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Pterinosomes in Erythrophores of the Guppy, *Lebistes reticulatus*

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Erythrophores and xanthophores in integuments of fish are considered to contain both pteridines and carotenoids as a source of their pigmentation (Bagnara, 1966; Hama and Kajishima, 1967). Ultrastructural studies have indicated that pteridines were localized in pteridine-containing vesicles, or "pterinosomes" (Matsumoto, 1965), and carotenoids were dissolved in small electron-dense particles (Takeuchi and Kajishima, 1972).

Pterinosomes are spherical or somewhat ellipsoidal in shape, ranging in diameter about 0.4 μ to 1.0 μ. Two types of pterinosomes of different inner structures have been reported (Obika, 1973); the one found in goldfish xanthophores contained irregularly arranged fibrillar materials (Matsumoto and Obika, 1968; Takeuchi and Kajishima, 1972), and the other encountered in erythrophores of the swordtail, *Xiphophorus helleri*, and also in xanthophores of the medaka, *Oryzias latipes*, had well-arranged concentric lamellae (Matsumoto, 1965; Kamei-Takeuchi et al. 1968; Kamei-Takeuchi and Hama, 1971). It would seem reasonable, however, to expect that many other morphologically distinct types of pterinosomes could be found elsewhere. This report describes the fine structure of pterinosomes in erythrophores of the guppy.

Materials and methods

Varicolored males of the guppy (*Lebistes reticulatus* Peters) were obtained from a commercial hatchery. Tail fins showing red coloration by scattering distribution of numerous erythrophores, were selected and cut off into small pieces in a chilled Dalton's chrome-osmium solution (Dalton, 1955). Fixation was carried out with the same solution for two hours at 4°C. Epon-embedding was done according to Coulter (1967). Thin sections were obtained using a Porter-Blum MT-2 ultramicrotome with a glass knife, double-stained with uranyl acetate and lead nitrate, and examined with a Hitachi HU 11-DS electron microscope at 75 kV.

Results and discussion

Cytoplasm of the erythrophore was filled with numerous round to oval membrane-limited pterinosomes, which were approximately 0.3~0.4 μ in diameter and irregular in the profile of their inner structures. Four types of pterinosomes could be distinguished according to their respective inner components. The first type contained no inner structure except for a few membranous materials in the vicinity of the limiting membrane and running parallel to it. The second type was characterized by, in addition to the membranous materials in the first type, the accumulation of fine particular substances throughout the inner part of the vesicle. A small amount of more coarse granular materials was frequently observed at the central part of the vesicle. In the third-type vesicle, the coarse granular materials increased in amount and were distributed throughout the vesicle. The fourth type contained no fine particular substances; instead, the coarse granular materials occupied the interior of vesicle. They were often found to be more dense in the central part than at the periphery of the vesicle. The membranous materials described in the first-type vesicle were sometimes obscure in this vesicle (Fig. 1). The typical features of these four types of pterinosomes are schematically represented in Fig. 2.

The question arises as to whether these vesicles represent several developmental stages of the same pterinosome, or essentially different kinds of pterinosomes. As shown in Fig. 1, an intermediate form of vesicle was also found between the vesicles of first-type and second-type, second-type and third-type, and also third-type and fourth-type, in the same erythrophore. From this fact, it seems reasonable to regard that the types represent the consecutive developmental forms of the same pterinosome. In xanthophores of the medaka, *Oryzias latipes*, the onset of pterinosome development was the membrane-limited vesicle which had no inner components, and the second step was the accumulation of fine particular substances in the interior of the vesicle (Takeuchi and Hama, unpublished data). This may be applicable to the present study; that is, the first-type vesicle in this study may represent the first developmental stage of the pterinosome in the guppy erythrophore, and the fourth-type the final one. A more detailed examination is necessary to verify this presumption.

Besides the above-mentioned pterinosomes, still another type of pterinosome could very occasion-

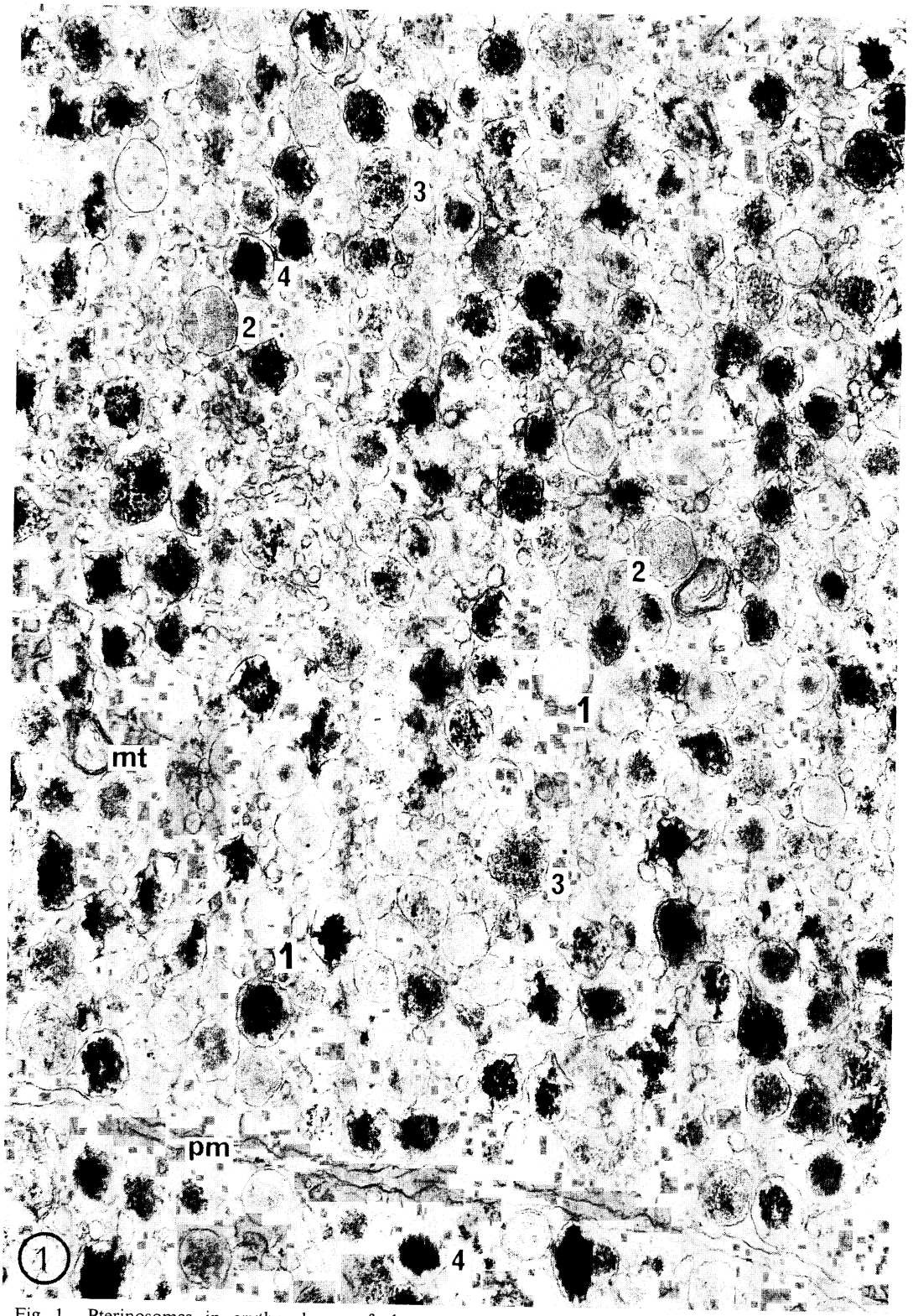

Fig. 1. Pterinosomes in erythrophores of the guppy. 1, 2, 3 and 4 correspond to the first-type, second-type, third-type and fourth-type pterinosome in the text, respectively. mt, mitochondria; pm, plasma membrane of the erythrophore. ×27,000.

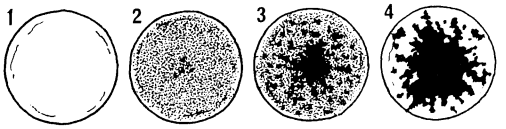

Fig. 2. Schematic representation of the pterinosomes found in erythrophores of the guppy. 1, 2, 3 and 4 correspond to the first-type, second-type, third-type and fourth-type pterinosome in the text, respectively.

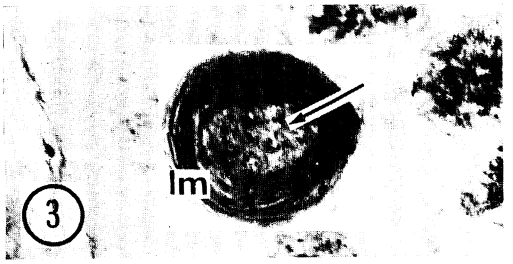

Fig. 3. Pterinosome having concentric lamellar materials (lm) with granular and fibrous materials (arrow). ×72,000.

ally be observed in the cell. This type had concentric lamellar materials which were more well-developed at the periphery of the vesicle, and contained granular and fibrous materials in its central part (Fig. 3). Thus, it is very similar in its inner component to the pterinosomes reported in erythrophores of the swordtail (Matsumoto, 1965) and xanthophores of the medaka (Kamei-Takeuchi *et al.*, 1968; Kamei-Takeuchi and Hama, 1971). The origin of this pterinosome and its relationship to the above-mentioned four types of pterinosomes, remain to be clarified.

Acknowledgments

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グッピーの赤色素胞におけるプテリノゾーム

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グッピー (*Lebistes reticulatus* Peters) の赤色素胞細胞質には多数の，直径約 0.3～0.4 μ の，球型または卵型のプテリノゾームが充満していた．これらは微細構造的には，過去に報告されたソードテール赤色素胞やメダカ黄色素胞内のプテリノゾームとも，金魚黄色素胞内のプテリノゾームとも異なっており，その内部構造の差異によって，大きく４つのタイプに分けられた．これらのタイプは，それぞれが別の種類のプテリノゾームを表わすのではなく，一種類のプテリノゾームの連続した発達過程を表わしているものと考えられた．まれに，これらとは別のタイプの，ソードテール赤色素胞やメダカ黄色素胞に存在するプテリノゾームと類似した内部構造を有するものが見られたが，このプテリノゾームの性質や，上述した４つのタイプのプテリノゾームとの関係は不明であった．

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