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NUTRITIONAL VALUE OF *SKELETONEMA COSTATUM* (CLEVE, 1873) FROM PARANGIPETTAI, SOUTHEAST COAST OF INDIA

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ABSTRACT: Present aim to study the biochemical composition, *i.e.*, protein, carbohydrate, lipid, ash, amino acids, fatty acids, vitamins, minerals and Carbon, Hydrogen, Nitrogen from *Skeletonema costatum.* The biomass of marine diatom (*S.costatum*) were collected from Parangipettai, Southeast cost of India. The lyophilized powder of *S.costatum* was used for biochemical analysis. The results of proximate composition showed that the percentage of protein was (12.12%), (carbohydrate 5.94%), (lipid 1.567%) and ash (2.96%). Totally 10 essential and non-essential amino acids were analyzed (24.49mg/g - 22.36 mg/g). The saturated mono unsaturated and poly unsaturated fatty acids was (14.86%), (4.25%) and (10.86%). The vitamins and mineral content was 384.19 mg/g - 459.64 mg/g respectively and 1.627 microgram dry powder of *Skeletonema costatum* contained the ratio of Carbon (15.04%), Hydrogen (2.59%) and Nitrogen (3.17%) were present. The results of this research showed that *S.costatum* contained valuable nutritional values and we suggest that in future research on *S.costatum* can be use food for human.

INTRODUCTION: Microalgae, being at the base of the food chain, are contributing to the critical components of many habitats on the planet. Most importantly, they are also the major O_2 producer. Moreover, they have been ascertained as a promising and commercially importance in the food industry and aquaculture, as a natural source of high-value products such as fatty acids, carotenoids, steroids and etc., [5]. Microalgae belong to a highly diverse group of photoautotrophic organisms which are important for aquatic animal feeding. They play important roles of primary producers, in mariculture as food for consumers such as rotifer, copepod, daphnia, brine shrimp etc. which are fed to late larval and juvenile fish and crustaceans [17].

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The biochemical composition of microalgae is influenced by environmental conditions (light, temperature, salinity, pH, and aeration), nutritional factors (sources and availability) and culture age [13]. The content of lipids, proteins (amino acids), carbohydrates and vitamins of various microalgae species is one of the main reasons for considering these organisms as feed source for aquaculture animal [14].

Microalgae have an important role in aquaculture as a means of enriching zooplankton for feeding to fish and other larvae. Animal consumers that feed on microalgae, the dietary demand for gross biochemical constituents will likely vary among species and life stages [10].

In the present study, *S. costatum* was chosen because it is an important coastal organism that can tolerate a wide variety of light regimes and temperatures, and it is an ideal laboratory organism that grows readily in various media. The objective of this study was to evaluate the proximate composition of *Skeletonema costatum.*

MATERIALS AND METHODS:

The Folin- ciocalteu Phenol method [11] was adopted for the estimation of total protein. The estimation of total carbohydrate content, the procedure [6] using phenol-Sulphuric acid was followed. The chloroform-methanol extraction procedure [12] was used for extracting lipid. Ash was determined gravimetrically in a muffle furnace by heating at 550 ºC constant weight [1]. The experimental lyophilized samples were finely ground for estimating the amino acids in the HPLC (Merck Hitachi L-7400) following the method [2]. For fatty acids analysis, the samples were homogenized with chloroform: methanol (2: 1 v/v) mixture and they were extracted using the method [3]. After fat was extracted, they were esterified with 1% H_2So4 and fatty acid methyl esters were prepared by following the procedure [1].

The identification and quantification of fatty acids was done using Gas Chromatography (Hewlett Packard 5890 model). The fat soluble vitamins A, D, E and K and the water soluble vitamins $B_{1,}$ $B_{2,}$ $B_{6,}$ B_{12} and C were analyzed in the HPLC (Merk Hitachi L-74000) following the method [15]. The folic acid was estimated by following the calorimetric procedure [16]. The pyridoxine, panthothenic acid and vitamin B_{12} were estimated by following methods suggested in USP NF 2000 Asian edition. The samples were oven dried at 60^0C for 24 hours and used for the estimation of mineral content [17]. CHN analyzed by using CHNS/O Analyzer, Perkin Elmer company 2400 series II model made in USA.

RESULTS AND DISCUSSION:

Diatom *Skeletonema costatum* exhibited protein, carbohydrate, lipid and ash shown in **Table 1**. The percentage of carbohydrates (5.94%) is in the *S. costatum* were recorded. 1.627 mg dry powder of *S. costatum* contained, the ratio of Carbon, Hydrogen and Nitrogen (15.04%), (2.59%) (3.17%) were present. The total essential amino acids 24.498 mg/g and non-essential amino acids 22.365 mg/g were found in *Skeletonema costatum*. Among the essential amino acids Phenylalanine ranked first in the list by contributing 3.499 mg/g on dry matter basis and the other essential amino acids were found fluctuating between Tryptophan 0.158 and 3.499 mg/g shown in **Table 2**. The non-essential amino acids Glycine ranked first in the list by contributions 3.456 mg/g on dry matter basis and the other non-essential amino acids were found fluctuating between Aspartic acid 0.435 and 3.456 mg/g shown in **Table 3.**

TABLE 1: PROXIMATE COMPOSITION CONTENTS OF DIATOM *SKELETONEMA COSTATUM*.

Proximate Composition	*S. costatum*
Carbohydrate	5.94%
Protein	12.12 %
Lipid	1.567 %
Ash	2.96 %

TABLE 2: ESSENTIAL AMINO ACID CONTENTS OF DIATOM *SKELETONEMA COSTATUM*

Amino acids	Percentage of mg/g
Phenylanine	3.499
Lysine	3.496
Arginine	3.463
Methionine	3.456
Histidine	3.452
Leucine	2.486
Threonine	2.063
Iso Leucine	1.419
Valine	1.006
Tryptophan	0.158

TABLE 3: NON-ESSENTIAL AMINO ACID CONTENTS OF DIATOM *SKELETONEMA COSTATUM*

Amino acids	Percentage of mg/g
Glycine	3.456
Serine	3.423
Glutamic acid	3.341
Cystine	3.142
Gultamine	2.782
Alanine	2.743
Proline	1.496
Asparagines	1.023
Tyrosine	0.524
Aspartic acid	0.435

In *Skeletonema costatum* 7 different fatty acids were analyzed, out of which three saturated fatty acids (SFA) one monounsaturated fatty acids (MUFA) and two polyunsaturated fatty acids (PUFA).

The percentage availability of SFA content was 14.86%; MUFA content was 4.253% and PUFA 10.806 % shown in **Table 4**. The percentage availability of SFA content was 14.86% in *S. costatum* and the percentage of MUFA (4.253) and PUFA (10.806).

Trace minerals	Sample (mg/gm)
Calcium	358.6
Copper	3.49
Sodium	51.897
Potassium	42.375
Zinc	0.348
Magnesium	0.548
Iron	0.417
Manganese	0.648
Cadmium	0.028
Cobalt	0.043
Chromium	0.31
Nickel	0.294

TABLE 4: FATTY ACIDS PROFILE OF *SKELETONEMA COSTATUM*

Name of the fatty acids	Percentage
Saturated fatty acids	
Palmitic acids	6.129
Stearic acid	4.963
Marggaric acid	3.768
Mono Unsaturated fatty acids	
Oleic acid	4.253
Poly Unsaturated fatty acids	
Alpha Linolenic acid	5.473
Linolenic acid	4.788
Moroctic acid	0.545

Totally vitamins was contributed 384.19 mg/gm likewise Retinol (A) 345.22, Calciferol (D) 16.61, Tocopherol (E) 0.679, (K) 3.467, Pyridoxin (B6) 0.528, Cobalamin (B12) 3.472 and Vitamin (Bc) 14.22 shown in **Table 5**. Totally one macro minerals and three trace minerals were detected. Among the macro minerals, Calcium (358.6mg/gm) and were present at higher and, while other macro-minerals sodium, potassium and Copper were present in negligible level. The trace minerals such as Manganese (0.648), Magnesium (0.548), Iron (0.417), Zinc (0.348), Chromium (0.31), Nickel (0.294), Cobalt (0.043) and Cadmium (0.028) were also detected in this species in **Table 6**. In the present study the percentage of lipids (1.567%) is in the *S. costatum*.

Vitamins	Sample (mg/gm)
Vitamin- A	345.22
Vitamin- D	16.61
Vitamin- E	0.679
Vitamin- K	3.467
Pyridoxin (B6)	0.528
Cobalamin (B12)	3.472
Vitamin (Bc)	14.22

TABLE 5: VITAMIN CONTENT OF THE *SKELETONEMA COSTATUM*

TABLE 6: MINERALS CONTENT OF THE *SKELETONEMA COSTATUM*

Microalgae have an important role in aquaculture as a means of enriching zooplankton for feeding to fish and other larvae. In addition to providing protein (essential amino acids) and energy, they provide other key nutrients such as vitamins, essential PUFAs, pigments and sterols, which are transferred through the food chain [4, 13]. In stationary-phase cultures of *Isochrysis* sp. (clone T-Iso) significantly more carbohydrates and lipids than protein [6]. Fatty acids from microalgae may be efficiently transferred to higher trophic levels (e.g. to fish larvae) via intermediary zooplankton [18]. Bacterial production of B12 has been shown to be an effective source of vitamin B12 to phytoplankton cultures [9].

Microalgae are rich sources of two key vitamins, ascorbic acid and riboflavin, but some species lack specific vitamins because microalgae may be limiting in one or more of the key nutrients, mixed-algal diets provide a better balance and normally are used in mariculture [7]. Lipids are considered very important during gametogenesis for gonad maturation and especially in females to provide an energy source for subsequent embryo development [9].

CONCLUSIONS: The main aim of the present study was to ascertain the levels of nutritionally significant minerals and their variations in *S. costatum.* In plankton there are very few products that provide all, or even most, of the raw materials to make new cells and sustain the existing ones. The problem is that we need all of them at the same time for things to work. One of those rare products that contains almost everything human need for life (and the rebuilding of a healthy life) is marine phytoplankton. It contains the nine amino acids that the body cannot make. The essential fatty acids are also present (Omega 3 and Omega 6). Vitamins A, B1, B2, B3, B5, B6, B12, C, D and major and trace minerals are all present in marine phytoplankton."

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