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ORIGINAL ARTICLE

THE FIFTH DIMENSION OF THE TASTE IN *Spirulina platensis* FEED. STUDY ON THE INFLUENCE OF MONOSODIUM GLUTAMATE IN THE DEVELOPMENT AND COMPOSITION OF THE *Spirulina platensis* ALGAE*

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Food additives have become a way of life, creating pleasure and food request. But from the point of view of health promotion, it is necessary to demonstrate the risks and find out new possibilities for a good sensorial aspect of the food. This would apply especially in the case of long-term consumption, or in some particular conditions (allergies to different ingredients which appear more often to consumers).
Cheap products are manufactured by using E-dangerous. The explanation is simple: the natural E extracted from various fruits and vegetables are very expensive.
The study wants to demonstrate that the monosodium glutamate (MSG) into the culture medium of plants can affect their healthiness. *Spirulina platensis* has the same type of amino acids as humans and this is why it has been chosen as an experiment plant. Four samples obtained from the Spirulina's culture medium were studied: one blank and three with 0.2%, 0.4% and respectively 0.6% MSG in the culture medium. The mineral content was evaluated using the Atomic Absorption Spectroscopy (AAS) and a rapid increase of calcium and magnesium content was registered for the sample with the biggest amount of MSG. The structure of the filaments and the cells appearance were evaluated microscopically. There were changes identified in the structure after three days of cultivating. Also, the sample with 0.6% MSG presented dead cells and the ones which were still alive had profound changes in form and structure.

Key words: umami, monosodium glutamate, *Spirulina platensis*.

1. Introduction

Even since ancient times, humans have been looking for ways to improve the quality of life, especially in the food area. They tried to improve the food′s appearance, colour, the flavour and none the less the taste.
The taste studies demonstrated that palatability is a very important attribute of taste and flavour quality. It promotes the selection, intake, absorption and digestion of food (Yamaguchi and Ninomiya, 2000).

The pleasure of a delicious taste has been known for 2000 years. The Romans used garum a fermented fish sauce to improve the taste of food. The delicious taste was mentioned for the rirst time in the treatise of Brilliat Savarin "The Physiology of Taste" under the name of meaty taste in some foods but without mentioning the key substance. In 1908, Ikeda identified in dried knobu the monosodium glutamate as mainly responsible for the delicious taste (Halpern, 2002). After identifying the substance, Dr. Ikeda proposed temporarily the term UMAMI for this taste. The word is pronounced oo- MA- mee and is made of two distinct words: Umai which means delicious and Mi which means essence (Citriglia, 2006).

Although Ikeda coined the term "umami" in 1908, it took more than 75 years for it to become accepted internationally as a basic taste. When the Japanese subjects familiar with the umami taste were asked to express the changes in the flavour profile of foods after MSG addition without using the word umami they reported that the overall taste intensity of the foods was increased by the addition of MSG (Yamaguchi and Ninomya, 2000).

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After Ikeda has identified brown crystals left behind after the evaporation of a large amount of kombu broth he patented a method of mass-producing a crystalline form of glutamic acid.
MSG was patented in 1909 by Ajinomoto Corporation in Japan. The Ajinomoto Company was formed to manufacture and market MSG firs in Japan (the name Ajinomoto means essence of taste). From that moment, MSG conquered the market and became more and more usual in the Asian cuisine. Later in a paper in English (1912) he used the term "glutamate taste".

Of course, the negative effects of the use of chemical compound appeared soon by adverse reactions. The Chinese Restaurant Syndrome (CRS) was taking its name because bronco-constriction in asthmatics and neurotoxicity in children occurred often after eating Chinese food (de Jong, 2003).
Therefore, monosodium glutamate has become one of the most intensively studied food ingredients. The studies were made on rats, and the effect of this ingredient proved that the use of this induces neurotoxicity and creates very energicaly allergic phenomena.

The study wants to demonstrate that the MSG in plants culture medium can affect their healthiness. *Spirulina platensis* has the same type of amino acids as humans and this is why it has been chosen as an experimental plant.

Spirulina platensis prefers only the alkaline water from tropical and subtropical areas from Africa and Latin America.

Currently, this seaweed is produced and used in over 60 countries. The annual production is over 130 kg dry matter in Mexico, 120 kg USA, 110 kg in Thailand, 140 kg in Japan, 40 t kg in Taiwan, in India and China, 110 kg each, and are grown in open tanks with natural energy resources. Are there any difficulties in maintaining a clean culture? Open systems are used in Italy, Israel, Chile, Brazil, Bulgaria, Central Asia, Kazakhstan. We use the semi-open system, the flat method. Japan uses greenhouses to grow Spirulina on 10 ha. Italy has started a massive growth in recent years and expects more than 2.5 thousands ha, 5 ha Ukraine, Moldova 1 ha, all methods based on reproducing the composition of water in Ciad Lake (light: 4-6 Klux per m2, temperature: 30-34°C, are factors with a particular role). There are many technologies, depending on the parameters used to obtain different compositions for these algae. These technologies can obtain a quantity of Vitamin B12 up to 120-150 mg/kg instead of 25-30 mg/kg.

Spirulina contains a balanced mixture in terms of the physiological albumin, saccharides, vitamins, amino acids, micro and macroelements, essential fatty acids, accounting for more than 50 components. It contains only 5% fat and 0.8% cholesterol. In these algae, there is a "huge laboratory" which is a phenomenon due to its chemical composition.

WHO, FAO and other national and international bodies of research and production are focused on Spirulina today. Hundreds of research studies are carried out in countries such as USA, Japan, France, Russia, Ukraine, all leading to the same conclusion: "Spirulina contains all the necessary substances for the human body normal vital activity".

2. Materials and methods

Four samples of the culture medium of *Spirulina platensis* were prepared one blank and three having different concentrations of monosodium glutamate in their culture medium (Table 1).

Table 1. The sample prepared for the experiment

No.	Code of the sample	Sample
1	B	No MSG
2	P1	0.2 % MSG
3	P2	0.4 % MSG
4	P3	0.6 % MSG

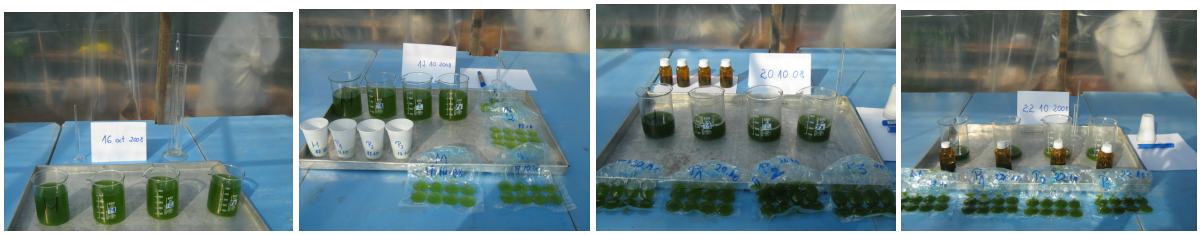
The samples were exposed to light at a temperature of 20°C for 7 days. The culture medium was Zarrouk classic. The mineral content was evaluated after one, five and seven days of cultivating (Figure 1) using different types of spectroscopy. A GBC AVANTA Atomic Absorption Spectrometer

(deuterium lamp, Pb cavitar catod lamp, air-acethilene flame). DIONEX HPLC – UVD 340 with manual injection system, GC-17A+QP-5000 SHIMADZU, ABBE refract meter, SELECTA mineralisator and SARTORIUS MA 100H thermo balance were used. After the calcination treatment the samples were treated with HCl and water (1:1, v/v) both with a correlation coefficient on a standard curve no less than 0.9800. After dry evaporation the samples were washed three times with HCl and water (1:5 v/v) treated with nitric acid and water solution (1:2 v/v) and again dry evaporated. The samples were washed again with water.

The absorbance was evaluated using a nitric acid blank. The band for the mineral content was 422.7 nm for calcium, 228.8 nm for cadmium, 327.7 nm for copper, 248.3 nm –iron, 766.5 nm - potassium, 285.2 nm - magnesium, 279.5 nm - manganese, 589.0 nm – sodium, 217.0 nm – plumbum and 213.9 nm – zinc respectively.

The images of the cells were taken using a Zoom Zenith STZ 4500 Stereomicroscope, optical zoom: 0.7X ÷ 4.5X, work distance: 95 mm, 3600 rotation, scheduled with a SRL (Single Lens Reflex) photo camera- resolution 10.1 megapixels

After 7 days, the samples were evaluated from the appearance and odour point of view.



a b c d

Figure 1. The Spirulina platensis samples
(a) – the day when they were prepared - t0; (b) - after 1 day; (c) - after 5 days; (d) - after 7 days

3. Results and discussions

The content of certain minerals was estimated using AAS. Ca and Mg had a quick evolution, Fe and Zn had a constant and equal evolution, Cu and Pb were unmodified for the 7 days of the study.

The calcium (Figure 2) content grew very slowly for the blank sample (from 1.1 to 1.4 mg/100 g), moderate for the samples with 0.2 and respectively 0.4 % MSG, and very quick for P3 (from 2 mg/100g to 3 mg/100g in the seventh day).

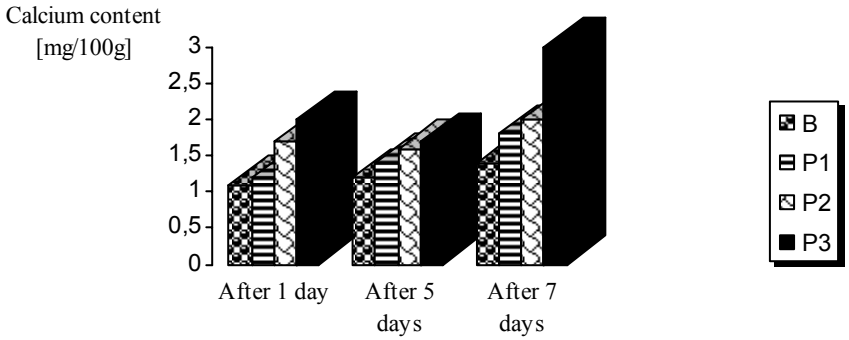


Figure 2. The calcium content evolution for the seven days experiment

The magnesium content (Figure 3) varied only by 0.4 mg/100 g for the blank sample (culture medium without MSG) and P1, by 0.3 mg/100 g for P2 and respectively by 0.5 mg/100 g for the sample P3.

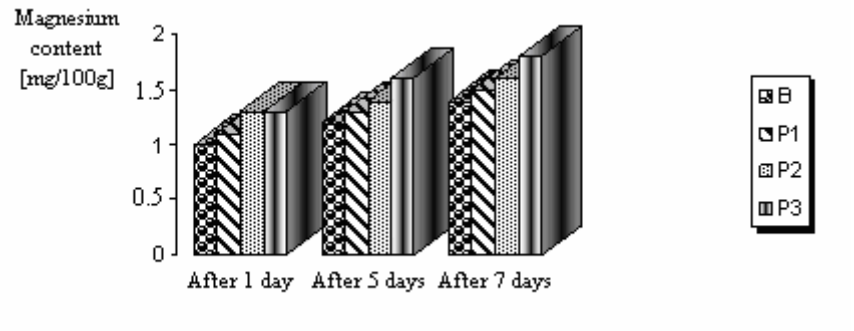


Figure 3. The magnesium content variation for the seven days experiment

The Fe content was the same for all the samples for the first (< 0.1mg/100g) day of life, after five days (< 0.2 mg/100 g) and respectively after seven days (< 0.3 mg/100 g). The iron is present in small quantities in the culture medium and was not influenced by MSG presence. Zn content also varied in the same way as Fe (<1mg/100g - after 24 hours, <1.2 mg/100g, <1.5 mg/100g – for the seventh day). Cu and Pb were constant for all the samples and for all the 6 days < 0.05 mg/100 g. Mn and Cd could not be detected.

pH of the medium (Figure 4) varied from 9.4 to 10.1 for the blank sample and was approximately in the same range for P1, P2, P3 from 9.3 to 9.7.

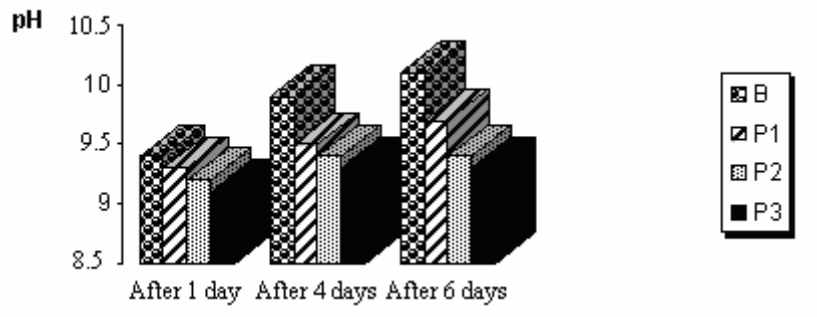


Figure 4. The pH variation for the 6 days experiment

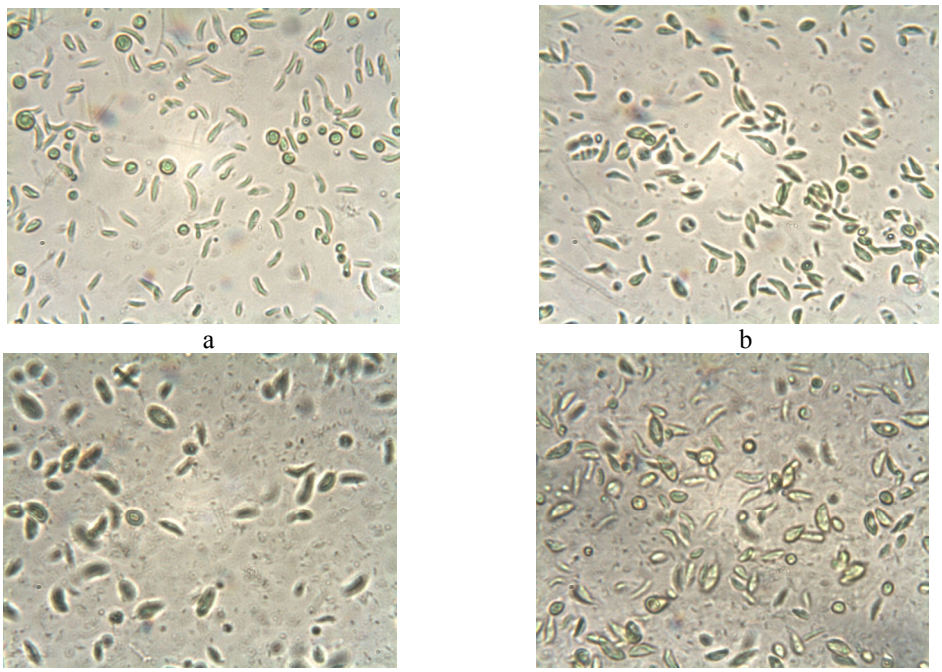
The values prove that the medium content respectively the feed composition can act on algae composition in short time, but these values didn't demonstrate as the microscopically structure of the tissue the real influence of MSG on the sample.

In Figure 5, the cells structure is presented after 7 days of culture medium supplemented with the MSG.

The blank sample preserve the cells unmodified after 7 days, with a well defined form and elastic cellular walls, the sample with 0.2% MSG presents small deviations from the standard form like the 0.4 % MSG content sample, but the 0.6 % MSG content sample presents dead cells and the ones which are still alive presented with profound changes in form and structure.

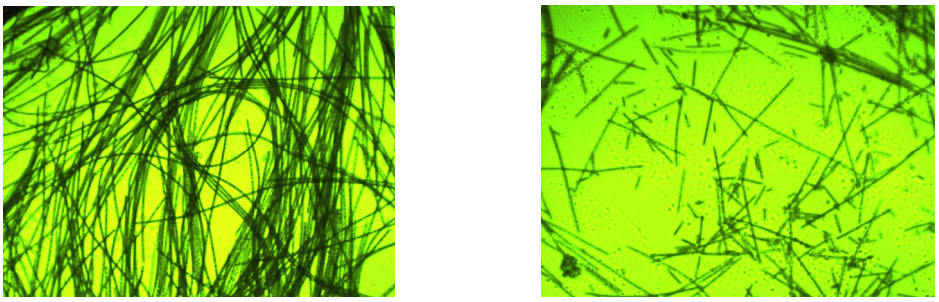
The filaments of *Spirulina platensis* were long and continuous on the first day; after seven days the filaments were broken and very small, very thin like needles for P3 (Figure 6).

The appearance, from colour point of view, demonstrated the fresh green colour for the blank sample, respectively the dark green colour for P3 which shows a discommode for this one created by the culture medium. After 7 days, the blank sample was a suspension with well defined particles, while P3 almost like gel aspect. The odour was green - fresh for blank sample and readily modified with hard hues for P3.



a b c d

Figure 5. The cells structure after 7 days of cultivating in the culture medium without and with different quantities of MSG. (a) - blank, (b) -P1, (c) - P2, (d) -P3



a b

Figure 6. Spirulina platensis after 1 day (a) respectively 7 days (b) of adding 0.6 % MSG in the culture medium

4. Conclusions

The research demonstrates that the use of monosodium glutamate as an additive in the Spirulina platensis culture medium induces a rapid growing of calcium and magnesium content. The iron and zinc content varied very slowly due to the culture medium composition. The pH of the samples was 10.1 for the blank and varied insignificantly for the samples with MSG. The use of monosodium glutamate in the culture medium of *Spirulina platensis* produced visible and measurable changes in the composition (in terms of minerals content), in structure and appearance, in a short time.

The samples with MSG presented visible changes in cells form, cells walls elasticity, the sample with 0.6 % MSG had a great number of dead cells after 7 days of living.

The colour and appearance of the samples were typical for *Spirulina platensis* in the blank case and visibly modified for the P3 especially.

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