

<https://doi.org/10.48047/AFJBS.7.2.2025.447-455>



African Journal of Biological Sciences

Journal homepage: <http://www.afjbs.com>



Research Paper

Open Access

Effect of *Lactobacillus acidophilus* on Growth Performance of Koi Carp (*Cyprinus carpio*)

Sahraoui Naima ¹, Cherif Mohamed Sif Islam ¹, Boukert Razika ^{1,2*}, Abdelli Amine ³, Gramit Saida ¹, Abed Ghania ¹, Hornick Jean Luc ⁴

1. Institute of Veterinary Sciences, University Saad Dahleb- Blida 1, Route de Soumâa, BP 270, 09000, Blida, Algeria,
2. Laboratory of Biotechnologies related to Animal Reproduction, Institute of Veterinary Sciences, Saad Dahleb University Blida 1, Algeria
3. Faculty of Science of Nature and Life, Akli Mohand Oulhadj University of Bouira, 10000, Bouira, Algeria.
4. Animal Nutrition Unit, Department of Veterinary Management in Animal Resources, Faculty of Veterinary Medicine, Belgium

*Corresponding author: Razika Boukert

Postal address: Veterinary sciences institute, Saad Dahleb University Blida 1, 9000, Algeria.

Phone : (213) 542605790

E-mail: razika555@live.fr

Volume 7, Issue 2, Feb 2025

Received: 05 Jan 2025

Accepted: 29 Jan 2025

Published: 09 Feb 2025

[doi:10.48047/AFJBS.7.2.2025.447-455](https://doi.org/10.48047/AFJBS.7.2.2025.447-455)

Abstract

Koi fish (*Cyprinus carpio*) is one of the fish species of high economic value. The world-wide importance of common carp (*Cyprinus carpio*) in inland fisheries stems from its role in contributing to animal protein supply for human demand. This study evaluated the effects of probiotics on growth performance of juvenile koi carp (*Cyprinus carpio*). A 30 day feeding experiment was conducted to measure the effects of adding a commercial preparation of *Lactobacillus acidophilus* (LA; 6×10^9 CFU/kg DM) in the diet of koi carp. The experimental diet contained 6×10^9 CFU LA/kg of a control diet. The incorporation of LA as a dietary probiotic in the basal diet for koi carp showed no significant effects on growth performance and Koi carp survival rate.

Keywords: Koi carp, Probiotics, *Lactobacillus acidophilus*, growth performance.

Introduction

Fisheries play a very significant socioeconomic role in many countries and communities, as a resource addressing poverty reduction and food security for poorer households (FAO, 2010).

If currently the rise in demand for animal protein is largely supplied by terrestrial farm animals, aquaculture is an increasingly important option in animal protein production (Henchion et al., 2017). Koi fish (*Cyprinus carpio*) is one of the fish species of high economic value.

There is increasing recognition that widespread antibiotic use in aquaculture might contribute to the development of resistance to antibiotics (Pepi and Focardi, 2021).

In recent years, probiotics have been widely used in aquatic animal feed because of their non-toxic, harmless, no residue, low cost and convenient use (Gao et al., 2013). Probiotics have been reported to provide beneficial effects on fish growth, immune response, disease resistance, and hence survival rate (Wang et al., 2018; Sîrbu et al., 2022) and now their use is considered as an important management tool in fish breeding (Falconer et al., 2019).

The aim of the present study was to evaluate the efficacy of a probiotic based on *Lactobacillus acidophilus* (6×10^9 CFU/kg feed), on growth performance of koi carp.

Materials and Methods

Animals study

Sixty juvenile koi carps were transported from a private hatchery (Boumerdes, Algeria) to the experimental station of Blida Institute of Veterinary Sciences. The experiment was conducted for 30 days and for this purpose 60 unsexed fingerlings common carp were used. All fish were sorted depending on size, then weighed and put in experimental batches. They were acclimated to laboratory conditions and fed with the control diet of the feeding trial for two weeks.

After the acclimation, the fishes (initial body weight 1.22 ± 0.02 g) were randomly assigned to six 100 L tanks. The number of treatment-groups was two (Control Group receiving a basal diet

and Experimental group, receiving a basal diet enriched with the probiotic). There were three replicates per dietary treatment. The tanks were part of a recirculation system, and 10% of the water was renewed daily. An evaluation of the physico-chemical parameters of the water was performed for the purpose of monitoring the aquatic environment. During the experiment, the temperature ranged from 23 to 26 °C, dissolved oxygen (DO) ranged from 5.6 to 7.8 mg/L, pH was 7.82 ± 0.05 and total ammonium and nitrite were kept below 0.1 and 0.05 mg/L.

Feed formulation

The formulation and chemical composition of the basal diet is shown in Table 1. The ingredients were mixed and air-dried at room temperature. In the diet 3% *Spirulina platensis* powder was incorporated.

The experimental diet was prepared using the basal formulation with the supplementation of 6×10^9 CFU/kg feed of a commercial probiotic for terrestrial vertebrates based on *L. acidophilus* NCC2463, provided by the Nestlé culture collection (Nestec Ltd., Lausanne, Switzerland). Feeds were stored in a cool dry place until used.

The animals were fed twice daily at 9:00 and 15:00 per day. Morphometric analysis was performed and survival rate measured at the beginning and at the end of the trial. The fish were weighed by batch thanks to an electronic balance (Roy Scientific Industries). The parameters were calculated according to the following formula in table 2.

Statistical analysis

All statistical analyses were done using R (version 3.5.1; R Foundation for Statistical Computing, Vienna, Austria) via RStudio (version 1.1.383, RStudio Inc., Boston, MA). Repeated-measures analysis of variance (ANOVA) in R was performed for all variables using compound symmetry (CS) structure. Post-hoc comparisons were computed using the ls means function from the ls means package in R. Mortality rates were analysed according to Fischer's Exact Test. The results were represented by the last square means (LSM) \pm standard error of mean (SEM).

We performed a power analysis with the help of G-power (version 3.1.9.7) on the basis of repeated measurements (3 blocks) on 2 groups and Power value of 0.95. The size effect was set at 0.5 (lower than the ones observed in the experiment). In that case, the effective number was calculated as equal to 38, while we used a total of 60 fishes. Such a low number may be associated to the fact that the SD within groups was low.

Discussion of Results

The fishes growth parameters are presented in Table 3. No significant difference was observed for weight gain, total length or FCR when comparing the two experimental groups. Nor survival rate differed between groups. Similar results have been reported by Deng et al. (2022) who found that dietary *B. subtilis* did not significantly improve growth and apparent feed conversion in Nile tilapia larvae.

In addition, Sahraoui et al. (2021) using *Lactobacillus* strain in feeding diets of tilapia fingerlings observed non significant – although numerical - effects on growth. However the same probiotic proved positive results on growth performance in common carp (Savin et al., 2022). In addition, Gatesoupe (1991) also reported increased weight gain in *Scophital mus* larvae fed a diet containing LAB and *Bacillus toyoi*. Moreover, supplementation with *Enterococcus casseli flavus* improved growth performance in common carp (Akbari et al., 2021). The beneficial effects of probiotics on growth performance have also been reported by Zaineldin et al., (2018) in the case of red sea bream, when adding probiotic *Bacillus subtilis* to food in a concentration of 108 and 1010 CFU kg⁻¹. Similar results were also observed in studies on gilthead sea bream (*Sparus aurata L.*) (Avella et al., 2010), Nile tilapia (*Oreochromis niloticus*) and large yellow croaker (*Larimichthys crocea*) (Aiqh et al., 2011). These results suggest that the effects of probiotics on fish growth may depend on fish species, probiotic type and interaction between them (Mocanu et al., 2022).

Food conversion ratio (FCR) was not influenced by addition of probiotics, but a significant effect was reported when a complex of *Bifidobacterium* sp. and *Lactobacillus* sp. was used in carp diet (Savin et al., 2022). Sîrbu et al. (2022) indicated that the probiotic *Bacillus licheniformis* (DSM 5749) and *Bacillus subtilis* (DSM 5750) contributed both maximizing feed utilization efficiency

and reducing infestation rates from various pathogens by activating immune cells. Several studies indicated that inclusion of probiotic in diets stimulated fish appetite (El-feky et al., 2017). This improvement can also be partially attributed to the probiotic composition itself, as a result of its richness in protein, carbohydrates, nucleic acids and vitamins and its dose.

A numerical difference between the two groups was noted regarding the mortality rate (10% vs. 00%). Carnevali et al. (2008) successfully used two strains of *Lactobacillus* to decrease mortality in sea bream larvae. Probiotics could have inhibitory effect on growth of pathogens, as well as could improve health and survival rate of fish.

Finally, a large number of studies have shown that the addition of probiotics can promote gut health of fish (Poolsawat et al., 2020).

Conclusion

The *Lactobacillus*-based probiotic used in this experiment did not induce noticeable benefits on animal performance to juvenile Koi carp. More studies must be performed to extend the duration of such experiment and to evaluate the impact of *Lactobacillus* probiotics on intestinal microbiota of Koi Carp.

Acknowledgements

The authors would like to thank all participants of this study.

References

- **Akbari, N., Maynou, F., Bjørndal, T., Failler, P., Drakeford, B. and Forse, A. (2021).** Scenarios of profitability of western Mediterranean demersal fisheries in an effort control regime. *Journal of Environmental Management*, 300, 113794.

- **Avella, M. A., Gioacchini, G., Decamp, O., Makridis, P., Bracciatelli, C. and Carnevali, O. (2010).** Application of multi-species of *Bacillus* in sea bream larviculture. *Aquaculture*, 305(1-4), 12-19.
- **Deng, Y., Verdegem, M. C., Eding, E., Kokou, F. (2022).** Effect of rearing systems and dietary probiotic supplementation on the growth and gut microbiota of Nile tilapia (*Oreochromis niloticus*) larvae. *Aquaculture*, 546, 737297.
- **Carnevali, O., de Vivo, L., Sulpizio, R., Gioacchini, G., Olivotto, I., Silvi, S. and Cresci, A. (2006).** Growth improvement by probiotic in European sea bass juveniles (*Dicentrarchus labrax*, L.), with particular attention to IGF-1, myostatin and cortisol gene expression. *Aquaculture*, 258(1-4), 430-438.
- **El-feky, M. M., Essa, M. A., Osman, A. G. M., Shalaby, S. M. and Moustafa, A. M. (2017).** Growth Performance of African Catfish *Clarias gariepinus* (Burchell, 1822) treated with Live Baker's Yeast (*Saccharomyces cerevisiae*) in Egypt. *International Journal Of Biotechnology And Bioengineering*, 3(6), 176-187.
- **El-Saadony, M. T., Alagawany, M., Patra, A. K., Kar, I., Tiwari, R., Dawood, M. A. and Abdel-Latif, H. M. (2021).** The functionality of probiotics in aquaculture: An overview. *Fish & Shellfish Immunology*, 117, 36-52.
- **Feng, S., Zeng, Y., Cai, Z., Wu, J., Chan, L. L., Zhu, J. and Zhou, J. (2021).** Polystyrene microplastics alter the intestinal microbiota function and the hepatic metabolism status in marine medaka (*Oryzias melastigma*). *Science of The Total Environment*, 759, 143558.
- **Falconer, L., Ozretich, R., Ekpeki, A., Telfer, T. (2019).** Carrying capacity and production models for aquaculture within freshwater lake systems in Europe EU H2020 TAPAS project Deliverable 5.6 Report. 21pp.
- **Gao, D., Gao, Z., Zhu, G. (2013).** Antioxidant effects of *Lactobacillus plantarum* via activation of transcription factor Nrf2. *Food & function*, 4(6), 982-989.
- **Gatesoupe, F. J. (1991).** The effect of three strains of lactic bacteria on the production rate of rotifers, *Brachionus plicatilis*, and their dietary value for larval turbot, *Scophthalmus maximus*. *Aquaculture*, 96(3-4), 335-342.

- **Henchion, M., Hayes, M., Mullen, A. M., Fenelon, M. and Tiwari, B. (2017).** Future protein supply and demand: strategies and factors influencing a sustainable equilibrium. *Foods*, 6(7), 53.
- Mocanu, E. E., Savin, V., Popa, M. D., Dima, F. M. (2022). The Effect of Probiotics on Growth Performance, Haematological and Biochemical Profiles in Siberian Sturgeon (*Acipenser baerii* Brandt, 1869). *Fishes*, 7(5), 239.
- **Pepi, M., Focardi, S. (2021).** Antibiotic-resistant bacteria in aquaculture and climate change: A challenge for health in the Mediterranean area. *International Journal of Environmental Research and Public Health*, 18(11), 5723.
- **Poolsawat, L., Li, X., He, M., Ji, D., Leng, X. (2020).** *Clostridium butyricum* as probiotic for promoting growth performance, feed utilization, gut health and microbiota community of tilapia (*Oreochromis niloticus* × *O. aureus*). *Aquaculture Nutrition*, 26(3), 657-670.
- **Sahraoui, N., Dahmani, Y., Djemaa, H., Bouachaa, C., Hornick, J. L. (2021).** Effect of a strain of *Lactobacillus* used as probiotic on the biological parameters of tilapia (*Oreochromis niloticus*). *Journal of Negative Results*, 14.
- **Savin, V., Cristea, V., Mocanu, E., Dima, F., Popa, M. D. and Patriche, N. (2022).** Efficiency of probiotics in carp (*Cyprinus carpio*) growth in the aquaculture recirculation system. *Animal Food Science Journal Iasi, (ION IONESCU DE LA BRAD)* 77, 269-273.
- **Sîrbu, E., Dima, M. F., Tenciu, M., Cretu, M., Coadă, M. T., Țoțoiu, A., Cristea, V. and Patriche, N. (2022).** Effects of Dietary Supplementation with Probiotics and Prebiotics on Growth, Physiological Condition, and Resistance to Pathogens Challenge in Nile Tilapia (*Oreochromis niloticus*). *Fishes*, 7(5), 273.
- **Wang, A. R., Ran, C., Ringø, E., Zhou, Z. G. (2018).** Progress in fish gastrointestinal microbiota research. *Reviews in Aquaculture*, 10(3), 626-640.
- **Zaineldin, A. I., Hegazi, S., Koshio, S., Ishikawa, M., Bakr, A., El-Keredy, A. M., Yukun, Z. (2018).** *Bacillus subtilis* as probiotic candidate for red sea bream: growth performance, oxidative status, and immune response traits. *Fish & shellfish immunology*, (79), 303-312.

- **Zhao, Y., Cao, X., Fu, L., Gao, J. (2020).** n-3 PUFA reduction caused by fabp2 deletion interferes with triacylglycerol metabolism and cholesterol homeostasis in fish. Applied microbiology and biotechnology, 104, 2149-2161.

Table 1. Formulation of the basal diet

Fed composition (% feed)	
Corn	40
Soybean meal	42
Olive oil	15
Spirulina	3
Chemical analysis (%)	
Dry matter	91.30
Crude protein	32.11
Ether extract	7.51
Ash	7.34

Table 2. Formula of different parameters

Parameters	Formula
Survival rate (SR,%)	$SR = \frac{\text{Nbr of fish at the end of experiment}}{\text{Nbr of fish at the start of experiment}} \times 100$
Relative weight gain (RWG, %)	$RWG = \frac{\text{Final body weight} - \text{initial body weight}}{\text{initial body weight}} \times 100$
Feed conversion ratio (FCR)	$FCR = \frac{\text{Feed intake (g)}}{\text{weight gain of fish(g) per batch}}$
Standard length (SL, cm)	SL = length from tip of snout to posterior end of the last vertebra, i.e., to posterior end of midlateral portion of hypural plate
Total length (TL, cm)	Length from tip of snout to tip of the longest lobe of caudal fin, with lobes compressed along midline

Table3. Average mortality rates in unequipped buildings

Parameters	Control (30)	Experimental (30)	P > F

Relative weight gain (g)	1.86 ± 0.04	1.90 ± 0.04	0.98
Total length (TL, cm)	4.91 ± 0.04	4.98 ± 0.04	0.82
Standard length (SL, cm)	3.88 ± 0.03	3.91 ± 0.03	0.98
Mortality rate (%)	10	0	0.24
Feed Conversion ratio (FCR)	2.85 ± 0.24	1.81 ± 0.28	0.32