

## **Effect of *Angelica archangelica* L. extract on growth performance, meat quality and biochemical blood parameters of rainbow trout (*Oncorhynchus mykiss* W.), cultivated in a recirculating system**

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### **Abstract**

Koshinski, R., Velichkova, K., Sirakov, I. & Stoyanova, St. (2020). Effect of *Angelica archangelica* L. extract on growth performance, meat quality and biochemical blood parameters of rainbow trout (*Oncorhynchus mykiss* W.), cultivated in a recirculating system. *Bulg. J. Agric. Sci.*, 26 (1), 232–237

The medicinal herbs as natural products can be use like not expensive additives in artificial diets for aquatic animals which are safe for fish and the environment. The purpose of this study is to determine the effect of the *Angelica archangelica* L. extract on the growth performance, meat quality and biochemical blood parameters (glucose, urea, creatinine, total protein, albumin, ASAT, ALAT, ALP, Ca, P, Mg, *triglycerides*, *cholesterol*) of rainbow trout (*Oncorhynchus mykiss*). Thirty specimens from the rainbow trout with an average weight of  $42.55 \pm 7.48$  g (control, C) and  $42.51 \pm 6.02$  g (experimental, Ang.a.) in good health condition were placed in each tank and cultivated for 60 days. A control group (no added) and an experimental (with added  $433 \text{ mg} \cdot \text{kg}^{-1}$  of angelica extract) option, each with a two repetition, were set in a recirculating system in the Aquaculture Base of the Faculty of Agriculture at the Trakia University. At the end of the experiment were calculated average final weight, specific growth rates, feed conversion ratio, meat quality and blood biochemical parameters. The average individual weight gain of rainbow trout from the group fed with *A. archangelica* extract supplemented was  $84.61 \pm 0.06$  g which was with 15.01% higher compared to this one of control fish and the differences were statistically significant ( $P < 0.05$ ). The blood biochemical parameters glucose, urea, albumin, ALP, ASAT, cholesterol in control variant were higher compare to values of this parameter of fish from the experimental ( $P > 0.05$ ). Better growth performance and blood parameters were measured in trout fed with angelica supplement.

*Keywords:* biochemical blood parameters; *Angelica archangelica*; meat quality; rainbow trout

### **Introduction**

The rapid growth of the world's population leads to an increase in demand for fish products, and their advantage over other animal proteins is their health effect. That is why aquaculture is an important and growing part of the livestock industry (Choi et al., 2015). For the modern aquaculture are very important the quality of the feed. The nutrition plays a crucial role in immune function and disease resistance (Ali et al., 2018). Over the past decade, various dietary supplements

have been used to improving the quality of fish food (Gabor et al., 2010). Their main purpose is to raising the growth of different species, to reduce feed conversion factor and to increase survival rate (Gabor et al., 2011). Such natural products that are safe for both fish and the environment are herbal extracts. In addition, these plants and their parts have been used for centuries for human treatment. Herbs are not expensive supplements and can be used such as dried, fresh, powdered, and extracted in difference solvents (Raman, 2017). It would be very useful for aquaculture to trace the effects

of herbal extracts that lead to increased appetite, improves immunity and have anti-pathogen properties. The medicinal herbs can be optimal additives of artificial diets for aquatic animals because of their antimicrobial actions (El-Dakar et al., 2015). However, the phyto additives effect on different fish species, their productivity, growth and health is still not well researched.

*Angelica archangelica* L. is a medicinal herb and used in food and medicinal industry due to multifunctional pharmacological activities (Wiersema & León 1999). This plant has the presence of essential oil, coumarins, acids, sugar, a bitter principle, flavonoids (Nivinskiene et al., 2005). *A. archangelica* has been shown to stimulate gastric and pancreatic secretions. The roots of this plant have been used internally for digestive problems, including gastric ulcers (Sarker and Nahar, 2004). Research on coumarins have shown promising activities like anti-tumor, antifungal, neurotoxic, anticonvulsants, hepatoprotective, antiulcerogenic (Bhat et al., 2011). The purpose of this study is to determine the effect of the dandelion (*Angelica archangelica* L.) extract on the growth performance, meat quality and biochemical blood parameters (glucose, urea, creatinine, total protein, albumin, ASAT, ALAT, ALP, Ca, P, Mg, triglycerides, cholesterol) of rainbow trout (*Oncorhynchus mykiss*).

## Material and Methods

### Experimental fish and feeding

Thirty specimens from the rainbow trout with an average weight of 42.55±7.48 g (control, C) and 42.51±6.02 g (experimental, Ang. a.) in good health condition were placed in each tank and cultivated for 60 days. The concrete tanks have an effective water volume of 0.8 m<sup>3</sup>, which are part of a recirculation system. Fish from the control group (no added) and the experimental (with added of angelica extract) option, each with a two repetitions, were set in a recirculating system in the Aquaculture Base of the Faculty of Agriculture at the Trakia University. Fish were fed with 6 mm extruded pellets “Aqua UNI”, produced by “Aqua garant”. To the fish feed of trouts from the experimental group was added 433 mg.kg<sup>-1</sup> extract of angelica, as well as oiling the granules with 5 ml of sunflower oil for every 100 g of pellets. Rainbow trout from control group were fed with granules only greased with the same amount of sunflower oil. The nutrient content in the feed of the two groups is: 45% crude protein, 16% crude lipids, 2% crude fiber, 1% P, 18.5 MJ/kg ME, 10000 IU/kg Vitamin A, 1500 IU/kg Vitamin D3, 200 mg/kg Vitamin E. The daily ration that the studied fish received was 1.8% of their live weight and they were fed three times per day. The tanks were daily cleaned and excreta were si-

phoned. Light was about 12:12 h light: dark cycle throughout the day.

### Fish growth performance

The average individual weight (g) of the fish was calculated at the start, middle and end of experiment in order to study the extract of *A. archangelica* influence on the weight gain and feed conversion ratio in the rainbow trout, cultivated in recirculation system. At the end of the trial the weight gain (g), survival rate (%) and the feed conversion ratio in fish were determined.

The biometrical calculations were carried out according to the following formulas:

Specific growth rate (SGR) (Zhou et al., 2006):

$$SGR = \frac{(\ln W_f - \ln W_i)}{n} \times 100,$$

where *SGR* – specific growth rate, %; *W<sub>i</sub>* – initial weight, g; *W<sub>f</sub>* – final weight, g; *n* – number of days

Feed conversion ratio (FCR):

$$FCR = \frac{\text{Feed given}}{\text{Fish weight gain}},$$

where *FCR* – feed conversion ratio; *Feed given*, g; *Fish weight gain*, g.

### Hydrochemical parameters

The oxygen content (mg.l<sup>-1</sup>), pH, water temperature (°C) and electrical conductivity (μS.cm<sup>-1</sup>) were measured daily with a portable meter (HQ30D), accordingly with LDO, pH (liquid) and conductivity electrodes. Other water quality parameters, ammonium (mg.l<sup>-1</sup>) and phosphates (mg.l<sup>-1</sup>) were monitored on a weekly in Ecolab Agriculture Faculty.

### Chemical analyses of meat samples

The musculature samples of rainbow trout were determined on atomic absorption spectrometer (AAS) “A Analyst 800” – Perkin Elmer. Crude protein content (%) was calculated by converting the nitrogen content, quantified by Kjeldahl’s method, using an automatic Kjeldahl system (Kjeltec 8400, FOSS, Sweden). Lipid content (%) was determined by the method of Soxhlet, using an automatic system (Soxtec 2050, FOSS, Sweden). Ash content (%) was investigated by incineration in a muffle furnace (MLW, Germany) at 550°C for 8 h. Crucibles were brought about the room temperature and weighed (mg).

### Biochemical blood analyses

Blood was taken from the examined fish directly from the heart with disposable sterile plastic syringes (3 ml) with a

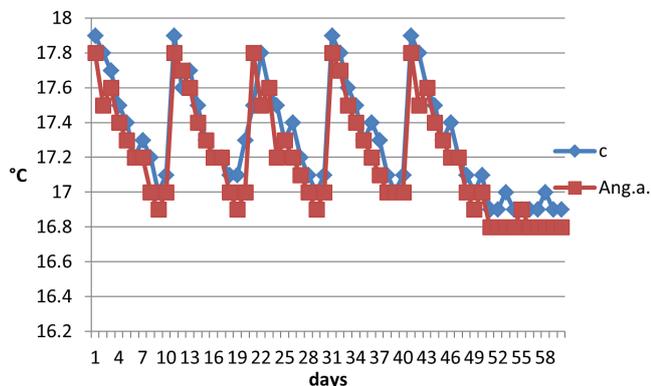
needle. As an anticoagulant Heparine sodium (1%) was used. The blood samples were instantly transmitted and analyzed in a hematological laboratory (NCPTC – Trakia University) and reported in Mindray BC – 120 hematology analyzer. Follow biochemical blood parameters were investigated: glucose ( $\text{mmol.l}^{-1}$ ), urea ( $\text{mmol.l}^{-1}$ ), creatinine ( $\mu\text{mol.l}^{-1}$ ), total protein ( $\text{g.l}^{-1}$ ), albumin ( $\text{g.l}^{-1}$ ), ASAT ( $\text{U.l}^{-1}$ ), ALAT ( $\text{U.l}^{-1}$ ), Ca ( $\text{mmol.l}^{-1}$ ), P ( $\text{mmol.l}^{-1}$ ), Mg ( $\text{mmol.l}^{-1}$ ), *triglycerides* ( $\text{mmol.l}^{-1}$ ) and *cholesterol* ( $\text{mmol.l}^{-1}$ ).

### Statistical analysis

The data received from the trial were statistically analysed with ANOVA single factor (MS Office, 2010).

## Results and Discussion

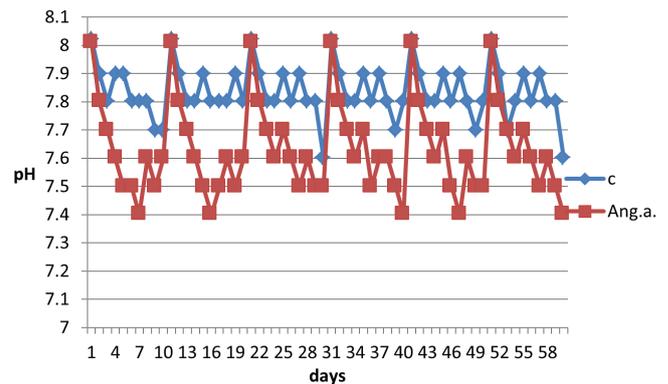
One of the important indicators for the optimal development of the cultivated fish species is a water temperature. In our trial it was  $16.7\text{--}17.9^\circ\text{C}$  in control and experimental tanks which were within the optimum values for trout farming (Figure 1).



**Fig. 1. Water temperature in control and experimental tanks**

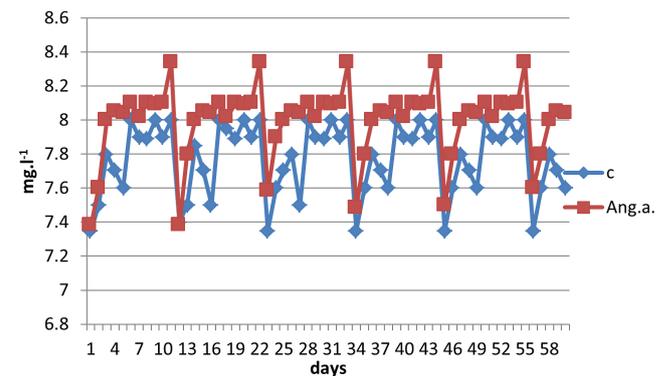
During the trial a water pH values in the recirculation system varied between 8.02 and 7.4 which were slightly alkaline (Figure 2).

The dissolved oxygen ranged between  $7.35\text{ mg.l}^{-1}$  and  $8.34\text{ mg.l}^{-1}$  in the recirculating system using for the experiment (Figure 3). The values of this parameter during the trial period were higher with 3.85% in the experimental tanks comparison to these of the controlled. These differences in the values of dissolved oxygen in water of both variants could be a result of better digestibility and assimilation of feed from trouts of the experimental group, leading to a decreased level of metabolites in the experimental tanks.

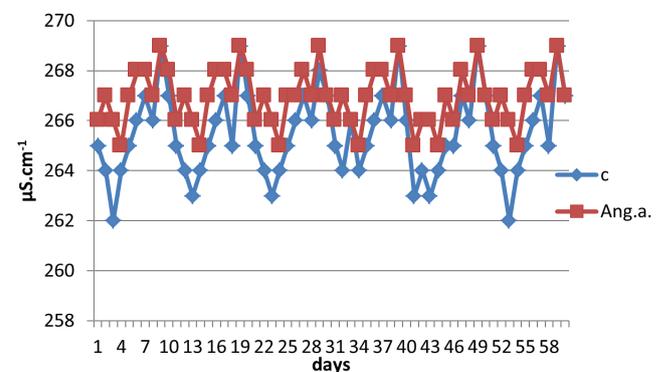


**Fig. 2. Water pH in control and experimental tanks**

Electric conductivity of water in the recirculating system varied from  $262\ \mu\text{S.cm}^{-1}$  to  $269\ \mu\text{S.cm}^{-1}$  (Figure 4). The conductivity values of experimental variant were with 1.13% higher compared to these one of the control. The received hydrochemical data were optimum for the farmed species during the experiment. Three times per



**Fig. 3. Dissolved oxygen in control and experimental tanks**



**Fig. 4. Electric conductivity in control and experimental tanks**

day were cleaned tanks and the addition of fresh water in an amount of 10% of the total recirculation system volume was added.

The mechanical filter and the biofilter were of major significance to maintain the optimum water chemical parameters during the experiment. This led to good results concerning survival, weight gain and feed conversion ratio in experimental fish. Ammonium concentration was with 10.5% lower in the water of the control variant compare to experimental for 60 days period, but the differences was not statistically proven ( $P > 0.05$ ). Phosphorus was with 39.5% lower in control variant compared to variant with angelica extract for the same period, but again the differences was not statistically proven ( $P > 0.05$ ) (Table 1).

**Table 1. Ammonium and phosphorus concentration in control and experimental tanks**

Parameters/Group	n	NH <sub>4</sub> <sup>+</sup> mg.l <sup>-1</sup>	P-PO <sub>4</sub> - mg.l <sup>-1</sup>
C	8	0.85±0.49	0.55±0.31
Ang.a.	8	0.95±0.52	0.91±0.4

#### Growth performance and feed utilization efficiency

The results of the growth performance of cultivated trout in both variants are presented in Table 2.

Survival rate during the experiment showed 100% in fish in experimental and control group. The average initial live weight of rainbow trout from control and experimental variants was respectively 42.55±7.48 g and 42.51±6.02 g and the differences were not statistically significant ( $P > 0.05$ ) (Table 2).

By the end of the experiment was received average live weight of fish, fed with angelica extract supplemented 127.13±16.08 g. It was with 9.97% higher compared to the value of the same parameter of control trouts and the differences was statistically proven ( $P < 0.001$ ) (Table 2).

The average individual weight gain of rainbow trout from the group fed with *A. archangelica* extract supplemented was 84.61±0.06g which was with 15.01% higher

**Table 2. Growth performance of rainbow trout in control and experimental tanks**

Parameter	n	C	Ang.a.
		$\bar{x} \pm SD$	$\bar{x} \pm SD$
Initial body weight, g	30	42.55±7.48	42.51±6.02
Final body weight, g	30	114.46±17.03***	127.13±16.08***
Survival rate, %		100	100
SGR % per day		1.64±0.003*	1.82±0.05*
Average individual weight gain, g	30	71.91±0.02*	84.61±0.06*
FCR		1.46	1.24

\* $P < 0.05$ , \*\*\* $P < 0.001$

compared to this one of control fish and the differences were statistically significant ( $P < 0.05$ ) (Table 2).

The analysis of consumed extruded pellets at the end of the trial showed that feed conversion ratio of the trout in the experimental group was 1.24 and it was 15.06% lower than this one in control fish (Table 2). The growth parameters of rainbow trout were higher in the group fed with *A. archangelica* extract supplemented.

#### Biochemical blood parameters

In the present study, the glucose level was 20.63% lower in rainbow trout from control group, but the differences was not statistically proven ( $P > 0.05$ ) (Table 3).

**Table 3. Biochemical blood parameters of rainbow trout in control and experimental groups**

Blood parameters	n	C $\bar{x} \pm SD$	Ang. a. $\bar{x} \pm SD$
Glu mmol.l <sup>-1</sup>	6	4.70±0.61	3.73±2.91
Urea mmol.l <sup>-1</sup>	6	1.17±0.95	1.03±0.72
Crea μmol.l <sup>-1</sup>	6	10.00±1.10	17.67±9.60
TP g.l <sup>-1</sup>	6	45.47±4.21	32.77±25.57
Alb g.l <sup>-1</sup>	6	22.50±2.83	15.37±12.66
ASAT U.l <sup>-1</sup>	6	153.33±147.41	60.00±45.57
ALAT U.l <sup>-1</sup>	6	12.33±1.70	35.33±21.38
ALP U.l <sup>-1</sup>	6	41.67±6.26	175.67±29.37
Ca mmol.l <sup>-1</sup>	6	1.94±1.16	3.82±1.93
P mmol.l <sup>-1</sup>	6	6.98±0.64	5.65±4.76
Mg mmol.l <sup>-1</sup>	6	0.94±0.20	0.90±0.28
TG mmol.l <sup>-1</sup>	6	0.98±0.84	1.17±0.60
CHOL mmol.l <sup>-1</sup>	6	4.27±0.72	2.93±1.13

The urea level was 11.96% higher for control fish compare to these ones from the experimental variant, but with not statistically significant differences ( $P > 0.05$ ). The creatinine level was 43.4% higher in versus fed with *A. archangelica* extract supplement compare to control group ( $P > 0.05$ ). The level of the total protein was higher

by 27.93% in the rainbow trout fed with the supplement compared to control, although this difference did not reach statistical significance ( $P > 0.05$ ). Albumin transports hormones, vitamins, and substances like calcium throughout the body. Also keeps fluid from leaking out of blood vessels and nourishes tissues. The amount of albumin and ASAT in the blood of experimental fish is lower respectively with 31.68% and 60.86% compare to control group. ALAT and ALP values are higher with 65.1% and 76.27% respectively in blood of trouts from the experimental group compare to control variant but the differences was not statistically proven ( $P > 0.05$ ). Cholesterol and triglyceride levels of fish may be affected by pollution agents (Yang & Chen, 2003). The triglyceride concentrations in serum of control fish were lower with 16.23% than in rainbow trout fed with supplement but the differences was not statistically proven ( $P > 0.05$ ). According to Modaresi & Khosravian (2011) an extract of *A. archangelica* have a positive effective on the blood parameters in mice. In this study the measured cholesterol in fish blood are higher with 31.38% in control variant compare to the angelica extract supplement experimental group, but with not statistically significant differences ( $P > 0.05$ ). The change in blood electrolytes may bring disturbances in the normal vital physiological functions of the fish and its growth rate (Prasad et al., 2011). Calcium is contained in the bones in combines with phosphorus under the form of calcium phosphate. In this study the blood calcium in experimental group is higher with 49.21% compare to control variant, while phosphorus and magnesium of rainbow trouts in control variant are higher than the experimental variant, but they are not statistically proven ( $P > 0.05$ ).

#### Chemical analyses of meat samples

The analysis of the data, concerning the chemical composition of the meat of the rainbow trout (Table 4), cultivated in recirculation system showed that the dietary angelica supplementation in amount of 433 mg.kg<sup>-1</sup>

**Table 4. Chemical composition of the fillets of the rainbow trout (*O. mykiss*) in control and experimental groups (%)**

Indicator/ Groups	n	C $\bar{x} \pm SD$	Ang. a. $\bar{x} \pm SD$
Moisture	6	74.65±0.51	76.20±0.09**
Dry matter	6	25.36±0.51	23.81±0.06**
Grude protein	6	19.90±0.16	19.23±0.14***
Fat	6	3.89±0.48	3.26±0.19
Ash	6	1.57±0.03	1.32±0.02

\*\* $P < 0.01$ , \*\*\* $P < 0.001$

increased significantly the moisture and decreased with 6.11% the dry matter content of the fillets compare to control group ( $P < 0.01$ ). At the end of the trial was received with 3.36% higher protein in the fillets from control variant compare to experimental fish fed with *A. archangelica* extract and the differences was statistically significant ( $P < 0.001$ ). The fat concentrations in fillets of rainbow trout fed with supplement were lower with 16.19% compared to control fish, but the differences was not statistically proven ( $P > 0.05$ ).

#### Conclusion

Better growth performance and blood parameters were measured in rainbow trout fed with *A. archangelica* supplement. The additive of angelica in the feed of trouts has negatively effect on the meat quality, because increase the moisture and decrease a protein level.

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