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Cost-Effective Cultivation of *Spirulina platensis* Using Digested Banana Supernatant

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ABSTRACT

An experiment was conducted to assess the culture and production of spirulina (*Spirulina platensis*) in three distinct concentrations of digested rotten banana supernatants (*Musa acuminata*), and Kosaric medium (KM) as control. Two hundred grams of rotten banana was allowed to digest using aeration in 5.0L glass jar. After 30 days, an almost colorless supernatant was obtained. This supernatant was filtered using a 30 µm mesh and supplemented with 9.0 g/L $NaHCO_3$, 0.20 g/L urea, and micronutrients. Three distinct concentrations of the supernatant (20, 40, and 60%) were prepared, each with three replications. Spirulina reached its maximum cell weight (dry wt. basis) of 16.44 ± 0.78mg/ L in KM followed by 11.876 ± 0.798, 9.724 ± 0.288 and 1.833 ± 0.263mg/ L in the supernatants of 40, 60 and 20% DRBM, respectively, on the 10th day of culture. A comparable pattern was also noted in the case of visual density of the media contained spirulina, total biomass (mg/L), chlorophyll a content (mg/L), specific growth rates based on cell weight and chlorophyll a) of spirulina. Cell weight of *S. platensis* had significant (P<0.05) direct correlation with chlorophyll a (r = 0.426) of spirulina grown in the supernatants of different DRBM, and Kosaric medium. On the other hand, total biomass of *S. platensis* had a significantly (P< 0.05) close relationship with chlorophyll a (r= 0.404) of spirulina grown in different DRBM supernatants, and Kosaric medium. The results showed a substantial (P<0.05) and direct correlation between the cell weight and the total biomass of spirulina (r = 0.421) of spirulina grown in the supernatant of different DRBM, and Kosaric medium. We might conclude that 40% digested rotten banana medium can be used for *S. platensis* mass cultivation.

INTRODUCTION

Bangladesh is the world's largest deltaic nation **(Tandra *et al.*, 2019; Mahmuda *et al.*, 2020; Rahman *et al.*, 2021)**. Additionally, as noted by **Baroi *et al.* (2019)**, **Islam *et al.* (2020)** and **Mahmuda *et al.* (2020)**, the subsector of fisheries and aquaculture is essential in mitigating the adverse effects of protein shortage. Aquaculture is becoming a

more significant method of fish production as a result of Bangladesh's diminishing natural fisheries resources and expanding human population **(Mahmud *et al.*, 2021; Nasrin *et al.*, 2021; Rahman *et al.*, 2021; Noor *et al.*, 2024)**. The sub-sector of fisheries accounts for 1.24% of the country's total export revenue, 26.50% of its agricultural GDP, and 3.57% of its total GDP according to **Mou *et al.* (2023)**. Microalgae are extremely useful for fish health. Microalgae can be utilizeed rather than utilizing chemical in aquaculture **(Uddin *et al.*, 2020; Rahman *et. al.*, 2022)**. The multicellular, filamentous algae spirulina has grown in popularity in the health food sector and as an increasingly popular addition to aquaculture feeds, being a source of protein and vitamins. Spirulina is a multicellular, blue-green algae. They are extremely small and range in length from 300 to 500µm **(Hossain *et al.*, 2021)**. Fish that eat microalgae have improved nutritional absorption. Through better digestion, increased feed conversion efficiency, and improved nutrient absorption and utilization, silica nanoparticles can improve the growth performance and survival rate of a range of fish species **(Murshed *et al.*, 2023)**. Since ancient times, people have used spirulina as nourishment because of its high nutritious value. Up to 70% protein, significant levels of fatty acids (1822%), essential amino acids, minerals, vitamins (particularly B_{12}), antioxidants, pigments (phycobili proteins and carotenoids), and polysaccharides have all been found to be present in spirulina **(Noor *et al.*, 2024)**. Its production can be done on many different sizes, from vigorous commercial expansion across enormous areas to "pot culture" in the home. Its production is especially well-suited to saline and alkaline environments, which are usually unsuitable for traditional crops and are often populated by underprivileged individuals who are either victims of or susceptible to natural disasters. Bangladesh's advantageous geographic location attracts a wide variety of aquatic animals and an abundance of resources that can sustain its potential for fishing. Millions of people rely on the production of fish for their livelihoods and jobs; it is Bangladesh's second most valued agricultural crop, after rice. Therefore, fish culture and consumption have a significant impact on both food security and national wealth. The current state of affairs necessitates a rapid expansion in fish production, and the development of fish production is heavily dependent on the quality and amount of food available. Rotten banana are one of the blooming wastes in our country. In the nation, between 12 and 15 percent of bananas rot, this number is rising daily, resulting in enormous amounts of banana waste annually. Protein, carbohydrates, minerals, fat, vitamins, and phosphorus are all present in bananas. This phosphorus may have contributed to the production of elevated phospholipids, which in turn may have raised the overall lipid content **(Lu & Takeuchi, 2004)**. *Spirulina platensis* could be created using this cheap waste material. Reduced-cost spirulina is required when thinking about industrial-scale, large-scale farming. Zarrouk's medium has been the standard medium (SM) used for a long time to cultivate spirulina, with good results. According to **Zarrouk (1996)**, the cost of nutrients is assumed to be the second major element impacting the cost of producing spirulina biomass, after labor. The present investigation's

objective was to examine the spirulina (*Spirulina platensis*) culture and growth performance in rotten banana media. This experiment's main objective was to provide inexpensive media for spirulina production on a massive scale. The findings of this study will usher in a new era of inexpensive live feed production as well as inexpensive fish and crustacean feed.

MATERIALS AND METHODS

Study area

The experiment was conducted at the Department of Aquaculture, Faculty of Fisheries, Bangladesh Agricultural University (BAU) (Fig.1).

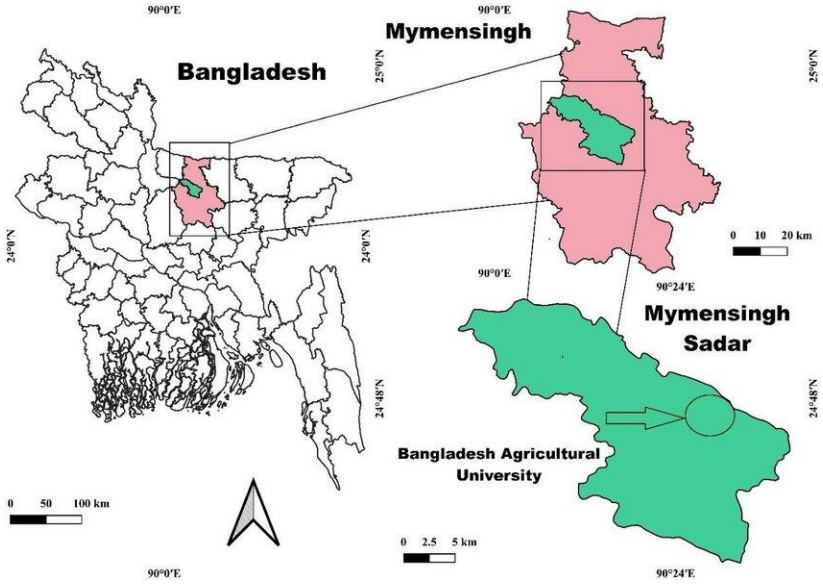

Fig. 1. The place from where the rotten banana was collected and experiment was conducted

The Microalgae culture

Picking and gathering of spoiled bananas

The spoiled banana was chosen for the culture of *Spirulina platensis* investigation. The rotten banana was retrieved from Bangladesh Agricultural University, Mymensingh, Kamal Ranjit (KR) Market.

Preservation of an unadulterated Spirulina platensis stock culture

In the lab, a pure stock culture of *Spirulina platensis* was kept in Kosaric medium (KM) **(modified after Zarrouk, 1996)**. Every other day, the growth of *Spirulina platensis* was observed, and its purity was verified under a microscope. The source of *S. platensis* used in the experiment was the Live Food Culture Laboratory at Bangladesh Agricultural University, where continuous culture of *S. platensis* was maintained. After collection, the spirulina was dried and preserved in a standard refrigerator.

Making the Kosaric medium (KM) and the digested rotten banana medium (DRBM)

In a 5.0L glass container, 200g/ 4L of dry rotten banana was allowed to decompose for a day in an aerobic environment at the Department of Aquaculture, Live Food Culture Laboratory, BAU, Mymensingh. Subsequently, the bottle supernatant was diluted to create three concentrations: 20, 40, and 60% digested rotten banana. Next, three replications of the supernatant at three distinct concentrations were collected into a 1.0L flask. Kosaric medium (KM) was made for the *S. platensis* using culture as a brake at the same time (Table 1). To cultivate *Spirulina platensis*, compositions of Kosaric medium (KM) and rotten banana medium (RBM) were made. Tables (2, 3) display the rotten banana medium and kosaric medium, respectively, in varying concentrations and compositions. The collected samples were initially broken down by aerating them in a 5-liter volumetric flask containing 3 liters of distilled water to prepare the supernatant from rotten bananas. After several days, when the concentration of the juice became less dense, an additional 1 liter of distilled water was added to the flask. The total amount of rotten banana used was 200g. It is important to note that a consistent concentration of 200g/ 4L of rotten banana was maintained throughout the digestion process. When the banana's 22-day digestion was finished, the supernatant was removed from the flask and filtered through plankton net. Subsequently, three replications of the digested rotting banana were diluted with distilled water following the preceding instructions. After that, the medium was thoroughly combined and autoclaved at high pressure with bumping water for 15 minutes at 121°C. The media were autoclaved and then left for three days to ensure that there was no contamination before microalgae were cultured.

Table 1. Concentration of digested rotten banana medium (DRBM) for *Spirulina platensis*

Sl. No.	Rotten banana ingredients	Concentration/dilution of RBM (%)
1.	Digested rotten Banana medium (DRBM)	20
2.	Digested rotten Banana medium (DRBM)	40
3.	Digested rotten Banana medium (DRBM)	60

Preparation of media of control

The elements listed in Table (2) (numbers 1 through 8) were weighed using an electronic balance to prepare the control medium. The resulting mixture was then placed into a 1.0L conical flask. We pipetted 0.5ml of the micronutrient solution into the flask and then added distilled water to create a volume of 1.0L. Mixing, autoclaving, and cooling were done in order to follow the protocol used to prepare RBM.

Table 2. Composition of Kosaric medium **(Modified after Zarrouk, 1996)** for *Spirulina platensis* culture

Sl. No.	Chemicals/compounds	Concentration in stock solution g/l
1	$NaHCO_3$	9.0
2	K_2HPO_4	0.250
3	$NaNO_3$	1.250
4	K_2SO_4	0.50
5	NaCl	0.50
6	$MgSO_4$ 7H2O	0.10
7	$CaCl_2$	0.02
8	$FeSO_4$ .2H_2O	0.005
9	A_5 micronutrient solution	0.5ml/L
	a) A_5 micronutrient solution	G/L
	i) HBO_4	2.86
	ii) $MnCl_2$.4H_2O	1.81
	iii) $ZnSO_4$.7H_2O	0.22
	iv) CuSO4.7H_2O	0.08
	v) MoO_3	0.01
	vi) $CoCl_2$. 6H_2O	0.01

Design of *Spirulina platensis* cultivation experimentation

To cultivate *Spirulina platensis*, three different types of media were used: rotten banana medium (RBM), kosaric medium (KM), and others. From the stock culture, inoculum *Spirulina platensis* was obtained. Table (3) displays the experimental design. The cultivation process of spirulina is shown in Fig. (2).

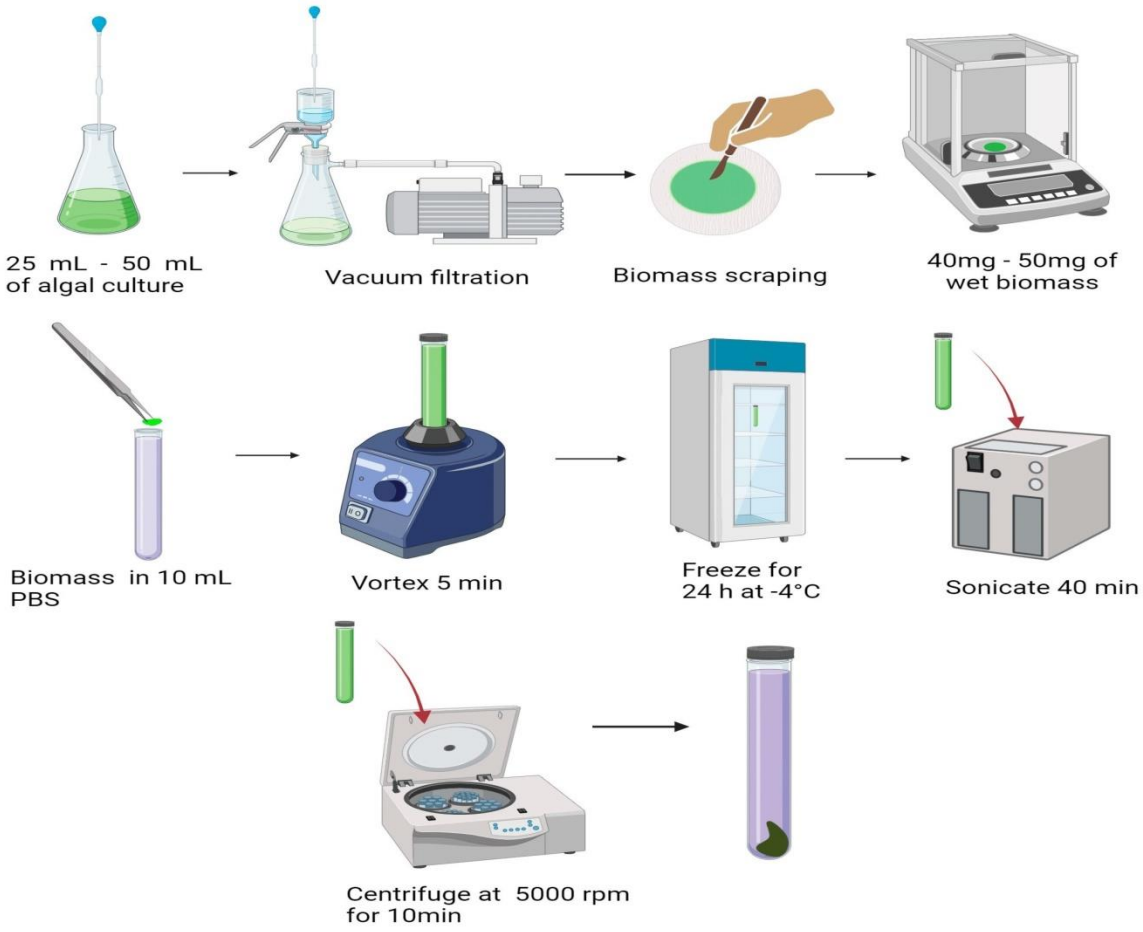

Fig. 2. The bioreactor of *Spirulina platensis* cultivation process

Table 3. Three distinct concentrations of the digested rotten banana supernatant (DRB), diluted and used to cultivate spirulina

Type of medium	Treatment	Replications	Amounts of digested rotten Banana(ml/L)	Duration of culture (days)
Supernatant of DRB	1	3	20	14
	2	3	40	
	3	3	60	
Kosaric Medium (KM)	4	3	-	14

Culture of *Spirulina platensis* in the KM and DRBM

Four treatments were used to grow microalgae, or spirulina, in a 1.0L volumetric flask: three from the DRBM supernatant at three different concentrations (20, 40, and 60%) and one KM as a control with three replications. Spirulina was added to each culture flask in order to produce a culture with a 10% spirulina suspension **(Habib, 1998)**. To reach the required density, 20 milliliters of spirulina suspension are required. In the Live Food Culture Laboratory, all of the flasks were maintained in a light-dark (12 h:12 h) environment under fluorescent lamps. Utilizing an electric aerator for aquariums, these culture flasks were continuously aerated. To measure the dry cell weight, spirulina's chlorophyll a content, and the characteristics of the culture media, eight sub-samplings (15ml vial) were taken from each flask on alternate days. Overnight, dry heat at 70°C was used to disinfect all of the glassware used in the experiment.

Estimation of *Spirulina platensis* cell weight and chlorophyll a

The specimen, containing 20 milliliters of spirulina suspension, was passed through a Sartorius filter paper with a 47mm diameter and 0.45um mesh size. Before filtering, the filter sheets were weighed and dried at 70°C for 24 hours overnight. To get rid of insoluble salts, the filtered samples were rinsed three times. Subsequently, the filter papers were placed in a glass dish and were allowed to cool in an oven set at 70°C for the entire night. Before the filter papers were weighed, the petri dish was placed in a desiccator for 20 minutes. The following equation was used to calculate the algae's dry weight on the filter paper:

$$\text{Dry weight (mg/L), } W=\frac{FFW-IFW}{\text{Amount of sample taken for filtration (ml)}}X100$$

Where,

W = Cell dry weight in mg/L; FFW = Final filter paper weight in g; and IFW = Initial filter paper weight in g.

Estimation of chlorophyll a of spirulina

The amount of chlorophyll a in the *Spirulina platensis* samples was assessed after they were collected at various intervals. An electric filtration device was used to filter 10 milliliters of the *S. platensis* sample using Sartorius filter paper, which has a 0.45µm mesh size and measures 47mm. These filtered samples were placed in test tubes with filter paper, powdered with a glass rod, and then combined with 10 milliliters of 100% redistilled acetone. To avoid light from coming into touch with the test tubes, foil papers were wrapped around each one. Overnight, the test tubes previously wrapped were stored in the laboratory refrigerator. Chilled samples were then centrifuged for 10 minutes at 4000rpm after being homogenized for 2 minutes. The supernatant was separated and taken for chlorophyll analysis after centrifugation. The samples' optical densities were

calculated at 664nm utilizing a UV spectrophotometer at wavelengths of 647 and 630nm **(Clesceri *et al*,. 1989)**. Simultaneously, a blank using 100% acetone was run. **Clesceri *et al.* (1989)** provided the following formula for calculating the concentration of chlorophyll a:

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

Total spirulina biomass

Vonshak and Richmond (1988) provided the following formula, which was used to compute total biomass: Total biomass = Chlorophyll a x 67

RESULTS

Measures of spirulina growth

The spirulina-containing media's optical density

When spirulina was cultivated in the supernatant of 20% DRB, the optical density (OD) of the medium containing the spirulina increased up to the eighth day (0.285 ± 0.085) and then declined up to the fourteenth day (0.126 ± 0.054) (Fig. 3). When spirulina was grown in the 40% DRB supernatant, it peaked on day 10 (1.859 ± 0.102) and subsequently started to decline until day 14 (1.203 ± 0.096) (Fig. 3). On the tenth day of the experiment, it was discovered (1.237 ± 0.082) in the medium of the 60% DRB supernatant, and it reduced until the fourteenth day. On the tenth day of the experiment, it was measured in Kosaric medium (2.64 ± 0.114), and it decreased until the fourteenth day (1.762 ± 0.093) (Fig. 3).

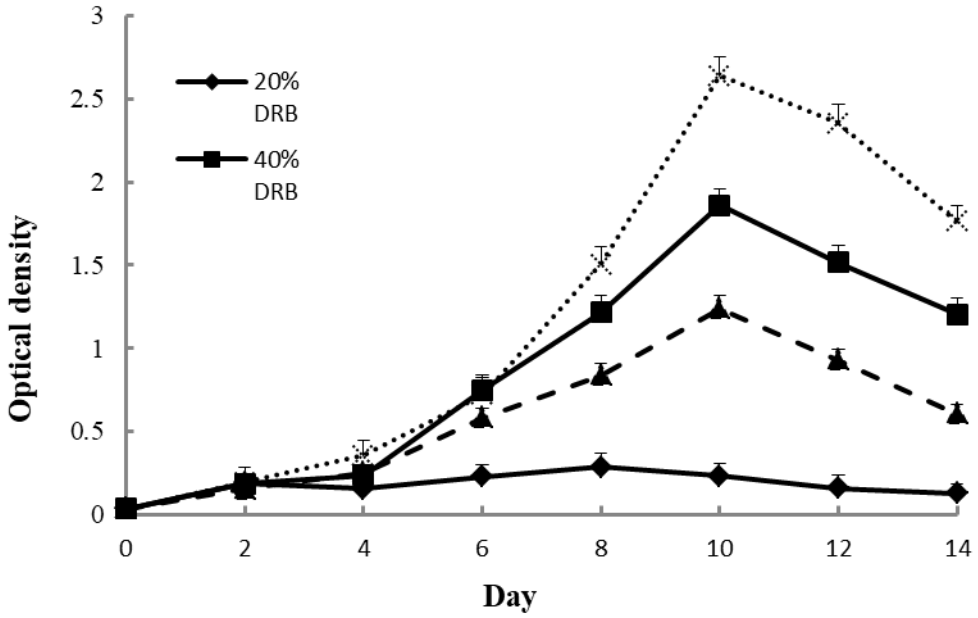

Fig. 3. Mean values of optical density of media containing *Spirulina platensis* in supernatant of three different digested rotten banana, and Kosaric medium

Cell weight of spirulina

The experiment's cell weight of spirulina showed a rise from the first day (0.0022 ± 0mg/L) to the eighth day (2.034 ± 0.276mg/ L) when it was cultured in 20% digested rotten banana (DRB). However, it thereafter reduced until the fourteenth day (1.017 ± 0.195mg/ L) (Fig. 4). When grown in a 40% DRB medium, spirulina's maximum cell weight was reported to be 11.876 ± 0.534mg/ L on the tenth day of culture, and it decreased until the fourteenth day (Fig. 4). Spirulina cell weight rose in a clear growth trend from the first day of culture in 60% DRBM (0.0022 ± 0mg/ L) to the tenth day (9.724 ± 0.288mg/ L) (Fig. 4). The Kosaric medium with spirulina reached its maximum cell weight on day 10, at 16.44 ± 0.78mg/ L, compared to the opening day of 0.0022 ± 0mg/ L. On day 14, it fell to 11.44 ± 0.28mg/ L (Fig. 4). In every growth medium containing digested rotten banana, the cell weight of spirulina exhibited a distinct fluctuating tendency.

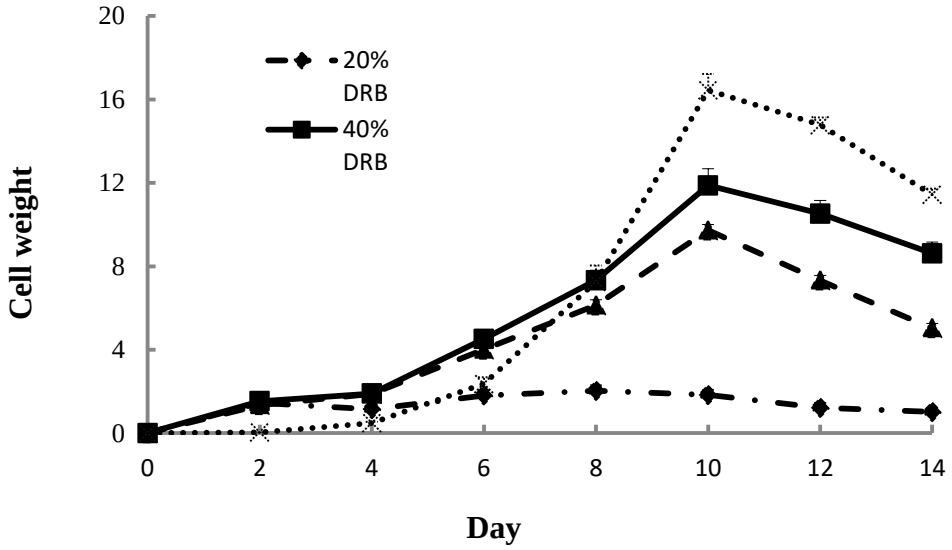

Fig. 4. *Spirulina platensis* cultured in the supernatant of three digested rotten bananas and Kosaric medium: mean values of cell weight (mg/L).

Chlorophyll a of spirulina

Spirulina's chlorophyll a content rose from the first day (0.0015 ± 0mg/ L) to the eighth day (1.573 ± 0.212mg/ L) of a culture of 20% digested rotten banana medium (DRBM), and subsequently fell until the experiment's fourteenth day (0.8491 ± 0.077mg/ L) (Fig. 5). Conversely, though, the amount of chlorophyll a in spirulina grown in 40% DRBM peaked on day 10 (10.219 ± 0.351mg/ L), and thereafter decreased until day 14 of the experiment (Fig. 5). Spirulina grown in 60% DRBM had higher levels of chlorophyll a (8.493 ± 0.131g/ L) on day 10 compared to other days, and thereafter the levels declined until day 14 (4.25 ± 0.432mg/ L) of the experiment (Fig. 5). Spirulina grown on Kosaric medium had the highest chlorophyll a content on day 10, at 14.96 ± 0.462g/ L, which fell until day 14, recording 10.56 ± 0.46mg/ L (Fig. 5).

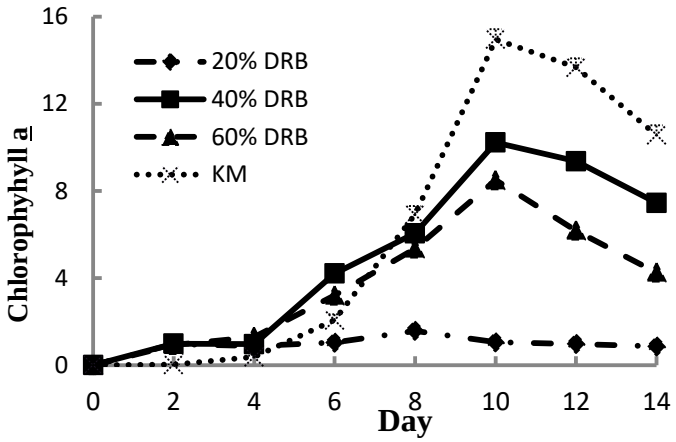

Fig. 5. *Spirulna platensis* growing in the supernatant of three distinct digested rotting bananas and Kosaric medium, measured for mean concentrations of chlorophyll a (mg/L)

Total biomass of spirulina

The 10th day of culture showed a larger total biomass (mg/L) of spirulina developed in all the media compared to the other days of the experiment (Fig. 6). In the culture of 20% digested rotten banana medium (DRBM), the total biomass of spirulina grew from the first day (0.1005) to the eighth day (105.39 ± 24.40g/ L), and subsequently dropped until the fourteenth day (57.55 ± 17.40mg/ L) of the experiment (Fig. 6). The maximum total biomass of spirulina cultivated in a 40% DRBM culture was measured on day 10 at 684.67 ± 40.7g/ L. During the experiment, this biomass declined until day 14 at 499.22 ± 33.20mg/ L (Fig. 6). Once more, the total biomass of spirulina grown in a 60% DRBM culture was increased from the first day (0.1005) up to the 10th day (569.03 ± 13.20mg/ L), and then decreased up to the 14th day (284.75 ± 30.2g/ L) of the experiment (Fig. 6). The most biomass overall of spirulina grown in Kosaric medium was found to be 1002.32 ± 37.60mg/ L on the 10th day, and then fell till the fourteenth day (707.52 ± 25.20mg/ L) during the experiment (Fig. 6).

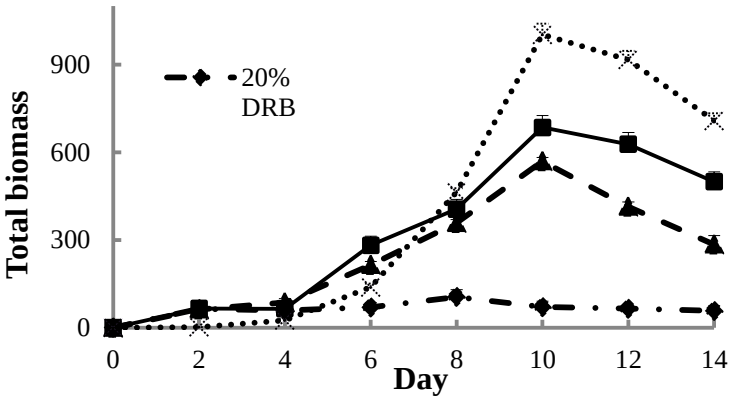

Fig. 6. *Spirulina platensis* grew in the supernatant of three distinct digested rotten banana and Kosaric medium. Mean values of total biomass (mg/L)

Comparison of the spirulina's growth characteristics at 10th day of culture

Optical density of media contained spirulina

The optical density of the Kosaric medium containing *Spirulina platensis* was found to be considerably ($P< 0.05$) greater than that of the 40% DRB supernatant, 20% DRB, and 60% DRB supernatant (Table 4). Throughout the investigation, the optical densities of the medium containing 40, 60, and 20% DRB varied significantly ($P< 0.05$).

Cell weight of spirulina

Spirulina (*S. platensis*) cultivated on Kosaric medium was shown to have the highest cell weight (mg/L) (Table 4). Table (4) shows a substantial ($P< 0.05$) variation in cell weight between spirulina grown in Kosaric medium and that cultured in the supernatant of 40% DRB medium, followed by 60% and 20% DRB. The cell weights of spirulina cultivated in 40, 20, and 60% DRB media varied significantly ($P> 0.05$).

Table 4. *Spirulina platensis* cultivated in supernatant of 20% DRB on the eighth day, 40 and 60% DRB on the tenth day, and Kosaric medim on the tenth day of culture prior to stationary phase, compared for cell weight, chlorophyll a, and total biomass

Parameter	T1 (20% DRBM)	T2 (40% DRBM)	T3 (60% DRBM)	T4 (KM)
Optical density	0.285 ± 0.085^{d}	1.859 ± 0.102^{b}	1.237 ± 0.08^{c}	2.64 ± 0.114^{a}
Cell weight (mg/L)	2.034 ± 0.276^{d}	11.876 ± 0.798^{b}	9.724 ± 0.288^{c}	16.44 ± 0.78^{a}
Chlorophyll a (mg/L)	1.573 ± 0.212^{d}	10.219 ± 0.351^{b}	8.493 ± 0.131^{c}	14.96 ± 0.462^{a}
Total biomass (mg/L)*	105.59 ± 24.40^{d}	684.67 ± 40.70^{b}	569.03 ± 13.20^{c}	1002.32 ± 37.60^{a}

(Vonshak and Richmond, 1988) * Total biomass = Chlorophyll a n x 67. At the 5% level of probability, there is no significant difference between the figures in common letters.

Chlorophyll a of spirulina

Spirulina cultured in the supernatant of DRB 40% medium, followed by 60% and 20% DRB medium, had considerably ($8< 0.05$) lower chlorophyll a (mg/L) than spirulina grown in Kosaric medium (Table 4). During the investigation, the chlorophyll a content of spirulina cultivated in supernatant of 40, 60, and 20% DRB media varied significantly.

Total biomass of spirulina

Total biomass (mg/L) of spirulina cultured in Kosaric medium was significantly ($P< 0.05$) higher than that of spirulina grown in supernatant of 40% DRB medium followed by 60% and 20% DRB media (Table 4). There were significant differences discovered in the spirulina cultivated in the supernatant of 40, 60, and 20% DRB media overall biomass.

Correlation among the growth parameters of spirulina

Throughout the investigation, the cell weight of *S. platensis* exhibited a highly significant ($P< 0.05$) direct association with the amount of chlorophyll a (r = 0.426) in the supernatant of various digested rotten banana media and Kosaric medium (Fig. 7). Comparably, the total biomass of *S. platensis* showed a strong positive correlation ($P < 0.05$) and a direct relationship (r = 0.404) with the chlorophyll a of spirulina expanded in the supernatant of different digested rotten banana and Kosaric medium (Fig. 8). It was discovered that the cell weight (r = 0.421) of spirulina grown in the supernatant of various digested rotten banana and Kosaric medium was high ($P< 0.05$) and directly linked with the total biomass of spirulina (Fig. 9).

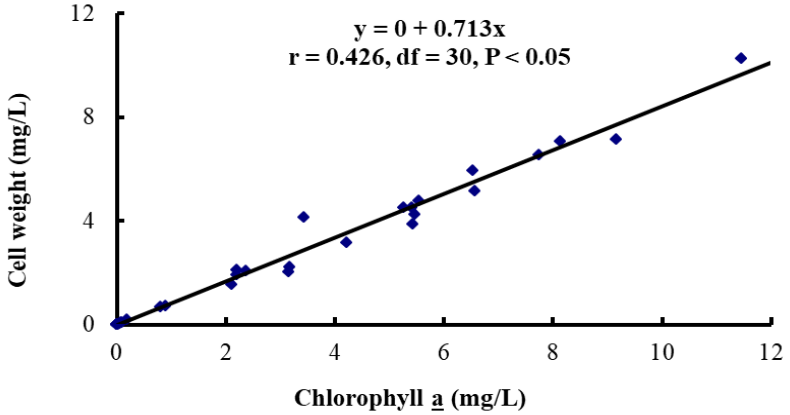

Fig. 7. Correlation coefficient (r) of cell weight (mg/L) of *Spirulina platensis* with chlorophyll a (mg/L) of spirulina grown in supernatant of three digested rotten banana, and Kosaric medium

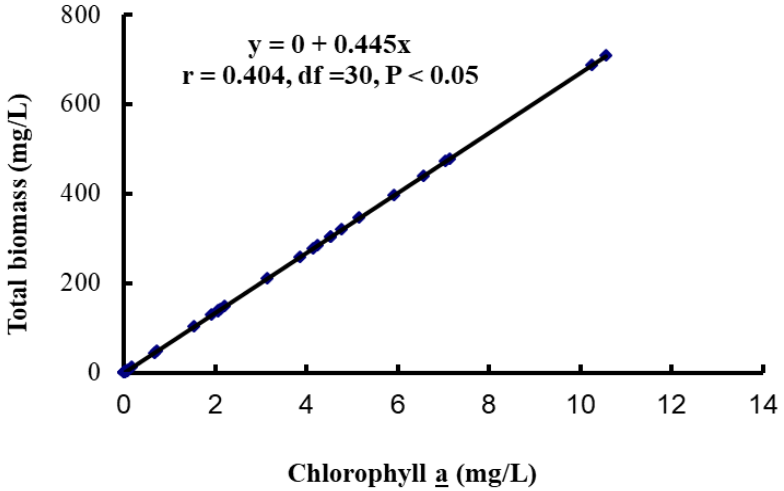

Fig. 8. Correlation coefficient (r) of total biomass (mg/L) of *Spirulina platensis* with chlorophyll a (mg/L) of spirulina grown in supernatant of three digested rotten banana, and Kosaric medium

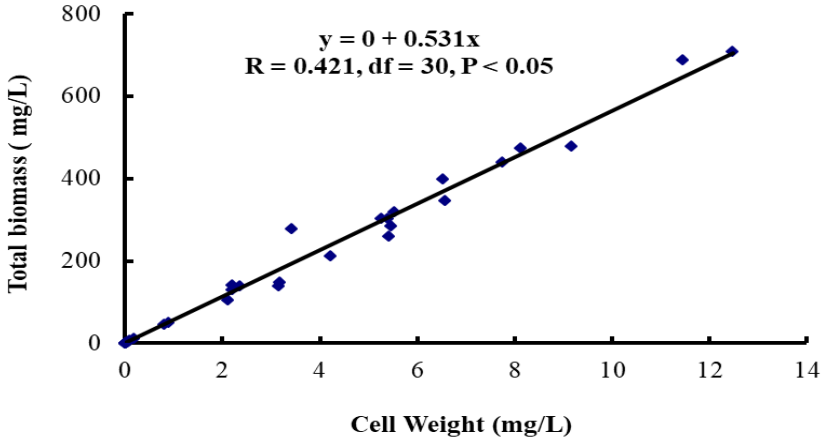

Fig. 9. Correlation coefficient (r) of total biomass (mg/L) of *Spirulina platensis* with cell weight (mg/L) grown in supernatant of three digested rotten banana, and KM

DISCUSSION

Three distinct concentrations (20, 40, and 60%) of the digested rotten banana (DRB) supernatant were used to cultivate *Spirulina platensis*, with KM serving as the control. The cell weight of *S. platensis* in the supernatant of DRB was 0.0022 ± 0 to 1.017 ± 0.195mg/ L in 20% digested DRB medium (DRBM), 0.0022 ± 0 to 8.621 ± 0.534mg/ L in 40% DRBM, 0.0022 ± 0 to 5.032 ± 0.225mg/ L in 60% DRBM, and 0.0022 ± 0 to 11.44 ± 0.28mg/ L in KM. With the exception of KM, the growth performance of *S. platensis* in a 40% DRBM supernatant was superior to 20% and 60% DRBM. This variance may result from the content and nutrient concentrations of different media. In controlled KM, *S. platensis* showed the highest growth performance. It may have happened due to the suitability and availability of the nutrients for the growth of the species. On the other hand, 20 and 60% DRBM showed lower growth performance of *S. platensis* in relation to 40% DRBM, which may be due to suitable nutrient concentration and dilution in the medium. Due to their high nutritional content, DRBM concentrations of 20 and 60% are appropriate and conducive to the growth of *S. platensis*. In comparison to other media where temperature, aeration, and light intensity were important factors in the culture system, **Satter (2017)** found that the cell weight and chlorophyll a content of *S. platensis* were significantly (P<0.05) greater in 4.0g/ L digested poultry waste. Similarly, *S. platensis* was cultivated on mustard oil cake medium at concentrations of 3.0, 4.0, 0.5mg/ L, and KM, according to **Dey (2004)**. 451.0, 614.33, 403.4, and 719.0mg/ L were the maximum growth values, in that order. The current findings and these findings are essentially comparable. These current findings roughly align with those of **Habib (1998)** and **Khan (2003)**. The starting cell weight in the current investigation was 0.0022mg/ L, which reached its greatest weight in cells of 16.44mg/ L grown in KM and 1.833mg/ L in 20% DRBM, 11.876mg/ L in 40% DRBM, and 9.724mg/ L in 60% DRBM on the tenth day of the culture. The inoculated *S.*

platensis had chlorophyll a content of 0.0015mg/ L; on the tenth day of culture, this content increased to 14.96mg/ L in KM and 10.219mg/ L in 40% DRBM. The results of **Phang *et al.* (2000)**, **Habib *et al.* (2003)** and **Satter (2017)** are almost identical to these findings. In the current investigation, three concentrations of the digested rotten banana supernatant were utilized as a culture medium for *S. platensis*. When compared to KM, the supernatant of 40% digested rotten bananas displayed the highest optical density on the tenth day of culture, which is consistent with the findings of **Habib *et al.* (1997, 2003)** and **Satter (2017)**. In contrast to the other two different media, **Satter (2017)** discovered that the supernatant of 4g/L digested poultry waste (DPW) for the culture of *S. platensis* offered superior growth performances; nonetheless, it was marginally lower than the growth of spirulina in KM. However, when cultured in the supernatant of rotting banana and KM, it had growth capabilities that were nearly identical. This discussion suggests that the technical facilities, chemical parameters, and physical characteristics employed in this study were largely comparable to those of previous investigations. However, in certain instances, disparities in technical infrastructure, environmental factors, media nutrition, etc., contributed to variability in outcomes. We were unable to locate any information indicating that 40% DRB exhibited superior spirulina growth; however, we did discover that other vegetables, such as rotten ladies finger, where 50% DRLFM demonstrated superior growth **(Noor *et al.*, 2024)**. Moreover, digested rotten potatoes, where 60% DRPM demonstrated the best spirulina growth **(Hossain *et al.*, 2021)**.

CONCLUSION

Spirulina platensis was cultured, and its growth performance was evaluated in an experiment using different quantities of rotten banana medium (RBM) and Kosaric medium (KM). The three-month study was conducted at the Live Food Culture Laboratory, Department of Aquaculture, Faculty of Fisheries, Bangladesh Agricultural University. These media were chosen because they are readily available and cost-effective, particularly in Bangladesh. One of the primary objectives of using these media is to raise awareness about the economic and health benefits of cultivating *S. platensis* and to promote the use of rotten bananas as a medium for its culture. Rotten bananas are easily accessible and can serve as an inexpensive medium for large-scale production of *S. platensis*, reducing waste by utilizing digested rotten banana as a culture medium. A concentration of 40% digested rotten banana (DRB) is recommended for large-scale industrial production, as it is both commercially and financially viable for bulk cultivation. Additionally, *S. platensis* has been demonstrated to have positive effects as a feed supplement, enhancing growth, reproduction, carcass composition, immune response, and disease resistance in various fish species. It is essential to prioritize high production at low costs, especially in a country like Bangladesh, where banana production is abundant, but a significant portion is wasted due to the fruit's perishable

nature. Utilizing rotten bananas as a low-cost medium presents a valuable opportunity. Further research should be conducted to optimize the use of digested rotten banana as a medium for *S. platensis* culture, with the aim of increasing productivity and exploring its full potential

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Author contribution

Md. Ahsan Bin Habib and Md. Hamidur Rahman conceived the idea; Md. Hamidur Rahman and Tawshifah Jannat Ava performed the experiment. Md. Hamidur Rahman, Md. Sazzad Hossain, Md. Asadujjaman, Zakia Sultana and Md. Abdus Salam analyzed the data, and wrote the manuscript, participated in the research, discussed and commented on earlier drafts. All authors have read and approved the final manuscript.

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