Lateral Structure and Electrondensity Layer Profile of Bacterial Thylakoids

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The photosynthetic apparatus of the nonsulfur purple bacterium Rhodopseudomonas viridis excels by having only one stack of flattened thylakoids, which shows a high stacking order as well as an ordered arrangement of particles in the membrane plane. In spite of this the X-ray diffraction patterns of the thylakoid in-plane structure show no or few reflections which could correspond to the electronmicroscopically observed hexagonal lattice. There may be mainly two reasons for the absence of such reflections. At the first place it seems to be possible that there are differences in the composition of the electronmicroscopically observed unit cells. At the second place we assume that the hexagonal arrangement is only due to the nearly equal size of the particles and that there is a considerable disorder with respect to the orientation of the particles in the plane. To improve that, treatment with various detergents was performed. The results were:

1) Treatment of the thylakoids with Triton X-100 reduced the phospholipid to protein ratio from 0.34 to 0.125. SDS-gelelectrophoresis showed, that the protein pattern is almost the same after Triton treatment.

2) The number of X-ray reflections of the hexagonal lattice increased from 0 or 1 to 3 after Triton treatment.

3) Electronmicrographs of Triton X-100 treated thylakoids show large areas with hexagonally arranged particles. The lattice constant is 12.5 $\pm$ 1 nm. Image reconstitution methods and optical diffraction patterns of the micrographs showed, that there are considerable contributions to the unit cell which have hexagonal symmetry.

4) The electrondensity layer profiles of Triton treated and untreated thylakoids were evaluated from the meridional X-ray diffraction intensity of ordered stacks. The applied evaluation procedure takes into account statistical distortions of the membrane distances, differences between the mean electrondensities of the thylakoid stacks and the surrounding medium as well as the differences between the electrondensities of the inter- and intrathylacoid space. Besides that the evaluation procedure allows an absolute calibration of the profile in electrondensity units. The differences between the profiles of untreated and Triton treated thylakoids suggests that the removed lipids must have had an almost symmetric distribution in the membrane.