

Morphological characteristics of *Porphyra* collected from Hua Hin, Thailand

Hisao OGAWA^{1*}, Akira KANEKO¹, Chatcharee KAEWSURALIKHIT² and Khanchanapaj LEWMANOMONT²

¹ School of Fisheries Science, Kitasato University, Iwate 022–0101, Japan

*E-mail: seaweeds@kitasato-u.ac.jp

² Department of Fishery Biology, Faculty of Fisheries, Kasetsart University, Chatujak, Bangkok 10900, Thailand

Received: 26 August 2005; Accepted: 10 November 2005

Abstract—Foliose thalli of *Porphyra* were collected from Hua Hin, Thailand in January 2005. Their morphological characteristics were observed in the herbaria. They showed various shapes: round shape with smooth or splitting margin or lanceolate shape with smooth or splitting margin. The ratios of each shape were as follows: round shape with smooth margin was 11%, round shape with splitting margin was 21%, lanceolate shape with smooth margin was 11%, lanceolate shape with splitting margin was 39%, and the thalli showing mixed morphological characteristics of round and lanceolate shape were 19%.

Foliose thalli of round shape were 2–6 cm long and 2–4 (5) cm broad; monostromatic were about 25–35 μm in thickness and denticulated at the margin; monoecious; The division formula of antheridium was a/4, b/4 and c/4 and sixty-four spermatia were formed. The division formula of carpogonium was a/2, b/4 and c/2 and sixteen carpospores are formed. These observed characteristics were not different from that reported for *Porphyra suborbiculata*. On the other hand, foliose thalli of lanceolate shape were 4–10 cm long and 1–4 cm broad; monostromatic about 20–30 μm in thickness and denticulated at the margin; the seaweed was monoecious. The division formula of antheridium was a/4, b/4 and c/4 and sixty-four spermatia were formed. The division formula of carpogonium was a/2, b/2 and c/2 and sixteen carpospores are formed. These observed characteristics were not different from that reported for *Porphyra vietnamensis*. Foliose thalli having both morphological characteristics of *P. suborbiculata* and *P. vietnamensis* would be a crossed species between them.

From these observations, the foliose thalli collected from Hua Hin were identified as *P. suborbiculata*, *P. vietnamensis* and a crossed species between them.

Key words: morphology, macroalgae, *Porphyra*, Thailand

Introduction

Species of the genus *Porphyra* C. Agardh are widely distributed from subarctic to tropical waters (Tanaka 1952, Kurogi 1972, de Oliveira Filho and Coll 1975, Coll and Cox 1977, Kapraun and Lemus 1987, Masuda et al. 1991). At present 133 species of *Porphyra* are known world widely. In Southeast Asia, the following three species are reported from Indonesia, Philippines, Thailand and Vietnam (Cordero 1974, Tanaka and Ho 1962, Ogawa and Lewmanomont 1978, Oguri et al. 2000): *P. crispata*, *P. suborbiculata* and *P. vietnamensis*.

From Thailand, only two species, *P. crispata* and *P. vietnamensis*, are collected until now. In January 2005, foliose thalli of *Porphyra* were collected from Hua Hin facing the Gulf of Thailand, and they were classified in three groups according to the morphological characteristics; round shape, lanceolate shape, and mixed shape having both characteristics of round and lanceolate shapes. Their morphological attributes suggested that the round shape foliose thallus is identified as *P. suborbiculata* and the lanceolate shape foliose

thallus is identified as *P. vietnamensis* based on their morphological attributes. The mixed shape foliose thallus was considered as the intraspecific species between *P. suborbiculata* and *P. vietnamensis*. As the results of this study, *P. crispata*, *P. suborbiculata* and *P. vietnamensis* grow at least on the coasts of Thailand, and the present study is the first report on the growth of *P. suborbiculata* in Thailand.

Materials and Methods

Foliose thalli of *Porphyra* were collected from Hua Hin, Thailand in January 2005 (Fig. 1). Collected thalli were sent to Japan by air for culturing and morphological observation and they were washed in sterilized seawater in the laboratory. The washed materials were grouped according to their shape characteristics. For species identification, following external morphological features were observed; shape, and microscopic denticulation at the margin of blade, color of blade, sexuality, size and feature of vegetative and rhizoidal cells and surface division formulas of both the sexual reproductive cells. To observe the internal features, such as thickness of

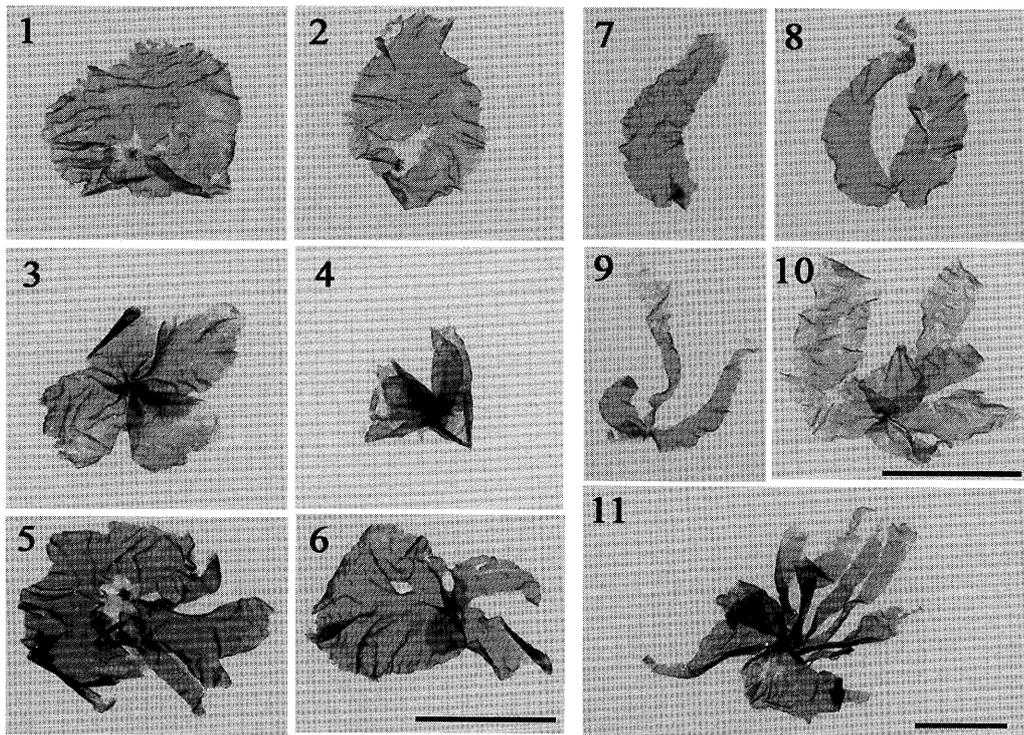


Fig. 1. Foliose thalli of *Porphyra* collected from Hua Hin Thailand in January 2005.

blade, and vertical division formulas of both the sexual reproductive cells, the vegetative and mature parts of the thalli were cut by razor blade and vertical sections were made.

The thalli were classified in 3 groups by the blade features, round shape, lanceolate shape, and mixed shape. To determine their proportion, 179 thalli were used in this study.

Results and Discussion

Morphological observation

1) Round shape thallus

Thalli are membranaceous, monostromatic, and round or ovate with 2–6 cm long and 2–4 (5) cm broad and about 25–35 μm thick, and purplish red in color. Their margins are slightly denticulate. Vegetative cells are polygonal and rhizoidal cells are capitate with rhizoidal filaments in surface view. Mature thalli form antheridia and carpogonia along the margins. Sixty-four spermatia are formed in the antheridium having a division formula of $a/4$, $b/4$ and $c/4$ (a, b, and c refer to longitudinal, horizontal, and cross-section divisions, respectively). While sixteen carpospores are formed in the carpogonium and the division formula is $a/2$, $b/4$ and $c/2$ (Fig. 2).

The morphological characteristics and manner of spermatium and carpospore production in the examined thalli are similar to the original description of *Porphyra suborbiculata* from Japan, Philippines and Indonesia (Kjellman 1897, Ueda 1932, Cordero 1974, Oguri et al. 2000). However, the divi-

sion formula of the carpogonium and the size of the thalli differed from the reported descriptions of *P. suborbiculata* from Indonesia. Nonetheless, deviations exhibited in these characters have been often observed in most species of *Porphyra* since morphological attributes are oftentimes influenced by environmental conditions (Kurogi 1959).

The thalli collected from Hua Hin are diminutive and small in size compared to the original ones reported from Japan, but the size is similar to that collected from Bitung, Indonesia (Oguri et al. 2000). This result shows a sequence variation with *P. suborbiculata*. Hence, the foliose thalli collected from Hua Hin are identified as *Porphyra suborbiculata*, and this is the first report and collection of *P. suborbiculata* from Thailand.

2) Lanceolate shape

Thalli are membranaceous, monostromatic, and lanceolate to ovate with smooth or slitting margin, 2–10 cm long and 2–4 cm broad and about 20–30 μm thick, and redish purple in color. Their margins show conspicuous denticulation. Vegetative cells are round-polygonal and rhizoidal cells are capitate with rhizoidal filaments in surface view. Mature thalli form antheridia and carpogonia along the margins. Sixty-four spermatia are formed in the antheridium having a division formula of $a/4$, $b/4$ and $c/4$ (a, b, and c refer to longitudinal, horizontal, and cross-sectional divisions, respectively). While eight carpospores are formed in the carpogonium and the division formula is $a/2$, $b/2$ and $c/2$ (Fig. 3).

The morphological characteristics and manner of sper-

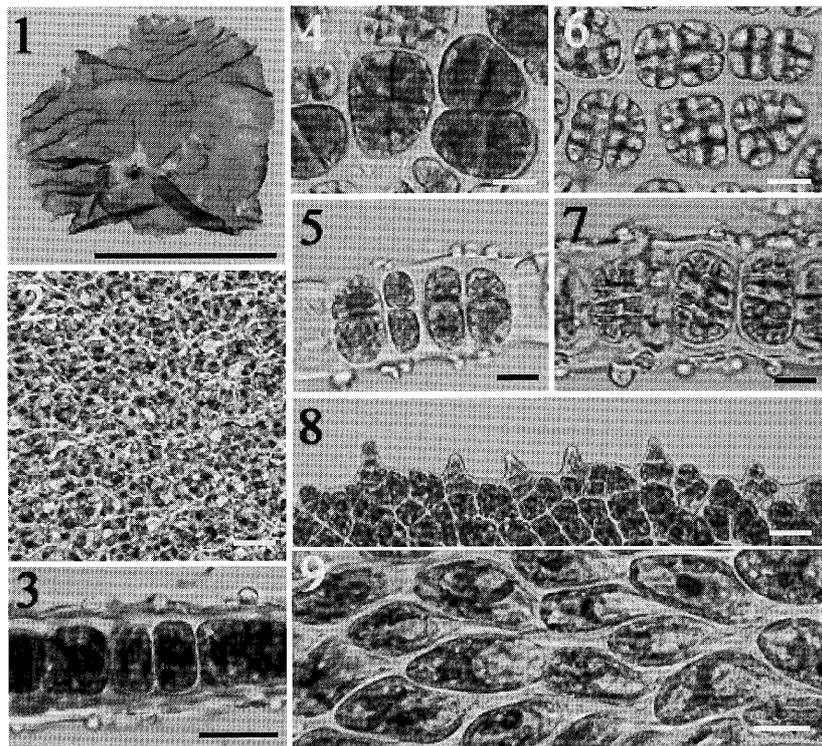


Fig. 2. Morphological characteristics of round shape thallus.

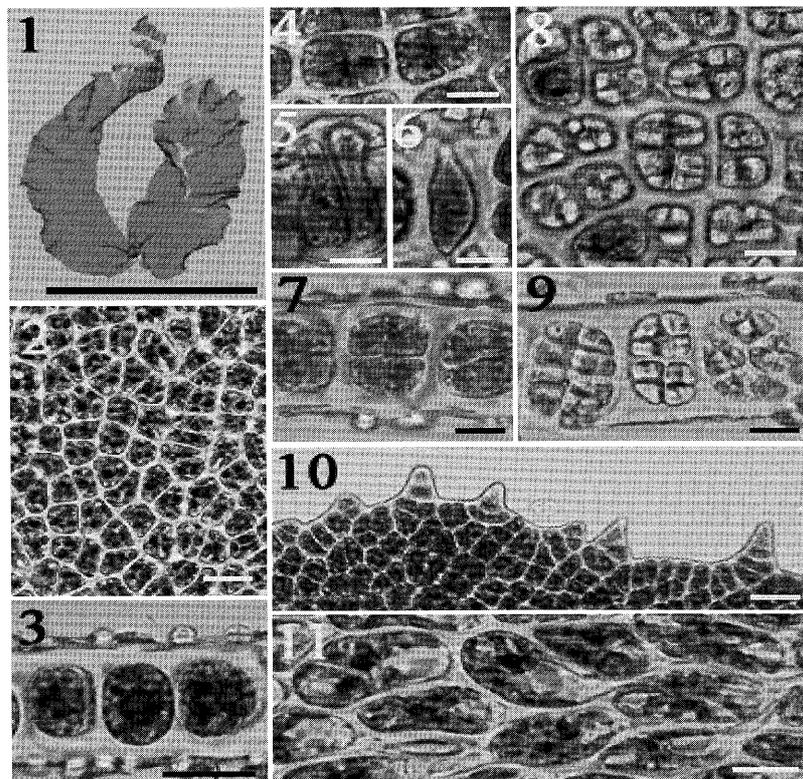


Fig. 3. Morphological characteristics of lanceolate shape thallus.

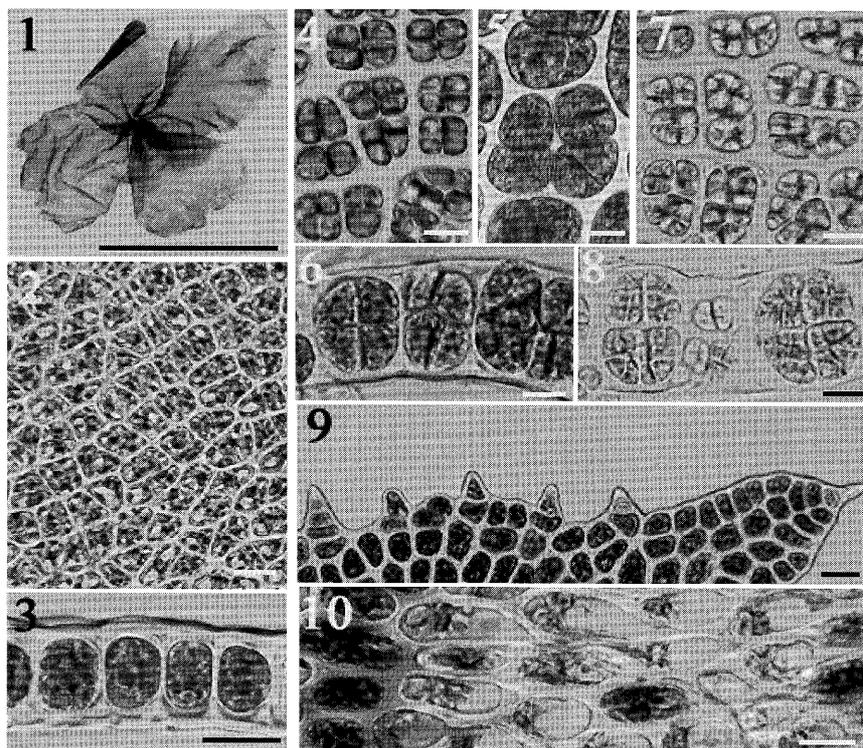


Fig. 4. Morphological characteristics of mixed shape thallus.

matium and carpospore production in the examined thalli are similar to the original description of *P. vietnamensis* from Vietnam (Tanaka and Ho 1962) and from Thailand (Ogawa and Lewmanomont 1978). From the results, the foliose thalli with lanceolate shape collected from Hua Hin, Thailand were identified as *P. vietnamensis*. Their morphological characteristics are oftentimes influenced by environmental conditions (Kurogi 1959).

3) Mixed shape

Thalli are membranaceous, monostromatic, and lanceolate, sometime ovate with 4–8(10) cm long and 2–3(4) cm broad and about 20–30 μm thick, and redish purple in color. Their margins show slight denticulation, and sometimes conspicuous denticulation. Vegetative cells are polygonal and rhizoidal cells are capitate with rhizoidal filaments in surface view. Mature thalli form antheridia and carpogonia along the margins. Sixty-four spermatia are formed in the antheridium having a division formula of a/4, b/4 and c/4. While eight or sixteen carpospores are formed in the carpogonium and the division formula is a/2, b/2–4 and c/2 (Fig. 4).

The morphological characteristics and manner of spermatium and carpospore production in the examined thalli are similar to the descriptions of *Porphyra suborbiculata* (Cordero 1974, Matsuda et al. 1991, Oguri et al. 2000), and *P. vietnamensis* from Philippines (Cordero 1974, Matsuda et al. 1991), from Thailand (Ogawa and Lewmanomont 1978), and from Vietnam (Tanaka and Ho 1962).

On the other hand, Numbers of round shape, lanceolate, and mixed thalli were 57, 89 and 33, respectively, and the proportions were also 32%, 50% and 19%, respectively. From the results, lanceolate shape is dominant and mixed shape is smallest, which means the mixed shape shows a possibility of crossed species between *P. suborbiculata* and *P. vietnamensis*.

Acknowledgements

Present work was partially supported by a Core University Program of Japan Society for the Promotion of Science.

References

- Coll, J. and Cox, J. 1977. The genus *Porphyra* C. Ag. (Rhodophyta, Bangiales) in the American North Atlantic. I. New species from North Carolina. Bot. Mar. 20: 155–159.
- Cordero, P. A. Jr. 1974. Genus *Porphyra* of the Philippines, its species and their occurrences. Jpn. J. Phycol. 22: 134–142.
- De Oliveria Filho, E. C. and Coll, J. 1975. The genus *Porphyra* C. Ag. (Rhodophyta, Bangiales) in the American South Atlantic. I. Brazilian species. Bot. Mar. 18: 191–197.
- Kapraun, D. F. and Lemus, A. J. 1987. Field and culture studies of *Porphyra spiralis* var. *amphiloa* Oliveira Filho et Coll (Bangiales, Rhodophyta) from Isla Margarita, Venezuela. Bot. Mar. 30: 483–490.
- Kjellman, F. R. 1897. Japanska arter af slagtet *Porphyra*. Bihang till K. Svenska Vet.-Akad.-Handl. 23: 1–34.
- Kurogi, M. 1972. Systematics of *Porphyra* in Japan. In Contributions to the systematics of benthic marine algae of the north

- Pacific, Abbott, I. A. and Kurogi, M. (eds.), pp. 167–191, Jpn. Soc. Phycol., Kobe, Japan.
- Masuda, M., Ohno, M. and Trono, G. C. Jr. 1991. A taxonomic assessment of *Porphyra suborbiculata* Kjellman, a food species from the Philippines. Jpn. J. Phycol. 39: 375–380.
- Ogawa, H. and Lewmanomont, K. 1978. The *Porphyra* of Thailand. I. Morphological characters and spore development of *Porphyra vietnamensis* Tanaka et P.-H. Ho. Jan. J. Phycol. 26: 31–34.
- Oguri, Y., Ogawa, H. and Hatta, A. M. 2000. Morphological and ecological characteristics of *Porphyra* collected from Bitung, North Sulawesi, Indonesia. Procs. 11th JSPS Joint Smt. Mr. Sci. pp. 98–106.
- Tanaka, T. 1952. The systematic study of the Japanese Protofloridae. Mem. Fac. Fish. Kagoshima Univ. 2: 1–92.
- Tanaka, T. and Ho, P. H. 1962. Notes on some marine algae from Vietnam. I. Mem. Fac. Fish. Kagoshima Univ. 11: 24–40.
- Ueda, S. 1932. A systematic study of genus *Porphyra* found on the Japanese coasts. J. Indus. Sci. Inst. 2: 1–45.
- Zaneveld, J. S. 1955. Indo-Pacific Fisheries Council, Spec. Ed. No. 3.