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REARING EFFICIENCY AND NUTRITIONAL QUALITY ASSESSMENT FOR CARP SAPLING (*CYPRINUS CARPIO* LINNE, 1758) FROM RECIRCULATING SYSTEMS

EFICIENŢA CREŞTERII ŞI EVALUAREA CALITĂŢII NUTRIŢIONALE A PUIETULUI DE CRAP (*CYPRINUS CARPIO* LINNE, 1758) CRESCUT ÎN SISTEM RECIRCULANT

PALTENEA ELPIDA, PATRICHE N., JECU ELENA,
TALPEŞ MARILENA, MOCANU ELENA

Institute of Research and Development for Aquatic Ecology, Fishing and Aquaculture Galati, România

Common carp, Cyprinus carpio L. of 8 months older, rearing in recirculation system during 107 days period - he has been analysed from the point of view of feeding efficiency and nutritional quality of carp carcass. The stocking of breeding ponds has been made at 12.17 kg/m^3 density, the initial average weight of fishes has been 82.2 g/ex., biochemical composition of carp carcass has been following: protein 14.35%, fat 1.10%, ash 1.67% and moisture 82.22%. Weekly, there has been analysed biochemical composition of meat and protein efficiency coefficient (PER), protein using efficiency (PUE), retained protein (RP). The nutritional quality of fish meat and appreciation coefficients of fish rearing they indicate a good capitalization of delivered food.

Key words: carp (*Cyprinus carpio* Linne, 1758), carcass composition, flesh quality, rearing efficiency, recirculating system

Introduction

Using rearing of fish technologies in recirculation system needs to find out an balance between water quality, quality and food delivery and quality and quantity of initial fish number.

Growth performance of common carp and nutritional quality has extensively been studied in recirculating system and survival and growth of common carp larvae are influenced by both the stocking density and the type of food (J.G. Sharma and R. Chakrabarti, 1999, Sfetcu, L. at all, 2006).

The quality of feed is not enough to obtain the desired results regarding the quality of biologic material. To cover nutritional exigencies of fishes request feeding and exploitation technology that's adequate in accordance with breeding stage of fish material. The capitalization method for administrated food inclusive the environmental quality indicates the quality of biologic material and the level of

bio-productive indicators (individual body weight, survival coefficient at certain densities, breeding rate) (Papoutsoglou et al. 2000).

The goal of work has been the study of biochemical composition and carp's rearing efficiency in recirculation system in certain technological and environmental conditions.

Materials and Methods

Fish and experimental design

The analyzed biologic material has been constituted from carp fingerlings (*Cyprinus carpio*) of 8 months age, provided through natural-controlled spawning in Brateş Research Farm and feeding with specific age feed (figure 1), thus:

- in the first month it has used extruded feeds having 0.5 – 0.7 mm granulation;
- in the following months until the end of experiment it has used extruded feeds, with 1.5 – 1.7 mm granulation.

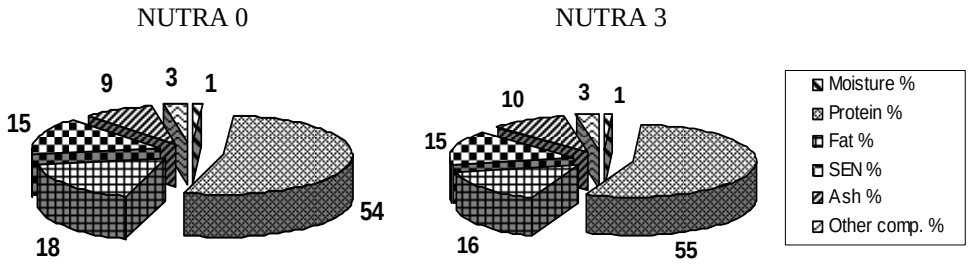

Figure 1. Biochemical composition of fish feed

The water quality parameters have been observe and control in the time of the experiment. The following water quality parameters were controlled every day within the system: pH; temperature; dissolved oxygen concentration, nitrogen compounds.

Carcass composition

The quality of the fish is represented by the totality of real attributes and characteristics in concordance with the goal for what has been created inclusive economical efficiency.

The assessment of reared carp quality in recirculation system was achieved on a 107 days period. Carcass composition was determined through biochemical analysis effectuated weekly on fish material in various breeding stages, on 15 samples of 5 individuals each.

The feed valorification and the influence of the medial conditions of the system were appreciated through the main biochemical parameters analyses: crude protein, fat and ash, according to Kjeldahl and Soxhlet methods, ash through

calcification at 600^0C and moisture through heating sample at 105^0C until it gets constantly weight. For biochemical feed composition has been the same analysis methods.

Growth efficiency

The rearing indicators of experimental biologic material in those are involved the biochemical parts as: protein rate or retained protein RP and rearing efficiency: retained protein (RP), protein efficiency coefficient PER, protein utilisation efficiency (PUE), these have been calculated based on following formulas:

Retained protein (RP)= Wt x Pt –W0 x Po (g)

Protein efficiency ratio (PER) = Total weight gain (W) / amount of protein fed (g)

Protein utilisation efficiency (PUE) = 100 (Wt x Pr –W0 x Pr) F x Pf (%)

Feed and fish energy content has been determined starting from biochemical composition using 23.64 ; 39.54 and 17.15 factors that represents energy in kj for 1g of protein, fat and glucose respectively.

Results and Discussions

The conditions provided by fish breeding in recirculation system is reflected on fishy material quality through muscles biochemical composition and others parameters which indicates increase and efficiency of rearing.

In the table 1 are presented the results concerning the main technological indicators used in rearing efficiency calculation and in the table 2 is shown biochemical composition of carp sapling rearing in recirculation system.

In order to evaluate and characterize the quality of carp meat (*Cyprinus carpio* Linne, 1758) there have been weekly harvested fish samples from recirculation system. The analysis have been effectuated immediate after fishing in first state of freshness in order to avoid the damages of sensorial, physical, chemical and biochemical characteristics due to storage and conservation.

Biochemical composition of carp meat

Biochemical composition of carp meat is influenced by many factors whose depends especially by species, size, age, environmental conditions and feeding. The age has an important role concerning the biochemical composition of muscles (Cho, S. H.,2001). Along with ageing is taking place a decrease of water content from muscular tissue, an increase of conjunctive tissue and of adipose cells volume and as consequence results an increase of fat deposit.

Determination of fish meat biochemical content allows appreciation of nutritional fish quality and physiologically fish state. The importance of these parameters conducts at establishing the optimum environmental conditions whose influence aught the specificity of metabolic processes as well as capitalization degree for various types of food (fodder and natural food, in controlled system and natural environment).

Table 1

Main technological growth indicators for carp sapling in recirculation system

Indicators /Period (week)	**Number exemplars**	**Total biomass (kg)**	**Average weight (g/ex)**	**Total feed (g)**	**Feed consumption /ex. (g)**	**Gain in weight individ.(g)**	**Total gain of rearing (g)**	**FCR g/g**
	1850	148.0	80.0	0	0.0	0.0	0	0.0
1	1840	151.2	82.2	5888	3.20	2.2	4048	1,45
2	1835	158.4	86.3	8258	4.50	4.1	7524	1.10
3	1830	166.9	91.2	9626	5.26	4.9	9490	1.07
4	1825	175.9	96.4	10074	5.52	5.2	12376	1.06
5	1820	187.8	103.2	12922	7.10	6.8	15065	1.04
6	1815	202.4	111.5	15428	8967.0	8.3	18100	1.02
7	1810	219.9	121.5	19005	10.50	10.0	20758	1,05
8	1805	240.1	133.0	21660	12.00	11.5	24840	1.04
9	1800	264.2	146.8	25290	14.05	13.8	31164	1.02
10	1795	298.0	166.0	36080	20.10	19.2	34464	1.04
11	1790	331.9	185.4	36158	20.20	19.4	35343	1.04
12	1785	366.3	205.2	36592	20.50	19.8	35956	1.03
13	1780	401.2	225.4	37113	20.85	20.2	36565	1.03
14	1775	436.7	246.0	37275	21.00	20.6	36565	1.02
15	1770	472.6	267.0	38940	22.0	21.0	37170	1.05

In figure 2 and 3 are presented investigation's results regarding biochemical determination content for carp exemplars rearing in controlled system.

Moisture of fish meat is varying in large limits according to age. By fat and proteins accumulation humidity is decreasing. The determined values for carp meat humidity are constantly decreasing from 82.22% (for sampling of 8 months old at the beginning of experiment) to 77.33% (for carp sapling at the end of experiment). Proteins mostly establish sensorial characteristics of meat. Proteins can be classified by cellular location in: extracellular proteins (collagen, reticuline, elastine, etc.) or intracellular (protoplasma) and indissoluble proteins by collagen type.

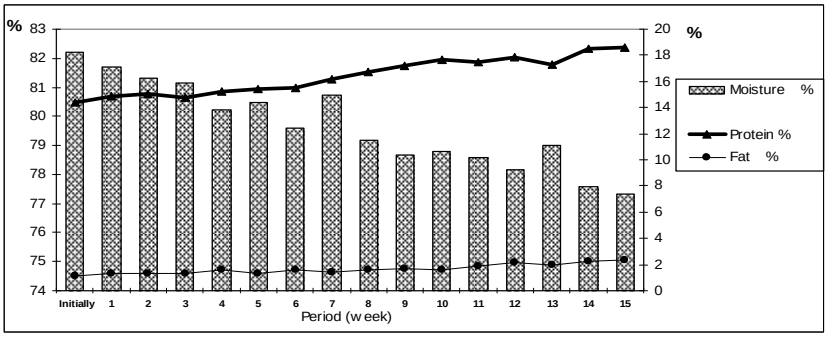

Figure 2. Variation of protein, lipids and moisture concentration from carp's muscle

Crude protein is varying between 14.35g% and 18.60 g%, being influenced by age of biologic material, season, and especially in our case by quality of feeding. During all period of experiment protein was constantly accumulated in

carp muscle thus at the end of experiment the protein concentration was with 23% more than initial value.

Table 2

Biochemical composition of carp meat (*Cyprinus carpio* Linne, 1758)

Indicators /Period (week)	Moisture %	Crude protein %	Crude fat %	Ash %	M/P
initially	82.22	14.35	1.10	1.67	5.72
1	81.69	14.86	1.30	1.43	5.49
2	81.33	15.01	1.31	1.41	5.41
3	81.15	14.78	1.34	1.59	5.49
4	80.23	15.24	1.57	1.48	5.25
5	80.48	15.46	1.31	1.17	5.20
6	79.61	15.48	1.56	1.61	5.13
7	80.74	16.18	1.41	1.20	4.99
8	79.18	16.75	1.55	1.28	4.72
9	78.67	17.21	1.66	1.30	4.57
10	78.79	17.71	1.59	1.23	4.45
11	78.60	17.49	1.90	1.34	4.50
12	78.18	17.89	2.13	1.35	4.37
13	79.01	17.31	1.97	1.29	4.56
14	77.59	18.49	2.26	1.21	4.19
15	77.33	18.60	2.32	1.17	4.16

In the lax conjunctive tissue the isolated or grouped cells can store lipids. These cells are numerous and organized as adipose tissue in which the lipids are concentrated (Pirone A et al, 2000). This adipose tissue is located in inter-peritoneal, hypodermic and intramuscular areas. He shows a high quantitative and qualitative variability given by separation degree of adipose cells and also by rearing and feeding conditions (Manjappa K., 2002).

The carp muscle has values of total fat between 1.1g% and 2.3g %, with constant fat accumulation during experiment and without significant variations from one sample to other.

Certain authors said that in oocytes the high concentrations of saturated and monounsaturated fat acids represent the energetic reserves needed to embryonic development.

In adipose cells the cytoplasm mass is reduced and concentrated at the edge of cell; there is enzymatic complex capable to accumulate and esterifies fats, glycerol and fat acids at triglycerides.

This veritable adipose organ is poly functional being capable to transfer in blood the fat acids for synthesis and triglyceride accumulation, in the same time it is capable to synthetize fats starting from glucose. The report between water percentage and protein from muscular fish tissue (M/P) is varying between 4.16 and 5.72, that reflect alimentary value of this. Determination of M/P report is important for fish consumption. Less M/P report the more valuable is the fish meat and better maintenance state.

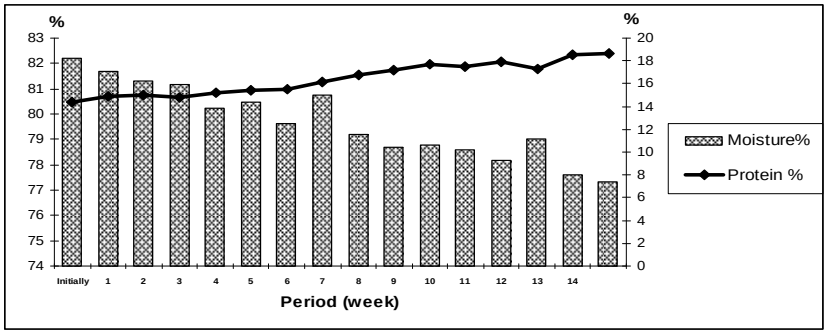

Figure 3. Variation of protein concentration and moisture from carp muscle

Growth efficiency of carp sapling

In the figure 4 are presented the results regarding growth and efficiency of sapling carp rearing in recirculation system. Through results analysis viewing nutrients retention efficiency in fish body may obtain useful information about fish breeding in correlation with feeding efficiency.

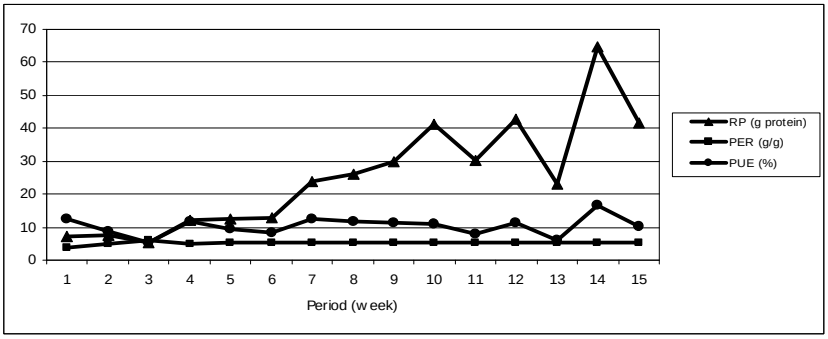

Figure 4. Rearing efficiency for carp sapling

Analyzing the proteins gain (RP) at carp sapling during experiment one consider that has a significant increase after sixth week because of fish adaptation to specific administrated food. That's proving as well as protein body accumulation has proportionally done with weight gain. However the oscillations concerning proteins gain showed in figure 2 there is owing to problems with assurance of optimum breeding conditions occurred during experiment and that have direct reflected on protein gain but also on others indicators that would be further presented.

The protein efficiency report (PER) depends on rearing spore and quantity of protein from fish feed. From figure 4 one can observe that PER and PUE have a relative constantly evolution during experiment: thus, more fed protein, more fish protein concentration.

After this study may estimate that rearing indicators, efficiency parameters of nutrition and biochemical fish composition are influenced by quality and quantity of feed, rearing system and environmental conditions.

Conclusions

Environmental changes can disturb metabolic equilibrium of fishes especially physiology and fish meat quality. The first stress reaction is a decrease of appetite that reduces digested energy. Also, the inanition conducts at the ending of muscular glycogen reserves and fat deposits through cleavage of fat. While fat deposits are less important the protean activity produces corruption of muscular structure, Kiessling *et al.* (1993), quoted by Billard R, (2002).

At the end of experiment, after 107 days of carp rearing of 8 months old in recirculation system, the nutritional meat parameters were recorded an increase of 22.85% crude protein and 52.58% fat and M/P report was decreased from 5.72 to 4.16. The parameters that indicate rearing eficiency in these technological conditions it shows a good food assimilation during experiment.

Having in view these aspects may appreciate that applying fish rearing technologies in controlled systems is advantageous by reason of surveillance of environmental conditions and giving possibility to action in case of modifications on environment quality and fish's physiology.

Bibliography

1. Cho, S. H., J-Y, Jo and D. S. Kim (2001)- *Effects of variable feed allowance with constant energy and ratio of energy to protein in a diet for constant protein input on the growth of common carp*. Aquac. Research Vol. 32, Issue 5, Page 349.

2. Kadadakatte Manjappa, Perar Keshavanat, Barlaya Gangadhara (2002) *Growth performance of common carp, Cyprinus carpio fed varying lipid levels through low protein diet, with a note on carcass composition and digestive enzyme activity*", Acta Ichthyologica et Piscatori a, vol. xxxii, fasc. 2

3. Papoutsoglou, S.E., G.Mylonakisa, H.Milioua, (2000) – *Effects of background color on growth performances and physiological responses of scaled carp reared in a closed circulated system* Aquacultural Engineering 22, 309–318

4. Sfetcu, L., E. Paltanea, V. Cristea, L. Oprea, A. Docan (2006) **–** *Data regarding biochemycal composition of carp fingerlings (Cyprinus carpio, Linne, 1758) reared in a recirculating system*. Lucrari Stiint. - Seria Zooteh. Vol. 48 (10)

5. Sharma, J.G., Rina Chakrabarti (1999) - *Larval Rearing of Common Carp Cyprinus carpio: A Comparision Between Natural and Artificial Diets Under Three Stocking Densities*, Journal of the World Aquaculture Society, vol. 30 Issue 4 Page 490-495