

## Study of chromatophore diversity in freshwater fish species from the local market of Baramati tehsil, district- Pune (MS), India

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### Abstract

The aim of this study was to investigate the chromatophores in fish. Chromatophores are cells in fish skin that contain pigments or reflect light. Fish chromatophores from the Baramati local market were examined using an inverted microscope equipped with a camera at 10X magnification. The study included eight species, focusing on photographs and scales from the head, middle, and tail regions of the fish. The analysis revealed that light-absorbing chromatophores were the most abundant, i.e., melanophores. *Channa striata*, *Cirrhinus molitorella*, *Osteochilus vittatus*, *Oreochromis mossambicus*, and *Cirrhinus mrigala* scales contain large numbers of dendritic-shaped melanophores. Melanophores and erythrophores are also observed in *Labeo rohita*. *Pygocentrus nattereri* has an abundance of melanophores and iridophores.

**Keywords:** Freshwater fishes, chromatophores, melanophores, pigment granules, Baramati

### Introduction

The vibrant coloration and striking patterns seen in many poikilotherms and particularly well-developed in fish. Ornamental fish are becoming increasingly popular for their aesthetic and commercial value in the global export trade. Their commercial appeal is largely due to their attractive colours, which result from the activity of chromatophores, the pigment-containing cells in their skin.

Fish coloration depends on different types of chromatophores, each identified by its color. There are six main kinds. Light-absorbing chromatophores include melanophores, xanthophores, erythrophores and cyanophores. Melanophores contain melanin granules called melanosomes, giving them a brown or black color. Xanthophores contain carotenoids within their xanthosomes, or carotenoid vesicles, which are insoluble in water. Light-reflecting chromatophores include iridophores and leucophores. (R. Fujii, 2000) [6].

The color pattern of a fish is influenced by the combination of its chromatophores. (R. Fujii, 1969) [7]. The distribution, density, size, and motility of these pigment cells influence the display of patterns. (D. Burton, 2002) [3]. Fish colours and patterns have ethological implications, serving as communication among species. Coloration helps protect from predation and aids in catching prey (R. Fujii, 1993; G. Healey, 1999) [5, 8]. In highly visual social teleosts, colour patterns often serve as “signals within the species to attract mates, exhibit aggression, or communicate with their young”. Instantaneous colour changes, characteristic of many social teleosts, are typically under neural (sympathetic) control. Body coloration is due to pigment cells derived from multipotent neural crest cells that differentiate into diverse cell types (R. Fujii, 1993) [9].

Chromatophores are cells containing pigments that disperse or concentrate, changing the organism's color. Researchers have been fascinated by chromatophore responses since the time of Aristotle because of their visible effects. Parker's foundational work on animal color changes was published in 1948, followed by monographs from Fingerman and Waring in 1963. Functional chromatophore systems are common in cephalopods, crustaceans, and cold-blooded vertebrates.

A-melanophore-stimulating hormone (MSH) causes the dispersion of pigment granules within chromatophores. Another factor, melanophore-concentrating hormone (MCH), aggregates pigment and was first identified by Enami (1955). Baker and Rance (1983) [1] noted that melanocyte-stimulating hormone (MCH) is a small peptide with activity in the hypothalamus.

### Material and method

The Baramati City Fish Market was visited weekly on Fridays, where various fishermen brought in different fish species from local rivers and some distant locations. Fish were identified using standard scientific methods, and photos were taken. Sellers provided a few scales from each species, which were collected from the head, trunk, and tail regions. These scales were placed in sample bottles containing 70% alcohol and labeled with the local names of the fish. The scale samples were then taken to the Dr. Hargobind Khorana Laboratory in the Department of Zoology for further analysis. They were treated with glycerin to prevent drying and enhance clarity for imaging. Micrographs were captured using a light microscope with an attached camera, and the images were viewed directly on a laptop. Chromatophores were examined at 10X magnification.

### Results

Identified fishes and micrographs of their chromatophores:

#### 1. *Channa striata*

In the *Channa striata* scale (Fig.1), the most prevalent chromatophores were melanophores, primarily located in the head region. Pigmented granules exist in a fully dispersed phase, meaning they are spread throughout the cytoplasmic processes, which gives melanophores a dendritic shape. The tail region chromatophore shows melanophores and xanthophores in a state of dispersion. In the middle region, super-dispersed chromatophores in fish.

#### 2. *Cirrhinus molitorella*

In *Cirrhinus molitorella* (Fig.2), melanophores were seen in the head region. A large number of melanophores were seen, and they showed melanosomes with different

morphologies that were present in the scale of the *Cirrhinus molitorella* fish. In the middle region, Pigment granules were widely distributed within the cytoplasmic processes, contributing to a grayish color in the skin., but the number of melanophores was not so large as to give black colour at the tail region, aggregate pigmented granules observed; some minor melanophores are at the dispersed stage, along with yellow xanthophores.

**3. *Notopterus notopterus***

In *Notopterus* (Fig.3), iridophores were seen in the head region at the middle of the scale. A few numbers of super-dispersed melanosomes were seen at the back of the melanosome, and silver iridophores were present, which are light-reflecting chromatophores with guanine pigment. middle of abdomen body scale highly aggregated type of melanophore presence of iridophores which are highly scattered. tail region full of reticulate and punctate types of melanophore.

**4. *Osteochilus vittatus* (Ambli)**

In *Osteochilus vittatus* (Fig.4) mostly punctate types of melanophore were observed in the region of the head, very few punctate aggregate types of melanophore were observed, and some granule cells were fully spread within the cytoplasmic process, giving greyish colour to the skin. In the middle region, xanthophores are moderately dispersed, and melanophores are dendritic in shape; melanophores are large enough to give dark colours to skin.

**5. *Labeo rohita* (Rohu)**

On the Rohu scale (Fig.5), two types of chromatophores observed were melanophores and erythrocytes. In the head region, melanophores at higher magnification revealed the morphology of dendritic processes filled with melanosomes. Those are superdispersed erythrocytes underlying melanophores. erythrocytes appeared in the dispersion stage. Erythrocytes are abundant in middle-region melanophores, with dispredmelanosomes demonstrating the different morphology in the dendritic process. At the tail region, melauophores are abundant, along with xanthophores, in which pigment gradually spreads within the cytonlasmic process, giving it a yellowish colour.

**6. *Oreochromis mossambicus* (chilapi)**

In chilapi scale (Fig.6), melanophores are present. In the head region, melanophores are involved in the dispersion stage together with leucophores. In the middle region, a few cells have a higher dispersion, mostly in the punctate state, along with a somewhat round shape. At the tail region,

mostly melanosomes are despersed, but a few are punctate, along with a few xanthopore.

**7. *Cirrhinus mrigal* (Mrigal)**

In *Cirrhinus mrigal* scale (Fig.7), mostly melanophores are seen; in the head region, melanophores are moderate, but those are aggregated pigment granules that are not observed. In the middle region of the abdomen, very few aggregate melanosomes are present. leucophores, along with a few aggregated melanosomes. In the tail region, xanthophores along with abundant melanosomes, which are aggregated pigmented granules, are giving them an them an oval shape.

**8. *Pygocentrus nattereri* (Halwa)**

In Halwa fish (Fig.8), mostly melanophores along with erythrocytes are observed, as are iridophores at the head region of the red bellied piranha. Melanophores are seen, which are dispersed and some are aggregated. In the region of the tail, melanophores are few in comparison to the head region melanosomes. Those are dispersed stage melanosomes, along with iridophores, region of abdomen pigmented granules were fully spread within the cytoplasmic process, giving a reddish colour to the skin. In that region, erythrocytes are seen.

**Discussion**

In this study, the chromatophores of freshwater fish from the Baramati local market were examined using scales from eight species. It was found that melanophores were the most abundant type of chromatophore. *Channa striata* exhibited a high number of melanophores, while *Pygocentrus nattereri* had the fewest. Many fish species showed a significant presence of melanophores alongside xanthophores.

The number and shape of chromatophores varied among different species and across different regions (head, middle, and tail) within the same species. In the head region, densely arranged, dendritic-shaped chromatophores were primarily observed. In *Labeo rohita*, melanophores and erythrocytes, which also displayed dendritic shapes, contributed to the red coloration of the skin. *Channa striata* and *Oreochromis mossambicus* scales contained a large quantity of dendritic-shaped melanophores. Although *Labeo rohita* showed dendritic-shaped melanophores, the most abundant chromatophores were erythrocytes.

*Pygocentrus nattereri* scales displayed fewer chromatophores, with their pigment granules moderately dispersed, resulting in lighter skin. *Notopterus notopterus* primarily exhibited iridophores, which are light-reflecting chromatophores.

**Result**

**Table 1**

Sr no.	Species	Chromatophore		
		Abundant	Moderate	Less
1.	<i>Channa striata</i>	Melanophore	Xanthophore	Erythrocyte
2.	<i>Cirrhinus molitorella</i>	Melanophore	Xanthophore	Iridophore, Erythrocyte
3.	<i>Notopterus notopterus</i>	Iridophore	Melanophore	-
4.	<i>Osteochilus vttatus</i>	Melanophore	Xanthophore	Leucophore
5.	<i>Labeo rohita</i>	Melanophore	Xanthophore,Erythrocyte	-
6.	<i>Oreochromis mosambicus</i>	Melanophore	-	Xanthophore
7.	<i>Cirrhinus mrigal</i>	Melanophore	Xanthophore	Leucophore
8.	<i>Pygocentrus nattereri</i>	Iridophore,melanophore	Xanthophore,Melanophore	Erythrocyte

At certain observations this table belongs to diversity of chromatophore.all up and down results are as follow:

**Melanophores>Xanthophores>Iridophores>leucophore>Erythrocytes**



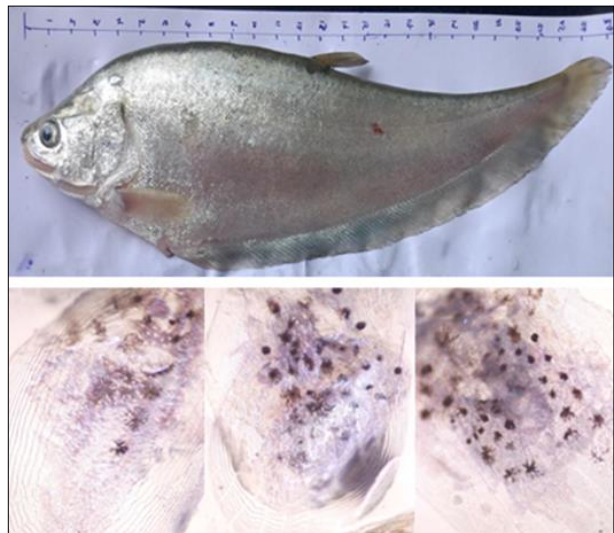
A. Head region B. Middle region C. Tail region

**Fig 1:** Micrographs of scales of *channa striatus*



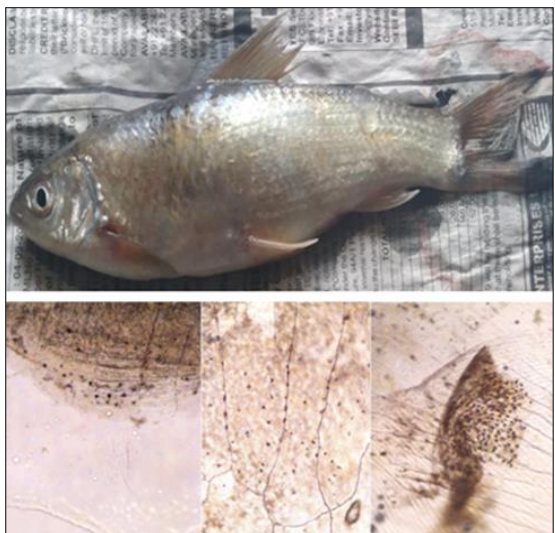
A. Head region B. Middle region C. Tail region

**Fig 2:** Micrographs of scales of *Cirrhinus Molitrorella*



A. Head region B. Middle region C. Tail region

**Fig 3:** Micrographs of scales of *Notopterus notopterus*



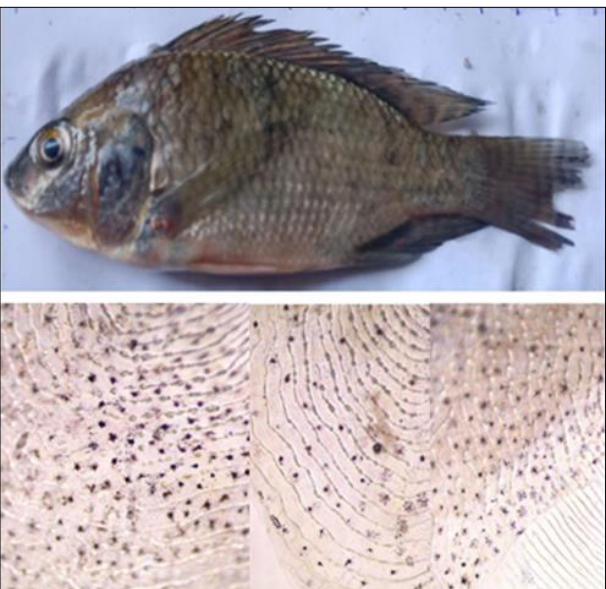
A. Head region B. Middle region C. Tail region

**Fig 4:** Micrographs of scales of *Osteochilus vttatus*



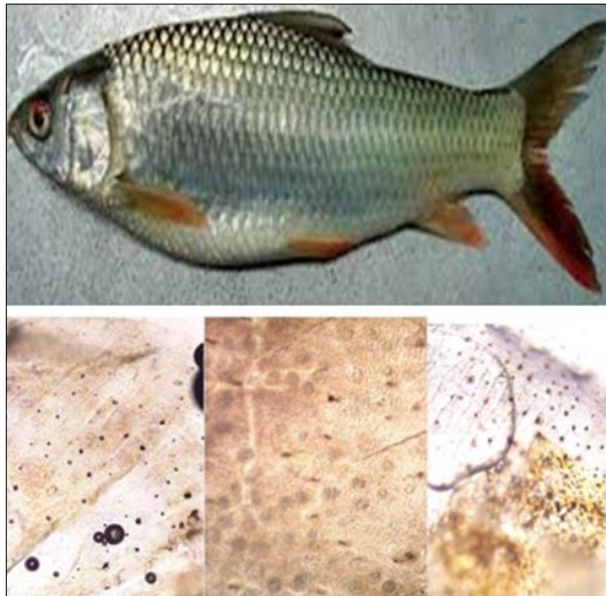
A. Head region B. Middle region C. Tail region

**Fig 5:** Micrographs of scales of *Labeo rohita*



A. Head region B. Middle region C. Tail region

**Fig 6:** Micrographs of scales of *Oreochromis mosambicus*



A. Head region      B. Middle region      C. Tail region

**Fig 7:** Micrographs of scales of *Cirrhinus mrigala*



A. Head region      B. Middle region      C. Tail region

**Fig 8:** Micrographs of scales of *Pygocentrus nattereri*

### References

1. Baker Bridget I, Theresa A, Rance. "Further observations on the distribution and properties of teleost melanin concentrating hormone." *General and Comparative Endocrinology*, 1983;50(3):423-431.
2. Bennett WA, RJ Currie, PF Wagner, TL Feininger. Cold tolerance and potential overwintering of the red-bellied piranha *Pygocentrus nattereri* in the United States. *Transactions of the American Fisheries Society*, 1997;126:841-849.
3. D Burton. The Physiology of flatfish chromatophores. *Microscopy Research and Technique*, 2002;58:481-487
4. Fingerman Milton. "Chromatophores." *Physiological reviews*, 1965;45(2):296-339.
5. G Healey. The skin pattern of young plaice and its rapid modification in response to graded changes in background tint and pattern. *J. Fish Biol*, 1999;55:937-971.
6. R Fujii. The regulation of motile activity in fish chromatophores. *Pigment Cell Res*, 2000;13:300-319.
7. R Fujii. "6 Chromatophores and Pigments." *Fish physiology*. Academic Press, 1969;3:307-353.
8. R Fujii. Colouration and Chromatophores. *The Physiology of fishes*, Eds. Evans, D.H., CRC Press. Boca Raton, FL, 1993, 535-562.
9. R Fujii. Cytophysiology of fish chromatophores. *International review of cytology*, 1993;143:191-250.
10. Waring H. Color change mechanisms of cold-blooded vertebrates. Academic Press, 2013.