

Taxonomic Identification of Selected Seaweeds from the Jarjar Oma Coast and Quantitative Determination of Chlorophyll and Carotenoid Pigments

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التعريف التصنيفي لبعض الطحالب البحرية الكبيرة من ساحل جرجار أمه والتقدير الكمي لأصباغ الكلوروفيل والكاروتينات.

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Abstract

Marine macroalgae (Seaweeds) are important components of coastal ecosystems and play a significant role in primary production and biodiversity. This study aimed to identify seaweed species from the Jarjar Oma coast, Libya, and evaluate their photosynthetic pigment content. Seaweed samples were manually collected at different time points between May and August 2024 to account for seasonal variation. Species identification was carried out using morphological and anatomical characteristics, supported by microscopic examination and taxonomic references. A total of 12 species belonging to 10 genera were identified. The recorded species were classified into three major algal groups: Chlorophyta (50%), Phaeophyta (25%), and Rhodophyta (25%). The genus *Cystoseira* was the most dominant throughout the study period. Pigment analysis showed significant variation among species. *Ulva lactuca* exhibited the highest concentrations of chlorophyll a (20.435 µg/mg) and chlorophyll b (18.173 µg/mg), whereas *Cystoseira barbata* recorded the highest carotene content (8.817 µg/mg). Red algae, including *Laurencia papillosa* and *Jania rubens*, showed comparatively lower pigment concentrations. These differences reflect adaptations to varying environmental conditions, particularly light availability and habitat depth. The findings provide baseline information on the diversity and physiological characteristics of marine macroalgae along the Libyan Mediterranean coast and may support future ecological and biotechnological studies.

Keywords: Photosynthetic pigment, Seaweed, Jarjar Oma coast, Chlorophyll, carotene.

الملخص

هدفت هذه الدراسة إلى التعرف على أنواع الطحالب البحرية الكبيرة على ساحل جرجار أمه في ليبيا وتقييم محتواها من أصباغ البناء الضوئي. جُمعت العينات يدويًا في فترات زمنية مختلفة بين شهري مايو وأغسطس 2024، وذلك لرصد التغيرات خلال فترة الدراسة. وتم التعرف على الأنواع اعتمادًا على الصفات المورفولوجية والتشريحية، مدعومة بالفحص المجهرى والمراجع التصنيفية المعتمدة. أسفرت الدراسة عن تسجيل 12 نوعًا تنتمي إلى 10 أجناس، وصنفت ضمن ثلاث مجموعات رئيسية هي: الطحالب الخضراء (Chlorophyta) بنسبة 50%، والطحالب البنية (Phaeophyta) بنسبة 25%، والطحالب الحمراء (Rhodophyta) بنسبة 25%. وكان جنس *Cystoseira* الأكثر سيادة خلال فترة الدراسة.

وأظهرت نتائج تحليل أصباغ البناء الضوئي وجود تباين ملحوظ بين الأنواع المختلفة، حيث سجلت *Ulva lactuca* أعلى تركيز لكل من الكلوروفيل أ (20.435 ميكروغرام/ملغم) والكلوروفيل ب (18.173 ميكروغرام/ملغم)، في حين سجلت *Cystoseira barbata* أعلى محتوى من الكاروتينات (8.817 ميكروغرام/ملغم). كما أظهرت الطحالب الحمراء، بما في ذلك *Laurencia papillosa* و *Jania rubens*، مستويات منخفضة نسبيًا من الأصباغ مقارنة بالأنواع الأخرى. هذه الاختلافات تعكس تكيفات مع ظروف بيئية مختلفة، خاصة توافر الضوء وعمق الموطن.

و *Jania rubens*، تراكيز أقل نسبيًا من أصباغ البناء الضوئي مقارنةً بالأنواع الأخرى. وتعكس هذه الاختلافات تكيفات فسيولوجية مع الظروف البيئية المختلفة، ولا سيما تباين شدة الإضاءة وعمق الموانئ. توفر هذه الدراسة بيانات أساسية حول التنوع الحيوي والخصائص الفسيولوجية للطحالب البحرية الكبيرة على الساحل الليبي للبحر الأبيض المتوسط، ويمكن أن تشكل مرجعًا مهمًا لدعم الدراسات البيئية والتطبيقات الحيوية المستقبلية.

الكلمات المفتاحية: أصباغ البناء الضوئي، الطحالب البحرية الكبيرة، ساحل جرجر أمه، الكلوروفيل، الكاروتينات.

Introduction

Macroalgae (seaweeds) are multicellular photosynthetic organisms that constitute an essential component of marine and coastal ecosystems. They are generally classified into three major groups: Chlorophyta (green algae), Phaeophyta (brown algae), and Rhodophyta (red algae), based on their morphological characteristics and pigment composition [1]. These algae contribute significantly to primary production, nutrient cycling, habitat formation, and the maintenance of marine biodiversity [2]. Seaweeds represent a diverse group of photosynthetic organisms characterized by the presence of various light-harvesting and photoprotective pigments. The diversity and distribution of these pigments serve as important taxonomic markers in classification and biodiversity assessments. Photosynthetic pigments play a fundamental role in light absorption and energy transfer during photosynthesis. The major pigments found in macroalgae include chlorophylls, carotenoids, and phycobiliproteins, which vary among taxonomic groups and environmental conditions (Rowan, 1989). Consequently, pigment composition serves as an important tool for algal classification, ecological studies, and biodiversity assessments [3]. In addition, algal pigments possess considerable economic and biotechnological value due to their antioxidant, pharmaceutical, nutraceutical, and industrial applications [4]. The collection and identification of macroalgae are essential steps in understanding their diversity, distribution, and ecological significance. Accurate taxonomic identification, combined with pigment analysis, provides valuable information on species adaptation, physiological status, and environmental responses. Therefore, the present study aimed to collect macroalgal samples from Jarjar Oma coast, identify the recorded species using morphological characteristics, and estimate their photosynthetic pigment content to evaluate variations among different algal groups.

Material and methods

Seaweed has been harvested by hand for generations, and this method is still widespread for species that grow naturally along the coast [5]. Because there are no industrial operations along this seashore, it was essential to choose this spot. To avoid desiccation, the collected samples were carefully washed with seawater in seawater filled plastic bags before being sent right away to the lab. To get rid of epiphytes, tiny invertebrates, and unnecessary material, fresh seaweeds were extensively cleaned with water and then distilled water.

Identification of the seaweeds

All species' morphological and anatomical traits were examined using a zoom stereo microscope. Based on the microscopic analysis, morphometric features, all seaweeds were identified taxonomically the most important references of which is [6,7,8,9,10,11,12,13,14,15]. The names of the species were used according to [16,17,18] were confirmed using Algae Base website [19]. The collected samples were identified in Botany Department, Faculty of Science, Omar Al Mokhtar University.

Estimation of photosynthetic pigment contents

The algae samples were individually placed in 20 milliliters of acetone 90% solvent per gram, and grinded by Morta [20].

After filtering the sample, the resulting extract was centrifuged for roughly ten minutes at 5000 rpm. After the supernatant was separated, a UV spectrophotometer was used to measure absorbance between 400 and 700 nm. The maximum absorbance of total carotene is 470 nm, that of chlorophyll b is 645 nm, and that of chlorophyll a is 662 nm. A three-time run of the experiment was conducted for statistical analysis [21].

The sample was based on the following equations:

- $Cha = 11.75 A_{662} - 2.350 A_{645}$
- $Chb = 18.61 A_{645} - 3.960 A_{662}$
- $Cx+c = 1000 A_{470} - 2.270 Cha - 81.4 Chb/230$

Where:

Total carotene = Cha = Chlorophyll a, Chb = Chlorophyll b, Cx+c

Statistical analysis:

Statistical analysis was carried out using Minitab software 17; statistical significance was assessed using two samples T- test analysis, ONE WAY ANOVA after detecting the normal distribution of data and appropriate $P < 0.05$ consider significant [22].

Results and discussion

Identification of seaweeds from the Jarjar Oma coast

The Jarjar Oma coast located on the Mediterranean coast of Libya, is the beach of the Qasr Libya area (Olebi), located in the north of it, 180 km east of the city of Benghazi and 50 km from Al Bayda. Seaweeds used in this study were manually collected in different seasons during May 2024 to August 2024. Algae samples were initially examined in the study area according to their color with the naked eye Then, seaweeds were defined and classified through morphological and anatomical study, as well as using an optical microscope and using some taxonomic references.

The percentage of algal groups calculated as number of species to all seasons were represented. The results showed that the seaweeds that have been collected and identified were 12 seaweeds species (10 genera) were recorded in the study area. Six species of them (50%) were belonging to Chlorophyta (5 families), Three species (25%) belonging to Phaeophyta (2 families) and Three species (25%) belonging to Rhodophyta (2 families).

The results indicated that Rhodophyta represented the most common algal group in the study area, with twelve species identified. In contrast, the abundance of Chlorophyta and Phaeophyta was comparatively lower among the specimens collected along the Jarjar Oma coast. Notably, species belonging to the genus *Cystoseira* was consistently the most dominant genus during the study period., underscoring their ecological prevalence in this region Table (1)

Table1: Taxonomic classification of seaweeds recorded at Jarjar Oma coast

Sr. No	Scientific name of Algae	Family
CHLOROPHYTA (Green algae)		
1	<i>Cladophora glomerata</i>	Cladophoraceae
2	<i>Cladophora albida</i>	
3	<i>Oedogonium grande</i>	Oedogoniaceae
4	<i>Ulva lactuca</i>	Ulvaceae
5	<i>Dasycladus vermicularis</i>	Dasycladaceae
6	<i>Acetabularia acetabulum</i>	Polyphysaceae
PHAEOPHYTA (Brown algae)		
7	<i>Cystoseira compressa</i>	Sargassaceae
8	<i>Cystoseira barbata</i>	
9	<i>Padina pavonica</i>	Dictyotaceae
RHODOPHYTA (Red algae)		
10	<i>Laurencia papillosa</i>	Rhodomelaceae
11	<i>Polysiphonia lanosa</i>	
12	<i>Jania rubens</i>	Corallinaceae
Total	12 seaweeds species	9 families

Chlorophyta:



Cladophora albida



Cladophora glomerata



Oedogonium grande



Ulva Lactuca



Dasycladus vermicularis



Acetabularia acetabulum

Figure 1: Collected from Chlorophyta (green algae)

Phaeophyta:



Cystoseira compressa



Cystoseira barbata



Padina pavonica

Figure 2: Collected from Phaeophyta (Brown algae)

Rhodophyta:

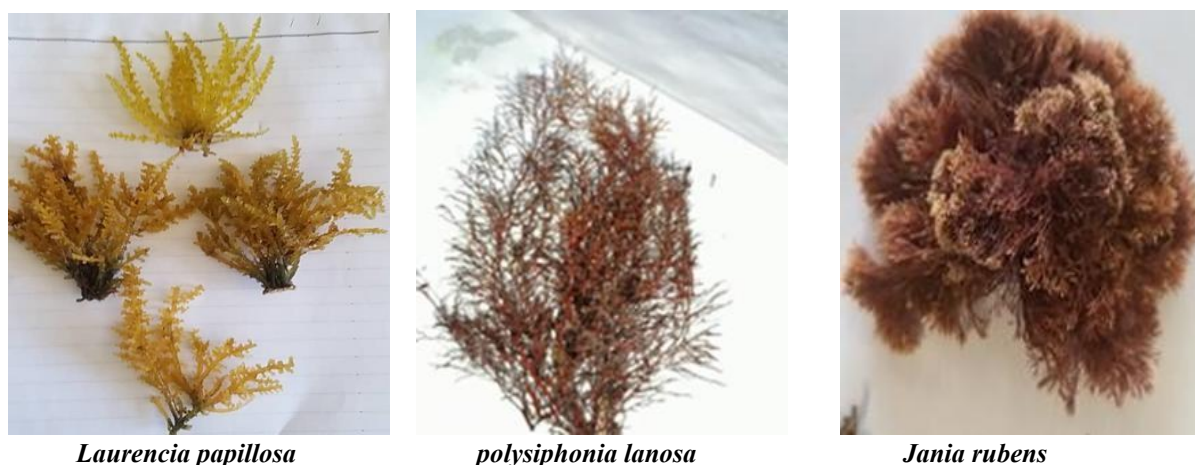


Figure 3: Collected from Rhodophyta (Red algae)

Estimation of pigment contents in seaweeds:

The pigments of seaweeds were identified in the current study by extracting different pigments using acetone. Since carotene and chlorophyll pigments are non-polar organic molecules in comparison to other chemicals, the extraction was finished. The compatibility of the solute's inherent characteristics with a solvent that dissolves similarly due to its polarity determines how well a material can be extracted [23]. These pigments are essential for photosynthesis and photoprotection in seaweeds and provide insights into their physiological and ecological adaptations. In this study, pigments were estimated in twelve species of seaweeds collected from the study area shown on (table 2), Figure 1,2,3

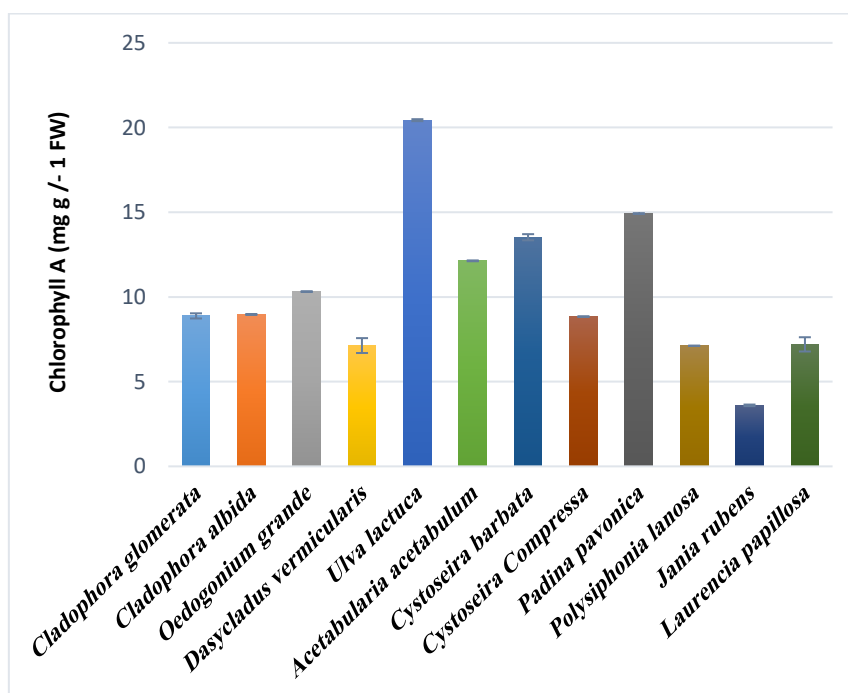
Table 2: Taxonomic classification of seaweed recorded at Jarjar Oma Coast.

Sr. No	Scientific name of Algae	Family
CHLOROPHYTA (Green algae)		
1	<i>Cladophora glomerata</i>	Cladophoraceae
2	<i>Cladophora albida</i>	
3	<i>Oedogonium grande</i>	Oedogoniaceae
4	<i>Ulva lactuca</i>	Ulvaceae
5	<i>Dasycladus vermicularis</i>	Dasycladaceae
6	<i>Acetabularia acetabulum</i>	Polyphysaceae
PHAEOPHYTA (Brown algae)		
7	<i>Cystoseira compressa</i>	Sargassaceae
8	<i>Cystoseira barbata</i>	
9	<i>Padina pavonica</i>	Dictyotaceae
RHODOPHYTA (Red algae)		
10	<i>Laurencia papillosa</i>	Rhodomelaceae
11	<i>Polysiphonia lanosa</i>	
12	<i>Jania rubens</i>	Corallinaceae
Total	12 seaweeds species	9 families

Table 3: Photosynthetic pigments($\mu\text{g/ml}$) content extracted using 80% Acetone.

Species	Chlorophyll A	Chlorophyll B	Carotene
<i>Cladophora glomerata</i>	8.882 \pm 0.152 ^f	3.483 \pm 0.029 ^f	3.778 \pm 0.007 ^e
<i>Cladophora albida</i>	8.966 \pm 0.001 ^f	2.9287 \pm 0.009 ^g	4.367 \pm 0.008 ^d
<i>Oedogonium grande</i>	10.316 \pm 0.005 ^e	4.5527 \pm 0.0078 ^e	4.333 \pm 0.016 ^d
<i>Dasycladus vermicularis</i>	7.130 \pm 0.440 ^g	5.359 \pm 0.491 ^d	2.805 \pm 0.171 ^f
<i>Ulva lactuca</i>	20.435 \pm 0.058 ^a	18.173 \pm 0.014 ^a	4.193 \pm 0.076 ^{de}
<i>Acetabularia acetabulum</i>	12.132 \pm 0.025 ^d	8.223 \pm 0.095 ^b	6.809 \pm 0.127 ^b
<i>Cystoseira barbata</i>	13.526 \pm 0.181 ^c	5.874 \pm 0.0257 ^c	8.817 \pm 0.208 ^a
<i>Cystoseira compressa</i>	8.8397 \pm 0.0042 ^f	1.334 \pm 0.095 ^{hi}	4.581 \pm 0.036 ^d
<i>Padina pavonica</i>	14.9213 \pm 0.0035 ^b	4.718 \pm 0.028 ^e	6.105 \pm 0.025 ^e
<i>Polysiphonia lanosa</i>	7.1177 \pm 0.006 ^g	1.772 \pm 0.051 ^h	3.002 \pm 0.032 ^f
<i>Jania rubens</i>	3.602 \pm 0.047 ^h	0.641 \pm 0.034 ⁱ	1.374 \pm 0.011 ^g
<i>Laurencia papillosa</i>	7.201 \pm 0.421 ^g	0.977 \pm 0.0897 ^{ij}	2.759 \pm 0.40 ^f

Values are presented as means \pm standard deviation (SD), with n = 3 for each algal species. Mean values within a column that do not share the same superscript letters (A, B, C) are significantly different at $P < 0.05$, whereas means sharing the same superscript letter indicate no significant difference at $P < 0.05$.

**Figure 4:** The contents of chlorophyll (A) pigment in seaweeds from the Jarjar Oma coast

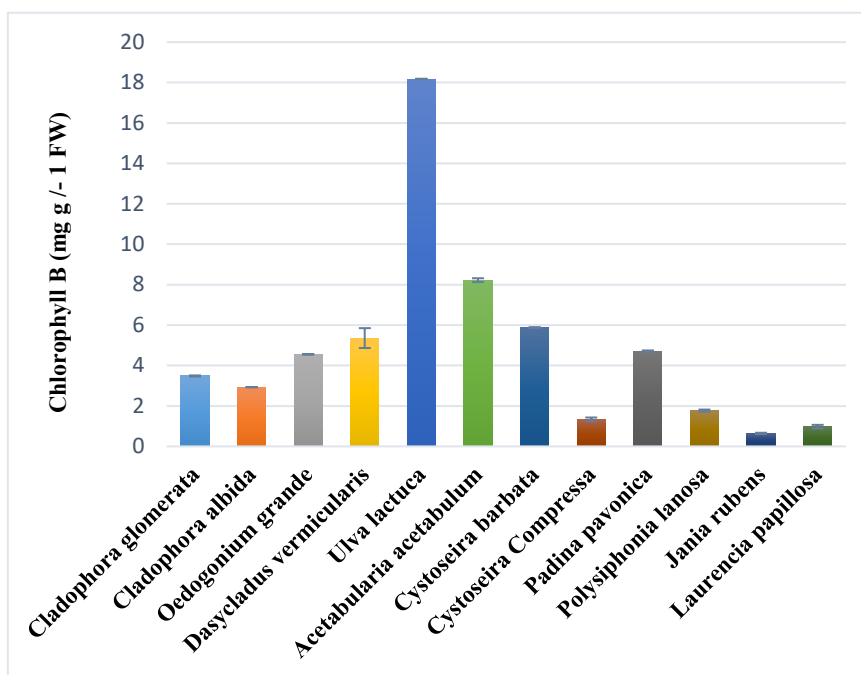


Figure 5: The contents of chlorophyll (B) pigment in seaweeds from the Jarjar Oma coast

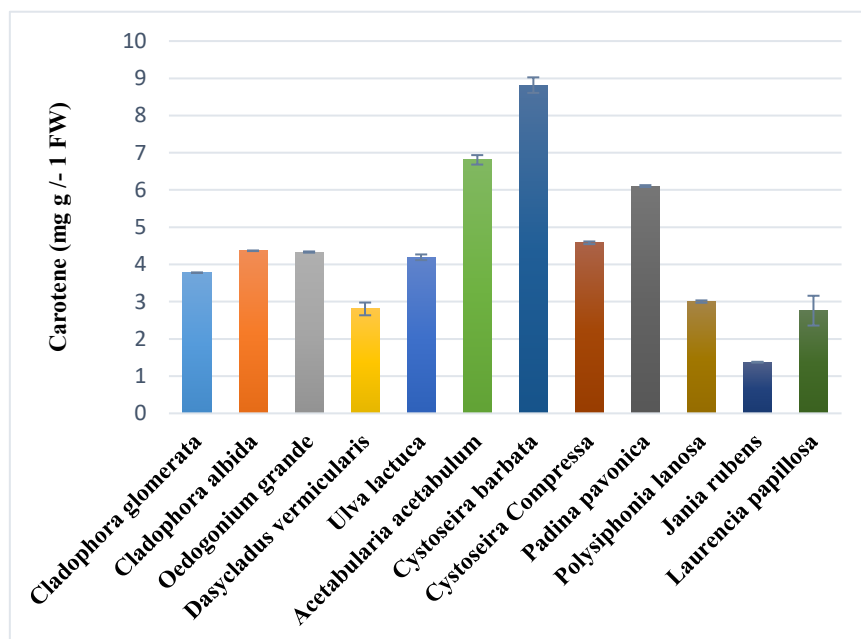


Figure 6: The contents of carotenoids pigment from the Jarjar Oma coast

The pigment analysis revealed that *Ulva lactuca* exhibited the highest pigment concentrations, with chlorophyll A (20.435 $\mu\text{g}/\text{mg}$) and chlorophyll B (18.173 $\mu\text{g}/\text{mg}$), indicating a highly efficient photosynthetic system likely attributable to its adaptability to environments with high or fluctuating light availability. This elevated pigment content supports its rapid growth and widespread distribution along the shoreline, consistent with the findings of [2], who reported that *Ulva* species possess high pigment levels and rapid turnover rates to optimize photosynthesis under intense irradiance. In contrast, the greatest carotene concentration (8.817 $\mu\text{g}/\text{mg}$) was observed in *Cystoseira*, reflecting robust photoprotective mechanisms.

Carotenoids, including carotene, play a critical role in shielding photosynthetic tissues from photooxidative damage by dissipating excess energy and mitigating oxidative stress. As noted by [24], carotenoids such as zeaxanthin and β -carotene are essential components of non-photochemical quenching (NPQ), particularly in algae exposed to high

light intensities. These findings suggest that *Cystoseira Barbata*, a brown alga, is well adapted to shallow, light-saturated habitats.

Chlorophyll A, B, and Carotene levels were noticeably lower in species like red algae *Laurencia papillosa* and *Jania rubens*. This is consistent with the overall pattern of red algae, which may flourish in deeper or darker marine habitats with less light penetration. These results align with the findings of [25], who noted that red algae are generally better adapted to deep or shaded environments due to their reliance on phycoobiliproteins accessory pigments that efficiently absorb green and blue light at greater depths.

Green and Brown Algae Intermediate Profiles Chlorophyll and carotene levels were moderate in other brown algae (*Cystoseira compressa*, *Padina pavonica*) and green algae (e.g., *Cladophora*, *oedogonium*). These variances are a reflection of variations in light circumstances, metabolic methods. Compared to red algae, brown algae often contain more chlorophyll, but they frequently have less than *Ulva* and other rapidly growing green algae. For example, *Padina pavonica* relatively high Chlorophyll A levels align with findings by [26], who reported that brown algae display variable pigment content depending on habitat light exposure and nutrient availability.

This study reveals unique physiological strategies influenced by ecological and evolutionary considerations, highlighting the notable variance in pigment concentration Chlorophyll A, Chlorophyll B, and Carotene among several marine algae species. The main environmental factors affecting pigment regulation in marine algae are light intensity, water depth, and photoperiod Wynne [27].

Conclusion

A total of 12 seaweed species belonging to three major algal groups (Chlorophyta, Phaeophyta, and Rhodophyta) were identified along the Jarjar Oma coast. Pigment analysis showed significant variation among species, with *Ulva lactuca* exhibiting the highest chlorophyll a and b contents, while *Cystoseira barbata* had the highest carotene concentration. These differences reflect the adaptation of seaweeds to varying environmental conditions, particularly light availability and habitat depth. The study provides valuable baseline information on the diversity and physiological characteristics of marine macroalgae in the Libyan Mediterranean coast.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare that they have no conflict of interest.

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References

- [1] R. E. Lee, *Phycology*, 4th ed. Cambridge, U.K.: Cambridge University Press, 2008.
- [2] C. S. Lobban and P. J. Harrison, *Seaweed Ecology and Physiology*. Cambridge, U.K.: Cambridge University Press, 1994.
- [3] S. W. Jeffrey, R. F. C. Mantoura, and S. W. Wright, Eds., *Phytoplankton Pigments in Oceanography: Guidelines to Modern Methods*. Paris, France: UNESCO Publishing, 1997.
- [4] L. Pereira, "Seaweeds as a source of bioactive substances and skin care therapy: Cosmeceuticals, algotherapy, and thalassotherapy," *Cosmetics*, vol. 5, no. 4, Art. no. 68, 2018.
- [5] S. W. K. van den Burg, P. Bikker, M. M. van Krimpen, and A. P. van Duijn, "Economic feasibility of offshore seaweed production in the North Sea," presented at the *Aquaculture Europe Conference*, Trondheim, Norway, 2013.
- [6] A. A. Aleem, *The Marine Algae of Alexandria, Egypt*, 1993.
- [7] C. T.-H. Stadtländer, "Review of *Freshwater Algae: Identification and Use as Bioindicators*," 2013.
- [8] A. Demirbas, "Use of algae as biofuel sources," *Energy Conversion and Management*, vol. 51, pp. 2738–2749, 2010.
- [9] W. R. Taylor, *Marine Algae of Tropical and Subtropical Americas*. Ann Arbor, MI, USA: University of Michigan Press, 1960.

- [10] I. A. Abbott and G. J. Hollenberg, *Marine Algae of California*. Stanford, CA, USA: Stanford University Press, 1992.
- [11] B. Jha, C. R. K. Reddy, M. C. Thakur, and M. U. Rao, *Seaweeds of India: The Diversity and Distribution of Seaweeds of the Gujarat Coast*, 2009.
- [12] M. Nizamuddin, *Contribution to the Marine Algae of Libya: Dictyotales, Bibliotheca Phycologica*, vol. 54, 1981.
- [13] M. Nizamuddin, *The Green Marine Algae of Libya*. 1991.
- [14] M. Godeh, F. El-Menifi, and A. Said, "Marine algae of Tobruk and Ain Ghazala coasts, Libya," *Journal of Science and Its Applications*, vol. 3, pp. 42–55, 2009.
- [15] S. Hess *et al.*, "A phylogenomically informed five-order system for the closest relatives of land plants," *Current Biology*, vol. 32, pp. 4473–4482.e7, 2022.
- [16] M. D. Guiry, *AlgaeBase*. Galway, Ireland: National University of Ireland, 2010.
- [17] M. D. Guiry and G. M. Guiry, *AlgaeBase: World-wide Electronic Publication*. Galway, Ireland: National University of Ireland, 2013.
- [18] M. D. Guiry, "How many species of algae are there? A reprise: Four kingdoms, 14 phyla, 63 classes and still growing," *Journal of Phycology*, vol. 60, pp. 214–228, 2024.
- [19] M. D. Guiry and G. M. Guiry, *AlgaeBase: World-wide Electronic Publication*. Galway, Ireland: University of Galway, 2024.
- [20] D. I. Arnon, "Copper enzymes in isolated chloroplasts: Polyphenoloxidase in *Beta vulgaris*," *Plant Physiology*, vol. 24, pp. 1–15, 1949.
- [21] H. K. Lichtenthaler and A. R. Wellburn, "Determinations of total carotenoids and chlorophylls *a* and *b* of leaf extracts in different solvents," *Biochemical Society Transactions*, vol. 11, no. 5, pp. 591–592, 1983.
- [22] T. J. Quirk, "One-way analysis of variance (ANOVA)," in *Excel 2007 for Educational and Psychological Statistics: A Guide to Solving Practical Problems*, 2012.
- [23] I. Fatima *et al.*, "Advanced methods of algal pigments extraction: A review," *Critical Reviews in Food Science and Nutrition*, vol. 64, pp. 9771–9788, 2024.
- [24] B. Demmig-Adams and W. W. Adams, "The role of xanthophyll cycle carotenoids in the protection of photosynthesis," *Trends in Plant Science*, vol. 1, pp. 21–26, 1996.
- [25] J. T. O. Kirk, *Light and Photosynthesis in Aquatic Ecosystems*, 2nd ed. Cambridge, U.K.: Cambridge University Press, 1994.
- [26] C. S. Lobban and M. J. Wynne, *The Biology of Seaweeds*. Berkeley, CA, USA: University of California Press, 1981.

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