GENETIC BASIS OF BEHAVIOUR

Q. 1. Discuss genetic basis of behaviour with suitable examples.

There are ample examples to support that behaviour has a genetic basis. The inheritance of behaviour depends like all inherited factors on genes which are transmitted to the next generation. This is most aparent in case of stereotyped behaviours which are performed in the same way by all members of the same species, generation after generation with near perfect execution. But in learned behaviour also the ability to learn various skills is inherited. Determining the role of heredity in such cases is not easy.

Examples :

1. Genetic Control of Mating Behaviour in Drosophila : In *Drosophila*, a mutant gene which affects some morphological or physiological characters also affects its behaviour. For example, the gene called **bar** reduces the number of facets in the compound eyes; gene for **white** reduces pigmentation in the eyes, **forked** and **hairy** genes affect the number and gene **dumpy** alters the shape of wings. These mutant genes also have other effects and some of them affect *Drosophila's* mating behaviour. Males with any of these mutants are less successful in stimulating females to mate with them. Following reasons have been attributed to it :

1. The male flies with bar eyes or white eye colour cannot see and have difficulty in finding females to mate.
2. Male flies with forked or hairy genes have defective bristles and lack tactile sense causing failure of mating.
3. Flies with vestigial and dumpy mutant genes have malformed wings that cannot vibrate properly and fail to arouse the female for copulation.

2. Genetic Control of Hygienic Behaviour in Honeybees : Though it is very difficult to isolate any one gene as an operator for particular behaviour pattern, **W.C. Rothenbuhler** demonstrated that **hygienic behaviour** (i.e. cleaning of beehive by worker bees) is controlled by two pairs of genes. There are two strains of honeybees :

1. **Normal hygienic strain** (brownstrain) : The bees of this strain clean those waxen cells of the hive which contain dead larvae.
2. **Unhygienic strain** (Van Scoy strain) : The members of this strain do not clean the waxen cells. They suffered from serious epidemic disease known as **American foul-brood.**

The hygienic behaviour has two components :

1. The removal of wax cap of the waxen cell.
2. The removal of dead larvae lying in the cells of hive.

In 1964, **Rotherbuhler** crossed the above hygienic and unhygienic strains. The hybrids of F_1 generation were all unhygienic, showing that unhygienic trait is dominant. A test cross between F_1 hybrid and hygienic strain produced four behavioural phenotypes in approximately equal proportions :

1. Worker bees that neither uncap the cells of dead larvae nor remove the corpses of dead larvae even though the cap was removed by the experimenter.
2. Worker bees that both uncapped the cells and also removed the corpses of larvae.
3. Worker bees that opened the caps of waxen cells but left the larvae untouched.
4. Worker bees that did not uncap the cells but when cells were uncapped by the experimenter, the corpses were removed.

From the above results it was concluded that unhygienic behaviour is controlled by two pairs of genes. 1. The ability to uncap is controlled by one pair of genes, and 2. The ability to remove dead larvae from cells by another pair.

It is likely that most behaviour patterns are controlled by more than two gene pairs. In complicated behaviour patterns large number of genes are associated. Along with these, gene complexes have a switiching mechanism also.

3. Genetic Control of Courtship Display in Ducks : The courtship display of ducks consists of a series of patterns, most of which can be observed with slight modifications throughout the closely related family of species. **Konard Lorenz** studied 'down-up' pattern in ducks. In this behaviour pattern the drake dips bill into the water and then suddenly raises his head and with it a plume of water. This behaviour is lost in yellow-billed teal and pintail ducks. When these two species were crossed, the hybrid showed 'down-up' behaviour pattern.

Gene Control Mechanism

In case of fixed action patterns (FAPs) a group of genes are involved, each one controlling one specific step in the behaviour. For example, in honeybees, one gene controls uncapping of lid of cell and other gene is associated with removing the dead larvae. Associated with these two genes is expected the presence of a **gene control mechanism.** In normal worker bees, the control mechanism switches on the genes associated with this complicated social behaviour. It is absent in unhygienic strain.

It is also expected that all the genes associated with a complete entity of behaviour should be close together. Then only, these will be inherited together. Otherwise, there is every likelyhood of their getting separated when chromosomes divide and segregate during reproduction, disrupting the total form of behaviour.

Thus greater part of behaviour pattern is fixed in the chromosomes and is triggered only when stimulated by physical, physiological or environmental changes. These may modify by learning and reasoning.