Use of the pituitary glands of the sharptooth catfish *Clarias gariepinus* in the induced spawning of the European common carp *Cyprinus carpio* and the Chinese grass carp *Ctenopharyngodon idella*

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Abstract

Pituitary gland extract (PGE) of the sharptooth catfish *Clarias gariepinus* was used in the successful induced spawning of the European common carp *Cyprinus carpio* and the chinese grass carp *Ctenopharyngodon idella*. The ease with which spawning is achieved in both recipient species suggests that *C. gariepinus*, which is generally available in South Africa, may well become a suitable PGE donor for at least the cyprinid species spawned artificially under local conditions.

Introduction

A considerable amount of information exists on the types of hormones used in the induced spawning of fin fish species including reviews and manuals, such as Shehadeh (1975), Chaudhuri (1976), Harvey and Hoar (1979), Pullin and Kuo (1980), Woynarovich and Horváth (1980). Although synthetic hormones and human chorionic gonadotropins (HCG) are increasingly used to assist in, or to replace pituitary gland hormones in the artificial spawning process of some fin fishes (Weil *et al.*, 1980; Donaldson *et al.*, 1982), the hypophysation process still remains the most popular method of induced spawning amongst fish culturists. One of the major problems confronting the fish breeder, however, remains the availability, during the spawning season, of adequate quantities of pituitary gland material. In the case of cyprinid fish species, the pituitary gland of the European common carp is used exclusively or in combination with HCG in the artificial spawning programmes (Woynarovich and Horváth, 1980; Lam, 1982; Prinsloo and Schoonbee, 1983; Schoonbee and Prinsloo, 1984).

In South Africa where pond culture of the European common carp is practised on a very limited scale, a scarcity of freshly prepared pituitary gland material of this species is generally experienced. The success with which the African sharptooth catfish, *Clarias gariepinus* (Burchell) could be spawned purely with the aid of pituitary gland homogenate (Schoonbee *et al.*, 1980), prompted the authors to investigate the use of the pituitary glands of this species in the artificial spawning of the European common carp and the Chinese grass carp.

The sharptooth catfish is widely distributed in Southern Africa, occurring in large numbers in rivers and impoundments as far south as the Orange River system in the west and the Umtamvuna River, Natal, in the east (Jubb, 1967). Its distribution extends northwards in Africa to the Nile River (Bruton *et al.*, 1982; Teugels, 1982). With the construction of the Fish River tunnel, which connects the Orange River with this basin, this fish now also invades and becomes more readily available in the Fish River system of the Eastern Cape. (Cambray and Jubb, 1977; Fogarty, 1980; Scott and Hamman, 1984).

During the 1985 induced spawning program of the European common carp and the grass carp at the Umtata Dam Fish Research Centre, the gonadotropic potency of the pituitary glands of the sharptooth catfish was compared with that of the common carp. In both cases pituitary gland material was collected towards the end of winter prior to the onset of the fish breeding programme. Glands collected were individually kept in vials, indicating the sex and mass of each of the respective donor fish. All material collected was from live mature adult specimens of both fish species. In the case of the sharptooth catfish, glands were collected (mid-August) from fish in a reservoir, the Roodeplaat Dam near Pretoria, whilst those of the common carp were obtained from pond grown fish kept for this purpose at the Umtata Dam Fish Research Centre. The glands were dehydrated in absolute alcohol and kept refrigerated at temperatures below 4°C until the day of use.

Hatchery procedures

Two-year old common carp males and females, ranging in mass between 1 and 1,5 kg, as well as 3 to 5 year old grass carp males and females were transferred from the ponds to the hatchery where they were disinfected against external parasites according to Leteux and Meyer (1972) before they were weighed, marked and placed in groups of three females in 500 ℓ PVC containers. Sufficient numbers of males of both species required for the fertilization programme were kept in separate tanks in the hatchery. Conditioned water from previously prepared fish ponds was used in a closed recirculating system. Water temperatures in the system were kept above 20°C. All fish were acclimated for six hours in the hatchery, before the hormone injection programme commenced.

Injection programme

Two fractional injections were given eight hours apart. For the purpose of comparison, pituitary gland extract (PGE) of both the

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sharptooth catfish as well as the common carp was administered to different groups of common and grass carp spawners (Table 1). The relative dosage strength of each of the series of two injections applied was as follows: *Common carp:* First injection: one third gland per kilogram recipient female; second injection: two thirds of a gland per kilogram recipient female. *Grass carp:* first injection: one fifth gland per kilogram recipient female; second injection: one gland per recipient female. In both cases the concentration of the gland was based on the mass equivalent of the donor fish and recipient female. Each dosage was applied with a separate clean sterilized syringe. Glands were homogenized in 0,9% NaCl solutions and volumes restricted to the minimum (approximately 1 cc) to minimize stress in recipient females. To stimulate the release of sperm, males of both species were injected once, coinciding with the injection of the second dosage to the females and at a concentration of half a gland from a kilogram donor per male irrespective of the biomass of the recipient male. This is a standard procedure to effect a thinning response and consequent easier release of the sperm by the male at the time of the artificial fertilization of the eggs.

Ovulation and fertilization of eggs

A hundred per cent success rate was obtained in the ovulation of both the common carp and grass carp females for all types of treatment followed (Table 1). The common carp females receiving carp PGE from both male and female donors spawned first, approximately four hours after the last injection. One of the common carp females receiving carp male PGE had already partially spawned in the tank before the artificial stripping of the eggs could be effected. Procedures followed for the stripping of eggs and the fertilization thereof for this species was done according to Schoonbee and Prinsloo (1984). Rinsing of the eggs of the common carp to remove stickiness was according to Woynarowich and Woynarowich (1980), using urea as a solvent for the sticky glycoprotein surrounding the eggs, followed by a tannic acid solution to harden the eggs before transfer to breeding funnels. Observations on the development and survival of embryos were made six hourly as from the 12th hour after fertilization until the time of hatching. Survival and hatching rate was generally good, fluctuating between 55% and 85%.

In the case of the grass carp the ovulation and hatching success of the eggs was equally good in both cases of PGE donor fish. Where the period before ovulation fluctuated between 3,5 h and 5,5 h in the case of the common carp recipient females, the corresponding period for the grass carp was between 7,3 h and 8,3 h before the successful stripping of eggs occurred.

Water quality conditions

The water used in the recirculating system provided with a gravel biological filter was of good quality. Water temperatures varied between 21,6 and 25,0°C. pH always exceeded 7 with a maximum of 7,24 indicating the alkaline condition of the water. Conductivity fluctuated between 159 to 179 $\mu S.cm^{-1}$. Oxygen concentration of the water varied between 8,3 and 8,9 $mg.\ell^{-1}$.

Discussion

Spawning results obtained from both carp species clearly showed that the PGE of *Clarias gariepinus* can be used with great success as a substitute for common carp PGE in the large-scale artificial spawning of both latter species (Table 1). Indications are that the gonadotropic potency of the common carp PGE per equivalent body mass of donor fish may be higher than that in *Clarias* when both are collected in August towards the beginning of the spawning season. This tendency can be expected if it is taken into consideration that the European common carp is cold water adapted and usually spawns naturally during late winter or early spring when water temperatures have not yet reached 20°C. In contrast, spawning behaviour of the African catfish usually takes place after the first summer rains when water temperatures exceed 20°C (Holl, 1968; Van der Waal, 1972; Gaigher, 1977; Bruton, 1979).

One of the most important factors in the stripping of female spawners during the induced spawning programme, is the complete hydration of the gonads and subsequent release of free-flowing eggs. When carp PGE is used, it often happens that incomplete release of the eggs occurs, largely as a result of the formation of blood clots in the gonadal tissue of the recipient spawners. This can happen irrespective of the sex of the common carp PGE donor. Although complete spawns were obtained during the present series of experiments with both carp species,

TABLE 1
A COMPARISON OF THE GONADOTROPIC POTENCY OF THE PITUITARY GLANDS OF THE SHARPTOOTH CATFISH *CLARIAS GARIEPINUS* AND THE EUROPEAN COMMON CARP *CYPRINUS CARPIO* USED IN THE ARTIFICIAL SPAWNING OF THE COMMON CARP AND THE CHINESE GRASS CARP

	Common carp		Grass carp	
Type of gland used and sex of donor	Mean mass in grams of recipient carp females	Mean ovulating time (in hours) after last dosage	Mean mass in grams of recipient grass carp females	Mean ovulating time (in hours) after last dosage
C. gariepinus (females)	1 336 (n = 3)	4,5	5 700 (n = 3)	8,3
C. gariepinus (males)	1 353 (n = 3)	5,5	6 367 (n = 3)	7,5
C. carpio (females)	1 353 (n = 3)	4,0	6 733 (n = 3)	8,5
C. carpio (males)	1 471 (n = 3)	3,5 to 4,0	7 667 (n = 3)	7,3

blood clots were again found in spawning females receiving carp PGE. This condition did not occur in any of the cases where *Clarias* PGE was employed. Best results in this connection were obtained where *Clarias* female PGE was used and where all spawners were completely stripped of the eggs without any sign of the formation of blood clots. Although no blood clots were found in the eggs of spawners receiving *Clarias* male PGE, complete hydration of the gonads occurred later in the case of the common carp females receiving *Clarias* male PGE. Stripping of the eggs was also slightly more difficult than for those receiving *Clarias* female PGE.

Results on the fertilization incidence of the eggs of both carp species receiving *Clarias* PGE further confirm that the pituitary glands of *Clarias* can indeed be a suitable substitute for common carp PGE when used in an artificial spawning program of these fish and, possibly also for other cyprinid species. The application of an *in vitro* bio-assay to determine the gonadotropic potency of *Clarias* pituitary material used in spawning programmes as developed by Yaron *et al.* (1982; 1985) for PGE of the common carp *Cyprinus carpio* should alleviate most of the minor problems encountered during the present study.

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