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**SHORT REVIEW**

## Use of fish scales as a tool for research - A Review

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### ABSTRACT

Various kinds of scales are found in fishes which are derived from the connective tissue of the dermis and form the exoskeleton. Scales of the fishes had been used as tool for experimental justifications. Structurally they are composed of circuli, radii, focal region and chromatophores region. Scales of fish are used for classification, identification and growth studies of different fishes, pollution indicators etc.

### 1) INTRODUCTION

One of the unique features in a fish is the presence of the scales (except fishes of order siluriformes) on the outer surface of the body. Various types of scales are found in fishes eg. placoid, cycloid, ganoid, cosmoid or ctenoid. Placoid scales are found in cartilaginous fishes and rest all are found in bony fishes. These are derived from the connective tissue of the dermis and form the exoskeleton.

The scales of bony fishes are derived entirely from the dermal layer of the skin and overlap one another like the tiles. The overlapping (imbrications) of the scale is important in the sense that it imparts mechanical support. Each scale is shaped roughly like a human finger nail whose front end is inserted deep into the dermal layer, while the hinder end is free of exposed and bears the pigment cells or chromatophores on it. These chromatophores provide specific colour to the fish body.

The muscles attached to the dermis tend to exert a somewhat unequal pull and therefore, depresses the scale area, particularly their front margins. In this way, the growing scale is forced to lie obliquely and at later stages its hinder end appears through the skin covered by thin epidermal and dermal membranes.

**General structure of the scales-** In the teleost an group which constitutes major percentage of the fishes, scales are quite thin, flexible and transparent structures and are commonly termed as leptoid scales [1]. These may either be cycloid or ctenoid; the former is simpler of the two and is characteristic of more primitive teleost fishes with soft ray fins. These scales have lost all traces of cosmine and ganoine layers and have only fibrous layer or fibrous plate. Both cycloid and ctenoid scales are very similar to each other.

They are either circular or long-ovoid in shape. They have a soft anterior and a hard posterior end. Structurally they differ from each other in having ctenii or spines on the posterior end which provide rough appearance to the scale. The exact function of the ctenoid scales is not known but they improve

the hydrodynamic efficiency of swimming. They also bear scalar denticles called lepidonts on their dorsal surface [2].

A typical cycloid scale (a characteristic feature of most of the crap is circular or oval in shape. These scales have a soft anterior part and hard posterior part. The dorsal surface of the scales is rough as it bears the lines of growth, whereas the ventral surface that touches skin in shining. The cycloid scale has concentric rings around the focus and these rings/lines of growth as sclerites. Only the anterior and lateral sides of scale have these circuli. These are the marks of periodical growth of fish. Any sudden changes in fish's environment is recorded on the scales in the form of alteration in the circuli shape, pattern or altered elemental deposition [3, 4] thus making these hard structures a testimony to life history of the fish. These revealing marks may be annual marks, winter marks or the larval marks.

There is sufficient proof that the shape and arrangement of circuli are species-specific. According to [1], circuli arise whenever bone-forming material occurs in a quantity that is greater than the required need of the growing edges. These ridges may also probably help in anchoring the scale of the skin. The radii are the grooves radiating from the focus to the margin of the scale. These structures are formed due to the less available space in the anterior part of the scale, thus circuli exhibit invariable folding on the mid-central region of the scale. The numbers of radii are less on the later side. Maximum on the anterior and may be completed absent on posterior of the scale [5, 6, 7, 8].

### 2) REVIEW OF LITERATURE

**Classification:** According to [9] scales of Poecillid fish have a wide range of structural variation in the dentition (lepidonts)

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present on the crest of the circuli when viewed through electron microscopy. Lepidontal character such as shape, angle in relation to scale and type of attachment were described. He also suggested that lepidonts are useful in separating different taxa. The structure of scales, its sculptural design and shape have been interestingly used as limiting character in fish taxonomy [10].

Fish scales are remarkable structures which plays a significant role in fish taxonomy. Therefore, a study was carried out to notice the significance of different scale parameters such as; scale length (TLS), scale width (WDS), number of ctenii in horizontal row (HRS), number of ctenii in vertical row (VRS) and number of radii (RDS) in fish taxonomy using statistical calculations. A total of 54 specimens of *Scatophagus argus* were collected from the commercial landings at fish harbours of West Wharf and Korangi creek, Pakistan. Different parameters of scales (i.e., TLS, WDS, HRS, VRS and RDS) were studied under compound microscope. The relationship among these scale parameters were studied with the help of linear regression equation. All results were found significant ( $p < 0.05$ ). The correlation between fish length and different parameters of fish scales showed moderate ( $r = 0.59-0.50$ ) to strong ( $r > 0.70$ ) correlations. The analysis showed that the growth of scale parameters is mostly proportional to fish body length [11].

According to [12] fish scales helps to study the feeding habits of some scale eating fishes and also helps to study the life history and age of fish. Several scientists such as, [13,14 and 15] and have been used scales for fish identification because scale collection does not involved in killing of fish and scale sample preparation for study is a simple procedure.

### 2.2 Age and growth studies

Scales of fish are used for classification, identification and growth studies of different fishes [16, 17, 18, 19, 20, 21, 22, 23, 24 and 25]

**Toxicological studies:** Some workers also suggested successful use of scales as pollution indicator when fish was exposed to pesticides [26]. They recommended that fish scale is most suitable system for the study of psychoactivity and toxicity of plant extracts on fish *Labeo rohita*. They also showed that fish scales chromatophores changed from reticulate to punctate, when exposed to 150-350 ppm doses [27].

They [28] demonstrated effects of Lindane on *Clarias batrachus* there is marked loss of pigmentation could be because of reduction in release of melanophore stimulating hormone as was reported by [29] when working with Endosulfan.

On the basis of SD and SEM it is concluded that in all the cases calcium is the most affected mineral followed by phosphorus, iron and aluminum. Thus, calcium deposition can be termed as a true pollution indicator in quantitative analysis. This is in accordance with the earlier studies [4 and 30].

Percent and the elemental composition of the scale are attributed to the chemistry of the surrounding water in which the fish resides. In the scales of the bony fishes elements like Al, Ca, P, Si, F, Mg, Li, Na, Ca and Bu have been reported by various workers. Cowgill *et al.* [10] reported twenty elements (Ca, Cl, Cr, Co, Cu, F, I, Pb, Mg, Mn, Ni, K, Rb, Se, Si, Na, Sr, S, Ti and Zn) in the scale of *Latimaeria chalumnae* (Smith). However, four major elements, which are studied during the study, are of common occurrence [1, 7].

## 2.3 Structural studies

**2.3.1 SEM studies:** To study the impact on the hard parts of fish, scales were removed with tweezers from the second row, above the lateral line and directly under the anterior rays of the dorsal fin. These were then washed with distilled water, suspended in mild acetone and were subjected to sonication for 5 minutes so as to remove mucous, organic particles, dust or any other extraneous matter. The scales were then subjected to scanning electron microscopy and electron probe microanalysis.

The clean and air-dried scales were mounted on the metal stubs. These stubs are either made up of Aluminum or Brass. The scales are placed with dorsal surface upward and the ventral surface sticking to the double stick tape. Care was taken to avoid the trapping of air-bubbles under the tape. As scales are non-conductive specimens, these were coated with a thin layer (100 Å) of Gold in a Gold coating unit so as to overcome the problems of "charging" and "beam damage". An additional advantage of coating is an improvement in the strength of the secondary electron signal from the specimen surface. Since high molecular weight materials yield stronger secondary electrons. The Gold coating was done in a sputter coating unit. The scale samples were viewed under vacuum in the JEOL JSM-6100 scanning electron microscope, at an accelerating voltage of 15/20 Kv at low probe current. The specimens were stored in a dessicator.

Through electron microscopy [31] observed numerous minute processes called scalar denticles on the scales of *Tilapia mossambica*, which help to secure the position of the scale with reference to its surrounding dermal tissue.

The structure of scale of *Channa punctatus* differs from the scale structure of India major carps [32 and 33] in the following respects:

- Circuli present are not in circular fashion
- The bifurcation of the lateral circuli when these enter into anterior portion
- Presence of distinct circuli on the posterior part of the scale

## 3) CONCLUSION

As discussed by various authors the fish scale have been used for the various parameters like classification, age and growth relationship, toxicological studies and SEM studies of the fish. So, it is proved that fish scales are very good tool for the research studies.

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