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Opportunities to improve health and production performances of trout fed Salt cedar (*Tamarix ramosissima*) and Dog rose (*Rosa canina*) phytoadditive supplements

[1]Liviu Todoran, [2]Ioan Bud

[1] S.C. Aquaserv Company Corp., Targu Mures, Romania; [2] University of Agricultural Sciences and Veterinary Medicine, Cluj-Napoca, Romania. Corresponding author: L. Todoran, todoran.liviu.nicu@gmail.com

Abstract. Considering the benefits of phytoadditives in livestock production, they are increasingly being used, opening new favorable perspectives in efficiency of farm growth species. Given the diversity and relatively safe effects of the impact (side effects) that it had phytoadditives on production increase, improving products quality and increasing resistance to disease or to reduce losses, their usage seems to be a growing and a suitable for several species, including those from aquaculture. Given this situation, this paper presents the results obtained from research that focused on analyzing the impact of two phytoadditives, Salt cedar (*Tamarix ramosissima*) and Dog rose (*Rosa canina*) respectively, on growth performance and stock losses (mortality). Studies was conducted on a stock consisting of 800 Brook trout (*Salvelinus fontinalis*) individuals, during six months (185 days).
Key Words: Brook trout, natural antibiotic, growth performance, survival rate, disease resistance.

Introduction

In recent years the scientific literature has well highlighted the beneficial role of aquatic products on human health, and the diversification of species extracted from continental or marine water is one of the most important concerns of our century's human being.

Today there is a sharp increase in demand and consumption of aquatic organisms, to the detriment of other food components, more or less processed.

Aquaculture specialists concerns are focused to improve growth performances, product qualities, protect aquatic organisms from different pathogens and enhancing food safety. In this respect, phytoadditives can be extremely favorable to food security in terms of replacing synthetic chemical compounds, which was proved to have particularly risky for human health.

According to information's given by the literature, the benefits of phytoadditives in livestock production lead to an increasing trend in their usage, opening new favorable perspectives on efficiency of farm growth species.

Given the diversity and relatively safe effects of the impact that it had phytoadditives on increasing production, improving products quality, increasing resistance to disease and reduced losses, their use seems to be increasing and used in many species, including those of salmon farming.

Given these considerations and the potential benefits of phytoadditives in aquaculture, of the effects on production and products quality, and reduce losses during growth period, we considered it appropriate to approach a topic in which to test the impact of two phytoadditives: Salt cedar (*Tamarix ramosissima*) and Dog rose (*Rosa canina*) and to highlight their effect on improving production performances of Brook trout (*Salvelinus fontinalis*). We chose these two phytoadditives given the results obtained on

other species where they were using and see the extent to which the two phytoadditives help improve trout rearing and to achieve a positive financial balance.

Next, we present briefly some of the characteristics of these phytoadditives used in our experiment.

***The Salt cedar* (*Tamarix ramosissima*)**. The Salt cedar is thorny shrub species, also called the Romanian Ginseng it is considered one of the most valuable plants due its pharmaceutical and special curative qualities. The fruits are white to yellowish or red-orange, the optimal harvest period being between August and October and are resistant at temperatures up to -30° C (Korovitna 2003; Brad et al 2002).

The Salt cedar is also called the "queen of vitamin C" and is a rich source of minerals, essential amino acids, trace elements, eight types of carotene, vitamin A, B_1, B_2, E, D_2, D_3, to which are added folic acid, nicotinic acid, unsaturated fatty acids, essential amino acids (glutamine, arginine, lysine), sodium ions, calcium, magnesium and volatile oils.

The Salt cedars fruit are considered a general multivitamin supplement used in case of hypovitaminosis, eye infections, liver disease, tissue regeneration, dermatitis, with antibacterial properties, energizing, anti-inflammatory, stimulates the immune system, and protects the skin from external factors. Serotonin is a very rare element in the vegetable kingdom, being a compound which is found in a dissociated state, and plays an important role in protecting the body against infections (http://www.garbo.ro) (Figure 1).

A B

Figure 1. Salt cedar (*Tamarix ramosissima*) fruits (a – raw; b – dried).

Salt cedar fruits are richer in carotene compared to carrot, as well in sugars, essential amino acids, fatty acids, pectins, vitamins, trace elements such as magnesium, potassium, phosphorus, sodium, etc (http://www.terapiinaturiste.ro).

Unlike other plants, in the case of Salt cedar are used not only fruits but also the bark and the roots. Recently, scientists have discovered that certain compounds from the bark and leaves of Salt cedar have anti-tumoral and anti-cancer properties (Bohatir 2014).

***The Dog rose* (*Rosa canina*)**. The Dog rose is a woody shrub related to the rose, it is also known as: Brier rose, Dog berry, Hep tree, Hip fruit, Hop fruit, Hogseed, Sweet brier, Wild brier, Witches brier, German rowan, etc.

The Dog rose can reach up to a height of 2-3 m, with several elongated and branched stems, grouped, on which small red buds and found. The flowers are fragrant and white pink or pinkish red and in the fall it is full of fruit which are relatively small ruby colored (Pârvu 2000).

In botanical term hipberry are false fruits, the true fruits are considered the small hairy achenes inside the berry, which commonly called seeds. It flowers in May and in

autumn appear the red crimson like fruits, shiny, rubies like. Rosehip is initially spherical shaped, and elliptical, initially green colored, then orange, and red at maturity (Figure 2).

A B

Figure 2. Dog rose (*Rosa canina)* (a – raw; b – dried).

Rosehip has great biological importance, being a valuable repository of vitamin C (ascorbic acid and dehydroascorbic acid), being 50 times richer in vitamin C than lemons, 100 times richer than tangerines, cherries and sour cherries and 200 times richer than apples (Bohatir 2014; Costin & Segal 1999).

Intake of carotenoids like beta-carotene, lycopene and rubizantine isomers as multivitamin A, is one of the strengths of rosehip. They are also, contains vitamins B_1, B_2, B_3, B_5, K, P, alpha and beta tocopherol, nicotinic acid, etc.

Rosehips are true health boosters due to its richness of vitamins and minerals, increasing the body's resistance against infectious diseases, increasing immunity and are an important source of antioxidants (www.daciccool.ro).

Material and Method. The biological material used in the present studies was a stock of 1,200 individuals of Brook trout (*Salvelinus fontinalis*). The experiments was set up in 3 groups of 400 individuals each: group I – control (basic forage); group II – feed with basic forage + 1 % Salt cedar flour and group III - feed with basic forage + 1 % Dog rose hip flour.

The biological material weights were around 93-94 g, with slight and insignificant differences, as it shown in table 1.

The experimental period was 185 days, during which trout received the same maintenance and feeding conditions with the only difference that in groups II and III was added 1% Salt cedar and 1% rose hip flour respectively. Preparation of pelleted feed with phytoadditive supplementation followed the next steps:

1. The needed amount of pelleted feed during the experiment was calculated (enlarged value).
2. Function of the pelleted feed quantity for the entire experimental period the needed amount of Salt cedar and Dog rose hip flour calculation was performed.
3. The whole amount of pellets was grinded for addition of Salt cedar and Dog rose hip flour.
4. Dried Salt cedar and Dog rose fruits were were ground to a very fine particle size.
5. The mixture of grinded basic forage with Salt cedar and Dog rose flour was performed.
6. The mixture was pelleted according to the established 2 variants.
7. The forage was bag packed according to the experimental groups.

Organizational scheme of the experiment is shown in table 1.

Table 1

Organizational scheme of the experiment: Salt cedar (*Tamarix ramosissima)* and Dog rose (*Rosa canina)* influence on growth performance, meat quality and health of the Brook trout (*Salvelinus fontinalis*)

Experimental period	*Location*	*Experimental groups*	*n*	*Initial average weight*	*Feed*	*Monitored performance indices during the experiment*
04.26.2013 - 10.26.2013	Lăpuşna salmon breeding farm, Mureş county	Group I Control	400	94.56 ± 3.25	Basic feed	Weight gain dinamics Total weight gain Average daily weight gain Meat production indices Survival rate and general health condition
		Group II Salt cedar supplement	400	94.12 ± 3.40	Basic feed + 1 % Salt cedar flour	
		Group III Dog rose supplement	400	93.15 ± 3.10	Basic feed + 1 % Dog rose flour	

n – number of individuals.

The main aims of the research have considered quantifying the impact of the two phytoaditives they have on growth performance, and health condition of trout.

Results and Discussion. Feeding programme of the three groups was established in view of the weight of the biological material and water temperature. The feed was manually administered twice a day, at 9 AM and 4 PM (Table 2).

Table 2

Feeding schedule of the trout in relation of their weight and water temperature

Trout's weight (g)	*Forage diameter (mm)*	*Water temperature (° C)*					
		10-12	*12-14*	*14-15*	*15-16*	*17-18*	*>de 18*
80-110	3.0	2.2	2.2	2.4	2.0	1.8	According appetite
110-150	4.0	1.4	1.6	2.0	1.8	1.6	
150-200	6.0	1.4	1.5	1.9	1.7	1.5	
200-250	6.0	1.3	1.5	1.5	1.6	1.4	
250-300	6.0	1.3	1.2	1.3	1.4	1.2	

Regarding the monitored environmental parameters during the experiment, we find that the most important physico-chemical parameters of the water in pools, which had the same source, were relatively similar, the differences being insignificant.

The values of the physico-chemical characteristics of the water were directly in line with the calendar month and outdoor temperature evolution, falling within optimal limits for raising trout (Bud 1999; Păsărin 2007). The dissolved oxygen, the most important parameter for salmonids living, stood at an average of 9.32 mg/L, with variations function of calendar months between 8.7 mg/L in August and 10.2 mg/L in April, which are comfortable levels for the species (Bud et al 2007, 2010).

Also throughout the experiment the water reaction was consistent with the optimum levels with low and insignificant differences between calendar months, with an average of 7.31 pH units during research.

If we consider the growth dynamics of biological material in the three groups (50 individuals from each group) during the experiment, we can make the following assessments, displayed in table 3.

Body weight at the start of the experiment was between 93.15 g and 94.56 g, the differences between the groups was small and insignificant. After 30 days it is found that small differences occur between batches, noting that both groups who benefited from the phytoadditive supplements have a slightly higher average weight compared to controls. The best results are obtained in group II, which benefited the addition of Salt cedar flour supplement, where the average weight is 124.24 ± 3.56 g, followed by group III, with an average weight of 122.75 ± 3.20 g, and lastly the control group with 121.26 ± 2.85 g/individual. At 60 days after the start of the experiment, differences between groups is widening, so that the second group recorded the best performance, reaching an average weight of 163.19 ± 3.25 g, a higher weight with 6.24 g towards trout's from group III and with 13.73 g higher toward trout's from the control group. Differences between weight of individuals is emphasized further in the coming months so that this indicator grow in favor of group II, which benefited by the addition of Salt cedar flour supplement and those in group III, which benefited by the addition of Rosehip flour forage supplement.

Several feed additives are incorporated to farm animals feed, including salmon, to improve certain carcass qualities as meat color or taste, to improve physical properties, to increase palatability and prolong preservation of forage, to improve digestibility or osmoregulation (Pop 2006), but these products are obtained by synthesis which can also hide undesirable side efects, thats why we choose this two natural phytoadditive supplements which can be easily harvested from the unpolluted spontaneous flora of our country.

Table 3

Growth dynamic of Brook trout (*Salvelinus fontinalis*) function of experimental scheme

Group	*n*	*Weight at:*						
		04.26.2013 (initial)	*05.26.2013*	*06.26.2013*	*07.26.2013*	*08.26.2013*	*09.26.2013*	*10.26.2013 (final)*
I - Control	50	94.56±3.25	121.26±5.80	149.46±10.35	179.16±15.10	212.76±18.55	252.61±20.18	296.30±25.65
II Experimental – with 1 % Salt cedar flour supplementation	50	94.12±3.40	124.24±6.15	163.19±12.40	204.39±13.20	247.09±19.30	295.99±20.40	350.82±20.45
III Experimental – with 1 % Dog rose flour supplementation	50	93.15±3.10	122.75±5.95	156.95±3.10	194.10±4.15	234.49±15.40	276.69±8.50	322.54±2.75

n – number of individuals.

At the end of the experiment, the superiority of individuals in group II in terms of weight gain is obvious and significant with an average weight of 350.82 ± 12.08 g, compared to group III where the average weight is 322.54 ± 11.46 g and control with an average weight of 296.30 ± 10.15 g respectively. Differences between groups were relatively high and significant. Mean body weight was greater in individuals who received Salt cedar flour supplement with 54.52 g to those in the control group and 28.28 g compared to those who received Rosehip flour supplement.

We also need to highlight and performance of the third group, which recorded a higher weight with 36.24 g compared to individuals in the control group, which only serves to highlight the beneficial role that is given to the two phytoaditives in the dynamics of growth of the biological material during the experiment.

By analyzing the data in table 4 relating to the accumulation of body weight of the individuals of the three groups, we find the same hierarchy.

Throughout the experimental period, body mass accumulation was highest in individuals from group II with an average weight of 256.70 g who have benefited by Salt cedar flour, compared to group III, where the total mass accumulation was 229.39 g, and at the end the individuals from the control group, which achieved a total accumulation of 201.74 g body mass. Here we can observe the positive impact that had the phytoaditives on growth performance, revealing an opportunity to use them successfully in salmonid units.

If we analyze the average daily gain during the experiment (Table 5), we find that in all cases it has an upward trend, from values that grow from less than 1 gram in the first month, to 1.82 g in the last month of the experiment.

The best results are obtained in the second part of the experiment, with increasing weight and that with increasing water temperature and feed consumption.

Similar to weight gain and accumulation of body mass also average daily weight gain increases differentiated. The best performance being achieved in individuals from group II, with an average per total period of 1.38 g/day within limits depending on considered month, between 1 g in the first month and 1.82 g in the last month of the experiment.

At the second place are situated the individuals from group III, which achieve an average daily weight gain of 1.23 g/day, ranging between 0.98 g/day in the first month and 1.52 g last month of the experimental period.

The control group records the lowest performance, achieving an average daily weight gain of 1.09 g per total period, with values ranging between 0.89 g and 1.45 g/day.

Following are presented data regarding stock mortality during the experiment in all the three studied groups. The data presented in table 6 confirm the beneficial effect of phytoadditives feeding on health and losses in trout. If in the control group, morality reach up to 55 individuals, representing 13.75 % from the initial stock and this is in according within limits set by the literature, in the experimental groups these losses were much lower, respectively 34 individuals at both experimental groups, representing 8.5 % of the initial stock, being lower with 21 individuals to the control group (5.2 %).

As the above data's confirm the addition of the two phytoaditives reduced mortality by increasing the experimental lots immune system activity. Usually in conventional farming the disease prevention is assured by the use of systematic and large amount of synthetic antibiotics, which involve sooner or later antibiotic resistance or other side effects with different intensity of manifestation. Our results underlined the importane of natural feed additives which should not be neglected. A lessening of mortality under 10 % is challenging issue in any field of animal husbandry, and in our experiment we achieved this goal by supplying basic forage with 1 % of Salt cedar and Dog rose hip flour respectively. Therefore medicinal plants as *T. ramosissima* and *R. canina* can be successfully used as replacements for synthetic antibiotics (Ştef 2006), and more, they also can improve some commercial aspects of the meat, subject which will be addressed in a forthcoming experiment.

Table 4

Total and monthly weight gain of Brook trout (*Salvelinus fontinalis*) function of experimental groups

Group	*n*	*Initial weight (g)*	*Monthly weight gain (g)*						*Final weight (g)*	*Total weight gain 185 days (g)*
			Month I	*Month II*	*Month III*	*Month IV*	*Month V*	*Month VI*		
I - Control	50	94.56 ± 3.25	26.70 ± 1.15	28.20 ± 1.125	29.70 ± 0.55	33.60 ± 1.20	39.85 ± 1.15	43.69 ± 0.90	296.30 ± 25.65	201.74 ± 10.15
II Experimental – with 1 % Salt cedar flour supplementation	50	94.12 ± 3.40	30.12 ± 1.25	38.95 ± 1.40	41.20 ± 1.10	42.70 ± 0.95	48.90 ± 1.20	54.83 ± 0.85	350.82 ± 20.45	256.70 ± 12.40
III Experimental – with 1 % Dog rose flour supplementation	50	93.15 ± 3.10	29.60 ± 0.95	34.20 ± 1.15	37.15 ± 1.15	40.39 ± 1.15	42.20 ± 0.90	45.85 ± 0.90	322.54 ± 22.75	229.39 ± 11.30

n – number of individuals.

Table 5

Monthly average daily weight gain and per total experimental period of Brook trout (*Salvelinus fontinalis*)

Group	*n*	*Initial weight (g)*	*Monthly average daily weight gain (g)*						*Final weight (g)*	*Total weight gain (g)*	*Average daily weight gain (g)*
			Month I	*Month II*	*Month III*	*Month IV*	*Month V*	*Month VI*			
I - Control	50	94.56 ± 3.25	0.89 ± 0.30	0.94 ± 0.25	0.99 ± 0.20	1.12 ± 0.18	1.32 ± 0.20	1.45 ± 0.30	296.30 ± 25.65	201.74 ± 10.15	1.09 ± 0.32
II Experimental – with 1 % Salt cedar flour supplementation	50	94.12 ± 3.40	1.00 ± 0.40	1.29 ± 0.09	1.37 ± 0.30	1.42 ± 0.20	1.63 ± 0.35	1.82 ± 0.25	350.82 ± 20.45	256.70 ± 12.40	1.38 ± 0.46
III Experimental –with 1 % Dog rose flour supplementation	50	93.15 ± 3.10	0.98 ± 0.40	1.14 ± 0.20	1.23 ± 0.15	1.34 ± 0.15	1.40 ± 0.20	1.52 ± 0.28	322.54 ± 22.75	229.39 ± 11.30	1.23 ± 0.28

n – number of individuals.

Table 6

Recorded mortality of the experimental groups during April-October

Group	Initial n	Monthly mortality during studies						Total losses	
		04.26-05.26	05.26-06.26	06.26-07.26	07.26-08.26	08.26-09.26	09.26-10.26	n	%
I - Control	400	17	12	8	6	7	6	55	13.75
II Experimental – with 1 % Salt cedar flour supplementation	400	15	6	6	3	2	2	34	8.5
III Experimental – with 1 % Dog rose flour supplementation	400	15	5	3	5	3	3	34	8.5
Total	1.200	47	23	17	14	12	11	123	10.25

n – number of individuals.

These results show the beneficial effect of phytoadditives on growth performance and enhanced disease resistance and significantly reduce mortality. In accordance with our results Csép et al (2010) reported enhanced health condition in fish using natural additive supplement, as sea-buckthorn (*Hippophae rhamnoides*). The actual total losses were 123 individuals, representing 10.25 %, value located within the limits of rearing technology for this category of salmonids.

Not at least should be mentioned that beyond improvement of health condition by use of food additives the state of the aquatic environment plays a primordial role in disease prevention and welfare (Popa & Bud 2010; Vass & Bud 2010; Popa & Bud 2011; Crişan & Bud 2013) toward which can directly implied human food security issues (Pop et al 2013; Savu & Georgescu 2004).

The main indices of meat production at capitalization and the use of phytoadditives influence on improving the quality and color of the meat will be presented in a forthcoming paper.

Conclusions. This studies approach revealed that using the two phytoadditives highlighted the opportunity and seasonableness of such research topics according to the significant results obtained.

After testing the two phytoadditives was found that in both cases they had a beneficial effect in achieving superior performance against control group, with statistically significant differences.

The use of Salt cedar flour has proven to be the most effective option in terms of growth performance, which is higher more than 54.52 g compared with the control group and in the case of Rosehip flour use the differences being of 28.28 g compared to control.

Both, body mass accumulation and average daily gain during research in the experimental groups were superior to the control group, which indicates the beneficial effect that it has the two phytoadditives on growth performances.

As a result of these two phytoadditives effect on growth, immunity and disease resistance of trout, actually the losses decreased significantly, falling by more than 5% compared to the control group, results which inevitable lead to economic efficiency.

In conclusion, we can say that our research has demonstrated the important role of phytoadditives use on production performance and the increase of survival percentage, with major implications for achieving higher economic indicators.

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Authors:
Liviu Todoran, S.C. Aquaserv Company Corp., Romania, Targu Mures, Koos Karol Street, no. 1, todoran.liviu.nicu@gmail.com
Ioan Bud, University of Agricultural Sciences and Veterinary Medecine Cluj-Napoca, Faculty of Animal Husbandry and Biotechnology, Romania, Cluj-Napoca, Mănăştur Street, no. 3-5, ioanbud2000@yahoo.com

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