AgroLife Scientific Journal - Volume 12, Number 1, 2023
ISSN 2285-5718; ISSN CD-ROM 2285-5726; ISSN ONLINE 2286-0126; ISSN-L 2285-5718

THE EFFICIENCY OF CARP GROWING IN FLOATING CAGES THROUGH RARING AND LOTTING

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Abstract

Cypriniculture is the growth of cyprinids in a controlled environment. By planning and rationalizing feed and creating appropriate conditions to cover the needs of carp farming, this branch of aquaculture is made more efficient. Carp is a poikilothermic animal that does not consume energy to maintain body temperature. Thus, the administered food is converted into body mass more effectively than in other animal species. The feed conversion ratio shall not exceed 2. The action of lotion is differentiated from the one of raring by the process of populating the floating cages according to the weight category in which the carp individuals fall. The study involves the identification of an effective method of growing carps in floating cages, depending on the weight and amount of food administered. The technique of separating carp by lotting was proven to be more efficient compared to decreasing the number of individuals on floating cage. Carp individuals remained in the same weight category without large differences between them. This ensures the uniformity of biological material, and an economic beneficial effect.

Key words: *aquaculture, feed, floating cage, production, weight.*

INTRODUCTION

Scientific advances over the past decades have led to spectacular developments in aquaculture. Today, aquaculture provides more than 50% of the world's fish for human consumption (https://www.fao.org/fishery/en/aquaculture).
Raising fish in floating cages is an efficient way to obtain large quantities of high-quality protein through sustainable use of water resources and protection of the environment (Aïzonou et al., 2021). In order to achieve higher production, it is necessary to determine the optimal fish population density and fish size (Upadhyay el al., 2022). These two factors directly influence the health status, growth rate and survival of fish (Shamsuddin et al., 2022). Fish weight and water temperature are the parameters that determine the frequency of feeding sessions in order to establish a superior feed conversion ratio. It is necessary to maintain a low density within the cage to avoid significant numbers of underdeveloped fish and to ensure uniform growth of individuals (Anin et al., 2021). Scientific studies provide basic information for the feasibility and management of fish farms using floating cages (Ayal & Lewerissa, 2021).
The use of cages for fish breeding is an increasingly popular method of breeding, involving relatively low initial costs, technology and simple methods of management.
Floating ponds can be used for the production of fish in waters that do not allow the realization of high-performance fish farms.
The technology of growing fish in floating cages can be improved in order to increase economic efficiency by fish production.

MATERIALS AND METHODS

The present study aims to compare the results obtained after the thinning and distribution of the carp juveniles grown intensively in floating aviaries. Through this analysis it was tried to highlight the obtaining of the largest quantity of fish meat depending on the growth method applied by thinning and batching, and the amount of feed administered. The biological material used to conduct the study was represented by carp individuals, juveniles, with the average weight when populated in cages of 0.11 kg. The population with biological material was carried out on September 12, the carp individuals being equally distributed in two cages so, in Cage A and Cage B was distributed a number of 10000 pieces. On September 14th, the feeding of both cages began, the water temperature being 20°C. At the beginning of October, after 16 days of feeding, the first sorting took place so Cage A was sorted and batched according to weight in two cages, Cage A1-4000 pcs; A2-6000 pcs. The individuals in Cage B were thinned and divided equally, respectively B1-5000 pcs, B2-5000 pcs. Carp individuals were fed until November 5, when the water temperature dropped below 20°C. The wintering period lasted until April 17. After the end of the wintering period, the second sorting took place, following which the carp individuals from the B1 and B2 cages were divided into 3 cages: B3- 3290 pcs, B4- 3290 pcs, and B5-3290 pcs, while the carp individuals from cages A1 and A2 were sorted and separated according to weight into 3 cages as follows: A3- 3400 pcs, A4- 4000 pcs, A5 -2498 pcs (Figure 1).

In order to follow the growth dynamics following the two methods applied, namely thinning and batching, the fish were weighed after each stage of growth and distribution in cages including folk. The weighing was done using an electronic scale using randomly captured fish. The average weight was established by dividing the total weight weighed by the number of individuals weighed. Losses were established by summing up all the dead fish.

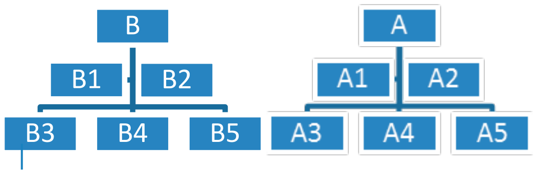

Figure 1. Cage division scheme

The results obtained during the study period, were statistically analysed with Microsoft Excel (Office 2019) and SPSS Statistics 20.0 for Windows.

The significance of results was tested with the Student test.

RESULTS AND DISCUSSIONS

The feed used during the research provided from an important company that imports fodder produced in a European country. Several types of granulations were used, depending on the category of fish fed (Ballester-Moltó et al., 2017). Body weight and water temperature were the two factors taken into account when was feed the carp fish (Table 1 and Table 2).

Table 1. Recommended feed level in kg per 100 kg fish/day (Source: https://www.aller-aqua.com)

Specification		Water temperature									
Fish weight (g)	Granulation (mm)	12°C	14°C	16°C	18°C	20°C	22°C	24°C	26°C	28°C	30°C
100-300	2	0.75	1.26	2.01	3.02	3.77	4.52	5.03	4.52	4.02	3.02
300-750	4	0.60	1.01	1.61	2.41	3.02	3.62	4.02	3.62	3.22	2.41
750-1500	6	0.48	0.8	1.29	1.93	2.41	2.9	3.22	2.9	2.57	1.93
>1500	8	0.39	0.64	1.03	1.54	1.93	2.32	2.57	2.32	2.06	1.54

Table 2. Number of meals according to water temperature (Source: https://www.aller-aqua.com)

Water temperature	12°C	14°C	16°C	18°C	20°C	22°C	24°C	26°C	28°C	30°C
Number of meals	1	1	1	2	3	4	5	4	3	2
Meal period	11:00	11:00	11:00	10:00	08:00	07:00	07:00	07:00	08:00	10:00
				14:00	13:00	11:00	11:00	11:00	13:00	14:00
					18:00	15:00	14:00	15:00	18:00	
						19:00	17:00	19:00		
							20:00			

Depending on the water temperature, the number of meals administered daily can vary from a single meal to five meals (Table 2). The minimum feeding interval between meals during all day was three hours.

The used fish feed fulfilled the following conditions:

- buoyancy, because the fish feed in the upper layer of the water;
- nutritionally complete, because the fish have no other source of feed;
- resistant packaging so as not to break during handling, thus avoiding feed losses.

The feed components consisted of: blood products, fish meal, rapeseed, rapeseed oil, soy protein concentrate, sunflower protein, vitamins, minerals. The crude protein content of the administered feed was 30%, crude fat 7%, and fibber 5.5%. The digestible energy was 12.6 MJ, regardless of the pellet size.

Following the first distribution both Cage A and Cage B were populated with a number of 10000 pieces of carp with an average weight of 0.11 kg. On September 14, the forage of both cages began, the water temperature being 20°C. Feed was given for 16 days at 3.77% of the live weight of carp individuals. During the 16 days of feeding, 663 kg of feed was administered, with a feed conversion ratio of 1.6, carp individuals reaching an average weight of 0.15 kg (Figure 2).

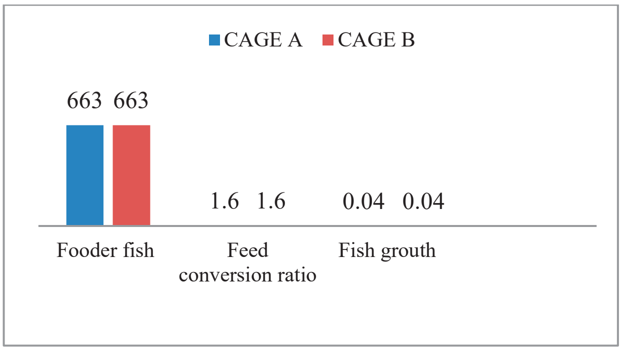

Figure 2. Comparison of cages before the first sorting

At the beginning of October, after 16 days of feeding, the first sorting took place. Cage A was sorted and batched according to fish weight as follows: cage A1-4000 pcs with an average weight of 0.17 kg; A2-6000 pcs with an average weight of 0.14 kg. Individuals in cage B were thinned and divided equally, respectively B1-5000 pcs with an average weight of 0.15 kg; B2-5000 pcs with an average weight of 0.15 kg. Individuals of carp were fed until November 5. At the end of this interval, the results presented below were obtained (Figures 3-6).

In Cage A1 it recorded a mortality of 0.9% with a loss of 36 individuals of carp, the amount of feed administered was 273 kg, the feed conversion ratio was 1.6, and the average weight of carp individuals was 0.21 kg.

Cage A2 recorded a mortality of 1.1% with a loss of 66 carp individuals, the amount of feed administered was 337 kg, the feed conversion ratio was 1.6, and the average weight of carp individuals was 0.17 kg.

Cage B1 recorded a mortality of 1% with a loss of 50 individuals of carp, the amount of feed administered was 301 kg, the feed conversion ratio was 1.8, and the average weight of carp individuals was 0.18 kg.

Cage B2 recorded a mortality of 1.4% with a loss of 70 individuals of carp, the amount of feed administered was 301 kg, the feed conversion ratio was 1.8, and the average weight of carp individuals was 0.18 kg. The wintering period lasted until April 17.

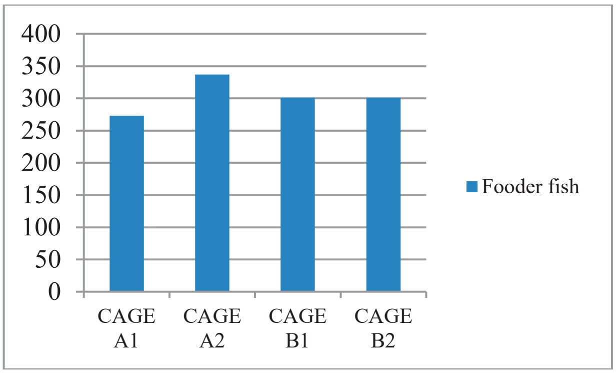

Figure 3. Comparison of the quantity of feed administered after the first sorting

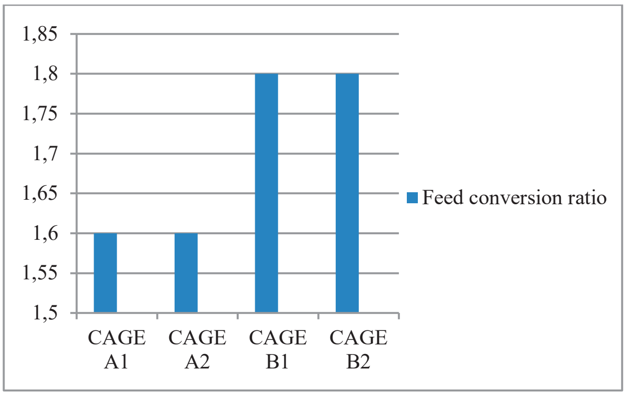

Figure 4. Comparison of the conversion ratio after the first sorting

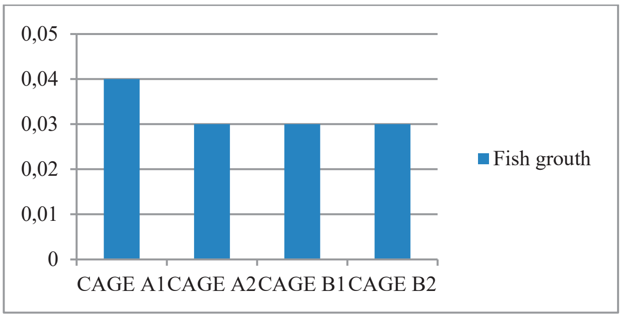

Figure 5. Comparison of weight gain after the first sorting

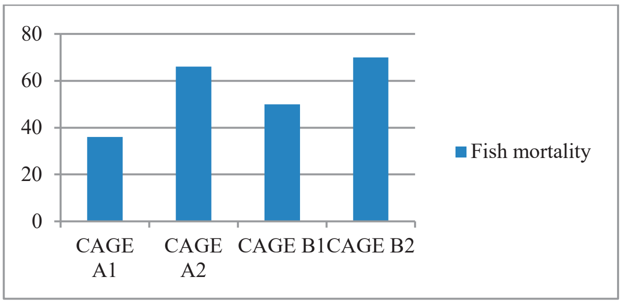

Figure 6. Comparison of mortality after the first sorting

After the second sorting by weighing all the individuals it was obtained the following results:

- Cage A3 - 3400 pcs (34% of the starting herd) with an average weight of 0.24 kg;
- Cage A4 - 4000 pcs (40% of the starting staff) with an average weight of 0.18 kg;
- Cage A5 - 2498 pcs (26% of the starting herd) with an average weight of 0.16 kg;
- Cage B3 - 3290 pcs (33% of the starting staff) with an average weight of 0.18 kg;
- Cage B4 - 3290 pcs (33% of the starting staff) with an average weight of 0.18 kg;
- Cage B5 - 3290 pcs (33% of the starting herd) with an average weight of 0.18 kg.

Looking at the results obtained it can see a better conversion rate (Table 3) for the cages that have been batched according to the weight of the individuals which can be translated by a lower production price (Figure 7).

Table 3. Results obtained after fish lotting and raring

Cage	Final weight	Mortality	Feed intake	Feed conversion rate	Weight gain
A (lotting)	1935 kg	102 pcs	1273 kg	1.52	835 kg
B (raring)	1776 kg	120 pcs	1265 kg	1.87	676 kg

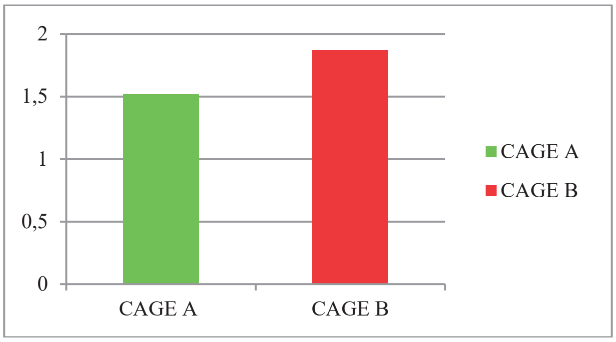

Figure 7. Comparison of the feed conversion ratio in both cages

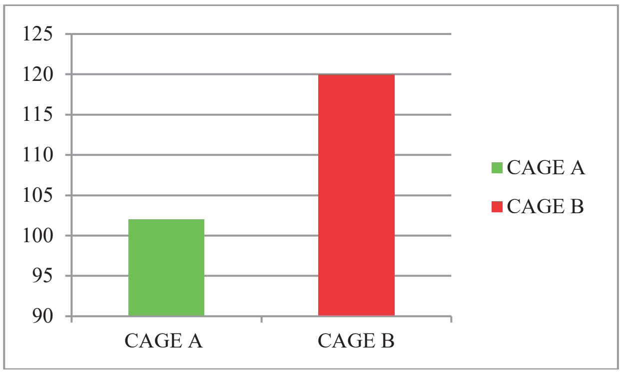

Figure 8. Comparison of mortality at the end of the study

The differences regarding the mortality between the cages where the fish individuals were raring and the cages where the fish individuals were sorted and batched are not considerable. The mortality difference was only 18 carp individuals (Figure 8).

Starting from the same number of fish individuals and the same weight at the beginning of the study, it is observed after the second sorting a considerable difference between the final weight (Figure 9), and the quantity of administered feed (Figure 10).

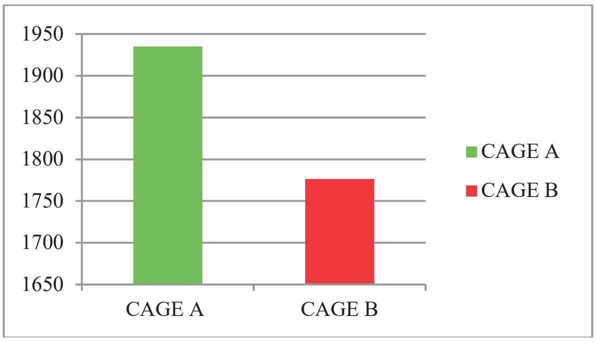

Figure 9. Comparison of the final weight

The relevance of results obtained at the end of experimental study on carp juveniles growth in floating cages was evaluated using the Student test.

The lots comparison started from the first stage meaning from the distribution in the two cages.

The averages for the cages were compared following the three parameters (mortality, feed quantity, and feed conversion ratio) (Tables 4, 5, 6).

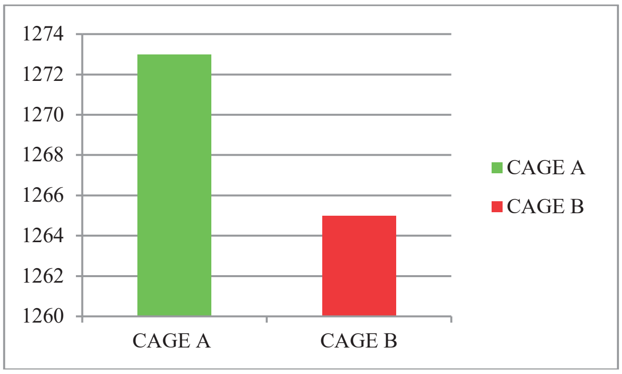

Figure 10. Comparison of the amount of food administered

Table 4. Testing the significance of the obtained results regarding mortality

Morality	Variable 1	Variable 2
Mean	68	80
Variance	1092	1300
Group of Observations	3	3
Pooled Variance	1196	
Hypothesized Mean Difference	0	
Df	4	
t Stat	-0.42497	
P (T<=t) one-tail	0.34636	
t Critical one-tail	2.131847	
P (T<=t) two-tail	0.69272	
t Critical two-tail	2.776445	

Table 5. Testing the significance of the obtained results regarding feed quantity

Feed quantity	Variable 1	Variable 2
Mean	627.6667	622.3333
Variance	313365.3	309765.3
Group of Observations	3	3
Pooled Variance	311565.3	
Hypothesized Mean Difference	0	
Df	4	
t Stat	0.011702	
P (T<=t) one-tail	0.495612	
t Critical one-tail	2.131847	
P (T<=t) two-tail	0.991224	
t Critical two-tail	2.776445	

Table 6. Testing the significance of the obtained results regarding feed conversion ratio

Feed Conversion Ratio	Variable 1	Variable 2
Mean	1.573333	1.823333
Variance	0.002133	0.001633
Group of Observations	3	3
Pooled Variance	0.001883	
Hypothesized Mean Difference	0	
df	4	
t Stat	-7.05541	
P(T<=t) one-tail	0.001064	
t Critical one-tail	2.131847	
P(T<=t) two-tail	0.002128	
t Critical two-tail	2.776445	

Statistical analysis for the three parameters that were measured was performed with Student test. The two groups of cages (A and B) for the mortality trait it was not statistically differences, p-values 0.69 (Table 4) show it that in both groups there were similar mortalities. Also, for the feed quantity, there are non-significant statistical differences with a p-values greater that 0.05 which was almost 1 (p-values 0.99, Table 5).

But when the analysis was made for conversion ratio it can be observed clear differences between the two groups of cages, differences that are sustained statistically with a p-value of 0.002 (Table 6). Therefore, after statistical analysis, only one trait of three gives us some statistical differences between the two groups of cages (A and B).

CONCLUSIONS

As a result of the research carried out and the results obtained regarding the carp breeding technology in floating cages by sorting and batching, the following conclusions resulted:

- Fish that were batched according to weight had a weight gain of 20% higher than those that were only rare.
- By batching, a feed conversion ratio is obtained lower by 19% than by thinning, this leading to a lower production price.
- By separating them, we obtained a uniform growth of the entire batch of individuals, and by thinning we obtain an uneven growth -the individuals being underdeveloped.

ACKNOWLEDGEMENTS

This research work is a part from the PhD thesis and was carried out with the support of Faculty of Animal Productions Engineering and Management, University of Agronomic Sciences and Veterinary Medicine of Bucharest.

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