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Cladistic Analysis of Species Infesting (Amblycera: Menoponidae) Fowls of District Hyderabad, Sindh, Pakistan

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ABSTRACT

The present research work covers the phylogentic relationship of five species belonging to a family Menoponidae (Amblycera: Phithraptera), recovered from variety of fowls as host from district Hyderabad, Sindh Pakistan. These were analyzed cladistically by cladogram, using of their apomorphic characters. The Key to the five species of family Menoponidae has also been developed for the three genera. This is the first attempt to cladistics analysis of the family Menoponidae from district Hyderabad, Sindh, Pakistan.

Figures : 06 References : 27 Table : 01

KEY WORDS : Amblycera, Cladistic Analysis, Hyderabad Mallophaga, Menoponidae.

Introduction

Lice are highly successful ectoparasites. Most species of mammals and birds are infested by about at 1- 6 species of lice at one time which are causing itching, skin irritation and dermal inflammation to host. The group Mallophaga has dorsoventrally flattened body and wingless parasitic insects of most of the orders of birds and mammals. The chewing lice have three suborders Amblycera, Ischnocera and Rhynchophthirina, of which the Amblycera are the most primitive group of chewing lice which are active and fast moving than group of lice[10,16-18]. The Amblycera includes seven families: the Menoponidae, Laemobothriidae, Ricinidae, Boopiidae, Trimenoponidae, Gyropidae, and Abrocomophagidae[10,11,19,20,24]. The family Menoponidae is one of the oldest and largest family among all families of Amblycera. The family Menoponidae (Amblycera) consists of nine genera which are parasitizing world wide *Afrimenopon*, *Myrsidea*, *Colpocephalum*, *Menacanthus*, *Menopon, Holomenopon*, *Heleonomus, Hohorstiella* and Neokelerimenopon gen. nov. Both morphological and molecular phylogentic analysis supported the relationship among all menoponid genera[14]. It is a comparative study based on morphological characteristics of adult avian lice producing 50 characters from five species belonging to three genera and the cladogram of the grouped lice based on diversity and distribution of characters appears as a result of coevolution throughout the clade. By using both morphological and molecular[5,6] data have studied the phylogenetics of amblycera. The classification of the family is relatively stable, but classification within this group upto the subfamily level has been difficult progressively[10,14,19]. The key to genera of Menoponidae[9] covered only 15 genera with two main groups, *Colpocephalum*-complex and *Menacanthus*-complex. One of a taxonomist[19] covered 35 menoponid genera and provided phylogenetic analysis of morphological characters to support four major groups of Menoponidae. Lice were studied[18] by the classification and phylogeny of the Psocodea with reference to lice (Order Phthiraptera) the apomorphies of Psocodea and both Phthiraptera and Psocoptera were considered to be holophyletic group, but lies separately. Mallophagan lice should be important proof on the phylogeny of their hosts; three factors were discussed in the principle of host–parasite co-evolution, discontinuous distribution, secondary infestation and parallel evolution[7,8]. They also have considered the amblycera to be the most primitive lice, their ancestors may start to live as ectoparasitic of warm blooded animals in Triassic Period (225–190 million years ago)[12,13,26]. By

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the phylogenetic and cladistic analysis, it is believed that the chewing lice have evolved from an ancestral stock before the division into Anoplura and the Ischnocera, other that they diverged from those Ischnocera, which are already parasitic on mammals[15,19,20].

The main purpose of the present study was to know Mallophagan fauna from the host birds of Hyderabad region and to see whether new facts thus obtained could contribute to the existing knowledge of the phylogeny. Unfortunately not a single family has been revised from this region. The morphological characters and characterstats have been derived from[9,19]. The line drawing of the specimens was made with the help of U-DA, Drawing tube attachment, fixed with Olympus Microscope (CH 20). The species diagram was made on the white paper sheet in which the whole mounts were drawn at 10 X whereas the different parts of body of chewing lice were drawn at 100 to 400X. The diagram was traced on tracing paper sheet of 80gm with the help of water proof black ink using rotering pens of diameters of the nibs ranging from0.5 mm.

Key to the species of chewing lice of family menoponidae (amblycera) found on fowls of Hyderabad district, Sindh Pakistan[2,3,4].

1. Postpalpal process present; preocular groove in the formofslit
   - Postpapal process absent; preocular groove in the formofknotch
2. Total length of female body >2mm; pleural knots absent; head index 1.7or more; abdominal sternites with thicksetalbrushes
   - Total length of female body <2mm; pleural knots present; head index1.73; abdominal sternites with thinsetal brishes———-***Menacanthus pallidulus***
3. Body elongated and oblong; ocular nodi very weak to absent; female vulval margin narrow; male genitalia very a typical and peculiar in structure, genitalsacsclerite wing shaped, elongated ----------———————***Menacanthus stramineus***
   - Body broader and oval; ocular nodi weakly present; female vulval margin broad; male genitalia typical of menoponid type, genitalial sac sclerite rod shaped, short inlength————----------———----------———***Menacanthus abdominalis***
4. Ocular nodi and occipital nodi absent; oculo-occipital carina absent; terminal segment of antennae globose; pleural ribs present; tergites complete, undivided; lateral setal brushes on terminalia of female absent; male abdomen bears thick, long tergalsetae in single row ----------———----------***Menopon gallinae***
   - Ocular nodi and occipital nodi present; oculo-occipital carina present; terminal segment of antennae elongated and oval; pleural ribs absent; tergites incomplete, III- VIII divided; lateral setal brushes on terminalia of female present; male abdomen bears thin, short tergal setae in double row————————---------—-***Colpocephalum tausi***

Cladistics analysis of chewing lice of fowls of family menoponidae upto generic level from Hyderabad, Sindh, Pakistan

LIST OF CHARACTERS

A^0Anterior head margin thin andnarrow.

A^1 Anterior head margin rounded, smooth and convex narrowly (*Menopon*)

A^2 Anterior head margin rounded, smooth and convex broadly (*Colpocephalum, Menacanthus*)

B^0 Preocular dorso-lateral margin of head wavy or sinuate.

B^1 Preocular dorso-lateral margin of head bearing notch (*Colpocephalum*)

B^2 Preocular dorso-lateral margin of head bearing slit (*Menacanthus, Menopon*)

C^0 Temples small and condensed.

C^1Temples short and small (*Menopon, Menacanthus*)

C^2Temples long and quadrate(*Colpocephalum*)

D^0 DHS 8-11 Preocular setae not present.

D^1 DHS 8-11 Preocular setae present on margin (*Colpocephalum, Menopon*)

D^2 DHS 8-11 Preocular setae present on submargin (*Menacanthu*)

E^0Dorsal Head Seta 9 notpresent.

E^1 DHS 9 marginal in position (*Colpocephalum, Menopon*)

E^2 DHS 9 submarginal in position (*Menacanthus*)

F^0 Dorsal Head Seta 10 and Dorsal Head Seta 11 identical in length.

F^1 Length of DHS 10 is more than DHS 11 (*Menopon*)

F^2 Length of DHS 10 is less than DHS 11 (*Colpocephalum, Menacanthus*)

G^0 DHS 19 and DHS 20 occular setae very long.

G^1 DHS 19 longer than DHS 20 (*Menopon, Menacanthus*)

G^1 DHS 19 shorter than DHS 20 (*Colpocephalum*)

H^0 DHS 21 and DHS 22 occipital setae absent.

H^1 DHS 21 and DHS 22 occipital setae reaching upto pronotal carina (*Colpocephalum*)

H^2 DHS 21 and DHS 22 occipital setae longer beyond pronotal carina and long macrosetae (*Menopon, Menacanthus*)

I^0 DHS 23 temporal setae undeveloped.

I^1 DHS 23 temporal setae are developed macrosetae (*Colpocephalum, Menopon, Menacanthus*)

J^0 Dorsal Head Seta 23 spreadable with Dorsal Head Seta 22.

J^1 DHS 23 is close with DHS 22 in straight line (*Colpocephalum, Menopon, Menacanthus*)

K^0Dorsal Head Seta 24 immature,condensed.

K^1 DHS 24 is short, microseta (*Colpocephalum, Menopon*)

K^2 DHS 24 is long macroseta(*Menacanthus*)

L^0Dorsal Head Seta 26immature.

L^1 DHS 26 is small, microseta (*Colpocephalum, Menopon*)

L^2 DHS 26 is long, macroseta (*Menacanthus*)

M^0 Alveoli of Dorsal Head Seta 26 distant from Dorsal Head Seta 27.

M^1 Alveoli of DHS 26 is separated from DHS 27 (*Menacanthus*)

M^2 Alveoli of DHS 26 and DHS 27 are contagious (*Menopon, Colpocephalum*)

N^0 Dorsal Head Seta 29 terminal in position.

N^1 DHS 29 is marginal in position (*Menopon, Menacanthus*)

N^2 DHS 29 is submarginal in position (*Colpocephalum*)

O^0 Occipital and ocular nodi absent.

O^1 Occipital nodi is weakly developed only (*Menacanthus, Menopon*)

O^2 Occipital and ocular nodi are well developed (*Colpocephalum*)

P^0Immature development of posterior part of maxillarypalpi.

P^1 Absence of posterior part of maxillary palpi (*Colpocephalum, Menopon*)

P^2 Presence of posterior part of maxillary palpi (*Menacanthus*)

Q^0 Hypopharyngeal sclerite condensed.

Q^1 Weakly development of hypopharyngeal sclerite (*Menacanthus*)

Q^2 Well development of hypopharyngeal sclerite (*Colpocephalum, Menopon*)

R^0 Gular plate not present.

R^1Weakly sclerotization of gular plate (*Menopon, Menacanthus*)

R^2Highly sclerotization of gular plate (*Colpocephalum*)

S^0 Flagellomeres not as much of two segments.

S^1 Flagellomeres are only one pair and present on segments, segments III and IV (*Colpocephalum, Menacanthus, Menopon*)

T^0 Flagellomer II filiform.

T^1 Enlarged and ovoid flagellomere II (*Colpocephalum, Menopon*)

T^2 Rounded and globulated flagellomere II (*Menacanthus*)

U^0 Ventro – lateral groove of antenna not present.

U^1Small and shallow ventro – lateral groove of antenna (*Menacanthus*)

U^2Small and narrow ventro – lateral groove of antenna (*Colpocephalum*)

U^3Largesizeandthinventro–lateral groove of antenna (*Menopon*)

V^0 Ventro – lateral marginal setae arranged anterior termination not present.

V^1Ventro – lateral marginal setae is present on anterior termination and one small and one large size (*Menopon, Menacanthus,Colpocephalum*)

W^0Transverse pronotal carina is notpresent.

W^1Transverse pronotal carina is weak (*Menacanthus, Menopon*)

W^2Transverse pronotal carina is strong(*Colpocephalum*)

X^0 Posterior pronotal setal row half-finished.

X^1Posterior pronotal setal row is complete (*Menopon, Menacanthus, Colpocephalum*)

Y^0 Postnotum on pronotum absent.

Y^1 Postnotum on pronotum is always present (*Menopon, Colpocephalum*, *Menacanthu*)

Z^0 2^{nd} seta of metanotal termainal setal row elongated macro setae.

Z^1 Development of 2^{nd} seta of metanotal terminal setal row as surface seta (*Colpocephalum*)

Z^2Development of pin like or plucky 2^{nd}seta of metanotal terminal setal row which is smaller than surface seta (*Menacanthus,Menopon*)

AA^0 Not presence of prosternal plate.

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AA[1]Weakly development of prosternal plate (*Colpocephalum, Menacanthus, and Menopon*)

BB[0] Anterior setae continuously Prosternal plate not presents.

BB[1] Anterior setae are present and close to the prosternal plate (*Menopon, Menacanthus*)

BB[2] Anterior setae are present and away from the prosternal plate (*Colpocephalum*)

CC[0] Ordinary prosternal plate lateral margins.

CC[1] Reduced and clear prosternal plate lateral margins (*Colpocephalum, Menopon*)

CC[2] Unclar development of prosternal plate lateral margins (*Menacanthus*)

DD[0] Posterior margin of prosternal plate notpresent.

DD[1] Convex prosternal plate posterior margin (*Menopon, Menacanthus, Colpocephalum*)

EE[0] Metasternal plate not present.

EE[1] Weakly development of metasternal plate (*Menopon*)

EE[2] Well development of metasternal plate (*Colpocephalum, Menacanthus*)

FF[0]Absence of setae on femurIII.

FF[1] Thin brushes of setae are present on its venter of femur III (*Menopon*)

FF[2] Thick brushes of setae are present on its venter of femur III (*Menacanthus*)

FF[3] Combs of setae are present on its venter of femur III (*Colpocephalum*)

GG[0] Immature female tergites.

GG[1] Undivided and complete female tergites (*Menacanthus, Menopon*)

GG[2] Division of female tergites into two or three parts (*Colpocephalum*)

HH[0]Posterior row of tergal setae notpresent.

HH[1] Presence of one row of tergal setae posteriorly (*Menopon*)

HH[2] Presence of two rows of tergal setae posteriorly (*Colpocephalum, Menacanthus*)

II[0] Pleural spiracles in particular position.

II[1]Particular position of tergal spiracles is occured (*Colpocephalum, Menopon, Menacanthus*)

JJ[0] Postspiracular setae not present.

JJ[1]Postspiracular setae is present posterior to spiracles (*Menopon, Menacanthus*)

JJ[2]Postspiracular setae is present latero – posterior to spiracles (*Colpocephalum*)

KK[0]Sternites of abdomen are withoutsetae.

KK[1] Sternites of abdomen are with brushes of setae (*Menacanthus, Menopon*)

KK[2] Sternites of abdomen are with ctenidia (*Colpocephalum*)

LL[0] Arrangement of seta on sternites III – V.

LL[1]Arrangement of seta on sternites III only (*Colpocephalum*)

LL[2]Arrangement of seta on sternitesIII and IV (*Menopon*)

LL[3]Arrangement of seta on sternites IV and V (*Menacanthus*)

MM[0] Irregular or patchy appearance of sternal setal brushes.

MM[1] Weakly development of sternal setal brushes (*Menopon*)

MM[2] Well development of sternal seta brushes (*Menacanthus*)

NN[0] Many numbers of sternal ctenidia.

NN[1] Presence of three pairs of sternal ctenidia (*Colpocephalum*)

NN[2] Presence of more than three or additional pairs of sternal ctenidia (*Menacanthus* and *Menopon*)

OO[0]Subgenital plate of female is withoutsetae.

OO[1] Subgenital plate of female is bearing shortl and stout setae (*Menopon*)

OO[2] Subgenital plate of female is bearing short and fine setae (*Menacanthus*)

OO[3] Subgenital plate of female is bearing elongated thick setae (*Colpocephalum*)

PP[0] Female Anal margin is without setal fringe.

PP[1] Female anal margin is furnished with fringe of small and stout setae (*Menopon*)

PP[2] Female anal margin is furnished with fringe of small and fine setae (*Menacanthus*)

PP[3] Female anal margin is furnished with fringe of elongated and thick setae (*Colpocephalum*)

QQ[0] External genitalia of male very lengthy reaching upto the segment IV.

QQ[1] External genitalia of male is large size, reaching upto to the segment IV (*Menacanthus, Menopon, Colpocephalum*)

RR[0]Framework of male genitalia is verycondensed.

RR[1]Framework of male genitaliais simple or modest (*Colpocephalum, Menopon*)

RR[2]Framework of male genitalia is complex or typical and very unique (*Menacanthus*)

TABLE-1 : Raw Data Matrix Chart for character and characterstates of the three genera of family Menoponidae (Amblycera) collected from fowls.

Characters	*Colpocephalum*	*Menacanthus*	*Menopon*
Head Anterior Margin (A)	2	2	1
Head Dorso-lateral Margin (B)	1	2	2
Structure of Tamples (C)	2	1	1
Preocular Setae DHS 8-11 (D)	1	2	1
Position of DH9 (E)	1	2	1
Length of DHS 10 and 11 (F)	2	2	1
Ocular Setae 21 and 22 (H)	1	2	2
Ocular setae Dorsal Head Seta 19 and 20 (G)	1	2	1
Temporal Seta DHS 23 (I)	1	1	1
Position of DHS 23 (J)	1	1	1
Nature of DHS 24 (K)	1	2	1
Nature of DHS 26 (L)	1	2	1
Alveoli of DHS 26 and DHS 27 (M)	2	1	2
Position of DHS 29 (N)	2	1	1
Ocular and Occipital Nodi (O)	2	1	1
Postpalpal Processes (P)	1	2	1
Hypopharygeal Sclerite (Q)	2	1	2
Gular Plate (R)	2	1	1
Number of Flagellomeres (S)	1	1	2
Structure of Flagellomere II (T)	1	2	1
Ventro-lateral Antennal Groove (U)	2	1	3
Setae on Ventro-lateral Margins (V)	1	1	1
Transverse Pronotal Carina (W)	2	1	1

Characters	*Colpocephalum*	*Menacanthus*	*Menopon*
Pronotal Setal Row Posterirly (X)	1	1	1
Postnotum on Pronotum (Y)	2	1	1
2nd Seta of Terminal Row of Metanotum (Z)	1	2	2
Prosternal Plate (AA)	1	1	1
Prosternal Setae (BB)	2	1	1
Prosternal Plate Lateral Margin (CC)	2	1	2
Prosternal Plate Posterior Margin (DD)	1	1	1
Metasternal Plate (EE)	1	1	2
Chaetotaxy of Femur III (FF)	3	2	1
Female Abdominal Tergites (GG)	2	1	1
Posterior Row of Tergal Setae (HH)	2	2	1
Position of Abdominal Spiracles (II)	1	1	1
Postspiracular Seta (JJ)	2	1	1
Abdominal Sternites Chaetotaxy (KK)	2	1	1
Arrangement of Setae on Sternites III-V (LL)	1	3	2
Condition of Sternal Brushes (MM)	2	2	1
Number on Sternal Ctenidia (NN)	1	2	2
Female subgenital Plate (OO)	3	2	1
Female Annal Margin (PP)	3	2	1
Length of External Genitalia of Male(QQ)	1	1	1
Male Genitalia Framework (RR)	1	2	1
Nature of Basal Apodeme (SS)	2	1	3
Structure of Parameres (TT)	1	2	2
Position of Both Ends of Parameres and Endomeres posteriorly(UU)	1	2	2

SS^0 Absence of basal apodeme.

SS^1Well sclerotized and wide basal apodeme(*Menacanthus*)

SS^2 Weakly sclerotized and narrow basal apodeme (*Colpocephalum*)

SS^3 Reduced and undeveloped basal apodeme is (*Menopon*)

TT^0 Parameres condensed.

TT^1 Parameres is small, stout and straight (*Colpocephalum*)

TT^2 Parameres is convex and outward (*Menopon, Menacanthus*)

UU^0Both margins of parameres and endomeres are parallel posteriorly.

UU^1Margin of parameres ends is smaller posteriorly than margin of endomeres ends (*Colpocephalum*)

UU^2Margin of parameres ends is larger Posteriorly than margin of endomeres ends (*Menacanthus,Menopon*)

CHARACTER STATES AND ANALYSIS

Head Anterior Margin (A)

Head anterior margin thin, smooth, rounded and convex narrowly in *Menopon* which shows its autapomorphic condition (A^1), while in *Colpocephalum* and *Menacanthus*, the head anterior margin is smooth and convex broadly, which is showing their synapomorphic condition (A^2).

Head Dorso –lateral Margin (B)

Head dorso –lateral margins in *Colpocephalum*, is bearing preocular notch which shows its autapomorphic condition (B^1), while in *Menacanthus*and *Menopon*, the head dorso –lateral margins is bearing preocular slit, which is showing their synapomorphic condition(B^2).

Strucutre of Temples (C)

Temples in *Menopon* and *Menacanthus*, are short and smooth, which shows their synapomorphic condition (C^1), while in *Colpocephalum*, the temples are long and quadrate, which is showing its autapomorphic condition(C^2).

Preocular Setae Dorsal Head Setae 8 to 11 (D)

The preocular setae DHS 8 to 11 in *Menopon* and *Colpocephalum*, present on margin which is showing their synapomorphic condition (D^1), while in *Menacanthus,* the preocular setae DHS 8 to 11 present permanently on submargin, which is showing its autapomorphic condition(D^2).

Positions of Dorsal Head Seta 9(E)

DHS 9 in *Colpocephalum, Menopon*, is marginal in position, which shows their synapomorphic condition (E^1), while in *Menacanthus* the DHS 9 is small and submarginal in position, which is showing its autapomorphic condition (E^2).

Length of Dorsal Head Setae 10 and 11 (F)

Length of DHS 10 in *Menopon*, is more than DHS 11, which is showing its autapomorphic condition (F^1),while in *Colpocephalum* and *Menacanthus* theDHS 10 is smaller than DHS 11, which is showing their synapomorphic condition(F^2).

Ocular setae Dorsal Head Seta 19 and 20(G)

Ocular setae in *Colpocephalum,* DHS 19 is longer than DHS 20 are present, which shows its autapomorphic condition (G^1), while in *Menopon* and *Menacanthus*, the Ocular setae DHS 19 is smaller than DHS 20 are evident, which is showing their synapomorphic condition(G^2).

Occipital Setae 21 and 22 (H)

Occipital setae in *Colpocephalum,* DHS 21 and 22 are reaching upto the pronotal carina, which is showing its autapomorphic condition (H^1), whilein *Menacanthus* and *Menopon*, DHS 21 and 22 large sizes beyond pronotal carina and large macrosetae, which shows their syanpomorphic condition(H^2).

Temporal Seta Dorsal Head Seta 23 (I)

Temporal seta in *Colpocephalum, Menopon and Menacanthus,* DHS 23 is very developed macroseta, which is showing their synapomorphic condition (I^1).

Position of Dorsal Head Seta 23 (J)

DHS 23 in *Colpocephalum, Menacanthus* and *Menopon*, is close with DHS 22, which is showing their synapomorphic condition (J^1).

Nature of Dorsal Head Seta 24(K)

DHS 24 in *Colpocephalum* and *Menopon*, is short, microseta, which is showing their synapomorphic condition (K^1), while in *Menacanthus*, DHS 24 is long macroseta, which is showing its autapomorphic condition(K^2).

Nature of Dorsal Head Seta 26(L)

DHS 26 in *Colpocephalum* and *Menopon*, is small microseta, which is showing their synapomorphic condition (L^1), while in *Menacanthus*, DHS 26 is long macroseta, which is showing its autapomorphic condition(L^2).

Alveoli of Dorsal Head Setae 26 and DHS 27 (M)

The alveoli of DHS 26 and DHS 27 in *Menacanthus*, are separated from each one other, which shows its autapomorphic condition (M^1), while in *Menopon* and *Colpocephalum*, the alveoli of DHS 26 and DHS 27 are

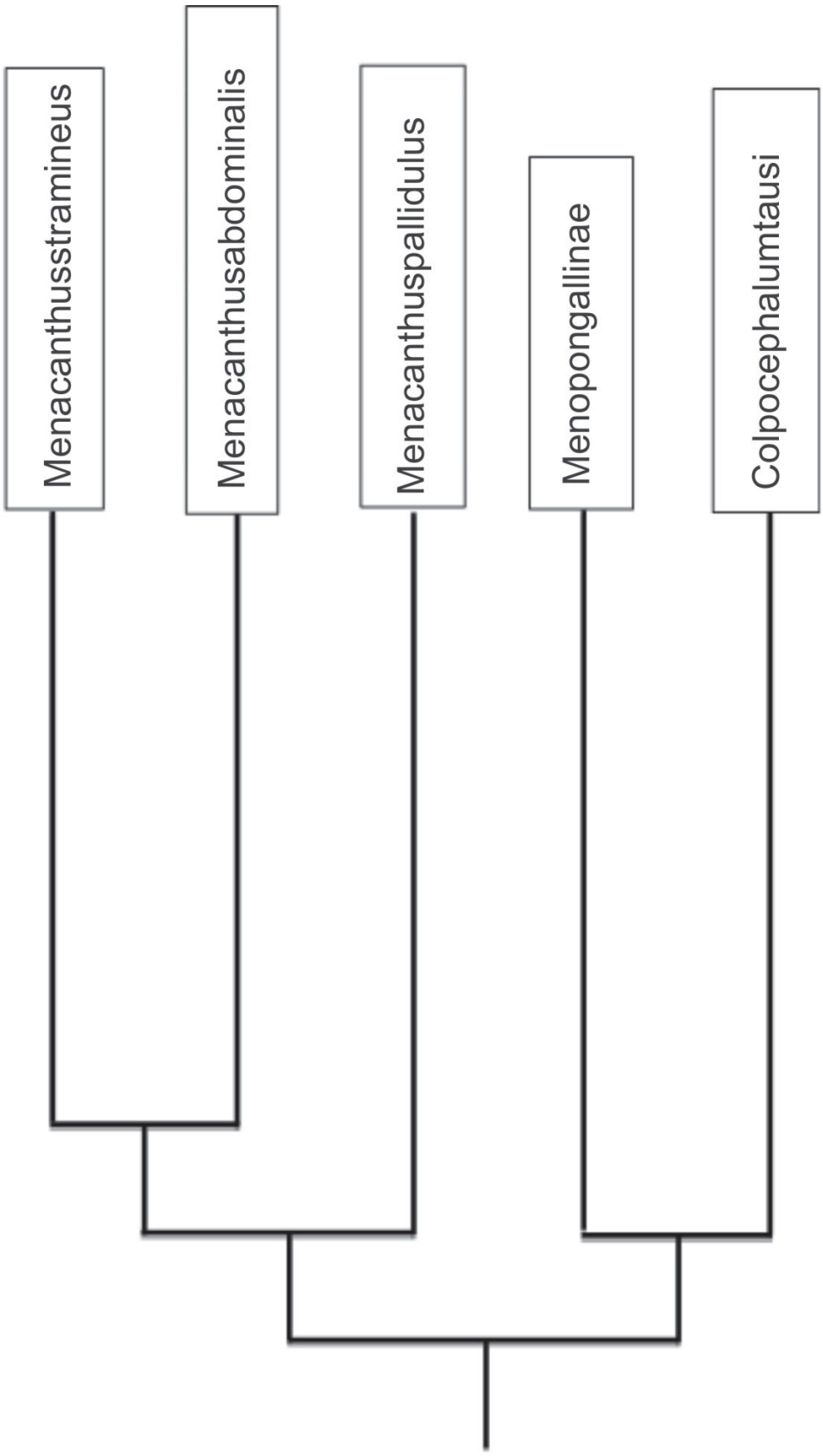

Fig. 1 : Cladogram of the genera of Family Menoponidae collected from Fowls in District Hyderabad, Sindh, Pakistan, showing their phylogenetic relationship.

contagious,which is showing their synapomorphic condition (M^2).

Position of Dorsal Head Seta 29 (N)

DHS 29 in *Menopon* and *Menacanthus*, is marginal in position, which is showing their synapomorphic condition (N^1), while in *Colpocephalum*, the DHS 29 is slightly submarginal in position, which is showing its autapomorphic condition (N^2).

Ocular and Occipital Nodi (O)

Occipital nodi in *Menopon* and *Menacanthus*, is weakly developed only, which is showing their synapomorphic condition (O^1), while in *Colpocephalum*, the well development of ocular and occipital nodi, which is showing its autapomorphic condition (O^2).

Postpalpal Processes (P)

Postpalpal processes in *Menopon* and *Colpocephalum*, are not present, which is showing their synapomorphic condition (P^1), while in *Menacanthus*, the postpalpal prosesses are present, which is showing its autapomorphic condition (P^2).

Hypopharyngeal Sclerite(Q)

Weakly development of hypopharyngeal sclerite in *Menacanthus*, which shows its autapomorphic condition (Q^1), while in *Colpocephalum* and *Menopon*, the well development of hypopharyngeal sclerite, which is showing their synapomorphic condition(Q^2).

Gular Plate (R)

Gular plate in *Menacanthus* and *Menopon*, is weakly developed, whichis showing their synapomorphic condition(R^1), while in *Colpocephalum*, thegularplate is well developed and completely sclerotized, whic shows its autapomorphic condition (R^2).

Number of Flagellomeres(S)

Flagellomeres in *Colpocephalum, Menacanthus* and *Menopon*, are only one pair, which is showing their synapomorphic condition (S^1).

Structure of Flagellomere II (T)

Enlarged and ovoid structure of flagellomere II in *Colpocephalum* and *Menopon*, which is showing their synapomorphic condition (T^1), while in *Menacanthus*, the rounded and globulated structure of flagellomere II is present, which shows its autapomorphic condition (T^2).

Ventro-lateral Groove of Antenna (U)

The ventro-lateral groove of antenna in *Menacanthus*, is small and little deep, which shows its autapomorphic condition (U^1), while in *Colpocephalum,* the ventro-lateral antennal groove is small and narrow, which is showing its autapomorphic condition (U^2), while in *Menopon,* the ventro-lateral groove is large and thin, which shows its autapomorphic condition(U^3).

Setae on Ventro-lateral Margins (V)

Ventro-lateral marginal setae in *Colpocephalum, Menacanthus* and *Menopon*, present on anterior termination, one small and one large size, which is showing their synapomorphic condition (V^1).

Transverse Pronotal carina (W)

Transverse pronotal carina in *Colpocephalum, Menacanthus* and *Menopon*, is present and sclerotized, which is showing their autapomorphic condition (W^1).

Pronotal Setal Row Posteriorly (X)

Pronotal setal row posteriorly in *Colpocephalum, Menacanthus* and *Menopon*, is complete, which is showing their autapomorphic condition (X^1).

Postnotum on Pronotum (Y)

Postnotum in *Colpocephalum, Menacanthus* and *Menopon*, is always present, which is showing their autapomorphic condition(Y^1).

2nd Seta of terminal Row of Metanotum (Z)

Development of 2nd seta of terminal row of metanotum in *Colpocephalum*, which shows its autapomorphic condition (Z^1), while in in *Menopon* and *Menacanthus*, development of pin like or plucky 2nd seta of terminal row of metanotum which is smaller than the surface seta1, showing their synapomorphic condition(Z^2).

Prosternal Plate (AA)

Prosternal plate in *Colpocephalum, Menopon* and *Menacanthus*, is weakly developed, which is showing their autapomorphic condition (AA^1).

Prosternal Setae (BB)

The anterior prosternal setae in *Menacanthus, Menopon*, is present near to the plate, which shows their autapomorphic condition (BB^1), while in *Colpocephalum,* the anterior prosternal setae is situated away from the plate, which shows its synapomorphic condition(BB^2).

Prosternal Plate Lateral Margin (CC)

Prosternal plate lateral margin in *Colpocephalum* and *Menopon*, are reduced and clear, which is showing their autapomorphic condition (CC^1), while in *Menacanthus*, the prosternal plate lateral margin are unclear, which is showing its synapomorphic condition(CC^2).

Prosternal Plate Posterior Margin (DD)

The prosternal plate posterior margin in *Menopon, Colpocephalum* and *Menacanthus*, is convex, which is showing their autapomorphic condition (DD^1).

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Metasternal Plate (EE)

Weakly development of metasternal plate in *Menopon*, which is showing its autapomorphic condition (EE^1), while in *Menacanthus*, *Colpocephalum*, the welldevelopment of metasternal plate, which is showing their synapomorphic condition(EE^2).

Chaetotaxy of Femur III (FF)

Presence of small brushes of setae on its venter of femur III in *Menopon*, which shows its autapomorphic condition (FF^1), while in *Menacanthus*, the presence of thick brushes of setae on its venter of femur III, which is showing its synapomorphic condition (FF^2), while in *Colpocephalum,* the evidenceof ctenidia on its venter of femur III, which is showing its derived synapomorphic condition(FF^3).

Female Abdominal Tergites (GG)

Female abdominal tergites in *Menopon* and *Menacanthus*, are broad, complete and undivided, which shows their autapomorphic condition (GG^1), while in *Colpocephalum*, the female abdominal tergites are divided medially or laterally, which is showing its synapomorphic condition(GG^2).

Posterior Row of Tergal Setae (HH)

There is one row of posterior tergal setae in *Menopon*, which shows its autapomorphic condition (HH^1), while in in *Menacanthus* and *Colpocephalum*, there are two rows of posterior tergal setae, which is showing their synapomorphic condition(HH^2).

Position of Abdominal Spiracles (II)

The abdominal spiracles in *Colpocephalum*, *Menopon* and *Menacanthus*, are always tergal in position, which is showing their autapomorphic condition (II^1).

Postspiracular Seta (JJ)

The postspiracular seta in *Menopon* and *Menacanthus*, is posterior to spiracles, which is showing their autaapomorphic condition (JJ^1), while in *Colpocephalum*, the postspirscular seta is latero-posterior to the spiracles, which is showing its synapomorphic condition (JJ^2).

Abdominal Sternites Chaetotaxy (KK)

Abdominal sternites in *Menopon* and *Menacanthus*, are with setal brushes, which is showing their autapomorphic condition (KK^1), while in *Colpocephalum*, the abdominal sternites are with ctenidia, which is showing its syntapomorphic condition(KK^2).

Arrangement of Setae on Sternites III-V (LL)

Arrangement of setae in *Colpocephalum*, on only sternites III, which shows its autapomorphic condition (LL^1), while in *Menopon*, arrangement of setae on sternite III and IV, which is showing its synapomorphic condition (LL^2), while in *Menacanthus*, the arrangement of setae on sternites IV and V, which is showing its derived synapomorphic condition(LL^3).

Condition of Sternal Setal Brushes(MM)

Thin and weakly development of sternal setal brushes in *Menopon*, which shows its autapomorphic condition (MM^1), while in *Colpocephalum* and *Menacanthus*, the thick and well development of sternal setal brushes, which is showing their synapomorphic condition(MM^2).

Number on Sternal Ctenidia (NN)

Presence of three sternal ctenidia in *Colpocephalum*, which shows its autapomorphic condition (NN^1), while in *Menacanthus, Menopon*, presence of more than three sternal ctenidia, which is showing its synapomorphic condition (NN^2).

Subgenital Plate of Female (OO)

The subgenital plate of female in *Menopon*, is short and stout, which shows its autapomorphic condition (OO^1), while in *Menacanthus*, the subgenital plate of female bears short and fine setae, which is showing its synapomorphic condition (OO^2). While in *Colpocephalum*, the subgenital plate of female is furnished with large and thick setae, which is showing its derived synapomorphic condition (OO^3).

Female Annal Margin (PP)

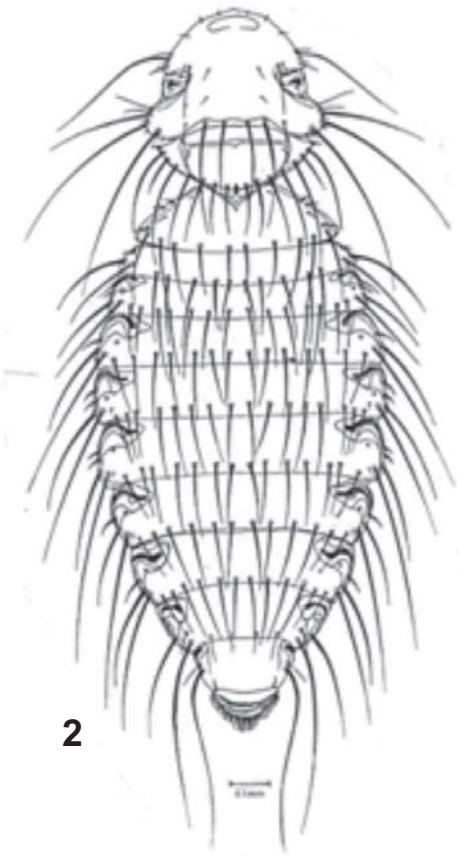
The female anal margin in *Menopon*, is furnished with fringe of small, stout setae, which is showing its autapomorphic condition (PP^1), while in *Menacanthus*, the female anal margin is furnished with fringe of small and fine setae, which is showing its synapomorphic condition (PP^2), while in *Colpocephalum*, the female anal margin is furnished with fringe of large size and thick setae, which is showing its derived synapomorphic condition(PP^3).

Length of External Genitalia of Male (QQ)

External genitalia of male in *Menopon, Colpocephalum* and *Menacanthus*, are moderate to large size and reaching up to abdominal segment IV, which is showing their autapomorphic condition(QQ^1).

Framework of Male Genitalia (RR)

Framework of male genitalia in *Colpocephalum* and *Menopon* is simple or modest, which shows their autapomorphic condition (RR^1), while in *Menacanthus,* the framework of male genitalia is complex, or characteristic, and very unique, which is showing its synapomorphic condition(RR^2).



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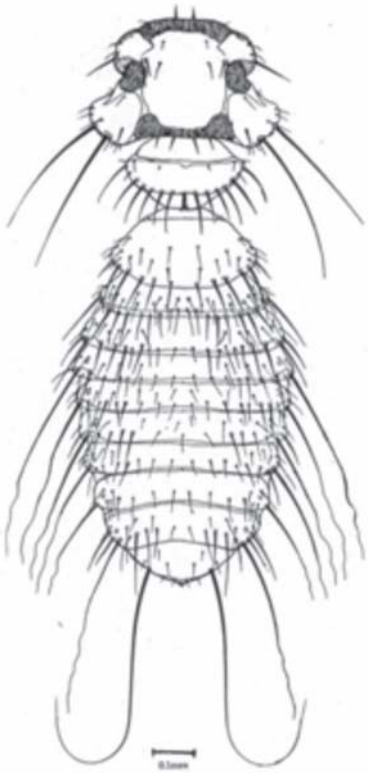

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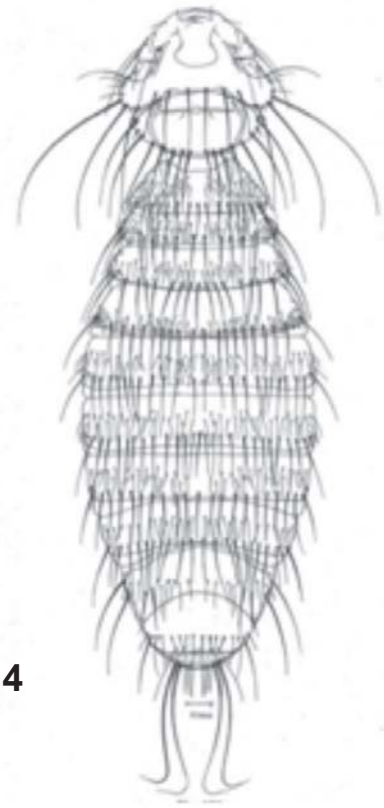

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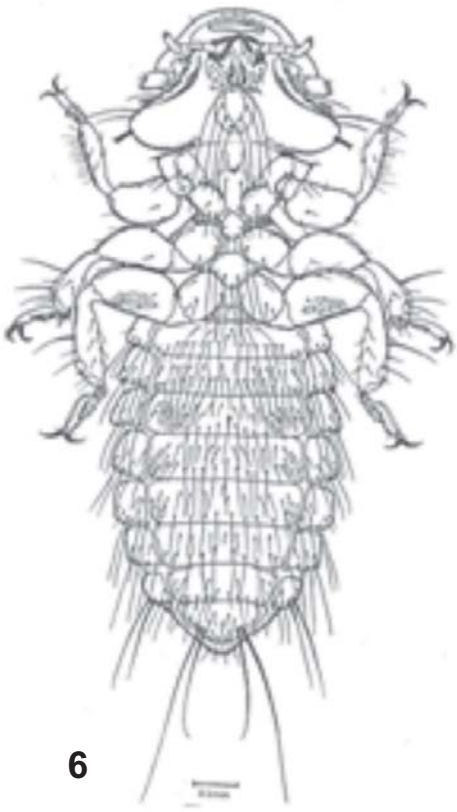

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Figs. 2-6 : 2- ***Menopon gallinae*****;**
3-*Colpocephalum tausi*;
4-*Menacanthus stramineus*;
5- ***Menacanthus abdominalis*** **and**
6- ***Menacanthus pallidulus*****.**

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Nature of Basal Apodeme (SS)

The wide and well sclerotization of basal apodeme in *Menacanthus*, which is showing its autapomorphic condition (SS^1), while in *Colpocephalum*, the thin and weakly sclerotization of basal apodeme, which shows its synapomorphic condition (SS^2), while in *Menopon*, the presence of reduced and undeveloped basal apodeme, which is showing its derived synapomorphiccondition (SS^3).

Structure of Parameres (TT)

Parameres in *Colpocephalum*, are small, stout and straight, which shows its autapomorphic condition (TT^1), while in *Menopon* and *Menacanthus*, the parameres are highly curve outward, which is showing their synapomorphic condition (TT^2).

Position of Both Ends of Parameres and Endomeres Posteriorly (UU)

Parameres posterior end is smaller in *Colpocephalum*, than endomeres posterior margin, which is showing its autapomorphic condition (UU^1), while in *Menacanthus* and *Menopon*, the parameres posterior end longer than endomere posterior end, which is showing their synapomorphic condition (UU^2).

Position of Both Ends of Parameres and Endomeres Posteriorly (UU) Parameres posterior end is smaller in *Colpocephalum*, than endomeres posterior margin, which is showing its autapomorphic condition (UU^1), while in *Menacanthus* and *Menopon*, the parameres posterior end longer than endomere posterior end, which is showing their synapomorphic condition (UU^2).

Discussion

Family Phasianidae (Aves: Galliformes) is a large family, of the avian order Galliformes includes pheasants, domestic fowls, patridges quails (Batairs), red jungle fowls, turkey fowls, pea fowls and guinea fowls. The birds are also known as game fowls with three pairs of clasping types of legs terminating to one or two tarsal claws[25]. The birds have heavy body, moderate to large size are common in our region and are mostly kept in captivity by humans and provide them natural environment. The family Menoponidae (Amblycera) consists of nine genera which are parasitizing avian fauna worldwide, these genera are *Afrimenopon*, *Myrsidea*, *Colpocephalum*, *Menacanthus*, *Menopon*, *Holomenopon*, *Heleonomus*, *Hohorstiella* and Neokelerimenopon gen. nov. During present investigation, 05 species of family Menoponidae were recovered which are *Menacanthus stramineus*, *Menacanthus pallidulus, Menacanthus abdominalis, Menopon gallinae* and *Colpocephalum tausi*[4]. The cladogram of amblycera species shows that *M. stramineus* and *M. pallidulus* are the sister group I, outgroup I of sister group I includes *M. gallinae* and *C. tausi.* The sister group II consist of *M. stramineus* and *M. abdominalis,* outgroup II of sister group II includes *M. pallidulus* and *M. gallinae* (Fig. 1). Presently included appear to fall into two groups (Fig. 1). Group I *includes Menacanthus stramineus*, *Menacanthus abdominalis* and *Menacanthus pallidulus* which appear to be closely related and play sister group relationship to each other by having apomorphies of head which is circumfasciate, postpalpal process developed, preocular grooves in the form of slit, body elongated, oval and oblong, ocular nodi weakly present, abdominal sternites with setal brushes, male genitalia is typical with genital sac sclerites and female vuval margin is broad. The group II further consisting of two subgroups. Subgroup I comprises of *Menopon gallinae* which appear to be closely related and play sister group relationship to each other by having apomorphies of DHS 8-11 preocular setae are present on margin (D^1), DHS 9 marginal in position (E^1), DHS 24 Small and microseta (K^1), alveoli of DHS 26 touching the alveoli of DHS 27 (M^2), Dorsal head sensillae a-c present (O^2), posterior part of maxillary palpi not developed into postpalpal process (Q^1), hypopharyngeal sclerite well developed (R^2). The subgroup II comprises of *Colpocephalum tausi* which appear to be closely related and play sister group relationship to each other by having apomorphies of flagellomere II oval and elongated (U^1), posterior pronotal setal row complete (Y^1), prosternal plate is weakly developed (BB^1), lateral margins of prosternal plate reduced (DD^1), spiracles tergal in position (KK^1), male external genitalia moderate to long , extending up to the segment IV (QQ^1) and male genitalia armature simple or modest(RR^1).

Chewing lice are the source of mechanically damage to host body, exasperate, because irritating, and swelling, and also cause bacterial or viral diseases, and in some circumstances, they become the source of the death of young to old birds. The information about the infestation caused by parasitic insects chewing lice in birds, exposed that there are more than hundreds species harboring in birds, have got unlimited, monetary, commercial, financial, ecologically, and health value. The chewing lice of Phasianid birds have studied, in different parts of the world[2,3,7,9,19,20] but in Pakistan there is no thorough study on chewing lice especially of fowls in Hyderabad Sindh, Pakistan. The review of literature revealed that some work has been done on the chewing lice particularly in the province of Sindh[21-23] however, sporadic investigations were carried out in Faisalabad (Punjab) before partition of indo- pak region[1-3]. The cladistic relationship of chewing lice species was analyzed to understand the evolutionary aspect of their morphologies as well as their host specificity by using the key

characters of lice.This is the first investigation of its kind on various types and breeds of fowls from Sindh, Pakistan, made a valuable contribution to the chewing lice fauna of Pakistan.

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