

## EFFECT OF ASCOGEN PROBIOTICS SUPPLEMENTATION ON FARMING SUCCESS IN RAINBOW TROUT (*ONCORHYNCHUS MYKISS*) AND WELS (*SILURUS GLANIS*) UNDER CONDITIONS OF INTENSIVE CULTURE

### UTJECAJ DODATKA PROBIOTIKA ASCOGEN U HRANU ZA PASTRVE (*ONCORHYNCHUS MYKISS*) I SOMA (*SILURUS GLANIS*) U INTENZIVNIM UVJETIMA UZGOJA

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#### SUMMARY

ASCOGEN (Chemoforma Augst, Switzerland) is known to be a suitable growth promoting and health condition supporting agents in Farm warm-blooded animals. The experiments which were performed with this preparation in fish farming have brought very promising results as well.

In intensive culture of rainbow trout (*Oncorhynchus mykiss*), the addition of 0,62 and 2,5 g of ASCOGEN per kg of pelleted feed mixture resulted in enhanced individual increment of experimental fish (by 8,9 and 10,5% respectively) and specific growth rate (by 9,0 and 13,0% respectively). Simultaneously, protein content in the flesh of fish fed with ASCOGEN supplemented feeds was higher (by 11,2 and 12,1% respectively), but fat content was reduced by 42,9 and 45,8% respectively in comparison with control fish fed with commercial diet without ASCOGEN. However it must be pointed out that the level of 5 g ASCOGEN per kg of feed mixture did not bring positive results and parameters of fish investigated were similar to the control ones or even worse.

In wels (*Silurus glanis*) culture in silos, the addition of 5 g/kg led to lower feeding quotient by 27,9% and increased specific rate by 15,4%.

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## INTRODUCTION

Aquaculture (particularly in sense of fish farming) is a rapidly developing important branch of animal husbandry. Many fish species have been proved to be fully suitable for the purposes of intensive farming since the steadily rising demand for fish flesh cannot be met any longer by exploitation of natural resources. Today, much effort has been made to increase the proportion of fish produced by intensive culture based exclusively on feeding with artificial feed mixtures since quality feeds are generally considered to be a very important part of the total costs. The requests on appropriate formulation of feeds and good growth efficiency are naturally of special importance from these reasons.

Probiotics as a growth performance factor are going to be widely applied in animal nutrition. Many data are available on their use in poultry, pig, cattle and sheep husbandry. Some positive results indicating their applicability in intensive farming have been reached also in fish culture. The application of probiotics Lactiferm and its results in experimental rearing of carp (*Cyprinus carpio*) and tench (*Tinca tinca*) were presented by Párová et al. (1987), in elvers (*Anguilla anguilla*) fattening by Párová and Pár (1986) and Peňáz et al. (1988), and in European catfish (*Silurus glanis*) fattening by Hamáčková et al. (1992). The promoting effect of Lactiferm was demonstrated by decreased mortality and higher growth intensity in these trials.

This experiment was aimed at testing of ASCOGEN (Chemoforma Ltd., Augst, Switzerland) as a growth performance factor in rainbow trout (*Oncorhynchus mykiss*) and wels catfish (*Silurus glanis*) fattening. ASCOGEN consists of biologically active complex of metabolites of nucleotid metabolism (NSM-complex). Pyrimidins are the most important item among them. ASCOGEN is completed by some inter-products like organic acids of citric and aspart acid cycle, vitamins and trace elements. Thermolysed dried yeast serves as a carrier of this complex.

The effect of ASCOGEN supplementation of feed mixtures was investigated already in late seventies by Durant and Cho (1979) using splake (*Salvelinus namaycush* x *Salvelinus fontinalis*) as a model fish. Ramadan et al. (1990/91a, b) studied the effect of ASCOGEN on growth and immune response in monosex tilapia (*Oreochromis niloticus*

x *Oreochromis aureus*) population. Adámek (1994) tested the effect of ASCOGEN supplementation growth performance of goldfish (*Carassius auratus*).

Rainbow trout and wels catfish were selected for our experimental purposes. These fish are widely farmed over the whole world and can be kept from eggs to adult under conditions of intensive farming, and are readily available and requested to buy. They are able to prosper in intensive aquaculture, which many other fish farm species do not, and their flesh has a delicate flavour which is widely appreciated. They are tolerant of high density stocking and take artificial feeds.

## MATERIAL AND METHODS

### Rainbow trout

ASCOGEN was added to original rainbow trout feed Kliba Forellenfutter 23/353 (Klingenthalmühle AG, Kaiseraugst, Switzerland) in following dosage levels:

0,00 g/kg - Control group

0,62 g/kg - 0,62A group

2,50 g/kg - 2,5A group

5,00 g/kg - 5A group.

Declared and assessed feed composition is given in Tab. 1. Pallets of diameter 4,5 mm were applied both to experimental and control groups of fish daily by automatic feeders continuously from 8 a.m. till 6 p.m. The daily feed ration amounted about 1,0% of total fish biomass.

Table 1: Nutrient content in Kliba Forellenfutter 23/363 (in%)

Tablica 1: Hranidbeni sastojci u Kliba hrani za pastreve 23/363 (u%)

Parameters - Pokazatelji	D	A
Protein - Bjelančevine	50-52	47.3
Fat - Mast	10-12	9.4
Ash - Pepeo	-	9.5
Fibre - Vlakhina	0.6-1	-
Dry matter - Suha tvar	-	92.98

Note: D - declared composition      D - deklarirani sastav  
A - assessed proportion            A - utvrđeni omjer

The experiments were performed in fibre-glass tanks (3,00x0,90x0,60 m) in trout farm at Herbetswil (Fontänfisch AG, Switzerland). Water level was maintained at height 0,32 cm, i.e. the volume of each tank amounted 0,86 m<sup>3</sup>. Water flow-through was arranged to maintain the water exchange in each tank every 1,5 hour. No additional aeration was applied.

Mean basic chemical parameters of inflow and outflow water are presented in Tab. 2. Due to the underground source of inflow water, its both chemical composition and temperature were very stable. Water temperature (average 9,4 °C) fluctuated from 9,3 - 9,6 °C.

Table 2: Chemical composition of inflow and outflow water in trout culture (mean values)

Tablica 2: Kemijski sastav ulazne i izlazne vode u uzgoju pastrva (srednje vrijednosti)

Determinant - Pokazatelji	Unit - Jedinice	Inflow - Ulazna Voda	Outflow - Izlazna Voda
O <sub>2</sub>	mg/l	7.84	6.67
pH		7.5	7.5
Alkalinity - Alkalitet	mval/l	4.20	4.30
Hardness - Tvrdća	mval/l	12.18	12.18
B.O.D.5	mgO <sub>2</sub> /l	1.0	2.0
C.O.D. Mn	mgO <sub>2</sub> /l	0.7	2.6
NH <sub>4</sub> - N	mg/l'	0	0.19
NO <sub>2</sub> - N	mg/l	0.001	0.002
NO <sub>3</sub> - N	mg/l	1.0	1.2
PO <sub>4</sub> - P	mg/l	0.009	0.014
Total P	mg/l	0.011	0.031

Experimental fish originated from trout farm Skalni Mlyn (Czech Republic) where they were cultured under temperature conditions comparable with the experimental ones. The experimental tanks were stocked (Tab. 3) immediately after the

transport. Feeding experiments were initiated on 15 Feb 1993 after two-week adaptation of fish on experimental conditions and were finished after 37 days on 24 March 1993.

Table 3: Stocking characteristics of individual experimental and control groups of rainbow trout

Tablica 3: Nasadne karakteristike kontrolne i pokusnih skupina pastrva

	Number of fish Broj riba	Total weight (g) Ukupna masa (g)	Av. ind. weight (g) Srednja ind. masa(g)	Stocking biomass (g/l) Nasadna biomasa g/l
Control	122	20.700	169.7	24.1
0.62A	124	20.800	167.7	24.2
2.5A	123	20.100	163.4	23.4
5A	125	20.900	167.2	24.3

The parameters evaluated included survival rate S.R. (in %) individual increment I.I. (in g) during growing period, feeding quotient F.Q. (in kg of feed per kg of mass gain) and specific growth rate S.G.R. (in% per day). Final evaluation included also biochemical composition and taste of fish flesh.

### Wels catfish

In feeding experiments with wels, the same feed carrier (Kliba) were employed but ASCOGEN was supplemented just in one proportion - 0,5% (5A). Both of variants, i.e. control and experimental groups, were duplicated.

Feeding tests with wels were carried out in fibre-glass silos (150 l). Silos were introduced into recirculating system with biological treatment of water employing submersed filters. The water flow-

through maintained the exchange of the whole content within one hour. Aeration of tanks was provided by compressed air and ceramic diffusers.

Four silos were used for the experiment. They were stocked by 34 fish of the average weight of 99,1 g what represents 3,370 g per silo (i.e. 22,5 g per litre).

Daily feed ration of 2,0% of actual (or expected) total fish biomass were given to individual stocks. When counting the daily feed ration the coefficient of conversion of 1,3 was accepted. The daily feed ration was divided into 7 approximately equal doses given to fish at 7, 9, 11 a.m., and 1, 3, 6, and 8 p.m.

The water temperature ranged between 22 and 25°C during the experimental culture. Actual temperatures were measured 7 times a day. Physico-chemical determinants of the experint are presented in Tabs. 4-6.

Tablica 4. Physico-chemical parameters of inflow water (mean, minimum and maximum values) in wels culture

Tablica 4: Fizikalno-kemijski pokazatelji ulazne vode (srednje, minimalne i maksimalne vrijednosti) u uzgoju soma

Parameter Pokazatelji	1st period 1. razdoblje	2nd period 2. razdoblje	3rd period 3. razdoblje	4th period 4. razdoblje
pH	7.23 (7.2-7.3)	72.3 (7.2-7.3)	7.23 (7.1-7.3)	7.10
alkalinity - alkalitet mmol. l <sup>-1</sup>	1.26 (1.13-1.39)	1.31 (1.19-1.49)	1.29 (0.98-1.55)	0.93
acidity - kiselost mmol. l <sup>-1</sup>	0.15	0.12 (0.05-0.15)	0.15	0.15
C.O.D. non-filtered	11.30 (10.3-12.3)	12.73 (11.0-13.7)	12.53 (11.4-14.7)	9.90
NH <sub>4</sub> <sup>+</sup> -N mg. l <sup>-1</sup>	1.22 (0.19-2.25)	3.63 (2.74-4.63)	2.89 (1.22-5.06)	0.41
NO <sub>3</sub> <sup>-</sup> -N mg. l <sup>-1</sup>	4.41 (3.71-5.11)	5.90 (4.79-7.57)	3.47 (1.12-6.17)	7.50
NO <sub>2</sub> <sup>-</sup> -N mg. l <sup>-1</sup>	0.238 (0.051-0.185)	0.400 (0.230-0.485)	0.382 (0.360-0.395)	0.305
PO <sub>4</sub> <sup>3-</sup> -P mg. l <sup>-1</sup>	1.50 (1.45-1.55)	2.28 (1.12-3.43)	2.02 (1.60-2.60)	1.75

**Table 5: The content of dissolved oxygen in the inflow water (mg. l<sup>-1</sup>) in wels culture**

**Tablica 5: Sadržaj otopljenog kisika u ulaznoj vodi (mg. l<sup>-1</sup>) u uzvoju soma**

Feed Hrana	Silo Nr. Silos	1st period 1. razdoblje	2nd period 2. razdoblje	3rd period 3. razdoblje	4th period 4. razdoblje
Control	S2	6.6 (5.9-7.2)	6.6 (5.6-7.7)	5.6 (4.8-6.5)	6.1 (5.8-6.3)
	S5	6.7 (6.3-7.5)	6.2 (5.3-7.6)	4.9 (3.9-5.7)	5.3 (5.0-5.8)
5A	S3	6.1 (5.4-7.0)	5.2 (4.0-7.4)	4.2 (2.8-5.1)	4.4 (3.9-5.4)
	S6	5.7 (5.0-6.7)	4.7 (2.7-6.9)	3.3 (2.5-4.3)	5.6 (3.6-5.4)

**Table 6: Mean daily water temperatures (in °C)**

**Tablica 6: Srednje dnevne temperature vode (u °C)**

Feed - Hrana	Silo Nr. Silos	1st period 1. razdoblje (min.-max.)	2nd period 2. razdoblje (min.-max.)	3rd period ( 3. razdoblje (min.-max.)	4th period 4. razdoblje (min.-max.)	Period 1-4 (x) Razdoblje 1-4 x
Control	S2	22.8 (19.1-23.8)	22.1 (17.7-26.8)	24.6 (20.8-27.6)	23.1 (20.5-25.5)	23.14
	S5	22.5 (18.7-23.5)	22.0 (18.0-26.5)	24.7 (20.5-28.2)	23.2 (20.8-25.5)	23.19
5A	S3	22.7 (18.9-23.7)	22.1 (18.0-26.6)	24.7 (20.6-27.8)	23.0 (20.5-25.4)	23.11
	S6	22.7 (18.8-23.5)	22.3 (17.9-27.0)	24.8 (20.5-28.5)	23.8 (20.7-25.7)	23.31

Fish were cultured in silos and fed by commercial pelleted trout feed mixture Pd1 (State Fishery Prague) before stocking them into experiment at Oct 4, 1991. The feeding experiment was divided into 4 periods lasting for 16 feeding days except of the last one (7 feeding days). Fish were not fed in the day of stocking and in the day following after the last feeding day of each period. Weighing and counting of fish in individual containers were performed in these days. The average individual mass, stock weight increment, specific growth rate (S.G.R.), and feeding coefficient (F.Q.) were counted for individual containers and experimental periods. Daily feed rations for the following period of culture were computed using

own program including the percentual rate of feed ration and expected feeding coefficient on the base of measured values.

## RESULTS AND DISCUSSION

As evident from Tab. 7 and Fig. 1, survival rates of rainbow trout were slightly decreased in 2,5A but this represents usual losses under conditions of intensive farming. The mortality was probably caused by delayed stress reactions on handling and stocking, and was not connected with feed composition.

Table 7: Results of trout feeding experiment with ASCOGEN addition (S.R. - survival rate in%, I.I. - individual increment in g. F.Q. - feeding coefficient, S.G.R. - specific growth rate in% per day)

Tablica 7: Rezultati pokusne hranidbe pastrva s dodatkom ASCOGEN (S.P. preživljavanje u%, I.P. individualni prirast u g, H.K. hranidbeni koeficijent, S.B.R. specifična brzina rasta u% dnevno)

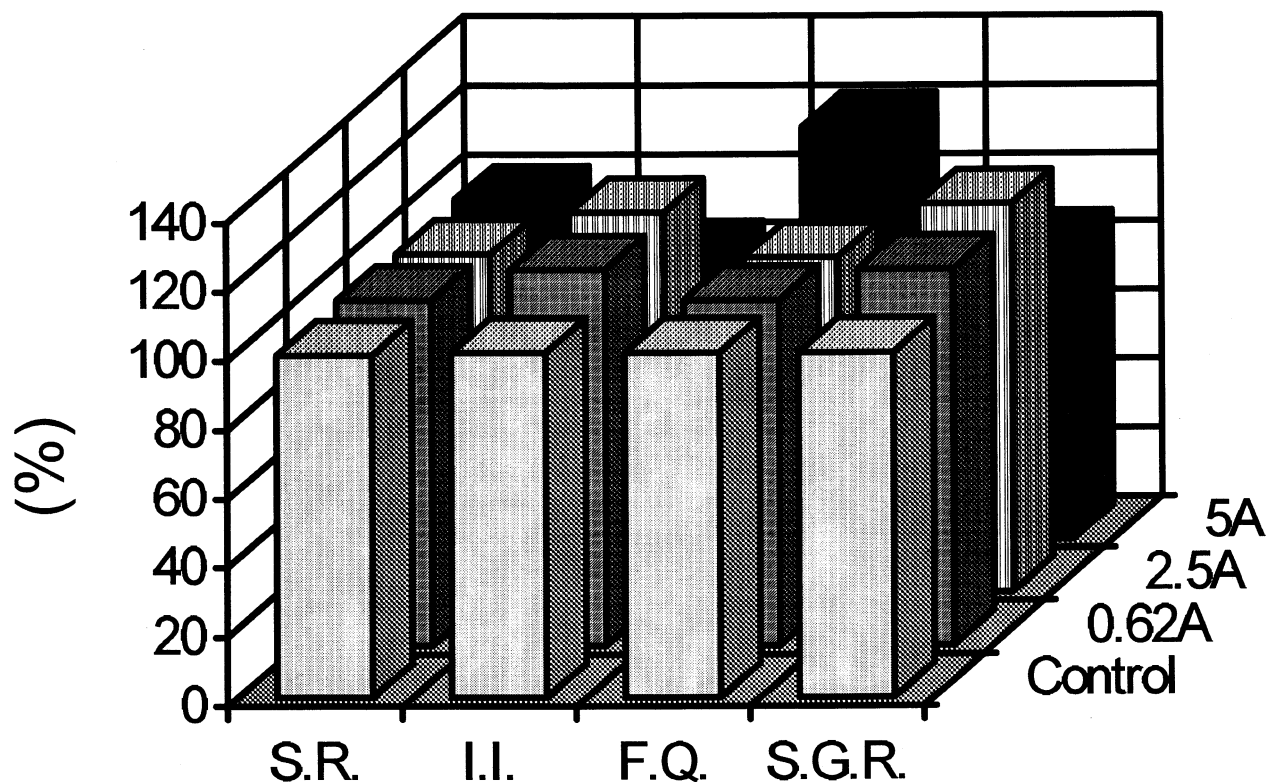
	S.R. - S.P.	I.I. - I.P.	index	F.Q. - H.K.	index	S.G.R. - S.B.R.	index
Control	99.2	42.8	100.0	1.46	100.0	0.610	100.0
0.62A	100.0	46.6	108.9	1.46	100.0	0.665	109.9
2.5A	98.4	47.3	110.5	1.42	97.3	0.689	113.0
5A	99.2	35.5	82.9	1.76	120.5	0.522	85.6

Note: Index - percentage compared with control (100.0%)

Index - postotak u usporedbi s kontrolom (100.0%)

Fig. 1: Production and growth parameters of experimental fish. For abbreviations see tab. 7

Slika 1: Proizvodni pokazatelji (preživljavanje S.R. - S.P., individualni prirast I.I. - I.P., hranidbeni koeficijent F.Q. - H.K., specifična brzina rasta S.G.R. - S.B.R.) pokusnih riba. Vezano uz tablicu 7



The initial trout stocking biomass amounted about 24 g/l. At the end of experiment, the individual increments of fish fed with ASCOGEN supplemented feeds (namely 0,62 and 2,5 g/kg) were higher by 8,9 and 10,5% than those of the control group respectively. Comparably, supplementation of 0,8 g ASCOGEN per kg feed in splake nutrition (Durant, Cho 1979) improved growth of splake by 10-15%. On the other hand, the adverse effect on weight gain (-17,1%) was proved in 5A

group with highest dosage of ASCOGEN in rainbow trout nutrition.

Similarly, best values of specific growth rate of trout were achieved in groups 2,5A and 0,62A with values higher by 13,0 and 9,0% respectively. Growth depression expressed in S.G.R. was proved in 5A group (by 14,6%).

As regards the wels culture, mean values of F.Q. and S.G.R. for the whole culture and its individual periods in individual silos are presented in Tab. 8 and 9.

**Table 8: Results of the experimental rearing in silos: increments, feed consumption (F.C.) and conversion (F.Q.) and specific growth rate (S.G.R.) in individual periods of wels culture**

**Tablica 8: Rezultati pokusnog uzgoja soma u silosima po razdobljima: prirast, utrošak hrane (U.H.), konverzija hrane (H.K.), specifična brzina rasta (S.B.R.)**

Feed Hrana	Silo Silos	Period Razdoblje	Stocked Nasad			Final results Izlov			Increment Prirast		F.C. Utrošak hrane g	F.Q. HK g.g <sup>-1</sup>	S.G.R. S.B.R. %.d <sup>-1</sup>
			ind.	Σ g	x g.ind <sup>-1</sup>	ind.	Σ g	x g.ind <sup>-1</sup>	Σ g	x g.ind <sup>-1</sup>			
Control Kontrola	S2	I.	34	3370	99.1	34	4005	117.8	635	18.68	1210	1.91	1.085
		II.	34	4005	117.8	34	4230	124.4	225	6.62	1440	6.40	0.342
		III.	34	4360	128.2	34	5130	150.9	770	22.65	1570	2.04	1.022
		IV.	34	5520	162.4	34	6020	177.1	500	14.71	809	1.62	1.246
	S5	I.	34	3370	99.1	34	3725	109.6	355	10.44	1210	3.41	0.628
		II.	34	3725	109.6	34	4480	131.8	755	22.21	1342	1.78	1.160
		III.	34	4450	130.9	34	5090	149.7	640	18.82	1602	2.50	0.843
		IV.	34	5290	155.6	34	5710	167.9	420	12.35	775	1.85	1.091
5A	S3	I.	34	3370	99.1	34	4000	117.7	630	18.53	1210	1.92	1.077
		II.	34	4000	117.7	34	4740	139.4	740	21.76	1441	1.95	1.067
		III.	34	4570	134.4	34	5900	173.5	1330	39.12	1643	1.24	1.609
		IV.	34	5925	174.3	34	6250	183.8	325	9.56	869	2.67	0.766
	S6	I.	34	3370	99.1	34	3975	116.9	605	17.79	1210	2.00	1.037
		II.	34	3975	116.9	34	4390	129.1	415	12.21	1430	3.45	0.623
		III.	34	4330	127.4	34	5220	153.5	890	26.18	1557	1.75	1.175
		IV.	33	4955	150.2	33	5390	163.3	435	13.18	749	1.72	1.209

**Table 9: Mean values of feeding coefficient (F.Q.) and specific growth rate (S.G.R.) for the whole rearing period in silos**

**Tablica 9: Srednje vrijednosti hranidbenog koeficijenta (H.K.) i specifične brzine rasta (S.B.R.) za cjelokupno uzgojno razdoblje soma u silosima**

Feed - Hrana	F.Q. (H.K.)			S.G.R. (% d <sup>-1</sup> ) (S.B.R. % dan <sup>-1</sup> )		
	1 <sup>*</sup>	2 <sup>*</sup>	Total x	1 <sup>*</sup>	2 <sup>*</sup>	Total x
Control x	2.99	2.38	2.69	0.924	0.932	0.928
s	2.28	0.76	1.60	0.399	0.243	0.306
5A x	1.95	1.93	1.94	1.130	1.011	1.071
s	0.58	1.20	0.88	0.351	0.267	0.296

\*single replication (mean from 4 periods tested)

\* jedno ponavljanje (prosjek za 4 istraživana razdoblja)

The average F.Q. of trout feed KLIBA for wels catfish during the whole rearing period amounted  $2,69 \pm 1,60$  with minimum and maximum values 1,62 and 6,4 respectively. The values of S.G.R. in fish fed by KLIBA amounted  $0,927 \pm 0,306\%$  per day with minimum and maximum values 0,342 and 1,246% per day respectively.

The addition of ASCOGEN into commercial KLIBA feed resulted in favourable effects in wels production criteria. The feeding coefficient decreased on  $1,94 \pm 0,88$  with minimum and maximum values 1,24 and 3,45 respectively and the specific growth rate (the percentual daily increment) increased on  $1,069 \pm 0,296\%$  per day with minimum and maximum values 0,623 and 1,609% per day respectively.

When evaluating the promoting effect of ASCOGEN addition into KLIBA trout feed in wels catfish it can be stated that the consumption of feed for the same weight gain was by 27,9% lower and the growth of fish by 15,3% more rapid as compared with original commercial KLIBA trout feed.

The dosage 5,0 g of ASCOGEN per kg of commercial feed supported the growth responses in other fish which had been studied previously. Ramadan et al. (1990/91a) described promoting effect of ASCOGEN supplementation on growth of tilapia in dosages of both 2 and 5 g/kg of feed but

the dependence of final effect on dosages of ASCOGEN was not of linear character but it showed the tendency to parabolic course. It seems on the base of results which had already been obtained in various fishes that the effect of probiotics supplementation differs according to individual species, families or developmental stages. Higher dosage of probiotics may result in growth depression due to disturbances of digestion in some cases (Párová pers. comm.). The dosage of 2,5 and 5 g ASCOGEN per kg of feed led to growth depression in goldfish *Carassius auratus* (Adámek 1994) alike as 5 g per kg in the case of hereby presented results of rainbow trout farming.

The biochemical investigation of trout flesh composition proved the promoting effect of ASCOGEN addition on the content of nutrient in filets of lateral white muscle (*musculus lateralis major*). Groups of fish fed with ASCOGEN supplement had lower content of fat and ash but higher proportion of protein in their flesh (Tab. 10 and Fig. 2). This fact gives evidence of intensified growth rate due to the ASCOGEN addition presented in promoted formation of growth-responding body tissues. In agreement with the above mentioned results concerning the growth effect of 5g/kg ASCOGEN dosage, the tendency of return to control group values was evident as well as in protein, fat and ash content.



Table 10: Biochemical composition of trout flesh (in% of fresh weight)

Tablica 10: Biokemijski sastav mesa pastrva (u% svježe mase)

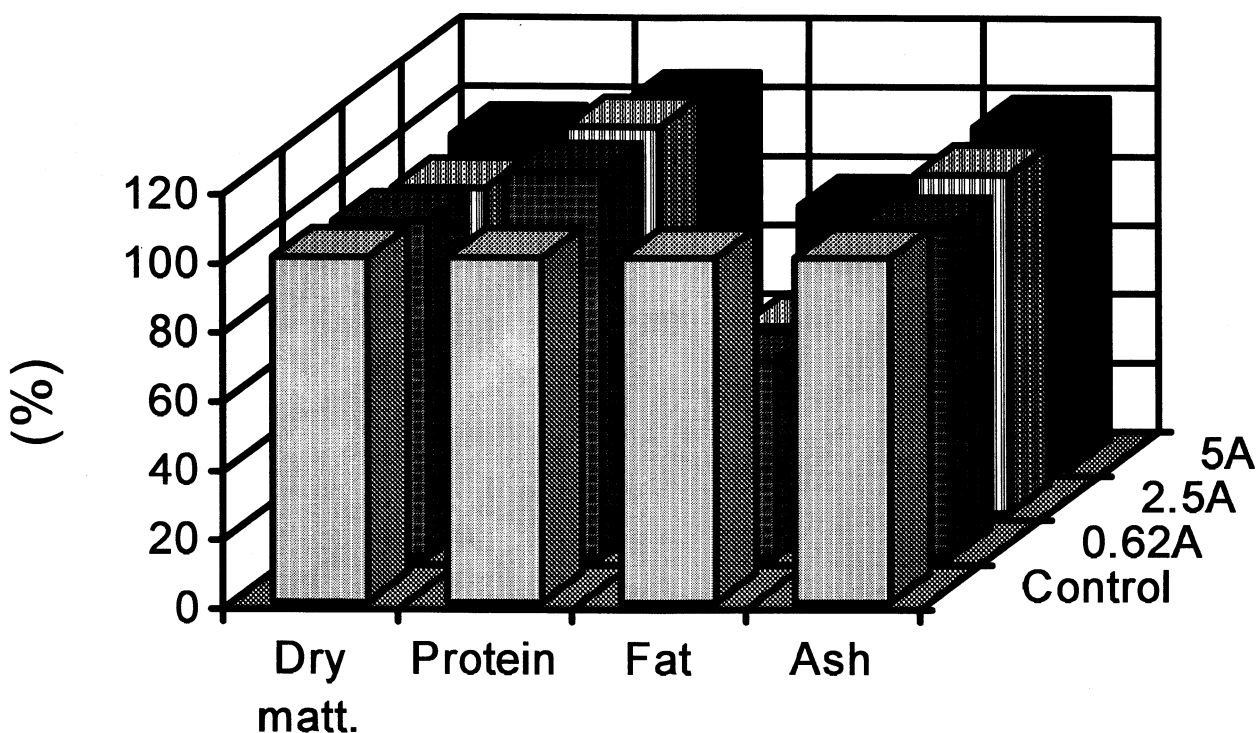
	Dry matt. Suha tvar	Index	Protein Bjelančevine	Index	Fat Mast	Index	Ash Pepeo	Index
Control	22.28	100.0	16.05	100.0	3.08	100.0	1.28	100.0
0.62A	21.69	97.4	17.94	111.8	1.76	57.1	1.23	96.1
2.5A	21.00	94.3	18.00	112.1	1.67	54.2	1.26	98.4
5A	21.54	96.7	17.07	106.4	2.35	76.3	1.27	99.2

Note: Index - percentage compared with control (100.0%)

Indeks - postotak u usporedbi s kontrolom (100.0%)

Fig. 2: Final biochemical composition of experimental fish

Slika 2: Biokemijski sastav pokusnih riba nakon završetka pokusa



Sensoric evaluation of random samples of experimental trout flesh by 6 persons did not prove any change of flavour or texture when compared

with control. The flavour of experimental fish was even considered to be better by some investigators.

## CONCLUSIONS

ASCOGEN, the yeast product with probiotical effects, was proved to be suitable for supplementation in feed mixtures for rainbow trout and wels. Its addition in dosages 0,62 and 2,5 g, and 5 g per kg feed resulted in better growth performance of rainbow trout and wels respectively under conditions of intensive farming. In trout culture, the supplementation brought an increase by 8,9-10,5% and by 9,0-13,0% in individual increments and in specific growth rate of trout respectively. When evaluating the promoting effect of ASCOGEN addition into feed in wels catfish, it can be stated that the consumption of feed for the same weight gain was by 27,9% lower and the growth of fish by 15,3% more rapid as compared with control commercial feed mixture. Rainbow trout fed with ASCOGEN supplement had lower content of fat and ash but higher proportion of protein in their flesh. No adverse sensoric effects were proved in the flesh of fish fed with ASCOGEN enriched feed.

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## SAŽETAK

Za ASCOGEN (Chemoforma Augst, Switzerland) se zna da je pogodan promotor rasta i pospješujući čimbenik za zaštitu zdravlja toplokrvnih životinja. Pokusi provedeni ovim preparatom u ribogojnoj proizvodnji dali su također pozitivne rezultate.

U intenzivnom uzgoju kalifornijskih pastrva (*Oncorhynchus mikiss*) dodatak od 0,62 i 2,5 g ASCOGENA na 1 kg peletirane hrane rezultiralo je u povećanju individualnog prirasta pokusnih riba (za 8,9% i 10,5%) i specifičnu brzinu rasta (9,0% i 13%). Istovremeno sadržaj bjelančevina u mesu riba hranjenih s dodatkom ASCOGENA je porastao za 11,2% i 12,1%, dok je sadržaj masti opao za 42,9 i 45,8% u usporedbi s kontrolnom skupinom riba hranjenih komercijalnom peletiranom hranom bez ASCOGENA. Međutim potrebno je naglasiti da razina od 5 g ASCOGENA po 1 kg peletirane krmne smjese nije dala pozitivne rezultate, a istraženi pokazatelji kod riba su bili slični ili lošiji od kontrolne skupine.

Kod soma, (*Silurus glanis*) uzgajanog u silosima dodatak od 5 g ASCOGENA po 1 kg krmne smjese rezultirao je nižim hranidbenim koeficijentom za 27,9% i povećanjem specifične brzine rasta (SBR) za 15,4%.