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OPTIMIZATION OF COMMERCIAL GRADE $NaHCO_3$ (MITHA SODA) CONCENTRATION FOR *SPIRULINA FUSIFORMIS* CULTIVATION

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ABSTRACT
As a food supplement *Spirulina* is gaining more and more attention. Its growing demand has led to its large scale cultivation, which had been a very costly affair and low cost nutrient are mandatory to minimize its economy. The present experiment was conducted to find out the optimum concentration of commercial grade $NaHCO_3$ *i.e.* mitha soda in CFTRI (I) medium for supporting the highest yield of *Spirulina fusiformis*. Algal samples with 4.5 g/L -10g/L concentration of mitha soda in CFTRI (I) medium were prepared and algal growth was recorded in terms of optical density upto the 25th day. Present experiment revealed that 6g/L concentration of mitha soda successfully proved to be better for the growth of *Spirulina fusiformis*. From the economy point of view, cost input for 6g/L mitha soda was 5 times cheaper than the analytical grade $NaHCO_3$.

INTRODUCTION

The growth of algal cultures is related to its inorganic nutrition. The essential elements according to requirement of algae are mandatory for the growth, its cellular constituents and its morphology. According to their essentiality, elements were divided into two groups: (a) Macronutrients included Nitrogen, Phosphorous, Potassium, Sodium, Magnesium, Sulphur, Iron, Calcium etc. and (b) Micronutrients incorporated Molybdenum, Zinc, Boron, Manganese, Copper etc. Most of these elements have been components of Zarrouk's medium (1966) suggested for *Spirulina* in the indoor cultivation, but for the outdoor cultivation, low cost nutrients have been replaced to minimize its economy. Nigam *et al*. (1981) proposed a cheaper CFTRI mix by replacing "Zarrouk's Complex Fertilizer Mixture". Majid (1992) investigated a new medium named "Bangladesh Medium", contained rice husk ash extract and common fertilizer with 10-50% Zarrouk's medium. Wu *et al*. (1993) have grown *Spirulina* in sea water, enriched with a commercial compound fertilizer N: P: K (15:15:15) $NaHCO_3$ and $FeSO_4$. Olguin *et al*. (1997) and Gami *et al*. (2011) tried seawater with $NaHCO_3$ to evaluate a low-cost medium for *Spirulina* sps. But the important contribution in this field was of Venkataraman and Becker (1985) who evaluated CFTRI (I) medium where only 4 chemicals were used i.e. $NaHCO_3$, $MgSO_4$, Super PO_4, N:P:K (15:15:15). Gupta and Changwal (1992) used commercial $NaHCO_3$ as the source of carbon. Raoof *et al*. (2006) also experimented with commercial grade $NaHCO_3$ in his newly formulated medium (RM_6) for mass production of *Spirulina* sps. Similarly Gajraj (1994) has also taken mitha soda as an alternate source in place of analytical $NaHCO_3$. The replacement of analytical $NaHCO_3$ by commercial $NaHCO_3$ in CFTRI (I) medium drastically reduced the cost of medium. The optimum concentration of mitha soda varied with the particular strain of *Spirulina*. Chandgothia (1996) and Bhatia (1996) added ground nut shell ash extract to further reduce cost inputs with enhanced biomass production of *Spirulina*. The present experiment was designed to find out the optimum concentration of mitha soda in CFTRI (I) medium, used for *Spirulina fusiformis* cultivation.

MATERIALS AND METHODS

12 Samples of CFTRI (I) medium were prepared, containing 4.5 to 10g/L mitha soda with a gap of 0.5g/L concentration. Experiment was set in beakers of 250mL. Three days old cultures were used as the inoculums. Since the cultures of *Spirulina fusiformis* were homogenous, growth was followed through optical density, which was recorded initially and on every 5th day over a period of 25 days.

RESULTS

Initial density of the algal samples was adjusted to as 0.55 (Fig.1). On the 5th day, density of experimental cultures was ranging between 1.20 to 1.29 times from the initial record. Cultures having 4.5 and 5g/L showed 1.25 times increase. The maximum growth was observed in cultures with 6g/L mitha soda. It was 1.29 times the initial density. Growth was 1.27 times in cultures with 6.5g/L mitha soda. 1.25 times growth was observed in cultures containing 7g/L mitha soda. Cultures having 7.5, 8 and 8.5g/L mitha soda showed 1.24 times growth. However it was 1.2 times in cultures containing 9, 9.5 and 10g/L mitha soda (Fig. 1).

All the samples showed their maximum growth on 10th day of the experiment. Thereafter, a linear reduction was observed. Density of cultures was ranging between 1.54 to 1.69 times the initial values. Maximum growth was detected in the cultures

having 6g/L mitha soda (1.69 times) and minimum was 1.54 times in cultures containing 10g/L. Cultures having 4.5 and 5g/L concentration of mitha soda showed 1.6 times growth, while with 5.5g/L mitha soda showed 1.65 times increase. 6.5g/L concentration of mitha soda enhanced 1.67 times growth, while 7 and 7.5g/L content showed 1.6 times increment. 1.58 times growth was reported in cultures containing 8 and 8.5g/L mitha soda. However1.56 times growth was observed in cultures containing 9 and 9.5g/L concentration of mith soda (Fig. 1).

On the 15th day of the experiment, a slight reduction was observed in the density of the cultures. Growth was ranging from 1.51 to 1.67 times. Cultures containing 6 and 6.5g/L mitha soda presented maximum growth (1.67 times), while

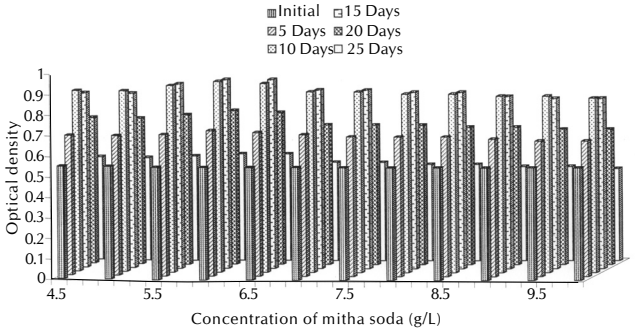

Figure 1: Growth pattern of *Spirulina fusiformis* under different concentration of mitha soda - a substitute of $NaHCO_3$

minimum growth of 1.51 times observed in cultures with 9.5 and 10g/L mitha soda. 1.54 times growth was recorded in cultures having 4.5 and 5g/L mitha soda, while with 5.5g/L it was 1.64 times. The enhancement of density was 1.58 times in cultures with 7 and 7.5g/L mitha soda. Cultures having 8 and 8.5g/L mitha soda showed 1.56 times growth. 1.53 times increase was reported in 9g/L mitha soda containing samples (Fig. 1).

On the 20th day of the experiment, density of cultures was ranging between 1.2 to 1.36 times of the initial record. It was 1.36 times in cultures containing 6g/L mitha soda, while with 8.5 to 10g/L concentration showed an increase of 1.2 times. Cultures having 4.5 and 5g/L mitha soda showed 1.29 times growth while 5.5 and 6.5g/L chemical content enhanced the density 1.33 and 1.35 times respectively. Cultures containing 7, 7.5 and 8g/L mitha soda presented only 1.24 times enhancement (Fig. 1).

25th day's observation revealed very much reduction in all the cultures. Density was less than the initial record. 6 and 6.5g/L added mitha soda cultures showed 0.95 times growth. Minimum density was recorded in cultures having 10g/L mitha soda concentration *i.e.* 0.82 times. Cultures containing 4.5 and 5g/L showed 0.91 times growth. 5.5g/L added mitha soda cultures showed 0.93 times growth. Cultures with 7 and 7.5g/L presented 0.87 times growth. 0.85 times increase was recorded in cultures of 8 and 8.5g/L mitha soda while 9 and 9.5g/L cultures showed 0.84 times increase (Fig. 1).

DISCUSSION

In the present investigation highest growth of *Spirulina fusiformis* was recorded in 6g/L concentration of mitha soda. A remarkable correlation in algal growth and $NaHCO_3$ concentration was reported by Huang *et al.* (2002). Similarly Jeeji Bai (2006) agreed that 70% of the total cost of chemicals in algal medium is due to $NaHCO_3$, $NaNO_3$ and K_2HPO_4 and modification with commercial grade $NaHCO_3$ gives equally good results. The result of the present experiment led to the conclusion that 6 g/L content ration of mitha soda favored the growth of *Spirulina fusiformis*. On the 10th day of experiment all samples showed their maximum growth, however highest growth was on record in 6 g/L concentration of mitha soda. From the economy point of view, cost input for 6g/L mitha soda was 5 times cheaper than the analytical grade $NaHCO_3$. Similar observation was recorded by Bhatia (1996) with *Spirulina labyrinthiformis*, the CFTRI (I) medium with commercial grade $NaHCO_3$ (mitha soda) at 6g/L concentration yielded as much growth as found in analytical grade 4.5 g/L $NaHCO_3$ added medium.

Gajraj (1994) reported that mitha soda at 4.5 g/L in CFTRI (I) proved to be as good as analytical grade $NaHCO_3$ for the optimum biomass yield with *Spirulina platensis*. As the concluding remark 6g/L added mitha soda in CFTRI (I) medium was better for *Spirulina fusiformis* cultures. Besides enhancing the growth rate, it also reduces cost input of its cultivation.

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