

Water quality management in gold fish (*Carassius auratus*) rearing tanks using different filter materials

Y. Prema Latha¹ and A.P. Lipton²

¹Department of Zoology, Holy Cross College, Nagercoil - 629 004, Tamilnadu, India
Centre for Marine Science and Technology, MSU, Marina Campus

Rajakkamangalam - 629 502, Tamilnadu, India

ABSTRACT

The present study deals with the management of water quality in *Carassius auratus* (gold fish) rearing tanks using different filter materials. The system with dead coral pieces (DCP) is the most suitable for rearing gold fish.

Introduction

The nitrogen compounds dissolved in the fish rearing tank are the most important in determining the health of fish. Most nitrogen compounds enter a tank in the form of nitrogenous wastes of fish. Generally ammonia is found in the water either as toxic unionized (NH₃) form or in nontoxic ionized form (NH₄). Ammonia containing nitrogenous organic matter is directly or indirectly toxic to many species of aquatic animals. Ammonia and other toxic metabolites can be managed by filtration methods. There are three types of filtration; 1. Mechanical filtration which removes the solid particles, like floss, gravel or a foam filter serve as mechanical filters. 2. Chemical filtration which is accomplished using activated carbon, ammonia absorbents or water softeners. 3. Biological filtration which occurs in a series of steps in which nitrogenous organic compounds are maintained, and converted into inorganic nitrogen and removed from solution by complete biochemical reduction by assimilation into plant tissues. It is provided by normal denitrifying water bacteria (*Nitrosomonas* and *Nitrobacter* spp) which breakdown ammonia into nitrites and nitrates

which are nontoxic to fishes (Sharma and Ahlert, 1977). Water bacteria play an essential role in maintaining water quality' (Cooper, 2006).

The application, design and maintenance techniques of bacteriological filters are well established (Spotte, 1973, 1979). It is understood from the earlier studies that most of the filters designed are gravel bed composed of calcareous material such as oyster shell, fossil DCP, calcite and dolomite etc (Spotte, 1979) and well graded with a grain that falls within the range of 2-5mm.

In the present study attempts were made using modified methods, to manage water quality in *Carassius auratus* rearing tanks using different filter materials such as gravel, pebbles, pebbles+DCP and DCP under laboratory conditions.

Materials and methods

Design and Maintenance of filter system

Five rectangular glass aquarium tanks of 40x20x15 cm were fabricated and numbered (1 to 5). The first tank was kept without any filter and treated as the control. The remaining four tanks were fitted with filter plates made of

acrylic sheets to the size of 39x19 cm with drilled holes of 3.0 mm diameter size. The holes were separated by a gap of 2.5cm. To each filter plates, two vertical PVC pipes were connected in holes made at the extreme ends. One of the pipes served as the inlet to which aerator is connected and the other as the outlet. The surface area of the filter plates in the four tanks numbered 2,3,4 and 5 was spread with gravel, pebbles, pebbles + DCP and DCP respectively to a thickness of 5 cm. All the tanks were filled with 25 L of water. Five fishes of same weight class (3.0 to 7.0g) were introduced into each of the system and were fed *ad libitum* with commercial fish feed (Sanyu tropical).

Determination of physio-chemical parameters in the aquaria :

The various parameters of water such as temperature, pH, CO₂ content, DO and ammonia in all the filter systems were determined daily for 30 days. The temperature in the tanks were measured daily at 9.0 a.m using a Celsius thermometer (N.S. Dimble make). The pH of water was determined daily using a pH meter (Systronics Model 321). The carbon dioxide level in the water was determined following the method of Adoni (1985). The dissolved oxygen content of the water was determined daily using modified Winkler's method (APHA, 1998). The dissolved ammonia was determined following the method of Solórzano (1969).

Results and Discussion

The various types of modified filter system with different filtrants, designed for rearing of *C. auratus* are found very economic, easily installable under laboratory or home condition.

The water temperatures, in the present study ranged between 23°C and 29°C with a difference of 6°C. Higher temperatures reduce the amount of oxygen content in the

water, reducing the tank's stocking density (Cooper, 2006).

Although the recommended pH range for fresh water fish falls between 6.8 and 7.2 (Cooper, 2004) most gold fish culturists were able to culture them successfully between 6.5 and 8.5. In the present study *Carassius auratus* was successfully reared in pH ranges between 6.0 and 8.3 in different types of filter systems (Fig.1). The changes in pH were very low and gradual. Higher pH can enhance the formation of ammonia in the water while low pH can adversely affect the functions of the fish's gills and can be detrimental to the growth of denitrifying bacteria (Cooper, 2006).

The carbon dioxide content was low only in the coral filter system (Fig.2). This shows a regular and steady respiratory metabolism in the fish.

In the present study the dissolved oxygen content was highest (7.5 ml/L) in dead coral piece filter system (Fig.3). Although there is no single upper limit on dissolved oxygen concentration which applies to all fishes or fish cultured situations, there is general agreement on the lower limit i.e. 4.0 ppm for warm water fishes and 5.0 ppm for Salmonids (Wedemeyer *et al*; 1999).

In fresh water fishes ammonia toxicity varies from species to species, other water quality parameters, experimental method, the age, acclimation history and conditions of the experimental fishes etc. There was a gradual increase in the amount of ammonia from the beginning to the 4th day and there was sharp decrease up to 28th day in gold fish rearing tank (Fig.4). It was reported that gold fish possesses higher tolerance to ammonia (12.75mg for 24 to 48 hr), compared to trout (12.75mg for 24 to 48 hr) (Olson and Fromm, 1971; Levin *et al*; 1972). The present study reveals that as the days of rearing increases, the ammonia content

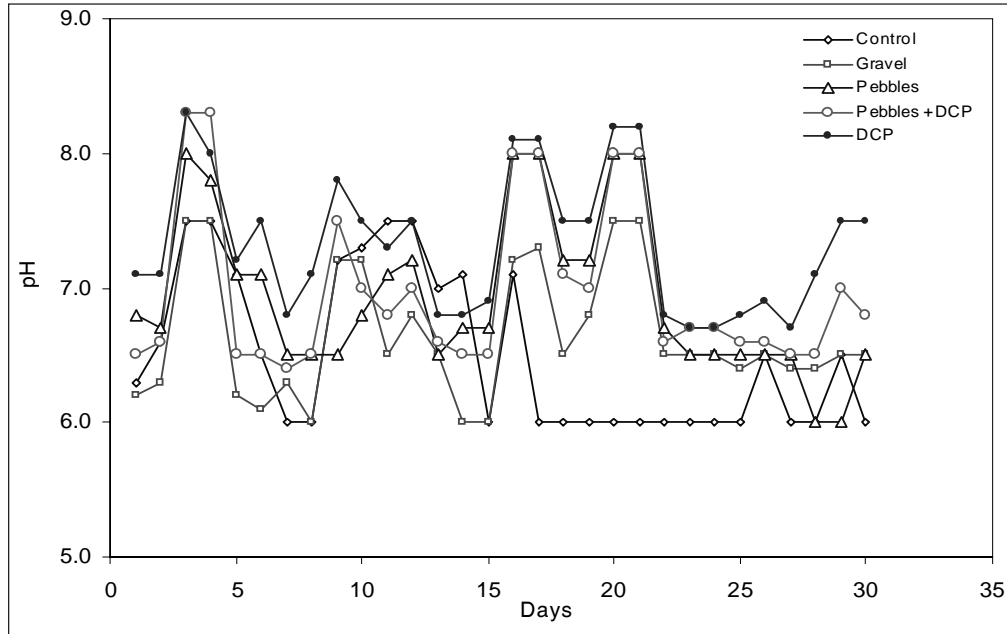


Fig. 1. Changes in pH in aquaria with different filter systems

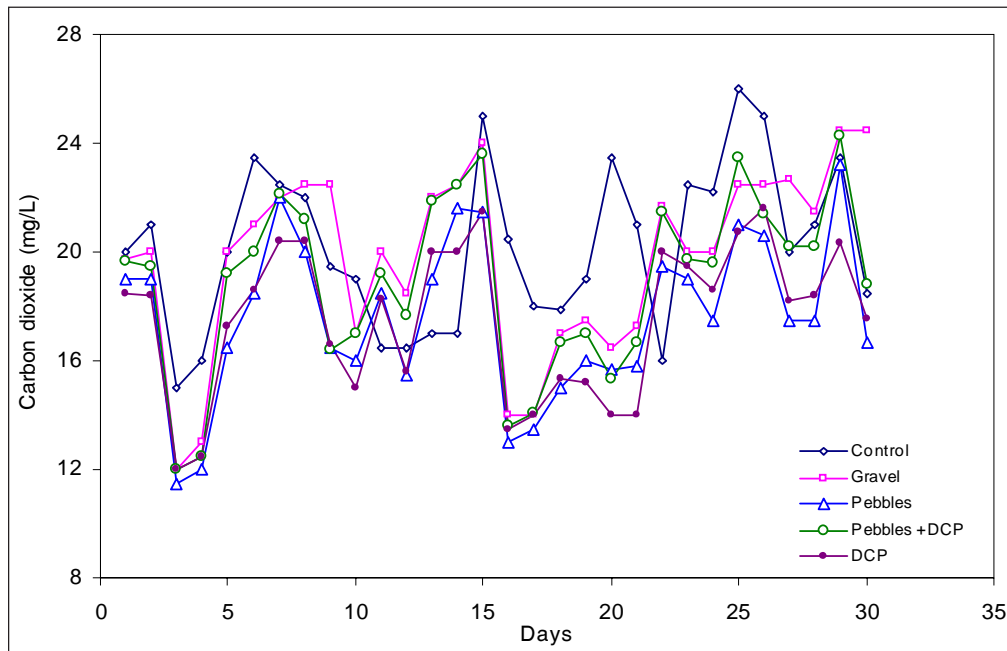


Fig. 2. Carbon dioxide content in aquaria with different filter systems (*Carassius auratus*)

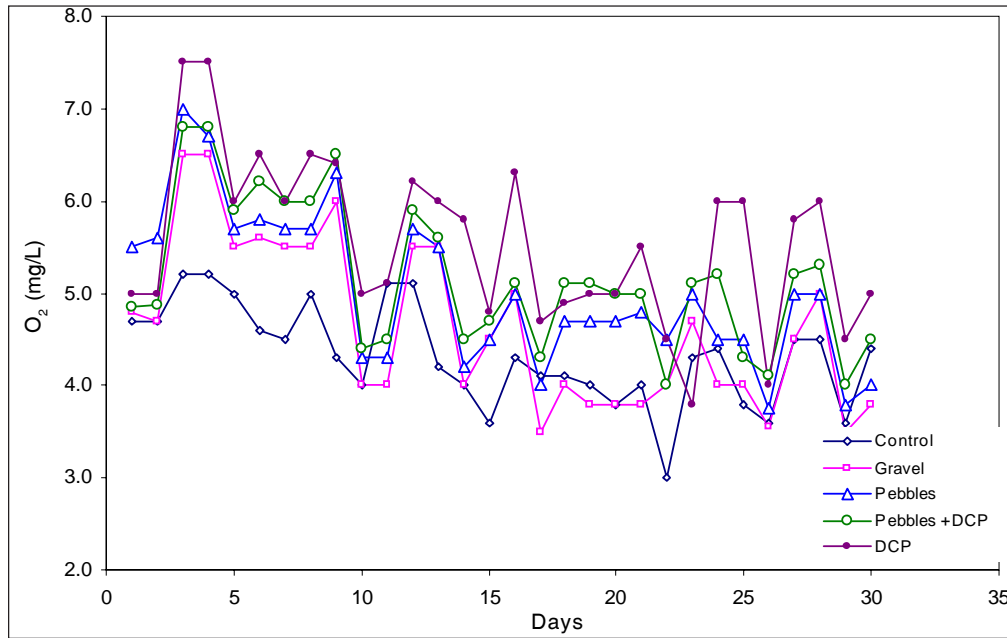


Fig. 3. Oxygen content in aquaria with different filter systems (*Carassius auratus*)

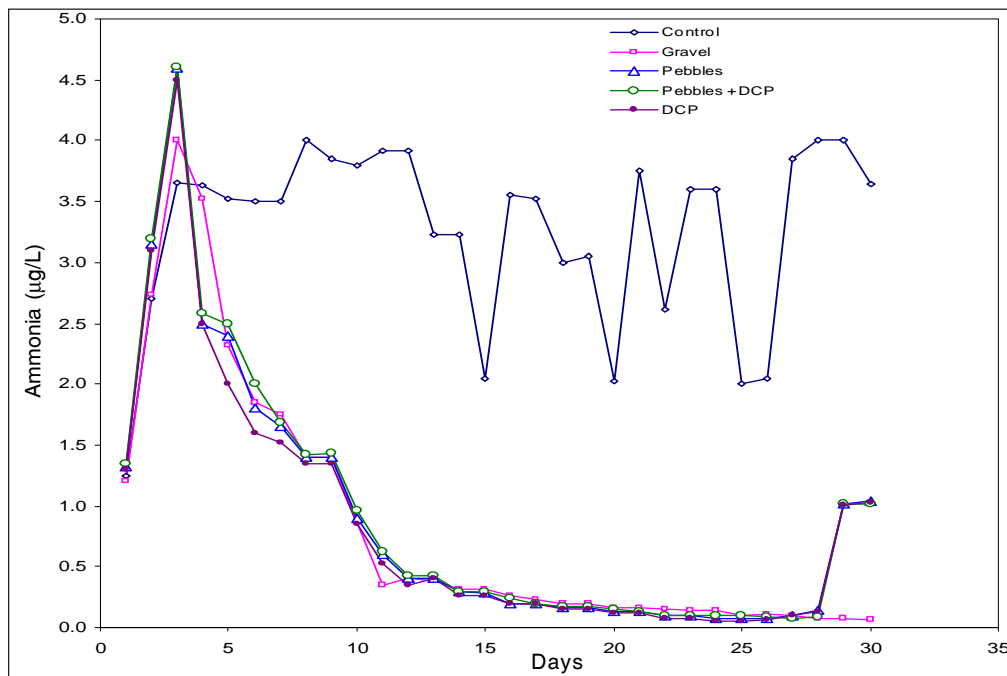


Fig. 4. Ammonia content in aquaria with different filter systems (*Carassius auratus*)

Table 1. Relationship between various hydrological parameters of *Carassius auratus aquaria* ('r' values)

Type of filtrant	Water temperature v/s oxygen content	Water temperature v/s carbon-dioxide content	Carbon dioxide v/s pH	Oxygen content v/s ammonia content	Days v/s ammonia content
1. No filtrant (Control)	- 0.805	0.708	- 0.272	0.422	0.042
2. Gravel	- 0.734	0.561	- 0.759	0.757	- 0.760
3. Pebbles	- 0.752	0.632	- 0.766	0.715	- 0.737
4. Pebbles + DCP	- 0.833	0.626	- 0.883	0.600	- 0.723
5. DCP	- 0.771	0.609	- 0.880	0.517	- 0.691

decreases in all types of filter systems. The calculated mean values show that, among all the four types of filtrants used, coral piece filter system contained low level of ammonia.

Relationship between various physicochemical parameters of *Carassius auratus aquaria* ("r" values) are presented in Table 1. The results obtained in the present study indicate that preference can be given to DCP filter system while designing a filter system and to pebble+DCP the next preference, rather than all other filtrants, to ensure better rearing condition.

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