# Cytoplasmic Inheritance of Kappa Particles in Paramecium

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**In this article we will discuss about the Cytoplasmic Inheritance of Kappa Particles in Paramecium.**

One of the most striking and spectacular cases of cytoplasmic inheritance occurs in paramecium aurelia. In 1938, T.M. Sonneborn reported that some strains contain kappa particles in the cytoplasm and are known as **“Killers “.** Kappa particles are about 2 μ x in diameter and contain DNA and protein.

Individuals not possessing Kappa particles are sensitive and are killed by a poison ‘paramecin’ which is secreted by Killer individuals. The secretion paramecin is harmless to the killers. The different killer strains have different means of killing their victims.

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Most of them do not kill their mates. But there are some strains that instead of killing from a distance by secretion, kill their mates through close contact. The killer character has a nuclear as well as cytoplasmic basis.

The existence and increase of Kappa particles is determined by the presence of a nuclear dominant gene K. The animals that are homozygous for recessive ‘k’ are sensitive to killing and they cannot themselves become killers. Animals that are homozygous for dominant K or heterozygous in normal cytoplasm are potential killers.

They are actual killers when their cytoplasms contain kappa particles which in turn produce the lethal poison. In animals of genotype KK or Kk, kappa particles are transmitted from cell to cell; once they have been lost from a cell, they do not again develop by themselves.

The individuals with genotype kk may also contain Kappa particles of some sort in the cytoplasm, although this state is unstable and eventually the particles disappear.

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Paramecium generally reproduces by conjugation method, a system of parasexual reproduction (Fig. 18.6) and autogamy (Fig. 18.6). When a killer strain of paramecium aurelia with genotype KK conjugates with sensitive strain having genotype kk, the ex-conjugants are all heterozygous (Kk).

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The genotype Kk of hetrozygous ex-conjugants suggests that they should be identical and killers. But, this is not always the case and Kk hetrozygotes are equally divided into killers and sensitive (Fig. 18.6). If the conjugation is accomplished in a short duration normally no exchange of cytoplasm takes place between the killers and sensitive individuals.

When autogamy takes place in hetrozygotes 8 nuclei are formed after meiosis and mitosis divisions and then 7 of the 8 haploid nuclei degenerate and the remaining nucleus undergoes mitosis and the two identical nuclei so formed fuse to form a homozygous diploid. Thus all the sensitive hetrozygotes produce only sensitive offspring and the killer hetrozygotes produce only killer offspring.

Since a heterozygote Kk after autogamy does not produce sensitive and killer types, this pattern of inheritance is Non-Mendelian which confirms cytoplasmic basis of killer trait. The inheritance of Kappa was at first considered a good example of cytoplasmic inheritance.

These particles are not true cell organelles like the plastids or mitochondria. Closer studies, however, have shown that kappa particles are infectious and resemble bacterium caedobacter taeniospiralis.

Their transmission in cytoplasm from cell to cell is, therefore, more correctly compared with the transmission of parasitic micro-organisms. The toxic substance produced by killer paramecia is diffusible in liquid medium. This is evident from the fact that when the killers were allowed to remain in a fluid medium for a time and were then replaced by sensitive individuals, the latter were killed.

The toxic substance had no effect on the killer strain. The fact that kappa particles can be maintained only in the animals with gene K is no rigid argument against the interpretations. Individuals with genotype KK will be sensitive if there are no Kappa particles in the cytoplasm.

When such sensitive cells are placed in concentrated suspension of disintegrated killer animals, some of them acquire kappa from the suspension and are changed to killers. Kappa is subject to mutation and if killer Paramecia is exposed to high temperature.

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X-rays and chloromycetin they become sensitive which can be crossed to killers in different ways as shown in Fig. 18.6. Sometimes one animal may carry two or more different forms of kappa.

The toxic substance has been shown to be associated with a particular kind of kappa, occurring in nearly 20% of kappa population. These kappa bacteria possess a refractile protein containing body called R body. The bacteria having R bodies are bright and they are infected with a virus that dictates the synthesis of viral protein as well as R protein body in kappa bacterium.

The virus may act as the toxin in the killing response and R body facilitates the penetration of the toxin. The non-bright kappa bacteria may also contain virus but the virus may be in provirus state in them