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PHILIPPINE *Porphyra* SPECIES: THEIR ECONOMIC POTENTIALS

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ABSTRACT

A description of the Philippine species of *Porphyra* and their economic potential is presented.

Keywords: *Porphyra*, economic algae.

INTRODUCTION

Since the introduction of seaweed mariculture in the 1970s, Filipino seaweed farmers and entrepreneurs have focused their efforts and money on farming *Eucheuma* and *Kappaphycus*. These red sea vegetables are in demand and export winners both as dried/raw unprocessed product or processed in the form of carrageenan. Carrageenan is a phyco/hydro colloidal substance extracted from red seaweeds like *Eucheuma* and *Kappaphycus*. The extract, that has made the Philippines the world's number producer/exporter, is raw material for several consumer products, e.g. pharmaceuticals, dairy, beauty, food, plastic and other items.

However, the strong competition shown by neighboring seaweed producing countries such as Indonesia and Malaysia, pose a threat to the Philippine Seaweed Industry. It is high time, therefore, to look for other commercial seaweed species which could be an export commodity and as food to supply the protein needs of the Filipinos.

Porphyra (Laver-English, Nori-Japanese, Gamet-Ilokano), is a red, papery sea vegetable. It is protein-rich with a high market demand, both domestically and internationally. This sea vegetable, though predominantly temperate in distribution, abounds in the Northeastern Coast of Luzon. In Southeast Asia, only Vietnam and the Philippines have positively documented the presence of *Porphyra* among its sea vegetables species.

REVIEW OF LITERATURE

Initial report on the presence of *Porphyra* in Philippine waters was that by Sulit (1952). He found this papery red seaweed in moderate growth in the northern provinces of Cagayan and Ilocos Norte, which he reported plainly as *Porphyra.* Later, Galutira and Velasquez (1963), named their *Porphyra* materials collected from Ilocos Norte as *Porphyra crispata* Kjellman. They noted its abundance during the 'cold' months of November and December.

De los Reyes (1967), included *Porphyra* among her specimens collected from Biliran Island (present Biliran Province). Cordero expressed desire to examine her specimens, but was unable to locate the materials. Cordero had doubted the presence of *Porphyra* in the Visayas and Mindanao, principally due to the relatively higher water temperature than that in Luzon the year round. In another report, Velasquez *et al*., (1971), described a specimen gathered from Orion, Bataan as *Porphyra variegata*. Both the Biliran and Bataan *Porphyra* materials had remained unavailable for critical taxonomic study.

RESULTS AND DISCUSSION

Factors attributable to the presence of *Porphyra* in Philippine Waters

The distribution of Porphyra is believed confined to the cooler waters well above the Tropic of Cancer (Kjellman, 1897; Hus, 1902; Okamura, 1931; Ueda, 1932; Tanaka, 1952; Krishnamurthy, 1972). The presence of *Porphyra* in the warm waters of Taiwan (Chiang, 1973), Vietnam (Dawson, 1954; Tanaka and Pham-Hoang, 1962), and the Philippines (Sulit, 1952; Galutira and Velasquez, 1963) is of great ecological significance, expecially so that *Porphyra* has been taxonomically documented only from the Ilocos Norte and Cagayan provinces; notwithstanding 'unverified reports' from Biliran and Bataan (Cordero, 1979).

One probable factor for this is that the northern waters of the Archipelago is relatively cooler than in the central (Visayas) and southern (Mindanao) parts. On an average, the temperature drops to 15 degrees (-18 degrees) in the northern waters in the winter/cooler months, but remains at about 25-28 degrees celcius in the central and southern waters. As the latitudinal difference in the tropical region between the northen and central parts of Luzon is insignificant, the remarkable temperature difference must be brought about by some hydrographic state in the northern waters in winter. It is well-known fact that the sea current along the continent flows in different directions with the seasons from the northwest in the region under consideration. This suggests that the continental waters (Kuroshio Current) can reach the Luzon Strait at least in the winter/cooler months. This likely explains for the settlement of *Porphyra* on the coasts of Ilocos Norte and Cagayan in the Philippines and on the southernmost coast of Taiwan (Chiang,

1973) facing the Strait and further up to Vietnam (Dawson, 1954; Tanaka and Pham-Hoang, 1962).

Philippine *Porphyra* Species

Todate, three (3) species of Philippine *Porphyra* have been taxonomically documented – all from northern Philippines. These species bear some peculiar characteristics common to all three, viz., presence of microscopic denticulate marginal growths, monoecious, and for having monostromatic type of thallus. However, meticulous studies show that the three species differ greatly from each other in their gross morphological and internal structures.

Key to the Species:

1 Leafy-thallus linear-lanceolate, branched; to 14 cm tall; microscopic denticulate marginal processes densely distributed; margin distinctly crenulate . .. .*Porphyra marcosii*

1 Leafy-thallus obovate or reniform, unbranched; to 6 cm tall; microscopic denticulate processes moderately distributed; margin slightly undulate 2

2 Plant grows clustered; formula for the division of antheridia 128 (a/4 b/4 c/8). . *Porphyra crispata*

2 Plant grows 'singly-unclustered'; formula for the division of antheridia 64 (a/4 b/4 c/4) . . . . . *Porphyra suborbiculata*

Taxonomic Treatment

1) *Porphyra marcosii* Cordero

Cordero 1976: 14-24; Cordero 1977: 36-37; as *Porphyra* sp. in Cordero 1974:134-142; Cordero 1979:20-35.

Frond monostromatic, membranaceous, linear-lanceolate, laterally or very rarely basally branched, light purplish or brownish-red, 0.8-10 mm broad, 10-14 cm tall; jelly-like substance 11.4-26.6 um thick; margin decidedly crenulate; base cordate; holdfast small and disc-shaped; rhizoidal filament-borne cells angulato-capitate, others oblongo-capitate 5.6-19 um broad, 19-60.8 um long; chromatophore stellate, arms pointing to different directions, with central pyrenoid; microscopic denticulate processes well-developed; vegetative cells 9.5-15.2 um in diameter; angular with rounded angles in surface view, more or less irregularly arranged upon maturity, with stellate chromatrophore; monoecious; sporocarpic and antheridial patches heavily occupying the marginal and apical portions of thallus.

The antheridium mother cell, following a cruciate and perpendicular to the surface of the frond divisions, gives rise to 4 antheridia. Each antheridium undergoes a division parallel to the surface of frond followed by another parallel division in all segments. The antheridium is now divided into 16 parts, each of which by a cruciate division, gives rise to 4 antherozoids. The whole antheridium now consists of 64 antherozoids arranged in 4 tiers of 16 each, or a formula 64 (a/4 b/4 c/4). The development of carpospores starts off with the division of sporocarp cruciately and perpendicularly to the surface of the frond. This is followed by a division parallel to the surface of the frond. This type of division produces 2 tiers of 4 carpospores each. Thus, the final count of carpospores produced is 8 or a formula 8 (a/2 b/2 c/2).

Type: Holotype is PNH 98660, collected from Dirique Bay, Burgos, Ilocos Norte, by H. G. Gutierrez, January 20, 1963.

Geographical distribution: Philippines (Northern Luzon)

This new species of *Porphyra* has been appropriately named after then President Ferdinand E. Marcos who hails from Ilocos Norte and the species assignment was in conformity of the International Rules on Botanical Nomenclature.

2) *Porphyra crispata* Kjellman

Kjellman 1897: 15; Ueda 1932: 18; Okamura 1936:16; Tanaka 1952:34; Dawson 1954:412; Segawa 1956:54; Cordero 1974:138; 1977: 36.

Frond purplish-red, obovate or roundish, membranous, in clusters of up to 7 sheets, to 15 mm in height, to 6 mm broad; stipitate; rhizoidal attachment of minute adhesive disc; marginal spinulate processes moderately distributed; base cuneate; rhizoidal filament-borne cells usually oblong-capitate, 11.4 um broad, to 70.6 um long; chromatophore strongly stellate with one centrally located pyrenoid; vegetative cells irregularly arranged, oblong-elliptical in surface section, 7.6-11.4 um in diameter; surface jelly to 11.4 um thick; monoecious; antheridia (yellow streaks) and sporocarps (purplish) marginally located, each occupying definite area.

The antheridial mother cell follows the divisional formula of 128 (a/4b/4 c/8); while carpospores are formed following the formula 32 (a/2 b/4 c/4).

Habitat: Cape Bojeador, Burgos, Ilocos Norte, Galutira No. 67 (also as PNH 103646) collected by E. G. Galutira, April 20, 1960; Candilian, Currimao, GTV 2325 collected by G. T. Velasquez et al., June 3, 1950.

Geographical distribution: Japan, Vietnam, Formosa, China, Philippines.

3) *Porphyra suborbiculata* Kjellman

Kjellman 1897:10; Okamura 1916: 6; Ueda 1932: 15; Tseng 1936 34; Noda 1968: 81; Cordero 1974: 138; 1977: 37.

Porphyra leucosticta (non Thuret) Yendo, 1916: 52
P. areolata Kjellman, 1897: 8.

Frond purplish, membranous, reniform, to 6 cm tall, to 3.5 cm broad, monostromatic; mode of attachments by rhizines; margin slightly undulate; microscopic denticulate processes intense; base cordate; fron in cross-section shows surface jelly 22.8-30.4 um in thickness; rhizoidal filament-borne cells oblong to angulato-capitate, 11.4-26.6 um at its broadest part, to 30.2 um long; vegetative cells 7.6-11.4 um in diameter regularly arranged, angular with rounded angles in cross-section; chromatophore one per cell with centrally located pyrenoid; monoecious; antheridial patch yellowish; cystocarpic areas reddish, both located marginally, oftentimes alternating.

The antheridial mother cell divides according to the formula 64 (a/4 b/4 c/4). The formula followed in the development of carpospores is 32 (a/2 b/4 c/4).

Habitat: Bobon, Burgos, Ilocos Norte, PNH 103607 collected by H. G. Gutierrez and R. Espiritu, June 12-19, 1970; Palaui Island, Sta. Ana, Cagayan, PNH 112306 and PNH 112307; Bobon, Burgos, Ilocos Norte, PNH 112182, all collections of H. G. Guitierrez, P. A. Cordero, Jr., and E. J. Reynoso, February-March 1973.

Geographical distribution: Japan, China, Korea, Philippines.

Economic Potentials

These three species are dried, mixed and marketed in the form of roundish or squarish shaped stuff in Ilocos Norte and Cagayan provinces.

One of these, *P. marcosii* is being recommended for sea farming because the culture technology is known and the expertise is available. In 1970, Cordero successfully did a laboratory and field culture of *Porphyra tenera* (Asakusa-nori, Japanese), while doing Master's Degree studies in Kagoshima University, Japan

(Cordero, 1975). A modified mariculture technology for the *P. marcosii* farming is suitable to fit the condition obtaining in the country.

Viability of *a Porphyra* Industry

In a feasibility study on the farming of *Porphyra marcosii*, Cordero (1982) reported that a *Porphyra* seaweed industry will be a viable venture by farming the seaweed using the modified culture technique

The market forecast of the feasibility study identified actual and potential users/ consumers as well as an economically encouraging return of investment (ROI) . This included both industrial and commercial sectors as well as households which utilize *Porphyra* as food or ingredient in manufactured products or as garnish in food and soup preparations. *Porphyra*, known for its nutritive values, contains high percentage of protein, iodine, vitamins A, B, and C (Madlener, 1977), that makes it a high value additive to the Filipino meal.

Referred to as Ilocandia's 'black gold' (though technically *Porphyra* is a red seaweed), dried regular-sized sheet of 'nori' or 'gamet' sells at an average of P600 a piece. Local *Porphyra* gatherers from Burgos, Ilocos Norte believes that 'gamet' from this coastal barangay has a scent distinct from those gathered elsewhere, e.g. Cagayan. Accordingly, gamet traders would travel to Ilocos Norte where they "… wash off (the gamet) in Burgos seawater before trading them in the market."

Likewise, *Porphyra* is an export potential among large sea vegetable processors and consumer markets like Japan, South Korea, mainland China and the USA as well as in countries where seaweed is accepted as food. Asian countries like Japan have a long history of having seaweeds as part of their meals (Okasaki, 1971; Tanikawa, 1971). In Japan, this red seaweed is well-studied biologically (Miyata and Notoya, 1997) and its aquaculture technology most improved, explaining for the country being the world's leading producer of *Porphyra*. In the Philippines, of the two (2) dozens species of seaweeds/sea vegetables or so, *Porphyra* is singled as highest in protein and most expensive. Ilokano balikbayans buy bulk of dried gamet as presents when they return to their adopted countries. *Porphyra* production comes from natural habitats, with the gatherers, often than not, exposed to hazards – having to wait for the waves to retreat before starting to quickly pick gamet stuck deep in fissures of sharp-edged rocks and corals.

The primary domestic markets are the people of the Ilocos Region long known for their acceptance of sea vegetables, *Porphyra* being the most relished among Philippine seaweeds, as part of their meals. Also, included are the restaurants and hotels all over the country specializing in Japanese food wherein *Porphyra* comes in various preparations.

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