Fine Structure of Synaptonemal-Like Complexes in *Allium cepa* Microspores

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With 2 Figures

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Summary

Synaptonemal-like complexes appear in *Allium cepa* microspores as tubular structures. They are formed of 60 nm large granules which show a finely fibrillar texture. The multiple exposure rotation technique by MARKHAM et al. suggests that these tubular structures are composed of twelve subunits.

1. Introduction

The presence of the synaptonemal complex is universal in the meiotic event and its functional role in the processes of chromosome synapsis and crossing over has been widely discussed (Moses 1969, WETTSTEIN and SOTÉLO 1971, WEEESTERGAARD and von WETTSTEIN 1972, GILLIES 1975). The morphology of synaptonemal complexes is well known as a triplelayered structure associated with the chromatin of the homologous chromosomes. Nevertheless, structures similar in morphology to the synaptonemal complex sometimes appear in germinal cells during premeiosis, late meiotic prophase and postmeiotic stages. These have been called “polycomplexes”, “synaptonemal-like complexes”, or “anomalous complexes” (SCHIN 1965, ROTH 1966, MOENS 1969, FIIL and MOENS 1973, DUDLEY 1973). It has been suggested that these structures are the result of synaptonemal complex evolution, but their real significance is unknown. In *Allium cepa* microspores they appear as tubular structures with a central axis and present cytochemical characteristic similar to those of the synaptonemal complex (ESPONDA and GIMÉNEZ-MARTÍN 1973). In this article the fine structure of this type of synaptonemal-like complexes is analyzed.

2. Material and Methods

*Allium cepa* anthers were fixed in 2% glutaraldehyde in Sorensen's phosphate buffer at pH 6.9, washed in the buffer and post-fixed in 2% OsO₄. After dehydration in alcohol the samples were embedded in Epon. Ultrathin sections were stained with uranyl acetate.
and lead citrate (Reynolds 1963). Other samples were fixed in glutaraldehyde only and were used for the EDTA staining method (Bernhard 1969). Ultrathin sections were stained with uranyl acetate for two minutes, floated on a solution of 0.2M EDTA at pH 7 for 30 minutes, and finally stained with lead citrate for two minutes. A LKB Ultratome was used for sectioning and a Philips 300 electron microscope at 60 kV for the observations. The rotation technique was employed as described by Markham et al (1963), considering the arguments of Friedman (1970). Different rotation angles were used (r3, 6, 9, 10, 11, 12, 13, 14, 24). All the pictures were made on Negtor paper (NBN 1) using similar times for exposure and developing.

3. Results and Discussion

Synaptonemal-like complexes in Allium cepa microspores appear as tubular structures with a central axis. They are usually observed in groups and show associated the tubular walls (Figs. 1 a and b; see Esponda and Giménez-Martín 1973). After EDTA staining the chromatin appears bleached but the structures containing ribonucleoproteins are deeply stained. After EDTA the synaptonemal-like complexes present characteristics similar to those of synaptonemal complexes (Esponda and Stockert 1971) and appear deeply stained (Figs. 1 b, d, and e). By comparing both structures it can be noted that the lateral elements of the synaptonemal complex show a fibrillar texture composed of very thin and tightly packed filaments (Fig. 1 c). On the other hand, synaptonemal-like complexes appear to be composed of granular, generally rounded, structures about 60 nm in diameter. These granules can be identified in both longitudinal and transverse sections (Figs. 1 d and e) and, at higher magnifications, the granules seem to be composed of thin filaments (Fig. 1 f).

The rotation technique by Markham et al. (1963) has been applied in many cases as a method for the enhancement of symmetrical patterns for the morphological analysis of various structures such as myosin filaments, nuclear pore complexes, centrioles etc. (Friedman 1970, Wolfe 1972). In Allium synaptonemal-like complexes a defined image appear only in rotation with r = 12, and 12 subunits discernible (Figs. 2 a–c). This observation suggests

Fig. 1 a. A synaptonemal-like complex detached from the chromatin (arrow). Uranyl lead staining. \( \times 23,000 \)

Fig. 1 b. Two synaptonemal-like complexes (arrows), one of them in loop form, deeply stained after EDTA method. The nucleolus (nu) is positively stained. \( \times 34,000 \)

Fig. 1 c. A pachytene synaptonemal complex after EDTA stain. The fine fibrillar texture of the stained material in the lateral elements can be observed (arrows). \( \times 112,000 \)

Fig. 1 d. A synaptonemal-like complex. The granules are indicated by arrows. EDTA stain. \( \times 100,000 \)

Fig. 1 e. Transverse section of a group of synaptonemal-like complexes. The central axis can be perceived in some cases. EDTA stain. \( \times 25,000 \)

Fig. 1 f. One of the complexes of the previous figure at higher magnification. The apparently fibrillar texture of the material composing the granules can be seen. \( \times 105,000 \)