Dataset describing the growth pattern, amino acid and fatty acid profile of five indigenous marine microalgae species of Bangladesh

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\textbf{A B S T R A C T}

This paper presents the data on the growth pattern, amino acid, and fatty acid profile of five (5) selected indigenous marine microalgae (Chaetoceros sp.; Isochrysis sp.; Skeletonema sp.; Nannochloropsis sp.; and Tetraselmis sp.) of Bay of Bengal, Bangladesh. The microalgae species were cultured in f/2 Guil-lard’s medium with maintaining standard physico-chemical parameters. The growth pattern was determined for all the microalgae as a prerequisite for further necessary experimental works. All the species were mass cultured using the same culture medium and harvested (centrifuging method), and dried (60 °C for 12 h) at their stationary phase. Finally, the amino acid and fatty acid analyses were performed. In many contexts, the amino acid and fatty acid data showed significant differences ($p < 0.05$) among these experimental species. However, by understanding these experimental species’ nutritional profiles, one can easily choose the desired one that is most appropriate for their intended application.

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Specifications Table

| Subject | Agricultural Sciences, Aquatic Science |
|---------|----------------------------------------|
| More specific subject area | Microalgae, Algal-biodiversity, Nutrition science |
| Type of data | Table, chart, and figure |
| How data were acquired | Growth pattern was observed through cell count and biomass measurement. Morphological traits were identified using a computer based light microscope. Amino acid analysis was done through SYKAM amino acid analyzer. Fatty acid analysis was done through gas chromatographic mass spectrophotometry (GCMS). |
| Data format | Raw and analyzed primary data |
| Description of data collection | For morphological trait: Microscopic observation For growth pattern: cell count and biomass. For water quality: temperature, pH, salinity, dissolve oxygen, total ammonia nitrogen, nitrite nitrogen, and soluble reactive phosphorus. For amino acid: SYKAM amino acid analysis of aliquot HCl extract from microalgae. For fatty acid: GCMS analysis of extracted oil from microalgae. |
| Data source location | Live Feed Laboratory, Marine Fisheries and Technology Station, Bangladesh Fisheries Research Institute, Cox’s Bazar-4700, Bangladesh |
| Data accessibility | Data are available with this article and also at https://doi.org/10.17632/6YHWWT57YP.2 |

Value of the Data

- Providing the presence and its percentages in the amount of amino acid and fatty acid content in the selected five indigenous microalgae species with mentioning essential and non-essential classifications.
- Providing a basis in complete understanding of the nutritional profiles (amino acid, fatty acid) of these selected commercially important microalgae species of Bay of Bengal, Bangladesh.
- Understanding the differences in growth pattern, amino acid, and fatty acid among the commercially important different microalgae species which will help in choosing the best-suited microalgae species for a definite use.
- Fatty acid data and amino acid data will be useful to select suitable microalgae species as biofuel production raw material as well as to select suitable microalgae species as animal feedstuff.

1. Data Description

The raw data on growth pattern, amino acid and fatty acid profile of five indigenous marine microalgae species of Bangladesh are as in [1]. Microalgae have recently attracted considerable interest worldwide due to their potential applications in renewable energy, biopharmaceuticals, and nutraceuticals. Fig. 1 shows the experimental indigenous marine microalgae species

![Fig. 1. Experimental microalgae species. (a) Chaetoceros sp. (b) Isochrysis sp. (c) Skeletonema sp. (d) Nannochloropsis sp. (e) Tetraselmis sp.](image-url)
collected from previously preserved samples at Marine Fisheries and Technology Station (MFTS), Bangladesh Fisheries Research Institute (BFRI), Cox’s Bazar, Bangladesh.

Among the five (5) selected species, Chaetoceros sp., Isochrysis sp., and Skeletonema sp., were brown microalgae whereas Nannochloropsis sp., and Tetraselmis sp. were green microalgae. All of the species were identically distinct from one another in terms of their physical characteristics (Table 1).

Growth phases of the selected microalgae in F/2 Guillard’s culture medium are shown in this data (Fig. 2). The stationary and death phases of the selected species started at different distinct times (6–11 days).

This data shows Skeletonema sp. had significantly ($p < 0.05$) higher growth rates and biomass production ability, whereas Nannochloropsis sp. had significantly ($p < 0.05$) higher cell density compared to all other species (Table 2).

Physico-chemical parameters such as temperature, light intensity, salinity, pH, and total ammonium nitrogen, nitrite-nitrogen, and soluble reactive phosphorus data of the culture medium during the experimental period are shown in Table 3. In this case, dissolve oxygen, pH, total ammonium nitrogen, and soluble reactive phosphorus showed some significant ($p < 0.05$) differences among some cultures, whereas the rest of the parameters didn’t differ significantly ($p > 0.05$) during the experimental period.
Table 2
Growth dynamics of the selected microalgae species.

| Species            | Growth rates (µ/day) | Maximum cell density (<10^6 cells/mL) | Biomass (g/L/day) |
|--------------------|----------------------|---------------------------------------|-------------------|
| Chaetoceros sp.   | 0.41 ± 0.07a         | 4.92 ± 0.15c                          | 0.024 ± 0.006     |
| Isochrysis sp.    | 0.34 ± 0.04b         | 4.55 ± 0.22c                          | 0.029 ± 0.002     |
| Skeletonema sp.   | 0.49 ± 0.03a         | 5.13 ± 0.19b                          | 0.036 ± 0.004     |
| Nannochloropsis sp.| 0.22 ± 0.03c         | 7.66 ± 0.36a                          | 0.019 ± 0.006     |
| Tetraselmis sp.   | 0.53 ± 0.09a         | 4.91 ± 0.61bc                         | 0.025 ± 0.00b     |

Values are mean ± standard error of triplicate measurements; Different letters used in each column demonstrate the significant difference (p < 0.05).

Table 3
Physico-chemical parameters of the cultured medium during culture period (up to stationary phase).

| Species            | Temperature °C | Light intensity µEm-2s^-1 | Salinity Ppt | Dissolve oxygen mg/L | pH | Total ammonia nitrogen mg/L | Nitrite nitrogen mg/L | Soluble reactive phosphorus mg/L |
|--------------------|----------------|---------------------------|--------------|-----------------------|----|-----------------------------|-----------------------|-------------------------------|
| Chaetoceros sp.    | 26.60 ± 0.49a  | 150.0 ± 0.00b             | 29.33 ± 0.33ab| 6.70 ± 0.12abc        | 8.25 ± 0.06b | 0.71 ± 0.01ab | 0.65 ± 0.01a | 0.17 ± 0.00ab |
| Isochrysis sp.     | 26.73 ± 0.52a  | 150.0 ± 0.00b             | 28.33 ± 0.33b| 6.53 ± 0.03b           | 8.54 ± 0.07b | 0.67 ± 0.01b | 0.62 ± 0.01a | 0.13 ± 0.00b |
| Skeletonema sp.    | 26.73 ± 0.52a  | 150.0 ± 0.00b             | 30.67 ± 0.33c| 6.60 ± 0.06bc          | 8.34 ± 0.07b | 0.63 ± 0.00b | 0.62 ± 0.00a | 0.15 ± 0.00b |
| Nannochloropsis sp.| 26.80 ± 0.55a  | 150.0 ± 0.00b             | 30.00 ± 0.58a| 6.43 ± 0.08c           | 8.29 ± 0.05b | 0.61 ± 0.00b | 0.63 ± 0.00a | 0.15 ± 0.00b |
| Tetraselmis sp.    | 26.60 ± 0.49a  | 150.0 ± 0.00b             | 29.67 ± 0.67a| 6.43 ± 0.07c           | 8.30 ± 0.09b | 0.57 ± 0.00b | 0.60 ± 0.00a | 0.13 ± 0.00b |

Values are mean ± standard error of triplicate measurements; Different letters used in each column demonstrate the significant difference (p < 0.05).

Table 4
Amino acid content (% amino acid) in the cultured microalgae species.

| Species            | Histidine HIS | Isoleucine ILE | Leucine LEU | Lysine LYS | Methionine MET | Phenylalanine PHE | Threonine THR | Tyroline TYR | Valine VAL | Alanine ALA | Arginine ARG | Aspartic acid ASP | Glutamic acid GLU | Glycine GLY | Cysteine CYE | Seronine SER | Proline PRO |
|--------------------|---------------|----------------|-------------|------------|---------------|-------------------|--------------|-------------|------------|------------|-------------|------------------|-----------------|-------------|--------------|-------------|------------|
| Types              | EAA           | EAA            | EAA         | EAA        | EAA           | EAA               | EAA          | EAA         | EAA        | EAA        | EAA          | EAA               | EAA            | EAA          | EAA          | EAA         | EAA        |
| Code name          | 3.40 ± 0.04   | 6.97 ± 0.15    | 10.35 ± 0.34| 3.64 ± 0.01| 9.68 ± 0.06   | 5.80 ± 0.22       | 3.76 ± 0.28   | 6.28 ± 0.26 | 8.20 ± 0.35| 6.46 ± 0.17| 3.94 ± 0.21  | 9.00 ± 0.10       | 8.87 ± 0.01   | 5.16 ± 0.29  | 1.94 ± 0.08  | 4.03 ± 0.09| 2.53 ± 0.04 |
| Values             | 3.59 ± 0.12   | 3.75 ± 0.02    | 7.95 ± 0.05 | 5.80 ± 0.08| 2.28 ± 0.02   | 5.49 ± 0.01       | 5.69 ± 0.03   | 2.51 ± 0.00 | 6.51 ± 0.04| 7.78 ± 0.23| 4.81 ± 0.08  | 11.63 ± 0.06      | 15.20 ± 0.26   | 6.13 ± 0.10  | 1.60 ± 0.00  | 5.92 ± 0.25| 3.35 ± 0.07 |

Values are means ± standard error of duplicate measurements. EAA: Essential Amino Acid, NEAA: Non-Essential Amino Acid, ND: Not detected.
Fig. 3. Heat-map presentation of amino acid content in the cultured microalgae species. (EAA: Essential Amino Acid, NEAA: Non-Essential Amino Acid, Chaeto: Chaetoceros sp., Iso: Isochrysis sp., Sk: Skeletonema sp., Nanno: Nanochloropsis sp., Tetra: Tetraselmis sp.).

This data shows the amino acid content of these selected microalgae species (Table 4, Figs. 3–5). The chromatogram for all the analyzed microalgae species are shown in Fig. 9.

Finally, this data shows the fatty acid content of these selected microalgae species (Table 5, Figs. 6–8). The chromatogram for all the analyzed microalgae species are shown in Fig. 10.

2. Materials and Methods

2.1. Standard F/2 Guillard’s Medium Preparation

Guillard’s medium contains different micronutrients, trace elements and vitamins (Table 6). Initially seawater was collected from the Cox’s Bazar coast of Bay of Bengal, Bangladesh to prepare pure medium for culturing the selected microalgae. Then the collected seawater was stabilized, filtered and autoclaved (15 lbs./inch² for 15 min). To prepare 1 L medium 2 mL of solution A and B (in case of diatoms), 1 mL of solution C and D were added into the previously sterilized 28–30 ppt seawater (Table 6).

2.2. Collection of Selected Microalgae

These five (5) commercially important marine microalgae (Chaetoceros sp.; Isochrysis sp.; Skeletonema sp.; Nanochloropsis sp.; and Tetraselmis sp.) were collected from previously isolated and stocked samples of the Live feed laboratory of Marine Fisheries and Technology Station, Bangladesh Fisheries Research Institute, Cox’s Bazar, Bangladesh. These collected stocks were
| Carbon | Fatty acid          | Types | Chaetoceros sp. | Isochrysis sp. | Skeletonema sp. | Nannochloropsis sp. | Tetraselmis sp. |
|--------|---------------------|-------|----------------|----------------|------------------|----------------------|----------------|
| C8:0   | Octanoic acid       | SAFA  | 0.09 ± 0.00    | 0.18 ± 0.00    | 2.12 ± 0.10      | 1.45 ± 0.12          | 0.47 ± 0.00      |
| C10:0  | Decanoic acid       | SAFA  | 0.12 ± 0.00    | 0.36 ± 0.02    | 0.34 ± 0.04      | 0.42 ± 0.01          | 0.37 ± 0.01      |
| C12:0  | Lauric acid         | SAFA  | 0.05 ± 0.00    | 0.31 ± 0.24    | 0.50 ± 0.06      | 0.77 ± 0.01          | 0.38 ± 0.01      |
| C13:0  | Tridecanoic acid    | SAFA  | 0.06 ± 0.00    | 0.55 ± 0.04    | 1.89 ± 0.70      | 0.38 ± 0.08          | 0.28 ± 0.01      |
| C14:0  | Myristic acid       | SAFA  | 2.51 ± 0.00    | 0.86 ± 0.08    | 7.68 ± 0.06      | 2.35 ± 0.34          | 0.19 ± 0.03      |
| C16:0  | Palmitic acid       | SAFA  | 16.27 ± 0.11   | 3.61 ± 0.01    | 3.00 ± 0.06      | 13.26 ± 0.72         | 6.45 ± 0.22      |
| C18:0  | Stearic acid        | SAFA  | 4.01 ± 0.42    | 27.13 ± 1.10   | 1.15 ± 0.27      | 4.17 ± 0.25          | 6.03 ± 0.70      |
| C20:0  | Arachidic acid      | SAFA  | 12.15 ± 1.79   | 0.11 ± 0.00    | 1.12 ± 0.71      | 38.28 ± 4.39         | 7.14 ± 4.18      |
| C17:0  | Heptadecanoic acid  | SAFA  | 0.30 ± 0.00    | 0.31 ± 0.16    | ND               | 0.67 ± 0.44          | 1.85 ± 0.14      |
| C21:0  | Heneicosanoic acid  | SAFA  | 10.18 ± 0.42   | 37.99 ± 1.10   | 0.89 ± 0.35      | 2.84 ± 1.27          | 12.43 ± 0.81     |
| C22:0  | Behenic acid        | SAFA  | 0.06 ± 0.06    | 0.84 ± 0.63    | ND               | 0.24 ± 0.24          | 0.49 ± 0.04      |
| C23:0  | Tricosanoic acid    | SAFA  | ND             | 0.31 ± 0.12    | ND               | ND                   | 0.35 ± 0.02      |
| C24:0  | Lignoceric acid     | SAFA  | ND             | ND             | ND               | ND                   | 1.25 ± 0.34      |
| C16:1  | Palmitoleic acid    | MUFA  | 21.26 ± 0.60   | 2.17 ± 0.07    | 73.80 ± 1.52     | 0.63 ± 0.26          | 34.64 ± 1.24     |
| C18:1  | Oleic acid          | MUFA  | 0.37 ± 0.01    | 1.51 ± 0.10    | 0.20 ± 0.20      | 2.19 ± 0.52          | 0.32 ± 0.01      |
| C20:1  | cis-11-Eicosenoic acid | MUFA | 1.60 ± 0.09   | 0.03 ± 0.03    | 0.04 ± 0.02      | 1.59 ± 1.11          | 1.95 ± 0.12      |
| C22:1  | Erucic acid         | MUFA  | 17.09 ± 0.21   | 3.22 ± 0.13    | 0.28 ± 0.20      | 1.33 ± 0.83          | 10.42 ± 0.64     |
| C24:1  | Nervonic acid       | MUFA  | 0.02 ± 0.01    | 0.34 ± 0.05    | 0.06 ± 0.01      | 0.09 ± 0.05          | 0.72 ± 0.22      |
| C18:2n-6 | Linoleic acid   | n6-PUFA | 0.62 ± 0.04    | 7.33 ± 0.19    | 3.06 ± 0.00      | 14.88 ± 10.38        | 1.39 ± 0.05      |
| C20:3n-6 | Eicosatrienoic acid | n6-PUFA | 1.42 ± 0.18   | 6.44 ± 0.16    | 1.56 ± 0.44      | 5.32 ± 3.26          | 2.56 ± 0.18      |
| C18:3n-3 | Linolenic acid    | n3-PUFA | 9.83 ± 0.16    | 4.96 ± 0.20    | 2.05 ± 1.37      | 0.20 ± 0.01          | 7.22 ± 0.34      |
| C20:5n-3 | Eicosapentaenoic acid | n3-PUFA | 0.04 ± 0.02   | 0.30 ± 0.18    | 0.08 ± 0.05      | 0.02 ± 0.00          | 0.04 ± 0.02      |
| C22:5n-3 | Docosapentaenoic acid | n3-PUFA | 0.01 ± 0.00   | 0.15 ± 0.01    | 0.04 ± 0.01      | 0.09 ± 0.07          | 1.47 ± 0.09      |
| C22:6n-3 | Docosahexaenoic acid | PUFA  | 0.65 ± 0.02    | 0.63 ± 0.03    | ND               | 0.14 ± 0.01          | 0.13 ± 0.03      |

Values are mean ± standard error of duplicate measurements. SAFA: Saturated Fatty Acids, MUFA: Mono Unsaturated Fatty Acids, PUFA: Poly Unsaturated Fatty Acids.
cultured and maintained at a standard temperature range (25 ± 2 °C) at 150 μEm⁻²S⁻¹ light intensity for 24 h with continuous sterile aeration [2,3].

2.3. Determination of the Morphological Traits

All the species were observed under a microscope using optimum magnification and fining. The morphological traits (color, shape, length, flagella, motility, and chain formation) were determined using a computerized light microscope Leica DM1000.
2.4. Determination of Growth Dynamics

All the collected species were cultured in F/2 Guillard’s medium (triplicate replications), maintaining optimum standard parameters according to Islam et al. [3]. Cell density and biomass were measured to understand the growth pattern. Cell density was measured in everyday at a fix time. Haemocytometer (Hawksley AC1000, UK) was used to determine the cell density with following the method described by Lavens and Sorgeloos [4]. To determine dried biomass, initially 1 mL aliquot culture for each flask was filtered using a pre-weighted GF/C glass fibre filter paper and dried at 100 °C for 4 h. Then, the filter paper was cooled for 15 min in a desiccator and reweighted. Finally, the dried biomass was calculated from the weight differences.

In addition, growth rates were determined according to the following equation,

\[ K' = \ln \frac{N_2}{N_1} / (T_2 - T_1) \]

where, \( N_2 \) and \( N_1 = \) Cell density at time \( T_1 \) and \( T_2 \), respectively.
2.5. Determination of the Physico-Chemical Parameters of the Cultured Medium

The physico-chemical parameters of the culture medium were determined at every alternate day from day 0 to stationary phase for every species separately. Temperature, light intensity, salinity, dissolve oxygen, and pH of the culture medium were measured using glass thermometer, lux meter, refractometer, DO meter and pH meter respectively. Total ammonium nitrogen (TAN), and soluble reactive phosphorus (SRP) were measured according to the method suggested...
Fig. 9. Chromatogram of amino acid analysis of all samples. Standard (H-G INJ1) (a) Chaetoceros sp. (b) Isochrysis sp. (c) Skeltonema sp. (d) Nannochloropsis sp. (e) Tetraselmis sp. (f).

Fig. 10. Chromatogram of fatty acid analysis of all samples. Chaetoceros sp. (a) Isochrysis sp. (b) Skeltonema sp. (c) Nannochloropsis sp. (d) Tetraselmis sp. (e).
Table 6
Constituents of F/2 Guillard’s culture medium stock solution.

| Name of the Chemicals       | Quantity     |
|-----------------------------|--------------|
| (A) Main mineral solution   |              |
| NaNO₃                      | 84.15 g      |
| Na₂MoO₄·2H₂O               | 6.0 g        |
| FeCl₃·6H₂O                 | 2.90 g       |
| Na₂EDTA·2H₂O               | 10.0 g       |
| Dissolving in deionized/distilled water and make the volume 1 L. |    |
| (B) Silicate solution       |              |
| Na₂SiO₃·9H₂O               | 33.0 g       |
| Dissolving in deionized/distilled water and make the volume 1 L. |    |
| (C) Trace metal solution    |              |
| CuSO₄·5H₂O                 | 1.96 g       |
| ZnSO₄·7H₂O                 | 4.40 g       |
| Mg₂MnO₄·2H₂O               | 1.26 g       |
| MnCl₂·4H₂O                 | 36.0 g       |
| CoCl₂·6H₂O                 | 2.0 g        |
| Dissolving in deionized/distilled water and make the volume 1 L. |    |
| (D) Vitamin solution        |              |
| B₁                         | 0.4 g        |
| B₁₂                        | 0.002 mg     |
| Biotin                     | 0.1 mg       |
| Dissolving in deionized/distilled water and make the volume 1 L. |    |

by Parsons et al. [5]. In contrast, Nitrite nitrogen (NO₂-N₂) was determined according to the method suggested by Kitamura et al. [6]. Observe sure all of the equipment was calibrated before usage.

2.6. Mass Culture of Microalgae

For biomass preparation mass culture was done for all the species in a larger scale in a 20 L transparent food grade plastic jar using F/2 Guillard’s medium. The cultures were scaled up gradually from a 10 mL test tube to 20 L plastic jar with following the protocol described by Amira et al. [7]. Each species was harvested at their stationary phase through centrifugation and oven dried at 60 °C temperature for 12 h. Later the species were preserved at 4 °C in normal refrigerated conditions for further analysis.

2.7. Amino Acid Determination

Amino acids were determined according to Moore and Stein [8] method with slight modification. Initially, 1 g dried biomass of each microalga was hydrolyzed in 25 mL previously prepared acidic hydrolysis (6 M HCl + 0.1% phenol) solution at 110 ± 2 °C temperature for 24 h. After cooling, the samples were stabilized using little amount of SDB/Na (Sample Dilution Buffer). Then the pH of the samples was adjusted in between 2.1 and 2.3 with using basic neutralization agent. Finally, the hydrolysates were transferred into the injection vials through filtration and diluted using SDB/Na.

The analysis was done using SYKAM S 433 amino acid analyzer equipped with UV detector. Nitrogen gas was used as carrier gas with maintaining 0.5 mL/minute flow rate at 60 °C temperature, where the reproducibility was 3%. AA-S-18 Sigma-Aldrich, Germany standard wease used for amino acids concentration determination. The amino acids contents were expressed as mg/g, which were finally converted in % of total amino acids.
2.8. Fatty Acid Determination

Fatty acids were determined according to Prato et al. [9]. Initially, lipid was extracted from all the dried biomasses using Soxhlet apparatus. The sample were placed in a thimble paper for running the cycle. Acetone was used as solvent. Standard temperature 60 °C was maintained during lipid extraction. The extracted lipid was collected after complete extraction. Then fatty acids of methyl esters (FAMEs) were prepared for gas chromatography. The gas chromatography mass spectrophotometry analysis was run using a GCMS-QP2020 (Shimadzu, Japan), equipped with flame ionization detector. The 30 m long capillary column with 0.25 mm diameter and 0.15 μm thickness was used for FAMEs separation. Helium gas was used as carrier gas with maintaining 1.42 mL/minute flow rate at 180–280 °C temperature at 5 °C/ minute. FAME mix C8-C24; Sigma-Aldrich, Germany standard were used for FAMEs identification with comparing the retention time. The fatty acids content were expressed as μg/g which were finally converted in % of total fatty acids.

2.9. Statistical Analysis

Mean, standard error of mean (SE = σ /√n) of the data were calculated using MS excel (v. 2016). One-way multivariate analysis was performed to determine whether there is any significance difference among the species. The post hoc test was performed at 5% significance using IBM SPSS (v. 26.0).

Ethics Statement

These data were collected complying ARRIVE guidelines. Authors skipped obtaining legal authority's ethical consent before beginning the data collection process because microalgae are not protected by any regulations or laws in Bangladesh.

Declaration of Competing Interest

None.

Data Availability

Dataset describing the growth pattern, amino acid and fatty acid profile of five indigenous marine microalgae species of Bangladesh (Original data) (Mendeley Data).

CRediT Author Statement

Jakia Hasan: Conceptualization, Investigation, Supervision, Methodology, Writing – review & editing; Zahidul Islam: Conceptualization, Investigation, Methodology, Data curation, Writing – original draft, Writing – review & editing; Ahmad Fazley Rabby: Methodology, Writing – review & editing; Saima Sultana Sonia: Methodology, Writing – review & editing; Md. Aktaruzzaman: Methodology, Writing – review & editing; Turabur Rahman: Methodology, Writing – review & editing; Shafiqur Rahman: Supervision, Funding acquisition, Writing – review & editing; Yahia Mahmud: Supervision, Funding acquisition, Writing – review & editing.
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