Drosophila ananassae Doleschall and *Drosophila pallidosa* Bock and Wheeler: a unique pair of sibling species

The genus *Drosophila* belongs to the family Drosophilidae, order Diptera and class Insecta. It has rich species diversity and more than 1500 species are known to occur at global level[1,2]. It is a useful biological model and has been extensively used in a large number of studies involving genetics, cytogenetics, behaviour, evolution, ecology, molecular biology, etc. In India also, about 150 species are known to occur which include both new species and new records[1,2]. The concept of sibling species was given by Mayr[3]. In the genus *Drosophila*, a large number of sibling species which occur in pair or groups have been reported[4]. Sibling species have also been reported in a large number of plant and animal species including marine animals[3,5]. According to Mayr[3], sibling species are morphologically similar but reproductively isolated. The first pairs of sibling species in *Drosophila* are: *D. melanogaster* and *D. simulans* and *D. pseudoobscura* and *D. persimilis.* Since then, about 100 sibling species in pairs or groups have been reported in the genus *Drosophila* showing evolutionary significance[4]. The occurrence of sibling species contradicts the typological or morphological species concept which defines species as a group of morphologically similar individuals which remain constant or essentialism[6].

There is a unique pair of sibling species: *D. ananassae* and *D. pallidosa*[4]. *D. ananassae* is a dark, cosmopolitan and domestic species described for the first time from Indonesia by Doleschall[7]. However, *D. pallidosa* which is light form of *D. ananassae*[8] occurring in American Samoan Islands of Tutuila and Fijian group was described as a new species by Bock and Wheeler[9]. These two species were separated just on the basis of ethological isolation in natural populations and differences in sex comb teeth number. Both these species were designated as sibling species by Futch[10]. On these islands, both these species are sympatric although *D. pallidosa* is endemic in these islands but *D. ananassae* is cosmopolitan in geographical distribution. Both the species have identical male genitalia which is an important taxonomic character and they interbreed in the laboratory producing fertile hybrids of both sexes. Futch[10] suggested that occasional crosses between these two species must have occurred in natural populations but such incidents must have been less frequent and the fertile hybrids must have been reabsorbed in the original populations.

Although *D. pallidosa* has been described as a separate species, Schug *et al.*[11] suggested that it is not a good species based on behavioural and genetic studies. Singh and Singh[12] and Singh[13] have also suggested that *D. pallidosa* does not have full status of species rather it is in the process of speciation. It is designated as a species in *statu nascendi*[12,13]. The remarkable similarity observed by McEvey and Schiffer[14] has also pointed out that these species cannot be separated on the basis of male genitalia. These observations have raised doubts about the full status of *D. pallidosa* as a separate species. Evolutionary relationship among different members of the *ananassae* species subgroup of the *melanogaster* species group was discussed by Singh and Sisodia[15]. In the *ananassae* subgroup, there are different species complexes. Later, 'the *ananassae* species cluster' was designated which contains six species including *D. ananassae* and *D. pallidosa* to differentiate it from the large *ananassae* species complex[16].

Although a number of studies have been carried out on this pair of sibling species, I feel that whether it is valid to call them as a pair of sibling species. Figure 1 shows males and females as well as sex combs of both species. Fluctuating asymmetry (FA) has been studied by Vishalakshi and Singh[17] in these two species and their hybrids employing different morphological traits and the results have shown that the level of FA is similar in both species and their hybrids in both the sexes. Vishalakshi and Singh[18] studied different morphological traits such as thorax length, sternopleural bristle number, wing length, wing to thorax ratio, sex comb tooth number and ovariole number in males and females and significant differences were found in both the species. Interestingly, for all the morphological traits hybrids also differed significantly when compared to parental species. Singh and Singh[19] also noted significant variations in these morphological traits between the two species: *D. ananassae* showed higher values than *D. pallidosa*, and females showed higher values of these traits than males. Further, intraspecific variations were also noted in both the species[19]. Effect of age on mating success was studied by Singh and Singh[20] in these two sibling species by employing different

Figure 1. *Drosophila ananassae* and *Drosophila pallidosa*: two sibling species. ***a***, Female of *D. ananassae*; ***b***, Male of *D. ananassae*; ***c***, Sex comb of *D. ananassae*; ***d***, Female of *D. pallidosa*; ***e***, Male of *D. pallidosa*; ***f***, Sex comb of *D. pallidosa.*

geographic strains. There was effect of age as well as strain on mating success in both the species. Twelve days old flies showed higher mating propensity in both the species. Interestingly, *D. ananassae* showed higher mating propensity than *D. pallidosa*. Further, mating propensity was age and strain-specific. As far as ethological isolation between these two species is concerned, Doi *et al*.[21] demonstrated the role of acoustic signals produced by wing vibration of males which play important role in causing sexual isolation. Intra and interspecific behavioural isolation has been studied in these two species by using multiple choice method and evidence for sexual isolation has been presented based on significant deviation from random mating[22]. Interestingly, *D. pallidosa* showed strong intraspecific isolation compared to its sibling *D. ananassae* which is cosmopolitan in distribution[22].

As mentioned by Singh[4] on sibling species of *Drosophila*, there are two unique pairs: *D. aldrichi* and *D. wheeleri* as well as *D. ananassae* and *D. pallidosa*, *D. aldrichi* and *D. wheeleri* belong to the *repleta* species group and *D. ananassae* and *D. pallidosa* to the *ananassae* subgroup of the *melanogaster* species group[4]. In the earlier pair of sibling species, both the species have identical male genitalia and are homosequential for polytene chromosomes. Thus their status as a separate species may be questioned. However, they are considered as a separate species on the basis of post-mating reproductive isolation (hybrid sterility) and data related to molecular phylogeny[23]. The case of *D. ananassae* and *D. pallidosa* is entirely different. They have identical male genitalia and lack post-zygotic reproductive isolation. *D. pallidosa* is not occupying the full status of species rather it is in the process of incipient speciation (*statu nascendi*). Further, to verify the status of sibling species molecular techniques are to be used to elucidate whether they are really sibling species[23,24].

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