OBSERVATION ON CHROMOSOMES IN SOME SPECIES OF *PORPHYRA*

Hiroshi YABU*

The present paper is a continuation of mitotic study in *Porphyra* reported by Yabu & Tokida in 1963. Since that investigation, cytological studies in the Japanese species of *Porphyra* have been progressed by Kito (1966, 1967), Kito et al. (1967) and Migita (1967). In the course of my further cytological observations on *Porphyra*, a number of good prophase figures in vegetative and spermatangial cells were found to show a difference in the size of chromosomes in several species of *Porphyra* viz., *P. okamurai*, *P. pseudocrassa*, *P. pseudolinearis*, *P. seriata*, *P. suborbiculata* and *P. yezoensis*. Of these species, *P. okamurai*, *P. seriata* and *P. suborbiculata* are reported cytologically for the first timē, and the remaining three species are reexamined with reference to the length of chromosomes, though previously reported by Yabu & Tokida (1963) and others (Migita, 1967; Kito et al., 1967).

The materials used for the present study had been fixed with aceto-alcohol solution (1:3) at night when the collection was done after beg kept for some time in vats filled with sea-water. Wittmann's aceto-iron-haematoxylin-chloral hydrate solution was used for staining.

I offer cordial thanks to Mr. I. Shimmura of the Kagoshima Prefectural Fisheries Experimental Station, and to Mr. M. Tajima of the Nanao Branch of the Ishikawa Prefectural Fisheries Experimental Station for their courtesy in sending me the fixed materials.

Results

As to the chromosomes at the prophase stage of the nucleus in the vegetative cells of *Porphyra*, Krishnamurthy (1959, p. 153) had stated that in *P. umbilicalis* var. *laciniata* elongated chromosomes were seen surrounding the nucleolus in mid-

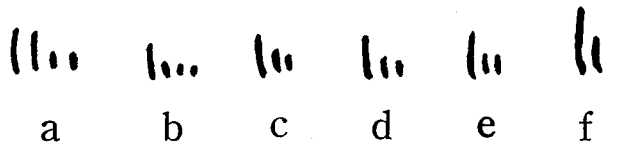
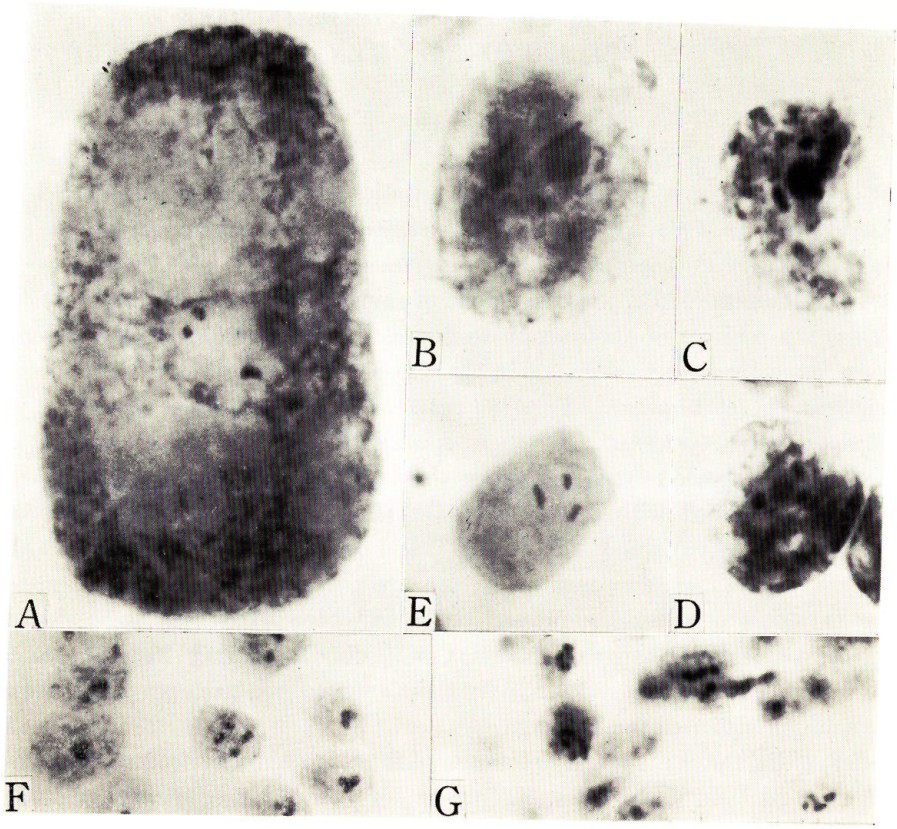
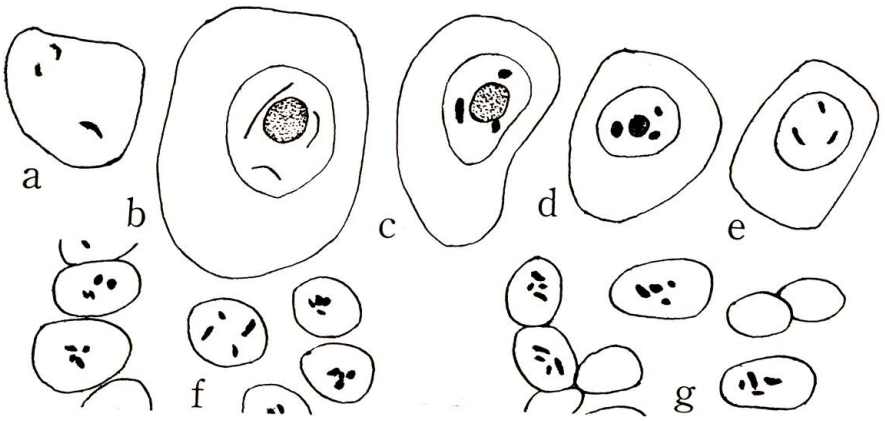


Fig. 1. Arranged chromosomes obtained from a fine prophase nucleus in the first division leading to spermatium-formation (a, c, d, e and f) or in the vegetative cell division (b) in each of the examined species. a, *Porphyra pseudolinearis*; b, *P. okamurai*; c, *P. yezoensis*; d, *P. pseudocrassa*; e, *P. seriata*; f, *P. suborbiculata*. (Magnification: × 2,600)

* *Laboratory of Marine Botany, Faculty of Fisheries, Hokkaido University*
(北海道大学水産学部水産植物学講座)


A
B
C
D
E
F
G


a
b
c
d
e
f
g

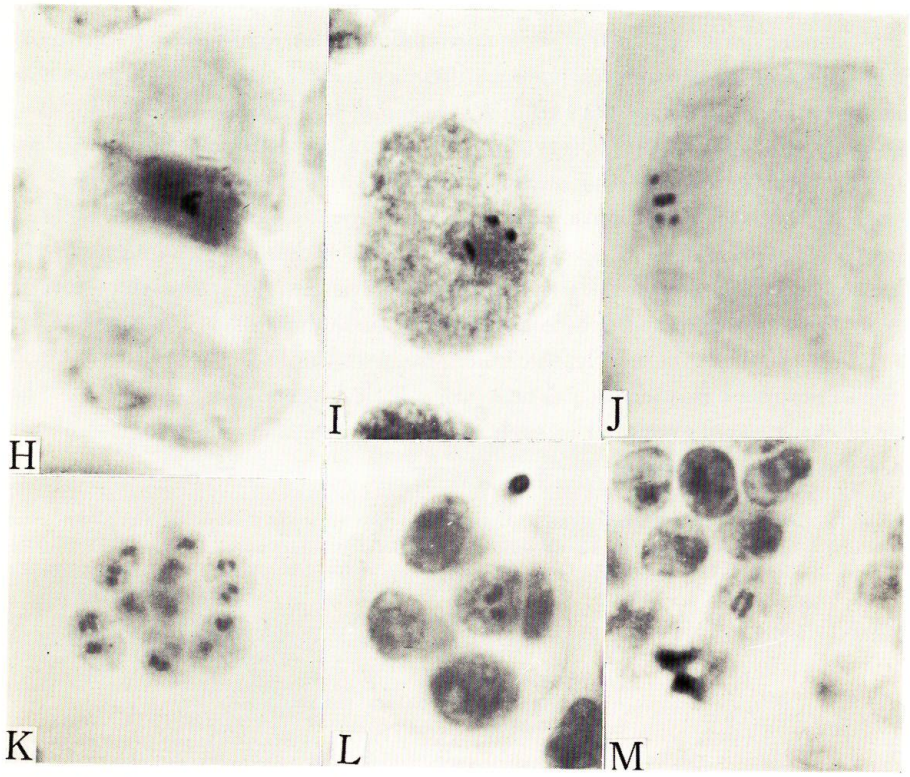


Fig. 2. Chromosomes in *Porphyra*: A, Chromosomes of *P. yezoensis* at late prophase in the first division leading to spermatium formation; B, Chromosomes of *P. yezoensis* at prophase in the second division leading to spermatium formation; C & D, Chromosomes of *P. yezoensis* at prophase in the third division leading to spermatium formation; E, Chromosomes of *P. yezoensis* at early metaphase in the third division leading to spermatium formation; F & G, Chromosomes of P. *pseudolinearis* at metaphase leading to spermatium formation; a-g, Corresponding drawing of photomicrographs of A-G, respectively; H, Chromosomes of *P. pseudocrassa* at metaphase in vegetative cell division; I, Chromosomes of *P. seriata* at metaphase in the second division leading to spermatium formation; J, Chromosomes of *P. okamurai* at metaphase in vegetative cell division; K-M, Chromosomes of *P. suborbiculata* at metaphase leading to spermatium formation (Magnification A-K, × 2,200)

prophase, and recently Migita (1967, p. 57) reported that in *P. yezoensis* chromatin threads which appear in the nuclear cavity during the prophase stage become chromosomes themselves. In the materials treated here the appearance of chromatin threads and their development into chromosomes were also observed in the same way as mentioned above in vegetative and spermatangial cells. According to my observation, in mid-prophase stage chromosomes become visible as faintly stained threads, and then with the advance of the process, they become thicker and shorter and their staining ability gradually increases.

In late prophase where the nucleolus is still present in a nuclear cavity, chromosomes of slender form are often seen surrounding that nucleolus. Until about this stage, chromosomes come to have a difference in size, and long chromosomes are usually observed in all species except *P. okamurai*. In *P. okamurai* different sized chromosomes are not usually observed in all vegetative cells but only in 20 per cent of the total number of the nuclei examined, and furthermore there is no difference in the size of chromosomes during the spermatium formation. Fig. 1 shows each chromosome of the examined species obtained from a fine figure of the dividing nucleus at prophase in the first division leading to spermatium formation or in the vegetative cell division. In early metaphase each chromosome becomes rod-shaped body in nearly the same size, but the long chromosome which appeared at prophase is often seen as one just a little longer than the others. The number of chromosomes counted in each species and the shape of chromosomes at prophase are shown in Table I.

Table 1. Chromosome number examined in six species of leafy thallus of *Porphyra* and length of the chromosome in prophase nucleus

Species (Collecting place and date)	Chromosome number		Chromosome length	
			long	short
P. okamurai (Nanao, Mar. '68)	somatic division	4	1	3
	spermatium formation	4		
	carpospore formation	8		
P. pseudocrassa (Akkeshi, Oct. '67)	somatic division	3	1	2
	spermatium formation	3	1	2
P. pseudolinearis (Hakodate, Feb. '67)	somatic division	4	2	2
	spermatium formation	4	2	2
	carpospore formation	8		
P. seriata (Kagoshima, Mar. '68)	somatic division	3	1	2
	spermatium formation	3	1	2
	carpospore formation	6		
P. suborbiculata (Kagoshima, Mar. '68)	somatic division	2	1	1
	spermatium formation	2	1	1
P. yezoensis (Hakodate, Mar. '67)	somatic division	3	1	2
	spermatium formation	3	1	2
	carpospore formation	6		

As seen in Fig. 1 and Table I, the species of *P. pseudocrassa*, *P. seriata* and *P. yezoensis* have the same karyotype; they have 3 haploid chromosomes, one of which is longer than the other two. *P. okamurai* and *P. pseudolinearis* have the same number of 4 chromosomes in haploid, but the karyotype is different between two species; the former species has one long and three short chromosomes, and the latter two long and two short ones. On the other hand, in *P. suborbiculata* the haploid chromosome number is 2, one is longer than the other, and in most cases these two chromosomes are slightly curved in shape. This chromosome number

2 is the smallest among the Japanese species of *Porphyra* that have been studied cytologically until now and is the same with that of *P. linearis*, a foreign species, reported by Dangeard in 1927.

In nuclear division leading to carpospore formation a clear differenciation in the size of chromosomes could hardly be observed.

Summary

Observations are given for chromosomes in the prophase nucleus of the following six species of *Porphyra*; *P. okamurai*, *P. pseudocrassa*, *P. pseudolinearis*, *P. seriata*, *P. suborbiculata* and *P. yezoensis*. Karyotype analysis is shown in each species. Chromosome number is first reported in *P. okamurai* as n=4 and 2n=8, in *P. seriata* as n=3 and 2n=6 and in *P. suborbiculata* as n=2.

References

Dangeard, P. (1927). Recherches sur les Bangia et les Porphyra. *Botaniste*, **18**, 183–244.

Kito, H. (1966). Cytological studies of several species of *Porphyra* I. Morphological and cytological observations on a species of *Porphyra* epiphytic on *Grateloupia filicina* var. *porracea* (Mert.) Howe. *Bull. Fac. Fish., Hokkaido Univ.* **16** (4), 206–208.

———— (1967). Cytological studies of several species of *Porphyra* II. Mitosis in carpospore-germlings of *Porphyra yezoensis*. *Bull. Fac. Fish., Hokkaido Univ.* **18** (3), 201–202.

Kito, H., Yabu, H. & Tokida, J. (1967). The number of chromosome in some species of *Porphyra*. *Bull. Fac. Fish., Hokkaido Univ.* **18**(2) 59–60.

Krishnamurthy, V. (1959). Cytological investigations on *Porphyra umbilicalis* (L.) Kütz. var. *laciniata* (Lightf.) J. Ag. *Ann. Bot.* **23** (89) 147–176.

Migita, S. (1967). Cytological studies on *Porphyra yezoensis* Ueda. *Bull. Fac. Fish., Nagasaki Univ.* **24**, 55–64.

Yabu, H. & Tokida, J. (1963). Mitosis in *Porphyra*. *Bull. Fac. Fish., Hokkaido Univ.* **14** (3), 133–136.