AACL BIOFLUX
Aquaculture, Aquarium, Conservation & Legislation
International Journal of the Bioflux Society

Comparative study on rearing some valuable species in intensive system using non-conventional fodders

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Abstract. The authors of this work proposed an experiment on rearing two valuable fish species (*Cyprinus carpio* and *Polyodon spathula*) in intensive system, using non-conventional fodders (sunflower groats and rice bran) - first variant (I) and mixed/conventional fodders (fine grained) – second variant (II) (using as control). It is expected, that testing the fodders to obtain the best effect in the optimization of the performances in rearing the target fish species. The experiment has taken place in conditions of an intensive system in ground ponds (pond no 8 - HC8 and pond no 9 - HC9), at the Nucet Fish Farm (Experimental Base), with the two experimental feeding variants: I. feeding the material with non-conventional fodders (30% protein) in HC8, and II. feeding the material with mixed fodders (24.86% crude protein) in HC9. Taking into consideration the almost identical environmental conditions and the population density the rearing of the fish depends on additional food given and its quality. Following the performed investigation we can appreciate that, the feeding with non-conventional fodders in intensive and semi-intensive rearing systems, in ponds, can provide the energy and complete range of essential nutrients for the combined culture of common carps and *P. spathula*. Using good quality stocking biological material (obtained in summer I), a "cheap formula" for feeding, a good quality and volume of water, it is possible to get fish that can be delivered on the market at the required dimensions next year. Taking into account the obtained production using conventional and non-conventional fodders and having in view their price, we can conclude that fodders from the aquaculture market can be successfully replaced with non-conventional ones, which have a more affordable price, resulting in a lower cost per kilogram of fish in the case of mixed culture *C. carpio* and *P. spathula*.
Key words: non-conventional fodders, *Cyprinus carpio*, *Polyodon spathula*, intensive system.

Introduction. Although the economic and/or ecological importance in some countries of many cyprinid fish is debatable (Mills et al 1993; Ricciardi & MacIsaac 2000; Montchowui et al 2009; Ozcan & Balık 2009), in Romania, but also in several Christian countries from Europe, they have a quite important role in both aquatic biodiversity and human alimentation (Balon 1995; Cioboiu & Brezeanu 2009; Luca et al 2010; Gheorghe et al 2011; Györe et al 2011), being by tradition very appreciated and therefore the cyprinid group is a component of fish polyculture in Europe but also in Asia (Sharma & Leung 2000; Terziyski et al 2009). In mixed culture, cyprinids can be reared in ponds together with sturgeons, another important category of fish with great economic value. However, sturgeons were introduced only recently (around 2000) in Romanian aquaculture (Bura & Szelei 2009; Muscalu et al 2010; Coada et al 2011; Sion et al 2011; Docan et al 2011).

Fish nutrition became over decades a „three-dimensional" science; the first dimension seemed to be „the best formula", the second was „the cheap formula", while the newest and third dimension was „a natural formula" (Ognean & Barbu 2009; Dragoş et al 2010; Antofie et al 2010; Gabor et al 2012). Taking into consideration the present situation of the global energetic and economic depression and the disorders that unfold on its fund, it is necessary to use any resource that can be capitalized with minimum effort and the lowest price. Fish nutrition is one of the most important elements that determine the meat production in a controlled environment. A judicious feeding needs complete fodders in terms of nutritional requirements and ways of administration, suitable for the rearing system, stage of development and according to the foraging and

feeding behavior of the species (Costin et al 1992). Some practical and economic problems as regards fodders production are: the price, accessibility of ingredients, anti-nutritional factors or toxicity of some ingredients (Sadighara et al 2010; Caipang et al 2011; Muhammad et al 2011) and the ability of fish to harness the fodders, having in view that different sized fodders are used in aquaculture, depending on the stage of development. The evaluation on the fodders quality is made using chemical and biological methods, applicable to different moments and reference systems: raw material and/or finished food, or the qualitative and quantitative conversion of the feed in fish biomass respectively (Oprea & Georgescu 2000).

Many countries from wide world have in view the utilization of some cheap fodders but with a high efficiency in terms of their transformation in fish meat (fodder kg/kg fish). It is also known that this kind of feeding, using "the cheap formula" principle, is frequently used in intensive and semi-intensive rearing systems from Romania. The authors of this paper proposed an experiment on rearing two valuable species (*Cyprinus carpio* and *Polyodon spathula*) in intensive system, using non-conventional fodders (sunflower groats and rice bran).

Material and Method. The experiments were done in Experimental Base 1 – Nucet Fish Farm, pond 8 (called also HC8) with an area of 2.2 ha and pond 9 (HC9) with an area of 2.5 ha. Both ponds are rectangular in shape, have approximately the same area and depth, providing similar conditions for living (see Figure 1). The experimental ponds are gravitational water supplied from a channel, whose water comes from the Ilfoveni accumulation lake, located a few hundred meters upstream. The average depth of the experimental ponds is 1.6 m, each of them having the necessary supplying and exhausting equipments. From this brief presentation, it is noticed that the two ponds had almost the same living conditions for the fish population.

The ponds preparation works for the purpose of populate them were made according to the classical technology (see Gheracopol 1981), such as:
- checking and repairing the breakwater, canals and hydro-technical installations;
- mobilizing of watersheds in the less deep areas and removing the harsh vegetation;
- administering the amendments, 200 kg calcium oxide, through uniform scattering all over the ponds surface, and a quantity of 2000 kg/ha manure.

The flooding of the ponds was made using a mesh of 1 mm in order to prevent the breakthrough of the wild fish larvae.

Figure 1. General view of experimental ponds.

In the second summer, the rearing experiment was made in two variants: I. using non-conventional fodders in pond 8 (HC8), and II. using mixed fodders in pond 9 (HC9).

The populating of the basins was done around the date of 15th of April in both rearing variants with one summer old young fish from Nucet Fish Farm as it follows: HC8 was populated with 4150 specimens of *Cyprinus carpio*, with an average weight of 106g/ex and 240 specimens of *Polyodon spathula* with average weight of 320g/ex; HC9 was populated with 4700 specimens of *Cyprinus carpio*, with an average weight of 101g/ex and 270 specimens of *Polyodon spathula* with average weight of 332g/ex.

Water quality control. In order to evaluate the environmental conditions in the both experimental ponds, samples of water and soil have been prevailed from May to

September in order to determine the hydro-chemical parameters. As it is known, the fish production depends largely on the physical and chemical quality of water (Billard 1995). The parameters taken into account in our intensive system of fish rearing were: temperature, dissolved oxygen, pH, content in essential mineral elements, turbidity and the color (Billard 1995).

The monitoring of the hydro-chemical parameters was done as presented below.

The water temperature was measured every day in the morning, in the afternoon and in the evening using a mercury thermometer. In the experimental ponds the temperature was reported to be between 17-27°C. During June-August the water's temperature was favorable (22-27°C) for production, and in May and September the temperature was a little bit lower 17-21°C.

The dissolved oxygen was measured every day, early in the morning before the sun rise, using portable oxygenometers OxiGuard and it had optimal value throughout the survey period 5.5-9.6 mg/L, the same as the pH value 7.2-8.5.

Turbidity was measured using the Secchi disk and recorded values between 15 and 30 cm.

The other parameters: pH, alkalinity and water hardness were analyzed every week being determined as a result of laboratory analysis on water samples (see guidelines in Hadjinikolova & Ivanova 2009).

Feeding of animals. Protein requirements for fish are higher than for other land animals, because fish have a quick-growing (Bogatu 1991; Kerepeczki et al 2011). The efficiency of alimentation in pisciculture depends greatly on their preparation, on how the mixture is made, on optimal concentration of the components in mixtures which have to fit to the animal feeding behavior (Cadar 1990) because the feed consumption and conversion depends on both the taste and the nutritional quality of food.

In the first variant (HC8) the non-conventional fodders contained two components: sunflower groats 10440 kg representing 75% of the total used fodders amount and 3480 kg rice bran representing 25% from total.

In our country the sunflower is the most widespread oleaginous plant, which contains a great quantity of protein in its seeds (10-35%), being well digested (approx. 90%) (Oprea & Georgescu 2000). The sunflower groat is a proteic food with a high content of cellulose and poor in carbohydrates being widespread in Romanian farms for animal feeding.

The rice bran has the following biochemical features: water 14%, carbohydrates 62%, crude protein 14%, lipids 4% and mineral substances 6%.

In the second experimental variant (HC9) the feeding was made using mixed fodders. The mixed fodder (complex and conventional one) was of flour type one, with 24.86% crude protein and containing: corn, wheat, barley, sunflower groat, soy groats, fish flour, premix with vitamins and minerals, and yeast (see composition in Table 1).

The nutritional value of these mixed (conventional) fodders grows as in their composition are added grains (corn, barley, wheat) some oleaginous seeds and leguminous groats (soy, sunflower) and materials of animal origin (Costin et al 1992).

Table 1

Composition of mixed fodder used in variant II

Range of products	Percent (%)	Crude protein (%)
Soy groats	20	8.80
Sunflower groats	24	7.87
Wheat	16	2.01
Barley	17	1.80
Corn	14	1.20
Fish flour	4	1.92
Yeast	4	1.26
Premix with vitamins and minerals	1	-
Total	100	24.86

Feeding lasted until 21st of October 2011 (during a total period of 142 days). The fodder quantity for both experimental variants (I and II), distributed per months and days, during all the feeding period is displayed in Tables 2 and 3.

Table 2

Quantity of fodder administered per day and per month in experimental variant I

Month	May	June	July	August	September	October	Total
Kg/month	780	1,560	3,380	4,050	3,380	770	13,920
Kg/day	30	60	130	150	130	70	-
Percentage (%)	5.60	11.21	24.28	29.10	24.28	5.53	100.00

Table 3

Quantity of fodder administered per day and per month in experimental variant II

Month	May	June	July	August	September	October	Total
Kg/month	1,040	2,080	4,160	5,400	4,160	1,100	17,940
Kg/day	40	80	160	200	160	100	-
Percentage (%)	5.89	11.50	23.19	30.10	23.19	6.13	100.00

Results and Discussion. During the warm season control fishing was made on 5th of every month in order to check the growing and the sanitary status of the animals. The final results recorded at the harvest fishing, which began on 28th October 2011, are synthesized in Table 4.

In the intensive and semi-intensive aquaculture systems the parasites control and sanitation is one of the most important issues as serious infestation with parasites triggers other diseases, the risk of disease increasing with increasing density of fish or other vectors (Hemananda et al 2009; Düşen et al 2010; Banerjee et al 2011; Ebrahimzadeh Mousavi et al 2011; Mehdizadeh Mood et al 2011; Rahmati-holasoo et al 2011; Sahandi & Hajimoradloo 2011).

The sanitary status of the animals in both experimental ponds was generally good all over the rearing period. We mention that, at the first control fishing *Lernaea sp.* ectoparasite was detected (the intensity of the parasitism being low: about 1-2 parasites/ex.) together with *Dactylogyrus sp.* At the second control fishing, *Lernaea sp.* ectoparasite was found only on a small number of fish and had a much lower frequency, while for *Dactylogyrus* the problem was solved by bathing the fish in an ammonia solution 30% in a dose of 1 mL/L of water, for 30 seconds (according to recommendation of Munteanu & Bogatu 2003).

We can say that the survival was good due to the quality of the fodders, good water quality and due to the volume that we had at our disposal and transited in ponds. The dynamics of growth rate of the animals, in both experimental variants, is presented in Figures 2-3, while fresh capture of *Cyprinus carpio* and *Polyodon spathula* at final of the growth season is shown in Figure 4.

Table 4

Output of data acquired at the harvest fishing, in October

Ponds		Populating			Sv. [%]	Production			Fodders	
		No. ex.	Average weight [g]	Quantity [kg]		No. ex.	Average weight [g]	Quantity [kg]	Quantity [kg]	K
HC8 (I)	*C. carpio*	4150	106	440	92	3643	1140	4153	13920	3.35
	P. spathula	240	320	79	90	217	1530	332		
HC9 (II)	*C. carpio*	4700	101	474	93	4371	1320	5770	17940	3.1
	P. spathula	270	332	90	89	240	1610	386		

Sv [%] = fish survival; K = coefficient of conversion of the fodder.

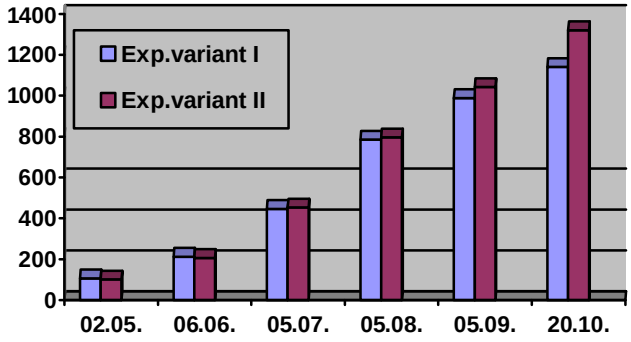

Figure 2. Dynamics of growth rate in *Cyprinus carpio.*

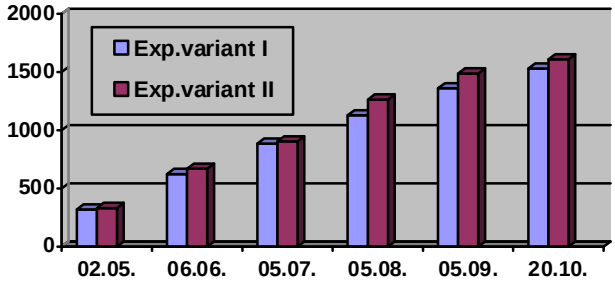

Figure 3. Dynamics of growth rate in *Polyodon spathula.*

Figure 4. *Cyprinus carpio* and *Polyodon spathula* at the crop fishing.

Conclusions. Following the performed investigation we can appreciate that, the feeding with non-conventional fodders such as sunflower groats (75%) and rice bran (25%) in intensive and semi-intensive rearing systems, in ponds, can provide the energy and complete range of essential nutrients for the combined culture of common carps and *Polyodon spathula*.

Using good quality stocking biological material (obtained in summer I), a "cheap formula" for feeding, a good quality and volume of water, it is possible to get fish (common carps and *P. spathula*) that can be delivered on the market at the required dimensions next year.

Taking into account the obtained production using conventional and non-conventional fodders and having in view their price, we can conclude that fodders from the aquaculture market can be successfully replaced with non-conventional ones (sunflower groats and rice bran), which have a more affordable price, resulting in a lower cost per kilogram of fish in the case of mixed culture *Cyprinus carpio* and *P. spathula*.

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Received: 26 September 2012. Accepted: 10 October 2012. Published online: 22 October 2012.
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How to cite this article:
Dobrotă N., Dobrotă G., Costache M., Marica N., 2012 Comparative study on rearing some valuable species in intensive system using non-conventional fodders. AACL Bioflux 5(5):361-368.