Bull. Korean Fish. Soc. 19(6), 575~580, 1986 韓水誌 19(6), 575~580, 1986

A Report of Triploid Rainbow Trout Production in Korea

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(Received August 25, 1986)

Triploid rainbow trout (*Salmo gairdneri*) were produced on a large scale practice by the application of moderate heat treatment in 1986.

Triploid treatment of the fertilized eggs was carried out with heat shock at 27°C for 10 to 14 minutes starting 10 minutes after insemination at 10°C. Estimated triploidy ranged from 45% to 57% and the incidence of triploidy slightly increased with the treatment time. No significant differences of growth rate were observed between triploidy and diploidy at the early stage of growth. This observation was consistent with results of other fish species and other reports on this species.

This heat shock technique, expecting further improvement, should be useful in the mass production of sterile triploid rainbow trout.

Introduction

Experiments for the manipulation of chromosome sets in fish have focused on the areas of induced gynogenesis and polyploidy (Parson and Thorgaard, 1985). The induction of diploid gynogenesis and triploidy as a tool for sex control and genome manipulation has generated considerable interest in recent years. In rainbow trout (*Salmo gairdneri*), early attempts to induce diploid gynogenesis and triploidy were unsuccessful (Lincoln et al., 1974; Svärdson, 1945), but recent works have shown that high level of diploid gynogenesis and triploidy could be induced using thermal shock, chemical and hydrostatic pressure treatment soon after artificial fertilization (Chourrout, 1980, 1984; Chourrout and Quillet, 1982; Lincoln and Scott, 1983; Lou and purdom, 1984; Onozato, 1984; Purdom et al., 1985; Refstie et al., 1977; Solar et al., 1984; Thorgaard et al., 1981).

Induced triploidy as a means of suppressing gonad development may have great commercial advantages in rainbow trout culture because a major problem in rainbow trout culture on a large scale is the detrimental effect of sexul maturation on growth, survival and marketability of fish (Bye and Lincoln, 1981; Johnstone et al., 1979). The adults of triploid rainbow trout were reported to become significantly larger than normal diploid together with better feed conversion because of their gonadic sterility (Thorgaard and Gall, 1979).

Recently, the authors used moderate heat shock to induce triploidy in rainbow trout on a large scale practice at Kihwari Trout Farm of Horim Fisheries Company, Kangwon-do, Korea. The objective of this experiment was to determine if triploidy could be induced in Korean strain of rainbow trout using moderate heat shock technique and if so, what combination of exposure time would produce the best results.

Materials and Methods

Eggs and sperm of rainbow trout were obtaind at the Kihwari Trout Farm of Horim Fisheries Company, Mitan myon, Pyongchang-gun, Kangwon-do, Korea in 1986.

Eggs were hand-stripped and fertilized by dry method. The inseminated eggs were rinsed with tap water at 10°C.

To induce triploidy, the eggs were divided into 6 groups for 10-minutes-post-insemination heat treatment. Moderate heat shocking was administered in a water bath at 27°C, except one group as control.

Ten to fourteen minutes after starting heat treatment, treated eggs were transfered to incubator. The water temperature was maintained at around 10°C during incubation.

Ploidy ratio from 30 4-months-old individuals from each group was determined by cell size, chromosome number and its karyotypes. Cell size was analyzed by the method of Park and Chung (1985) and the chromosome slides were made by the direct method of Kim et al. (1982).

Results

The rainbow trout eggs treated for 10 to 14 minutes, 10 minutes after insemination induced triploidy (Fig. 1) and the size of triploid rainbow trout erythrocytes was significantly larger than that of diploid controls (Fig. 2).

The results of inducion of triploid rainbow trout in this experiment as determined by the analysis of chromosome number and cell size are presented in Table 1. Treatment at 27°C for 10 to 14 minutes post-insemination yielded 45.5 to 57.1% triploids and the incidence of triploid was slightly increased with treatment time of heat shock. No significant differences in growth rate were however observed between triploid and diploid in the early stage of growth (Table 2).

Table 1. Induction of triploidy obtained from heat shock at 27°C for 10 to 14 minutes starting 10 minutes after insemination

Treatment time (min)	Triploid incidence* (%)
0	0
10	12/23(52.5)
11	10/22(45.5)
12	14/28(50.5)
13	16/30(53.3)
14	16/28(57.1)

* No. of triploid fish/total No. of fish examined

Table 2. Mean length of 4-months-old diploid and triploid rainbow trout

Treatment time (min)	Total length (*mm*)*	
	2 n	3 n
0	89.5±14.4	
10	93.7±19.4	91.6±12.4
11	82.0± 3.1	72.0± 3.0
12	80.1±11.1	70.0± 8.1
13	93.4± 2.8	88.8±22.1
14	83.0±12.3	79.2±11.0

*Values are means±S.D.

Discussion

The most common mechanism involved in the production of triploid fish is suppression of the second meiotic division in the fertilized eggs (Thorgaard, 1983). Therefore, the timing of the shock treatment must coincide with the time of the second meiotic division in the zygote. A general review of different results reported to date seems to indicate that moderate temperature shocks between 26 to 28°C for 10 to 20 minutes after fertiliiization would be the recommeneded treatment to induce triploid in rainbow trout (Solar et al., 1985). Triploidy induced in this experiment confirms the effectiveness of our treatment conditions.

Triploidy is of interest to aquaculturists due to the possibility that these sterile animals will grow faster than normal ones (Valenti, 1975) as well as they will refrain from aggression during spawning seasons. Althrough our triploid rainbow trout did not grow faster than diploid in the early stage, these phenomena were consistent with the results of other report (Thorgaard and Gall, 1979).

The point of this report is the first induction of triploid rainbow trout on a commercial scale practice in Korea. Therefore, the use of this treatment condition with expected further improvement should be useful to produce sterile rainbow trout for local farmers.

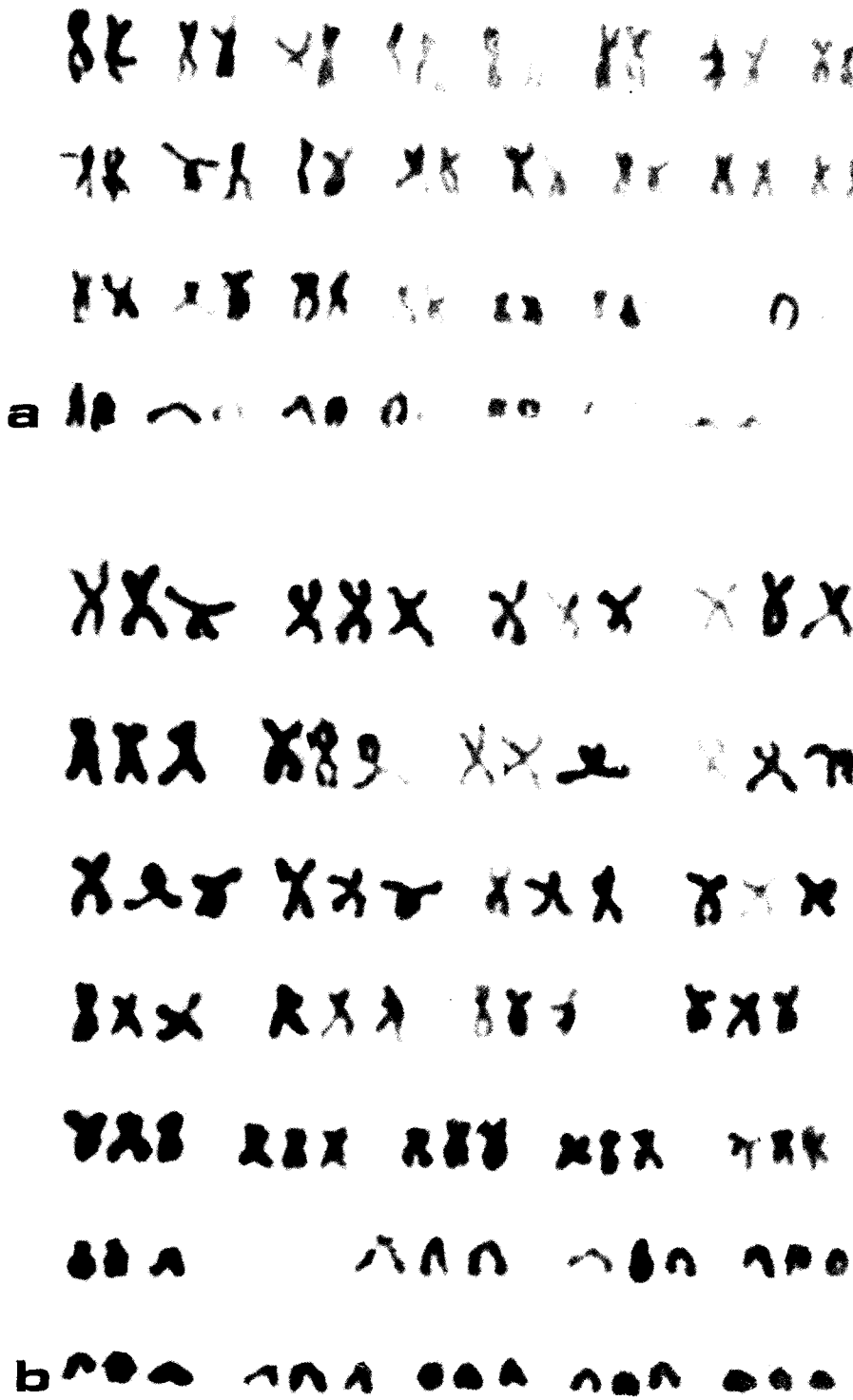

Fig. 1. Idiograms of diploid (a) and artificial triploid (b) rainbow trout.

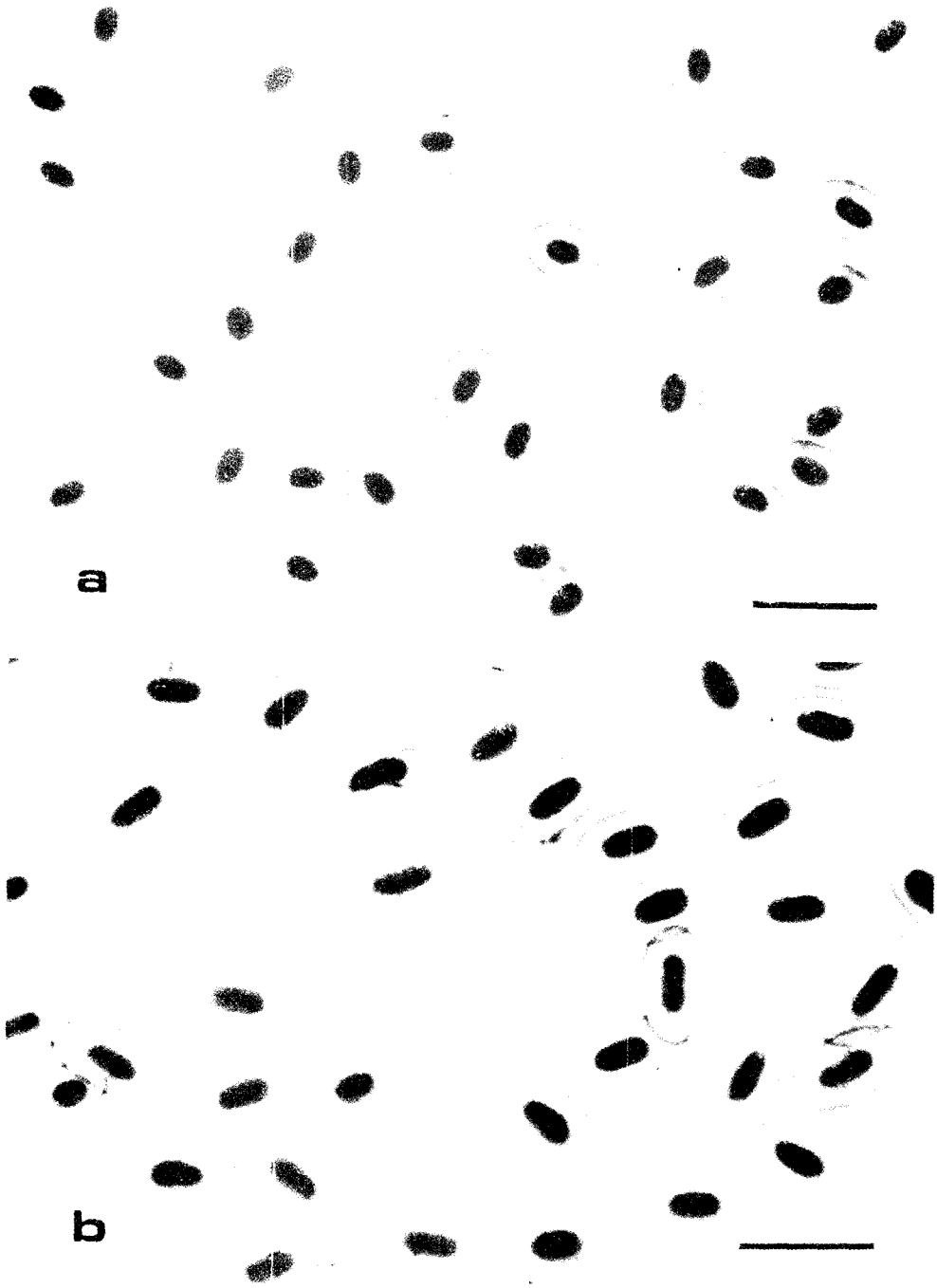

Fig. 2. Microphotographs of diploid (a) and artificial triploid (b) erythrocytes of rainbow trout. Bars indicate 20 μm.

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3배체 무지개송어의 대량 생산에 대한 연구

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(1986년 8월 25일 수리)

1986년초 저자들은 불임 3배체 무지개송어의 대량 생산을 위하여 수정난을 27°C로 열처리하였다.

그 결과 50% 전후의 3배체 무지개송어가 유도되었으며 유도된 3배체 송어의 초기 성장률은 여타 보고들과 같이 정상 2배체와 유사하였다.

앞으로 본 방법을 수정개량하여 처리함으로써 산업적으로 중요한 불임 무지개송어의 생산성을 높일 수 있으리라 사료된다.