Acta Universitatis Latviensis, 2003, Vol. 662, pp. 45–50

Promotion of salmon rearing efficiency by including yeast extract *Aqualase Two* in the diet

Ruta Medne*, Inese Savicka

Latvian Fisheries Research Institute, Daugavgrīvas iela 8, Rīga, LV-1007, Latvia
*Corresponding author, E-mail: medne@latfri.lv

Abstract

The effect of Baltic salmon growth and development treated with ß-glucan yeast extracts *Aqualase Two* was studied in the fish hatchery "Tome" and Latvian Fisheries Research Institute. A total of 30 000 fish from larvae (0+) to smolt stages were used in the experiment. Basic food with and without supplements of *Aqualase Two* (0.5 and 1 g kg^{-1}) was used for feeding. Health of fish was regularly assessed. The investigations showed that testing the preparation decreased mortality during feeding and increased the rate of growth in autumn. The best results – lower mortality and greater increase in weight of smolts, were obtained in the group of fish fed glucan at dose of 0.5 g kg^{-1}. The results of the experimental study showed that immunostimulation with a ß-glucan yeast preparation can be used to improve growth in industrial conditions.

Key words: *Aqualase Two*, feeding, salmon, ß-glucan.

Introduction

Glucan is polysaccharide found in the cell wall of fungi, bacteria and plants. Glucan has multiple effects in animals when administered intramuscular, intravenous, intraabdominal and per rectum (Dalmo, Seljelid 1995; Fuente et al. 1998; Krakowski et al. 1999; Waller, Colditz 1999).

Some studies have shown that intraperitoneal injection of a ß-1,3 and ß-1,6 linked glucan from cell walls of the yeast *Saccharomyces cerevisiae* into Atlantic salmon resulted in increased resistance to several bacterial pathogens and decreased fish mortality (Dalmo, Seljelid 1995). Intraperitoneal injection of glucan increased the resistance of trout (Jorgensen et al. 1993). Intravenous injection of a yeast glucan into mice increased the host antibacterial defense (Kokoshis et al. 1978), but resulted in no gain in weight in penaeid shrimps (*Penaeus vannamei*) on the glucan diet and decreased the host antibacterial defense (Scholz et al. 1999).

Growth efficiency (growth as a percentage of body weight per day) changes with temperature and dietary intake. As both temperature and food amount decrease, the growth efficiency also decreases (Brett 1970).

Healthy fish are more resistant to changes in living conditions and they have better gain in weight. With a change in the environment when the smolt are released in the estuaries or rivers, they do not feed for about two weeks. During that time the fat and protein levels in the body decrease. Therefore the survival of large fish is higher (Stoskopf 1993).

The present work examines the effect of *Aqualase Two* (producer Doxal Italia SpA) on growth and survival of salmon parr.

Materials and methods

The experiment was carried out in the hatchery "Tome". Experiment started in June. A total of 30 000 Baltic salmon (*Salmo salar*) males and females weighing 0.70±0.03 g were divided randomly into three groups (10 000 fish in each group). The fish were kept in 300 litre tanks, later in 800 litre tanks, and supplied with aerated fresh water. The fish were fed daily with commercial salmonid food according to the prescription of the food producer (Table 1). One group (EI) received *Aqualase Two* 0.5 g per kg^{-1} supplements to food, and a second group (EII) had *Aqualase Two* 1.0 g per kg^{-1} additions; a third group served as a control without additions.

Fish samples were placed on the ice and immediately transported to the laboratory for bacteriological analyses. For bacterial analyses smears were made from fish gills and the surface of the body and inoculated on the plates with specific agar and cytophagous medium. All plates were cultivated at +18 - +25 ºC for 24-72 h, and representative colonies were reisolated for characterization and identification according to standard bacterial methods (Bergey's Manual of Systematic Bacteriology, 1980).

Mortality was estimated daily. Monthly mortality was calculated as a proportion between a number of dead fish and a number of alive fish at the start of a month. Fish weight was estimated monthly.

All the data analyses were performed using the statistical methods. Standard deviation (SD) of mean length of fish was determined. The experimental groups were compared using the T-test (Arhipova et al. 1997).

Results

There were no significant differences ($P>0.05$) between the mean or range of initial body masses for the two experimental groups and control group in June (Table 2). The mass of parr was similar in the summer months. The differences began in September when the water temperature decreased. The highest growth of fish was seen at the end of November in the group EI (additions 0.5 g kg^{-1}) with a mean mass of 20.4±8.6 g. The mass of the fish from groups EII and K in that time were 16.8±8.0 and 15.0±8.3 g, respectively (Table 2). There was no gain in mass of parr in the winter months. The rate of growth increased at the end of February in all groups, but the differences in mass were maintained. There

Table 1. Diet of fish depending on lengths and mass

Food type	Fish length (cm)	Fish mass (g)	Size of pellets (mm)
Aller-Aqua SGP-493	2.0-3.0	0.1-0.3	0
Aller-Aqua SGP-493	3.0-4.3	0.3-0.5	1
Aller-Aqua SGP-493	4.3-7.0	0.5-3.0	2
Aller-Aqua SGP-493	7.0-9.0	3.0-8.0	3
Aller-Aqua SGP-493	9.0-11.0	8.0-15.0	4
Safir	> 10	> 13	5

Table 2. Mass of salmon parr in the experimental groups (mean ± SD)

Date	Experimental groups		
	E I	E II	K
June 1	0.7±0.0	0.7±0.0	0.7±0.0
July 1	1.6±0.5	1.3±0.5	1.2±0.5
August 1	2.9±1.8	2.4±1.7	2.0±1.7
September 1	6.9±3.9	5.6±4.0	5.9±3.0
October 1	11.4±5.3	10.0±5.0	8.5±5.0
November 1	20.3±8.0	16.7±7.5	14.8±7.7
December 1	20.4±8.6	16.8±8.0	15.0±8.3
January 1	20.4±10.0	16.2±8.9	15.1±9.1
February 1	21.2±12.0	17.0±10.6	15.1± 9.8
March 1	22.9±12.0	18.5±11.9	15.9±11.0
April 1	26.3±13.3	21.6±13.2	19.3±13.1
May 1	29.5±13.7	26.9±13.0	24.6±13.2

were significant differences (P=0.000) between body mass for the two experimental groups and the control group in spring.

Fish from each experimental group were divided in to three groups by mass. There were 45 % of fish with a mean mass of 20.0±2.0 g in group EI (Fig. 1), compared with 39 % and 34 % in group EII and K, respectively. The proportion of the group of fish with a medium mass (14.0±4.0 g) in the group EI was 39 %, in group EII – 25 %, in control (K) group – 30 %. The proportion of small fish with a mean mass at 10.0±3.0 g in EI was 16 %, and in groups EII and K – 36 %.

At the smoltification time in group EI there were 97 % smolt, compared to 90 % and 87 % in groups EII and K, respectively (Fig. 2).

There were significant differences in mortality between the EI and K group (P=0.035), but no significant differences between the EII and K group (P=0.796) (Fig. 3). Mortality increased in summer and decreased in autumn. Salmon mortality slightly increased in June, sharply increased in July and achieved in groups EI, EII, and K 16 %, 21 % and

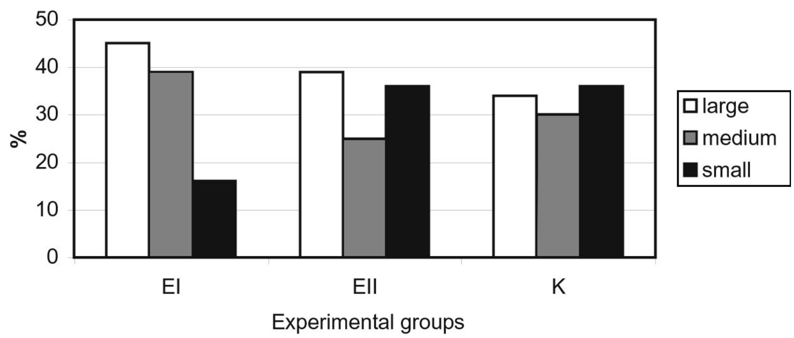

Fig. 1. Mass distribution of fish. Large, fish average mass 20.0±2.0 g; medium, fish with average mass 14.0±4.0 g; small, fish with mass less than 10.0 g.

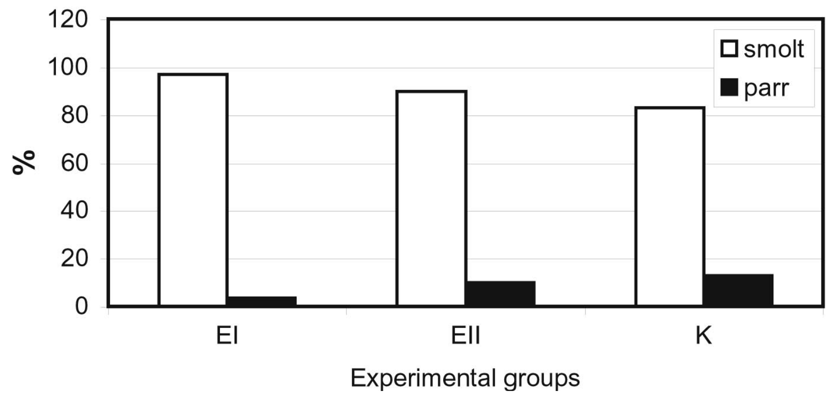

Fig. 2. Relative numbers (%) of smolt and parr in experimental groups in May.

20 %, respectively. Mortality decreased from the beginning of August. In June there was a lower mortality in the group EII – 2 %, in July in the group EI – 17 %. The highest mortality in the summer was in the group K (9 % in June, 19 % in July, 6 % in August; Fig. 3). The highest overall survival of salmon smolt was in group EI. The winter mortality in other groups was similar, due to the beneficial effect of cold water. The highest survival of fish was in the group where 0.5 g yeast glucan per kg of food was added.

Clinical examination showed signs of myxobacteriosis in some fish in every pond. Bacteriological examination confirmed the diagnosis of myxobacteriosis and *Flexibacter* spp. bacteria was isolated.

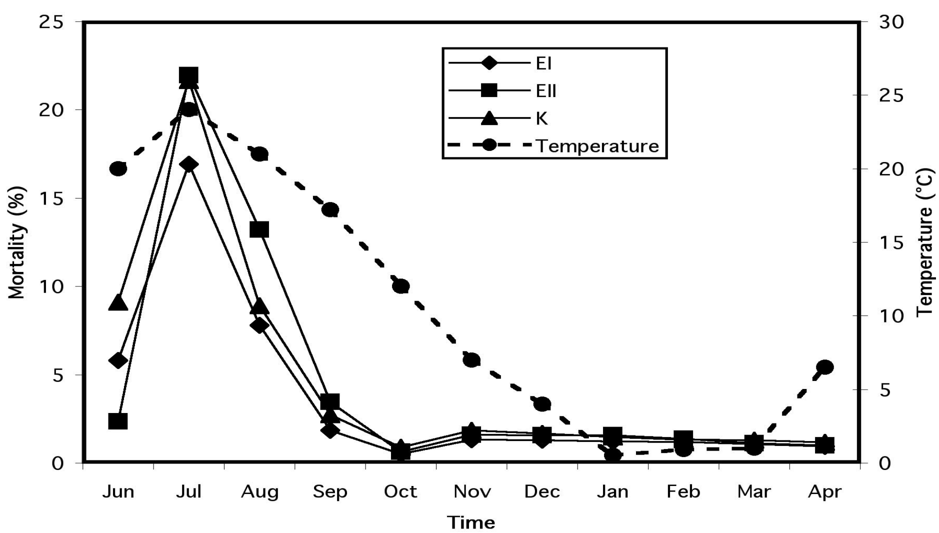

Fig. 3. Fish mortality in experimental groups and water temperature. EI, group with *Aqualase Two* 0.5 g kg^{-1}; EII, group with *Aqualase Two* 1 g kg^{-1}; K, control group. There were significant differences between the EI and K groups in July - September (P=0.035), but no significant differences between the EII and K group (P=0.796).

Discussion

Sockeye juveniles in fresh water have nearly the same growth efficiency on 3 % of a body mass diet at 5 °C as they have on a 6 % diet at 15 °C (Brett 1970). In our experiment, the rate of growth increased in September, decreased from December to February, and then increased again. Previous investigations have shown that there was no gain in mass in shrimps fed a glucan diet (Scholz et al. 1999). We found significant differences between body mass for the two experimental groups and the control group in spring in our experiment.

In the experiments with crayfish, glucan did not promote mass gain and immunity (Scholz et al. 1999). *Aqualase Two* treatment of salmon in summer months resulted in a rapid gain of mass in autumn when the water temperature approached the salmon comfort level. The obtained difference of gain of mass remained for the whole winter period.

Treatment of salmon with glucan per os decreased the mortality after infection with *Aeromonas salmonicida* by 10 % (Dalmo, Seljelid 1995). The mortality decreased by about 20 % when glucan was injected compared within the control group. In contrast, the resistance of shrimps fed with glucan diet decreased (Scholz et al. 1999). In our investigation when 0.5 g *Aqualase Two* per kg of food was added to the diet, mortality was about 19.7 % lower than in the control group. When 1 g *Aqualase Two* per kg of food was added, mortality was about 2.3 % lower than in the control group.

In conclusion, the results of our study showed that immunostimulation with a ß-glucan yeast preparation in a form of *Aqualase Two* can be used to improve growth in industrial conditions

Acknowledgements

We have express great thanks to the collective of the fish farm "Tome" for assistance and help in our work.

References

Arhipova J., Ramute L., Žuka L. 1997. Matemātiskās statistikas uzdevumu risināšana ar MS Excell. 1. daļa. LLU, Jelgava.

Brett J.R. 1971. Energetic responses of salmon to temperature. A study of some thermal relations in the physiology and freshwater ecology of sockeye salmon (*Oncohynchus nerka*). *Am. Zool.* 11: 99–113

Dalmo R. A., Seljelid R. 1995. The immunomodulatory effect of LPS, laminaran and sulphated laminaran [ß(1.3)-D-glucan] on atlantic salmon, *Salmo salar* L., macrophages in vitro. *J. Fish Diseas.* 18: 175–185.

Fuente J. M., Deayala P.P., Flores, A., Villamide M.J. 1998. Effect of storage time and dietary enzyme on the metabolizable energy and digesta viscosity of barley-based diets for poultry. *Poult. Sci.* 77: 90–97.

Krakowski L., Krzyzanowski J., Wrona Z., Siwicki A.K. 1999. The effect of nonspecific immunostimulation of pregnant mares with 1,2/1,6 glucan and levamisole on the immunoglobulins levels in colostrum, selected indexes of nonspecific cellular and humoral immunity in foals in neonatal and postnatal period. *Vet. Immunol. Immunopathol.* 68: 1–11.

Scholz U., Diaz G.G., Ricque D., Suarez L.E.C., Albores F.V., Latchfold J. 1999. Enhancement of vibriosis resistence in juvenile penaeus-vannamei by supplementation of diets with different

yeast products. *Aquaculture* 176: 271–283.
Stoskopf M.K. 1993. Fish medicine. In: *Fish Medicine*. Anderson D.P., Gratzek J.B (eds.). WB Saunders Company, London, p. 883.
Waller K.P., Colditz I.G. 1999. Effect of Intramammary infusion of ß-1.3-glucan or interleucin-2 on leucocite subpopulations in mammary-glands of sheep. *Am. Vet. Res.* 60: 703–707.

Laša mazuļu audzēšanas efektivitātes paaugstināšana, izmantojot barības piedevu *Aqualase Two*

Ruta Medne*, Inese Savicka

Latvijas Zivsaimniecības pētniecības institūts, Daugavgrīvas iela 8, Rīga, LV 1007, Latvija
*Korespondējošais autors, E-pasts: medne@latfri.lv

Kopsavilkums

Valsts zivjaudzētavā "Tome" un Latvijas Zivsaimniecības pētniecības institūta Akvakultūras laboratorijā tika pētīta ar rauga β-glukānu bagātinātās barības piedevas *Aqualase Two* ietekme uz Baltijas laša (*Salmo salar*) mazuļu augšanu un attīstību. Eksperimentā izmantoti 30 000 laša mazuļu no kāpura līdz smolta stadijai. Laša mazuļiem trīs mēnešus (no 1. jūnija līdz 31. augustam) tika izēdināta barības piedeva *Aqualase Two*, aprēķinot divas dažādas devas: 0,5 un 1,0 g uz vienu kilogramu barības. Zivju veselības stāvoklis tika kontrolēts visā to audzēšanas periodā. Mūsu pētījumi parāda, ka izmēģinātais preparāts mazina zivju mirstību tā izbarošanas laikā, bet augšanas tempu paātrina rudenī. Kopumā, salīdzinot eksperimenta un kontroles grupas lašus, vislabākie rezultāti iegūti zivju grupā, kurai barībā ir pievienota piedeva *Aqualase Two* 0,5 g uz kg barības. Šīs grupas zivīm ir viszemākā mirstība, lielākais svara pieaugums un viengadnieku-smoltu iznākums. Eksperimenta rezultāti ļauj ieteikt barības piedevas *Aqualase Two* izmantošanu laša mazuļu audzēšanai rūpnieciskos apstākļos.