Arch.Ryb. Pol.	Archives of Polish Fisheries	Vol. 6	Fasc. 2	383-390	1998

THE EFFECT OF SOME IMMUNOMODULATORS ON THE GROWTH RATE OF STURGEON FRY (*Acipenseridae*)

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A B S T R A C T. The effect of levamisole, ISC, and chitosan applied per os on the growth rate of sturgeon fry was studied. Levamisole added to the feed caused a 20% increase of fish body mass compared to the control, while ISC treatment - 8%. On the other hand, chitosan affected adversely fish growth, causing 33.5% reduction of body mass compared to the control.

Key words: STURGEON (*Acipenseridae*), REARING, GROWTH RATE, IMMUNOMODULATORS

INTRODUCTION

Development of intensive technologies of stock material production evoked a change in fish disease prophylaxy methods. Immunological studies revealed that resistance mechanisms of the fish reared in water recirculation systems with water purification are different than in the fish exposed to environment with wide pathogen range (Kolman H. 1996, Kolman H. et al. 1997). At the same time, high stock density in rearing tanks creates a risk of epizootic diseases. Traditional immersion treatments should not be used in the recirculation systems due to possible negative impact of therapeutics on the biofilter (Kolman 1989). Thus, in case of sturgeon fry reared in tanks with water recirculation system, new methods of disease prevention should be developed. This issue was already studied and partly solved in the case of teleost fishes (Siwicki et al. 1989, Siwicki 1990, Siwicki, Cossarini-Dunier 1990).

Studies on the effect of Levamisole, ISC, Chitosan, and FinnStim on the fry of sturgeon species and their hybrids revealed that these immunomodulators stimulated non-specific cell and humoral responses (Kolman H. 1996, Kolman H. et al. 1997). The effect on biotechnological indices, such as fish survival and growth rate, was also observed (Kolman R. et al. 1996). The aim of the present study was an assessment of the effect of some immunomodulators on the growth rate of sturgeon fry.

MATERIAL AND METHODS

The effect of immunomodulators on sturgeon fry growth rate was studied in three rearing series which differed as to the treatments and fish used.

In the first series larvae and fry of bester (*Huso huso* L. x *Acipenser ruthenus* L.) and *Acipenser gueldenstaedti* Brandt hybrids were studied. Intensively feeding 27 days old larvae were divided into four groups, each in two replicates, of 500 ind. of average body mass 0.67 g. They were placed in 8 tanks 0.4 m^3 in volume, supplied from water recirculation system with the thermoregulation, a biofilter, and a UV disinfection system (Kolman R. 1992). Group I was used as the control, and the remaining three were trated with various therapeutics in the following doses:

group II – Chitosan – 100 mg/kg of fish,
group III – Levamisole – 5 mg/kg of fish,
group IV – ISK – 10 mg/kg of fish.

The therapeutics were applied *per os*. Daily feed dose containing the medicine was applied three times, every 2 days. The fish were fed trout starter „Kristall-3700" produced by Aller Mølle. The fish were weighed twice a week. Average fish mass was calculated as an arithmetic mean for 30 randomly harvested fish. Growth rate was calculated in per cent of body mass increment per day, according to the formula:

$$\Delta W\% = \frac{W_p - W_k}{W_p / n} \cdot 100$$

where:
$\Delta W\%$ - increment of average body mass per day [%],
W_p – initial average body mass [g],
W_k – final average body mass [g],
n – number of days.

After each weighing, new daily feed dose was calculated basing on the current fish mass, reducing the feeding rate from 10% to 6.4% of fish mass per day. Feed was supplied continuously using conveyor feeders. Rearing temperature was 20±1°C. Dissolved oxygen level in the outflowing water did not drop under 50% of saturation, and toxic nitrogen compounds did not exceed levels considered to be dangerous for salmonid fish larvae (Kolman 1993).

In the second series, the effect of Levemisole on the growth rate of bester fry (*Huso huso* L. x *Acipenser ruthenus* L.) was studied, and in the third series – the effect of ISK (ImmunoStimulating Complex) on the growth rate of Siberian sturgeon (*Acipenser baeri* Brandt). Therapeutics were applied in the same way as in series I. Second and third series differed as regards the time of starting and ending of the experimental rearing. In the second series the experiment was started on 57, and finished on 120 day of rearing, and in the third – on 38 and 77 day respectively. In these two series the fish were reared in larger tanks (V = 2.0 m^3), so the initial number of fish (the same in the control and the experimental groups) was higher: 1750, and 1250 ind. respectively. Moreover, due to fast growth of the fish, it was necessary to reduce stock density during rearing. Final number of fish was 550 ind. per tank, and 600 ind. per tank in series III. Fish growth monitoring, feeding, and environmental conditions were the same as in series I.

RESULTS AND DISCUSSION

In the present study, for technological reasons, the fish were treated with immunomodulators when their body mass exceeded 0.5 g, in the period when mortality of healthy fry is usually low (Kolman, Szczepkowski 1995). Thus, it was impossible to observe the effect of therapeutics on fry survival. However, the results of other experiments (Kolman R. et al. 1996) revealed that Levamisole applied in immersion on day 4 after hatching increased survival of Siberian sturgeon (*Acipenser baeri* Brandt) larvae by over 20%.

The present study revealed the effect of immunomodulators on sturgeon fry growth rate. The results show that Levamisole caused the highest increase of the growth rate. In the case of bester and Acipenser gueldenstaedti hybrids (Fig. 1), and bester alone (Fig. 2), average body mass of treated fish at the end of the experiment was higher by 19.6%, and 22.7% compared to control groups. Similar effect of Levamisole on growth rate was observed in common carp larvae (Siwicki, Korwin-Kossakowski 1988).

Weaker stimulatory effect was observed in ISC-treated bester and *Acipenser gueldenstaedti* hybrids (Fig. 1), and in *Siberian sturgeon* (Fig. 3). Average final body mass of the fish treated with ISC was higher by 8.1% and 7.5% compared to the control. ISC is a polypeptide, thus it is possible that the effect of this polypeptide (time of

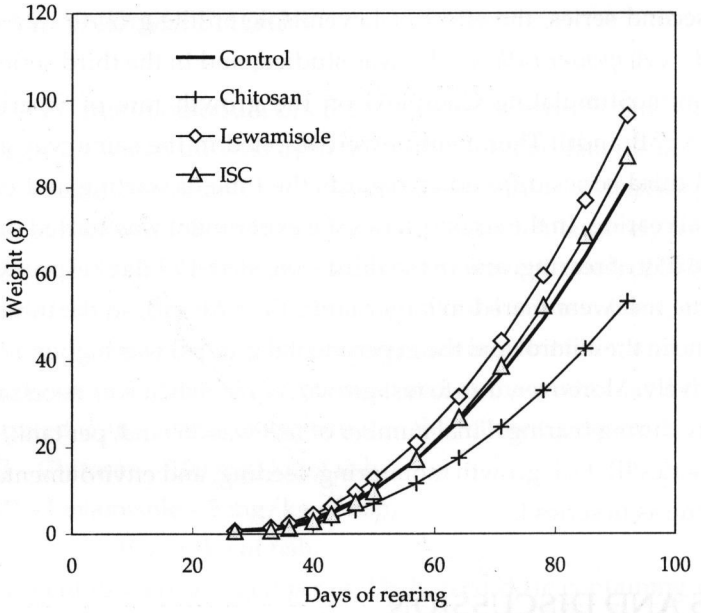

Fig. 1. The effect of Levamisole, ISC, and Chitosan on the average individual body mass of bester (*Huso huso* L. x *Acipenser ruthenus* L.) and *Acipenser gueldenstaedti* Brandt hybrid fry

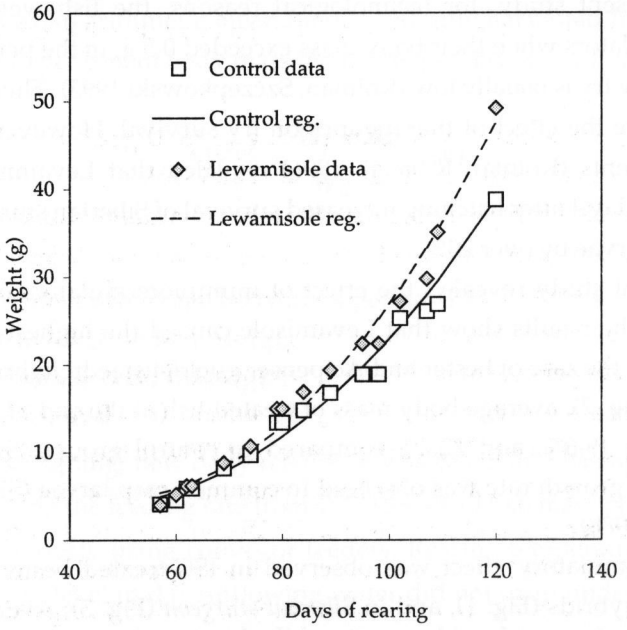

Fig. 2. The effect of Levamisole on the average individual body mass of bester fry (*Huso huso* L. x *Acipenser ruthenus* L.)

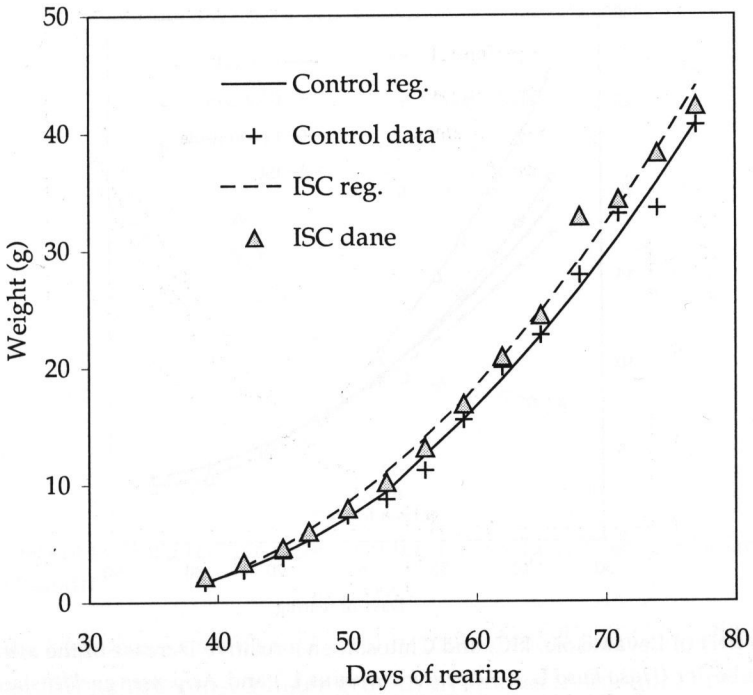

Fig. 3. The effect of ISC on the average individual body mass of Siberian sturgeon (*A. baeri* Brandt)

activity and effective dose) was reduced due to its digestion by the proteolytic enzymes in the fish digestive tract (Gawlicka et al. 1995).

Chitosan applied in higher dose than the other immunomodulators considerably inhibited the fish growth. Average body mass of bester and *Acipenser gueldenstaedti* hybrid fry treated with Chitosan was 33.5% lower than in the control (Fig. 1).

The effect of immunomodulators on growth rate dynamics, expressed as a regression of daily per cent of body mass increment (PPM) is shown in Figs. 4, 5, and 6. All regressions are statistically highly significant (r = 0.98-0.97, and over 0.99 according to Student's test). The curves show that PPM in the initial phase of rearing was strongly affected by ISC. Daily body mass increment of ISC-treated fish was higher by 38% in series I, and by 45% in series III compared to the control (Figs. 4, 6). Levamisole, on the other hand, caused much lower growth dynamics in the initial phase of rearing, in the first and second series 8.1%, and 33% respectively (Figs. 4, 5).

These, apparently contradictory results concerning the effect of ISK and Levamisole on the final body mass of fish and its daily increments, may be explained

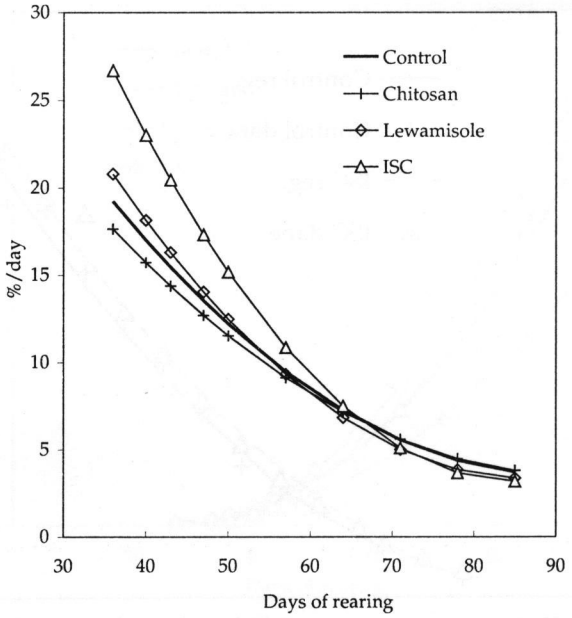

Fig. 4. The effect of Levamisole, ISC, and Chitosan on a relative increase of the average body mass of bester (*Huso huso* L. x *Acipenser ruthenus* L.) and *Acipenser gueldenstaedti* Brandt hybrid fry

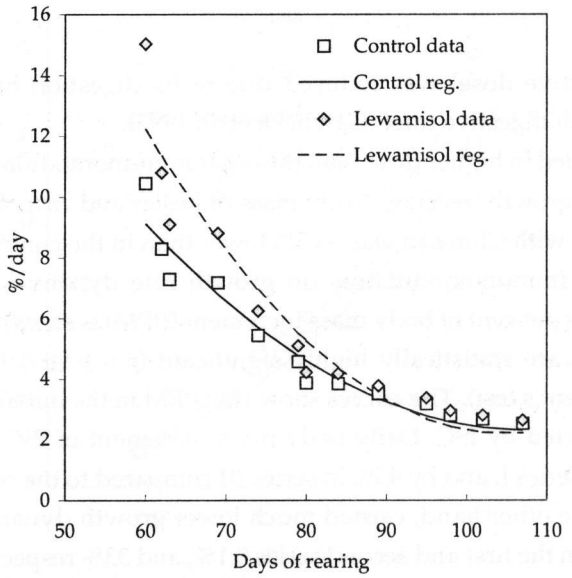

Fig. 5. The effect of Levamisole on a relative increase of the average body mass of bester fry (*Huso huso* L. x *Acipenser ruthenus* L.)

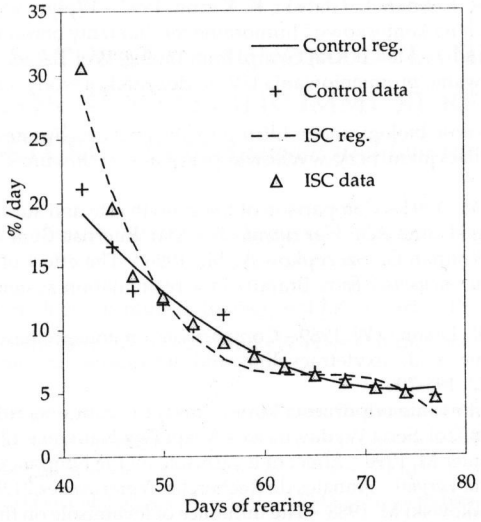

Fig. 6. The effect of ISC on a relative increase of the average body mass of Siberian sturgeon (*A. baeri* Brandt)

only with the hypothesis on different activity time of these immunomdulators. It is possible that ISC ,which caused higer growth dynamics in the initial phase of rearing, had shorter time of activity, so its overall effect on the final average individual body mass was lower than in the case of less effective but longer active Levamisole.

The changes of growth rate caused by immunomodulators, compared to the control groups, were probably related to the effect on metabolic mechanisms of juvenile sturgeon subjected to various stress during intensive rearing on artificial feed (Wedemeyer et al. 1981).

The results indicating positive effect of Levamisole, and to the lesser degree, also of ISC on the fish survival and growth rate are very important from a practical point of view. They allow to increase efficiency of production of sturgeon stocking material, and to improve economic effects of intensive rearing of market-size fish.

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STRESZCZENIE

WPŁYW WYBRANYCH IMMUNOMODULATORÓW NA TEMPO WZROSTU NARYBKU RYB JESIOTROWATYCH (*Acipenseridae*)

Przeprowadzono trzy serie badań nad wpływem lewamizolu, ISK'u i chitozanu podanych per os na tempo wzrostu narybku ryb jesiotrowatych: krzyżówki bestera (*Huso huso* L. x *Acipenser rutenus* L.) z jesiotrem rosyjskim (*Acipenser gueldenstaedti* Brandt), bestera i jesiotra syberyjskiego (*A. baeri* Brandt). Badania prowadzono Stwierdzono, że zastosowanie lewamizolu w paszy powoduje wzrost masy stymulowanego narybku o ok. 20% w porównaniu z grupą kontrolną. Również pozytywnie na wzrost wpływa ISK, dzięki któremu narybek osiąga wyższą masę średnią o ok. 8%. Natomiast chitozan negatywnie wpływał na wzrost. Po jego zastosowaniu masa średnia narybku obniżyła się o 33,5% w porównaniu z grupą kontrolną. Ponadto stwierdzono, że ISK wpływał najbardziej skutecznie na tempo wzrostu w początkowej fazie chowu, jednakże efekt jego działania trwał krócej niż lewamizolu.

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