



EVALUATION OF PHYTOCHEMICAL CONSTITUENTS OF TWO DIFFERENT SPECIES OF TURBINARIA

Biochemistry

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ABSTRACT

Seaweeds are one of the natural sources of many organic and inorganic substances which are of nutritive and nutraceutical value. The main aim of the present study was to evaluate and estimate the biochemical constituents of the selected metabolites of two species of Turbinaria, viz, *Turbinaria ornata* and *Turbinaria conoides* of the class Phaeophyceae. Phytochemical screenings were done in hexane and methanolic extracts using standard procedures. Estimation of Carbohydrates, Protein, Lipid, Phenol and Flavonoids were also conducted. There were variations in the presence of metabolites in both the extracts of both the species of Turbinaria. It was found differences in the quantity of metabolites among the two species. Carbohydrate and protein content was found to be more in *T. conoides*, but quantity of lipid, phenol and flavonoid were more in *T. ornata*. Evaluation of biochemical constituents can be attributed to the nutritive and bioactive properties of Turbinaria species.

KEYWORDS:

SEAWEEDES, TURBINARIA ORNATA, TURBINARIA CONOIDES, NUTRACEUITICAL, BIOACTIVE PROPERTIES

INTRODUCTION

Algae are found in many places where there is light for photosynthesis such as sea, rivers and lakes, on soil and walls, in animal and plants (symbionts). Seaweeds are marine plants and are classified based on their colours, such as red, green and brown and contribute to 4,500, 900 and 1,000 species respectively and constituting total of 25-30,000 species. They can exist as unicellular microscopic organisms (microalgae) to multi cellular organisms of great size (macro algae). Sea weeds or marine algae are potentially prolific sources of highly bioactive secondary metabolites that might represent useful leads in the development of new pharmaceutical agents (Chanda *et al.*, 2010). Many pharmacological studies on algae have reported that the chemical compounds produced by marine algae have different biological activities such as anti-inflammatory, anticancer, anti-HIV, anti-mutagenic and scavenging free radicals (Cornish and Garbary, 2010; Bechelli *et al.*, 2011).

In comparison with many common vegetables, high levels of fibre, minerals, omega-3 fatty acids, and moderate concentrations of lipids and proteins available in most of the edible seaweed help it to be considered as an important food source for human nutrition. However, the available amounts of the above nutrients may vary basically depending on the variety, season, and the area of production (Murata and Nakazoe, 2001). Products of primary metabolism, such as amino acids, carbohydrates and proteins are playing vital role in the maintenance of life processes, while others like alkaloids, phenolics, steroids, terpenoids are products of secondary metabolism and have toxicological, pharmacological and ecological importance (Kaviraj, 1993).

Lipids are widely distributed in several resistance stages of algae (Miller 1962). A few studies were done on the fatty acids of microalgae and seaweeds (Takagi *et al.*, 1985; Wood 1988). The macro algal biomass can store large amounts of oil, which can be exploited for the production of biodiesel (John and Anisha, 2011). The multi-target nature of phytochemicals may be precious as antioxidant, antimicrobial, anti-carcinogenic, anti-inflammatory, antidiabetic, antiulcer, antimalarial, antispasmodics, antipyretics, antiemetics, anti diarrhoeals, antituberculous, analgesics and antipyretics, anthelmintics, anti-allergics. Phytochemicals may also modulate transcription factors (Andreadi *et al.*, 2006), redox-sensitive transcription factors (Surh *et al.*, 2005) redox signalling, and inflammation.

The phytochemical evaluations of plants, which have a suitable history of use in folklore, have often resulted in the isolation of principle compounds with remarkable bioactivities (Matsukava *et al.*, 1997). Polyphenols derived from seaweed may be more potent than analogous polyphenols derived from terrestrial plant sources due to the presence of up to eight interconnected phenol rings (Hemat, 2007). Phlorotannins, a group of phenolic compounds which are restricted to

polymers of phloroglucinol have been identified from several brown algae (Koivikko *et al.*, 2007). These compounds have been reported to possess strong antioxidant activity. In addition, polysaccharides have also been demonstrated to possess excellent antioxidant potential (Yan *et al.*, 1999; Zhao *et al.*, 2008). Increased consumption of phenolic compounds is found to be associated with reduced risk of several diseases such as cardiovascular diseases and certain types of cancer (Tilak *et al.*, 2004; Dasgupta and De, 2004; Chung *et al.*, 2006; Kaviarasan *et al.*, 2007; Kaisoon *et al.*, 2011). The objective of the present study is to evaluate the phytochemical constituents of two Turbinaria species viz., *Turbinaria ornata* and *Turbinaria conoides*.

MATERIALS AND METHODS

The algae selected for the present study was *Turbinaria ornata* and *Turbinaria conoides* of the class Phaeophyceae. Seaweed samples were collected during low tides and washed with seawater followed by fresh water and finally with distilled water. Then these were shade dried for 8-10 days and finally grounded to fine powders. The finely powdered samples were subjected for sauhlet extraction sequentially with the solvents Hexane and Methanol for 6-8 hrs. The extracts were concentrated under reduced pressure and evaporated to dryness. The final residue was stored at 40C in a refrigerator for qualitative and quantitative analysis of the phytochemical constituents.

Phytochemical Evaluation

Hexane and Methanolic extracts of Turbinaria species were subjected for the qualitative analysis to detect the presence of primary and secondary metabolites such as carbohydrates, protein, amino acids, lipids, phenol, saponin, flavonoid, terpenoid, alkaloid and sterol according to the standard procedures described by Harbone (1998).

Quantitative estimation

The dry powdered algal samples were used for the quantification of Carbohydrates by (Dubois *et al.*, 1956). Proteins (Lowry *et al.*, 1951), Lipids (Barnes and Blackstock 1973), Phenol (Turkman N *et al.*, 2005), and Flavonoid (Zhishen *et al.* 1999).

RESULTS AND DISCUSSION

The phytochemical evaluation of the primary and secondary metabolites showed presence in varying intensities in hexane and methanolic extract of *Turbinaria ornata* and *Turbinaria conoides*. In both the algal extracts, carbohydrates, proteins, amino acids and lipids showed their presence in good intensities of colour or precipitation. The secondary metabolites showed their presence in much more intensities in methanolic extract compared to hexane extract. Saponin was not detected in any of the extract in both the species of *Turbinaria*. Table 1 shows the phytochemical screening of the metabolites in Hexane and Methanol.

Quantitative estimation of carbohydrate, protein, lipid, phenol and flavonoid were done in *Turbinaria ornata* and *Turbinaria conoides*. It

was found that in the present study the carbohydrate content was more in the selected brown algal species as compared to protein and lipid.

Among the two members, the carbohydrate content of *Turbinaria conoides* was found to be more (37.24±0.01) than *Turbinaria ornata* (35.17±0.01). The difference in carbohydrate content may be due to the favourable environmental conditions. Earlier reports indicates that carbohydrate content in seaweeds varied from 28.64% to 64.17% of dry weight of the samples and variations are due to the changes in the sampling locations and ecological conditions. Roslin (2001) reported variation in carbohydrate content (1.4% to 59%) between species from Arokiapuram coast of Tamil Nadu. This reveals that local environmental condition play a major role in determining the chemical composition and the carbohydrate content of seaweeds. Rao and Rao (2004) reported highest carbohydrate content in *Sargassum polycystum* during its peak growth period.

The protein content of *Turbinaria ornata* was found to be in a much high quantity (15.23±0.03) than *Turbinaria conoides* (4.37±0.01) even though both the species belonged to the same genus. Generally the protein fraction of brown seaweeds were found to be less when compared to green and red seaweeds (10-47%) of dry weight. The protein content of seaweed also depends on seasons and also varied from species to species (Dhargalkar *et al.*, 1980).

In the present study, it was found that among the two species, the lipid content was found to be more in *T. ornata* (6.38±0.08) than *T. conoides* (2.33±0.05). This result is in accordance with the general trend in seaweeds that the lipid content is always in a lower quantity compared to that of protein. Lipids serve as a store of energy and provide much more energy through oxidation processes. Seaweed synthesizes higher amounts of polyunsaturated fatty acids (PUFAs) especially under the cool climates, and the total lipid content is elevated during the hot seasons (Narayan *et al.*, 2006). However, the content and the composition of fat can be greatly varied depending on the type of seaweed. Fatty acids are important for human and animal health because they are precursors in the biosynthesis of eicosanoids, which are important bio-regulators in many cellular processes. Polyunsaturated fatty acids content are high in seaweeds than terrestrial vegetables (Darcy-vrillon, 1993).

Total phenolic content was estimated and found a commendable difference in the quantity of phenol between two species of *Turbinaria*. Phenolic content was found to be more in *Turbinaria ornata* (5.92±0.004) than *Turbinaria conoides* (1.59±0.009). Phenolic compounds are commonly found in plants, including seaweeds, and have been reported to show a wide range of biological activities including antioxidant properties (Kuda *et al.*, 2007; Athukorala *et al.*, 2006). The phenolic compounds are the most effective antioxidant present in the brown algae. The phenolic content of brown was 20-30% dry weight.

Flavonoids are phenolics and contain conjugated aromatic systems and thus show intense absorption bands in the UV and visible regions of the spectrum. Total flavonoid estimated in *Turbinaria ornata* was 1.549±0.003 which was more than that of *Turbinaria conoides* (0.516±0.005). Flavonoids are important in plant defence mechanisms against invading bacteria and other types of environmental stress, such as wounding and excessive light or ultraviolet (UV) radiation (Harbone, 1994; Wallace and Fry, 1994). Several researchers have made attempts to identify the plants producing bioactive substances (Janakiraman *et al.*, 2012; Sengul *et al.*, 2011; Sangeetha and Vijayalakshmi, 2011). Quantitative estimation of the metabolites were given in Table 2 and graphically in Fig:1-2.

Metabolites	<i>Turbinaria ornata</i>		<i>Turbinaria conoides</i>	
	Hexane	Methanol	Hexane	Methanol
Carbohydrate	++	++	++	++
Protein	++	++	++	+++
Aminoacid	+	++	+	++
Lipid	+	+	+	++
Saponin	-	-	-	-
Phenol	+	++	-	+
Flavonoid	-	++	-	+
Alkaloid	+	+	+	+
Terpenoid	-	+	-	+
Sterol	+	+	+	+

Table 1: Phytochemical screening of metabolites

Name of the algae	Metabolites (mg/g)				
	Carbohydrate	Protein	Lipid	Phenol	Flavonoid
<i>Turbinaria ornata</i>	35.17±0.01	15.23±0.03	6.38±0.08	5.98±0.00	1.54±0.00
	1	3		4	3
<i>Turbinaria conoides</i>	37.24±0.01	4.37±0.01	2.333±0.0	1.59±0.00	0.516±0.0
	1		5	2	05

Table 2: Quantitative estimation of the metabolites (All values in mean±S.D)

CONCLUSION

It was noticed from the present study that *T.ornata* and *T.conoides* are a rich source of primary and secondary metabolites and there were variations in the biochemical content between the species too. This can be related to the nutritive and bioactive property of *Turbinaria* species. Further study is necessary to isolate and characterize the phytochemical constituents in these two species to confirm the importance of these two species to be used in food and pharmaceutical industry.

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