

**Two Newly Recorded *Epistylis* Ciliate Species
(Ciliophora: Oligohymenophora: Peritrichida) from Korea**

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ABSTRACT

Two epistylid peritrichous ciliates collected from the littoral aquatic plants at pond in a suburb of Ulsan, Korea were identified as *Epistylis plicatilis* Ehrenberg, 1831 and *E. hentscheli* Kahl, 1935. The description was based on the observation of living specimens and protargol impregnated specimens. This study is about redescription compared with original description. These species have not been reported in Korea and their characteristics are as follows: *E. plicatilis* is thin, long funnel form and has compact stalk, while *E. hentscheli* is unsymmetrical bell form and has hollow stalk.

Key words: Peritrichida, Epistylidae, freshwater, redescription, Korea

INTRODUCTION

The peritrichs are frequently encountered in benthic habitats of aquatic environments. In spite of their abundance they are recognized to be a difficult group to identify, because this is partly due to the lack of a suitable key for both specialists and non-specialists. About 30 species of the genus *Epistylis* was known to science up to now. The present work is concerned with the redescription of two species of epistylid peritrichs, *Epistylis plicatilis* and *E. hentscheli* which are unknown from Korea yet, the comparison with the original description of these species and some other

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related species, and the biometrical characterization of the species (Sokal and Rohlf, 1973; Wilbert, 1975; Foissner et al., 1992; Shin & Kim, 1993).

MATERIALS AND METHODS

The present study was based on the specimens collected from Yuli pond in Ulsan, Korea between May, 2001 and May, 2002. The specimens were collected at representative aquatic microhabitats such as pond water including aquatic plants. The laboratory cultures were maintained in the commercial mineral water provided with boiled wheat grains for supplying fungal and bacterial nutrients of ciliates.

The shapes and movements of the living specimens were captured by CCD camera. The infraciliature was observed by using the modified protargol method (Wilbert, 1975; Shin and Kim, 1993). The illustrations of the impregnated specimens were made with the aid of a camera. Biometrical analysis was performed using the method described in Sokal and Rohlf (1973). We adopted the classification schemes established by Small and Lynn (1985) and Lynn and Corliss (1991).

RESULTS AND DISCUSSION

Two epistylid ciliates were characterized cytomorphologically, analyzed biometrically and redescribed with illustrations of ciliatures and distributions. They are compared with related species and arranged as a systematic schemes.

Phylum Ciliophora Doflein, 1901
Class Oligohymenophora Jankowski, 1967
Order Peritrichida Stein, 1859
Family Epistylidae Jankowski, 1979
Genus *Epistylis* Ehrenberg, 1830

1. **Epistylis plicatilis* Ehrenberg, 1831 (Fig. 1, Table 1)

Epistylis plicatilis: Kahl, 1935, p. 690; Stiller, 1971, p. 58; Bick, 1972, p. 116; Foissner et al., 1992, p. 205.

Material examined. The living specimens collected from the Yuli pond in Ulsan, Korea (129° 15'20"E and 35° 31'20"N), on 4 May 2001 and 21 May 2002, respectively, were cultured at the laboratory and ten living and ten protargol impregnated specimens were observed and biometrically analyzed respectively.

Description. Colonial (Fig. 1A). Extended zooid body inverted bell-shaped, mounted upon branched & non-contractile stalk, ranging 65-85 µm long and 30-45 µm wide *in vivo*, thin and long funnel form (Fig. 1). Anterior tip of contracted zooid body like a lip and posterior portion a

little swelled and 5-6 swelled annulated ridges (Fig. 1E). Mode of life colonial and sessile, usually not epizoic. Stalk ramified, usually 10 μm in diameter or more (Fig. 1B, inner part of it compact and no muscle).

Contractile vacuole (CV) spherical and positioning at apical of peristome in dorsal wall. Peristome diameter ranging 40-55 μm *in vivo*, peristomial margin with bulge; peristome with a definite lip encircling the oral region, peristomial disc (PD) slightly tilt (Fig. 1D). Buccal cavity ranging 16-23

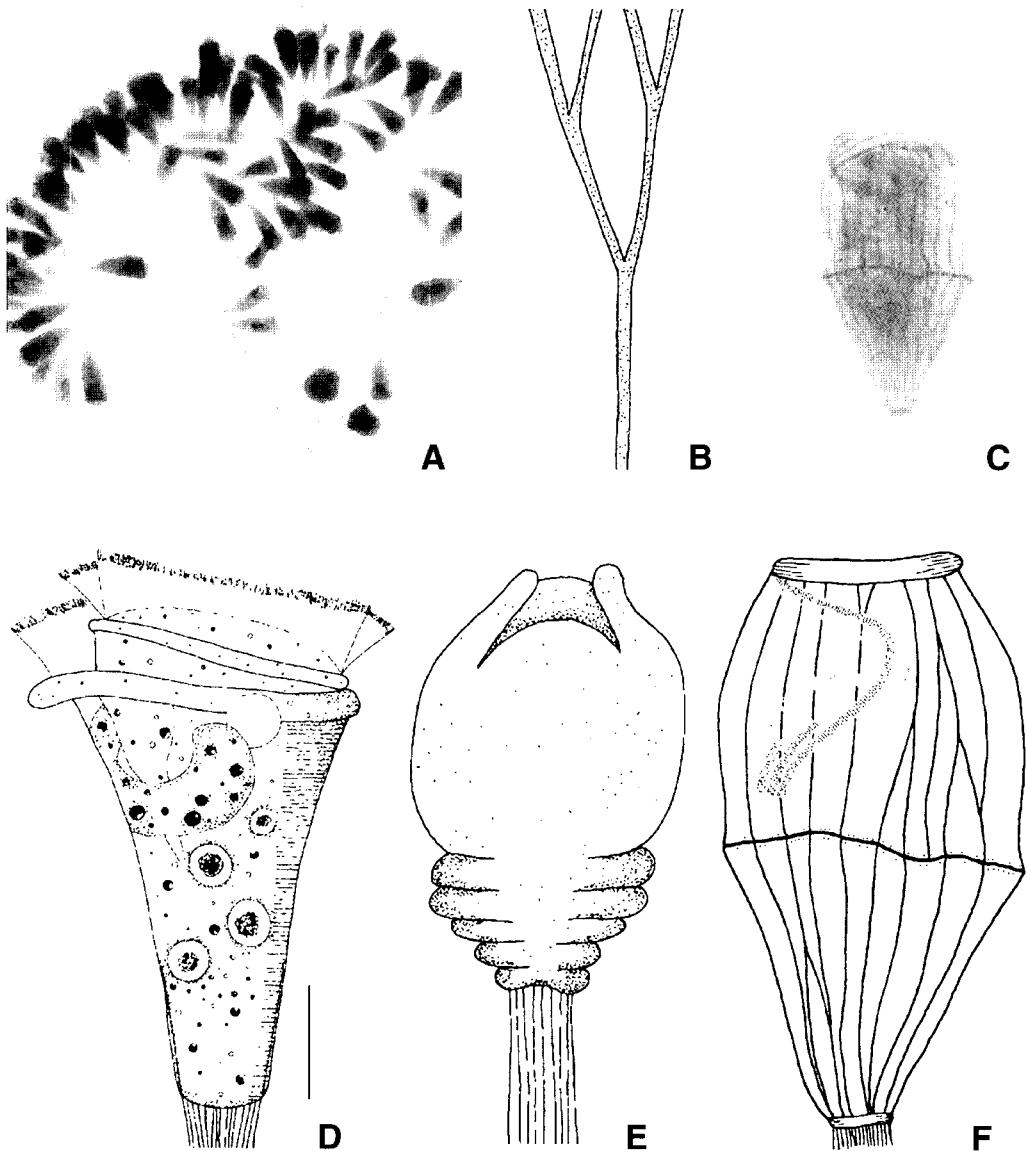


Fig. 1. *Epistylis plicatilis*. **A**, colony (protargol stained); **B**, dichotomously branching and compact stalk; **C**, protargol stained body; **D**, habitus, extended zooid; **E**, contracted zooid; **F**, ciliary pattern around buccal area. Scale bar = 20 μm (D).

μm in stained specimens. Body length/buccal cavity ratio average 3.38. Buccal cavity (BC) have three membranelles (M1, M2 and M3) and one undulating membrane (Figs. 1C and 1F). Adoral ciliary wreath (ACW) in posterior of zooid (Fig. 1B). Pellicle (P) convex and horizontally striped (Fig. 1D). Cortex of cell having longitudinal contractile fibrils of myoneme (My) (Fig. 1F).

Nuclear organelles with one macronucleus (Ma), semicircle or horseshoe-shaped, positioned at transverse axis of cell (Fig. 1D).

Distribution. Europe, Japan and Korea.

Remarks. The present species is closely related to *Epistylis entzii* Stiller, 1935 and *Epistylis coronata* Nusch, 1970, however distinguished from it by the following characteristics. (1) This species is thin, long funnel form, while *E. entzii* is club shape and *E. coronata* is cylindroid and also have a umbilicated peristomial disc. (2) The size range of this species is 90-160 μm , while *E. entzii* is 125-190 μm and *E. coronata* is 70-120 μm (Foissner et al., 1992). The *E. plicata* Stiller, 1939 is 60 μm long and have a diagonal peristome discus (Stiller, 1971; Foissner et al., 1992). The contracted cell of *E. elegans* is not formed the lip shape in apical part of body. The contractile vacuole of *E. hentscheli* Kahl, 1935 is located in the ventral side and stalk of *E. hentscheli* is hollow. The macronucleus of *E. galea* Ehrenberg, 1831 is long and J-form (Foissner et al., 1992).

As a part of the biometrical data (Table 1), coefficients of variation (CV) were calculated. The number of buccal cirrus showed the CV of 0.00. This character is found to be very constant and therefore considered as important diagnostic features of this genus or species. Comparatively low CVs ranging from 2.95 to 18.64 were shown in the following characters: The numbers of dorsal kineties, adoral membranelles, transverse cirri, caudal cirri, and rows of marginal cirri. These characters are very important for the identification of species because of their low variability. Other characters showed fairly high value of CV ranging from 20.70 to 26.52.

2. **Epistylis hentscheli* Kahl, 1935 (Fig. 2, Table 1)

Epistylis hentscheli Kahl, 1935, p. 690; Foissner et al., 1992, p. 201.

Material examined. Ten specimens collected from the Yuli pond in Ulsan, Korea (129° 15'20"E and 35° 31'20"N), on 21 May 2002, were cultured at the laboratory, and ten living and eight protargol impregnated specimens were observed and biometrically analyzed respectively.

Description. Colonial (Fig. 2A). Zooid body unsymmetrical bell form, mounted upon branched and non-contractile stalk, ranging 100-130 μm long and 35-50 μm wide *in vivo* (Fig. 2). Mode of life colonial, sessile, usually not epizoic. Stalk ramified, usually 10 μm in diameter or more, hollow, having many wrinkles and no muscle within stalk (Fig. 2D). Nuclear organelles with one semicircled macronucleus (Ma), encircling buccal cavity. Contractile vacuole (CV) spherical and positioning at apical part of peristome in ventral wall. Peristome diameter ranging 58-70 μm *in vivo*, peristomial margin with bulge; one bulge in peristomial collar, peristome with a definite lip encircling the oral region, peristomial disc (PD) convex and slightly tilted (Fig. 2C). Buccal cavity (BC) ranging 20-24 μm long in stained specimen. The ratio of body length/buccal cavity average 3.69. Buccal cavity having three membranelles (M1, M2 and M3) and one undulating membrane (Fig. 2E). Pellicle

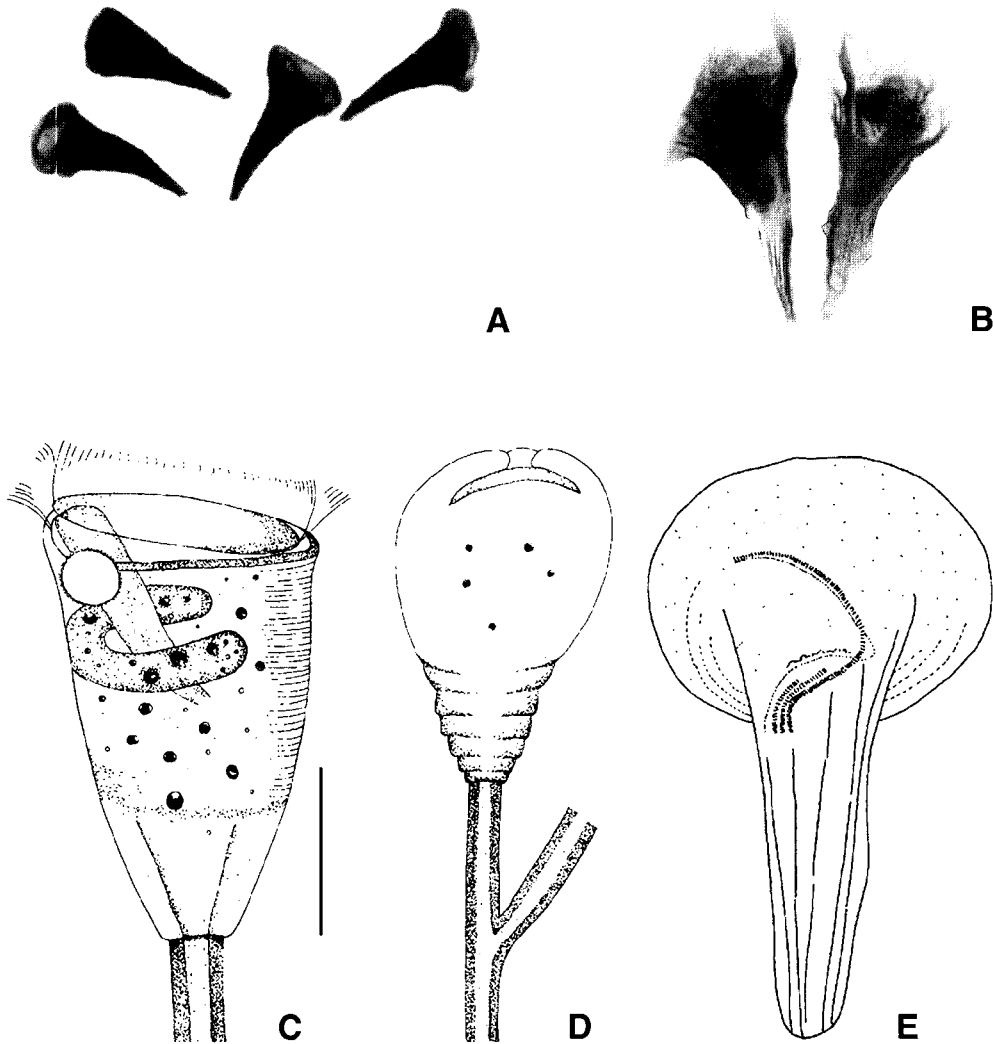


Fig. 2. *Epistylis hentscheli*. **A**, colony (protargol stained); **B**, protargol stained body; **C**, habitus, extended zooid; **D**, contracted zooid and dichotomously branching and hollow stalk; **E**, ciliary pattern in buccal area and membranelles. Scale bar = 50 μ m (C).

horizontally striped. Cortex of cell having longitudinal contractile fibrils of myoneme (My) (Figs. 2B and 2E).

Distribution. Europe, Japan and Korea.

Remarks. The present species is similar to *Epistylis chrysemydis* Bishop and Jahn, 1941, however, distinguished from it by the following characteristics. (1) This species is 110–170 μ m long, while *E. chrysemydis* is 140–220 μ m. (2) Peristomial collar of this species has one bulge but *E. chrysemydis* two bulges. The contractile vacuole of *E. galea* Ehrenberg, 1831 is located in the

Table 1. Biometrical characterization of *Epistylis plicatilis* Ehrenberg, 1831 (upper line) and *E. hentscheli* Kahl, 1935 (lower line). All data were based on protargol impregnated specimens. The abbreviations in the table are as follows: L = live specimen; S = stained specimen; Max. = maximum; Med. = median; Min. = minimum; SD = standard deviation; SE = standard error; CV = coefficient of variation in %; n = population size.

Character	Method	Mean	Med.	Min.	Max.	SD	SE	CV(%)	n
Body length	L	76	75	65	85	5.99	1.89	7.93	10
	S	62.12	59.59	55.65	76.52	6.48	2.05	10.44	10
	L	116	118	100	130	11.01	3.48	9.49	10
	S	81.33	78.73	74.15	94.13	7.26	2.57	8.92	8
Body width	L	40	40	30	45	4.38	1.38	11.08	10
	S	26.79	25.23	21.24	33.75	4.13	1.31	15.43	10
	L	43.20	43.50	35.00	50.00	4.73	1.50	10.96	10
	S	28.42	29.02	23.64	31.67	2.79	0.99	9.82	8
Number of macrocunei	S	1	1	1	1	0.00	0.00	0.00	10
	S	1	1	1	1	0.00	0.00	0.00	8
Number of contractile vacuole	L	1	1	1	1	0.00	0.00	0.00	10
	L	1	1	1	1	0.00	0.00	0.00	10
Peristome diameter	L	46	45	40	55	4.59	1.45	9.99	10
	S	25.52	25.56	22.19	30.41	2.29	0.73	8.99	10
	L	63	60	58	70	4.09	1.29	6.53	10
	S	48.07	47.27	31.39	63.88	12.24	4.33	25.47	8
Buccal cavity	S	18.46	18.21	16.42	22.77	1.89	0.60	10.26	10
	S	22.03	21.79	19.74	24.30	1.49	0.53	6.75	8
Body length/Buccal cavity	S	3.38	3.30	2.95	4.02	0.38	0.12	11.21	10
	S	3.69	3.67	3.37	4.17	0.23	0.08	6.31	8

dorsal side. The stalk of *E. galea* is compact and macronuclei is J-form. The contractile vacuole of *E. plicatilis* Ehrenberg, 1831 is located in the dorsal side and has a compact stalk (Foissner et al., 1992).

As a part of the biometrical data (Table 1) of this species, the coefficients of variation (CV) were calculated. The following characters showed the CV of 0.00: The numbers of buccal cirri, dorsal kinety and number of right marginal cirral rows. Thus these characters are found to be very constant and therefore considered as important diagnostic features of this genus or higher category. Comparatively low CVs ranging from 2.39-14.64 were shown in the most characters. These characters are important for the identification of the species of this genus because of their low variability. The number of caudal cirri showed fairly high CV value of 40.00.

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한국산 *Epistylis*속 섬모충류의 2미기록종 (섬모충문: 소막충강: 주모목)

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요 약

울산 인근의 연못 가장자리 수초에서 채집된 섬모충류가 겹가지섬모충과 (Epistylidae)에 속하는 겹가지섬모충 (*Epistylis plicatilis* Ehrenberg, 1831)과 빈겹가지섬모충 (*E. hentscheli* Kahl, 1935)으로 각각 동정되어 재기재하였다. 이 종들은 한국에서 처음 보고되는 종들로서 생체표본과 protargol로 염색한 표본에 근거하여 재기재하였다. 원기재와 유사종들과 비교하였는데 겹가지섬모충 (*E. plicatilis*)은 가늘고 긴 깔대기 형태를 가지며 줄기는 근섬유로 속이 찬 형태이다. 반면에 빈겹가지섬모충 (*E. hentscheli*)는 비대칭의 종 모양을 띠며 줄기는 속이 텅 빈 형태이다.