The Influence of some Phytobiotics (Thyme, Seabuckthorn) on Growth Performance of Stellate Sturgeon (*A. stellatus, Pallas*, 1771) in an Industrial Recirculating Aquaculture System

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Abstract

The objective of this experiment was to assess the influence of some phytobiotics on growth performance of stellate sturgeon (*A. stellatus*). There were two experimental variants: V1–thyme and V2–seabuckthorn. The fish used in this experiment were one year and four months old, with an initial mean weight of 122.78±31.60 g/fish (V1), respectively 121.21±32.54 g/fish (V2). The phytobiotics used, thyme (*Thymus vulgaris*) and seabuckthorn (*Hippophae rhamnoides*), have been embedded in fodder, by using gelatin, having a concentration of 2%/ kg fodder. Alterna Storioni feed-48% crude protein was used. The water quality parameters during the experiment were within normal limits for an optimum growth of experimental fish. At the end of the experiment significant differences ($p<0.05$) were observed between the two experimental variants in terms of final mean weight and individual growth rate. Differences regarding the SGR, FCR, PER were insignificant ($p>0.05$). Highest individual growth rate value (105.90 g) was recorded in V2 case and the lowest value (98.45 g) in case of V1. As a conclusion, it can be said that the two types of phytobiotics (thyme, seabuckthorn), administered in a concentration of 2%/kg fodder, have influenced the growth performance of stellate sturgeons.

Keywords: growth performance, growth rate, phytobiotics, recirculating aquaculture system, stellate sturgeons.

1. Introduction

Studies regarding rearing sturgeons in intensive production systems were done first in Romania in 2002 [1]. Among sturgeons, one of the most studied species related to super-intensive growth was and still is stellate sturgeon (*A. stellatus*).
Choosing this species is justified by its availability and small size as well as the fact that it can be retained and easily transported from the capture places–its reaction to fish transport activity, so necessary nowadays.

For growing sturgeons in intensive aquaculture systems, it is necessary to have a good knowledge of the factors that may influence, favorably or not, the growth and development of certain species.
The stocking density represents the key factor in rearing sturgeons process [2].
It has been demonstrated that a higher stocking density can suppress growth due to a stress status, which leads to non-consuming the amount of feed given and hence the deterioration of technological water quality parameters [3-6]
In aquaculture, one of the most promising methods for disease defense mechanisms is prophylactic administration of immunostimulants [7].
In fish, the immunostimulants are known to increase certain aspects of innate immunity [8].

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Phytobiotics are a wide range of bio-active compounds that can be extracted from different vegetal sources.

In the last years, new interesting applications of phytobiotics have appeared in animal production [9].

The phytobiotics used for this experiment were thyme and seabuckthorn.

Thyme is an herb known and used since ancient times, in the kitchen, cosmetics and for medicinal purposes. It includes thymol (44-60%) an essential oil having strong antiseptic properties, rich in antioxidants, potassium, magnesium and vitamins A, C and E [10]. The therapeutic properties of thyme in aquaculture are antiseptic, antioxidant, digestion stimulant, etc. [11].

The seabuckthorn origins are in Central Asia. The seabuckthorn fruits have twice the quantity of vitamin C than wild roses and ten times more vitamin C than citrus fruits.

Vitamins A, B_1, B_2, B_6, B_9, E, K, P and F are also present in the seabuckthorn fruits, in significant concentrations.

For obtaining good growth performances in the industrial aquaculture, we need to use diets that assure us of maximal survival and growth with the lowest costs possible (Piper, 1982) [12].

The purpose of this experiment was to observe the influence of the above mentioned phytobiotics upon the growth performance of *A. stellatus* species.

2. Materials and methods

The present experiment lasted for 63 days and was performed in the recirculating system pilot station at the pilot recirculating system station of Aquaculture, Environmental Science and Engineering Department from Food Science Faculty-„Dunarea de Jos'' University of Galati.

The design of the recirculating system includes two growing units having a volume of 600 l each and a water quality conditioning system [13].

Specimens of *A. stellatus* of 1 year and four months were used, which were distributed equally in the two growing units.

The phytobiotics used were embedded with gelatin in the fodder having a concentration of 2%/kg of fodder, them being: thyme (*Thymus vulgaris)* and respectively seabuckthorn (*Hippophae rhamnoides*).

There were two experimental variants: V_1– seabuckthorn and V_2–thyme.

The fish were fed with Alterna Storionii 2P feed, having 48% crude protein and 16% fat.

Table 1. Biochemical composition of the fodder Alterna Storionii 2P

Composition	2P
Crude protein %	48.0
Crude fat %	16.0
Crude cellulose %	1.9
Crude ash %	8.5
Phosphorus %	1.3
Digestible energy (MJ/kg)	16.6

The fish were fed four times a day with a daily ratio of 1.5 % of their total biomass.

At the end of the experiment, based on biometric measurements made upon the two fish experimental groups, the main performance growth parameters were determined: biomass growth rate, the daily growth rate, specific growth ratio, feed conversion ratio and protein conversion factor.

The data have been analyzed statistically in Microsoft Excel by using descriptive statistics.

3. Results and discussion

The growth performance may vary significantly depending on several factors such as: stocking density, type of feed used, water temperature, organic substance in water, pH of the water, concentration of dissolved oxygen, etc.

During the experiment, the physical-chemical parameters of the process water were within the normal limits for optimum growth (Table. 2).

Table 2. Values of main water quality parameters

Water quality parameters	V1	V2
$N\text{-}NO_2$ mg/l	0.119	0.124
$N\text{-}NO_3$ mg/l	23.59	23.92
$N\text{-}NH_4$ mg/l	0.555	0.292
pH	7.823	7.916

The experiment has started at the optimum temperature for sturgeon growth 18-20°C [14, 15] and this range was maintained during the entire experiment (Figure 1).

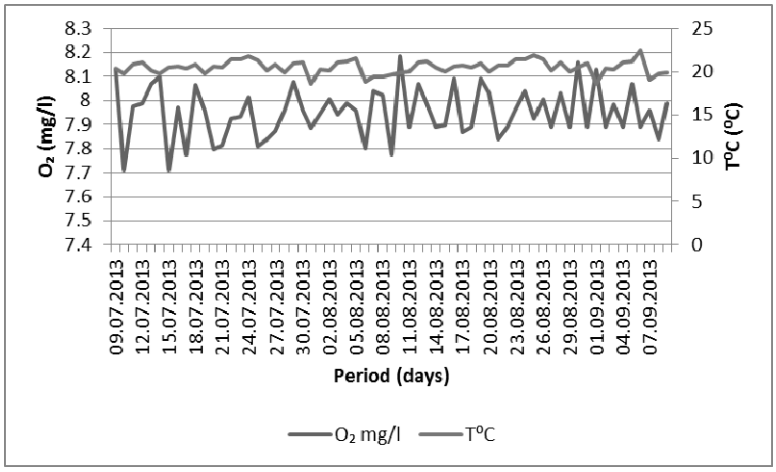

Figure 1. Variation of temperature and dissolved oxygen concentration

At the end of the experiment, differences were noticed in the final mean individual weight: V1–219.66 g/fish; V2–228.68 g/fish and individual growth rate: V1–98.45 g; V2–105.90 g.

The *A. stellatus* biomass yield is pointed out, in Table 3, by the values of initial and final fish stocking density.

Table 3. Growth performance parameters of both experimental variants

Experimental variants	V1-1.2 g/day (seabuckthorn)	V2-1.21 g/day (thyme)
Rearing units	C1	C2
Initial fish number	33	33
Final fish number	30	29
Survival (%)	90.91	87.88
Total initial biomass (g)	4000	4052
Initial stocking density (kg/m^3)	13.34	13.51
Total final biomass (g)	6590	6632
Final stocking density (kg/m^3)	21.97	22.11
Biomass gain (g)	2590	2580
Stocking density gain (kg/m3)	8.63	8.6
Initial weight mean (g/ex)	121.21	122.79
Final weight mean (g/ex)	219.67	228.69
Individual biomass gain (g)	98.45	105.9
Rearing days	63	63
Feed crude protein (PB%)	48	48
Feeding ratio (% biomass)	1.5	1.5
The total amount of feed distributed (g)	3780	3829.14
GR (daily growth rate) (g/day)	41.11	40.95
SGR (%/day)	0.79	078
FCR (g feed/g biomass gain)	1.46	148
PER (protein efficiency ratio) (g/g)	1.43	1.4

Aquaculture depends on a perfect equilibrium between growth performance and health status. Sturgeons are fish with a slower feeding behavior. By applying a continuous feeding timetable and an effective nutritional regime, good results in terms of growth performance indicators will be obtain [16]. Dicu et al., (2013) [18], after an experiment with 6 months old stellate sturgeons, that were

feed with Nutra MP-T 1.7 mm-50% crude protein, using a 2%biomass feeding intensity, has obtained SGR values between 2.35 and 2.52%/day and FCR between 0.77 and 0.84 g feed/g biomass gain [17]. Also, Dicu et al (2013) [18]., in order to evaluate the growth performance of 7 months stellate sturgeons using the same feeding conditions mentioned above registered a SGR value of 0.55 and a FCR value of 1.52 [18].

In our study, it can be seen that in case of the experimental variant where seabuckthorn was used, a slight improvement of growth parameters, comparing with the other variant, where thyme was used, was registered. By applying the statistical tests, not significant differences ($p>0.05$) were obtained between the two tested variants, in terms of growth performance parameters (Table3).

Also, the efficiency indicators values (FCR and PER) shows that there is not a significant difference ($p>0.05$) in terms of nutrients retention and feed conversion between the two experimental variants.

Better FCR results for stellate sturgeon have been obtained by Cristea, 2003, by using a feed with 54% protein content [19].

It has been shown that the immunity-stimulants based on plants are able to enrich the unspecific and specific defense mechanisms and/or reduce losses due to infections with viruses, bacteria and/or parasites in carp [20-22]. However, plants such as: *Eclipta alba* [23], *Aloe vera* [24], *Achyranthes aspera* [25], were reported as they would increase fish immunity.

Based on certain experiments, it was concluded that thyme, rosemary and fenugreek, introduced in the feed of fish can be considered as "food additives" to increase immunity and hematological status and also the welfare of the biologic material in aquaculture [25].

Seung-Cheol et al. [27] showed that the addition of different single herbal extracts (*Massa medicata*, *Crataegi fructus*, *Artemisia capillaries*, *Cnidium officinale*) or a mixture of all the herbs promoted growth and enhanced some non-specific immunity indicators of red sea bream *Pagrus major*.

Among a wide variety of herbs tested against *A. hydrophila* infection in tilapia (*Oreochromis niloticus*), the ethanol extract of *Psidium guajava* was found to have the highest antimicrobial activity [28].

Abd-El-Rhman (2009) evaluated the increased *Oreochromis niloticus* resistance to *A. hydrophila* by using crude propolis and its ethanolic extract as non-specific immunostimulant and to study their effect on growth performance. He found that the propolis-ethanolic-extract enhanced the growth, immunity and resistance of Nile tilapia against *A. hydrophila* more than the crude propolis [29].

At *Dicentrarchus labrax* species (european seabass), after the administration of thyme, rosemary and fenugreek diets, in a concentration of 1%/kg feed, the best values of growth indicators (SGR, FCR, PER) were met in case of thyme variant [30].

Protein efficiency ratio (PER) has a high value at thyme variant (30.13 g biomass increase/g feed), followed by fenugreek variant (27.08 g biomass increase/g feed distributed).

Zaki et all, in 2012, tested several phytobiotics, in two concentrations, 1% and 2%, at *Oreochromis niloticus* species, with an average initial weight of 0.82±0.3 g/fish. The results showed that dietary supplementation with fenugreek, eucalyptus, pepper, chamomile and thyme, in a concentration of 1%, had a positive effect on growth performance parameters, feed conversion ratio, nutrient utilization, protein efficiency and also on physiological parameters [31].

4. Conclusions

Phytobiotics contribute to improving the defense mechanism of fish, thus offering protection against infections and hence they influence its growth performance.

However, it should not be ignored that fish exposure to immunity-stimulants for a very long time can lead to loss of immune function, the innate immune system losing its sensitivity.

The final results of the present experiment show the fact that the growth performance was influenced favorable by both types of phytobiotics used; however we may state certainly that thyme acted as a digestion tonic, stimulating the appetite of fish, which was deducted from their behavior at meal time and also from the values obtained for the final mean weight: V1–219.66 g/fish; V2-228.68 g/fish and the individual growth rate: V1 98.45 g; V2–105.90 g

Further studies are needed to find out the effect of

various phytobiotics, with special reference to timing, dosage and method of administration.

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