

COMPARATIVE ANALYSIS ON THE LIFE CYCLE OF DROSOPHILA AND METAMORPHOSIS DROSOPHILA

DR.SUJIT KUMAR

DEPT.OF ZOOLOGY, P.M.J.COLLEGE, ARA (BIHAR),INDIA.

ABSTRACT :

Our current work aims to investigate the life cycle of *Drosophila* and Metamorphosis *Drosophila*. *Drosophila* is a small fly from the family *Drosophilidae* and its members are often called "FRUIT FLIES". The entire genus, however, contains roughly 1,500 species and have wide diversity in terms of appearance, behavior, and breeding habitat. One species of *Drosophila* in particular *D. melanogaster*, has been heavily used in research in genetics and is a common model organism in developmental biology. Basic genetic mechanisms are shared by most organisms. Therefore, it is only necessary to study the genetic mechanisms of a few organisms in order to understand how the mechanisms work in many organisms, including humans. *Drosophila melanogaster*, the fruit fly a little insect about 3mm long, is an excellent organism to study genetic mechanisms. The general principles of gene transmission, linkage, sex determination, genetic interactions; molecular, biochemical and developmental genetics, chromosomal aberrations, penetrance and expressivity, and evolutionary change may all be admirably demonstrated by using the fruit fly *Drosophila melanogaster*. Discrete genes regulated different aspects of development. Many of these genes turned out to be homologous to those involved in human development and disease. These genes had been conserved over millions of years of evolution and could be studied easily and rapidly in flies. This led to a boom in the field as more and more researchers saw the potential of flies for asking basic and applied questions, and to the development of ever cleverer molecular tools to address these questions. For example, chemical mutagenesis was used for many years to generate new mutations that were screened for interesting phenotypes, followed by careful genetic mapping, a chromosome walk, and finally gene cloning . Currently, the MiMIC transposon system is being applied to target all genes in the *Drosophila* genome, providing null mutations and a platform to land protein tagging, gene expression tracking.

INTRODUCTION:

Drosophila derived from the Greek word *drósos* meaning dew loving. *Drosophila melanogaster* is a fruit fly, of the kind that accumulates around spoiled fruit. It is also one of the most valuable organisms in biological research, particularly in genetics and developmental biology. Basic genetic mechanisms are shared by most organisms. Therefore, it is only necessary to study the genetic mechanisms of a few organisms in order to understand how the mechanisms work in many organisms, including humans. *Drosophila melanogaster*, a little insect about 3mm long, is an excellent organism to study genetic mechanisms. The general principles of gene transmission, linkage, sex determination, genetic interactions; molecular, biochemical and developmental genetics, chromosomal aberrations, penetrance and expressivity, and evolutionary change may all be admirably demonstrated by using the fruit fly. *D. melanogaster* and its hundreds of related species have been extensively studied for

decades, and there is extensive literature available. The extensive knowledge of the genetics of *D. melanogaster* and the long-term experimental experience with this organism together with extensive genetic homology to mammals has made it of unique usefulness in mutation research and genetic toxicology. Many *Drosophila* genes are homologous to human genes and are studied to gain a better understanding of what role these proteins have in human beings. Much research about the genetics of *Drosophila* over the last 50 years has resulted in a wealth of reference literature and knowledge about hundreds of its genes. It is an ideal organism for several reasons: 1) Fruit flies are hardy with simple food requirements and occupy little space. In the current study it has been emphasized how *Drosophila* is currently being used, and what directions they think the system is moving in. From human disease modeling to the dissection of cellular morphogenesis and to behavior and aging, this work examines the current uses of flies, and the influence of fly research on other models. It is an ideal organism due to following reasons:

Fruit flies are hardy with simple food requirements and occupy little space.

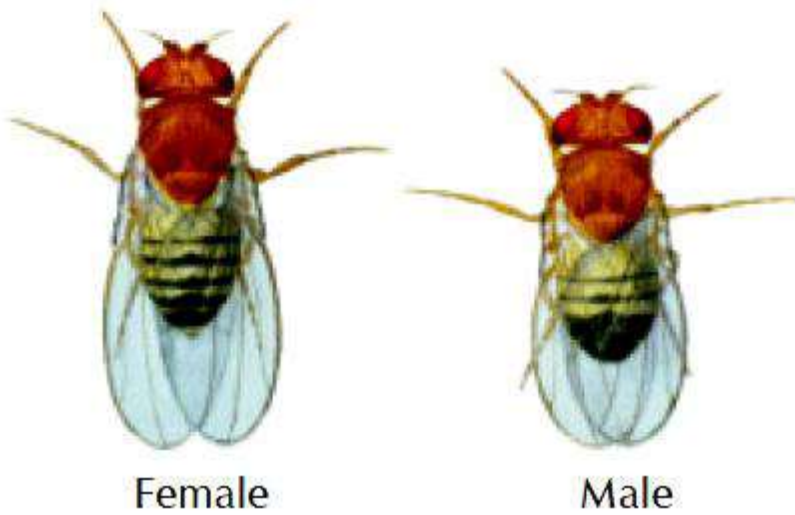
The reproductive cycle is complete in about 12 days at room temperature, allowing quick analysis of test crosses.

Fruit flies produce large numbers of offspring to allow sufficient data to be collected. Examination and data collection is easy because the flies can be quickly and easily immobilized for examination.

Many types of hereditary variations can be recognized with low-power magnification. The study suggested for the first time that the fitness of an organism is likely to be higher if there is a resonance between the endogenous clock and the environmental cycle. An organism possessing a circadian clock gains fitness advantage in two ways: by synchronizing its behavior through physiological process and, secondly, by coordinating its internal metabolic process. For example, studies on golden hamsters *Mesocricetus aureus* have shown that if there is inability of circadian clocks to entrain has deleterious fitness effects. Differences in photoperiod may also have contributed to the selection response as fitness traits may be affected by photoperiod.

METHODOLOGY FOR DETERMINING THE LIFE CYCLE OF DROSOPHILA AND METAMORPHOSIS DROSOPHILA:

Embryonic development, which follows fertilization and the formation of the zygote, occurs within the egg membrane. The egg produces larva, which eats and grows and at length becomes pupa. The pupa, in turn develops into an imago or adult. The duration of these stages varies with the temperature. At 20^o C, the average length of the egg-larval period is 8 days; at 25^o C it is reduced to 5 days. The pupal life at 20^o C is about 6.3 days, whereas at 25^o C is about 4.2 days. Thus at 25^o C the life cycle may be completed in about 10 days, but at 20^o C about 15 days are required. *Drosophila* cultures ought to be kept in room temperature where the temperature does not range below 20^o C or above 25^o C. Continued exposure to temperatures above 30^o C may result in sterilization or death and at low temperatures the viability of flies is impaired and life cycle prolonged.



Fig(1). Male and Female adult *D. melanogaster*

Different stages of the life cycle consist of the following:

The Egg # The Larva #The Pupa # The adult stage (Appearance of sex comb ,External genitalia on sex comb ,Sex organs during larval stage)

The egg :The egg of *Drosophila melanogaster* is about 0.5 of a millimeter long. An outer investing membrane, the chorion, is opaque and shows a pattern of hexagonal markings. A pair of filaments, extending from the anterodorsal surface, keeps the egg from sinking into soft food on which it may be laid. Penetration of spermatozoa into egg occurs through a small opening or micropyle, in the conical protrusion at the anterior end, as the egg passes through the uterus. Many sperms may enter an egg, through normally only one functions in fertilization. The spermatozoa have been stored by the female since the time of mating. Immediately after the entrance of the sperm, the reduction (meiotic) divisions are completed and the egg nucleus (female pronucleus) is formed. The sperm nucleus and the egg nucleus then come into position side by side to produce the zygote nucleus, which divides to form the first two cleavage nuclei, the initial stage of development of the embryo. Eggs may be laid by the mother shortly after they are penetrated by the sperm, or they may be retained in the uterus during the early stages of embryonic development

The Larval Stages

The larva, after hatching from the egg, undergoes two molts, so that the larval period consist of three stages (instars).The final stage, or third instar may attain a length of about 4.5millimeters. The larvae are such intensely active and voracious feeders that the culture medium in which they are crawling becomes heavily channeled and furrowed [2].

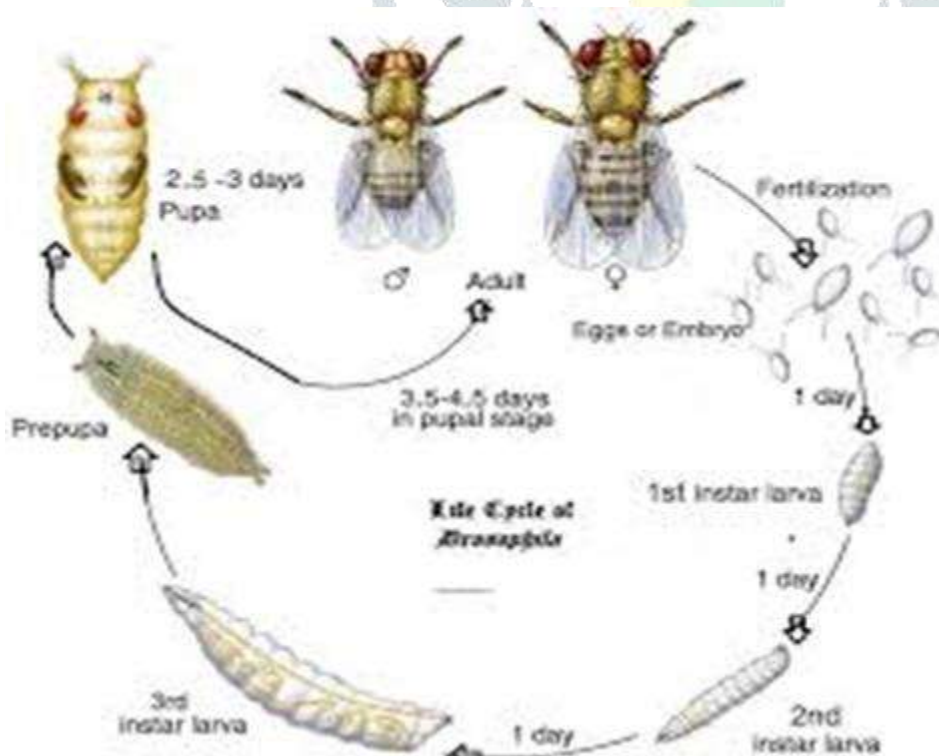
The larva has 12 segments: the 3 head segments, 3 thoracic segments, and 8 abdominal segments. The body wall is soft and flexible and consists of the outer noncellular cuticula and the inner cellular epidermis. A great number of sense organs are spread regularly over the whole body.

The pupa

A series of developmental steps by means of which the insect passes from the larval into the adult organism is called “metamorphosis”. The most drastic changes in this transformation process take place during the pupal stage. Shortly before pupation the larva leaves the food and usually crawls onto the sides of the culture bottles, seeking a suitable place for pupation, and finally comes to rest. The larva is now very sluggish, everts its anterior spiracles, and becomes motionless. Soon the larva shortens and appears to be somewhat broader, thus gradually acquiring its pupal shape. The shortening of the larval cuticle, which forms the case of the puparium, is caused by muscular action. The puparium, which is the outer pupal case, is thus identical with the cuticle of the last larval instar. When the shaping of the puparium is completed, the larval segmentation is obliterated, but the cuticle is still white. This stage lasts only a few minutes and is thus an accurate time mark from which to date the age of the pupa. Immediately after the cuticle reaches the white prepupal stage, the hardening and the darkening of the cuticle begin and proceed very quickly.

Adult stage

When metamorphosis is complete, the adult flies emerge from the pupa case. They are fragile and light in color and their wings are not fully expanded. These flies darken in a few hours and take on the normal appearance of the adult fly. Upon emergence, flies are relatively light in color but they darken during the first few hours. It is possible by this criterion to distinguish recently emerged flies from older ones present in the same c bottle. They live a month or more and then die. A female does not mate for about 10 to 12 hours after emerging from the pupa. Once she has mated, she stores a considerable quantity of sperm in receptacles and fertilizes her eggs as she lays them. Hence, to ensure a controlled mating, it is necessary to use females that have not mated before. These flies are referred to as virgin females.



Fig(2). Life cycle of Drosophila and Metamorphosis Drosophila

CONCLUSION:

The wide known information of the genetics of *D. melanogaster* and the prolonged experimental results with this organism together with extensive genetic homology to mammals has made it immensely useful in mutation research and genetic toxicology. Many of the *Drosophila* genes are homologous to human genes and are used to gain a better understanding of what role these proteins have in human beings. Specific mutations can be targeted and analyzed ease of handling; short reproductive cycle allows scientists to analyze test crosses. Much research about the genetics of *Drosophila* Metamorphosis *Drosophila* over the last 50 years has resulted in a wide variety of reference literature and knowledge about hundreds of its genes. Also, the offspring are produced in large numbers which provide statistically significant data and phenotypic mutant changes are easily recognizable under the microscope.

REFERENCES:

1. Demerec M, Kaufman P. *Drosophila* Guide: Introduction to the genetics and cytology of *Drosophila melanogaster*. Cold Spring Harbor Laboratory 1996, 4-8.
2. Milislav D. Biology of *Drosophila*. 10th ed. Cold Spring Harbor Laboratory 1950, 1-2. Available at: <http://www.vguk.hr/novosti/akt/231-100.pdf> (Accessed March 03 2009).
3. Williams M. UAB center for community outreach development – *Drosophila* Manual, University of Alabama at Birmingham Press 1998-2000, 2-4.
4. Available at: URL:[http://main.edu/cord/show.asp? dukre](http://main.edu/cord/show.asp?dukre) (Accessed February 12 2209)
5. Harry D, Mendelian genetics of *Drosophila*. Cambridge University Press 2001, 7-10.
6. Available at: [http://alpha.sci.ege.edu.tr/~genetik/ alpagut/dr.pdf](http://alpha.sci.ege.edu.tr/~genetik/alpagut/dr.pdf). (Accessed January 10 2009)
7. Marsh JL, Thompson LM, *Drosophila* in the study of neurodegenerative disease. *Neuron* 2006;52(1):69-78.
9. Whitworth AJ, Wes PD, Pallanck LJ, *Drosophila* models pioneer a new approach to drug discovery for Parkinson's disease. *Drug Discov Today* 2006;11:119-26.
10. Sang TK, Jackson GR, *Drosophila* models of neurodegenerative disease. *NeuroRx* 2005;2:438-466.
11. Baylies MK, Bate M, twist: A myogenic switch in *Drosophila*, *Science* 1996;272:1481-1484.
12. Bhanot P, Brink M, Samos CH, Hsieh JC, Wang Y, Macke JP, *et al.*, A new member of the frizzled family from *Drosophila* functions as a Wingless receptor, *Nature* 1996;382:225-230.
13. Brunner E, Peter O, Schweizer L, Basler K, Pangolin encodes a Lef-1 homologue that acts downstream of Armadillo to transduce the Wingless signal in *Drosophila*, *Nature* 1997;385:829-833.
14. Chawengsaksophak K, James R, Hammond VE, Kontgen F, Beck F, Homeosis and intestinal tumours in *Cdx2* mutant mice, *Nature* 1997;386:84-87.

15. Klarsfeld A, Rouyer F, Effects of circadian mutations and LD periodicity on the life span of *Drosophila melanogaster*. J Biol Rhythms 1998;13:471-478.
16. Kumar S, Mohan A, Sharma VK, Circadian dysfunction reduces lifespan in *Drosophila melanogaster*. Chronobiol Int 2005;22:641-653.
17. Lawrence PA, The genetics of animal design. Oxford: Blackwell Scientific Publications. The making of a fly 1992, 240.
18. Metzendorf C, Lind MI, *Drosophila mitoferrin* is essential for male fertility: evidence for a role of mitochondrial iron metabolism during spermatogenesis. BMC Dev Biol 2010;10:1-17.
19. Ouyang Y, Andersson CR, Kondo T, Golden SS, Johnson CH, Resonating circadian clocks enhance fitness in cyanobacteria. Proc Natl Acad Sci USA 1998;95:8660-8664.

