Lagascalia 19(1-2): 457-462 (1997)

BORZIA PERIKLEI ANAG. (CYANOPROKARYOTA): A TAXONOMICAL APPROACH

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Abstract

The filamentous cyanoprokaryota *Borzia periklei* Anag., a rare aerophytic species, was identified during a survey of the algae and cyanoprokaryota colonizing the stuccos of the Roman city of Baelo Claudia (Cadiz, Spain). This is the first record since its original description. An ultrastructural study of *B. periklei* has been carried out as well as a taxonomic study including the validation of the species.

Introduction

Borzia is a genus of cyanoprokaryota of the Order Oscillatoriales poorly known and rarely mentioned in the literature and even regarded by some authors as hormogones of other species such as *Tolypothrix* or *Stigonema* (BOURRELLY, 1970), although this point was later refuted by ANAGNOSTIDIS (1977), ANAGNOSTIDIS & al. (1983) and BICUDO (1985).

During a survey of the algae and cyanoprokaryota colonizing the stuccos of the Roman city of Baelo Claudia (Cadiz, Spain), a filamentous cyanoprokaryota of the genus *Borzia* Cohn ex Gomont was isolated. From its ecological and morphological features, it was identified as *Borzia periklei* Anag., a species not found since its original description (ANAGNOSTIDIS & KOMÀREK, 1988). Their characteristics are discussed and compared with those of *B. trilocularis* Cohn ex Gom.

Sampling site and culture

Samples of stuos were obtained from two temples loated in the Roman city of Baelo Claudia, Cadiz (Southern Spain). The climate of the area is dry but mild, with relatively heavy rainfall in winter, although there are long periods of aridity in summer.

Small stucco pieces were placed on Petri dishes containing BG11 solid medium, and kept at room temperature in continuous light provided by fluorescent lamps giving a light intensity of 400 lux. Organisms were isolated by transferring colonies to the same fresh culture medium.

Results

Borzia periklei Anag. was identified growing stuccos (mainly composed of calcium carbonate), originating - together with another algae - a cryptoendolithic community,

which developed even at 1-2 mm under the surface. This community was also abundant in some other Cyanoprokaryota (*Phormidium fragile* (Menegh.) Gom., *P. autumnale* (Ag.) Trevis., *Plectonema boryanum* Gom., *Chroococcidiopsis* sp., *Gloeothece* sp.), Chlorophyta (*Chlorosarcina stigmatica* Deason, *Muriella terrestris* Boye-Pet., *Bracteacoccus minor* (Chod.) Petrová) and Bacillariophyta (*Navicula mutica* Kütz., *Hantzchia amphioxys* (Ehr.) Grun.).

Isolated *Borzia periklei* grew very slowly on the agar surface of the culture medium, where diffuse colonies of light blue-green were originated. The cells were arranged in short sheathless trichomes, usually of 2-4 or 8 cells, strongly constricted at the crosswalls. They did not present apparent motility. Cells were barrel-shaped or cylindrical, 5-6 µm wide and 5-11 µm long, with granulate cytoplasm. End cells were rounded or hemispherical.

All cells were able to divide. Dividing cells grew to their maximum length before the next division. Cell division took place intercellularly, across a septum perpendicular to the longitudinal axis of the trichome. Filaments composed of more than 4/8 cells, were separated in small fragments by the ingrowth of the outer membrane. Frequently, the final aspect of the transverse constriction was slightly oblique with respect to the main axis.

Some characteristics previously published of *B. periklei* and *B. trilocularis* are given in Table 1.

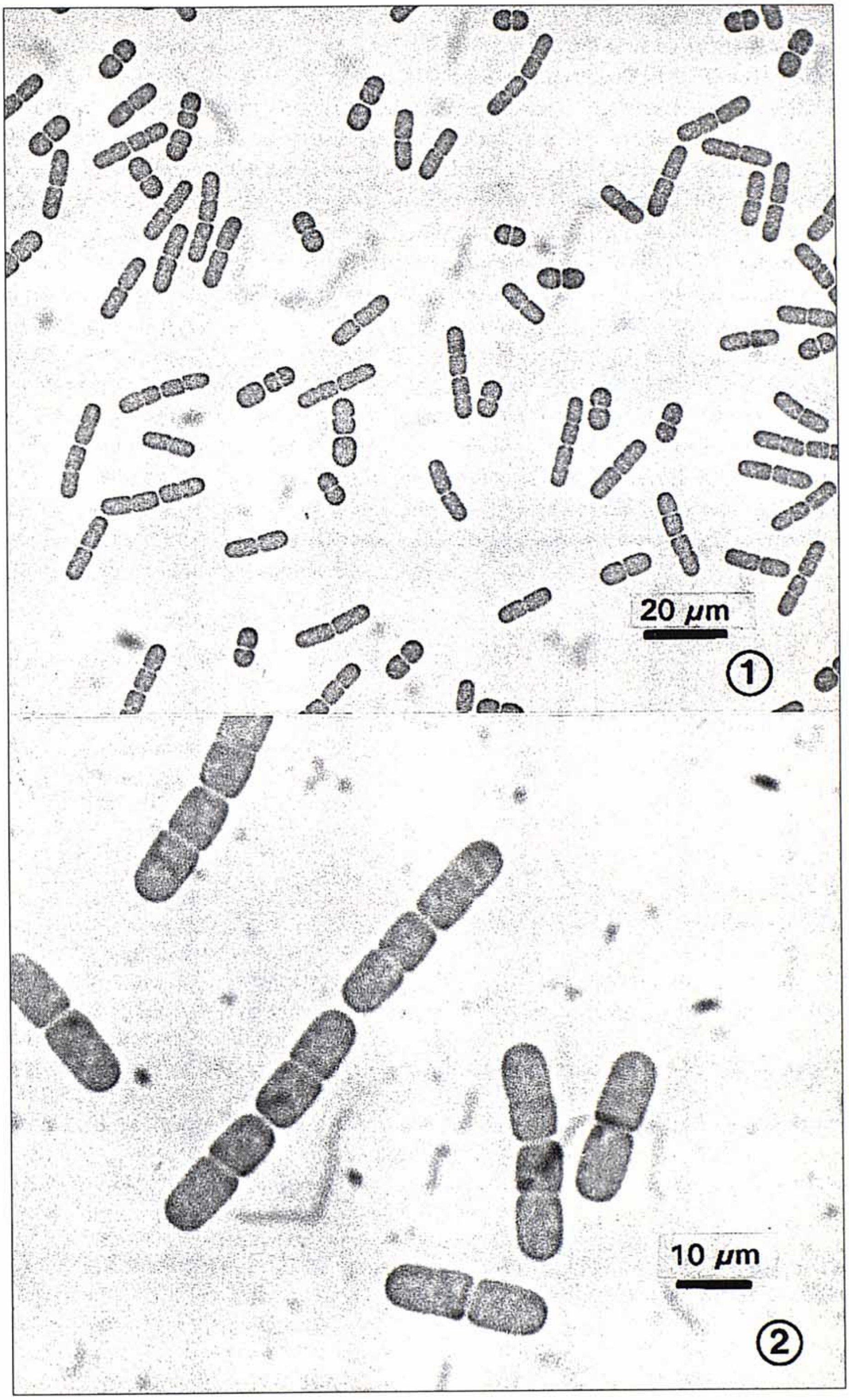
Thylakoids were peripheral in the cytoplasm and varied in number from 4 to 6, lying nearly parallel to the cell wall. Sometimes one thylakoid crossed them perpendicular to the wall. Cyanophycin granules and carboxysomes were conspicuous next to the thylakoids. Large, apparently empty spaces were distributed in the cells.

In ultrathin sections, the cell wall hardly followed the four layer scheme of the cyanoprokaryota type (DREWS & WECKESSER, 1982; JENSEN, 1993). A thick osmiophilic peptidoglycan layer was closely joined to the cytoplasmic membrane and to the outer membrane. Cells were surrounded by an external slime. Neither pores nor junctional pores were observed in any of the cell wall layers.

Discussion

The characteristics of the isolated strain from Baelo Claudia fits well with *Borzia periklei* Anagnostidis. Although ANAGNOSTIDIS (1977) and ANAGNOSTIDIS & al. (1983) previously assigned the aerophytic species described from material isolated in the Parthenon (Athens, Greece) to *B. trilocularis* Cohn ex Gom., it was mentioned as a collective species and later described as a new species (ANAGNOSTIDIS & KOMÀREK, 1988). The main differences between these taxa were related to the morphology and number of cells (ANAGNOSTIDIS & al. 1983). Other authors (BICUDO, 1965, 1985; RIBIER, & al. 1993) studying isolated strains of *B. trilocularis* enlarged the diagnosis and their findings could be used for comparison (Tab. 1). Trichomes of *B. trilocularis*

Fig. 1. *Borzia periklei* Anag. in culture (1). Trichomes of *B. periklei*, composed of 2-4-8 cells. (2).


20 µm
①
10 µm
②

Spècies	Author	Trichome	Cells width (µm)	Cells length (µm)	Habitat
B. trilocularis	BICUDO (1965)	3-6 cells	5-7.5	2-5-3.5	Aquatic
B. trilocularis	BOURRELLY (1970)	3-8 cells	5.5-6.5	2-5	Borzi's preparation
B. trilocularis	ANAGNOSTIDIS & al. (1983)	3-8 cells	4-6.2	2-5	Pringsheim's cultures
B. trilocularis	RIBIER & al. (1993)	3-8 cells	6-7	2-3	Soils samples
B. trilocularis	SANT'ANNA & AZEVEDO (1995)	3-6 cells	6-7	4-5	Lakes and puddles
B. periklei	ANAGNOSTIDIS & KOMAREK (1988)	2-4-8 cells	6.5	4.5-15	marbles

Table 1. Diagnostic features of *B. trilocularis* and *B. periklei* describd in literature.

are composed of shorter and broader cells than those of *B. periklei*, and often, they have more than 8 cells, up to 10 or 12. One of the main differences is the number of cells in the trichome, 3 or 6 in *B. trilocularis*, whereas there are 2, 4 or 8 in *B. periklei*. The difference in the cell number is related to the pattern of division. In *B. trilocularis*, terminal cells never divide; an isolated cell undergo a first division to produce a 2-celled individual, only one of which divides to produce a 3-celled individual in which the intercalary cell undergoes two regular cell divisions to produce the normal 6-celled individual (BICUDO, 1985). This produces the sequence 1, 2, 3, 6, 8 celled trichome before disintegrating. Another *B. trilocularis* isolated with similar 3-celled division pattern (RIBIER & al., 1993) displays additional features, such as a thin continuous sheath, a copious transparent capsule and necridia involved in the fragmentation of the trichomes.

Afterwards, the name of *B. periklei* Anagnostidis (ANAGNOSTIDIS & KOMÀREK, 1988) was regarded as invalid, as no type is designated (HOFFMANN & COMPÈRE, 1990). For this reason the Figure 8 of ANAGNOSTIDIS & al. (1983) is designed as Holotype.

The abundance of *Borzia periklei* in the samples of Baelo Claudia stuccos, and the similarity with the original habitat described by Anagnostidis, suggests that it is a cyanoprokaryota well adapted to cryptoendolithic and chasmoendolithic growth in carbonated substrata in dry environments.

Acknowledgements

This study is a contribution from the Cooperation Agreement between the Consejería de Cultura, Junta de Andalucía and the C.S.I.C. The authors thank Dr. P. Compère and Dr. C. Benedí for their valuable comments.

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