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INFORMATION

The Hokkaido University has granted the degrees of Doctor and Master of Veterinary Medicine to the following six graduates on March 24, 1962. The authors' summaries of the theses for the Doctor's and Master's courses are as follows:

Thesis for the Doctor's Course

ELECTRON MICROSCOPIC STUDY OF THE BULL SPERMATOZOON

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(Summary of Doctor's thesis directed by Dr. T. ISHIKAWA)

The present investigation deals with an electron microscopic study of spermatozoa collected from 4 Holstein bulls with normal fertility by the artificial vagina method. The investigation was carried out by means of three different techniques: suspension method, replica method and sectioning by means of an ultramicrotome. From the results of this investigation, a recommendable schedule for preparing block preparations was presented by the author.

The findings are as follows:

The head consists mainly of the sperm nucleus of which the anterior half is covered by the head cap, whereas its posterior half is covered by the nuclear sheath. The sperm nucleus which contains homogeneous nuclear substance with high electron density is flat and oval in shape, but it tapers away at the dorsal side of the anterior margin. The head cap consists of a double-layered acrosome membrane, the external and internal acrosome membranes. Both membranes are composed of two layers and are continuous with each other at the posterior margin of the equatorial zone. The interspace between them is filled by the acrosome substance and at the dorsal side of the anterior portion of the interspace the acrosome corpuscle is contained. The equatorial zone is a part of the head cap, forming a circular band around the head. It begins at the portion where the acrosome sack is almost empty of the acrosome substance and terminates at the mid-portion of the head. Its width is smallest at the two lateral sides and enlarges gradually toward the central portion of the dorsal and ventral sides. There are 2 basal granules one at each side of the basal portion of the nucleus, showing small structures; the whole granule

shows high electron density. Three fossula-like depressions are observed at the base; the central one is larger than the others, about twice in diameter. Along these depressions, there is a basal plate which connects with the neck.

The neck consists of a mitochondrial sheath, some kinds of radixes and a centriole. The mitochondrial sheath which originates from the basal granules of the head forms 2 spiral structures, the mitochondrial helixes, irregularly surrounding the radixes as a collar. In the anterior portion of the neck, 2 large radixes run along both lateral sides inside of the mitochondrial spirals. Likewise, at the dorsal side 3 small radixes and at the ventral 2 small radixes run, respectively. Thus, in a transverse section, these radixes take elliptic form around the centriole. In the middle portion of the neck, each of the large radixes branches off 2 medium radixes respectively, and at that point each of the pair of medium radixes on each side twists and exchanges its position with the other one. Therefore, in the posterior portion, the neck consists of each pair of medium radixes at both the lateral sides, 3 small radixes at the dorsal side and 2 small radixes at the ventral; these 9 radixes in relation to one another take a circular form in transverse section. Each radix is composed of about 15 segmental structures with high electron density, the neck platelets. Inside of these radixes there is a centriole which shows a radial structure with high electron density around a central point with low electron density. The centriole extends toward the posterior direction, forming the central radix within a short distance and then branching off 11 fine fibrils, i. e., 9 peripheral fine fibrils and 2 central ones.

The axial fibrillar bundle forms the central core, running through from middle piece to the end of the structure. The axial fibrillar bundle is composed of 20 fibrils: the outer ring, inner ring and central pair. The outer ring consists of 9 peripheral fibrils of which 4 are thicker than the other 5 in the middle piece. The arrangement of these fibrils is characteristic. Two pairs of the thicker peripheral fibrils originating from the 4 medium radixes of the neck are located at the lateral sides. On the other hand, the remaining 5 (3 and 2) peripheral fibrils originating from the small radixes of the neck are located at the dorsal and ventral sides, respectively. The inner ring consists of 9 peripheral fine fibrils with electron density approximately equal to that of the 2 central fine fibrils, and all of them originate from the central radix. The 9 peripheral fibrils, however, become gradually thinner as they approach to the end piece. Thus, in appearance the 20 fibrils resemble each other not only in size but also in electron density at the end piece.

The middle piece consists of a mitochondrial sheath, the axial fibrillar bundle and a JENSEN's ring. The mitochondrial sheath which continues from the neck is composed of 2 mitochondrial helixes twisting regularly about 32 times around the axial fibrillar bundle from the anterior portion of the middle piece as far as the JENSEN's

ring. Each helix has a double-layered mitochondrial membrane, mitochondrial lamellae and mitochondrial matrix. The JENSEN's ring is a circular body with high electron density, located at the junction of the middle piece and the tail piece.

The tail piece consists of a fibrillar coil sheath, 2 longitudinal fibrillar tail strips and the axial fibrillar bundle. The fibrillar coil sheath consists of 2 fibrillar spirals twisting more than 400 times around the axial fibrillar bundle from a point just inside of the JENSEN's ring to the anterior portion of the end piece. Each spiral shows the same electron density as the fibrils composing the axial fibrillar bundle. The longitudinal fibrillar tail strips run straight through the tail piece, attached closely inside of the fibrillar coil sheath; one is located at the dorsal side and the other at the ventral.

The end piece consists only of the axial fibrillar bundle, except for the double-layered cell membrane which covers the entire spermatozoon.

In conclusion, it may be said that the spermatozoon is quite symmetrical on flattened view, but difference between the dorsal and ventral sides can easily be distinguished by investigation of ultramicrotomed materials.