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Morphological Description Of Inner Ear In *Barbus luteus* Heckel (Teleostei: Cyprinidae).

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Abstract

The morphological description of inner ear in *Barbus luteus* have been investigated.

The results of the present study revealed that the fish under investigation has a pair of inner ears which are embedded in two otic capsules of the skull. The inner ear contains two main structures, the first is the Osseous Labyrinth (OL), and the second is the Membranous Labyrinth (ML).

Both of (OL) and (ML) consist of three semicircular canal (SCC). These are anterior, posterior and horizontal semicircular canals (ASCC, PSCC and HSCC).

The (OL) contains three chambers while the (ML) contains saccular structures which are called otoliths organs represented by utriculus (U), sacculus (S) and lagena (L). Each of the saccular structures has a solid structure called otolith. The otoliths are represented by lapillus, sagitta and astericus which are situated in (U), (S) and (L) respectively.

Key words: Inner ear , Fishes , Otoliths

Introduction

Barbus luteus is one of the Iraqi freshwater fish belonged to the family cyprinidae [1]. The family cyprinidae includes, all species belong to the genus *Barbus*, carp, goldfish, minnow and other species[2].

Cyprinids fish are in the series Otophysi[3]. Literatures review revealed that all the otophysians have a specialized linkage of bones called the Weberian ossicles which conduct vibrations from the gas bladder to the inner ear. This mechanism allows the auditory responses to lower level signals and higher frequencies in otophysans compared to many other teleosts, so that otophysans have been classified as hearing specialists[4,5].

Review of the literatures showed that there is almost no clear informations about the morphological description and histological structures of the inner ear in Iraqi freshwater fish with the exception of the studies done by. Al-Jumaily and Dauod[6], and Al-Jumaily[7].

The present study aimed to give a preliminary data about the morphological description of the inner ear of *Barbus luteus* , with hope to increase the information about the inner ear in Iraqi freshwater fish.

Materials and Methods

Abults *Barbus luteus* were collected in fresh condition from the local fish market at Baghdad city. Fishare selected in different sizes and ages. The method used by Al-Jumaily[7] was employed to get the inner ear of the fish under investigation. Camera lucida was used to draw the membranous labyrithes of the fish.

Results and Discussion

Vertebrate animals including fish have a pair of inner ear embedded inside of the otic capsules within the skull and situated on both sides of the hind brain[8]. Results of the present study confirmed this foundation, and showed that the inner ear of *Barbus luteus* consists of two structures represented by Osseous labyrinth and membranous labyrinth (Figure1). The later situated inside the first labyrinth (Figure2). The membranous labyrinth separated from the osseous labyrinth by the perilymp, and thin band of loss connective tissue with blood vessels. These results agree with several data reported by several workers[6, 7, 9, 10].

The osseous labyrinth has similar morphology of the membranous labyrinth with the exception that some parts of the osseous labyrinth are not complete.

These results agree with the results reported by Al-Jumaily[7] in *Liza abu* and Al-Jumaily and Dauod,[6] in *Silurus triostegus.*

The inner ear in *Barbus luteus* (Both osseous and membranous labyrinths) is divided into pars dorso-superior which includes the three semicircular canals including the utriculus (U), and the pars ventro-inferior which includes the sacculus (S) and lagena (L) (Figure 1, 2, 3 &4). These results agree with the previous results of several researchers [11, 12, 7].

The osseous labyrinth of the fish under investigation consist of three osseous chambers which are represented by (U), (S) and (L)(figure 1)

Previous studies revealed that there are three semicircular canals. These canals are represented by anterior semicircular canal (ASCC), posterior semicircular canal (PSCC)and Lateral or horizontal semicircular canal (HSCC) [11, 12, 13].

These results revealed some agreement with the results of the present study with the exception that the anterior semicircular canal in *Barbus luteus* is situated deeply in the otic capsule as in *Silurus triostegus* [6], and also the lateral semicircular canal in *B. luteus* appeared oblique with angle of 10° and that,is why it is called horizontal semicircular canal (Figure 4&6). These results confirmed the results of Al-Jumaily[7] in *Liza abu* and disagree with the data reported by Al-Jumaily and Dauod[6] in the inner ear of *Silulus triostegus*.

Previous studies revealed that there is an enlargement at the anterior end of each semicircular canal called the ampulla[13, 14]. Results of the present study showed that the ampulla of osseous labyrinth represented by a concave enlargement to rest the ampullae of each semicircular canal of membranous labyrinth (figure 1&3).

The present study also showed that there is a membranous bony plate surrounded the ampulla of the anterior semicircular canal (AA) which extend posteriorly to cover the ampulla of the lateral (horizontal) semicircular canal (HA), this is probably related to the fact that the anterior semicircular canal embedded deeply in the otic capsule cavity in *B. luteus*. This foundation confirmed the results reported by Al-Jumaily and Dauod[6] in *S. triostegus* and disagree with the data reported by Al-Jumaily[7] in *L. abu* . Several workers reported that the ampulla of the anterior and lateral semicircular canals are connected together anteriorly with the utriculus chamber, while the ampulla of posterior semicircular canal (PA) connected with its posterior part[5& 13] and this fact is an agreement with the result of the present study (figures 4&6). *B. luteus* has osseous plate supported by crus commune (CC) from the external side and extended lowerly to cover the ampulla of posterior semicircular canal and the end of the horizontal semicircular canal. This result disagrees with the data reported by Al-Jumaily and Dauod[6] and Al-Jumaily[7] in *S. triostegus* and *L. abu* respectively, in addition to the presence of the duct which connected the utriculus with sacculus called the utrico-saccular duct (US) which opened toward the internal lateral side of the cranium (Figures 4&5).

Results of the present study showed that the membranous labyrinth of *B. luteus* consist of the same of the above structures of the osseous labyrinth in addition to the presence

of the saccular structures represented by (U), (S) and (L), which are called otolith organs (figures 4&6). These results agree with several researches[13, 16& 17]

Results of the present study also showed that (U) is located dorsally while (S) is located venterally bellow the (U) and both of them connected together by Utrico-sacculas duct (figures 3&6) this result agree with several previous studies [18, 19]..

The Utrico-saccular duct in *B. luteus* appeared as a relatively long duct which is situated posteriorly. This result agrees with the foundation of Al-Jumaily and Dauod[6] and disagrees with the data recorded by Al-Jumaily[7] who worked on *Liza abu*.

Results of the present study revealed that the (S) in *B. luteus* appeared as a cylindrical shape pointed at both ends and formed from the external lateral wall of (S) the (L) appeared as a rounded saccular structure (Figures 5&6). This result agrees with the observation recorded by Jensen[20] and Al-Jumaily & Dauod [6], and disagrees with the data recorded by several researchers[7, 5& 18].

The present study showed that *B. luteus* has a transvers duct at the internal lateral wall of (S) which connects the right side of membranous labyrinth with the left side (Figure 5). This is perhaps important for good hearing as it is connected with weiberian system and the (S), due to the fact that *B. luteus* belonged to the family cyprinidae which represented a member of the otophysans fish (Super order: Ostariophysi). These results confirmed the data recorded in some previous research[6, 20, 21].

The present study declears similarity in the semicircular canals of membranous labyrinth with that of osseous labyrinth with the exception that the semicircular canals of membranous labyrinth are complete and the posterior ends of the anterior & posterior canals are connected with each other to form the crus commune which appeared compressed on both sides and connected from its posterior end with superior surface of (U) (Figures 4&6), and this confirmed some of the previous results[12, 22].

Results of the present study also showed that the posterior end of the horizontal semicircular canal is connected with the posterior region of (U) at the side of the posterior semicircular canal ampulla (figure 6) which is agreed with the foundation of [7, 23] and disagreed with the observations recorded by Harder[16], who stated that it is connected with the crus commune and the data recorded by Al-Jumaily and Dauod[6] in *S. triostegus*. This perhaps due to the direction angle of the horizontal canal.

The present study showed that the otoliths organs (U, S and L) contain solid structures called the otoliths which take different names (lapillus, sagitta and astericus) which are located in (U), (S) and (L) respectively (figures 7, 8&9). These results agreed with the previous studies foundations[13, 16, 21].

The shapes and sizes of the otoliths are differed in different species of fish[5, 7&13]. The results of the present study showed that the three otoliths of the (U, S, L) of *B. luteus* are similar to those in zebra fish[5] and *S. triestegus*[6], due to the fact that all of the above three species belonged to the otophysans group even they are belonged to different families. On the other, hand the otoliths of *B. luteus* are differed from those of *L. abu* due to the fact that this species of fish doesn't belong to the otophysans group and belonged to the order perciformes[7].

In conclusion *B. luteus* has ability for good hearing as it is belonged to the otophysans which has the ability of auditory responses to lower level signals and high frequencies [12].

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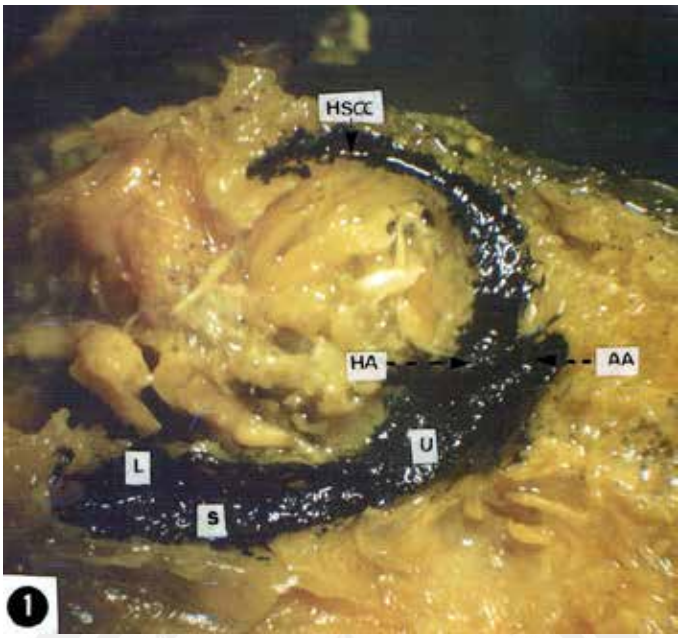
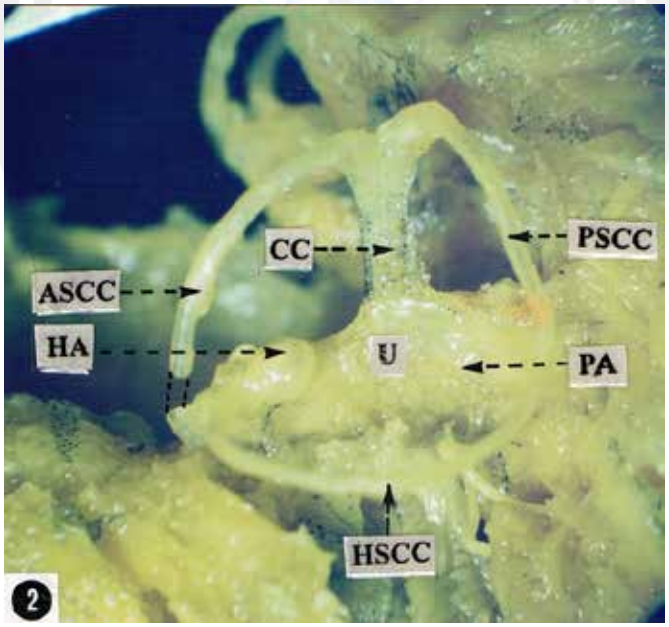
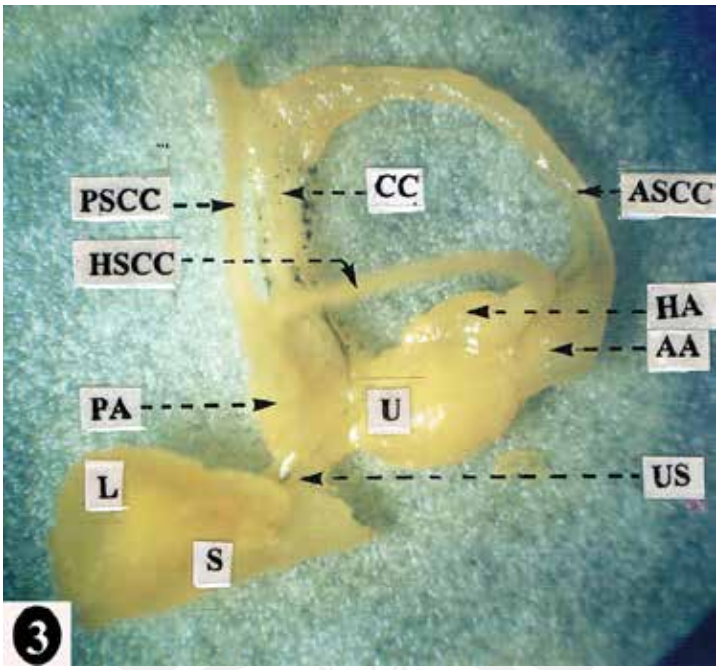


Figure(1): Internal lateral view of the cranial cavity in *B. lutues* , showing some parts of osseous Labyrinth.

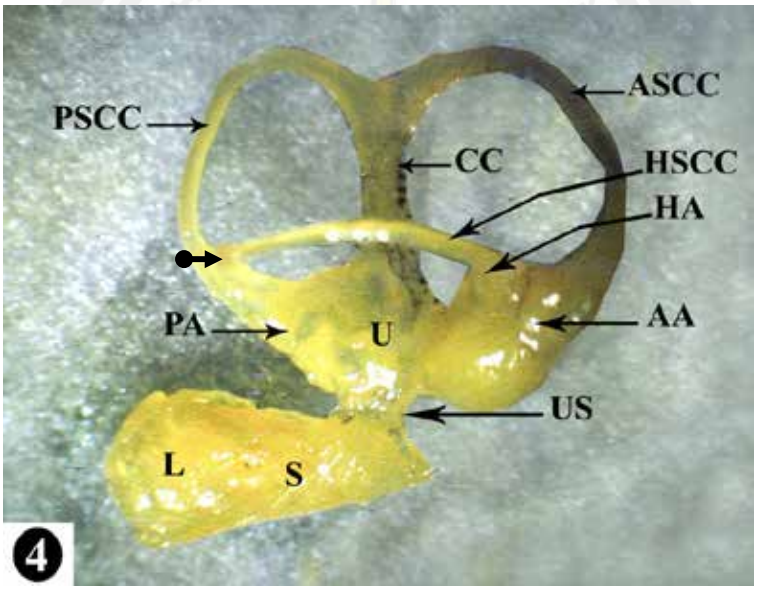


Figure(2): External lateral view of the cranial cavity in *B. lutes*, showing the pars dorso – superior of membranous labyrinth (semicircular canls and utriculus) (3.3X)

AA-Anterior Ampulla, ASCC-Anterior Semicircular Canal, , CC-Crus Commune, HA-Horizontal Ampulla, HSCC-Horizontal Semicircular Canal, L-Lagena, PA-Posterior Ampulla, PSCC-Posterior Semicircular Canal, S-Sacculus, U-Utriculus,.

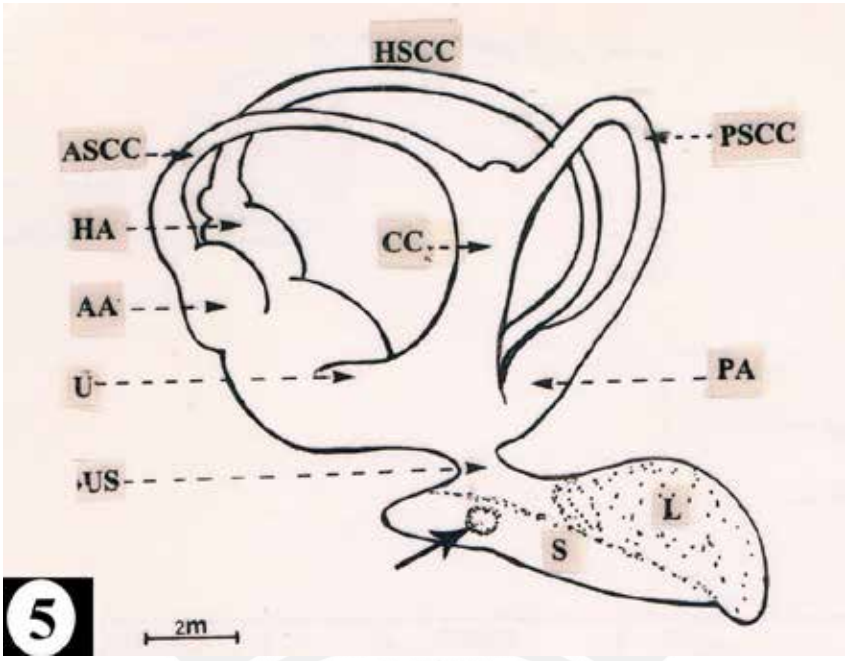


Figure(3): External lateral view of the right membranous Labyrinth , showing the main structures of it. (3.96X).



Figure(4): External lateral view, showing the Pars dorso – superior and pars ventro-inferior of the right membranous Labyrinth and appears the connected of posterior end horizontal semicircular with utriculus (➙) (4.4X).

AA-Anterior Ampulla, **ASCC**-Anterior Semicircular Canal, , **CC**-Crus Commune, **HA**-Horizontal Ampulla, **HSCC**-Horizontal Semicircular Canal, **L**-Lagena, **PA**-Posterior Ampulla, **PSCC**-Posterior Semicircular Canal, **S**-Sacculus, **U**-Utriculus, **US**-Utrico Saccular Duct.



Figure(5) : Schematic diagram of the internal side of the right membranous Labyrinth showed the main structures of it and appears the situation of transvers duct (——)(8X).

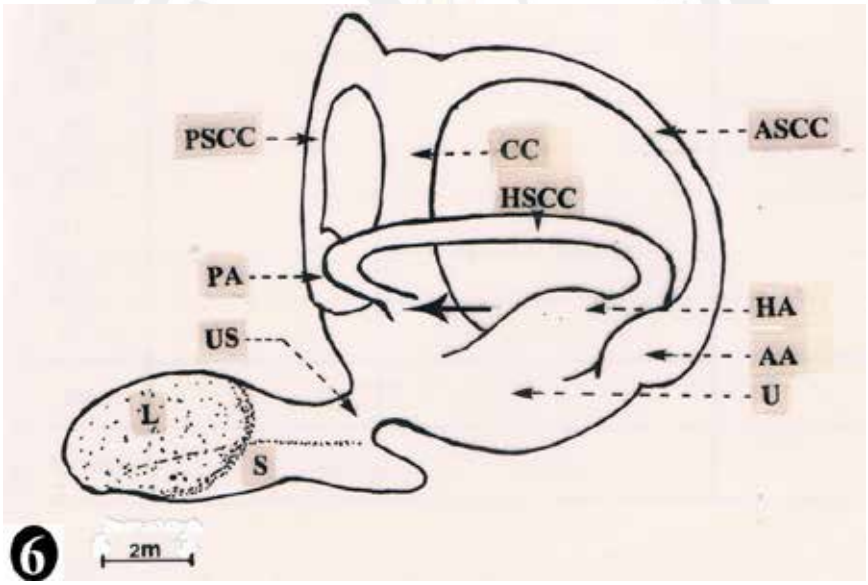


Figure (6): Schematic diagram of external side of right membranous Labyrinth showing oblique angle horizontal semicircular canal and it connected of posterior end with utriculus (←——) (8X).

AA-Anterior Ampulla, **ASCC**-Anterior Semicircular Canal, , **CC**-Crus Commune, **HA**-Horizontal Ampulla, **HSCC**-Horizontal Semicircular Canal, **L**-Lagena, **PA**-Posterior Ampulla, **PSCC**-Posterior Semicircular Canal, **S**-Sacculus, **U**-Utriculus, **US**-Utrico Saccular Duct.

Figure(7): The utriculus otolith (Lapillus) of *B. luteus* (7X).

Figure (8): The Sacculus otolith (Sagitta) of *B. luteus* (4.4X).

Figure(9): The Lagena otolith (Astericus) of *B. luteus* (7X).

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الوصف الشكليائي للاذن الداخلية في سمكة الحمري *Barbus luteus* Heckel (Teleostei:Cyprinidae).

ايمان سامي الجميلي
قسم علوم الحياة ، كلية التربية – ابن الهيثم ، جامعة بغداد
استلم البحث في: 5 ايلول 2012 قبل البحث في: 15 تشرين الاول 2012

الخلاصة

تمت دراسة الوصف الشكليائي للاذن الداخلية في سمكة الحمري (*Barbus luteus* Heckel) . أظهرت نتائج الدراسة الحالية ان سمكة الحمري تمتلك زوجاً من الآذان الداخلية مطمورة داخل زوج من العلب السمعية في الجمجمة وعلى جانبي الدماغ الخلفي. تتألف الاذن الداخلية في السمكة موضوع الدراسة من تركيبين ، خارجي عظمي يدعى بالتيه العظمي وداخلي يدعى بالتيه الغشائي، ويتألف كلا التركيبين (التيه العظمي والتيه الغشائي) في السمكة موضوع الدراسة من ثلاث اقنية نصف دائرية امامية وخلفية وافقية.

يحتوي التيه العظمي ثلاث حجيرات او ردهات في حين يحتوي التيه الغشائي تراكيب كيسية يطلق عليها بالاعضاء الحصوية تتمثل بالقريبة (U) والكييس (S) والقنينة (L) ، وتدعى بالاعضاء الحصوية. وتوجد في هذه الاعضاء الحصوية تراكيب صلدة يطلق عليها بالحصوات السمعية تأخذ مسميات مختلفة فالتي تقع في القريبة تدعى اللابه (Lapillus) والتي في الكييس تدعى بالسهيم (Sagitta) اما التي توجد في القنينة فتدعى بالنجيم (Astericus) .

الكلمات المفتاحية: الاذن الداخلية ، الاسماك ، الحصوات السمعية.