

The effect of pH and selected chemical variables on the reproductive cycle of *Oreochromis mossambicus*

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Abstract

Adult male and female *O. mossambicus* from Syt'erkuit Dam, situated 28 km NW of Pietersburg, were analysed for gonad mass and length, gonadosomatic indices, blood pH and gonad pH over a twelve-month experimental period. Male development seems to be dependant on female development in that it "lags" behind the female by two months. Male GSI reaches a peak of $0.78 \pm 0.12\%$ during November as opposed to the female maximum of $3.11 \pm 0.72\%$ during September. Blood and gonadal pH show an inverse relationship when breeding is prevalent. Male gonads are more alkaline (7.72 ± 0.29) and females more acidic (6.94 ± 0.16) during September. The chemical composition of the blood plasma and gonadal supernatant varied considerably over the experimental period. Glucose, lipids, lactate and proteins are all involved in energy production or provide a protective function to developing gonads. The presence of urea is indicative of protein metabolism. A breeding; resting and gonadal recrudescence season may be distinguished in both male and female *O. mossambicus*.

Introduction

Many tilapias, including *O. mossambicus*, are good candidates for fish farming due to their robustness, wide distribution, significant growth rate and ease of reproduction. Tilapias are generally deep-bodied, with a predominantly vegetarian diet that is reflected in their small teeth, fine pharyngeal teeth and extended intestines (Skelton, 1993).

According to Skelton, (1993) the Mozambique tilapia (*O. mossambicus*) breeds during summer, with the female raising multiple broods every three to four weeks during the season. Males construct a saucer-shaped nest on the sandy bottoms of the impoundment; the female mouths the eggs, larvae and small fry. Although *O. mossambicus* grows rapidly and may mature in the space of a year, it is prone to stunting under adverse or crowded conditions (Baroiller and Jalabert, 1989).

As a general trend in fish, it is considered that factors effecting reproduction are likely to act through or on the gonads by modulating their development. Tilapias are generally tolerant of wide temperature and salinity ranges, and *O. mossambicus* is able to live and breed in both fresh- and seawater.

Studies on body and gonad mass are common in determining the reproductive stage of freshwater fish and a gonadosomatic index (GSI) has been calculated to determine the reproductive maturity of gonads (Nel, 1978).

The pH of both the blood and the gonad is also used as an indicator of reproductive maturity (Morisawa and Morisawa, 1988). It is thought that spermatozoa acquire the potential for motility during their passage through the sperm duct. Although there is a critical pH value above or below which damage will occur to the spermatozoa, an increase in pH appears to be necessary to provide the spermatozoa with the ability to acquire motility (Morisawa and Morisawa, 1988).

Length-mass relationships have been examined by Taphorn and Lilyestrom (1983) in *Curimatus magdalenae* and by Marshall and Echeverria (1989) in the monkeyface prickleback *Cebidichthys violaceus*.

The chemical composition of both the plasma and gonads of freshwater fish may provide an indication of homeostasis and health status during reproductive development. Lipids (Rao and Rao, 1984; Besnard et al., 1989; Garcia-Garrido et al., 1990), proteins (Mukhopadhyay et al., 1986; Mukhopadhyay et al., 1987) and urea (Grubinko and Yakovenko, 1987) have been examined.

The presence or absence of inorganic and organic components and the osmolality and pH of the plasma and the gonads in association with the reproductive cycle are considered to be important (Ginzburg, 1972; Scott and Baynes, 1980).

Mukhopadhyay et al. (1986) have stated that mature fish eggs contain a very large amount of protein-rich yolk. Although it is known that the synthesis of protein and other cellular components in a species depends on its genome, it is conceivable that any seasonal variation in total protein may provide an indication of the reproductive development of the fish. Glucose, lactate and lipids, although more likely to be energy sources, may also provide an indication as to the stage of development of the gonads in *O. mossambicus*.

Very little information could be obtained pertaining to studies on glucose, lipids, proteins or lactate for freshwater fish. Loir et al. (1990) have shown that protein is present in seminal fluid to a much lesser extent than it is in the plasma. The importance of the study of proteins for biochemical systematics is usually used to show that both qualitative and quantitative differences in fishes may be related to genetic variants. In this study it would be more likely that the quantitative differences in total protein levels could be related to a developmental stage of the gonad.

Rao and Rao (1984) have measured the levels of total lipids, phospholipids, free fatty acids and total cholesterol in *O. mossambicus*. Their results suggest that lipids are utilized to mitigate any condition and as reproduction is a high stress condition, considerable lipids ought to be present during the spawning period of fish. When lipid levels are reduced it could be due to increased gluconeogenesis being induced, particularly in the liver and muscle.

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Received 11 May 1995; accepted in revised form 30 October 1995.