

# Seasonal fluctuations in gonadotropin levels in the plasma and gonads of male and female tilapia, *Oreochromis mossambicus*

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## Abstract

Syferkuil Dam is situated 8 km NW of the University of the North and comprises a series of eight interconnected rectangular dams, having cement sides and mud bottoms. Throughout the experimental period, male and female adult specimens of the mouthbrooding tilapia, *Oreochromis mossambicus*, were collected for further analysis. Aspects of the reproductive physiology of *O. mossambicus* that were investigated included the role of gonadotropin hormones in reproduction. There are two distinct gonadotropins in *O. mossambicus*, luteinizing-like hormone (LH-like), and follicle stimulating-like hormone (FSH-like). Both of these hormones are secreted in response to increased water temperature and both are involved in enhancing spawning. The gonadotropins also provide the impetus for steroid hormone secretion to occur. Human chorionic gonadotropin ("HCG") plays a role in the final maturation of the oocytes within the female ovary. The results imply a close interaction between environmental cues and endocrine control of reproduction. Endocrine control cannot be sustained without the appropriate environmental cues required to stimulate reproduction.

## Introduction

Seasonal cycles of gonadal activity have been described for many teleost species. The association of changes in gonad condition with plasma levels of gonadal steroids and the gonadotropins has proven to be a valuable tool in the development of an understanding of endocrine control of reproduction in teleosts (Cornish, 1993).

Although it has been ascertained in cyprinids that final oocyte maturation and ovulation are induced by a preovulatory gonadotropin surge, little is known about the plasma and gonadal changes in gonadotropin and steroid hormone levels during the reproductive cycle in *O. mossambicus*.

The role of hormones in the regulation of reproductive behaviour in fish is a highly investigated area of study. Evidence for the hormonal regulation of reproductive behaviour is based upon:

- the treatment of fish with exogenous hormone preparations, with or without prior gonadectomy; and/or
- the correlation of the timing of reproductive behaviour with endocrine activity as assessed by histological and cytological means.

More recently these techniques have been combined with the use of neurohormones, dopamine antagonists and other pharmacological agents. In comparison with these more traditional procedures which relied upon histological and cytological data, radio-immunoassay (RIA) assessment of plasma and gonadal hormone levels provides a more precise analysis of the relationship between endocrine state and behaviour (Liley et al., 1987), as well as the stage of gonad development.

The paramount importance of the pituitary gland in the control of teleost reproduction has been extensively reviewed by

Dodd (1960), Hoar (1969) and Lam et al. (1978). Idler and Ng (1983) state that until 1975, data from chemical fractionation studies and bioassays supported the concept that the teleost pituitary elaborated a single gonadotropin which controlled all phases of the reproductive cycle including vitellogenesis, oocyte maturation, ovulation, spermatogenesis, androgen production and spermiation. Since 1975, reports on the isolation of gonadotropins from more teleostean species have appeared, and the results have shed some light on the controversial issue of the number of gonadotropins in this important class of vertebrates.

Farmer and Papkoff (1977) and Hyder et al. (1979) have shown that there appear to be two distinct gonadotropins in tilapia; one that resembles luteinizing hormone (LH-like) and another that resembles follicle stimulating hormone (FSH-like) in terms of their biological activity and chromatographic behaviour. Tilapia gonadotropins seem to be involved in stimulating spermatogenesis and androgen secretion in males.

Considerable experimental data have been collected on the role of gonadotropins in tilapia (Gissis et al., 1986; 1991; Levavi-Zermonsky and Yaron, 1986; Planas et al., 1990; Yaron and Levavi-Sivan, 1990; Levavi-Sivan and Yaron, 1992). Gissis et al. (1991) have demonstrated the dual hypothalamic control of gonadotropin release in tilapia, particularly in response to circulating gonadotropin releasing hormone (GnRH) levels. Levavi-Sivan and Yaron (1992) have shown the involvement of cyclic adenosine monophosphate (AMP) in the transduction of the short-term effect of GnRH on gonadotropin release in tilapia. The cyclic AMP seems to operate in an interconnected manner with the system of calcium influx.

Zohar and Billard (1984) have examined annual plasma gonadotropin and sex steroid levels in relation to teleost gonad cycles. The plasma gonadotropin levels increase only gradually during the major part of gonadal development (vitellogenesis, spermatogenesis) but increase sharply toward the end of gametogenesis; that is at the time of oocyte maturation and ovulation and before spermiation.

Burlakov et al. (1985) have shown that by measuring the levels of gonadotropin in the plasma of tilapia (*Oreochromis*

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