UNIT 14

DIPTERANS AS DISEASE VECTORS–V (HOUSE FLIES)

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14.1 INTRODUCTION

In the earlier units, you studied about mosquitoes and sand flies as the vector of human diseases. All these insects are sanguivorous and transmit diseases while feeding on human blood. In the present unit, we will discuss about the structure and medical importance of house fly, which neither bites nor stings yet it is one of the most harmful carrier of germs for various diseases.

The scientific name of housefly is *Musca.* Many *Musca* species are prevalent worldwide, among which *Musca vicinia, Musca sorbens, Musca domestica* and

Musca nebulo are most commonly found in India. *Musca* species can be found throughout the year in close association to man and can be regarded as a sign of insanitation.

Objectives

After going through this Unit, the learner will be able to:

- explain the characteristic features and biology of housefly,
- detail and draw the life cycle of housefly,
- explain the behavior of housefly,
- discuss the role of houseflies as vector of diseases, and
- describe the preventive and control measures of houseflies,

14.2 LIFE CYCLE OF HOUSEFLY

Houseflies are dipterans and belong to Muscidae family. Common housefly *Musca domestica* is worldwide in distribution. Originally from Asia, they are now found all over the world around hovering over human habitation, near garbage bins and dirty places.

They contaminate our food and water and are responsible for millions of infant deaths. The sponging type of mouthparts allow them to feed us on the liquid food. Housefly is holometabolous insect and thus its life cycle comprises egg, larva, pupa and adult stage.

14.2.1 Adult

Housefly has a greyish and slightly hairy body with a yellowish tinge on the ventral surface. Like any other insect, the body is divisible into head, thorax and abdomen.Head bears a pair of antennae (aristate type), a pair of red-coloured compound eyes and three small simple eyes or ocelli. The compound eye is adapted for diurnal vision. They have sponging type of mouth parts to suck the liquid food by capillary action (you have already studied about these mouth parts and feeding mechanism in unit 2).

The thorax has 2-4 dark longitudinal stripes which is characteristic of the genus *Musca*. The three segments of the thorax (prothorax, mesothorax and metathorax) are not clearly demarcated. Each thoracic segment bears a pair of legs, longer in males than females. The terminal end of each leg bears a pair of curved claws. In between these claws is present a pair of glandular pads having numerous short and stiff hair called the **pulvillus**. The hair secretes a sticky substance which helps them in walking. Specialized sensory chemoreceptors are present in the tarsus of each leg. These can identify sugary food and taste sweetness while walking over them.

Like all dipterans, houseflies also have one pairs of wings. The forewing is broad, transparent, hairy and triangular with a yellowish tinge at the base while the hind wing is reduced and modified into the balancing organ known as **halteres.** During flight the wings vibrate rapidly producing a characteristic buzzing sound. When at rest the wings fully cover the abdomen. The wings of female housefly are larger than that of males.

The abdomen is hairy, 10-segmented with light and dark markings. First segment is underdeveloped while last segment has a pair of anal cerci. The last three to four segments in males form a genital pouch while in females they form **ovipositor** for laying eggs. The copulatory organ of males, **aedeagus** or penis is present on the ninth segment.

Adult flies generally do not live longer than 15 days in summers and 25 days in winters. The fly overwinters in the larval or pupal stage. They are most active during the hot summer months and breed from June to October. Breeding period is at its peak from August to September.

14.2.2 Eggs

The female fly lays eggs a week after copulation. A female can lay 500-700 eggs in 5 or 6 batches of 100-150 eggs each. The eggs are laid in decaying fruits and vegetables, rotting organic manure, garbage, human and animal excreta and debris where they get warmth, sufficient moisture and protection. Indian species of *Musca domestica* and *Musca vicinia* prefer to breed on human excreta. The ovipositor helps in digging the organic matter and laying eggs.

Fig. 14.1: Egg laying by a housefly

Eggs are white in colour, elongated with a curved dorsal thickening. They are about 1mm long and hatch in 8-24 hours. In summers, the eggs can hatch even in 3 hours.

14.2.3 Larvae

A soft, about 2mm, white, apodous (legless)and acephalous (headless) larva emerges out by making an elongated dorsal slit on the egg case. The larva of housefly is known as **maggot**. The anterior end of the maggot is narrower than the posterior end. A chitinous cuticle covers the body of the larva externally.

The body of the maggot is divided into thirteen segments. The anterior segment contains two oral lobes. Each oral lobe has two sensory tubercles and many branched food channels. Mouth is present between the oral lobes. Spiniferous pads are present in each of the 6-12 segments which help in locomotion.

The first instar larva is approximately 3 mm long, creamy white, voracious feeder, very active and rapidly increases in size. It molts twice to become the third instar mature larva. Full grown larva may be about 7-12mm in length, and greasy, creamy white in colour.

Fig. 14.2: Housefly maggots feeding on manure

The larva requires oxygen for its survival and thus are found in places where there is plenty of fresh air. They avoid light and bury themselves in the rotten moist manure heap. They can penetrate up to a depth of few meters. The optimal temperature for larval development is 35 to 38℃, though larval survival is greatest at 17 to 32℃. The larval period lasts for about 2 to 7 days but may be prolonged in winters.

14.2.4 Pupae

The full-grown larva stops feeding, defecates, shrinks in size and migrates to the dry region of the manure heap or other protected places. It then encloses itself in a hard pupal case formed by the last larval skin and converts to the pupa. Only the spiracles project out from the posterior end for breathing.

Pupa is barrel-shaped with blunt round ends and dark brown in colour. Within the hard covering, rapid changes take place and all the larval structures are broken down by histolysis except for the nervous system. New structures are formed from special cells called imaginal disc. When all the structures are fully formed a young colorless fly emerges out from the pupal case.

Pupal period lasts for about 3 to 6 days but this can also be prolonged in winters.

The newly formed fly has rudimentary delicate wings and short legs. However, in a short duration of time, different parts develop, wings become fully expanded, and become hard on exposure to air, and a fully mature adult is formed.

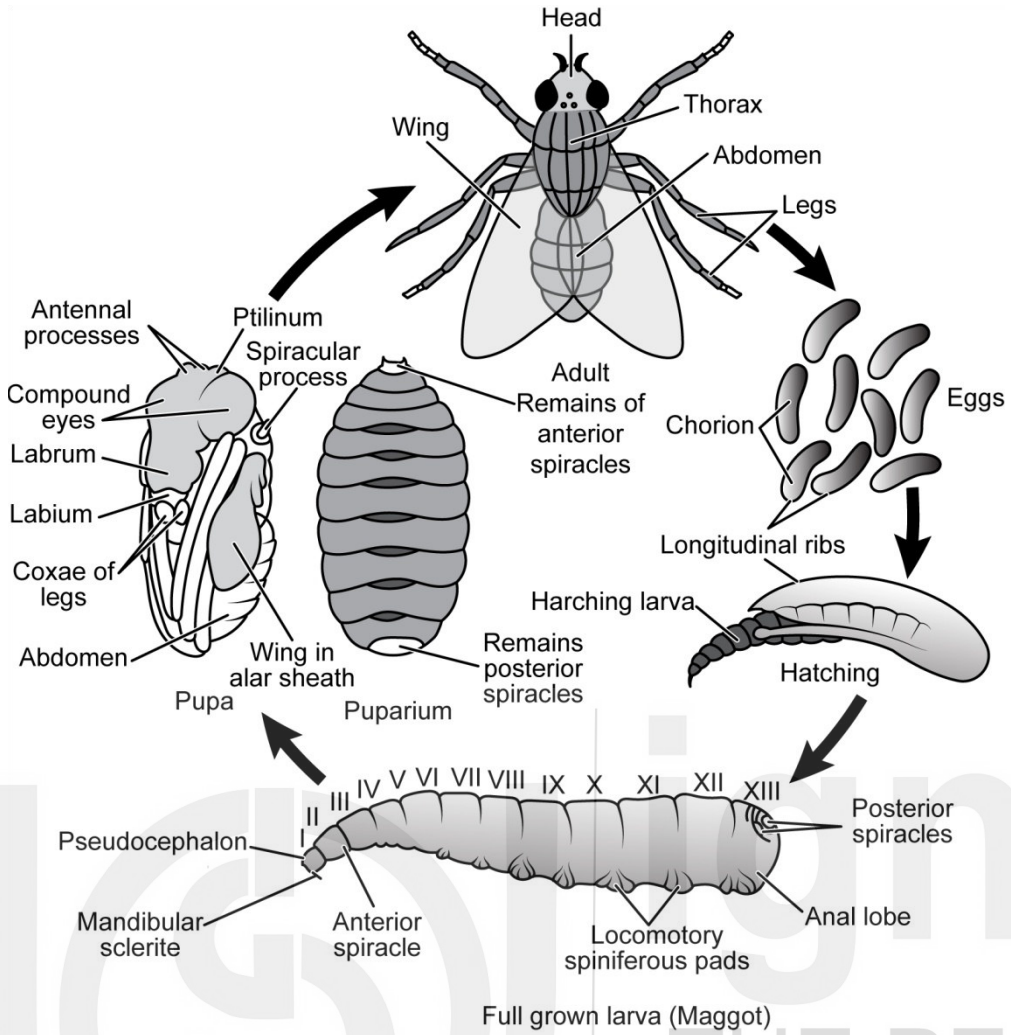

Fig. 14.3: Life cycle of *Musca nebulo*

The life cycle of house fly may be completed in 5-6 days at optimum conditions in summers which can be prolonged to 8 to 20 days depending on the temperature. However, it may extend to about two months under suboptimal conditions. The common house fly may have about 20 generations in a year in tropical and subtropical regions and about 10-12 generations in temperate regions.

SAQ 1

i) Fill in the blanks:

a. The scientific name of common housefly is .....……, …….. .

b. The optimum temperature for housefly development is …… .

c. The reduced hindwings of house fly are called …….. .

ii) Read the following statements and State whether 'True' or 'False':

a) The male copulatory organ of *Musca* is known as aedeagus.

b) Image in houseflies is formed by the ommatidia present in ocelli.

c) Pulvillus helps the fly in flying.

iii) Read the following sentences and choose the correct option given in the parentheses:

a. The larva of house fly is known as (maggot/ caterpillar/ wriggler).

b. House fly lays eggs in (stagnant water/decomposing organic matter/ honey comb).

c. Larvae of housefly are (apodous/oligopodous/polypodous).

d. The adult house fly which emerges from the puparium is known as (imago/ tumbler/ptilinum).

e. Spiniferous pads help the larva in (feeding/ respiration/locomotion).

14.3 BEHAVIOR

14.3.1 Activity

Houseflies are **diurnal** and are very active during the day in bright sunlight. The maximum activity of flies can be observed at a temperature of 25-30°C and at low humidity. They prefer to rest at 40-45°C or at very low temperatures of 10-15°C. At very low temperatures, the species can stay alive in a dormant state in the adult or pupal stage.

In a given locality, fly numbers vary with the availability of breeding places, daylight hours, temperature and humidity.

14.3.2 Resting

When not feeding, they rest near garbage bins, on floors, windows, ceilings, grass, hedges, bushes, clothes lines, electric wires, latrines and filthy places.

At night, flies are normally inactive and rest at ceilings, other overhead structures and outdoor sites such as fence, clothes lines, electric wires, weeds, grasses, hedges, bushes and trees. The resting places are generally near the breeding areas.

14.3.3 Feeding

They have sponging type of mouthparts and feed on liquid food. If the food is solid, the fly pours its saliva or regurgitates its liquid content from the crop over it, liquifies it and then sucks the liquid food. They feed very frequently.

14.3.4 Oviposition

Nutrient-rich substrates provide an excellent developmental substrate. Thus, the flies lay eggs in decaying fruits and vegetables, rotting organic manure, garbage, human and animal excreta and debris. The developmental stages get warmth, sufficient moisture, nutrients and protection.

Houseflies also breed in sewage sludge and solid organic waste in open drains, underground pools for sewage and cesspits.

14.3.5 Visual Response

Visual stimulus is one of the most important determinants in fly behavior. Houseflies rely on reflected sunlight to detect objects in their environment while flying, finding food, searching for harborage and resting areas.

It has been reported that flies response maximally to white and blue colours followed by yellow, red, green, and black. In fact, a tendency to repel by yellow colour has also been shown by flies.

14.4 HOUSEFLY-THE MECHANICAL VECTOR

The housefly is a mechanical vector of many pathogens-virus, bacteria, protists, fungi and nematodes. The fly picks up disease-causing organisms while crawling and feeding.

14.4.1 Transmission of Diseases

Transmission takes place when the fly makes contact with the people or their food. Most of the diseases can also be contracted more directly through contaminated food, water, air, hands and person-to-person contact. The housefly can transmit disease in the following ways.

1. **Contact transmission:** The houseflies carry the microorganisms, eggs and cysts of various parasites on their feet, hairy legs and other parts of the body and deposit them on our food and drinking water causing infection.
2. **Vomit drop (Regurgitation):** The housefly has a habit of frequent regurgitation while sitting on food items and water. This regurgitated stomach content contains rich bacterial culture which infects our food and water.
3. **Defecation:** The excrement of housefly has been found to contain many microorganisms, cysts and eggs of intestinal parasites and thus acts as a source of the transmission of diseases.

The pathogens that stick to the outside surfaces of the fly may survive for only a few hours, but those that are ingested with the food may survive in the fly's crop or gut for several days.

Houseflies are the potential vector for diseases like typhoid, paratyphoid fever, cholera, gastroenteritis, amoebiasis, salmonellosis, diarrhea, dysentery, anthrax, tuberculosis, trachoma, yaws (a chronic bacterial infectin that affcts the skn,bone and cartiage), and conjunctivitis. Eggs and larvae of tapeworm (*Taenia*) and roundworm (*Ascaris*) may be transmitted by housefly.

14.4.2 Myiasis

Myiasis is caused by the invasion of the body parts of humans or animals by the housefly eggs or larvae.

Houseflies can oviposit on or in human tissues if personal hygiene is not maintained. The flies sometimes can lay eggs on open wounds, nasal passage, anus, vagina, eyes etc. The larvae that hatch out cause serious disorders. Eggs and larvae ingested with contaminated food and water can cause intestinal disorders.

Signs and Symptoms

The symptoms of myiasis depends upon the area invaded by the larvae. A few types and the symptoms of the disorder are as follows.

a) **Cutaneous myiasis:** The maggots invade the skin and form painful ulcers that can last for long time.

b) **Nasal myiasis:** Maggots enter the nasal passages and obstruct them causing severe irritation. It can also result in facial edema and fever.

c) **Aural myiasis:** The larvae cause crawling sensations and buzzing noises in the ears. Entry of larvae in the middle ear can make their way to the brain.

d) **Ophthalmomyiasis:** Myiasis in the eyes cause severe irritation, edema, and pain.

e) **Intestinal myiasis:** Myiasis of the gastrointestinal tract may be asymptomatic or can lead to abdominal pain, vomiting, and diarrhea.

Others include urinary myiasis, migratory myiasis, vaginal myiasis, oral myiasis etc.

SAQ 2

i) Fill in the blanks with appropriate words.

a) Houseflies have …… type of mouth parts (biting/sponging).

b) The excellent developmental substrate for houseflies is rich in ……. (moisture/nutrients).

c) ……. myiasis forms painful ulcers (aural/cutaneous).

d) Houseflies transmit diseases …… (mechanically/biologically).

ii) State whether the following statements are 'True' or 'False'.

a) Houseflies response maximally to white and green colour.

b) Houseflies are the most active during evenings and inactive in night.

c) The housefly larvae invade various organs and cause disorders.

14.5 PREVENTION AND CONTROL

Houseflies and their breeding can be controlled by mechanical, cultural, biological and chemical methods. However, it is best to use all the four methods as an integrated approach.

14.5.1 Cultural Control

The best and the easiest method to control house flies is to eliminate their breeding places and take proper care of sanitation and hygiene, not only at home but also of the environment around us. It is not difficult to do it. Food and

materials on which the flies can lay eggs must be removed, destroyed as a breeding medium, or isolated from the egg-laying adult .Let us list some of the ways by which we can improve our environmental sanitation.

1. Proper disposal of any organic matter, such as vegetable or other food by-products can prevent breeding of houseflies. All such materials should be put in the tightly tied garbage bags. Alternatively; garbage, kitchen waste or refuse should be stored in bins and covered with tight-fitting lids.

2. Waste should be finally disposed by incineration, composting or sanitary landfill.

3. Open air defecation should be prohibited. Instead, sanitary latrines should be used.

4. Sanitary disposal of animal excreta helps to control housefly breeding.

In general, good environmental sanitation on a community-wide basis and a clean house with a clean surrounding is the preliminary step in fly management.

14.5.2 Mechanical Control

Mechanical control methods for keeping the housefly under control are:

1. Screening or covering of windows, doors and trash containers proves useful in preventing breeding.

2. **Fly traps;** such as sticky traps, ultraviolet light traps and pheromone traps placed at different places in homes or in business places can reduce housefly population.

    a) Sticky traps can be prepared by coating a suitable device/flypaper with honey, sugar, fruit, molasses or any substance that attracts housefly. These flypaper/devices are hanged in infested areas where there is little or no air movement and are dark. It is advisable to place one 10-inch strip per 1,000 cubic feet of space within 6 feet of the floor because most fly activity is near the ground and should be placed in dark areas away from bright light. Care should also be taken to place these traps away from the food and kitchen area to avoid the risk of food contamination. The strips are generally effective for up to about 3 months.

    b) Ultraviolet traps have a grid of wires mounted in front of the UV fluorescent tubes. The UV light attracts the files, trap and kill by electrocuting them.

    c) The sex pheromone (Z)-9-tricosene, called as muscalure, functions as an aggregation pheromone. Muscalure is added with sugar as a commercially available fly bait for local population suppression, as well as enhancement for population monitoring.

14.5.3 Biological Control

Parasitic wasps and fire ants suppress housefly populations naturally. The parasitic wasps do not harm people or animals. They kill immature houseflies. However, parasitic wasps alone cannot eliminate a housefly population. This method can be used in combination with other methods.

14.5.4 Chemical Control

- Insecticides can help suppress housefly populations.
- Fly baits, such as QuickBayt® and Golden Malrin®, are usually sugar-based and contain a compound that attracts the adult flies. Flies that feed on these baits are killed by the insecticide.
- Neem leaves and carbolic acid are good repellents for controlling flies. Fumigation can be done with dry neem leaves or carbolic acid. Repellents like creosote oil and borax solution sprinkled in animal sheds and other breeding places of the housefly are effective in controlling the fly population.
- Spraying of 2% malathion or diazinon, 1% chlordane or 0.5% dieldrin are effective insecticides for killing the flies.
- Anti-fly candles can be prepared by mixing pyrethrum, saw dust, wheat flour and potassium nitrate in the ratio of 5:1:2:2w/w and rolled into a candle. Burning of anti-fly candles gives a quick knock-down effect to the flies.
- Manure can also be treated with an insecticide, though this method is highly discouraged as it can be lethal to the biological control agents of flies.

SAQ 3

Match the following:

Column 'A'	Column 'B'
i) Cultural Control	a) Fly baits
ii) Biological Control	b) Fly traps
iii) Chemical Control	c) Sanitation and hygiene
iv) Mechanical Control	d) Fire ants

14.7 SUMMARY

Let us summarise what we have learnt so far:

- The common housefly is a diurnal insect found in filthy dirty places and human habitation.

- The housefly possesses sponging type of mouth parts to suck the liquid food.
- Adult body is divisible into three distinct regions *viz*. head, thorax and abdomen.
- Hindwings are greatly reduced to form halteres which act as balancing organs.
- Glandular pads, pulvillus, are present on the legs in between the claws which enable the fly to walk on the walls or ceilings.
- Males have aedeagus, the copulatory organ, on the ninth abdominal segment.
- Ovipositor of female receives the sperms during copulation and help in egg laying.
- Development is indirect with complete metamorphosis (holometabolous).
- Eggs are white in colour, elongated with a curved dorsal thickening.
- Larval form, called maggot is legless, headless and passes through three instars.
- The first and second instar larvae feed on organic matter and debris voraciously.
- Pupa is enclosed in a pupal case called puparium and emerges into adult within 3 days.
- Adult flies generally do not live longer than 15 days in summers and 25 days in winters. The fly overwinters in the larval stage or pupal stage.
- Nutrient-rich substrates provide an excellent developmental substrate for the flies where they get warmth, sufficient moisture, nutrients and protection.
- Houseflies rely on reflected sunlight to detect objects in their environment while flying, finding food, searching for harborage and resting areas.
- The housefly is a mechanical vector of many pathogens-virus, bacteria, protists, fungi and nematodes.
- It is a potential mechanical vector for diseases like typhoid, paratyphoid fever, cholera, gastroenteritis, amoebiasis, salmonellosis, diarrhea, dysentery, anthrax, tuberculosis, trachoma, conjunctivitis and yaws.
- Eggs and larvae of tapeworm (*Taenia*)and roundworm (*Ascaris*) may be transmitted by housefly.
- Contact transmission, vomit drop and defecation are three different ways in which housefly can transmit the diseases.
- Laying of eggs on or in human tissues can cause myiasis in which larvae invade body parts of humans and cause serious disorders.

- Eggs and larvae ingested with contaminated food and water can cause intestinal disorders.
- Mechanical, cultural, biological and chemical control methods can be used to keep a check on the housefly population. The integrated approach provides best result to control their population.

14.7 TERMINAL QUESTIONS

1. Explain the economic importance of housefly.
2. Write short notes on:
   a) Traps used for controlling houseflies
   b) Cultural control of *Musca*
   c) Chemical control of housefly
   d) Myiasis
3. Explain the life cycle of *Musca nebulo* with the help of a neat labelled diagram.
4. What are the different ways by which a house fly can transmit diseases?
5. Write the identifying features of adult *Musca* sp.
6. What is the role of halteres in house fly?
7. What type of mouth parts do the house fly possess and how is it beneficial to them?
8. List five diseases for which house fly acts as a mechanical vector.
9. With the help of an example explain the role of biological control in keeping a check on the housefly population.
10. What are anti-fly candles?
11. List five control measures that you will take at home to keep the flies away.

14.8 ANSWERS

Self Assessments Questions

1. i) a) *Musca domestica;* b) 25-30°C; c) halters.
   ii) a) True; b) False; c) False.
   iii) a) Maggot; b) decomposing organic matter; c) apodous; d) imago; e) locomotion.
2. i) a) sponging; b) nutrients; c) Cutaneous; d) mechanically.
   ii) a) False; b) False; c)True.
3. i) c, ii) d, iii) a, iv) b.

Terminal Questions

1. Write about the losses incurred by the houseflies and the amount of money spent by you to keep the flies away from you and your house. You have to keep in mind the involvement of economics while dealing with the flies.

2. a) Refer to Section 14.5.2.

   b) Refer to Section 14.5.1.

   c) Refer to Section 14.5.4.

   d) Refer to Section 14.4.2.

3. Refer to Section 14.2.

4. Refer to Section 14.4.1.

5. Refer to Section 14.2.1.

6. Refer to Section 14.2.1.

7. Refer to Section 14.3.2.

8. Refer to Section 14.4.1.

9. Refer to Section 14.5.3.

10. Refer to Section 14.5.4.

11. Refer to Section 14.5.