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Impact of Monosodium glutamate on the production and chemical constituents of *Spirulina maxima*

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ABSTRACT

In present research work impact of Monosodium glutamate (MSG) on the production & biochemical analysis of different pigment of spirulina has been done. As spirulina is a rainbow of pigment as it consists Chlorophyll a, Carotenoids including phycocyanin, phycoerythrin and allophycocyanin, for this spirulina maxima have been procured from Manjul Spirulina Samwardhan Sansthan Burthal Bassi Jaipur, Rajasthan. and sub cultured in spirulina lab Botany Department in CFTRI medium. In this MSG was used as additional nutrient in Spirulina maxima cultivation. MSG also known glutamic acid is one of the most common naturally occurring non essential amino acid and it is the main component of many proteins & peptides. For the studies it was revealed that Monosodium glutamate has been used as additional nutrient used to explore the impact on growth pattern of test alga Spirulina maxima following three sets were designed (a) MSG only (b) CFTRI only (c) MSG + CFTRI Optical density of the Spirulina maxima culture has been recorded regularly every 5 days interval up to 20 days at 415nm by using cistronic spectrophotometer 166. From the overall result it was found that CFTRI medium along with MSG shows good nutrient medium for the growth of Spirulna maxima

Key words: *Monosodium glutamate, spirulina maxima, CFTRI medium, cultivation, Biomass.*

INTRODUCTION

Spirulina is a prokaryotic micro alga which has been used since ancient times as a source of protein and vitamin supplement without any undesirable effects on human being.

In south india, *Spirulina* production has been takes place in *Spirulina* farm at Navallor village, kanchipurm district, Tamil Nadu. This algae is also cultivated at commercial scale all over the world due to its high protein (50-55%), pigment, essential fatty acids, vitamin and minerals[3].

Large scale production of *Spirulina* depends on many factors such as pH of nutrient medium, light intensity, photoperiod, depth of culture vessels & most important agitation. *Spirulina* reproduces asexually by mean of fragmentation therefore it is necessary to agitation it three a day for 4 minutes each time. It enhances the process of fragmentation as well as uniform distribution of the nutrients media. *Spirulina* requires inorganic salts, diffused light for growth.

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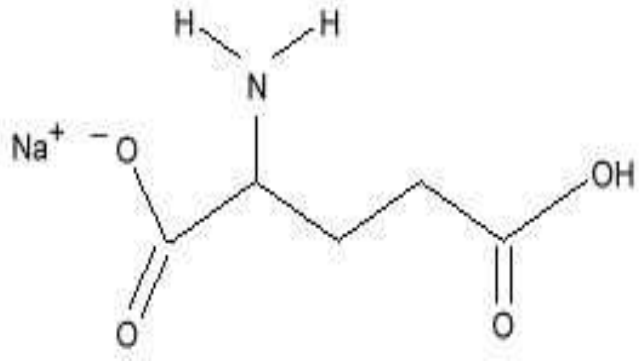
The temperature range is 25-35^{0}C, with optimum at 30^{0}C, ideal illumination is 3-4K lux and the medium should be alkaline with the pH around 9.0.

Spirulina is a rainbow of pigments as it consists chlorophyll a, carotenoids, including phycocyanin, phycoerythrin and allophycocyanin. Phycocyanin of *Spirulina* strengthens immune system and is known to increases the survival rate of cancer victims. It also raises the lymphocyte level in the blood. Carotenoids of *Spirulina* are precursor of vitamin A higher than even carrot and papaya. Chlorophyll is referred as "green blood" because it contains magnesium ion in its core while haemoglobin an ion of iron anemia is caused due to deficiency of iron in nutrition. Therefore it is beneficial in the treatment of anemia patients. *Spirulina* contain 15-20% of carbohydrates, which is easily absorbed by the body *Spirulina* carbohydrates are source of quick energy.

In the present research work impact of MSG on the production & biochemical analysis of different pigment of *Spirulina* has been done. *Spirulina maxima* sample have been procured from "Manjul *Spirulina* Samwardhan Sansthan Burthal Bassi, Jaipur, Rajasthan." and sub cultured in *Spirulina* Lab, Botany Department, D.E.I., Agra by using Central Food Technology Research Institute (CFTRI) medium, Venkatarman[5] at certain conditions such as temperature (25-35^{0}C), light (1600-2400 lux), photoperiod 10 h/day. Inorganic constituents of a medium are generally said to be responsible for growth and morphology of the *Spirulina maxima.*

So in my work an attempt has been made to explore the impact of additional nutrient Monosodium glutamate on growth and biochemistry of *Spirulina maxima.* In this work MSG were used as additional salt with CFTRI medium. MSG is commonly known as ajino-moto, ve-Tsin and E621. It is used to enhance the flaverin chineese food specially chummin or vegetable soups. MSG is the sodium salt of the amino acid- glutamic acid[6]. Glutamic acid is one of the most common naturally occurring non essential amino acid it is the main component of many proteins and peptides.

Chemical structure of Monosodium Glutamate[6]



MATERIALS AND METHODS

In vitro* and *in vivo* cultivation of *Spirulina maxima

The species of *Spirulina maxima* were collected from Manjul *Spirulina* Samwardhan Sansthan Burthal Bassi Jaipur, Rajasthan.

In vitro* cultivation of *Spirulina maxima *Spirulina* mother culture procured from Rajasthan were sub cultured in *Spirulina* Lab, Botany Department in CFTRI medium as proposed by Venkataraman[5]. Incubate these culture at 30°C in 1700 Lux light intensity. During incubation, flasks were agitated for 3 to 4 times per day 4 minutes each time.

***In vivo* cultivation** The micro alga *Spirulina maxima* were cultivated in PVC Tubs under natural day light The culture were agitated thrice a day to ensure the uniform distribution of nutrients in the medium and to provide fragmentation. So, it is very necessary to agitate the culture for artificial breakage of filament and uniform distribution of nutrient.

The chemical composition of (CFTRI) medium as proposed by Venkataraman[5]

S.NO.	Nutrients	Quantity g/l
1	Sodium bicarbonate	4.5
2	Di potassium hydrogen phosphate	0.5
3	Sodium nitrate	1.5
4	Potassium sulphate	1.0
5	Sodium chloride	1.0
6	Magnesium sulphate	1.2
7	Calcium chloride	0.4
8	Ferrous sulphate	0.01
9	pH	9.0

Impact of MSG on production & cellular metabolites of *Spirulina maxima*

Monosodium glutamate (MSG) was used as additional nutrient for *Spirulina maxima* cultivation. For this MSG was used with CFTRI medium. Take three conical flask of 2 litre capacity and labeled it as set I, II &III. Set I consist total 1 litre CFTRI +MSG (2gm) while set II has 1litre CFTRI only & set III has MSG (5g) only. All these flasks inoculate with 200 ml mother culture (*Spirulina maxima).*Then incubate these flask in *Spirulina* lab at certain conditions such as at 30°C in 1700 Lux light intensity . During incubation, flasks were agitated for 3 to 4 times per day at least for 4 minutes each time. Note the optical density of these flasks at the interval of 5 days up to 20th day with the help of cistronic spectrophotometer -166. After 20 days all culture was harvested by fine nylon cloth and sun dried. Dried powder from each set store at 4° C in dark and further use for biochemical analysis of chlorophyll a, protein, carotenoids, & carbohydrates.

Filtration & Drying: - Cultures were harvested after 20 days. The culture has been filtered firstly through ordinary sieve then by fine nylon cloth. The harvested slurry was washed thrice with sufficient tap water to remove adhered salts. The filtered and washed slurry was sun dried for 8-14 hours depending on climatic conditions. Harvested dried algal mass shows growth.

Biochemical assay of *Spirulina maxima*

Dried powder of *Spirulina maxima* were biochemically analyzed for metabolites such as Carotenoids, Chlorophyll a, Protein, Carbohydrates. Carbohydrates was estimated by Anthrone method[11], Proten estimated by the method proposed by Lowry *et al.*,[7] Chlorophyll a is estimated by Parson and Strickland[8], Carotenoid estimation by Jensen[4].

RESULTS AND DISCUSSION

Spirulina maxima were procured from Rajasthan and were sub cultured in Botany Department by using CFTRI medium. We used CFTRI Medium for cultivation purpose because it is cheaper and easily available. In the beginning mother culture of *Spirulina* was too diluted and Because of dilution it is difficult task to maintain the culture. *Spirulina maxima* were kept in laboratory under optimal growth conditions to save this precious alga from decaying. *Spirulina maxima* filaments were coiled just like ball pen spring and floats on the surface of culture medium. Daily, three times agitation must required for fragmentation and uniform distribution of nutrient. Algal culture leave for one month to got sufficient cultures to setup for further experiment.

Growth conditions such as environmental and nutrients both affected the yield and biochemistry of *Spirulina maxima*. The different nutrients were used for *Spirulina* cultivation. Biomass yield of *Spirulina* was different in all different medium. MSG was used additionally as nutrient with CFTRI and without CFTRI. Result revealed that Growth pattern was excellent of *Spirulina maxima* that grown in CFTRI with MSG. Minimum growth was reported in *Spirulina maxima* that growth in only MSG However recently scientist was found that MSG is not good for our health and for our nerves system (Amar ujala Nov. 2014).

Results showed that MSG having the ability to accelerats the growth of *Spirulina,* Now a day's MSG is being used as taste enhancer in various recipies. MSG is being used in children's adults as well as favorites food chaumin.

Present research work was focused on impact of MSG on growth performance of *Spirulina maxima* and its biochemistry. Monosodium glutamate has been used as additional nutrient used to explore the impact on growth pattern of test alga *Spirulina maxima* following three sets were designed (a) MSG only (b) CFTRI only (c) MSG + CFTRI Optical density of the *Spirulina maxima* culture has been recorded regularly every 5 days interval up to 20 days at 415 nm by using cistronic spectrophotometer 166.Optical density of 1stday' 0.94 respectively. Optical density of *Spirulina maxima* grown in MSG were 0.94, 1.24, 1.96, 2.48, &3.19 at 1st 5th, 10th.15th, & 20th day respectively. Optical density of *spirulina* grow in CFTRI were 0.94, 1.89, 2.43, 3.11, & 3.69 at 1st 5th, 10^{th,} 15th, & 20th day respectively. Optical density of *Spirulina maxima* grown in MSG + CFTRI were 0.94, 2.06, 2.95, 3.47 & 3.97 at 1st 5th 10th 15th& 20th day respectively (as shown in Table 1.).

Table 1:- Optical density of *Spirulina* grown in MSG, CFTRI medium, CFTRI + monosodium glutamate

Optical density	MSG	CFTRI	MSG+CFTRI
1st day	0.94	0.94	0.94
5 day	1.24	1.89	2.06
10day	1.96	2.43	2.95
15 day	2.48	3.11	3.47
20 day	3.19	3.69	3.97

Highest optical density has been recorded throughout the 20 days in the cultures those were supplied with CFTRI+ Monosodium glutamate.

Table:-2 Yield (Dried powder) of *Spirulina* (g/ litre) obtained from CFTRI medium, MSG & CFTRI + MSG

Nutrients	Dried powder (g / litre)
MSG	0.43
CFTRI medium	0.75
MSG + CFTRI medium	1.15

Maximum dry mass (1.15g/ litre) was recorded from the cultures those were supplied with (5g/ litre) CFTRI + monosodium glutamate. Dry mass (0.75g/ litre) reported from the culture those were supplied with CFTRI. Minimum dry mass (0.43g/litre) was reported from the culture those were supplied with MSG.

Biochemistry is also dependable on nutrients as well as environmental conditions. Biochemical analysis of *Spirulina maxima* showed the remarkable variation in the percentage of selected metabolite, Chlorophyll a, Carotenoids, Carbohydrates & Protein. The percentages of chlorophylsl a, carotenoids, carbohydrates & protein of *spirulina* grown in MSG were 1.15%, 0.168%, 7.3%, & 55% respectively. The percentages of chlorophyll a, carotenoids, carbohydrates & protein of *spirulina* grown in CFTRI medium were 1.40%, 0.196%, 7.8%, & 57% respectively. The percentages of chlorophyll a, carotenoids, carbohydrates & protein of *spirulina grown* in MSG + CFTRI were 1.51%, 0.24%, 8.9%, & 60% respectively. The metabolites percentage of *Spirulina species* procured from Jaipur, Rajasthan having Chlorophyll a 0.91-1.52%, Carotenoids 0.132-0.268%, Carbohydrates 10.9-13.1% & Protein 61-66% respectively.

Table:-3 Biochemical analysis of metabolites on *Spirulina maxima*

Metabolites	MSG	CFTRI	MSG+CFTRI
Chlorophyll a	1.15%	1.40%	1.51%
Carotenoids	0.168%	0.196%	0.24%
Carbohydrates	7.3%	7.8%	8.9%
Protein	55%	57%	60%

Algae being chlorophyllous and photoautotrophic often respond to environmental change by adjusting the concentration of photo-synthetic pigment and cellular components.

The highest values being obtained at early day light[1]. From a qualitative point of view, *Spirulina* protein is complete, since all the essential amino acids are present, forming 47% of total protein weight[2]. In general, carbohydrates constitute 15-25% of the dry weight of *Spirulina*[9]. These consist of Phycocynin (PC), Allophycocynin (APC) and Phycoerthrin. Highest PC and APC were recorded in *Spirulina platensis* (sp7, mutant).

CONCLUSION

MSG in used as additional nutrients with CFTRI medium. In the present research work an attempt were made to enhance the growth rate of micro alga- *Spirulina maxima* We used MSG as additional nutrients to enhance the production of *Spirulina* and ultimately found that monosodium glutamate. Additional nutrient, monosodium glutamate (Ajinomoto salt), have been used in *Spirulina* growth culture. To explore the impact of on growth pattern of test alga *spirulina maxima* following three sets were designed a CFTRI only, MSG only, & CFTRI+ MSG Optical density of the *Spirulina maxima* culture has been recorded regularly with 5 days interval up to 20 days at 415nm by using cistronic spectrophotometer 166.Optical densities of *Spirulina maxima* grown in CFTRI medium were 0.93, 1.89. 2.43, 3.11, & 3.69 at $5^{th,}$ 10^{th} .15^{th}, & 20^{th} day respectively. Optical density of grow in CFTRI + monosodium glutamate were 0.94, 2.06, 2.95, 3.47, &3.98 at 5^{th}, $10^{th,}$ 15^{th}, & 20^{th} day respectively. Optical density *Spirulina maxima* grown in MSG were 0.94, 1.24, 1.96, 3.48, & 3.19 at 5^{th} 10^{th} 15^{th}& 20^{th} day respectively. From the overall result it was found that CFTRI medium along with MSG shows good nutrient medium for the growth of *spirulina maxima.*

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