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THE MORPHOLOGICAL VARIABILITY OF *TETRASTRUM STAUROGENIAEFORME* (SCHRÖD.) LEMM. IN THE NATURE

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ABSTRACT. We investigated natural materials from different deposits of *Tetrastrum staurogeniaeforme* (SCHRÖD.) LEMM. Characterized are different types of coenobia and is analyzed their distribution in percentage for the different deposits. The size of coenobia and the length of the spines are biometrical studied.

KEY WORDS: *Tetrastrum staurogeniaeforme*, variability, biometry

INTRODUCTION

HINDÁK (1980a,1984) paid attention at the strong variability of *T. staurogeniaeforme* (SCHRÖD.) LEMM. His comments for the presence of the different length of the spines, have been based on the investigations of natural materials and laboratory cultures.

Tetrastrum staurogeniaeforme (SCHRÖD.) LEMM. according to KOMÁREK & FOTT (1983) is strong mutable and rich of forms species. Especially strong variability exists regarding the length of the spines which varies in different population from 3 to 23 µm. Therefore they doubted the length and the structure of the spine to be used as taxonomy mark. They impugn the existence of the described from different authors subspecies namely: var. *longispinum* G.M.SMITH 1926, f. *crassispinosus* HORTOB. & NÉMETH 1963, f. *crassispinum* HORTOB.1968, f. *obtusum* HORTOB. 1967, f. *exaltatum* HORTOB. 1962.

The purpose of our study is to analyze by biometrical methods the variability of the size of the coenobia (respectively the cells), number and length of spines and also the order of the cells in coenobium.

METHOD AND MATERIALS

We investigated plankton samples collected from different fish-farms where the species of our interest naturally develop. Two of those samples are collected from pool № 9 of the fish-farm Plovdiv on 03.08.2003 and 10.08.2003, and another two are collected from pool № 14 on 03.08.2003 and 08.06.2003 year. Additional plankton material is collected from the fish-farm Nikolaevo (Starozagorsko) on 08.09.2004.

Based on the literary data for genus *Tetrastrum* CHODAT (diagnosis and iconography) and also from our own observations we typified different coenobia of this species on the cell arrangement and the length of the spines (fig.1). Thereby we analyzed the types of coenobia and their distribution in percentage for the different deposits.

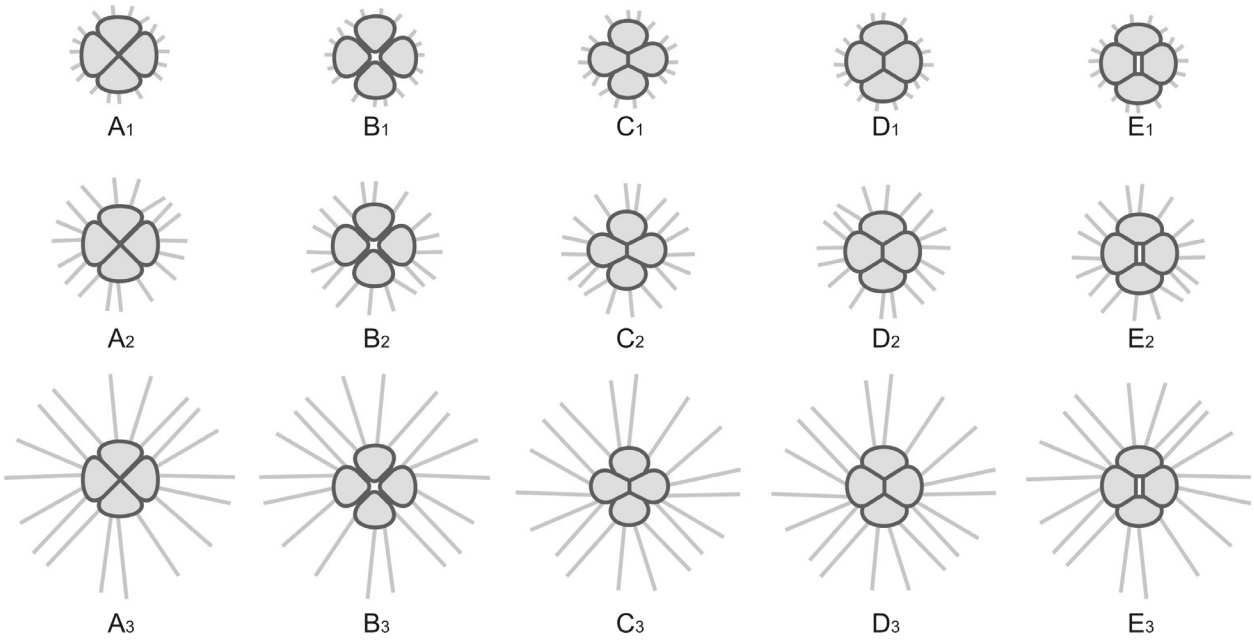

fig.1. *Different types of coenobia for genus Tetrastrum CHODAT*

The study is performed with microscope Laboval at magnification 400 X. The biometrical results are obtained by measurement of 50 coenobia from every pool. The materials are statistically of LAKIN (1980).

RESULTS

In the studied samples are observed the following types of coenobia:

- A_1 – square coenobium, the top of the four cells are in very close contact, the spines are shorter then the cells.
- B_1 – square coenobium, with opening in the interior, the spines are shorter then the cells.

- C_1 – rhomboid coenobium, differently long in the two symmetry axes with crosswise laying cells, as the tops of two cells have small contact area, the spines are shorter then the cells.
- D_1 – rhomboid coenobium, differently long in the two symmetry axes with four cells distributed crosswise, as the two cells are in contact with the most of there inner part, the spines are shorter then the cells.
- D_2 – rhomboid coenobium, differently long in the two symmetry axes with four cells distributed crosswise, as the two cells are in contact with the most of there inner part, the spines are as big as the cells.
- D_3 – rhomboid coenobium, differently long in the two symmetry axes with four cells distributed crosswise, as the two cells are in contact with the most of there inner part, the spines are longer then the cells.
- E_1– rhomboid coenobium, differently long in the two symmetry axes with four cells distributed crosswise, the interior of the coenobium is with rectangular opening, the spines are shorter then the cells.

In the materials we have investigated the biggest percentage is for coenobium type D_1 (46,8%), followed by type A_1 (32%), type B_1 (10%), type C_1 (9,6%) and type E_1 (4%). The most rare types are D_2 and D_3 only with 2%.

From pool № 9 (fish-farm Plovdiv) from date 03.08.2003 type D_1 is presented with the biggest percentage 42%, followed by type A_1 (32%), type C_1 (18%) and the rarely found is type B_1 with 10% (fig.2).

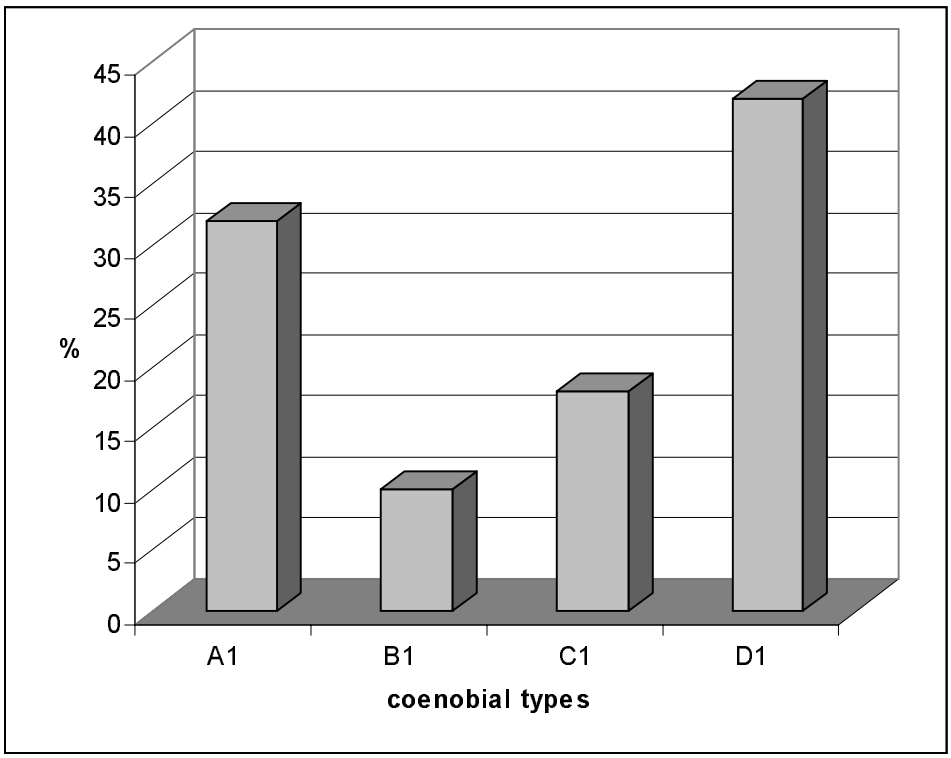

Fig. 2. *Types of coenobia (%) in the fish-farm Plovdiv – pool №9/03.08.03*

In the pool № 9 (fish-farm Plovdiv) from date 10.08.2003 the most dominant type is D_1 (44%), followed from type B_1 (22%), type A_1 (20%) and the less presented is type C_1 with 14% (fig.3).

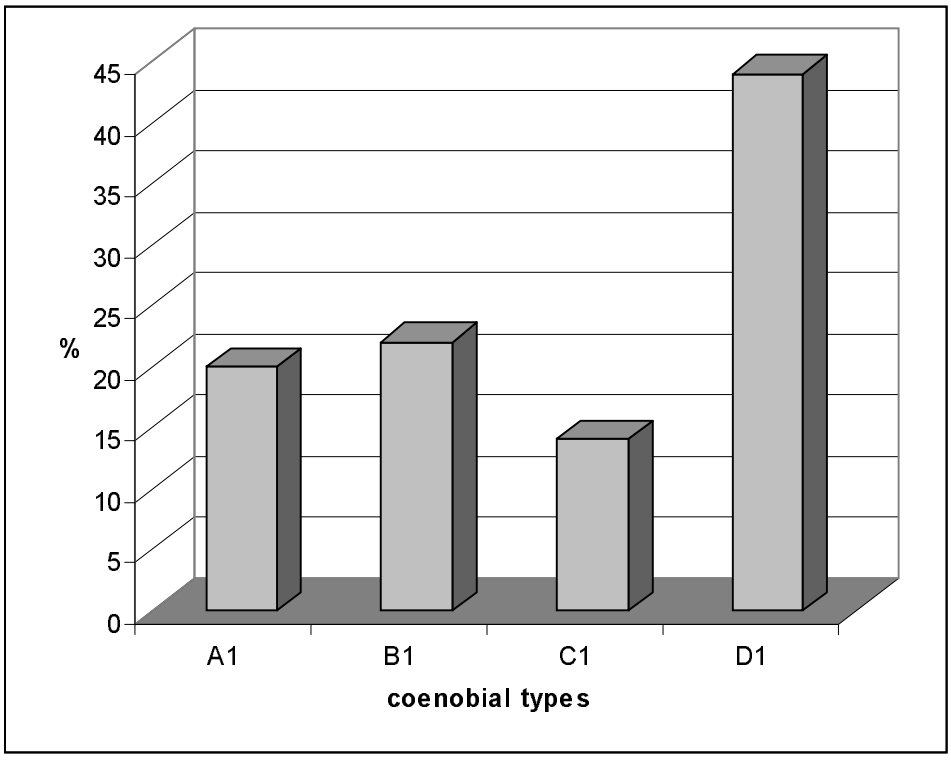

Fig. 3. *Types of coenobia (%) in the fish-farm Plovdiv – pool №9/10.08.03*

The pool №14 (fish-farm Plovdiv) from date 03.08.2003 is rich of different types of coenobia and here type A_1 (48%) in contrast to the other pools is more strongly presented compare to type D_1 (40%), followed from type C_1 (6%), type B_1 (4%) and hardly 2% of type D_3 (fig.4).

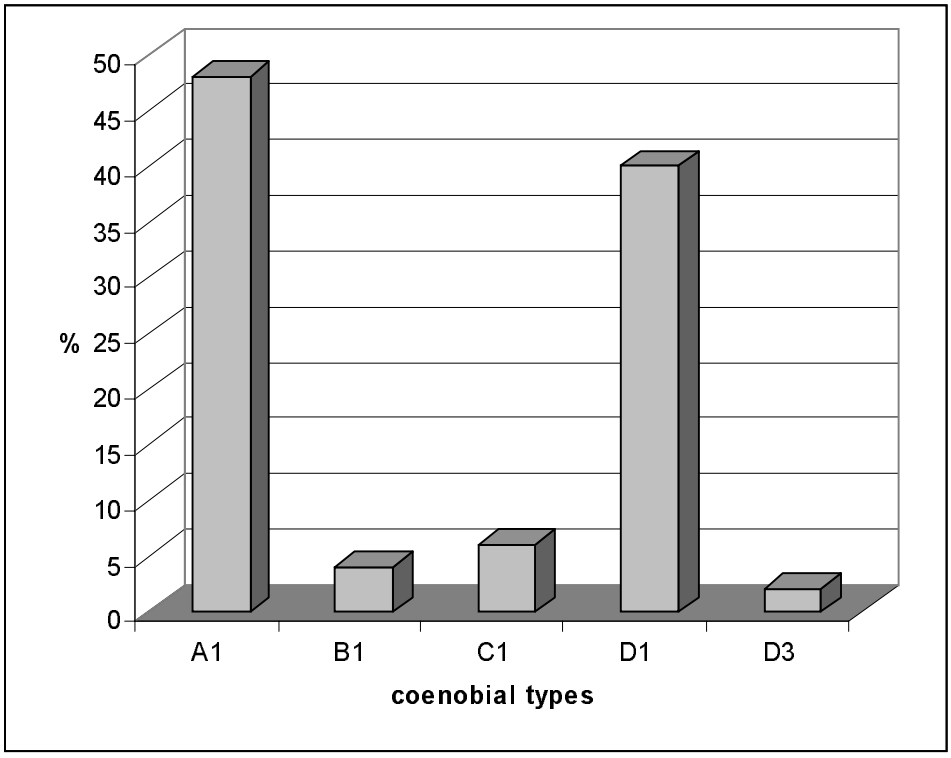

Fig. 4. *Types of coenobia (%) in the fish-farm Plovdiv – pool №14/03.08.03*

In pool №14 (fish-farm Plovdiv) from date 08.06.2003 the dominate type is D_1 (60%), followed by weakly presented type A_1 (22%), type B_1 (12%) and rarely found type C_1 with 6% (fig.5).

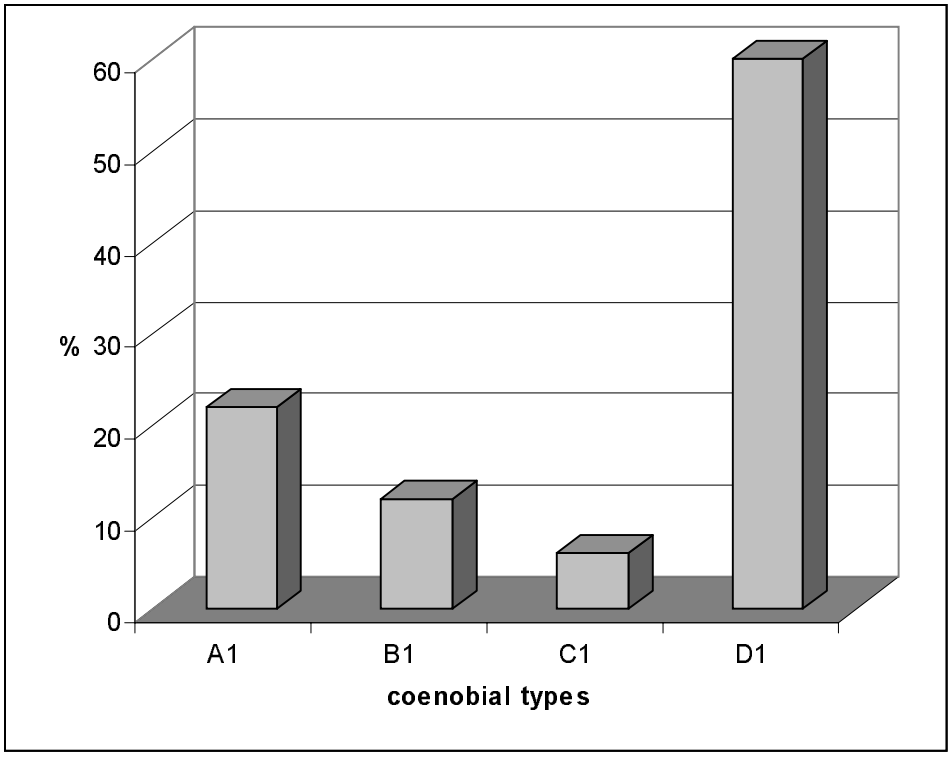

Fig. 5. *Types of coenobia (%) in the fish-farm Plovdiv – pool №14/08.06.03*

The most different types of coenobia – 5 types are detected in the materials from fish-farm Nikolaevo from date 08.09.04. In this pool once again the predominant type is D_1 (48%), followed by type A_1 (38%), while the remained types are weakly presents – type B_1, type C_1 and E_1 with 4%, and type D_2 only with 2% (fig.6).

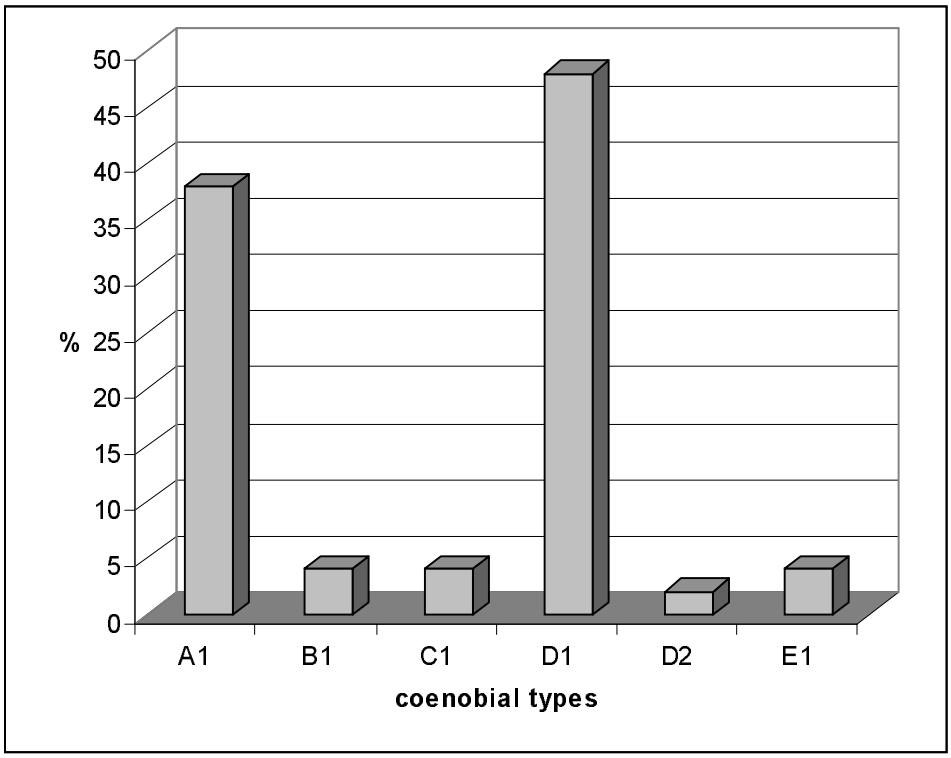

Fig. 6. *Types of coenobia (%) in the fish-farm Nikolaevo 08.09.04*

For all materials from the different deposits and dates are perform biometrical analysis. They are based on 50 coenobia on the following criteria: size of coenobia (for the rhomboid for long and short axis) and their mean value, number of spines per cells and the size for some spines. The obtained results are presented in table 1 – 4.

For type A_1 from all investigated deposits and dates the size of the coenobia varies between 5,5µm – 11,0µm. The most short coenobia (5,5µm) are found in the samples from pool № 14/03.08.03 (Plovdiv), and the biggest 11,0µm from fish-farm in Nikolaevo (table 1).

Table. 1 *Sizes of coenobia from type A_1*

Sizes of coenobia	Pools from the fish-farm Plovdiv				Nikolaevo
	№9/03.08.03	№9/10.08.03	№14/03.08.03	№14/08.06.03	08.09.04
Min.	6,2µm	6,5µm	5,5µm	6,0µm	8,0µm
$\bar{X}$	7,1µm	7,5µm	6,7µm	6,9µm	10,2µm
Max.	8,7µm	9,0µm	10,0µm	9,0µm	11,0µm

For type B_1 the size of coenobia are 5,0µm – 10,0µm, as minimum size (5,0µm) are detected for specimen from pool №9/03.08.03 (Plovdiv) and the maximum (10,0µm) in the fish-farm Nikolaevo (table 2).

Table. 2 *Sizes of coenobia from type B_1*

Sizes of coenobia	Pools from the fish-farm Plovdiv				Nikolaevo
	№9/03.08.03	№9/10.08.03	№14/03.08.03	№14/08.06.03	08.09.04
Min.	5,0µm	6,0µm	6,0µm	6,0µm	10,0µm
$\bar{X}$	6,0µm	7,5µm	7,0µm	7,0µm	10,0µm
Max.	6,8µm	9,0µm	8,0µm	8,0µm	10,0µm

For type C_1 in due to the specific way of contact between cells, coenobia are rhomboid. Therefore the long and the short axis are measured . The long axis of the coenobia are between 6,8 – 11,0µm, and the short 6,2 – 9,0µm.The short coenobia with size 6,8/6,2µm are found in materials from pool № 9/03.08.03г.(Plovdiv), and the biggest 11,0/9,0µm in the fish-farm Nikolaevo (table 3).

Table. 3 *Sizes of coenobia from type C_1*

Sizes of coenobia	Pools from the fish-farm Plovdiv				Nikolaevo
	№9/03.08.03	№9/10.08.03	№14/03.08.03	№14/08.06.03	08.09.04
Min.	6,8/6,2µm	7,0/6,0µm	9,0/8,0µm	8,0/6,0µm	11,0/8,4µm
$\bar{X}$	8,7/7,6µm	8,1/6,5µm	9,3/8,0µm	8,6/6,6µm	11,0/8,7µm
Max.	10,2/9,3µm	9,0/7,0µm	10,0/8,0µm	10,0/6,0µm	11,0/9,0µm

For type D_1, which is also rhomboid coenobium the size of the long axis is 6,2 – 12,0µm, and the short 5,5 – 10,0µm. Minimum size 6,2/5,5µm are like previous type from pool № 9/03.08.03 (Plovdiv), and maximum 12,0/10,0µm from fish-farm in Nikolaevo and pool № 9/10.08.03, № 14/03.08.03, № 14/08.06.03 on the fish-farm in Plovdiv (table 4).

Table. 4 *Sizes of coenobia from type D 1*

Sizes of coenobia	Pools from the fish-farm Plovdiv				Nikolaevo
	№9/03.08.03	№9/10.08.03	№14/03.08.03	№14/08.06.03	08.09.04
Min.	6,2/5,5µm	6,3/5,5µm	7,0/6,0µm	7,0/6,0µm	7,0/5,0µm
$\bar{X}$	8,9/7,3µm	9,2/7,7µm	9,1/7,2µm	9,2/7,1µm	9,8/7,8µm
Max.	10,6/9,3µm	12,0/10,0µm	12,0/10,0µm	12,0/10,0µm	12,0/10,0µm

The other types which are found with single coenobia have sizes: type D_2 established only in the fish-farm Nikolaevo – 8,0/10,0µm, type D_3 founded in pool № 14/03.08.03 (Plovdiv) – 8,0/10,0µm, and type E_1 from fish-farm Nikolaevo – 6,0/12,0µm.

From analyzed seven types of coenobia in the mentioned deposits with the smallest size are those from types with square coenobia – B_1 – 5,0µm, and the biggest in types with rhomboid coenobia – type D_1 and E_1 – on the short axis 10,0µm, on the long axis 12,0µm.

From all found types of coenobia the smallest are in pool № 9/03.08.03 (Plovdiv), and the biggest are in the fish-farm Nikolaevo. Beside this in the last fish-farm are detected the monotypes of type D_2 and E_1.

The number of spines per cells varies from 3 to 7, the most often is 5 or 4. The size of the spines is in the range from 1,0 to 3,0µm. The spines have two contours with blunted tops.

From all deposits are found only one coenobia from type D2 (fish-farm Nikolaevo), where the spines are 4 per cells 8,0µm length and one coenobium from type D3 (from pool № 14/03.08.03г.- Plovdiv), which spines are 3 per cells with 20,0µm length.

DISCUSSION

According to KOMÁREK & FOTT (1983) the size of coenobia are 6-15/5-12 µm. The number of the spines is (3)-5-(7) and there length is 3-23µm. HINDÁK published in 1980a that the size of the coenobia from materials from fish-farm in Bratislava is 13-15/12-13 µm, where as the number of the spines very often is 2-3 with length of 15-29µm. In his study the culture coenobia are characterized with numerous and shorter then cells spines.

Our results for the size of the coenobia and the spines, as well as the number of spines per cells are similar to the diagnosis for the species given by KOMÁREK & FOTT (1983) and with results of HINDÁK (1980a) for coenobia from culture.

The five different types of coenobia we have detected correspond to the diagnosis for the species and figures determined from KOMÁREK И FOTT (1983). HINDÁK (1980a) has illustrate for nature material and in culture coenobia with spines

with different length, but all of them belong only to the types C and D – rhomboid coenobia with cells distributed crosswise, where two cells touch in the centre.

Our results showed that the rhomboid coenobia (C, D and E) have bigger size compare to the square coenobia (A and B).

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