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# QUALITY OF RAINBOW TROUT (*SALMO GAIRDNERI* RICH.) SPERMATOZOA COLLECTED FROM DIFFERENT SECTIONS OF THE VAS DEFFERENS

# JAKOŚĆ PLEMNIKÓW PSTRĄGA TĘCZOWEGO (*SALMO GAIRDNERI* RICH.) Z RÓŻNYCH ODCINKÓW KANAŁU WYPROWADZAJĄCEGO JĄDRA

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Dissected gonads of rainbow trout (*Salmo gairdneri* Rich.) at various phases of spawning served to collect spermatozoa from three sections of the vas defferens (anterior, middle, and posterior). Spermatozoa motility was timed, spermatocrit measured, number of active spermatozoa calculated, and their fertilizing ability assessed. At the peak spawning, the percentage of fertilized eggs was high (90–100%) regardless of the testis section used to extract spermatozoa.

## INTRODUCTION

Size and appearance of fish testes change during the sexual cycle. In salmonids, the testes at the onset of spawning reach up to the end of the visceral cavity; during spawning, the testes gradually shrink in size from the rear, whereby the vas defferens is uncovered.

The changes in testes observed during spawning as well as variations in the texture of sperm obtained from rainbow trout males during artificial spawning and certain related changes in sperm quality prompted the authors to look into the quality of spermatozoa

contained in various sections of the testis throughout the entire spawning season. Important from the fish culturist's point of view is the fact that, so far, the practice of artificial spawning requires that an admixture of spermatozoa from the anterior part of the testis be excluded in order to prevent a complete removal of sperm because that section, as well as the middle one, contains either less valuable spermatozoa of a low activity and low fertilizing ability, or even immature ones. This opinion is justified by the analysis of results reported by Scheuring (1924, 1928) and Dyk (1953); the latter, however, studied only some sperm quality characteristics (duration of spermatozoa movement).

Recently, several authors have dealt with sperm from various parts of fish testes. For example, Billard (1976) studied fertilizing ability of the rainbow trout sperm from various sections of the testis and vas defferens, while Billard et al. (1971) studied concentrations of spermatozoa in sperm from the rainbow trout vas defferens. It seemed purposeful to carry out a more comprehensive study on a number of quality indices of sperm in testes.

The quality of sperm (spermatozoa) from various sections of the rainbow trout vas defferens was examined in 1976–1981.

## MATERIALS AND METHODS

Sperm was collected from 18 rainbow trout males kept in ponds at the Bukowo Morskie farm and in cages placed in the "Dolna Odra" power station cooling water. The males were fully mature, aged 1+ and 2+. The sperm was collected from the anterior, middle, and posterior sections of the right testis vas defferens Fig. 1), the section having been bound off to prevent mixing of the sperm during dissection of the testis and sperm collection with a glass pipette. Collecting the sperm from the vas defferens eliminated a possibility of testis tissues getting into the sample. The males had not been spawning before.

The following sperm quality parameters were studied:

a) motility of spermatozoa (duration of movement and its phase: progressive or oscillatory);
b) proportion of motile (activated) spermatozoa;
c) spermatocrit, i.e., the percentage of spermatozoa in sperm volume, as in Winnicki and Tomasik (1976);
d) fertilizing ability of spermatozoa.

The results are presented in Table 1 and Fig. 1. The analysis shows the spermatocrit (Fig. 1) to differ considerably in the males beginning to spawn and those at the peak spawning. The spermatocrit in the first decreases from 60% in the anterior section to 35–40% in the posterior part of the vas defferens (the spermatocrit reaches 90% in an incompletely mature testis when no sperm can be extracted for induced spawning), while in the latter, the anterior section spermatocrit is about 40% and decreases to 25% in the

Table 1

Activation of spermatozoa from various parts of rainbow trout testis

| | Males aged 1+ | | Males aged 2+ | | | |
|---|---|---|---|---|---|---|
| | | | beginning of spawning | | peak spawning | |
| | spermatozoa motility (s)[X] | amount of active spermatozoa | spermatozoa motility (s)[X] | amount of active spermatozoa | spermatozoa motility (s)[X] | amount of active spermatozoa |
| anterior part of testis | 8/21 | 70% | 15/23 | 40% | 19/29 | 80% |
| middle part of testis | 9/20 | 80% | 20/31 | 80% | 17/28 | 90% |
| posterior part of tsetis | 10/21 | 90% | 21/31 | 90% | 18/28 | 100% |

[X] duration of progressive movement in numerator, total time of movement in denominator

posterior part. This is related to the intensity of seminal fluid production based, as mentioned by Billard et al. (1971), mainly on the vas defferens epithelium secretion, particularly in the posterior part.

Duration of the progressive movement and the total duration of movement of spermatozoa from various sections of the testis are most often similar at the peak spawning, while on the onset of spawning the two indices are lower in the anterior part spermatozoa than in those from the middle and posterior sections. The anterior part spermatozoa show frequently disturbed motility manifest via a shorter duration of the progressive movement and excessively prolonged oscillatory movement. The spermatozoa from young males aged 1+ show a generally shorter duration of motility than those from older males.

At the peak spawning, the proportion of motile spermatozoa (Table 1) is very high in the posterior and middle sections (80–100%) and only slightly lower (70%) in the anterior part. At the beginning of spawning the amount of active spermatozoa in the anterior section is small (up to 40%).

The fertilization rate, as calculated at the stage of blastopore closure, was high (90–100%) in egg samples fertilized with sperm collected from various testis sections at the peak spawning, regardless of the section used.

As seen from the results obtained, the spermatozoa collected from the posterior part of the testis are highly active, as are – although somewhat less so – those from the middle section, the activity indices deviating only slightly from ejaculate standards known from other sources. The indices are lower for the anterior section spermatozoa, these

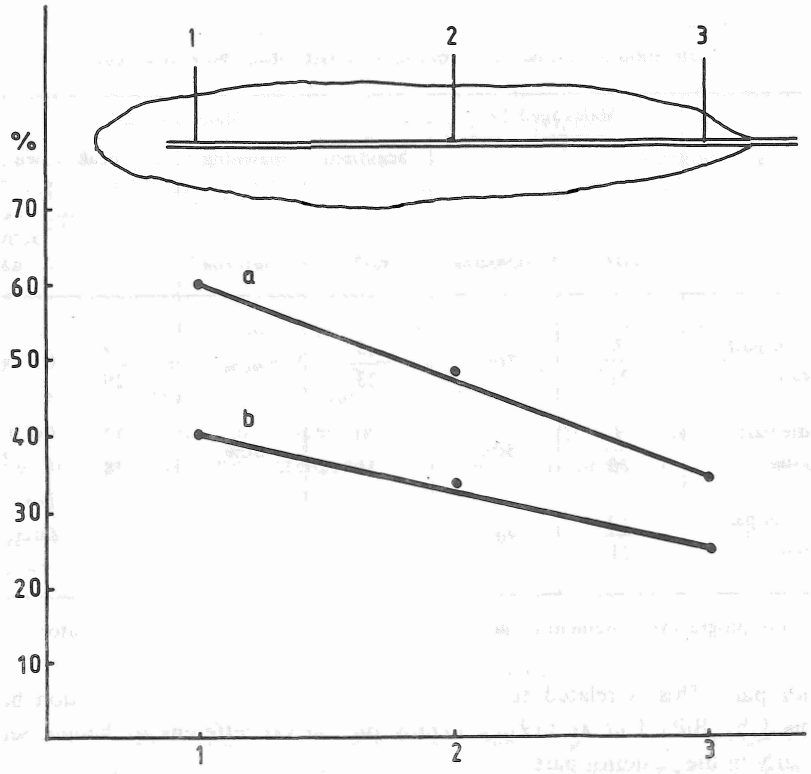


Fig. 1. Spermatocrit of the rainbow trout on the onset (a) and to the end (b) of spawning (1, 2, 3 – places of spermatozoa collected from different sections of the vas defferens)

spermatozoa being, however, equally capable of fertilizing the eggs. A lower activity is perhaps compensated for by a higher production of spermatozoa, as indicated by the higher spermatocrit values. However, low activity level prevents successful fertilization above a certain sperm density threshold (very high spermatocrit, little spermal fluid).

Moreover, it is suggested that the rainbow trout testes mature in succession, one section after another, rather than simultaneously along the whole length.

The observations described above were made basically on the right testis; in some instances, however, the indices obtained from both testes were compared. The differences detected, concerning mainly the spermatocrit, allow to conclude that one of the tested matures earlier than the other. There is, however, no indication whether it is the right or the left testis that matures first. The differences, along with section-wise maturation of the testes enable males to prolong their participation in spawning and to fertilize eggs several times.

It is concluded also that spermatozoa motility indices (percentage of active spermatozoa and duration of movement) become uniform as the testes mature, which is accompanied by decrease in the spermatocrit, particularly in the anterior part of the vas defferens. Thus the next conclusion, advanced in earlier studies as well (Billard, 1976; Billard et al., 1971), is obvious: at the peak spawning the proportion of fertilized eggs is very high (90–100%), regardless of the section of the vas defferens which yields the spermatozoa.

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## STRESZCZENIE

Z wypreparowanych gonad dojrzałych samców pstrąga tęczowego (*Salmo gairdneri* Rich.) w różnych okresach tarła pobierano plemniki z trzech odcinków przewodu wyprowadzającego (w części głowowej, środkowej i ogonowej). Mierzono czas ruchu plemników i spermatokryt, obliczano ilość plemników aktywnych i oceniano ich zdolność do zapłodnienia ikry. W próbach ikry zapładnianych spermą z różnych odciniów jądra od samców w pełni okresu tarłowego procent zapłodnionej ikry był wysoki (90–100%) niezależnie od tego czy sperma pochodziła z przedniego, środkowego czy tylnego

odcinka jądra. Również wskaźniki jakości spermy z odcinka tylnego i środkowego były podobne, a z przedniego tylko niewiele niższe. Znaczniejsze różnice występowały jedynie na początku okresu tarłowego.

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