highly complex one. This paper makes a preliminary exploration on the magnetoBE and its mechanism of green algae culture, and looks forward to more in-depth and comprehensive research on the BE of biological magnetic field in the future. For example, find more timely detection methods in the means of capturing magnetoBEs, find more detectable points in the experimental methods, and use a more comprehensive magnetic field intensity gradient to process the research object during the experiment, in order to obtain a more comprehensive experimental demonstration of magnetoBEs.

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