

# "FROM COAST TO LAB: RED ALGAE JOURNEY FROM ITS COASTAL LOCATION IN INDIA TO ITS BIOTECHNOLOGICAL EXPLOITATION"

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**KEYWORDS**

Marine ecosystem, Algae, Algae-based estimated benefits, Algal biomass.

**ABSTRACT**

Marine environment is the largest habitat in terms of area occupied on the planet, still most untapped resource found till today compared to terrestrial environment; less research work done on marine organisms evident the previous statement. Multiple sites of the coast of India such as Gujarat have been studied to find the fresh specimen. Different Gujarat coastal sites were visited during low tide time like Vijali Baru, Mahuva (Lat. 21° 2' 24.0036''N; Long. 71° 47' 53.5092"E), Nishkalank Mahadev Temple, Bhavnagar (21.5974125, 72.2924844), and Kodinar (20.7568750, 70.6589300). Red seaweed was freshly collected from the coastal region of Kodinar. Fresh red seaweeds were collected by cutting near hold fast without disturbing the algal bed from the collection spots mentioned earlier with the help of a small knife by following the method as described by Dawson (1956). Seaweed have been found in intertidal zone of the marine coast, sample must be collected during low tide period and for that reason, Tides timing from the local tide tables along with weather forecasts were kept analysed for the sample collection site visit. further analysis has been carried out in order to ensure after processing. Here the objective of the research work is to highlight the benefits along with the challenges and solutions achieved as different types of algal species perform different work as their capability to produce different metabolites.

**INTRODUCTION:**

Statistics on the global algae biomass market that is USD 3.8 - 5.4 billion has shown worldwide popularity for the societal use (1, 2). In national budget 2021 under "Swaatch Bharat Swasth Bharat", to combat against every aspect of pollutions focused; into that Algae can be actively participate (3, 4). Wide application possibilities of algae for the benefit to the economy as they can serve as: recycle carbon dioxide, biopharmaceutical, Antioxidant, Nutraceutical, food industries, continuous and reliable source of healthy natural products (5, 6). Due to their nutritional requirements and their location at the bottom of aquatic food chains, algal indicators provide relatively unique ecosystem status information compared to widely used animal indicators (7-9).

Red seaweed may be found in a range of aquatic settings, including arctic waters, deep-ocean habitats, and intertidal zones. Their distinctive coloring is partly responsible for their capacity to adapt to a variety of situations (10). The major pigment that gives the color red, Phycoerythrin, is essential to photosynthesis, the process by which plants and algae turn light energy into chemical energy to support their development (11). Since this pigment is particularly effective at absorbing light in the blue and green parts of the spectrum, red seaweed may flourish in deeper waters with less solar penetration (12). Beyond its ecological relevance, red seaweed and its colors have recently gained more attention. Its potential in a number of sectors, including food, medicine, cosmetics, and renewable energy, has been studied by

researchers. Red seaweed extracts have showed potential for having antioxidant, anti-inflammatory, and anti-cancer qualities because they are high in Phycoerythrin and other bioactive chemicals. Red seaweed's application in culinary items has also become more popular as a result of its high nutritional content and distinctive sensory sensations (13, 14).

Natural pigments, including the majority of metabolites known to come from algae, have a wide range of advantageous biological properties, including anti-oxidants, anti-inflammatory, anti-obesity, anti-carcinogenic, anti-angiogenic, and neuroprotective properties. Phycobiliproteins are highly coloured macromolecules that belong to three types of algae: Rhodophyta, Cyanophyta, and Cryptophyta. They are among the three photosynthetic pigments. With several uses in the food, chemical, and pharmaceutical sectors, the dyes and bioactive characteristics of this pigment family are fundamental to the significance of phycobiliproteins (PBPs) in the industrial setting. Water-soluble compounds known as phytobiliproteins are employed as natural pigments and have drawn a lot of interest because of their spectrum, fluorescent, and colouring qualities. Phycobiliproteins (PBPs) may be classified into three subclasses based on their absorbance maxima:

Phycoerythrin (PE,  $\lambda_{\text{max}}$ : 540 - 570 nm),

Phycocyanin (PC;  $\lambda_{\text{max}}$ : 610 - 620 nm), and

Allophycocyanin (APC;  $\lambda_{\text{max}}$ : 650 - 655 nm).

R-Phycoerythrin has been highlighted as it is especially helpful because it catches the interest of a researcher to tap the untapped field to take even more advantage of its new characters due to its fluorescence properties. In red algae among all Phycoerythrin, R-Phycoerythrin (R-PEs) are most abundant phycobiliprotein (15-17).

#### **METHODOLOGY:**

All the glassware such as conical flasks, beakers, test tubes, pipettes, glass vials, Petri plates, etc have been cleaned before using, with the help of the cleaning solution.

#### **Description of the sample collection site:**

Multiple sites of the coast of Mahuva have been visited to find fresh specimen. which were collected on 22 of September 2021 during low tide time from the coast near the Vijali Baru (Lat. 21° 2' 24.0036'N; Long. 71° 47' 53.5092"E), Mahuva, Bhavnagar, Gujarat, India.

#### **Seasonal impact on the algal pigment:**

According to the previous findings, the seasonal variations in photosynthetic pigments of red algal species has been noted. In which summer and autumn seasons are negatively impacted to the algal biomass following to the algal pigment. The marine algae for this investigation were collected from the Gujrat coasts on the basis of their unique red color, which show Phycoerythrin present in the sample.

#### **The details of collected samples are as follows:**

The red algal sample was identified on the basis of their morphology. Fresh red seaweeds were collected by cutting near hold fast without disturbing the algal bed from the collection spots mentioned earlier with the help of a small knife by following the method as described (15, 16).



**Image 1.1**



**Image 1.2**



**Image 1.3**

**(Pictures of Algae at different sample collection site)**

### **Extraction and quantification of phycobiliproteins from different red seaweeds:**

All the 3 red seaweeds (R1 to R3) collected from different locations and time frame were screened for the extraction of phycobiliprotein pigments, that are phycocyanin, allophycocyanin and Phycoerythrin. Seaweed sample preparation was conducted by separating the material from various impurities. Preliminary washing of the algal sample was performed with sea water to remove the impurities, gravel, sand and epiphytes and also other undesired foreign matter from the fronds. One gram of each kind of seaweed was removed and placed in a mortar and pestle along with ten milliliters of 0.1 M potassium phosphate buffer (pH  $7.2 \pm 0.2$ ) that had been chilled (14, 17). Biological samples have been collected directly from the marine environment. Images of the samples that have been studied here are as follows:



**Sample R1**

**Image 2.1**



**Sample R2**

**Image 2.2**



**Sample R3**

**Image 2.3**

### **Coding of algal samples collected from environment**

#### **Determination of the concentration of phycobiliprotein:**

In order to quantify the phycobiliproteins, the Bennett & Bogorad (1973) method was used (18).

The following formulas are used:

$$(\text{mg mL}^{-1}) \text{ of phycocyanin (PC)} = [A_{615} - 0.474 (A_{652})] / 5.34$$

$$(\text{mg mL}^{-1}) \text{ of allophycocyanin (APC)} = [A_{652} - 0.208 (A_{615})] / 5.09$$

$$(\text{mg mL}^{-1}) \text{ of phytoerythrin (PE)} = [A_{562} - 2.41 (PC) - 0.849 (APC)] / 9.62$$

| Algal Sample | PC<br>µg/g | APC<br>µg/g | PE<br>µg/g |
|--------------|------------|-------------|------------|
| R1           | 46.89      | 34.83       | 26.66      |
| R2           | 32.61      | 28.74       | 19.17      |
| R3           | 41.92      | 57.32       | 31.67      |

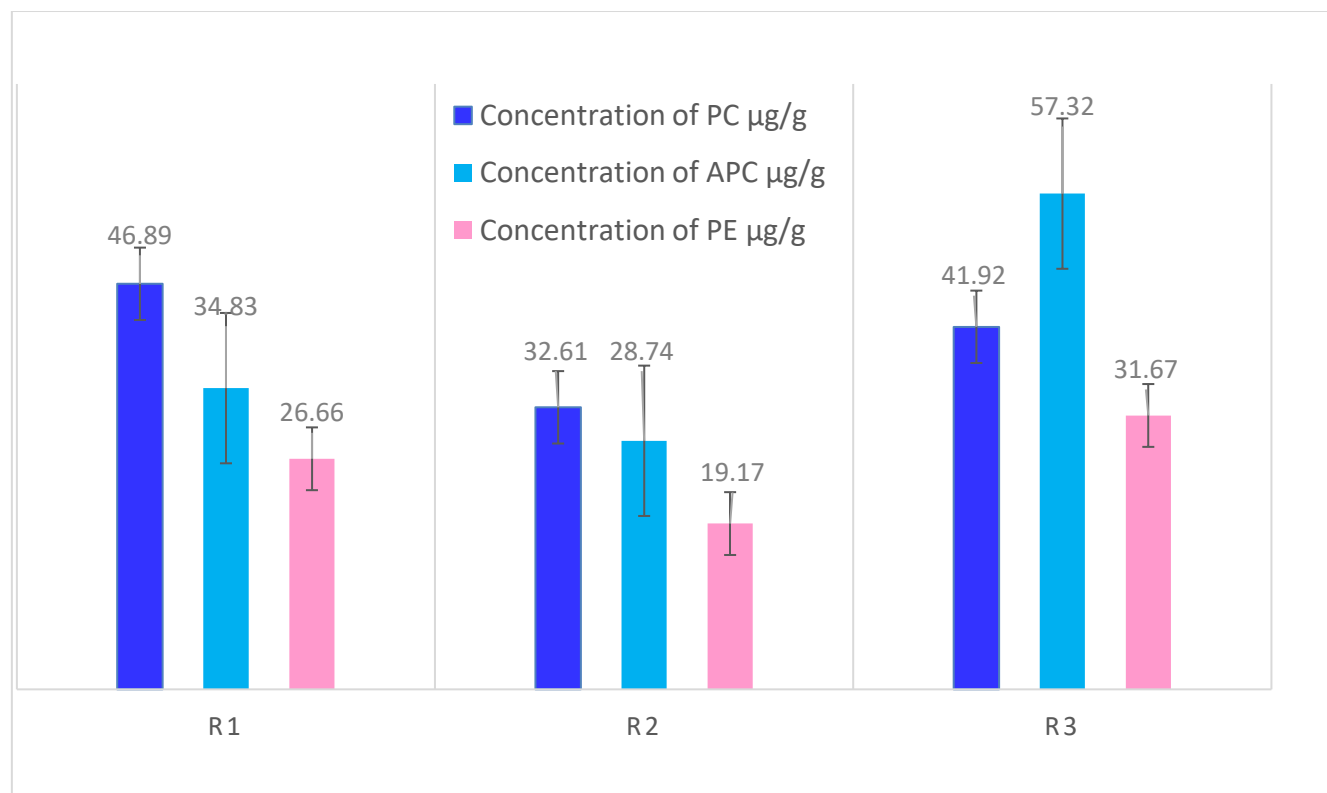
Table 1: Concentration of Phycobiliproteins

The algal biomass was homogenized into fine slurry with the help of mortar and pestle and were transferred to a 50 mL clean centrifuge tube. After that, the slurry-containing tube was centrifuged for 20 minutes at 12000 rpm while being kept at 4°C. Using a UV-visible spectrophotometer, the optical density was measured at 280, 562, 615, and 652 nm after the supernatant was collected. Experiments were repeated in triplicate (n=3) and the data were expressed as means ± SD (6, 19, 20).

### RESULTS:

By studying three distinct algae (R1, R2, and R3), the content of phycobiliproteins, such as Phycoerythrin (PE), allophycocyanin (APC), and phycocyanin (PC), was measured. The findings are shown in Figure 3. R3 had the greatest concentration of APC (57.32 µg/g) among the three different algae, followed by PC (41.92 µg/g) and PE (31.67 µg/g). This implies that R3 is ideal for phycobiliproteins, especially APC, which increased significantly in comparison to R1 and R2.

R3 also has the greatest PE content, which is of major relevance because of its prospective uses. Conversely, of the three phycobiliproteins, R2 had the lowest amounts, with PE only reaching 19.17 µg/g, as seen by the differences between R1, R2, and R3. R3 had the greatest PE production, measuring 31.67 µg/g. R2 exhibited the lowest yield (19.17 µg/g), but R1 also supported a comparatively high PE production (26.66 µg/g).



Concentration of Phycobiliprotein



**DISCUSSION:**

Marine environmental resource contains vast content to study and put to commercial use for the wellness of human as well as environment. In the previous studies marine environment successfully gave many novel compounds produced by distinct organisms in terms of enzymes, hormones, metabolites and so on. Algae with omnipresence in virtually every terrestrial ecosystem are one of the most characteristic species on Earth with possible use in food supplements, as biofertilizers in agriculture and soil improvement, in waste water treatment, and as biofuel sources.

This study effectively illustrates the potential advantages and real-world uses of marine algae, despite the difficulties faced throughout the collecting and processing phases. The work proposed here is to assess the ability of algae, with major focus on the Rhodophyta. This has also included the study of the influence on Phycoerythrin production by the organism; this study can be further followed by primary study on applications of the optimally produced R-Phycoerythrin from the algae for benefit of the humankind by turning out to be as economically advantageous result.

**CONCLUSION:**

Being the greatest ecosystem on Earth, the marine environment has a great deal of untapped potential for both economic and scientific use. This study emphasises how vital marine resources are for many different industries, especially algae. In order to minimise damage to the marine ecology, the research concentrated on the collection and analysis of red seaweed from several coastal locations in Gujarat, India, using careful sample methodologies.

Future studies have to focus on expanding our knowledge of the unique characteristics and uses of different algae species. It will take creative thinking and teamwork to overcome the obstacles in the use of maritime resources. This study highlights the value of marine biodiversity in promoting ecological balance and sustainable development, and it opens up new avenues for research in this area.

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**Declaration Of Conflicting Interests:**

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

**Limitations:**

The results confirm the important function that marine algae, particularly red seaweed, play in generating new substances that are beneficial to both the environment and human health. The variety of metabolites that various algae species create emphasises the need for more investigation and study in this area.

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