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## A Comparative Analysis of Key Parameters of the Species of Subgenus *Phlebotomus* (Diptera, Psychodidae) from Balochistan, Pakistan

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**Abstract:** During the revision of the genera of Phlebotomine sandflies collected by the author from the whole of the Balochistan Province during 1996-2001, a comparative external and anatomical analysis of forty-five key parameters were conducted for the species of the subgenus *Phlebotomus* and the same are presented here. Differential diagnosis of the member species of this subgenus is discussed. The results are compared with those reported in the literature to date.

**Key words:** Phlebotomine sandflies, subgenus *Phlebotomus*

### INTRODUCTION

Since the classical work of Lewis<sup>[1]</sup> on sandflies of the Punjab, N.W. F. P. and Sindh Provinces, till after the lapse of about 29 years, no taxonomic studies was ever conducted on the sandflies of the Balochistan Province. To fill this gap of knowledge, taxonomic revision of the sandflies of Balochistan Province was conducted by the author in 1996-2001<sup>[2]</sup>. During the revision of different genera and subgenera of Phlebotomine sandflies collected from the whole of the Balochistan Province, the author encountered specimens of the three species of the subgenus *Phlebotomus* (Genus *Phlebotomus*) namely *Ph. papatasi* (N=720), *Ph. bergeroti* (N=30) and *Ph. salehi* (N=70) in various localities of the Province. Lewis<sup>[1]</sup> did not report the prevalence *Ph. bergeroti* and *Ph. salehi* from Pakistan as his collection did not represent the specimens from Balochistan Province. In view of the insufficient work of Lewis<sup>[1]</sup>, a comparative analysis of forty-five taxonomic characters of the specimens of these three species are given in the present paper. Differential diagnosis of these species is also briefly discussed. This study adds new supportive taxonomic data to earlier works on the identification of sandflies of the subgenus *Phlebotomus*.

### MATERIALS AND METHODS

For collection, preservation, dissection and examination of external and internal parts of the body of the sandfly, the conventional methods especially those

used by Johnson *et al.*<sup>[3]</sup>, Lewis<sup>[4]</sup>, Killick-Kendrick<sup>[5]</sup>, Lawyer *et al.*<sup>[6]</sup> and Killick-Kendrick *et al.*<sup>[7]</sup> were generally followed. Standard taxonomic keys furnished by Lewis<sup>[1,8,9]</sup> and Artemiev<sup>[10]</sup> were followed. All the diagrams were drawn with a camera lucida and are to the given scales and the measurements are in millimeter (mm), unless otherwise indicated. All the specimens are housed with the Author's collection of Sandflies, Department of Zoology, University of Balochistan, Quetta.

### RESULTS AND DISCUSSION

**Key parameters studied:** Taxonomic features taken into account in the present study were primarily those of earlier works, but many are modified and others are new. Following, 45 key parameters (27 of male and 18 of female) are taken into consideration and are given in the (Table 1).

**Differential diagnosis among species of subgenus *phlebotomus*:** *Ph. papatasi* Scopoli<sup>[11]</sup>. The morphology of spermathecae, pharyngeal armature and position of basal and middle spine on style, bigger upper parameral lobe than the paramere and surstyle with 2 or some times 3 stout but similar apical bristles at once differentiates this species from other species of subgenus *Phlebotomus*.

***Ph. bergeroti* Parrot<sup>[12]</sup>:** The distance between basal and middle spines are greater or equal to that of between middle and distal spines. Further, 2nd dorsal process of paramere hardly longer than the paramere itself. Apical bristles of surstyles are long and thin. Pharynx of female

Table 1: Species of subgenus *Phlebotomus* (Genus *Phlebotomus*)

Key Parameters	<i>Ph. papatasi</i> Scopoli (N=720)	<i>Ph. bergeroti</i> Parrot (N=30)	<i>Ph. salehi</i> Mesghali meters (N=70)
Male			
Head length	0.44-0.52	-	0.464-0.468
Eye length	0.16-0.21	-	0.24-0.25
Eye breadth	0.128-0.16	-	0.168-0.17
Distance between eyes	0.104-0.152	-	0.128-0.133
Wing length	1.56-2.2	-	1.76-1.78
Wing breadth	0.384-0.576	-	0.49-0.52
$\alpha$	0.264-0.42	-	0.28-0.30
Alar index	1.4-1.5	-	1.27-1.30
Palpal length	0.52-0.99	-	0.7-0.8
A3	0.22-0.31	-	0.27-0.30
A3/ A4+5	0.95	-	0.85
A3/ labrum	1.227	-	1.239
Ascoid 3/A3	1.22	-	1.71
Ascoid 4/A4	0.236	-	0.291
Ascoid 5/A5	0.32	-	0.52
Positions of ascoids			
on A3	0.70	-	0.66
on A4	0.29	-	0.23
on A5	0.23	-	0.21
Position of papilla			
on A3	0.86	-	0.9
on A4	0.71	-	0.82
on A5	0.79	-	0.85
Labrum/ Wing length	0.115	-	0.129
Labrum sesilla depth	0.056	-	0.048
Hypopharynx dental depth	0.04	-	0.036
Maxilla teeth	10 lateral (2 apical dot like, and eight ill developed), 12 ventral weak and faint.	-	5 lateral
minute			
Cibarium	0.03-0.048 broad	0.056	0.053-0.056
Pharynx	1.833-2.25 times as wide as anteriorly,	Twice as wide posteriorly as anteriorly,	1.35-1.42 times as wide height of armature 0.225-
0.3xlength of pharynx of	0.189-0.19x length of pharynx,		pharynx,
Coxite	0.26xlength of pharynx,		1.44xlength of style
Paramere: Sickle shaped process	1.435xlength of style	1.3xlength of style	
Filament/Pump	0.19-0.24	0.23	0.16
Surstyle	1.7-1.77	1.89	2.08-2.24
Female	0.32-0.4	0.32	0.38-0.39
Wing length	0.48-0.56	0.36	0.46-0.49
$\alpha$	0.32-0.40	0.36-0.52	0.32-0.40
Alar index	1.395-1.6	1.5-1.75	1.56-1.60
Proboscis	0.27-0.34	0.22-0.36	0.30-0.32
A3	0.20-0.28	0.18-0.26	0.18-0.21
A3/ labrum	0.88	0.84	0.7
Ascoid 3/A3	0.187	0.214	0.29
Ascoid 4/A4	0.272	0.459	0.62
Ascoid 5/A5	0.28	0.469	0.6
Position of ascoid			
on A3	0.72	0.69	0.72
on A4	0.38	0.313	0.26
on A5	0.33	0.272	0.25
Position of papilla			
on A3	0.88	0.87	0.88
on A4	0.75	0.72	0.80
on A5	0.80	0.81	0.79
Labrum sensilla			
depth	0.048	0.052	0.046
Hypopharynx teeth	2 apical, 16 on each side	3 apical, 18 on each side	3-4 apical, 13 on each side
dental depth	0.056	0.04	0.028
Maxilla teeth	7 lateral (6 prominent, 1 less prominent), 19 ventral,	6 lateral (3 prominent, 3 less prominent), 20 ventral,	11 lateral, 23
ventral,			
Mandible teeth	7, re-curved	4, re-curved	31, re-curved,
dental depth	0.06	0.04	0.04
Pharynx length	2.48-3.33 times breadth	2.82-2.95 times breadth	2.61-2.64 times its breadth
height of armature	0.244xlength of pharynx	0.263-0.269xlength of pharynx	0.189-0.19xlength of pharynx

flies with blunt teeth directed obliquely down to the center.

**Ph. salehi Mesghali**<sup>[13]</sup>: Intermediate basal spine of the style is at the same distance from terminal spines and from another basal spine. Distal part of the paramere strongly curved up and has 7-8 hairs at the end. Second dorsal process is rather short, widens at the end and hairs present only at the wider distal part. Female pharyngeal armature consists of small teeth, those in the center are more hard and pigmented than the others and teeth are not pointing backward. Spermathecae become narrower towards its duct.

#### Comparative note

**Ph. papatasi Scopoli**<sup>[11]</sup>: Male flies were with a larger wing and alar index than those of from Sudan<sup>[14]</sup>. However, A3, labrum, ascoid 4/A4, coxite and aedeagus were measured shorter than those from Sudan. Labrum of male flies was found smaller than those from S. India<sup>[15]</sup>, central Asian countries<sup>[16]</sup>, countries of Eastern Mediterranean region<sup>[17]</sup>, Saudi Arabia<sup>[18]</sup>. The female flies were observed with shorter wing length, alar index, A3, labrum and ascoid 4/A4 but a greater wing breadth as compared with those from Sudan. However, wings of male and female flies were measured similar as those from India. Characters like ascoid formula (2/3-15) and palpal formula (1,2-4,3,5) were found similar as those from Sudan<sup>[14]</sup>.

**Ph. bergeroti Parrot**<sup>[12]</sup>: Female flies were found with a greater alar index and a larger A3 as compared with the published data of this species from Eastern Mediterranean region countries<sup>[17]</sup>. Further, female flies were observed having a shorter wing, A3 and shorter ascoid 4/A4, but a larger  $\bar{a}$ , alar index, labrum and larger A3/labrum as compared with the published data of this species from Africa (Sudan)<sup>[14]</sup>. Characters like coxite and style were found larger than those from Iran<sup>[19]</sup>.

**Ph. salehi Mesghali**<sup>[13]</sup>: Male flies were found with shorter wing, A3, labrum, toothed area of pharynx, coxite, style, surstyle as compared with those from Iran<sup>[13]</sup>. The cibarium of male flies were observed having several narrow spicules arranged laterally, but unarmed buccal cavity was reported by Mesghali and Rashti<sup>[20]</sup> in Iranian specimens. The over all figures of pharynx and kind of armature of present specimens showed a notable differentiation as compared with Iranian forms. Similarly, the surstyle of the present form were found armed with four apical bristles and not three as reported in Iranian specimens. The aedeagus were found having curved ends like a bird's and

not as figured in Iranian forms. Female flies were found with a shorter wing, A3, ascoid 4/A4 and shorter length to breadth ratio of pharynx as compared with Iranian specimens. Similarly, cibarium of female specimens were observed with 5-7 denticles scattered anteriorly and several narrow spicules arranged laterally but Mesghali and Rashti<sup>[20]</sup> reported 2-3 minute cibarial teeth arranged laterally. Further, the over all figure of pharynx and the kind of pharyngeal armature showed a notable difference as compared with the same structures of Iranian forms. Several punctiform ridges were also observed in posterior pharyngeal armature whereas the figure of pharynx drawn by Mesghali and Rashti<sup>[20]</sup> did not show such type of armature. Moreover, these Iranian workers neither described nor drawn diagram of papilla on antennal segments in Iranian flies whereas a single papilla on antennal segments (III,IV,V) was observed during present study.

In conclusion, it can be suggested that the data presented here will facilitate the workers in the correct identification of the species of the subgenus *Phlebotomus*.

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#### REFERENCES

1. Lewis, D.J., 1967. The Phlebotomine sandflies of West Pakistan (*Diptera, Psychodidae*). Bull. Brit. Mus. Nat. Hist. (Ent.), 19 :1-57.
2. Kakarsulemankhel, J.K., 2001. The Fauna of the Phlebotomine sandflies (*Diptera, Psychodidae*) in Balochistan, Pakistan and the disease Cutaneous leishmaniasis. Ph. D. Thesis, Department of Zoology, University of Balochistan, Quetta, pp: 389.
3. Johnson, P.T., E. McConnell and M. Hertig, 1963. Natural infections of leptomonal Flagellates in Panamanian Phlebotomus sandflies. Exp. Parasitol., 14: 107-122.
4. Lewis, D.J., 1973. *Phlebotomidae* and *Psychodidae*. In: Insects and other arthropods of medical importance (Ed. K.G.V. Smith). Brit. Mus. Nat. Hist. London, U.K, pp: 159-179.

5. Killick-Kendrick, R., 1983. Investigation of Phlebotomine sandflies-vectors of Leishmaniasis. Proceedings of the Indo-UK workshop on leishmaniasis, Dec. 6-10, 1982, Patna, India, pp: 72-83.
6. Lawyer, P.G., Y.B. Mebrahtu, P.M. Ngumbi, P. Mwanyumba, J. Mbugua, G. Kilu, D. Kipkoech, J. Nzovu and C.O. Anjili, 1991. *Phlebotomus guggisbergi* (Diptera, Psychodidae), a vector of *Leishmania tropica* in Kenya. Am. J. Trop. Med. Hyg., 44: 290-298.
7. Killick-Kendrick, R., Y. TANG, M. Killick-Kendrick, R.N. Johnson, P.M. Ngumbi, D.K. Sang and P.G. Lawyer, 1994. Phlebotomine sandflies of Kenya. (Diptera, Psychodidae). III. The identification and distribution of species of the subgenus *Larrousius*. Ann. Trop. Med. Parasit., 88: 183-196.
8. Lewis, D.J., 1978. The Phlebotomine sandflies (Diptera, Psychodidae) of the Oriental Region. Bull. Brit. Mus. Nat. Hist. (Ent.), 37: 217-343.
9. Lewis, D.J., 1982. A taxonomic review of the genus *Phlebotomus* (Diptera, Psychodidae). Bull. Brit. Mus. Nat. Hist. (Ent.), 45: 121-209.
10. Artemiev, M.M., 1978. Sandflies (Diptera, Psychodidae, Phlebotominae) of Afghanistan, pp: iv- 87, Kabul, Afghanistan.
11. Scopoli, J.A., 1786. Deliciae faunae et florae insubricae, 1: 85.
12. Parrot, L., 1934. Notes sur les phlebotomes. IX- Une variete nouvelle de *Phlebotomus papatasi* (Scop.) du Sahara central. Arch. Inst. Pasteur Alger., 12: 383-385.
13. Mesghali, A., 1965. *Phlebotominae* (Diptera) of Iran. III. Studies on sandflies in the areas of Bandar Abbas at Jasks (Littoral areas of Hurmoz strait and sea of Oman). Bull. Soc. Path. Exot., 58: 259-275.
14. Kirk, R. and D.J. Lewis, 1951. The *Phlebotominae* of the Ethiopian Region. Trans. R. Soc. London. 102: 383-510.
15. Ilango, K., V. Dhanda, R. Srinivasan, A.B. Sadanand and R. P. Lane, 1994. Phlebotomine sandflies (Diptera, Psychodidae) of Tamil Nadu and Pondicherry, Southern India, in relation to visceral leishmaniasis. Ann. Trop. Med. Parasit., 88: 413-431.
16. Perfiliev, P.P., 1968. *Phlebotomidae*. Translation of Perfiliev, 1966. Israel Program of Scientific Translation, Jerusalem.
17. Rashti, M.A. and A. Nadim, 1992. The genus *Phlebotomus* (Diptera, Psychodidae, Phlebotominae) of the countries of the Eastern Mediterranean Region. Iranian J. Publ. Hlth., 21: 11-50.
18. Lewis, D.J. and W. Buttiker, 1980. *Diptera*, Fam. *Psychodidae*, Subfam. *Phlebotominae*. Fauna of Saudi Arabia, 2: 252-285.
19. Nadim, A. and E. Javadian, 1976. Key for species identification of sandflies (*Phlebotominae*, *Diptera*) of Iran. Iranian J. Publ. Hlth., 5: 33-44.
20. Mesghali, A. and M.A.S. Rashti, 1968. *Phlebotominae* (Diptera) of Iran. IV. More information about *Phlebotomus* (*Phlebotomus*) *salehi* Mesghali, 1965, Bull. Soc. Path. Exot., 61: 769-772.