Thalassia Salentina
Thalassia Sal. 44 (2022), 27-40
ISSN 0563-3745, e-ISSN 1591-0725
DOI 10.1285/i15910725v44p27
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PARTIAL AND HYPER-MELANIC PIGMENTATION IN FISHES COLLECTED FROM THE MARINE WATERS OF IRAQ, ARABIAN GULF

SUMMARY

In the present study, report on incidences of partial and hyper-melanic pigmentation in 6 species belonging to the families, Lutjanidae, Nemipteridae, Platycephalidae and Sparidae based on 8 specimens collected in the marine waters of Iraq at the Arabian Gulf region. Severe case of hyper melanic pigmentation was noticed in *Nemipterus randalli* Russell, 1986 and *Crenidens crenidens indicus* (Forsskål, 1775), while an acute case of partial melanic pigmentation occurred in one specimen of *Lutjanus lutjanus* Bloch, 1790 and *Argyrops spinifer* (Forsskäl, 1775). Possible consequences of these colour aberrations on their ecology and on human eating insight were point out.

Key words: Arabian Gulf, pigmentation, fish disease, aberration**,** melanosis**,** Basrah.

INTRODUCTION

The disparity in colouration of the fish is owing to the kinds of pigments such as melanin, carotenoids, and porphyrins and to the building of the integument (Negro *et al*., 2009; Colombo *et al*., 2011; Olsson *et al*., 2013). Melanin can be separated into the brown/black eumelanin and yellow/reddish-brown pheomelanin pigments of diverse biophysical and chemical characteristics (Quigley and Parichy, 2002; Slominski *et al*., 2004; Ito and Wakamatsu, 2008; Jawad and Ibrahim, 2017; Gajić *et al*., 2020). Melanin stains are the only coloured dyestuffs that are manufactured in the animal body. Consequently, change in melanin-based colouration is frequently below the effect of con-

stricted genetic regulation in vertebrates (Majerus and Mundy, 2003; Roulin and Ducrest, 2013; Ducrest *et al*., 2014), however the countenance of colouration can be environment linked (Price, 2006; Vergara *et al*., 2009; Piault *et al*., 2012; Gajić *et al*., 2020).

As in the case of other abnormalities, several fish species might show skin pigment aberration both in wild or reared animals, mostly related with melanophore ailments. Amongst the most, fish abnormalities are the partial and hyperpigmentation. The former categorized by the occurrence of few dark spots in different regions of the fish body, while the latter is renowned by the existence of focal or general spots, patches or bands of dark colouration (Groff, 2001; Simon *et al*., 2009).

Apart from for the works of Jawad and Al-Mamry (2009), Jawad and Al-Kharusi (2013) and Jawad *et al*. (2013) on fishes of Oman and Jawad and Ibrahim (2014, 2017) on fishes from Saudi Arabia, no other investigations on the record about the colouration malformation in fishes in general and melanism in particular in the Arabian Gulf area. Hence, the results presented in this study are deliberated the first record of partial and hyper-melanic pigmentation in fishes from the marine waters of Iraq. The objective of this study is to designate the existence of partial and hyper-melanic pigmentation in 6 fish species belonging to 4 families collected from the Arabian Gulf waters of Iraq.

MATERIAL AND METHODS

On 20th February 2018, eight specimens of six fish specimens showing colour aberrations obtained from the marine waters of Iraq at the Arabian Gulf. Normal coloured specimens of the same species attained for comparison. The specimens were collected using small trawler net. Body and fins were inspected prudently for external parasites, malformations, amputations and any other morphological anomalies. In order to detect metazoan parasites, areas showing a melanic pigmentation were arbitrarily examined under a stereomicroscope with transmitted light. The specimens were deposited in the fish collection of the Marine Science Centre, University of Basrah, Iraq. Once in the laboratory, measurements were recorded to the nearest millimetre.

RESULTS

The seven cases of colour aberration found in six species of fishes collected from the marine waters of Iraq, Arabian Gulf represent the first incidences to be reported about melanism in fishes from this part of the world. The descrip-

tion of the distribution of the melanic pigmentations in each species studied is given below based on the case of pigmentation.

I. Partial melanic pigmentation cases
Family: Lutjanidae
Lutjanus lutjanus Bloch, 1790

Colour of normal specimen, TL 193 mm (Fig. 1a): the body colouration of the normal specimen is mainly dark silver colour on the back and bright silvery colour on the abdomen, with a horizontal brown-yellowish line traversed at the mid of the body (Randall, 1995)

Colour of abnormal specimen no. 1, TL 177 mm (Fig. 1b): the distribution of the melanic spots is confined to the lower part of the fish body, with the posterior edges of the scales in the upper part are dark lined. The black batches concentrated in two main locations, at the position of the pectoral fin ray and at the position of the anal fin and caudal peduncle. At the posterior region of the fish, the melanic patch dispersed posteriorly from the dorsal side of the anal fin to the ventral side of the caudal peduncle.

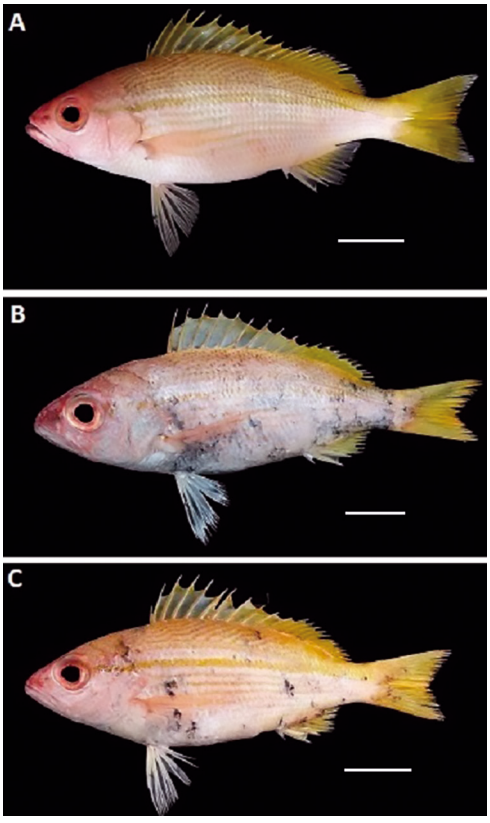

Fig. 1. *Lutjanus lutjanus*. A, normal specimen, TL 193 mm; B, abnormal specimen no. 1, TL 177 mm; C, abnormal specimen no. 2, TL 182 mm. Scale bar = 1cm.

Colour of abnormal specimen no. 2, TL 182 mm (Fig. 1c): The melanic patches are not many and they are concentrated in the anterior part of the fish body. In this region, there is one moderately dark patch located at the dorsal-posterior corner of the operculum. Another three dark patches situated behind the pectoral fin, with one of them extends ventrally reaching the ventral horizontal line of the fish body. In the posterior half of the fish body, there are two main dark large spots, one above the lateral line just below the posterior part of the spinous part of

the dorsal fin, the other dark spot is located below the lateral line just above the mid of the base of the anal fin.

Family: Nemipteridae
Scolopsis taeniatus Cuvier, 1830

Colour of normal specimen, TL 235 mm (Fig. 2a): the overall colouration of the body of this species is green-yellowish, with dark brown band extending posteriorly coming below the lateral line near the posterior end of soft ray part of dorsal fin and then moves dorsal to the lateral line afterward reaching the base of caudal fin.

Colour of abnormal specimen, TL 175 mm (Fig. 2b): light melanic patches are noticed at the dorsal and ventral side of the fish body. At the former location, dark patches positioned beneath the 3rd -5th dorsal spines. A dispersed pale patch observed directed posteriorly reaching mid of the soft part of dorsal fin. Ventrally, dark irregular spots are noted at the posterior corner of the lower jaw, at the ventral side of both preoperculum and the opercular bones and in the area between the pelvic and anal fins.

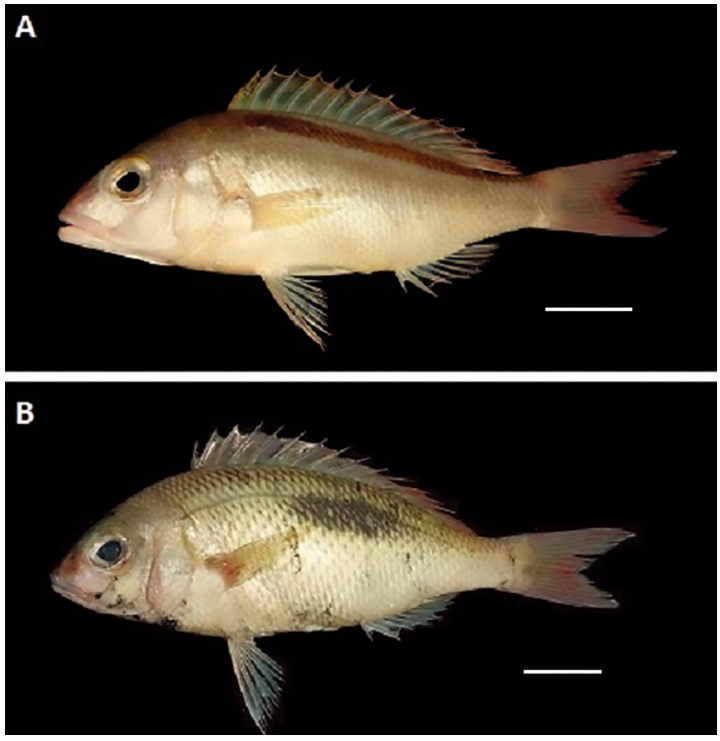

Fig. 2. *Scolopsis taeniatus*. A, normal specimen, TL 235 mm; B, abnormal specimen, TL 175 mm. Scale bar = 1cm.

Family: Platycephalidae
Platycephalus indicus (Linnaeus, 1758)

Colour of normal specimen TL 196 mm (Fig. 3a): olive colouration on the dorsal side of the body of this species, with white ventral side; presence of numerous large dark spots distributed regularly on the dorsal mid line and the sides of the body, but not on the abdomen; smaller dark spots found dispersed among the among the large spots regularly.

Colour of abnormal specimen, TL 224 mm (Fig. 3b): the dorsal-lateral side of the fish body is covered with irregular pale black patches extending from the base of the pelvic fin reaching the caudal peduncle area.

Fig. 3. *Platycephalus indicus*. A, normal specimen TL 196 mm; B, abnormal specimen, TL 224 mm. Scale bar = 1cm.

Family: Sparidae
Argyrops spinifer (Forsskäl, 1775)

Colour of normal specimen, TL 224 mm (Fig. 4a): body mainly silvery to pink in colouration, with part of the edge of the operculum above the spine red in colour.

Colour of abnormal specimen, TL 185 mm (Fig. 4b). Patches of pale melanic pigmentations are distributed vertically in two lines. One line extending from the mid of dorsal line, and ventrally to the area between the pelvic and anal fins. The other line spreads from the soft ray's part of dorsal fin down to the anterior edge of anal fin.

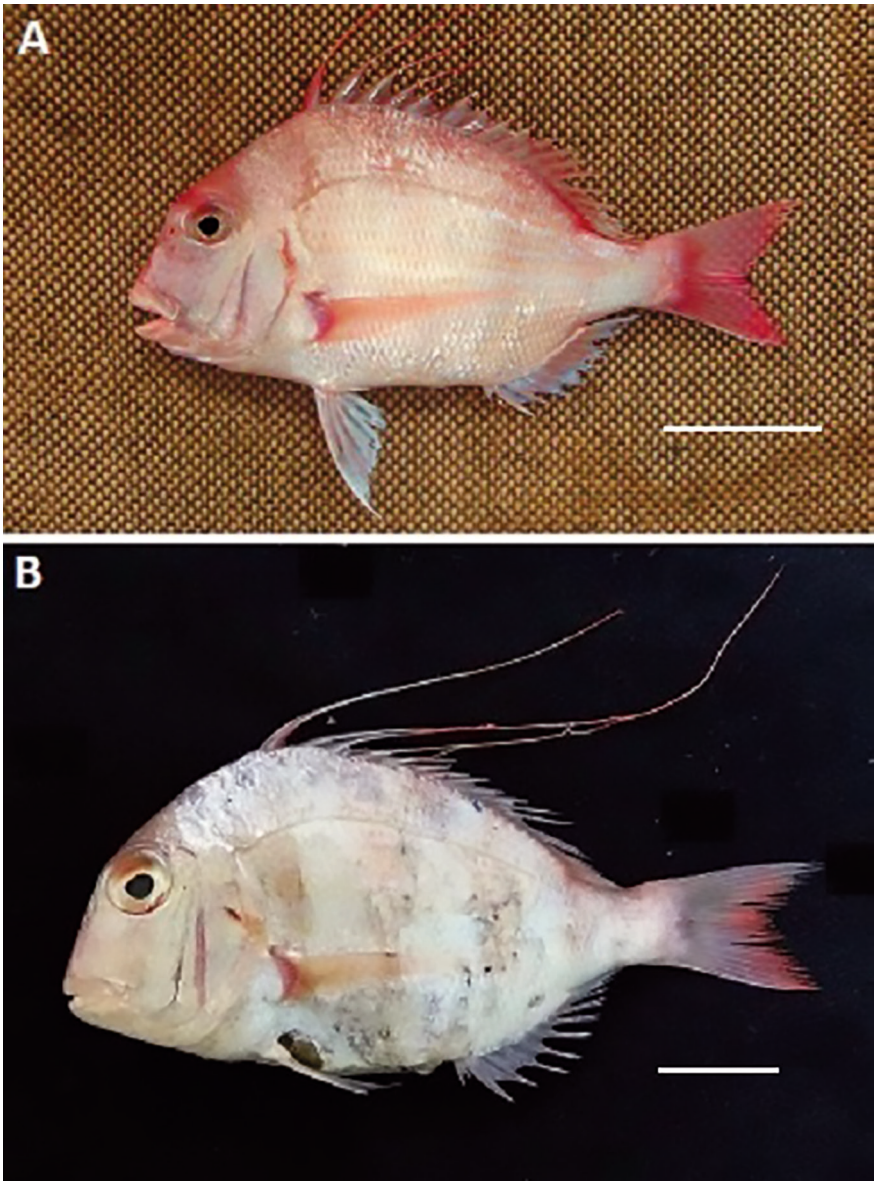

Fig. 4. *Argyrops spinifer*. A, normal specimen, TL 224 mm; B, abnormal specimen, TL 185 mm. Scale bar = 1cm.

II. Hyper-melanic cases
Family: Nemipteridae
Nemipterus randalli Russell, 1986

Colour of normal specimen, TL 228 mm (Fig. 5a): body generally silvery pink, with white silver abdomen, area below lateral line faint in colour.

Colour of abnormal specimen no. 1, TL 212 mm (Fig. 5b). The hyper-melanic patches are distributed in two main and two dispersed locations on the body of the fish. The first main hyper melanic patch centred vertically in the area between the pelvic and the anterior edge of the anal fin and dispersed posteriorly to the mid of the base of the anal fin. The two dispersed and pale patches are present at the base of both preoperculum and opercular bones and the other one at the caudal peduncle and extending posteriorly towards the caudal fin.

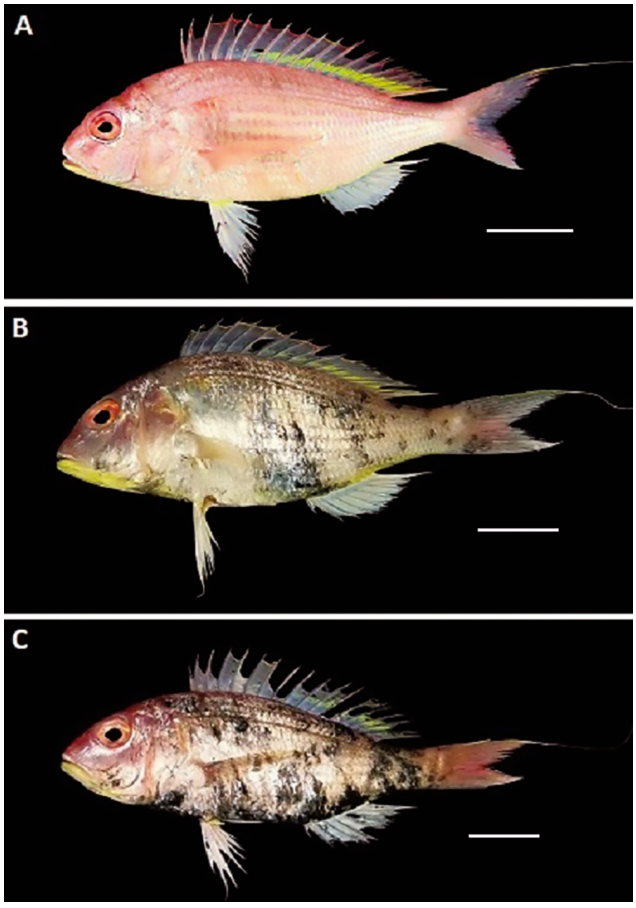

Fig. 5. *Nemipterus randalli*. A, normal specimen, TL 228 mm; B, abnormal specimen no. 1, TL 212 mm; C, abnormal specimen no. 2, TL 198. Scale bar = 1cm.

Colour of abnormal specimen no. 2, TL 18 (Fig. 5c). Most of the sides of the fish body is covered with dark hyper melanic patches. They are extending from the area posterior to the operculum and posteriorly to the base of caudal fin. The number of hyper melanic patches is more in the area below the lateral line than that above it.

Family: Sparidae

Crenidens crenidens indicus Day, 1873

Colour of normal specimen, TL 215 mm (Fig. 6a): Body mainly silvery in colouration, with horizontal dark silvery lines on the ventral side of the body.

Colour of abnormal specimen, TL 146 mm (Fig. 6b). The main hyper melanic patches are found in the lower half of the fish body centred in the area between the pelvic and anal fins. In the upper half, there are a few sporadic spots, with two dark spots beneath the anterior and posterior parts of the dorsal fin. There are two pale melanic spots on the caudal peduncle region, while the caudal fin and head are free of melanic patches.

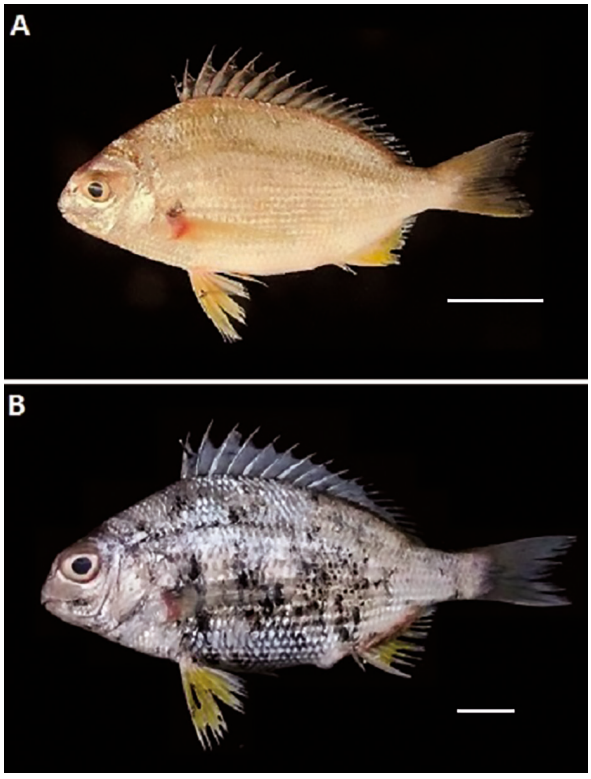

Fig. 6. *Crenidens crenidens indicus*. A, normal specimen, TL 215 mm; B, abnormal specimen, TL 146 mm. Scale bar = 1cm.

DISCUSSION

The six fish species belonging to four families obtained from a single locality in the marine waters of Iraq is high if it compared with the results attained from Sea of Oman (Jawad and Al-Kharusi 2013) and Arabian Sea coasts of Oman (Jawad *et al*., 2013). Such high number of species taken from one locality showing melanosis attracts the consideration to the unhealthy environment, where the fish are living in (Khwedim *et al*., 2009; Raaheem, 2009).

The cases of *N. randalli*, specimen no. 2 and *C. crenidens* were the most severe incidences examined in the present study. These cases are characterised in the concentration of the melanin and the large area their patches occupy on the surface of the fish body. On the other hand, there was variation in the intensity of melanin in the patches found on different parts of the fish body. For instance, those patches at the ventral side of the preoperculum and opercular bones are pale on the contrast to those found on other parts of the body. Such variation is also observed in some carangid species collected from the coasts of Saudi Arabia, Arabian Gulf (Jawad and Ibrahim, 2017).

From the results obtained, it appears that the sides of the fish body are the most areas affected by melanic patches. This variation could be owing to the reasons stated by Roulin and Ducrest (2011). They suggested that manipulating the genes of the melanocortin system or of their outcomes would have noteworthy influences on a series of features. Slominski and Wortsman (2000) proposed, the level of action of the different melanocortins is linked across tissues. Another investigations specified that with the assistance of neuroendocrine interaction, the activity of the melanocortin system can be close by controlled and organized (Slominski and Wortsman, 2000; Slominski, 2005; Zbytek *et al*., 2006) and such management could differ between tissue of the fish body (Hoglund et al. 2000).

Skin melanosis can happened with an austere hyperplasia of dermal melanophores, which cause the darkened skin. Melanophore hyperplasia could result from a recurrent source of hyperpigmentation in teleost fishes. This effect been stated heretofore in a number of fish species (Noguera *et al*., 2013; Ramos *et al*., 2013). Hyperplasia is characterized by an upsurge in organ size or tissue involved (Sweet *et al*., 2012; Lévesque *et al*., 2013). However, previous inflammatory incidences cannot eliminated owing to the inductor stimuli could been triggered long before the specimen was studied.

It was difficult to decide the source of the melanism for the specimens reported in the present study. Nevertheless, the condition of the specimens examined did not back the hypothesis that melanism can be because of a parasitic infestation. Hsiao (1941) stated that an Atlantic cod *Gadus morhua* perhaps showed melanism owing to the heavily infestation of the skin by trematode larvae. The macroscopic examination of the skin of the specimens

investigated revealed the absence of parasites. In addition, microscopic observation (50×) of the epidermis over the scales disclosed no change in the form or size of melanocytes nor any modification in the look of pigmented areas of melanistic and non-melanistic areas. Declining the cause of parasites and hybridisation also deliberated in study on another fish species (Simon *et al*., 2009; Jawad and Ibrahim, 2017).

Incidences of melanism could linked to the intergeneric hybridisation (Elwin, 1957). These circumstances, though, implausible since all the meristic characters of the specimens of the four studied were in agreement with the description given by Randall (1995), and not overlying features of other species.

Melanophore hyperplasia could be an outcome of a recurrent reason of hyperpigmentation in teleost fishes. This outcome been stated earlier in a number of fish species, such as *Pagellus acarne* and *Limanda limanda* (Gimenez-Conti *et al*., 2001; Noguera *et al*., 2013; Ramos *et al*., 2013). Hyperplasia is regarded as an increase in organ size or tissue intricate (Cockerell and Cooper, 2002; Sweet *et al*., 2012; Lévesque *et al*., 2013).

Previous upsetting measures in fishes that lead to chromatic variations such as wounds and injuries formerly been described in other fish species as *Carassius auratus* (Smith, 1931) and flatfishes (Norman, 1934; Dahlberg, 1970), which may have been the preliminary incentive that activated the propagation of melanophores. In the specimens studied presently, the occurrence of wounds or injuries could not established. Nevertheless, precise care to these deformities is obligatory in order to attain a more inclusive information about the existence of melanic hyper-pigmentation in coastal fish species.

Bolker and Hill (2000); Carnikián *et al*. (2006); Bukola *et al*. (2015) and Malik *et al*. (202) suggested that the environmental pollution of various kinds are also responsible for ambicoloration in fishes. In Iraq, water pollution in general and the marine water pollution in particular started in early 1980s. For marine waters, such studies were concentrated on Iraqi Coasts of the Arabian Gulf such Khor Zubair, Shatt Al-Arab estuary, Shatt AlBasrah and the marine water proper region. Most of the coastal areas are under development and water in these areas received pollutants from water discharge by boats and ships, marine transportation and ballast water discharges. While, wastewater, industrial and agricultural discharges and dredging are another sources of pollutant in this coastal area. These activities along the Iraqi coasts have caused this area to be exposed to different kinds of pollutants especially heavy metals. (Khwedim *et al*., 2009; Raaheem, 2009).

Leucism and piebaldism are two colour abnormalities in vertebrates other than fishes. The basic physiological principles are nearly the same in fish ambicolouration, but due to the complexity of the body, structures of the higher

vertebrate's leucism and piebaldism seem different. It is out of the scope of this study to compare leucism and piebaldism of higher vertebrates with the ambicolouration in fishes.

Besides to the economic influences that the melanic specimens may cause to the fishermen owing to being unsuitable for the customers, melanism revealed to affects the social relations and reproductive achievement in some fish species (Heemstra and Randall, 1993).

In conclusion Malpigmentation in the fish specimens obtained from the marine waters of Iraq could be happened due to some physiological issues rather than the effects of the parasite.

Author contributions

Laith Jawad: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Data Curation, Writing - Original Draft, Writing - Review & Editing, Visualization, Supervision, Project administration
Falah Mutlak: Resources, Investigation
Abbas Al-Faisal: Resources, Investigation

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflict of interest

The authors declare that they have no conflict of interest between them.

Ethical approval

This article contains studies with dead fish and in this case, ethical approval is not applicable.

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