

Changes in some water quality conditions in recycling water using three types of biofiltration systems during the production of the sharptooth catfish *Clarias gariepinus* (Burchell)

Part I: Relative efficiency in the breakdown of nitrogenous wastes by the different biofiltration units

JF Prinsloo*, W Roets**, J Theron, LC Hoffman*** and HJ Schoonbee
Aquaculture Research Unit, University of the North, Private Bag X1106, Sovenga 0727, South Africa

Abstract

A comparison is made of the relative efficiencies in the breakdown of nitrogenous wastes of three types of water recirculation biofiltration units used during the production of the sharptooth catfish *Clarias gariepinus* (Burchell). Two types of trickling filters were employed. One contained PVC shavings with a calculated surface contact area of 1 220 m². The second is a more sophisticated biofilter unit made up with Siporax porous sintered glass cylinders with a total surface water contact area of 32 000 m². The third filter consisted of a rotating biological contactor unit with a water contact surface area of 271.2 m². Investigations showed that the PVC shavings filter unit was clearly the most efficient of the three by transforming more than 96% of the NH₃-N into NO₃-N. This was followed by the rotating biological contactor with a 93% efficiency and lastly by the Siporax filter with an almost 93% efficiency. The outcome of the section on the production of *Clarias gariepinus* follows in **Part 2** of this series.

Introduction

Traditionally aquaculture is usually synonymous with pond fish culture. Originally, this implied the extensive propagation of fish in outdoor ponds where ample clean unpolluted water is available with little or no problem with water quality conditions (Bardach et al., 1972). Valuable information was subsequently gained in a number of countries on the use of fish polyculture in ponds utilising the various niches in a pond ecosystem. Use was also made of the addition of agricultural wastes to increase fish pond productivity further, thereby increasing fish yields (Prinsloo and Schoonbee, 1984a, b, c); Prinsloo and Schoonbee, 1986).

To further improve the productivity of fish pond systems, some integrated aquaculture-agriculture systems were investigated under local conditions such as duck-fish and vegetable production using the same water (Prinsloo and Schoonbee, 1987). To economise on the use of water in aquaculture in the present series of investigations, the indoor recirculation of water was coupled with the intensive monoculture of fish. This approach has already been followed for several decades in different countries in the world with variable degrees of success (Dryden, 1986). Problems are, however, encountered with the release and accumulation of metabolic wastes in pond water which may lead

to potentially toxic conditions as well as to significant fluctuations in some water quality parameters such as pH, alkalinity, turbidity, ammonia and, in the prevailing dissolved oxygen levels of the recirculation water. In order to remedy this situation, steps were implemented to minimise and, in some cases, also to reduce the initial levels of some of the potentially toxic metabolic wastes discharged into the recirculation water (Miller and Libey, 1983; Manthe and Malone, 1987; Stickney, 1986). Various types of mechanical and biological filters were developed to aerate the water and to facilitate the breakdown processes of nitrogenous wastes (Tucker, 1985; Provenzana and Winfield, 1987; Knösche, 1994; Timmons and Losordo, 1994). In the present investigation, the relative efficiencies of three types of biofiltration units, participating in the breakdown of nitrogenous wastes, were investigated in the semi-intensive production of the sharptooth catfish *Clarias gariepinus* (Burchell) in indoor water recirculation fish production systems. Results on the actual production of the sharptooth catfish over a 78 d period is considered in **Part 2** of this series.

Materials and methods

Fish production units

Three of five water recirculating units, housed in a 625 m² fibreglass tunnel (System 1 to 3, Fig. 1), were used in the production of *C. gariepinus*. The three units were basically identical and differed only in their respective types of biological filter units employed. The temperature inside the tunnel was regulated by four thermostatically activated electric extraction fans located at the one end of the tunnel, extracting cold air through a 40 m² wet wall. Matured, clean tap water was used to fill all the water-recirculating systems in the tunnel. Each of the

* To whom all correspondence should be addressed.

☎ (015) 268-2294; fax(015)268-2294;
e-mail koosp@unin.unorth.ac.za

** Presently at Department of Animal Science, University of Stellenbosch, P/Bag X1, Matieland, 7602, South Africa

*** Presently at Cape Nature Conservation, P/Bag X5014, Stellenbosch, 7599, South Africa

Received 14 May 1998; accepted in revised form 12 October 1998.