Cytoplasmic Inheritance

- The existence of genes as segments of nucleic acid molecules, located in chromosome of nucleus, has been demonstrated by several experiments. The nuclear genes control the phenotypes of the organisms and are concerned with the transmission of hereditary character from one generation to next generation is known and predictable Mendelian fashion
- The inheritance of genes of nuclear chromosomes is characterized by the fact that the genes from male and female parents contribute equally to the genetic constitution of the offspring.
- However, in certain cases, although male and female parents contribute equally their nuclear genes to the offspring's, the results show a non-Mendelian inheritance pattern and the result of reciprocal crosses varies.
- These variations suggest that the genes for the inheritance of certain characters do not occur within the nucleus, but they are present in cytoplasm and play an important role in transmission of certain specific traits, which are not controlled by nuclear genes. Therefore, it builds up the concept of cytoplasmic inheritance. The genes for cytoplasmic inheritance are independent, self-replicating nucleic acids.
- Evidence for cytoplasmic inheritance was first reported by Correns in *Mirabilis jalapa* and by Bar in Pelargonium zonule in 1908. Rhoades described cytoplasmic male sterility in maize in 1933. In 1943, Sonneborn discovered kappa particles in *Paramecium* and described its cytoplasmic inheritance. Presence of DNA in chloroplasts was first demonstrated by Ris in plant cell.
- In 1963, Nass and his co-workers proved the existence of DNA in mitochondria. Subsequently, from time to time, observations by several scientists have been reported the important role of cytoplasm in genetics. Thus, on the basis of observations made on

cytoplasmic inheritance of some specific traits, it has been suggested that cytoplasm is also genetically active.

➢ Characteristics and Detection of Cytoplasmic Inheritance:

- Hereditary traits which are transmitted by cytoplasm do not show Mendelian segregation in crosses and in reciprocal crosses with respect to a particular set of characteristics controlled by a set of cytoplasmic genes produce dissimilar hybrids.
- Most of the recorded cytoplasmically inherited characteristics would follow the maternal line, i.e., uniparental mode of transmission. In higher plants and animals, ovum or egg cell is comparatively large and contains large amount of cytoplasm. But male gametes or sperms have very little amount of cytoplasm. So, under this situation, most of cytoplasmic factors are transmitted to the progeny through the ovum of mother.
- It is known as maternal inheritance or trans-ovarian transmission. In this mode of transmission, all the offspring's of the parents have maternal condition and only female progeny can transmit the cytoplasmic characteristics to the succeeding generations. Hence the reciprocal crosses yield different or non-Mendelian results.

Characteristics of Mendelian Inheritance:

The inheritance pattern of characters of an organism as proposed by Mendel on the basis of monohybrid and di-hybrid crosses is referred to as Mendelian inheritance.

i. Contribution of both male and female is equal, hence results from reciprocal crosses are similar.

ii. Segregation produces the phenotypes ratio 3:1 and genotype ratio 1:2 :1 in the F2 generation of a monohybrid cross and a typical phenotype ratio 9:3:3 :1 in di-hybrid crosses.

Mendelian inheritance pattern is regarded as a sufficient evidence for a gene to be located in chromosomes; such genes are called nuclear genes or simply as genes.

Characteristics of Extra-Nuclear Inheritance

i. reciprocal differences in F1;

ii. which in most cases disappears in F2;

iii. a smaller variation in F2 as compared to that in F3.

Source:https://www.biologydiscussion.com/cytoplasm/cytoplasmic-inheritance-with-diagram-cell-biology/27271