Proc. Indian Acad. Sci. (Anim. Sci.), Vol. 95, No. 5, October 1986, pp. 557–560.


# Adaptedness of five closely related strains of *Drosophila* to media containing molasses or fructose

A USHAKUMARI and H A RANGANATH
Department of Post-Graduate Studies and Research in Zoology, Manasagangotri, University of Mysore, Mysore 570 006, India

MS received 9 February 1985; revised 18 April 1986

**Abstract.** Relative performance of morphologically indistinguishable and phylogenetically closely related forms of *Drosophila* was assessed in two different media. The flies performed better in media with molasses than in media with fructose. There were significant differences in the ability of these strains to exploit a similar sugar resource suggesting differences in the adaptedness of these forms. The implications of these findings are discussed.

**Keywords.** *Drosophila*; sugars; adaptedness.

## 1. Introduction

*Drosophila* species utilize a variety of sugar sources (Hassett 1948; Taylor and Condra 1983). The extent to which populations are differentiated in relation to such resources is not known. We herein report the 'adaptedness' of the members of the orbital sheen complex of the *nasuta* subgroup of the *immigrans* species group of *Drosophila* in two different media containing different types of sugars.

The orbital sheen complex is an assemblage of morphologically similar forms of *Drosophila*. The members of this complex include *D. sulfurigaster sulfurigaster*, *D. s. albostrigata*, *D. s. bilimbata*, *D. s. neonasuta* and *D. pulaua* (Wilson *et al* 1969; Nirmala and Krishnamurthy 1974; Ranganath and Krishnamurthy 1976). The extent of genetic differentiation between them in terms of mating behaviour (Spieth 1969), enzyme variation (Ramesh and Rajasekarasetty 1980), fixed inversion differences (Rajasekarasetty *et al* 1980) and heterochromatin content (Ranganath and Ushakumari 1984) have been recorded. To further these investigations, the present project was undertaken to understand the adaptive differences if any, under laboratory conditions among these phylogenetically closely placed and morphologically identical forms of *Drosophila*.

## 2. Materials and methods

The strains used were *D. s. sulfurigaster* (P–11, Port Moresby, Papua, New Guinea), *D. s. albostrigata* (S–11, Sandakan, Sabah, Malaysia), *D. s. bilimbata* (HNL–111, Hawaii), *D. s. neonasuta* (209·2 Mysore, India) and *D. pulaua* (S–18, Sandakan, Sabah, Malaysia).

Two types of media were used, viz (i) wheat cream agar medium with molasses and (ii) wheat cream agar medium with fructose. Flies were maintained in these media for 12 weeks. Four replicates were kept for each strain in each media. The populations were cultured at 22°C following the serial transfer technique of Ayala

(1965). Adult flies were introduced into quarter pint milk bottles containing the appropriate medium. Once in 7 days they were etherised, counted and transferred to fresh media bottles. When flies began to emerge in the bottles, the newly emerged flies were etherised, counted and added to the bottle with the adult flies. The bottle was discarded after 4 weeks. The adult ovipositing flies were thus always in a single bottle while other bottles contained different preadult stages of the flies. Four different facets of adaptedness were estimated. They are population size, productivity, flies per bottle and mortality.

## 3. Results and discussion

Species closely related phylogenetically and phenotypically similar are excellent materials to study the extent of differences if any, in their adaptation to particular environments. Populations of such species can be used in the laboratory as biological models to study the dynamics of adaptive differences.

Populations of organisms must live and reproduce, in a given situation, in order to be designated as adapted. 'Adaptedness' refers to the ability of the carriers of a genotype or a group of genotypes to survive and reproduce in a given environment (Dobzhansky 1968). It is a cumulative estimate of population size, productivity, flies per bottle and mortality. Productivity is the extent of its reproductive potential, measured in terms of new born flies every week. Population size is measured in terms of average population size it maintains during the experimental period. Values for flies per bottle and mortality reflect the average number of flies that survived in each bottle and the number of individuals dying every week, respectively, during the period of assessment.

The relative performance of the members of the orbital sheen complex of *Drosophila* in two different media is presented in tables 1 and 2. The mean values for

**Table 1.** Mean values (for 4 replicates) along with standard errors for population size, productivity, mortality and flies per bottle in the media with molasses for 5 different strains of *Drosophila*.

| Species<br>Parameters | *D. s. sulfurigaster*<br>(P–11) | *D. s. albostrigata*<br>(S–11) | *D. s. bilimbata*<br>(HNL–111) | *D. s. neonasuta*<br>(209·2) | *D. pulaua*<br>(S–18) |
|---|---|---|---|---|---|
| Population size | 126·44 ± 16·07 | 132·68 ± 19·09 | 114·86 ± 3·01 | 243·29 ± 11·37 | 159·93 ± 16·24 |
| Productivity | 82·58 ± 12·15 | 106·95 ± 13·52 | 71·61 ± 4·15 | 146·38 ± 6·49 | 120·27 ± 11·55 |
| Mortality | 64·70 ± 9·03 | 86·98 ± 12·65 | 53·87 ± 2·35 | 115·35 ± 5·10 | 102·90 ± 13·06 |
| Flies per bottle | 36·78 ± 4·68 | 38·55 ± 5·59 | 33·39 ± 0·87 | 70·75 ± 3·33 | 46·52 ± 4·75 |

**Table 2.** Mean values (for 4 replicates) along with standard errors for population size, productivity, mortality and flies per bottle in the media with fructose for 5 different strains of *Drosophila*.

| Species<br>Parameters | *D. s. sulfurigaster*<br>(P–11) | *D. s. albostrigata*<br>(S–11) | *D. s. bilimbata*<br>(HNL–111) | *D. s. neonasuta*<br>(209·2) | *D. pulaua*<br>(S–18) |
|---|---|---|---|---|---|
| Population size | 7·27 ± 1·26 | 32·01 ± 6·54 | 21·98 ± 1·82 | 69·10 ± 7·36 | 49·25 ± 2·54 |
| Productivity | 0·28 ± 0·28 | 23·44 ± 6·78 | 8·74 ± 1·93 | 26·13 ± 4·03 | 26·23 ± 2·96 |
| Mortality | 2·88 ± 0·24 | 22·77 ± 5·42 | 9·33 ± 1·00 | 18·68 ± 4·46 | 19·96 ± 2·69 |
| Flies per bottle | 2·75 ± 0·54 | 11·35 ± 2·66 | 7·16 ± 0·50 | 21·26 ± 2·26 | 15·16 ± 0·78 |

each one of the parameters assessed are given in these tables. To understand the extent of statistical significance between the mean values of the 'population size', the test for analysis of variance was carried out. The test revealed the occurrence of statistically significant differences between the mean values of the 'population size' (in the media with molasses $F=7{\cdot}53$; $df=30, 9$; $P<0{\cdot}01$; in the media with fructose $F=28{\cdot}38$; $df=30, 9$; $P<0{\cdot}01$). Thus, the differential ability of the members of the orbital sheen complex to utilize the media with molasses and the media with fructose is striking. The populations which maintain a larger population size may be said to be performing better from the biological point of view than the one having small population size. This provides means for comparing the overall biological performance of one species with another where both are maintained under similar and/or defined different environmental conditions. In the present experiment, *D. s. neonasuta* has exploited both the media better than the others and it tops the sequence. The ranking for these strains in the media with molasses is: *D. s. neonasuta* > *D. pulaua* > *D. s. albostrigata* > *D. s. sulfurigaster* > *D. s. bilimbata*; and in the media with fructose is *D. s. neonasuta* > *D. pulaua* > *D. s. albostrigata* > *D. s. bilimbata* > *D. s. sulfurigaster*. Similarly Ramachandra and Ranganath (1984) have shown the existence of 'subtle' differences between *D. melanogaster*, *D. ananassae*, *D. n. nasuta* and *D. n. albomicana* in their preference to the media with different types of sugars.

Further, all the strains under investigation have achieved a better expression in the media with molasses than in the media with fructose. Interestingly, *D. s. sulfurigaster* failed to breed in the media with fructose and it virtually reached a point of extinction during the experimental period.

## 4. Conclusion

The response of the strains measured in terms of 4 different aspects of adaptedness reveal (i) the media with molasses are more suitable for survival and reproduction; (ii) these morphologically indistinguishable forms have demonstrated significant differences in their response to a common type of media. This suggests the possibility of a certain degree of differentiation among these closely related species.

## Acknowledgements

The authors are grateful to Prof. N B Krishnamurthy, for help and encouragement, Indian National Science Academy, New Delhi for research grants to HAR and Prof. O Kitagawa for sending flies.

## References

Ayala F J 1965 Relative fitness of populations of *Drosophila serrata* and *Drosophila birchii*; *Genetics* **51** 527–544

Dobzhansky Th 1968 On some fundamental concepts of Darwinian Biology; *Evol. Biol.* **2** 1–34

Hassett C C 1948 The utilization of sugars and other substances by *Drosophila*; *Biol. Bull. Woods Hole* **95** 114–123

Nirmala S S and Krishnamurthy N B 1974 Cytogenetic studies on *Drosophila neonasuta*–A member of the *nasuta* subgroup; *J. Mys. Univ.* **26** 162–167

Rajasekarasetty M R, Ramesh S R and Krishnamurthy N B 1980 Interspecific chromosomal variation among a few members of the *nasuta* subgroup (Genus: *Drosophila*); *Entomon.* **5** 1–12

Ramachandra N B and Ranganath H A 1984 Preliminary studies on the differences in the nutritional requirements in *Drosophila*; *Dros. Inf. Serv.* **60** 171

Ramesh S R and Rajasekarasetty M R 1980 Studies on isozyme variations in a few members of *Drosophila nasuta* subgroup; *Proc. Indian Acad. Sci.* (*Anim. Sci.*) **89** 197–213

Ranganath H A and Krishnamurthy N B 1976 Status of *D. neonasuta* in the *nasuta* subgroup; *Egypt. J. Genet. Cytol.* **5** 141–145

Ranganath H A and Ushakumari A 1984 *C-band DNA in five closely related species of Drosophila*; *3rd Int. Cong. Cell Biology, Kyoto, Japan Abstr.* 1052

Spieth H T 1969 Courtship and mating behaviour of the *Drosophila nasuta subgroup of species*; *Studies in Genetics V* (Univ. Texas. Publ. No. 6918) pp 255–270

Taylor C E and Condra C 1983 Resource partitioning among genotypes of *Drosophila pseudoobscura*; *Evolution* **37** 135–149

Wilson F, Wheeler M R, Margaret H and Kambysellis M 1969 *Cytogenetic relations in the Drosophila nasuta subgroup of the immigrans group of species* (Univ. Texas. Publ. No. 6918) pp 207–254