

Ultrastructure of the Yolk Substance in Preimplantation Embryos of the Gerbil

P. K. Mehrotra, Barbro Einarsson and B. Ove Nilsson

From the Reproduction Research Unit, Biomedical Centre, Uppsala, Sweden

ABSTRACT

The yolk substance or deutoplasm in preimplantation embryos of the Mongolian Gerbil was observed to be composed of tubule-like structures which were grouped in slightly wavy bundles running in various directions and occupying the major cytoplasmic space in the cell. The tubules were about 70 nm wide and, where cut longitudinally, had a maximal length of 2 μ m in the micrographs. This deutoplasm structure has no similarity to that observed in other species, thus supporting the earlier assumption that the ultrastructure of deutoplasm is species specific.

INTRODUCTION

The yolk substance or deutoplasm is a nutritive material present both in the embryoblast and in the trophoblast of early embryos (2). The distribution of the yolk substance and its light and electron microscopic structure vary among the species (1, 4, 7, 10). This has raised the question whether the deutoplasm is species specific (7). In order to test this view further, the ultrastructure of the deutoplasm in early embryos of the Mongolian Gerbil (*Meriones unguiculatus*) was examined.

MATERIALS AND METHODS

Adult virgin females were mated and the day on which a vaginal plug was found was designated Day 1 of pregnancy. On day 6, the animals were autopsied and the uterus was carefully dissected out. Seven morulae or early blastocysts were flushed out from three gerbils with 2.5% glutaraldehyde in 0.125 M cacodylate buffer (pH 7.2) and fixed for 5–10 minutes. Then they were carefully rinsed in buffer and transferred to a solution of 1% OsO_4 in 0.125 M cacodylate buffer, where they were postfixed for 10 minutes. Dehydration was carried out in watch-glasses kept on a chilled plate (Histo-lab, Bethel Trading Ltd.,

Göteborg, Sweden) in a graded series of chilled ethanol containing 1% uranyl acetate. The last step took place in 100% ethanol without uranyl acetate, after which the embryos were transferred to a mixture of ethanol and Epon, and then into a droplet of pure Epon on the lid of a BEEM capsule. After prepolymerization overnight at room temperature, an inverted BEEM capsule without a bottom was placed over the lid and filled with an additional amount of pure Epon.

Ultrathin sections were obtained with an ultramicrotome (LKB, Sweden), using a diamond knife, and were stained with uranyl acetate and lead citrate and examined in a Jeol-100B and Philips-400 electron microscope.

RESULTS AND DISCUSSION

The yolk substance or deutoplasm occupied a major part of the cytoplasm of the blastomeres. The yolk substance was composed of tubule-like structures which were grouped in slightly wavy bundles running in various directions in the cytoplasm (Figs 1-2). The tubules were about 70 nm wide. Where cut transversely, they formed irregularly outlined circles or triangles. Where cut longitudinally, the tubular profiles measured maximally about 2 μ m in length. Since the course of the tubules was wavy the total length of the tubules could not be determined. The walls of the tubules were irregularly outlined, sometimes giving the impression of being built of twisted fibrils.

Organelles and inclusions appeared scattered within the deutoplasm. The mitochondria were elongated, had an orthodox conformation and lacked the large empty spaces which were observed, for instance, in mouse mitochondria (6). The ribosomes were scattered in the cells, mostly in small groups. Profiles of endoplasmic reticulum, whether smooth or rough, occurred sparsely. Among the inclusions, lipid granules were common. Vesicles containing both glycogen granules and a dense substance were also often observed.

A deutoplasmic structure similar to that of the gerbil preimplantation stages observed here has not been reported for other species hitherto examined. For instance, the yolk substance of the rat, mouse (4), and hamster (5) is fibrillar but differently shaped within these three species (10). The deutoplasm of the baboon egg is lamellar (8), while in the sheep egg it is flocculent (3). In the human egg, the deutoplasm is slightly dense (9). The present findings therefore support the earlier assumption (7) that the deutoplasm is species specific.

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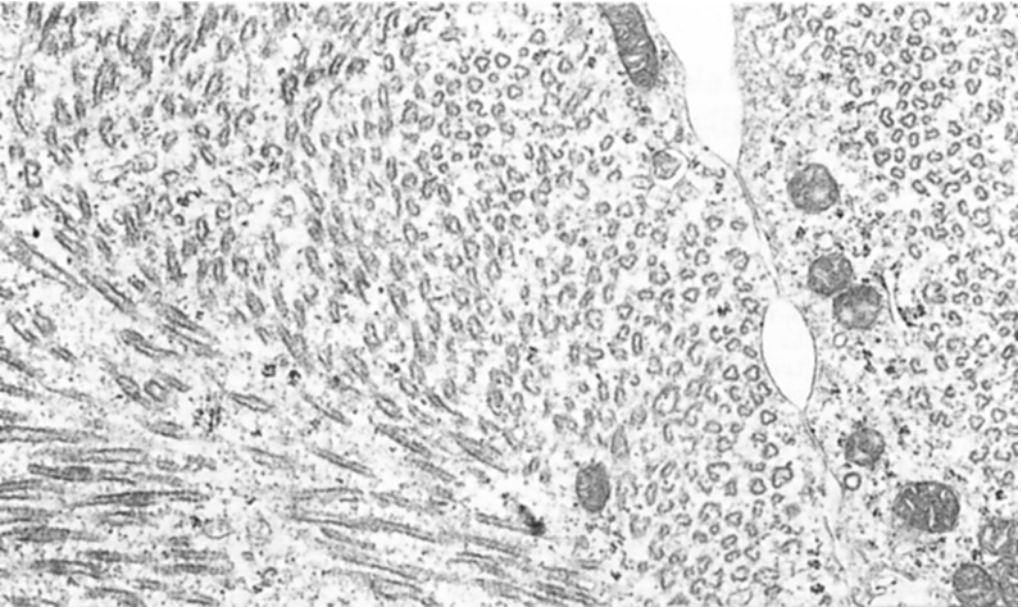


Fig. 1. Parts of blastomeres of a gerbil morula. The cytoplasm contains a yolk substance composed of tubule-like structures. The tubules have a wavy course and form profiles of various shapes after sectioning for electron microscopy. A few mitochondria are noticed. Mag. 20,000X.

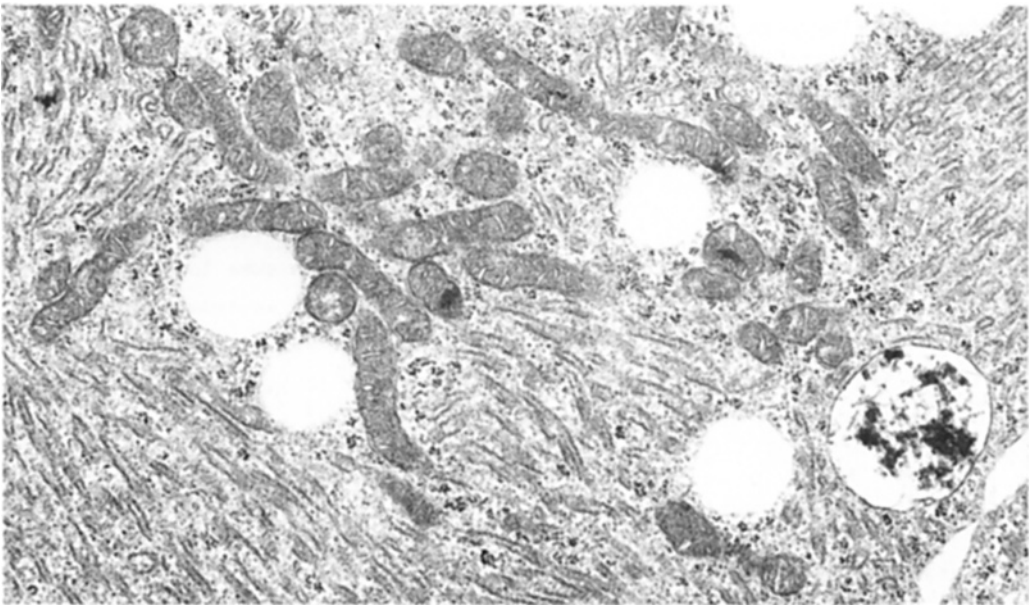


Fig. 2. Parts of blastomeres of a gerbil morula. Profiles of the tubular yolk substance are observed. Mitochondria and ribosomes are scattered among the tubules. Dissolved lipid granules appear as light circular areas. Mag. 20,000X.

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Address for reprints:

Purshottam K. Mehrotra
 Division of Endocrinology
 Central Drug Research Institute
 226001 Lucknow
 India