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RESEARCH ARTICLE

ASSESSMENT OF GROWTH PARAMETERS OF SPIRULINA (*Spirulina Platensis*) USING DIGESTED ROTTEN MANGO (*Mangifera Indica*) SUPERNATANT AS A COST-EFFECTIVE CULTURE MEDIA

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ABSTRACT

The culture and growth performance of *Spirulina platensis* in three different concentrations (25, 50, and 75 percent) of digested rotten mango media (DRMM) and Kosaric medium (KM) as control were investigated. This study intended to examine DRMM as a low cost culture media for microalgae. For 16 days, optical density, cell weight, chlorophyll a concentration, and total biomass of *S. platensis* under various treatments were measured in every alternate day. The growth rate of *S. platensis* cultured in the supernatant of DRMM and KM was varied and the maximum cell weight, chlorophyll a content and total biomass of *S. platensis* were 0.085 mg/L, 0.08 mg/L and 4.824±0.021 mg/L at 50% in DRMM of the culture. This study showed that the growth performance of *S. platensis* was higher in the supernatant of 50% DRMM than 25 and 75% of DRMM which resulted satisfactorily compared with standard KM. In the supernatant of 50% digested rotten mango medium, large volume spirulina culture may be feasible.

KEYWORDS

Spirulina, Aquaculture, Growth Performance, Suspended solids, Chlorophyll a, Optical density.

1. INTRODUCTION

Bangladesh is the largest active deltaic country of the world (Mahmuda *et al.*, 2020). Bangladesh is one of the world's leading inland fish producing countries, contributing about 3.50% to GDP (Gross Domestic Product), 25.71% to agricultural production (Baroi *et al.*, 2019). With the world's population continuously expanding, food security has become a critical concern in recent years. To sustain present levels of per capita consumption, the world's expanding population entails a rise in food demand and aquaculture is one approach to meeting this need. Aquaculture is the fastest-growing food production sector in the world. It provides half of the global fish supply (Nasrin *et al.*, 2021). Fish production through aquaculture is rapidly gaining importance due to increasing human population and diminishing natural fisheries resources in Bangladesh (Mahmud *et al.*, 2021). To sustain the current per capita supply of aquatic products into the future, further elevation of aquaculture production is required as the supply of fish through capture fisheries cannot grow any more (Rahman *et al.*, 2021). Furthermore, because traditional agriculture is insufficient to support the world's rising population, new alternative and unconventional food sources must be developed. With the expansion of aquaculture in Bangladesh, there has been an increasing trend in using chemicals in aquatic animal health management (Uddin *et al.*, 2020). Microalgae are very much helpful for fish health. We can use microalgae rather than using chemical in aquaculture (Uddin *et al.*, 2020). Increasing aquaculture practice might be a method for producing more fish to fulfill the protein needs of the world's enormous population. To do this, we must produce more fish at a lower cost of feed. The growing use of plant protein in fish diets is thought to lower the cost of fish meals and feeds (Mosha, 2019). This is why using dietary spirulina in fish feed might be beneficial. Spirulina has long been utilized as a nutritional supplement for fish, shrimp, and poultry, and is increasingly being employed as a protein and vitamin supplement in aquafeeds. Hossain *et al.*, explained that microalgae acts not most effective on agro-chemical but additionally animal wastes as nicely through changing them into meals substances (Hossain *et al.*, 2021). This *S. platensis* is very health effective for fish and shrimp production because microalgae play a critical position in oxygen in addition to carbon dioxide stability in the water (Rahman *et al.*, 2021). The microalgae used for biofuels production though require less land area in comparison to cereal crops but the cultivation, harvesting and processing of algae is not less costly (Rahman *et al.*, 2022). So we need a less cost technique for producing microalgae. As a result, this alga should be employed effectively and commercial spirulina production should begin to provide fish with improved nutrition and an alternate protein source. This will assist Bangladesh in becoming self-sufficient in fish production and meeting animal protein needs. Spirulina may also be cultivated quickly and cheaply with a low-cost culture media. It grows best in water, is readily collected and processed, that contains a substantial amount of macro-and micronutrients (Mosha, 2019). It has been commercially farmed in several nations throughout the world for over ten years due to its high nutritional content, which includes protein, amino acids, vitamins, minerals, vital fatty acids, and -carotene (Mosha, 2019). Spirulina platensis, often known as a "superfood," is high in protein, vitamins, and minerals. Due to its high quantity of nutritional elements as well as anti-viral, anti-bacterial, anti-oxidant, anti-diabetic, anti-cancer, and anti-inflammatory characteristics, spirulina has a long history as a dietary supplement (Jung et *al.*, 2019). Spirulina and its components, in addition to being a "complete" protein source, have been found to have good effects on a variety of human health indicators, ranging from malnutrition to antioxidant characteristics (Ravi

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et al., 2010). Bangladesh is presently producing a large volume of mango, which is being sold at a low price. Every year, between 15-25 percent of mangoes rot in the market while being sold, especially during peak season (Uddin *et al*., 2007). These rotten or damaged mangoes are tossed outside as rubbish, where they degrade and represent a threat to the environment. Mango is one of the most popular tropical fruits enriched with potent antioxidants, anti-lipid peroxidation, immunomodulation, cardiotonic, hypotensive, wound healing, degenerative and antidiabetic properties (Shah *et al*., 2010). After aerobic or anaerobic digestion of mangoes, these carbon-rich organic and inorganic elements can aid in the growth of spirulina in the supernatant. This study intended to examine *S. platensis* culture and growth performance in the supernatant of digested rotten mango. This research opened a new era for low cost live food production as a result fish production cost will be reduced. Fish farmers and hatchery owner will be benefited by this research outcome.

2. MATERIALS AND METHODS

2.1 Collection and Maintenance of The Pure Stock Culture of Spirulina (*S. Platensis*)

Microalgae *S. platensis* was collected from the stock of the laboratory of the Live Food Culture department of Aquaculture, BAU, Mymensingh. Obtaining pure culture of spirulina has maintained hygiene stock (Torzillo *et al*., 1986). Pure stock culture of *S. platensis* was maintained in the laboratory in Kosaric Medium (KM) (Zarrouk, 1996). The growth of *S. platensis* was monitored on every alternative day and was checked under the microscope to confirm its purity following (Phang and Chu, 1999).

2.2 Experimental Environment:

Temperature and light intensity of the culture media were recorded as follows:

Temperature: Water temperature (°C) of the culture media was measured during the time of sampling day by a celsius thermometer.

Light intensity: Light intensity (lux/m^2/s) was measured during sampling day by using a lux-meter [digital instrument, Lutron (LX-101)].

2.3 Preparation of Supernatant of Digested Rotten Mango Media (DRMM)

400 g/4.0 L wet rotten mango was allowed to decompose in a 5.0 L glass bottle for 26 days under aerobic conditions. Then a Light reddish white-colored supernatant from the bottle was screened through a net of 30 µm, mixed with 9.0 g/L sodium bicarbonate and 0.20 mL/L micronutrient, then diluted and made in three concentrations at the rate of 25, 50 and 75% of decomposed rotten mango (Table 1). Then the supernatant of three different concentrations was taken in a 2.0 L flask with three replications.

Table 1: Experimental Design for *S. Platensis* Culture Using Supernatant of Three Different Concentrations of Digested Rotten Mango.

Types of Medium	Treatments	Replications	Amounts of Rotten Mango (%)	Duration of Culture (days)
Supernatant of DRMM	T_1	3(101, 102 and 103)	25	16
	T_2	3(201, 202, 203)	50	
	T_3	3(301, 302, 303)	75	
Kosaric medium	T_4	3(KM-1, KM-2 and KM-3)	-	

2.4 Culture of Spirulina (*S. Platensis*) in Supernatant of DRMM and KM

Four treatments, three from the supernatant of digested rotten mango from three different concentrations (25%, 50% and 75%) and one (KM) as control each with three replications were used to grow microalgae, *S. platensis* in 1.0 L volumetric flask. Spirulina was inoculated into each culture flask to produce a culture containing 10% spirulina suspension (Optical density at 620 nm = 0.20) (Habib, 1998). All the flasks were kept under fluorescent lights in light: dark (12h:12h) conditions with continuous aeration. Four sub-samplings were carried out on every alternative day from each flask to record dry cell weight and chlorophyll a content of spirulina, and properties of culture media. All the glassware used in the experiment was sterilized with dry heat at 70^{o}C overnight.

2.5 Estimation of Cell Weight (Dry Weight) of Spirulina

Sample containing 20 mL spirulina suspension was filtered through a Sartorius filter paper of mesh size 0.45 µm and diameter of 47 mm. The filter papers were dried in an oven for 24 hours or overnight at 70°C and weighed before filtration. The filtered samples were washed three times to remove insoluble salts. After that, the filter papers were put in a glass Petri dish and kept in the oven at 70°C overnight. For cooling, petridish were put into a desiccator for 20 minutes and then filter paper was weighed. The dry weight of algae on the filter paper was measured using the following equation:

Dry weight (mg/L), $$W = \frac{FFW - IFW}{\text{Amount of sample taken for filtration (ml)}} \times 100$$

Where,

W = Cell dry weight in mg/L;

FFW = Final filter paper weight in g; and

IFW = Initial filter paper weight in g.

2.6 Estimation of Chlorophyll a of Spirulina

The samples of *S. platensis* were collected at different times and chlorophyll a content of *S. platensis* was estimated. 10 mL of *S. platensis* sample was filtered with an electric filtration unit using filter papers. These filtered samples together with filter paper were taken into a test tube and ground with a glass rod and finally mixed with 10 mL of 100% redistilled acetone. Each of the test tubes was wrapped with aluminum foil paper to inhibit the contact of light. The wrapped test tube was kept in a refrigerator (LMS Laboratory Refrigerator) overnight and then homogenized for 2 minutes followed by centrifugation at 4000 rpm for 10 minutes. After centrifugation, the supernatant was isolated and taken for chlorophyll a determination. The optical densities of the samples were determined at 664 nm, 647 nm and 630 nm by using UV. A blank with 100% acetone was run simultaneously. Chlorophyll a content was calculated by the following formula:

Chlorophyll a (mg/L) = 11.85 (OD 664) – 1.54 (OD 647) – 0.08 (OD 630)

2.7 Total Biomass of Spirulina (*S. Platensis*)

Total biomass was calculated using the following formula:

Total biomass = Chlorophyll a x 67

2.8 Specific Growth Rates (Sgrs) of *S. Platensis*

Specific growth rate (SGR) based on dry weight, chlorophyll a content and total biomass of spirulina (Clesceri *et al*., 1989) was calculated using the following formulae

1. Specific growth rate of cultured spirulina based on a dry weight, SGR (µ/day) = $\ln(X_1\text{-}X_2)/t_1\text{-}t_2$

Where,

X_1 = Dry weight of biomass concentration at the end of selected time interval;

X_2 = Dry weight biomass concentration at beginning of selected time interval; and

t_1-t_2 =Elapsed time between selected time in the day.

2. Specific growth rate of cultured spirulina based on Chlorophyll a, SGR (µ/day) = $\ln(X_1\text{-}X_2)/t_1\text{-}t_2$

Where,

X_1 = Chlorophyll a at the end of selected time interval;

X_2 = Chlorophyll a at the beginning of selected time interval; and

t_1-t_2 = Elapsed time between selected time in the day.

3. Specific growth rate of cultured spirulina based on total biomass SGR (µ/day) = $\ln(X_1\text{-}X_2)/t_1\text{-}t_2$

Where,

X_1 = Total biomass at the end of selected time interval;

X_2 = Total biomass at the beginning of selected time interval; and

t_1-t_2 = Elapsed time between selected time in the day.

2.9 Statistical Analysis

Analysis of variance (ANOVA) of mean cell weight and chlorophyll a, crude protein, crude lipid and ash of *S. platensis* cultured in different media were done. To find whether there is any significant difference among treatment means was done by Duncan's Multiple Range Test (DMRT) using a statistical package following Zar (1984).

3. Results and Discussion

3.1 Growth Parameters of Spirulina (*S. Platensis*)

3.1.1 Optical Density of Media Contained Spirulina

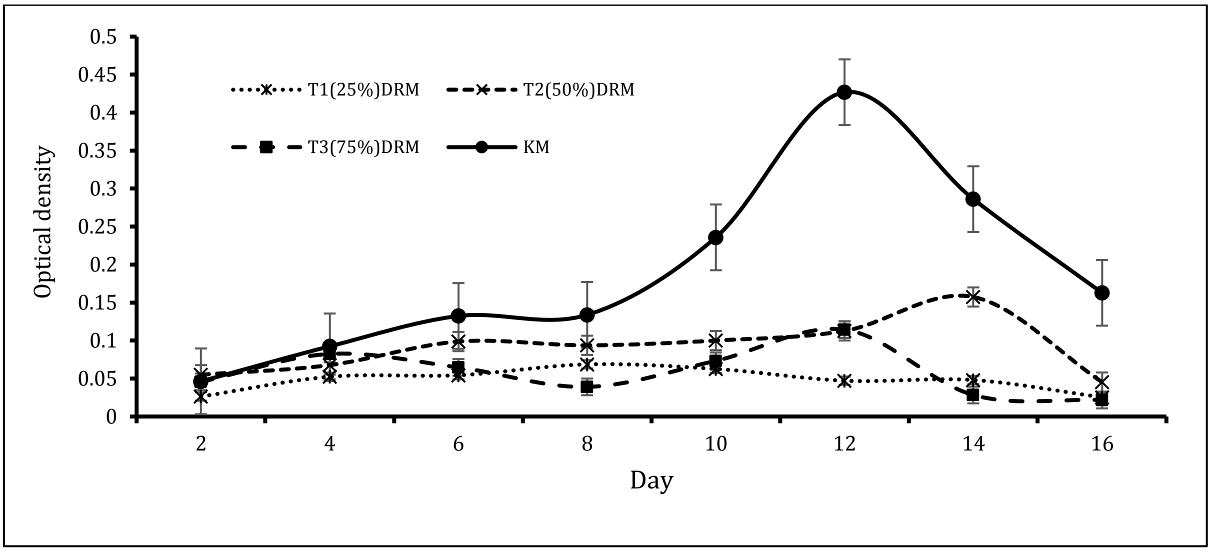

Figure 1: Mean values of optical density of media contained *S. platensis* in the supernatant of three different digested rotten mangoes, and KM. Vertical bars represent standard errors.

Optical density (OD) of media containing spirulina was found to increase up to the 14th day of the culture of all the media of DRMM and KM and then decreased up to the 12th day of the experiment (Figure 1). However, the OD of 25% DRMM contained spirulina was 0.068±0.002 g/L, whereas the highest OD of 50% DRMM contained spirulina was found 0.157±0.005 g/L (Figure 1). The OD of supernatant of 75% DRMM contained spirulina was 0.114±0.002 g/L and the highest optical density of Kosaric medium contained spirulina was 0.426±0.003 g/L (Figure 1). Soni *et al.* (2019) found that the algal cultures generated a very small amount of biomass when grown in darkness or light intensity below 1000 lux. On the other hand, higher light intensities of 1500 to 3500 lux resulted in significant biomass production. The best growth rates were obtained with a light intensity of 2500 lux.

3.1.2 Cell Weight of Spirulina

Cell weight (mg/L) of spirulina cultured in all the media was found higher on the 12th day of culture than on other days (Figure 2). Cell weight of spirulina increased from the initial day (first day) up to the 8th day (0.055±0.002 mg/L) of the culture of 25%digested DRMM and then decreased up to the 16th day (0.013±0.002 mg/L) of the experiment (Figure 2). However, the highest cell weight of spirulina was found to be 0.085±0.001 mg/L when grown in 50% DRMM. Cell weight of spirulina fluctuates from the initial day (first day) up to the 16th day (0.0102±0.001 mg/L) of the experiment (Figure 2). The highest cell weight of KM contained spirulina was 0.89±0.0021 mg/L on the 12th day and then decreased up to the 16th day of the experiment (Figure 2). Sharker (2007) conducted an experiment on the cultivation of S. platensis in various concentrations of papaya skin powder media (PSPM) and Kosaric medium for three months, carried out for 12 days and found that on the eighth day of the culture period, the starting cell weight of spirulina was 0.0004 g/L, with a maximum weight of 0.720 g/L concentrations of PSPM which supports the current study.

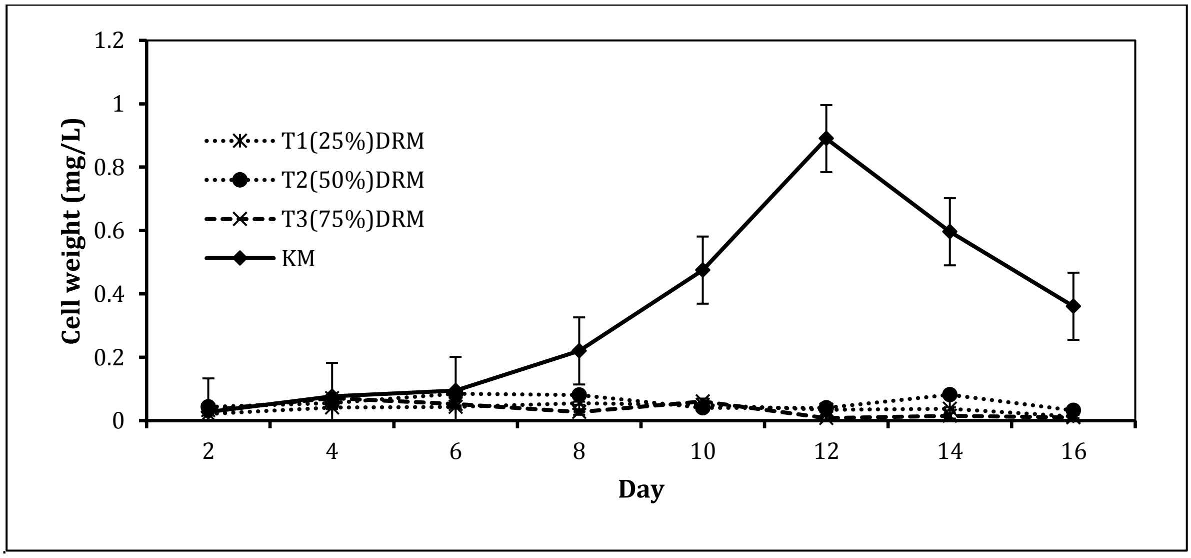

Figure 2: Mean values of cell weight (mg/L) of *S. platensis* grown in supernatant of three different digested rotten mangoes, and Kosaric medium. Vertical bars represent standard errors.

3.1.3 Chlorophyll a of Spirulina

Chlorophyll a of spirulina was found also higher on the 12th day of culture than on other days of culture of all the media (Figure 3). Chlorophyll a of spirulina increased from the first day up to the 4th day (0.042±0.002 mg/L) of the culture of 25% DRMM and then decreased up to the 16th day (0.003±0.001 mg/L) of the experiment (Figure 3). However, chlorophyll a of spirulina cultured in 50% DRMM was higher at 0.08±0.002 mg/L on the 10th day (Figure 3) and then decreased up to the 16th day of culture. Chlorophyll a of spirulina grown in 75% DRMM was 0.051±0.005 mg/L on the 12th day and then decreased on the 16th day of the experiment (Figure 3), where the highest chlorophyll a of spirulina cultured in KM was 0.854±0.003 mg/L on 12th day and decreased up to 16th day (last day) of the experiment (Figure 3). Looked at the differences in Chlorophyll a production of *S platensis* between an open pond and a closed reactor, and observed that a closed reactor with changing media (mixing with media and nutrient concentration modification) produces the best results (Soni *et al.*, 2019). Biomass was 8.568 g/l/day for OP ZM (open pond with Zarrouk media) and 10.231 g/l/day for PBR ZM (closed reactor with Zarrouk media), 11.34 g/l/day for OP MM (open pond with modified media), and 12.280 g/l/day for PBR MM (closed reactor with modified media).

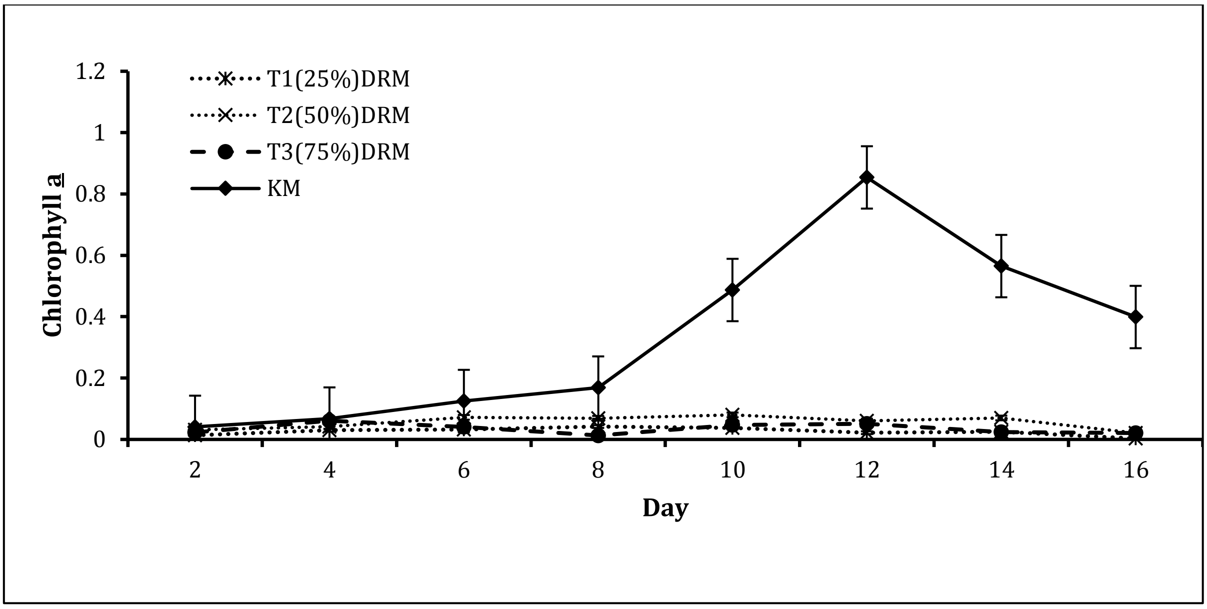

Figure 3: Mean values of chlorophyll a (mg/L) of *S. platensis* grown in supernatant of three different digested rotten mangoes, and Kosaric medium. Vertical bars represent standard errors.

3.1.4 Total Biomass of Spirulina

Total biomass (mg/L) of spirulina (*S. platensis*) grown in all the media was found to be higher on the 8th day at 25% DRMM, 6th day at 50% DRMM, 4th day at 75% DRMM and 12th day of culture in KM than other days of the experiment (Figure 4). Total biomass of spirulina was increased from the initial day (first day) up to the 8th day (2.814±0.001mg/L) in the culture of 25% DRMM and then decreased up to the 16th day (0.201±0.001 mg/L) of the experiment (Figure 4). However, the highest total biomass of spirulina grown in the culture of 50% DRMM was recorded at 4.824±0.021 mg/L on the 6th day of culture and then decreased up to the 16th day (1.407±0.043 mg/L) during the experiment (Figure 4). Again, the total biomass of spirulina cultured in the culture of 75% DRMM was increased from the first day up to the 4th day (4.084±0.023 mg/L) and then decreased up to the 16th day (1.407±0.001 mg/L) of the experiment (Figure 4). The highest total biomass of spirulina cultured in KM was found to be 56.615±0.045 mg/L on the 12th day and then decreased up to the 16th day (26.733±0.023 mg/L) during the experiment (Figure 4). Compared the dry weight (mg/L) growth rates of S. platensis in SM (standard control medium) and Reduced Cost media, finding that SM gave the highest biomass values (0.840 0.008 mg/L on the 15th day) (Madkour *et al.*, 2012). They also discovered that the growth curves for various concentrations of Reduced Cost medium displayed comparable growth rate characteristics, with peak biomass concentrations occurring between the 27th and 33rd days.

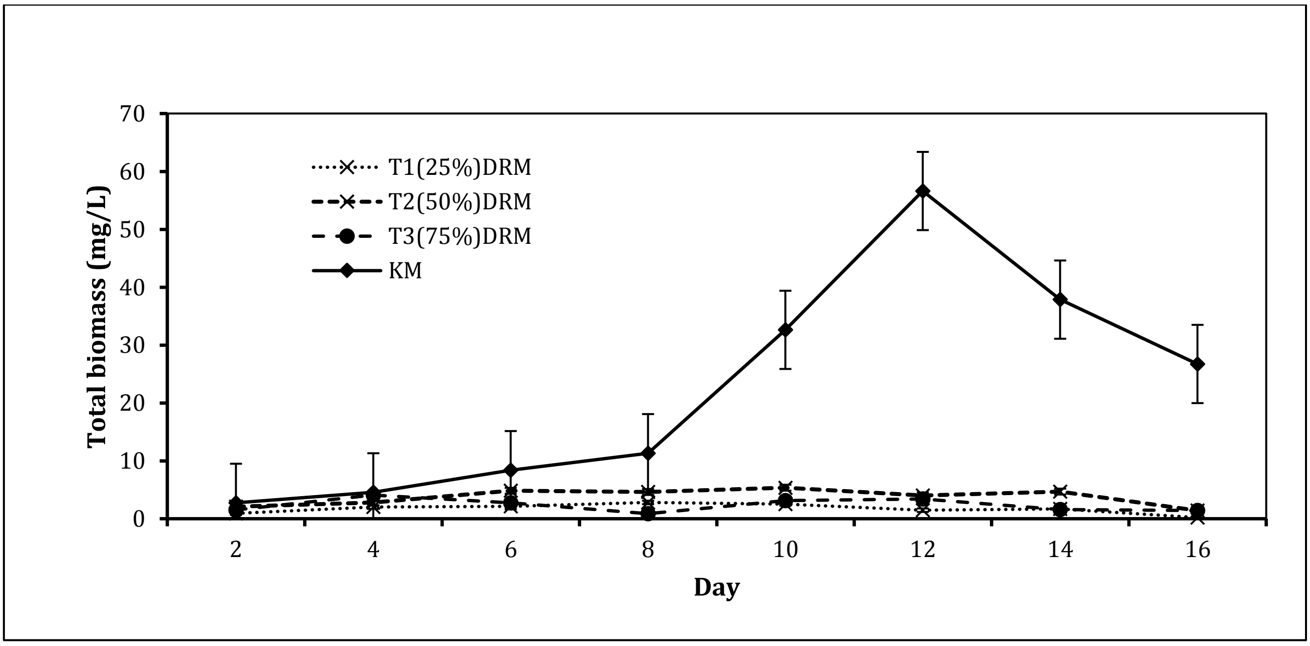

Figure 4: Mean values of total biomass (mg/L) of *S. platensis* grown in supernatant of three different digested rotten mangoes, and KM. Vertical bars represent standard errors

3.2 Comparison of Growth Parameters of Spirulina (*S. Platensis*) of 12th Day of Culture

Optical density, cell weight, chlorophyll a and total biomass of supernatant of 50% DRMM and KM contained spirulina (*S. platensis*) was significantly ($p < 0.01$) higher than that of two other media (25% DRMM) and (75% DRMM) (Table 2). There was no significant ($p > 0.05$) difference among optical density, cell weight, chlorophyll a and total biomass of 25% DRMM and KM, and among 50% and 75% DRMM during the study.

Table 2: Comparison of Optical Density, Cell Weight, Chlorophyll a and Total Biomass of *S. Platensis* Grown in Supernatant of Different DRMM, and KM on 12th Day of Culture Before Stationary Phase.

Parameters	T_1 (25% DRM)	T_2 (50% DRM)	T_3 (75% DRM)	T_4 (KM)
Optical density	0.047±0.003^b	0.112±0.002^a	0.114±0.002^b	0.426±0.003^a
Cell weight (mg/L)	0.034±0.002^b	0.04±0.003^a	0.008±0.002^b	0.89±0.0021^a
Chlorophyll a (mg/L)	0.022±0.002^b	0.06±0.004^a	0.051±0.005^b	0.854±0.003^a
Total biomass (mg/L) *	1.474±0.045^c	4.02±0.05^b	3.417±0.045^c	56.615±0.045^a

*Total biomass = Chlorophyll a x 67 (Vonshak and Richmond, 1988). Figures in common letters do not differ significantly at 5% level of probability.

3.3 Correlation Among The Growth Parameters of *S. Platensis*

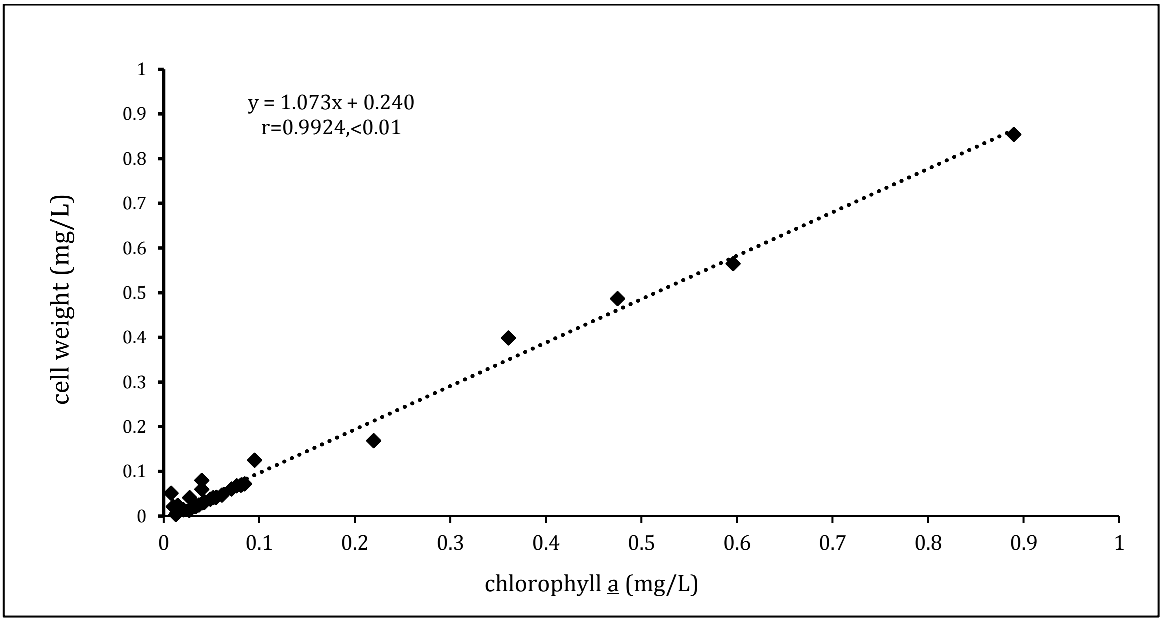

Figure 5: Correlation coefficient (r) of cell weight (mg/L) of *S. platensis* with chlorophyll a (mg/L) of spirulina grown in supernatant of three DRMM and KM.

Cell weight of *S. platensis* had highly significant ($P < 0.01$) direct correlation with chlorophyll a (r=0.9924) of spirulina grown in the supernatant of three different DRMM and KM during the study (Figure 5). Similarly, the total biomass of *S. platensis* was highly ($P < 0.01$) and directly correlated with chlorophyll a ($r = 0.999$) of spirulina cultured in the supernatant of various DRMM and KM (Figure 6). Again, the total biomass of spirulina was found to be highly ($P < 0.01$) and directly correlated with the cell weight ($r = 0.9941$) of spirulina grown in the supernatant of different DRMM and KM (Figure 7).

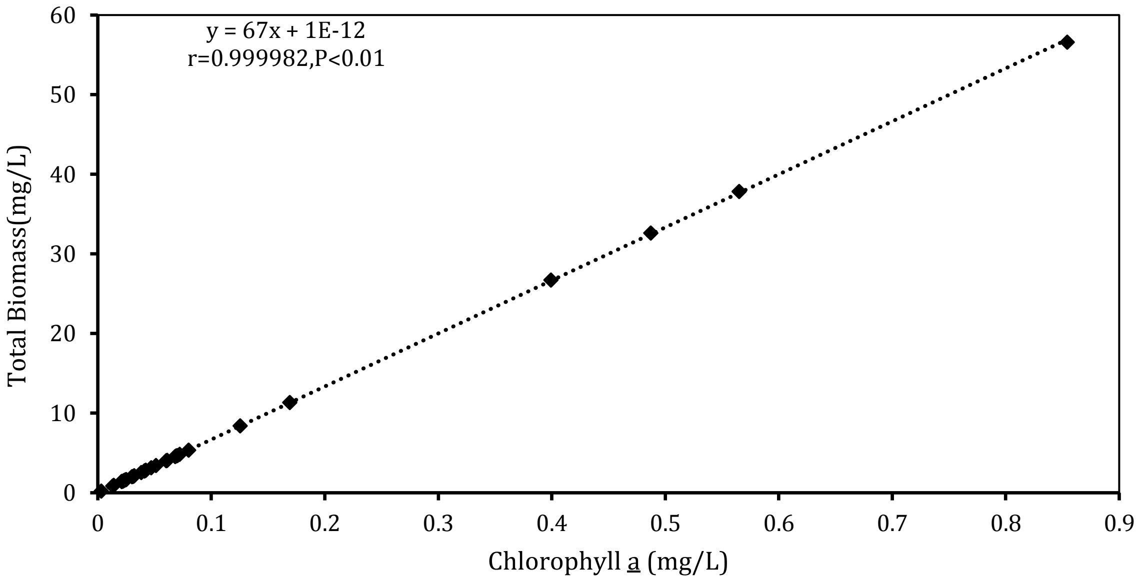

Figure 6: Correlation coefficient (r) of total biomass (mg/L) of *S. platensis* with chlorophyll a (mg/L) of spirulina grown in supernatant of three digested DRMM and KM.

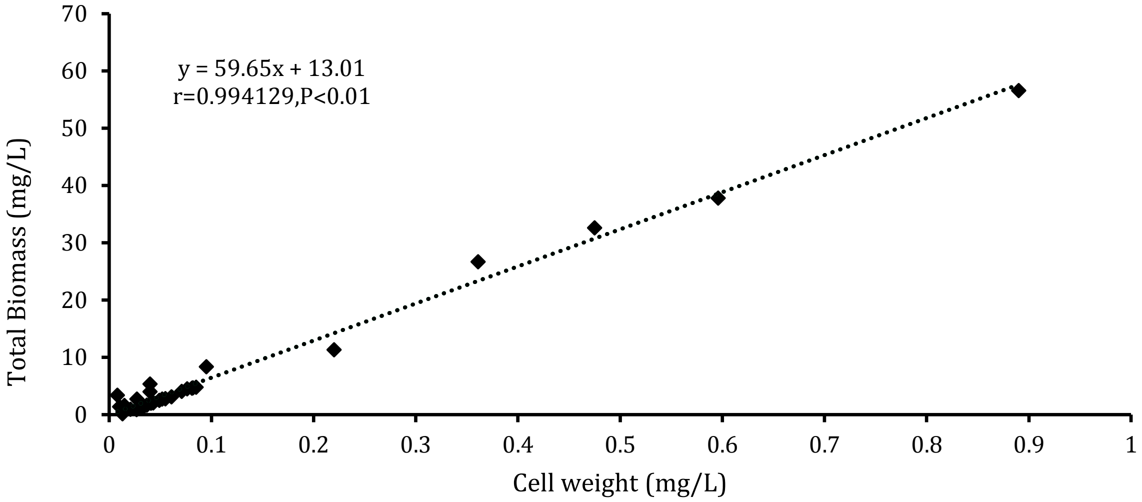

Figure 7: Correlation coefficient (r) of total biomass (mg/L) of *S. platensis* with cell weight (mg/L) of spirulina grown in supernatant of DRMM and KM.

3.4 Specific Growth Rates (Sgrs) of *S. Platensis*

The SGR concerning cell weight, chlorophyll a and total biomass of spirulina cultured in KM and supernatant of 50% DRMM was significantly ($P < 0.01$) varied from that of spirulina grown in the supernatant of 25% and 75% DRMM (Table 3). It had no significant difference in SGRs based on cell weight, chlorophyll a and total biomass when spirulina was grown in the supernatant of 25% and 75% DRMM, and a similar thing happened when spirulina was cultured in the supernatant of 25% and 75% DRMM, but there was a remarkable significant difference between SGRs of Chlorophyll a of KM and 50% supernatant of DRMM. Investigated the cultivation and generation of housefly larvae and spirulina from chicken waste, as well as its utilization as a diet for post-larvae catfish (Satter, 2017). He created spirulina and employed it as a major feed element to replace fish meal up to 100%, but the catfish grew well after being given a diet that included 25% fish meal, 50% spirulina meal, and 25% maggot meal. He also had good results with post-larvae-fed diets that had 25% fish meal and 75% spirulina meal, as well as a diet that contained 100% spirulina meal. During the culture of *S. platensis* in 25, 50, and 75 percent digested poultry waste (DPW), the 25 percent DPW showed superior growth at the same outcome as the current investigation.

Table 3: Specific Growth Rates (Sgrs) on The Basis of Cell Weight, Chlorophyll a and Total Biomass of *S. Platensis* Grown in Supernatant of Different DRMM, and KM.

Parameters	T_1 (25%of DRMM)	T_2 (50% of DRMM)	T_3 (75% of DRMM)	T_4 (KM)
SGR of cell weight	0.021 ± 0.002^c	0.085 ± 0.002^b	0.052 ± 0.003^c	0.30 ± 0.002^a
SGR of Chlorophyll a	0.032 ± 0.002^c	0.072 ± 0.03^b	0.061 ± 0.003^c	0.28 ± 0.004^a
SGR of total biomass	0.28 ± 0.021^c	0.48 ± 0.033^b	0.40 ± 0.043^c	0.81 ± 0.024^a

N.B. Figures in common letters in the same row do not differ significantly at 5% level of probability.

3.5 Temperature

Temperature around culture media was higher than the ambient temperature due to light intensity. The temperature (°C) of all the culture media was varied with slight ineffective fluctuations. However, the temperature around the culture of supernatant of 25% digested rotten mango media (DRMM) was found 21.57 ± 0.12 °C on the first day to 22.76 ± 0.03 °C at the end (16th day) of experiment with slight up on 22.66 ± .24 12th day of experiment. It was also follow the similar trend of fluctuation from first to last day of experiment when spirulina cultured in supernatant of 50% digested rotten mango media (DRMM). and 75% DRMM. But it was recorded 22.48 ± 0.03 °C on the first day of experiment to 23.63± 0.03 °C at the end of experiment when spirulina grown in Kosaric medium.

3.6 Light Intensity

It was varied slightly in different days in all the four culture media. However, light intensity (lux/m^2/s) was varied from 2725 ±1.85 on first day to 2742 ± 3.21 lux/m^2/s on the last day with slight variation in other days when spirulina grown in supernatant of 25% digested rotten mango media (DRMM). It was varied from 2742 ± 3.21 on first day to 2743± 3.92 lux /m^2/s on the last day of experiment when spirulina cultured in supernatant of 50% digested rotten mango media (DRMM). Similarly, it was observed 2742± 3.8 on the first day and 2752 ± 2.6 on the last day (12th day) of experiment when spirulina grown in supernatant of 75% digested rotten mango media (DRMM) where the maximum value 2760±5.29 on 8th day. Light intensity was found to be 2720 ± 2.3 lux /m^2/s on first day when spirulina grown in Kosaric medium and 2750± 3.17 lux /m^2/s on the last day (16th day) of experiment.

4. Conclusion

The experiment was carried out to evaluate the growth properties of digested rotten mango (*Mangifera indica*) employed as spirulina (*Spirulina platensis*) production medium for sixteen days after 26 days of digestion. Three different concentrations of DRM (digested rotten mango) were used: 25%, 50%, and 75% and were determined every other day, the growth characteristics of the cultured media, such as optical density, cell weight, chlorophyll a, and total biomass. As rotten mango contains a lot of broken organic and inorganic nutrients, as well as a lot of total dissolved solids, total suspended solids, nitrate, phosphate, and inorganic nutrients, it can be utilized to produce spirulina. During the culture of S. platensis, spirulina grows well in the supernatant of 50% digested rotten mango due to suitable and favorable levels of nutrients in 50% DRMM compared to other concentrations of DRMM, which is fairly equal to spirulina growth in Kosaric medium. To grow spirulina, a 50% digested rotten mango supernatant must be employed. Because of the usage of rotten mango, the environment may be safe and healthy, and so there is a significant risk of large-scale rotten mango being used for commercially cultured spirulina and promoted as stay food for good production and fish health control. This research opened a new era for low cost live food production as a result fish production cost will be reduced. Fish farmers and hatchery owner will be benefited by this research outcome.

References

Baroi, B., Rahman, M. H., Rohani, M. F., Hossain, M. S., 2019. Effect of dietary vitamin C on growth and survival of GIFT Tilapia. Bangladesh Open University Journal of Agriculture & Rural Development, 11(2), pp. 37-42.

Clesceri, L. S., Greenberg, A. E., Trussell, R. R., 1989. Standard Methods for the Examination of Water and Waste water. American Public Health Association, American Water Works Association and Water Pollution Control Federation. 17th Edition., 2015 Washington D.C., USA, pp. 10-203.

Habib, M. A. B., 1998. Culture of selected microalgae in rubber and palm oil effluents and their use in the production of enriched rotifers. Doctoral Thesis, University of Putra. Malaysia, pp. 532.

Hossain, M. A. A., Rahman, M. H., Hossain, M. S., Habib, M. A. B., Uddin, M. A. & Sarker, F., 2021. Smart production of spirulina (*Spirulina platensis*) using supernatant of digested rotten potato (*Solanum tuberosum*). Journal of Agriculture, Food and Environment (JAFE), 2(1), pp. 62-69. http://doi.org/10.47440/JAFE.2021.2111

Jung, F., Krüger-Genge, A., Waldeck, P., Küpper, J. H., 2019. *Spirulina platensis*, a super food? Journal of Cellular Biotechnology, 5(1), pp. 43-54.

Madkour, F. F., Kamil, A. E. W., Nasr, H. S., 2012. Production and nutritive value of *Spirulina platensis* in reduced cost media. The egyptian journal of aquatic research, 38(1), pp. 51-57.

Mahmud, M. T., Rahman, M. M., Shathi, A. A., Rahman, M. H., and Islam, M. S., 2021. Growth variation of tilapia (*Oreochromis niloticus*) with variation of environmental parameters. Journal of Agriculture, Food and Environment (JAFE), 2(2), pp. 75-79.

Mahmuda M., Rahman M. H., Bashar A., Rohani M. F., & Hossain M. S., 2020. Heavy metal contamination in tilapia, *Oreochromis niloticus* collected from different fish markets of Mymensingh District. Journal of Agriculture, Food and Environment (JAFE) 1(4), pp. 1-5.

Mosha, S. S., 2019. The Significance of Spirulina Meal on Fishmeal Replacement in Aquaculture: A Review. Journal of Fisheries and Aquaculture Development, pp. 145.

Phang, S. M., Chu, W. L., 1999. University of Malaya Algae Culture Collection (UMACC). Catalogue of Strain. Institute of Postgraduate Studies and Research, University of Malaya, Kualalumpur, Malaysia, pp. 77.

Ravi, M., De, S. L., Azharuddin, S., Paul, S. F., 2010. The beneficial effects of Spirulina focusing on its immunomodulatory and antioxidant properties. Nutrition and Dietary Supplements, 2, pp. 73-83.

Rahman, M. H., Mahmud, M. T., Hossain, M. S., Mou, A. T., Sarker, F., and Rahman, U. O., 2021. Variation of production performance of Gulsha (*Mystus cavasius*) monoculture with variation of water and soil quality parameters. Journal of Agriculture, Food and Environment (JAFE), 2(4), pp. 59-64.

Rahman, M. H., Rahman, U. O., Akter, F., Baten, M. A., Uddin, M. A.,. Bhuiyan, A. N. M. R. K & Mou A. T., 2021. Physico-chemical properties of digested rotten potato (*Solanum tuberosum*) used as a production medium of spirulina (*Spirulina platensis*). Journal of Agriculture, Food and Environment (JAFE), 2(4), pp. 52-58.

Rahman, M. H., Khan, A. A. I., Habib, M. A., Hossain, M. S., 2022. Evaluation of Sugar Mill By-product Molasses as a Low Cost Culture Media for Microalgae. Aquaculture Studies, 22(4), AQUAST776. http://doi.org/10.4194/AQUAST776

Satter, A., 2017. Culture and production of housefly larva and Spirulina using poultry waste, and their use as food for catfish post-larvae, PhD Thesis, Department of Aquaculture, Bangladesh Agricultural University, Mymensingh.

Shah, K. A., Patel, M. B., Patel, R. J., Parmar, P. K., 2010. *Mangifera indica* (mango). Pharmacognosy reviews, 4(7), pp. 42.

Sharker, M. G. U., Miah, M. I., Rahman, M. M., Habib, M. A. B., 2007. Culture of *Spirulina platensis* in various concentrations of papaya skin powder medium. Journal of the Bangladesh Agricultural University, 5(452-2018-3950), pp. 117-128.

Soni, R. A., Sudhakar, K., Rana, R. S., 2019. Comparative study on the growth performance of *Spirulina platensis* on modifying culture media. Energy Reports, 5, pp. 327-336.

Torzillo, G., Pushparaj, B., 1986. A new procedure for obtaining pure cultures of *Spirulina platensis* and *Spirulina maxima*. Annales Microbiology, 135, pp. 165-173.

Uddin, M. M., Nur, N.N., Parvin, M., Habib, M.A.B., 2007. Culture of Chlorella Ellipsoidea in supernatant of different concentrations of digested potato powder. Pakistan Journal of Scientific and Industrial Research, 50(3), pp. 199-203.

Uddin, M. A., Hassan, R., Halim, K. M. A., Aktar, M. N. A. S., Yeasmin, M. F., Rahman, M. H., Ahmed, M. U., & Ahmed, G. U., 2020. Effects of aqua drugs and chemicals on the farmed shrimp (*Penaeus monodon*) in southern coastal region of Bangladesh. Asian Journal of Medical and Biological Research, 6(3), pp. 491-498.

Vonshak, J., Richmond, A., 1988. Spirulina. In, Borowitzka, M.A., Borowitzka, L (editions). Microalgal Biotechnology, Cambridge U.P., Cambridge, UK, pp. 85-121.

Zar, J. H., 1984. Biostatistics. Prentice-Hall Inc., Englewood Cliffs, New Jersey, USA, pp. 718.

Zarrouk, C., 1996. Contribution al'etuded'unecyanobacterie: influence de divers facteurs physiques et chimiquessur la croissance et la photosynthese de *Spirulina maxima* (Setchell et Gardner) Geitler. PhD thesis, University of Paris, France.