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Phytochemical and Physicochemical Evaluation of Marine Red Algae *Laurencia papillosa* (C. Agardh) Greville

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ABSTRACT

Seaweeds are potential marine renewable assets for food, feed, and medicine since ancient times. Considering the latent characteristics of seaweeds, the prevailing has a look at the goal which has to assess the phytochemical composition of methanol extract of underexploited marine red alga *Laurencia papillosa.* The phytochemical analyses of *L. papillosa* confirmed the presence of nine phytochemicals amongst which glycosides had been discovered to be the very best with a value of 125.57 ± 3.52 mg/g dry wt, wherein because the saponins were found to be lesser in amount with the value of 2.68 ± 1.97 mg/g dry wt. The function of fluorescence emission and pharmacognosical capabilities which include the total ash content and the extractive values of the red alga *L. papillosa* analyzed. The results affirm that the chosen seaweed has energetic phytochemical content which will be a capacity supply for antimicrobial, antioxidant, and cytotoxic interest and the methanol extract of *L. papillosa* will be explored for its robust pharmacological activities in the drug development by the pharmaceuticals.

1. Introduction

Mother Nature has supplied beneficial biochemical specifically through plants, i.e., phytochemicals which have been an essential supply of medicine for thousands of years. Phytochemicals via plants are a crucial part of the primary health care system as a conventional remedy in many countries [1]. Over the last century, an era in the production, improvement, and use of synthetic drugs has elevated that has modified the world scenario in medicine [2]. The widespread convention of commercial drugs which are synthetic and non-natural direct to side effects and particularly, the development of drug resistance in the majority of the pathogenic microbes is a most important problem. Considering the awareness of side effects, it is important to screen the chemical content of plants to assess their potential pharmacological activities directly or indirectly. In this perspective, in current decades, great attention has been paid to the screening, study, and research of phytochemicals, metabolites, and biological activities from natural sources because of their non-side effects [3] by which usage of the synthetic drugs can be minimized.

The marine ecosystem is a rich natural resource of many biologically untapped active compounds such as proteins, polysaccharides, pigments, phytochemicals, vitamins, minerals, and polyunsaturated fatty acids (PUFAs) [4-8]. Algae especially seaweeds are one among the immense taxonomic diversity of marine ecosystems with a wide spectrum of active metabolites and they remain underexploited. Marine algae are a tremendous source of bioactive compounds with a variety of biological activities [9-15]. Although numerous phytoconstituents from different species of seaweed have been recorded and numerous compounds have been obtained from them. For the potential growth of novel products, there are still a vast number of species to be investigated. One such algal species is the marine red alga, *L.papillosa*.

Laurencia papillosa, belonging to member Rhodophyceae is an edible and economically important, located on the western and southern coast of India and its phytochemical composition is poorly known [16]. Hence, the goal of this study is to investigate the Phytochemical and physicochemical evaluation of marine red alga *L. papillosa* collected from the South East Coast of Tamil Nadu, India.

2. Experimental Methods

2.1 Sample Collection

The experimental alga was manually collected from the intertidal region during low tide periods from Mandapam, South East coast of India, Tamil Nadu. The sample was washed with seawater to remove the foreign particles such as sand particles and epiphytes. The seaweed was washed under running tap water followed by distilled water. The seaweed was identified as *L. papillosa* based on the morphological characteristics reported in the Rhodophyta monograph [16]. Seaweeds were shade dried till complete dehydration and were powdered using a blender. The pulverized powder was then used for the analyses of phytochemicals and pharmacognostic characteristics.

2.2 Quantitative Estimation of Phytochemicals

Extraction and purification of phytochemicals such as steroids, glycosides, anthraquinones, phenols, alkaloids, triterpenoids, tannins, saponins, and flavonoids were undertaken, as depicted by Irakli *et al*., [17] with slight alterations.

2.3 Evaluation of Pharmacognosical Characteristics

The pharmacognosical feature highlights such as ash value and the solubility of the experimental alga were also resolved. The fluorescence examination of the dried algal powder was carried out using the method depicted by Patil *et al.,* [18]. The total ash content of the alga was assessed by incineration using a silica crucible in a muffle furnace [19]. The percentage w/w of alcohol-soluble extractive was calculated by referring to the air-dried drug using the following formula as follows [20],

$$\% \text{ Alcohol-soluble extractive value} = \frac{\text{Weight of residue} \times 100}{\text{Weight of the drug}}$$

3. Results and Discussion

The phytochemical constituents of the methanol extract of *L. papillosa* were quantitatively evaluated (Table 1). Totally nine distinct phytochemicals were registered and glycosides were found to be the highest with a value of 125.57 ± 3.52 mg/g dry wt, whereas the saponins were found to be lesser in quantity with the value of 2.68 ± 1.97 mg/g dry wt. The other phytochemicals quantified by the experimental alga were

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steroids (14.53 ± 3.48 mg/g dry wt), anthraquinones (4.55 ± 0.34 mg/g dry wt), phenols (10.95 ± 1.04 mg/g dry wt), alkaloids (4.73 ± 1.48 mg/g dry wt), triterpenoids (12.31 ± 2.74 mg/g dry wt), tannins (15.56 ± 3.75 mg/g dry wt) and flavonoids (20.50 ± 0.20 mg/g dry wt).

Table 1 Quantitative phytochemical analysis of *L. papillosa*

S.No	Phytochemicals	mg/g dry weight
1	Steroids	14.53 ± 3.48^{e}
2	Glycosides	125.57 ± 3.52^{h}
3	Antheraquinones	4.55 ± 0.34^{b}
4	Phenols	10.95 ± 1.04^{c}
5	Alkaloids	4.73 ± 1.48^{b}
6	Triterpenoids	12.31 ± 2.74^{d}
7	Tannins	15.56 ± 3.75^{f}
8	Saponins	2.68 ± 1.97^{a}
9	Flavonoids	20.50 ± 0.20^{g}

**Values are expressed as Mean ± SEM, n=3; Means in each column with different superscript letters are significantly different at p<0.05*

The characteristic fluorescence emission from the sample of *L. papillosa* has been shown in Table 2. The sample was a light green color, while the extracts with different solvents were fluorescence differently in normal and UV lights. The dried, powdered sample exhibits different fluorescence properties, as can be seen in the information given in the table (Table 2).

Table 2 Fluorescence characteristics of **L. papillosa* in different solvents

S.No	Solvent	Day light	UV light
1	Hexane	Light green	Green
2	Benzene	Dark brown	Brownish green
3	Chloroform	Pale green	Yellowish green
4	Ethyl acetate	Green	Brownish green
5	Petroleum ether	Light green	Green
6	Acetone	Yellowish brown	Yellowish green
7	Ethanol	Pale green	Green
8	Water	Light green	Pale green
9	Acid 95% (H_2SO_4)	Pale Brown	Dark brown
10	Alcoholic KOH	Pale green	Green
11	Aqueous KOH	Green	Yellowish green
12	Methanol	Dark green	Green
L3	The algal powder as such	Brown	Pale Brown

**Shade dried powdered material*

Pharmacognosical features such as the total ash content and the extractive values of the red alga *L. papillosa* analyzed are defined in Table 3. In the current investigation, the maximum ash content was observed to be 193.43 ± 0.37 mg/g of dry wt. Among ash values, water-insoluble ash was greater (775.33 ± 13.96 mg/g dry wt) followed by alcohol-soluble ash (673.67 ± 9.20 mg/g dry wt). Water-soluble ash (123.67 ± 3.17 mg/g dry wt) was found to be lower followed by alcohol insoluble ash (136.27 ± 0.50 mg/g dry wt).

Table 3 Pharmacognasy study of *L. papillosa*

S.No.	Pharmacognostic parameters	mg/g dry weight
1	Total ash content	193.43 ± 0.37^{c}
2	Water-soluble ash	Water-insoluble
3	Water-insoluble ash	775.33 ± 13.96^{e}
4	Alcohol soluble ash	673.67 ± 9.20^{d}
5	Alcohol insoluble ash	136.27 ± 0.50^{b}

**Values are expressed as Mean ± SEM, n=3; Means in each column with different superscript letters are significantly different at p<0.0*

Seaweed is a significant marine biological resource with increased dietary significance, making it one of the most promising plants of the future. Marine algae are the richest sources of accepted and new bioactive metabolites and act as the compounds of interest to the pharmaceutical industry [21]. Because of its remarkable biochemical composition, it is commonly used in many industries as well as in terms of biotechnology aspects [22]. Bioactive substances from seaweed are currently receiving larger consideration from pharmaceutical and nutraceutical industries and scientists. As long as the population remains ever-expanding, the assessment of the chemical content of macroalgae gains importance in deciding whether to use them as food sources around the globe [23]. In the current study, an attempt is made produced to figure out the various phytochemicals in the experimental alga *L. papillosa* on a dry weight base.

The structure of sterol is characteristic of red algae. In general, cholesterol is the primary component of sterols, which is always more than 80% of the complete sterols [24]. Although *L. papillosa* is a rich source of secondary metabolites [25], only a few trials have been made on GC/MS steroid identification [26]. The steroid content of *L. papillosa* in the current examination was 14.53 ± 3.48 mg/g DW. In the current study, the glycoside content of *L. papillosa* was (125.57 ± 3.52 mg/g DW) which is higher in quantity compared to other phytochemicals recorded and greater than other red algae *T. glomerulata* [27]. These glycosides exhibit many biological activities including antibiotic drugs, treatment of schizophrenia, and immunomodulatory and hypolipemic activities [28]. Anthraquinone is a class of aromatic compounds with a broad array of bioactivity, including cathartic, anticancer, anti-inflammatory, antimicrobial, diuretic, vasorelaxant, and phytoestrogen [29]. In the current research, the methanol extract of *L. papillosa* showed a higher amount of anthraquinones than *K. alvarezii* and *A. spicifera* [30]. The methanol extracts from *L. papillosa* proved the existence of greater phenol content (10.95 ± 1.04 mg/g DW) in the present examination. Algal phenolic compounds have been reported to scavenge harmful free oxidizing radicals.

The biological and pharmacological properties of phenolic compounds are mainly antimicrobial, anti-viral, anti-inflammatory, cytotoxic, anti-mutagenic, and anticarcinogenic [31]. In the current research, the alkaloid content was recorded to be 4.73 ± 1.48 mg/g DW. Earlier, Vinoth Kumar *et al*. [9] recorded the alkaloid content of red algae *C. parvula* at 12.56 ± 0.00 mg/g DW which is higher than our present result. Alkaloids are reported to be biologically and therapeutically active and have many medical applications [32]. Alkaloids in marine algae are rare when compared to terrestrial crops and their biological potential is not completely implicit [33]. Triterpenoids are known to have cytotoxicity against an array of tumor cells and anticancer efficiency in preclinical animal models [34]. The triterpenoid content of the marine red alga *L. papillosa* was 12.31 ± 2.74 mg/g DW. In the current investigation, the methanol extract of *L. papillosa* has a fair quantity of tannins. The findings of this research are slightly greater than those of *C. parvula* recorded by VinothKumar *et al*. [9]. Vu Ngoc Boi *et al*. [35] revealed that phlorotannin obtained from brown algae *Sargassum serratum* had antioxidant activity and structural variety. The methanol extract of *L. papillosa* in the present examination showed that the content of saponin was found to be lesser in quantity with the value of 2.68 ± 1.97 mg/g dry wt compared to other phytochemicals. Saponins have a broad variety of medicinal characteristics, including hypocholesterolemic, anticarcinogenic, anti-inflammatory, anti-microbial, and antioxidant actions [36]. The methanol extract of *L. papillosa* in the present examination showed that it has a rich content of saponin. Flavonoids have an important pharmacological activity such as antioxidant, anticancer, antiviral, antibacterial, antiallergic, antileukemic, vasodilator, and antiosteoporotic [37, 38]. A higher number of flavonoids was recorded in the marine red alga *L. papillosa* in the current examination (20.50 ± 0.20 mg/g DW).

It is apparent that the seaweed has multiple uses biologically hence, it is of supreme significance to establish purity evaluation, quality control, sample identification, and standardization. Therefore, pharmacognosical tests for the experimental alga *L. papillosa* was conducted in the current study.

The fluorescence assessment of *L. papillosa* exhibited a range of colors that could be used to identify the likely classes of compounds in the plant. The total ash content was determined in our investigation. Water-insoluble ash content was higher than 775.33 ± 13.96 mg/g dry wt accompanied by alcohol-soluble ash 673.67 ± 9.20 mg/g dry wt. The total ash value and the extractive value will be useful for the recognition and authentication of plant material [39]. The quantity of ash content is linked to the number of mineral residues accumulated by the species in its tissues and the concentration of inorganic compounds and salts in the water location, where the algae grow [40]. It, therefore, acts as one of the parameters used to check contamination and adulteration [41].

4. Conclusion

Laurencia papillosa can be considered an under-exploited supply of health-promoting phytochemicals, which may be used as therapeutic agents. The present study has proven that the methanol extract of *L. papillosa* is rich in chemically active compounds i.e. phytopharmaceutical importance. Further research on the isolation of active compounds and investigation of biological activity assays might present more significant insights. Hence, the results of the research offer the scientific basis for the importance of seaweeds and the need to explore the naturally available plentiful resource of the ocean which can lead to the invention of novel compounds beneficial to mankind.

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