Abstract

Colossal fertility is one of the most important adaptations to a parasitic way of life of trematodes, as in other helminths, a phenomenon that gives them great resettlement opportunities in that they are carried out with the change of environments and hosts. Therefore, the study of the micromorphology of the reproductive system and gametogenesis process is very important. This article contains information about spermatogenesis, the morphology of tissue and cell structures of the male reproductive system of trematode Azygia lucii, which parasitizes in the digestive system (intestines) of pikes (Esox lucii). The obtained knowledge on the specifics of the structure of the male reproductive system and the process of spermatogenesis of trematode Azygia lucii will significantly complement the knowledge on fertility of gastroparasites and endoparasites in general.

Keywords: trematodes, helminthes, male reproductive system, spermatogenesis.

Introduction

Study of micromorphological features of the reproductive system organs of trematodes took place in the beginning of the XX century and
continues to the present time, however, of more than 15 thousand species of trematodes [1] only a few were studied in detail. Most studies on testis and spermatogenesis, contain fragmentary information, and only a few have a full account on the issue. For the first time the process of spermatogenesis was described in detail by Dingier M. [2] for the trematodes Dicrocoelium lanceatum. Further examination of the testis and spermatogenesis by other authors [3, 4, 5, and others] essentially confirmed the correctness of the descriptions by Dingier M. [2], but made some adjustments and additions. Daniel L.V. [6], summarizing data on the characteristics of spermatogenesis, noted that the process of spermatogenesis is highly species-specific. And this specificity as well as the morphology of the sperm, is related to a greater extent to the conditions of fertilization and animal breeding characteristics than their evolution and taxonomic position of the species.

Material and research methods

The object of this study is trematode Azygia lucii (Muller, 1776) related to the suborder Azygiata (La Rue, 1957), family Azygiidae (Odhner, 1911) of the digestive system (intestines) of pikes (Esox lucii).

The collected helminthological material was fixed in Bouin's fluid, passed the stage of washing in 70% ethanol for one day. Further work was carried out using Gistoprocessor for leading of the fabric Medide TPC-15, where dehydration and waxing of trematode tissues were held. After this stage, pouring of the material in paraffin blocks was carried out for further cutting in a microtome. Cutting of the material was held on a rotary microtome, sections of 5 micrometers were obtained. Obtained slices were dried in an oven, after which dyeing of the slices was carried out with hematoxylin-eosin dye according to Ehrlich [7]. The obtained total preparations were examined using a light microscope of company Keyence Bz-9000 with further photographing of the sections at different magnifications.

Micromorphology of male reproductive system of trematode Azygia lucii

Testes are paired, have a round shape, located one after another in the posterior segment of the worm (Figure 1). One sperm duct deviates from each testis. Gap of the sperm ducts is filled with sperm cells. By merging, sperm ducts form a vas deference, which has a wider gap than the gap of sperm duct. The vas deference increases in diameter, forming two loops. This part of the canal is the seminal vesicle. The seminal vesicle is followed by cirrus, which is a distal part of the male reproductive tracts (Figure 2, 3). The cirrus is a duct with muscular walls; it is the thickest wall of the duct in the male reproductive system. The distal part of the cirrus expands in a teardrop shape, forming a cirrus sac in accordance with Figure 2. The proximal part of the cirrus is surrounded by prostatic cells with teardrop-shaped ducts (Figure 3), directed into the gap of the cirrus. The cirrus of A. lucii is characterized by small prostate glands.
Coloration of hematoxylin-eosin according to Ehrlich. T – testes, Sd – sperm duct, O – ovary, U – uterus, Vg – vitelline glands, MC – Mehlis’ gland secretory cells

Figure 1 – General plan of the structure of reproductive organs of Azygia lucii

Coloration of hematoxylin-eosin according to Ehrlich. hc – hermaphrodite canal, C – cirrus, sp – spermatozoids

Figure 2 – Genital duct distal divisions of Azygia lucii
The structural organization of the testes. Spermatogenesis

The studied type of trematodes is characterized by a pair of testes (Figure 4). The wall of the testes in the form of thin membranes formed by fine connective tissue fibers, are dyed pink using hematoxylin-eosin.

A propagation zone is located as a continuous layer on the inner surface of the testes, directly adjacent to the walls; the zone consists of spermatogonial stem cells and spermatogonia. Spermatogonial stem cells have a round shape or slightly deformed due to large concentrations of cells and relative pressure on each other. Their sizes range from 6.7 to 10.6 micrometers. The nucleuses of these cells are of oval or round shape without the nucleolus, with distinct chromatin grains that have a rounded shape, and arranged almost evenly and sufficiently loosely around the core. Sizes of nucleous range from 3.8 to 4.9 microns. They have a maximum value right before a cell division, wherein the chromatin in the nucleus is denser.

Spermatogonial stem cells undergo a series of mitosis, resulting in formation of type Ad, type Ap, and type B Spermatogonia that have sizes which do not differ from spermatogonial stem cells. The structure of the nucleuses and the occurrence of chromatin in them remains the same, which indicates slight morphological differences between spermatogonia and spermatogonial stem cells. The most significant difference is that as a result of mitosis, the cytoplasm of the forming spermatogonia is not divided completely, and cytoplasmic bridges form between them. Thus, type Ad Spermatogonia form a clone of two cells, type Ap Spermatogonia - a clone of four cells, and type B Spermatogonia
- a clone of eight cells. In the center of the clone a small cytoplasmic body -
cytophor is formed. Increase of the number of cells in clones leads to the fact
that clones together with cytophors acquire a spherical shape. This suggests that
the division does not occur on the same surface.

Type Ad Spermatogonia have an elongated shape, especially the apical
ends, which extend into cytoplasmic bridges. The dimensions of these cells are
approximately equal to 6.7-8.9 microns. Type Ap Spermatogonia have the
largest dimensions of the gonial forms - 7.8-9.8 microns, and the clone diameter
reaches 17.3 micrometers. Type B Spermatogonia are smaller than type Ap
ones - 5.8-7.7 microns, and the size of the clone is also reduced as compared to
the clones of the type Ap Spermatogonia - 12.5-15.3 microns.

The formed type B Spermatogonia enter the growth stage and convert
into primary spermatocytes, dimensions of which reach 7.8 - 9.4 microns, and
the diameter of clone reach 22.1 - 25.9 microns, and the dimensions of cytophor
also increase. After the first meiosis the primary spermatocytes give rise to 16
secondary spermatocytes, which, in turn, form 32 spermatids after the second
meiosis, which corresponds to the data given by Tacahiro F., Yoichi J.,
Takayuki M. [8] on Euritrema pancreaticum. Dimensions of clones are reduced
accordingly to 21-23.1 microns for secondary spermatocytes, and 16.6 - 19.4 in
spermatids, but the size of cytophor increases, and on these preparations the cell
boundaries are clearly revealed in secondary spermatocytes and spermatids.

Figure 4 – Testes of Azygia lucii
Formation of spermatozoids begins with the fact that the nucleuses of spermatids, which had a rounded shape, begin to gradually lengthen toward cytophor. When the nucleuses length increases by more than twice and the shape becomes fusoid, they twist into rings and loops. As a further extension takes place, the tail end of the sperm comes from the cytoplasm to the outside. Gradually increasing in length, the spermatozoid is completely released from the cytoplasm remains. As a result, 32 spermatozoids and residual cytoplasmic body are formed from each spermatids clone; cytoplasmic body retains a clone size and shape for some time, and it’s cell borders are clearly visible.

The process of spermatozoids forming of A. lucii is completed within the testes.

The formed spermatozoids are derived from the gonads through the ducts of male reproductive system towards a copulatory organ.

Conclusion

Thus, the male reproductive system of A. lucii is represented by two testes of a round shape, with sperm ducts diverging from them, which are combined into a common seminal duct, which forms seminal vesicles in its path. The reproductive system of this type refers to the cirrus type containing cirrus and the prostatic part.

According to the generally accepted view of spermatogenesis in representatives of Trematoda class [9], type Ad Spermatogonia of A. lucii have parietal location. Type Ap Spermatogonia and type B Spermatogonia extend into the cavity of the gonad forming clones.

In representative of suborder Azygiata - A. lucii, which was investigated by us, there is a more ordered arrangement of clones of primary and secondary spermatocytes; the distance between the dividing islands is even, and the male reproductive cells retain the clonal structure up to the final stage of spermatozoid differentiation.

References:


