

Structure of male conceptacles of *Lithophyllum lobatum* (*Corallinaceae*, *Rhodophyta*)

J. REYES, J. AFONSO-CARRILLO & W. WILDPRET

Department of Vegetal Biology, University of La Laguna, 38271 La Laguna, Canary Islands.

Abstract

Estructura de los conceptáculos masculinos de *Lithophyllum lobatum* (*Corallinaceae*, *Rhodophyta*).

Anatómicamente, los conceptáculos masculinos de *Lithophyllum lobatum* Lemoine presentan los caracteres más significativos descritos en otras especies de *Lithophyllum*: (1) techo del conceptáculo formado por crecimiento de los filamentos que rodean el área fértil y (2) espermatangios simples situados sólo en el piso del conceptáculo. Además, son descritas algunas particularidades adicionales de la estructura del techo del conceptáculo: (1) una capa monostromática de células elongadas originadas directamente de los filamentos proximales que rodean el área fértil; (2) filamentos verticales cortos formados a partir de la capa monostromática y (3) células superficiales orientadas radialmente rodeando el poro.

Summary

The anatomical study has shown that male conceptacles of *Lithophyllum lobatum* Lemoine possess the more significant features reported in others species of *Lithophyllum*: (1) conceptacle roof formed by overgrowth of filaments surrounding the fertile area and (2) simple spermatangia occurring only on the conceptacle floor. Moreover some additional particularities of conceptacle roof structure are described: (1) a monostromatic layer of horizontally elongated cells directly originated from the proximal filaments that surround the fertile area (2) short vertical filaments formed from the monostromatic layer and (3) superficial cells radially oriented surrounding the pore.

INTRODUCTION

In coralline algae (*Corallinaceae*, *Rhodophyta*) reproductive cells mature within cavities known as conceptacles. When fully developed these conceptacles consist of well defined, roofed chambers either immersed in the surrounding thallus or forming mounds projecting above the thallus surface. The chambers connect with the outside by one several canals (only sporangial conceptacles of the *Melobesioideae*) ending in pores on the thallus surface. Four types of conceptacles can be recognized: asexual, male, female and carposporophytic (mature female).

According to JOHANSEN (1972) a conceptacle may be characterized by the orientation of filaments in the roof, the arrangement and extent of fertile surfaces, the shape of the chamber, and the type and structure of its contents. In addition, GARBARY (1978) in a scanning electron microscope study, proposed the nature of the conceptacle roof surface (stepped or not) as a significant feature, and CHAMBERLAIN (1983, 1986) showed that in *Pneophyllum* and *Titanoderma* respectively, the nature of the surface

and the anatomical structure of the roof are very useful characters in species' determination.

Male conceptacles of *Lithophyllum* have been studied in some species (SUNESON, 1937; ADEY, 1966, as *Pseudolithophyllum* and according to CHAMBERLAIN *et al.* 1988, a misidentification of *Lithophyllum crouanii* Foslie; MASAKI, 1968; ADEY *et al.*, 1974). According to these authors, male conceptacles have the following characteristics: (1) conceptacle roof formed by the overgrowth of vegetative filaments surrounding the area of fertile cells and (2) spermatangia liberated from spermatangial initials borne above basal cells that occur only on the conceptacle floor. Nevertheless, the nature of the conceptacle roof surface have not been previously investigated in male conceptacles of *Lithophyllum*. The present study was designed to evaluate these characters in *L. lobatum*. This species was described by LEMOINE (1929) from small crusts collected by Börgesen in Tenerife (Canary Islands). Later, this taxon has been recorded from the West Mediterranean (HAMEL & LEMOINE, 1953), and various Atlantic localities: Mauritanie, Sénégal and Cape Verde Islands (LEMOINE, 1964).

MATERIALS AND METHODS

Data were obtained from plants collected in the Canary Islands and deposited at TFC (Department of Botany, University of La Laguna, Canary Islands). Scanning electron microscopy procedures are outlined in AFONSO-CARRILLO *et al.* (1985). Selected dried fragments were sectioned with a scalpel and rinsed under distilled water. After air drying, fragments were coated with gold and viewed in a Hitachi S-450 Stereoscan Microscope. Anatomical studies were carried out on selected fragments fixed in 4% formalin in sea-water, decalcified in Perenyi's solution and embedded in paraffin. Sections, 8 μm thick, were cut and stained in Ehrlich's haematoxylin-eosine.

OBSERVATIONS AND DISCUSSION

Gametangial plants of *Lithophyllum lobatum* are dioecious but morphological differences between asexual, female-carposporophytic and male plants have not been observed. Plants studied consist of thin, foliose, lobate lamellae (20-60 mm in diameter and up to 1 mm thick), firm or little adhered to the substrate.

In scanning electron microscopy, the thallus surface shows a series of more or less rounded epithallial concavities separated by calcified regions. Male conceptacles are circular with the convex roof protruding only slightly above the surrounding thallus surface. Conceptacles can be unequivocally recognized by the radially oriented superficial cells surrounding the pore in conceptacle roof (Photo 1). In section, conceptacles are slightly convex, with a small chamber 55-90 μm in diameter by 24-30 μm high (Photo 2). The ostioles are also small, 12 μm in diameter. Conceptacles may become completely buried by subsequent vegetative growth or they may collapse after liberation of the reproductive cells. The collapse of the conceptacles roof (Photo 3) permits the observation of the conceptacle concavity (Photo 4) in surface view. Conceptacle roof is exclusively originated by the overgrowth of the proximal filaments surrounding the area of fertile cells. These filaments overgrow and centripetally surround the fertile area and form a monostromatic layer of horizontally elongated cells in the under region of the conceptacle roof (fig. 1). The cells of this monostromatic layer form very short vertical filaments 3-4 cells. The cell dimensions and the roof thickness decrease from the margin to the centre of the conceptacle. The fertile area is placed only on the conceptacle floor (fig. 1). Three types of cells are present in the fertile layer: basal cells, spermatangial mother cells and spermatangia (fig. 2). Basal cells subtending the spermatangial mother cells and they may be distinguished from other vegetative cells by their denser cytoplasm. Spermatangial mother cells are very numerous and they result densely packed on the conceptacle floor. Simple (unbranched) spermatangia are liberated from the upper region of the spermatangial mother cells. Spermatangia release their contents as spermatia 4-7 μm long by 2 μm in diameter.

This study has shown that male conceptacles of *L. lobatum* possess the characters described in others species of *Lithophyllum*: (1) roof formed by overgrowth of filaments surrounding the fertile area; and (2) simple spermatangia occurring only on the conceptacle floor. Nevertheless, the conceptacle roof structure presents some additional particularities: (1) a monostromatic layer of horizontally elongated cells directly originated from the proximal filaments that surround the fertile area; (2) short vertical filaments formed from the monostromatic layer; and (3) superficial cells radially oriented surrounding the pore. Recently, CHAMBERLAIN *et al.* (1988) have observed similar features in male conceptacles of *Lithophyllum crouanii*. In the next genus *Titanoderma*, CHAMBERLAIN (1986) has shown that the nature of the conceptacle roof and the anatomical structure of the roof are very useful features in species' determination. Nevertheless, the importance of these attributes have not been evaluated in *Lithophyllum*. Further studies are needed in order to elucidate the potential diagnostic value of the characters described in *L. lobatum*.

Acknowledgments

We thank A. Padrón for his technical assistance with the electron microscopy.

REFERENCES

- ADEY, W.H. 1966.— The genus *Pseudolithophyllum* (*Corallinaceae*) in the Gulf of Maine. *Hydrobiologia* 27: 479-497.
- ADEY, W.H.; MASAKI, T. & AKIOKA, H. 1974.— *Ezo epiyessoense*, a new parasitic species of *Corallinaceae* (*Rhodophyta*, *Cryptonemiales*). *Phycologia* 13: 329-344.
- AFONSO-CARRILLO, J.; GIL-RODRIGUEZ, M.C.; HAROUN-TABRAUE R. & WILDPRET, W. 1985.— Algunos aspectos de la aplicación de la microscopía electrónica de barrido al estudio de las algas *Corallinaceae* (*Rhodophyta*). *Cah. Biol. mar.* 25: 427-433.
- CHAMBERLAIN, Y.M. 1983.— Studies in the *Corallinaceae* with special reference to *Fosliella* and *Pneophyllum* in the British Isles. *Bull. Br. Mus. nat. Hist. (Bot.)* 11: 291-463.
- CHAMBERLAIN, Y.M. 1986.— A reassessment of type specimens of *Titanoderma verrucatum* and *T. macrocarpum* (*Rhodophyta*, *Corallinaceae*). *Cryptogamie, Algologie* 7: 193-213.
- CHAMBERLAIN, Y.M.; IRVINE, L.M. & WALKER, R. 1988.— A redescription of *Lithophyllum crouanii* (*Rhodophyta*, *Corallinales*) in the British Isles with an assessment of its relationship to *L. orbiculatum*. *Br. phycol. J.* 23: 177-192.

GARBARY, D.J. 1978.— An introduction to the scanning electron microscopy of red algae. In IRVINE D. E. G. & PRICE, J.H. (eds.), *Modern approaches to the taxonomy of red and brown algae*. Academic Press, London: 205-222.

HAMEL, G. & LEMOINE, Mme. P. 1953.— Corallinacées de France et d'Afrique du Nord. *Archs Mus. natn. Hist. nat., Paris, Ser. 7, 1*: 15-136.

JOHANSEN, H.W. 1972.— Conceptacles in the *Corallinaceae*. In K. NISIZAWA (ed.), *Proceeding of the 7th International Seaweed Symposium*. University of Tokyo Press, Tokyo: 114-119.

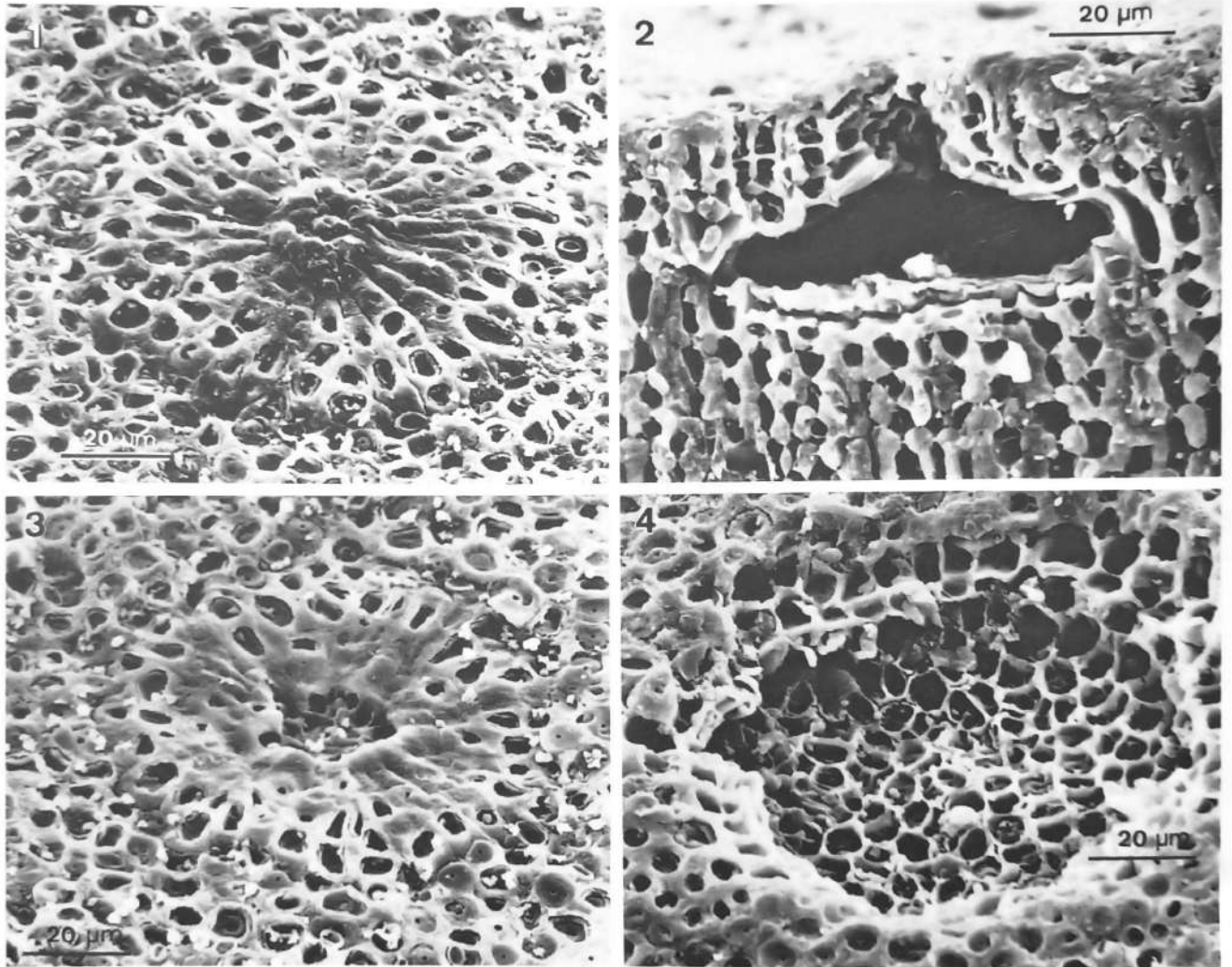
LEMOINE, Mme. P. 1929.— *Melobesiae* in Börgesen: Marine algae from the Canary Islands. III. *Rhodophyceae*: 19-68. *K. danske Vidensk. Selsk. Biol. Medd.*, 8, 1: 1-97.

LEMOINE, Mme. P. 1964.— Contribution à l'étude des mélobésiées de l'archipel du Cap Vert. *Proc. 4th Int. Seaweed Symposium* (Biarritz, 1961). Pergamon Press: Oxford, London, N.Y., Paris: 234-239.

MASAKI, T. 1968.— Studies on the *Melobesioideae* of Japan. *Mem. Fac. Fish. Hokkaido Univ.*, 16: 1-80, pl. 1-79.

SUNESON, S. 1937.— Studien über die Entwicklungsgeschichte der *Corallinaceen*. *Acta Univ. Lund., Sect. 2*, 33: 1-101.

Accepted: June 1989



Photos 1-4: Scanning electron micrographies of male conceptacles of *Lithophyllum lobatum*. 1. Surface view of conceptacles showing the radially oriented superficial cells surrounding the pore. 2. Section of conceptacle showing the roof structure. 3. The collapse of the conceptacle roof. 4. Detail of conceptacle concavity after collapse of the roof

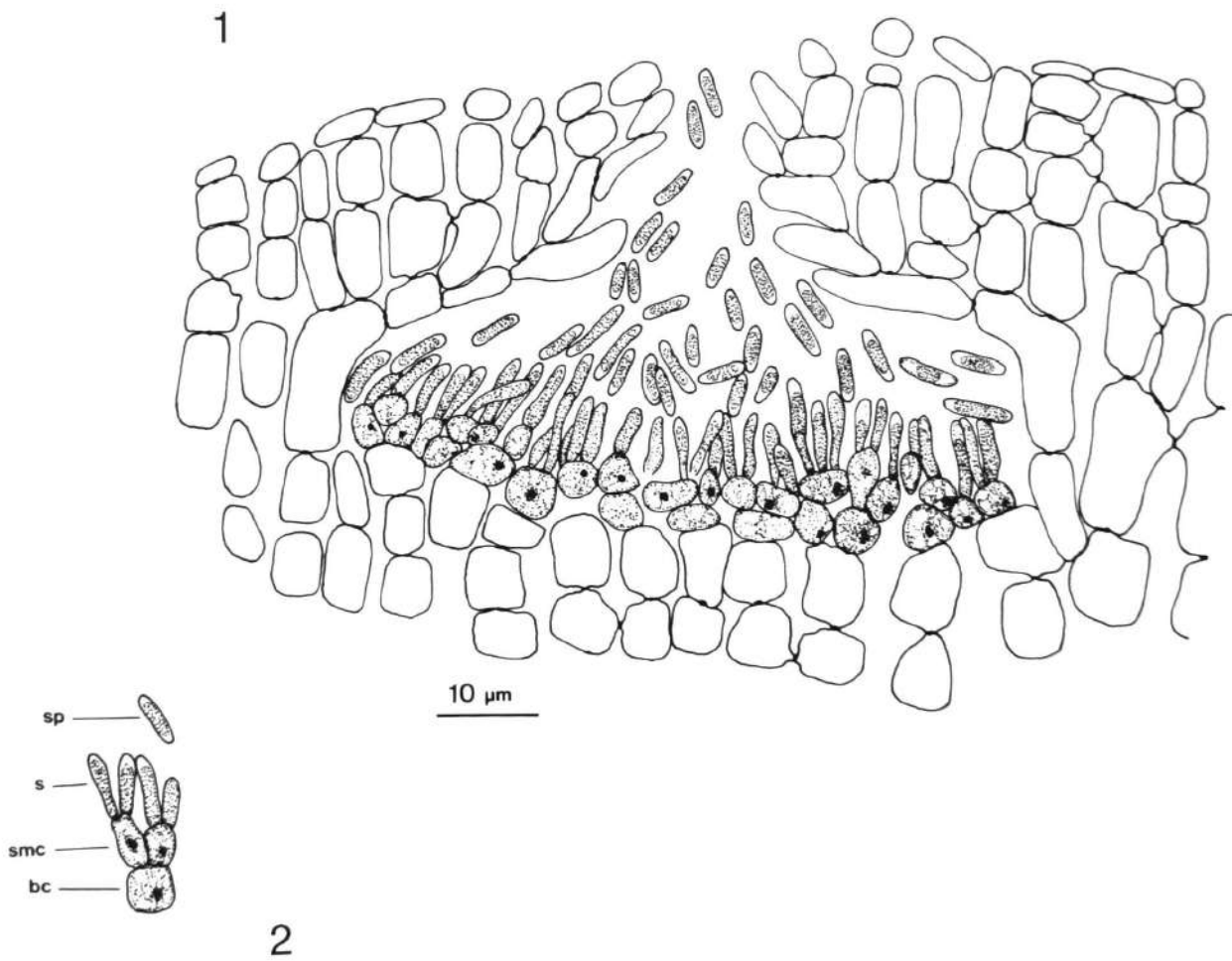


Fig. 1-2: Sections of male conceptacle of *Lithophyllum lobatum*. 1. Mature conceptacle showing the fertile area on the conceptacle floor and the roof structure. Note monostromatic layer of horizontally elongated cells at the under region of the conceptacle roof. 2. Detail of fertile area showing basal cells (bc), spermatangial mother cells (smc), spermatangia (s) and spermatia (sp)