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PROXIMATE COMPOSITION OF *PADINA BOERGESENII*- A BROWN ALGA FROM VADAKKADU COASTAL REGIONS, SOUTHEAST COAST OF INDIA

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ABSTRACT

The proximate composition of *Padina boergesenii* (Allender & Kraft) a brown alga from Vadakkadu coastal regions; Southeast coast of India was analyzed. Dry matter, crude protein, ether extract (lipids), carbohydrates, ash and total dietary fiber content of three samples were determined by standard methods. *P. boergesenii* showed a high content of ashes (45.65%), carbohydrates (44.05%) and total dietary fiber (47-56% on dry basis). About 8.69% of protein, 1.23% of lipids was low. The species showed temporal variations in the percentages of proteins, lipids, minerals, dietary fiber contents, and non-nitrogenous extracts. *Padina boergesenii* presented comparable values to those of algae used actually as food in the region.

KEYWORDS: Dietary Fiber, Lipids, Proteins, Vadakkadu, South East Coast of India.

INTRODUCTION

In Asian countries, the macroalgae are being used as food source. Macroalgae are attracting increasing attention as a valued food source.[1] There are about 220 macroalgal species have been commercially utilized worldwide.[2] The commercial algae are used in human food, fodder, fertilizer, drugs, paper production and in various industries. The industrial utilization of macroalgae is at present largely confined to extraction for phycocolloids and, to a much lesser extent, certain fine biochemicals. Recently, macroalgae have been used for the production of industrial aquaculture increasing the added value of this natural resource.[3]

Health, food and drug industries are interested in new sources for novel products. Although the chemical content and nutritional value of some macroalgae were examined earlier[4-7], there are about 550 species of macroalgae in this country, but only 1% of them are widely known.[8,9]

The algal genus *Padina* is well defined, widely distributed throughout the tropics and very easy to recognize.[10] Its geographical distribution reaches South America and Southeast Asia, from the tropics to cool temperate waters, where they occur in intertidal and subtidal habitats. With 43 currently recognized species, *Padina* is the second most species dictyotalean genus after Dictyota, and can be especially abundant in certain regions as well.[11] A few species of *Padina* spp. have been traditionally used as food source in some coastal cultures, e.g. as a gelatin-like sweetmeat[12], seasoning in dry flake forms or as salt replacement for high blood pressure patients[13] and for treatment of goiter and scrofula.[14] The macroalga *Padina boergesenii* is not listed in the 145 edible seaweeds of the world[2], and its chemical constituents have never been studied before in details. Hence, this work is to investigate the chemical composition of the common macroalga *P. boergesenii* from Vadakkadu coastal regions, South East Coast of India.

MATERIALS AND METHODS

Seaweed material

Padina boergesenii was collected from a distinct site of the Vadakkadu coastal region, South east coast of India. They were transported to the laboratory at 4°C. All the samples were washed with distilled water to remove associated debris and salt water. Epibionts were removed and the macroalgae were dried 48 hours at 35°C, grounded and stored in a dry place. Part of the macroalgae was fixed in 4% formaldehyde for its taxonomic identification. Algae were identified by examination of their thallus architecture and special morphological characters such as fronds, cell layers and reproductive structures.[15,10]

Chemical Composition

Dry matter, ether extract, total dietary fiber contents and ash of three samples were determined by standard AOAC methods.[16] Crude protein (N x 5.38) was determined according to Lourenco et al.[17] Carbohydrate contents were calculated with the formula: Carbohydrates = [100% - (%protein + %lipid + %ashes +%water)] according to Ortiz et al.[9] All inorganic salts, reagents, and buffers were analytical reagent grade. Total dietary fiber content was determined with the dietary fiber kit was from Sigma Chemical Co. (St. Louis,

CA, USA). The results were expressed as a percentage of the dry weight.

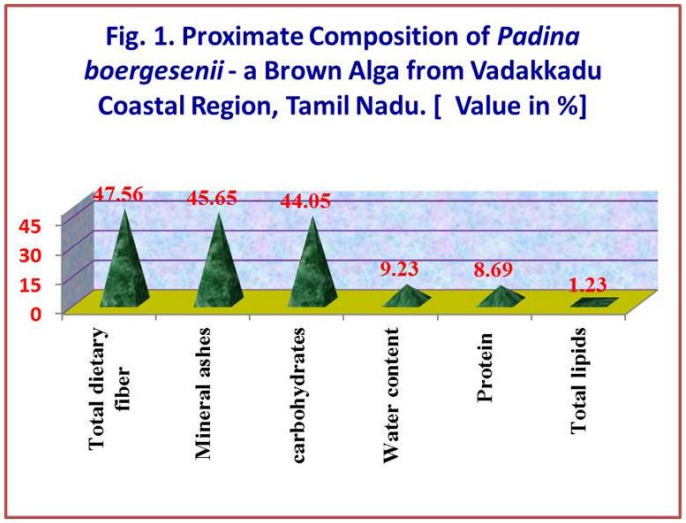
RESULTS AND DISCUSSION

The chemical composition of *Padina boergesenii* from Vadakkadu, South east coast regions of India, are shown in Fig-1. The water content of the samples was less than 10%.

Mineral Ashes

Ruperez[18] reported that the marine habitats in which macroalgae grow allow them to absorb a wide diversity and high amounts of minerals. In fact, trace elements and minerals are more abundant in macroalgae compared to terrestrial food sources.[1] In the present study, the mineral ashes content in the macroalgae collected in Vadakkadu coastal regions was high (45.65% - Fig-1).

Table.1: Proximate analysis of mineral ashes, proteins, lipids, carbohydrates and total dietary fiber) in the brown algae *Padina boergesenii* expressed as a percentage of the dry weight, all values are means ±sd (n=3).



Variations in the ash content according to the species and origin of the samples have been noticed in prior studies. Behairy & El-Sayed[19] explained the high content of ash in brown macroalgae by the presence of polysaccharides and divalent cations. For example, *Padina boergesenii* has showed a higher content of copper, chromium, iron, lead, sulphur, potassium and calcium.[20] Sulphate seems to be a typical component of marine macroalgal polysaccharides, related to high salt concentration in the environment and to specific aspects of ionic regulation.[20] *Padina* species are an important source of calcium carbonate and

organic matter in the shallow waters of tropical and subtropical areas.[21] This genus produces extracellular calcium in their erect and conspicuous fan-like fronds.[22] This mineral is precipitated in the form of aragonite within the apical portions of the frond and deposited as needles on the proximal dorsal surfaces.[10] This is an important aspect not only from a taxonomical, but also from a nutritional and biogeochemical point of view.

Proteins

From a nutritional point of view macroalgae are a good source of proteins.[23,24] But brown macroalgae, with the exception of Ecklonia spp., consist of only 5% to 15% protein.[25,26] Consequently, *P. boergesenii* collected in Vadakkadu coastal regions showed low content of protein (8.69%, Fig-1). As in this result, prior chemical studies of different *Padina* species showed a low and variable protein different *Padina* species showed a low and variable protein content too. It has been observed that the protein content of macroalgae is dependent on season and environmental growth conditions.[27] Besides the low protein content, it has been shown that those macroalgae are rich in essential amino acids. The specific content of amino acids in *Padina* spp. has been reviewed by Lewis[28], Khafaji et al.[29] and Wahbeh.[30]

Carbohydrates

Macroalgae are rich in carbohydrates.[25,18] The typical carbohydrates in brown macroalgae are fucoidan, laminaran, cellulose and alginates.[27] The levels of carbohydrates detected in the present study were within the ranges previously reported (41.22%) for other *Padina* species. *P. boergesenii* presented high contents of non-structural carbohydrates (44.05% dry weight - Fig-1).

Lipids

The results further confirm that the lipid fraction in macroalgae represents only 1.23% of algal dry matter (Fig-1).[31] Although macroalgae have been reported to have low lipid contents[25], their polyunsaturated fatty acid (PUFA) composition is superior to those of terrestrial vegetables in regard to the human diet.[7, 32] Some of those essential fatty acids like omega-3 and omega-6 PUFAs must be consumed by humans and animals in their normal diet.[1] The fatty acid content of different *Padina* species, from different biogeographycal regions, have been reviewed by.[30,33,34, 32], confirming this assumption.

Dietary fiber

Macroalgae are also potentially good sources of dietary fiber.[27] They are known to contain a variety of soluble and insoluble fibers including agar, carrageenans, xylans, alginates, fucans, laminarans, sulfated rhamnoxyloglucurons, and celluloses.[35] In *P. boergesenii* the content of total dietary fibers was high (47.56%, Fig-1). The present results presented are in the same range as described for other Dictyotales.[35] In previously studies, macroalgal fibers accounted for up to 50% of total dry mass[25], although for the *Padina boergesenii* has lesser values of crude fiber have been observed than the early reports.

Aforementioned, most of the macroalgal polysaccharides are not digested; therefore they can be regarded as dietary fibers.[30,36] Major non-digestible components in plant foods include not only dietary fiber but also resistant starch and proteins, minerals and other compounds such as oligosaccharides, polyphenols, lipids, that resist digestion.[37] The nature of soluble macroalgal fibers is such that their passage throughout the gastrointestinal tract occurs largely without digestion, and therefore it can increase feelings of satiety and aid digestive transit trough their bulking capacity.[1] The human consumption of macroalgal fiber has been proven to be health-promoting and its benefits include promotion of growth and protection of the beneficial intestinal flora, hypoglycaemic and reduction of risk of colon cancer.[27] Many macroalgal species have been used traditionally as ingredients in both medicinal and food preparations in different regions across the world[15,32], but in general, the nutritional properties of macroalgae are not known completely yet.[25] Over the past 50 years, the utilization of algae has increased considerably, with the consequent increase in applied research in various related fields.[38] Macroalgae are considered as low caloric foods with high contents of minerals, vitamins and carbohydrates.[32]

CONCLUSIONS

The mineral content of this *Padina boergesenii* has higher than land plants and animal products. As aquaculture, poultry culture and heliciculture need further calcium and other mineral complement diets, algal biomass could serve as dietary supplement. Seaweed meal has important benefits for animal health and nutrition that could be applied or tested in marine organisms of commercial importance.

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