Bolm Zool., Univ. S. Paulo
10:41-48, 1986

CORPUSCLES OF STANNIUS OF A FRESHWATER CATFISH, CLARIAS BATRACHUS

KRISHNA SWARUP
SHYAN P. SRIVASTAV
SUNIL K. SRIVASTAV
AJAI K. SRIVASTAV

Department of Zoology. University of Gorakhpur, Gorakhpur - 273009, India.(recebido em 30.VIII.1985)

RESUMO - O presente artigo estuda o número, localização e estrutura citológica dos corpúsculos de Stannius do bagre de água doce **Clarias batrachus**. Ocorre apenas um tipo celular e as células são eosina +, AF + e PAS +.

ABSTRACT - The present paper deals with the study of the number location and cytoarchitecture of corpuscles of Stannius of a freshwater catfish, **Clarias batrachus**. There is only one cell type and the cells are eosin +. AF + and PAS +.

INTRODUCTION

Corpuscles of Stannius (CS) are unique to holostei and teleostei because they are absent in other vertebrates. Fontaine (1964) reported hypercalcemia after Stanniectomy. Since then a number of workers (see review by Pang **et al.**,1980) have worked on the role of this tissue in calcium homeostasis which has led them to infer that they are important in the hypocalcemic regulation in bony fishes. The hypocalcemic factor(s) released from the CS reported thus far are - hypocalcin (Pang **et al.**, 1974) and teleocalcin (Ma & Copp,1978) Later on Milet **et al.** (1980) have reported that although CS extract administration induces hypocalcemia in eel but the same increases bone resorption in the rat. The bone resorption in rat according to them is due to parathyrine, a hypercalcemic factor from CS. Recently, CS extract - induced hypocalcemia has also been reported from non-piscine vertebrates by Leung and Fenwick (1978 - in rat), Srivastav & Swarup (1980 - in parrot) and Pandey **et al.** (1982 - in anurans) These facts suggest the involvement of CS in serum calcium regulation.

In this communication, light microscopic structure of CS of a freshwater catfish, **Clarias batrachus**, has been described.

MATERIAL AND METHODS

Live specimens of **Clarias batrachus** were obtained from local Ramgarh lake. The kidneys were dissected out and after recording the visual observations as to the number and disposition of CS, pieces of kidneys containing CS were fixed in Bouin's fluid and Zenker's formol. After processing with the routine paraffin methods, serial sections of 4-6 µm thickness were cut and stained with hematoxylin/eosin (H/E). aldehyde fuchsin (AF) and periodic acid Schiff's reagent counterstained with hematoxylin (PAS/H)

OBSERVATIONS

CS of **Clarias batrachus** are cream-coloured, oval,round or irregular bodies. They are scattered ventrally or ventrolaterally in the posterior two thirds of the kidney They are either superficially attached to the kidney or embedded in the kidney (partially or completely) (Fig. 1, 2) They exhibit individual variations in their number - ranging between two and ten. CS are unevenly distributed in the kidneys.

Each CS is enveloped by a thin connective tissue sheath from which a number of septa extend into the gland. Based on the arrangement their septa and cells, four principal architectural patterns can be distinguished:

First type - in this, cells are arranged in the form of cords. The cords when cut in transverse plane present a follicular appearance (Fig. 3)

Second type - here the connective tissue septa divide the CS into several incompletely delimited lobes. When such incomplete septa are cut in transverse plane. they appear as islands scattered among the cells of the CS (Fig. 4)

Third type - in this, the septa are better developed and the union of ramifying connective tissue causes some groups of cells to become separated from the rest, forming smaller lobes (Fig. 5)

Fourth type - the CS of this type are composed of aggregates of small lobes. Each lobe consists of a number of complete or incomplete lobules.

The corpuscular cells are without distinct boundaries but they have distinct nuclei and homogenous cytoplasm (Figs. 3, 4, 5) Their cytoplasm are eosin - (Fig. 5) AF - (Fig. 3 and PAS-positive (Fig. 4) The cells are all alike and show equal response to H/E, AF and PAS/H.

DISCUSSION

The corpuscles of Stannius are lodged in the mesonephric kidney of the majority of bony fishes. Their number va

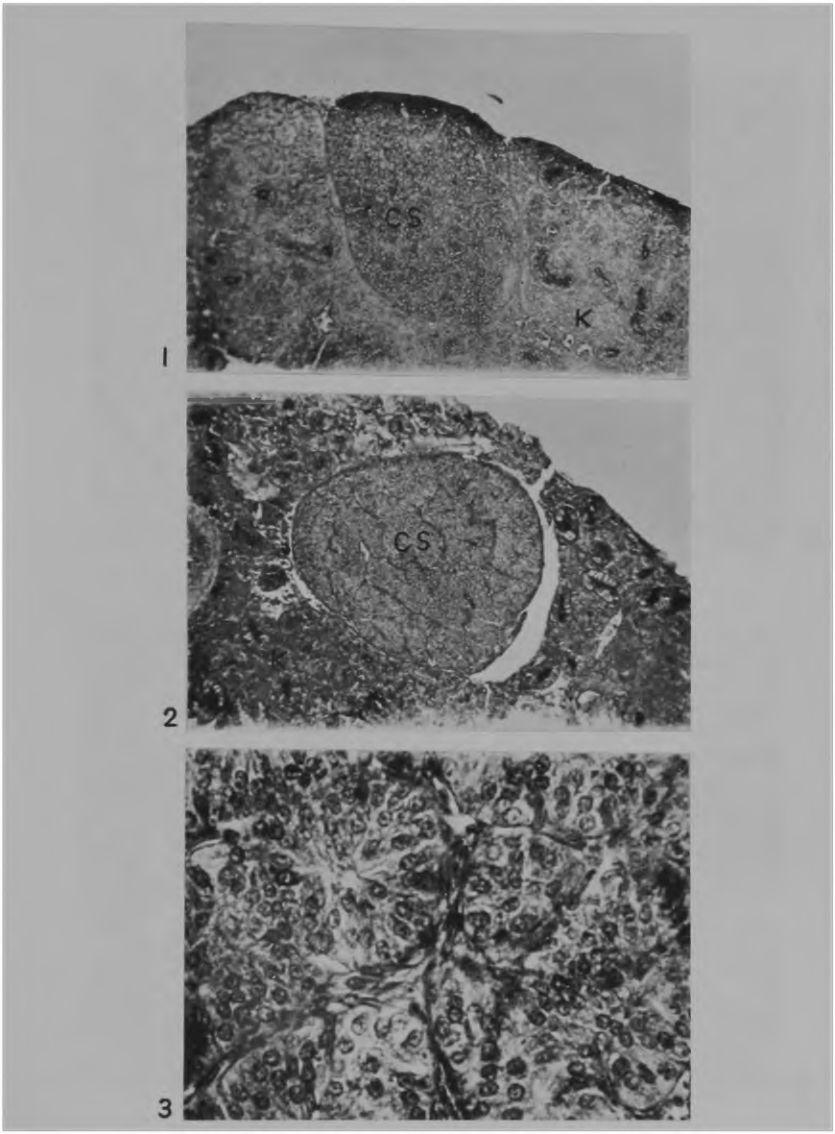

Fig. 1 - Photomicrograph of kidney (K) showing partially embedded corpuscles of Stannius (CS) Aldehyde Fuchsin X 70.

Fig. 2 - Photomicrograph of kidney (K) displayi g completely embedded corpuscles of Stannius (CS) Aldehyde Fuchsin X 70.

Fig. 3 - Photomicrograph of cross section of corpuscles of Stannius of **Clarias batrachus** showing cell cords arranged in form of follicles. Aldehyde Fuchsin X 650.

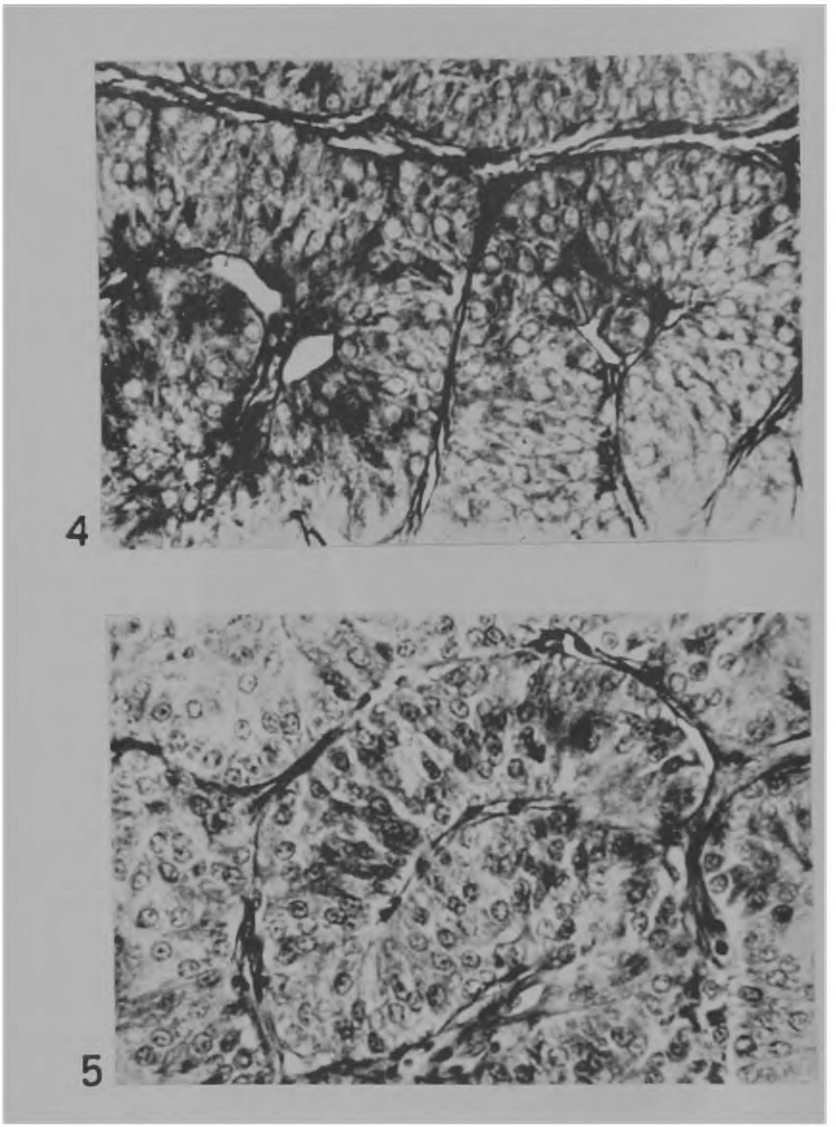

Fig 4 - Photomicrograph of cross section of corpuscles of Stannius of **Clarias batrachus** displaying incompletely delimited lobes of cells. Periodic Acid Schiff's/Hematoxylin X 500.

Fig 5 - Photomicrograph of cross section of corpuscles of Stannius of **Clarias batrachus** showing lobes of cells formed by the union of ramifying connective tissue septa. Hematoxylin/Eosin X 500.

ries from species to species viz. 6-8 in **Salmo trutta** (Bauchot, 1953), 4 in **Oncorhynchus gorbuscha** (Ford, 1959), 5-6 in **Oncorhynchus tshawytscha** and **O. kisutch** (Nadkarni & Gorbman, 1966), 3-7 in **Clarias lazera** (Rizkalla, 1969), 4-10 in **Salmo salar** (Heyl, 1970), 2-6 in **Xenentodon cancila** (Gupta & Shrivastava, 1971), 2-3 in **Labeo rohita** and **Cirrhinus mrigala** (Belsare, 1973), 2-4 in **Heteropneustes fossilis** and **Mystus vittatus** (Belsare, 1973; Ahmad & Swarup, 1979), 1-2 in **Rasbora daniconius** and **Pseudoechencis sulcatus** (Belsare 1973, Gill & Punetha, 1977) 1 in **Horaichthys setani** (Belsare, 1973), 332 in **Amia calva** (Youson **et al.**, 1976), 1-3 in **Notopterus notopterus** (Swarup & Ahmad, 1978) and 4-5 in toad fish (Bhattacharya & Butler, 1978). In the present study there are 2-10 corpuscles scattered ventrally or ventrolaterally in the posterior two thirds of the kidney. Garrett's (1942) observation that adult catfishes normally have single CS is in contradiction to the above statement.

According to Bauchot (1953) the most primitive position of CS is an anterior one about the midway of the length of kidney and, the most evolved, a posterior one, much nearer the vent, although there are exceptions, as in the salmonids and **Solea** where the location of CS is not consistent with the systematic position of the fishes. Garrett (1942) is of the opinion that large number of corpuscles is a primitive condition and the presence of two corpuscles is an advanced condition. But Belsare (1973) after studying the number and position of the corpuscles in ten species of teleosts belonging to four different orders concluded " the variation in the number and position of CS seems to be an embryological speciality rather than it has any evolutionary or taxonomic significance" Ahmad & Swarup (1979) also observed that there exists no correlation between the number and position of CS of **Mystus vittatus** and its taxonomic position. The variation in number (2-10) and distribution (i.e. on the ventral/ventrolateral surface of the posterior two thirds of the kidneys) of CS in **Clarias batrachus** is also in contrast to the suggestions made by Garrett (1942) and Bauchot (1953) correlating the corpusculer number and position to the phylogeny of the fish.

Krishnamurthy & Bern (1969) have classified the CS of teleosts into 4 types on the basis of the arrangement of cells and the nature of connective tissue septa in the 28 species they studied. Accordingly Johnson (1972) reported type IV CS in **Mugil cephalus;** Swarup & Ahmad (1978) types II and III in **Notopterus notopterus;** Bhattacharya & Butler (1978) type II in the toadfish. In the present study all the four structural arrangements have been observed which are in agreement with those reported from **Heteropneustes fossilis** (Subhedar & Prasada Rao, 1976) and **Mystus vittatus** (Ahmad & Swarup, 1979) Subhedar & Prasada Rao (1976) are of opinion that types I - IV described by various authors are not characteristic features for a species as they observed in **Heteropneustes fossilis** that the same section of CS exhibits differences in architectural pattern.

The CS of **C. batrachus** displays only one cell type (PAS + ve and AF + ve). Similar reports have been made by Ford (1959), Belsare (1973), Gill & Punetha (1977), Swarup & Ahmad (1978) and Ahmad & Swarup (1979) On the other hand a number of workers (Nadkarni & Gorbman, 1966; Krishnamurthy & Bern, 1969; Lopez, 1969; Bhattacharya & Butler, 1978; Srivastav, 1982) have observed two cell types in the CS (PAS + ve, AF + ve and PAS - ve, AF - ve).

The ultrastructural studies also reveal two cell types (Krishnamurthy & Bern, 1969; Wendelaar Bonga & Greven, 1975 ; Meats **et al.**, 1978 Wendelaar Bonga **et al.**, 1980) Of these two types, cells with a type-1 like structure are present in all the fishes studied so far (Krishnamurthy & Bern, 1969 ; Hiroi, 1970; Tomasulo **et al.**, 1970; Carpenter & Heyl, 1974 ; Wendelaar Bonga & Greven, 1975; Youson & Butler, 1978; Bhattacharya & Butler, 1978; Meats **et al.**, 1978; Wendelaar Bonga **et al.**, 1980)

REFERENCES

AHMAD, N. & K. SWARUP, 1979. Corpuscles of Stannius of **Mystus vittatus** in relation to calcium and sodium rich environments. **Arch.Biol. 90**:1-22.

BAUCHOT, R. 1953. Anatomie compareé des corpuscules de stannius chez les Teleosteens. **Arch.Zool.Exptl.Gen. 89**:147-169.

BELSARE, D.K. 1973. Comparative anatomy and histology of the corpuscles of Stannius in teleosts. **Z.microsk-anat. Forsch., Leipzig, 87**:445-456.

BHATTACHARYA, T.K. & D.G. Butler, 1978. Fine structure of the corpuscles of Stannius in the toadfish. **J.Morphol. 155**:271-286.

CARPENTER, S.J. & H.L. HEYL, 1974. Fine structure of the corpuscles of Stannius of the Atlantic salmon during the freshwater spawning journey. **Gen.Comp.Endocrinol. 23**:212-223.

FONTAINE, M., 1964. Corpuscles de Stannius et regulation ionique (Ca, K, Na) du milieu interieur de l'Anguille (**Anguilla anguilla** L.) **C.R.Acad.Sci. 259**:875-878.

FORD, P. 1959. Some observations on the corpuscles of Stannius. **In** Gorbman, A., ed., **Comparative Endocrinology**, Wiley, New York, pp. 728-734.

GARRETT, F.D., 1942. The development and phylogeny of the corpuscles of Stannius in ganoid and teleostean fishes. **J. Morph. 70**:41-68.

GILL, T.S. & J.G. PUNETHA, 1977. Studies on a hill-stream fish, **Pseudoechencis sulcatus** (Mc Clelland) II. Histocytology of the corpuscles of Stannius. **Z.mikrosk. - anat. Forsch., Leipzig, 90**:651-656.

GUPTA, O.P. & R.K. SHRIVASTAVA, 1971. Studies on the location, anatomy and the histology of the endocrine glands of **Xenentodon cancila** (Ham.) **Okajimas Fol.anat.Jap. 48**:189-203.

HEYL, H.L. 1970. Changes in the corpuscles of Stannius during the spawning journey of Atlantic salmon (**Salmo salar**). **Gen.Comp.Endocrinol. 14**:43-52.

HIROI, O., 1970. Morphological changes in the corpuscles of Stannius of the chum salmon, **Oncorhynchus keta**, during the migration and maturation. **Bull.Fac.Fish. Hokkaido Univ. 21**:179-192.

JOHNSON, D.W., 1972. Variations in the interrenal and corpuscles of Stannius of **Mugil cephalus** from the Colorado river and its estuary. **Gen.Comp.Endocrinol. 19**:7-25.

KRISHNAMURTHY, V.C. & H.A. BERN, 1969. Correlative histological study of the corpuscles of Stannius and the juxta - glomerular cells of teleost fishes. **Gen.Comp.Endocrinol. 13**:313-335.

LEUNG, E. & J.C. FENWICK, 1978. Hypocalcemic action of eel Stannius corpuscles in rats. **Can.J.Zool. 56**:2333-2335.

LOPEZ, E., 1969. Etude histophysiologique des corpuscles de Stannius de **Salmo salar** L. au coure des diverses etapes de son cycle vital. **Gen.Comp.Endocrinol. 12**:339-349.

MA, S.W.Y & D.H. COPP, 1978. Purification properties and action of a glycopeptide isolated from the corpuscles of Stannius which affects calcium metabolism in the teleost. **In** Gaillard, P.J & H.H. Boer, eds., **Comparative Endocrinology,** Elsevier/North Holland Biomedical Press, Amsterdam, pp. 283-286.

MEATS, M., P.M. INGLETON,I. CHESTER JONES, H.O. CARLAND & C. J. KENYON, 1978. Fine structure of the corpuscles of Stannius of the trout, **Salmo gairdneri**: structural changes in response to increased environmental salinity and calcium ions. **Gen.Comp.Endocrinol. 36**:451-461.

MILET, C., C.J. HILLYARD, E. MARTELLY, S. GIRGIS, I. MAC INTYRE & E. LOPEZ, 1980. Similitudes structurales entre l'hormone hypocalcemiante des corpuscules de Stannius (PCS) de l'anguille (**Anguilla anguilla** L.) et l'hormone parathyroidenne mammalienne. **C.R.Acad.Sc. Paris 291**:977 - 980.

NADKARNI, V.G. & A. GORBMAN, 1966. Structure of corpuscles of Stannius in normal and radiothyroidectomized chinook fingerlings and spawning pacific salmon. **Acta.Zool. 47**: 61-66.

PANDEY, A.K., L. KRISHNA, A.K. SRIVASTAV & K. SWARUP, 1982. Response of serum calcium to administration of an extract from Stannius corpuscles in the anurans. **Experientia** (in press)

PANG, P.K.T., R.K. PANG & W.H. SAWYER,1974. Environmental calcium and the sensitivity of killifish (**Fundulus heteroclitus**) in bioassays for the hypocalcemic response to Stannius corpuscles from killifish and cod (**Gadus morhua**). **Endocrinology 94**:548-553.

PANG, P.K.T., A.D. KENNY & C. OGURO, 1980. Evolution of endocrine control of calcium regulation. **In** Pang, P.K.T. & A. Epple, eds., **Evolution of vertebrate Endocrine systems** , Texas Tech.Univ.Press, Lubbock, pp.323-356.

RIZKALLA, W., 1969. Studies on the adrenal gland and corpuscles of Stannius of the teleost Nile fish, **Clarias lazera** C. and V. **Acta.Veterinaria Academiae Scientiarum Hungaricae 19**:343-350.

SRIVASTAV, A.K., 1982. Corpuscles of Stannius of freshwater mud eel, **Amphipnous cuchia. Bolm Zool. 7**:149-153.

SRIVASTAV, A.K. & K. SWARUP, 1980. Serum calcium level of **Heteropneustes fossilis** (teleost) in response to calcitonin treatment. **Nat.Acad.Sci.Letters 3**:373-375.

SUBHEDAR, N. & P.D. PRASADA RAO, 1976. On the cytoarchitecture of the corpuscles of Stannius of the catfish, **Heteropneustes fossilis** (Bloch) **Z.mikrosk.-anat.Forsch., Leipzig 90**:737-748.

SWARUP. K. & N. AHMAD, 1978. Studies of corpuscles of Stannius of **Notopterus notopterus** in relation to calcium and sodium rich environments. **Nat.Acad.Sci.Letters 1**:239-240.

TOMASULO, J.A., W.D BELT & E.R. HAYES, 1970. The fine structure of the Stannius body of the guppy and its response to deionized water **Am.J.Anat. 129**:307-328.

WENDELAAR BONGA, S.E. & J.A.A. GREVEN, 1975. A second cell type in Stannius bodies of two euryhaline teleost species. **Cell Tiss.Res. 159**:287-290.

WENDELAAR BONGA, S.E. & J.C.A. VAN DER MEIJ, 1980.The effect of ambient calcium on prolactin cell activity and plasma electrolytes in **Sarotherodon mossambicus (Tilapia mossambica). Gen.Comp.Endocrinol. 40**.391-401.

YOUSON, J.H. & D.C. BUTLER, 1978. Fine structure of the adrenal homolog and the corpuscles of Stannius of **Amia calva** L. **Acta.Zool. 57**:217-230.

YOUSON, J.H.,D.C. BUTLER & A.T.C. CHAN, 1976. Identification and distribution of the adrenocortical homolog,chromaffin tissue and corpuscles of Stannius in **Amia calva** L. **Gen. Comp.Endocrinol. 29**:198-211.