Mitochondrial Mutation in Saccharomyces

Moumita Pal, Zoology Dept., Raniganj Girls College

There are some charecters that are controlled by mitochondrial genes, and the inheritance pattern of petite mutants of *Saccharomyces cerevisiae (*baker's yeast) is one such example. Yeast cells normally form large colonies called as Grande on nutrient agar plates. Rarely , small or minute colonies called as petite, also appear amongst them. Petite colonies wear small not because the cells were small but because the growth rate of mutant petite strain is significantly slower than that of the wild type.Thus there are fewer cells in the petite colonies. These petite colonies grow slowly because of low respiration due to defects in the mitochondrial electron transport proteins.

, 'petite' yeast are unable to grow on media containing only non fermentable carbon sources and form small colonies when grown in the presence of fermentable carbon sources such as glucose. The petite phenotype can be caused by the absence of, or mutations in , mitochondrial DNA that is called "cytoplasmic Petites" , or by mutation in nuclear encoded genes involved in oxidative phosphorylation. This petite colonies were small not because the cells were small but because the growth rate of the mutant petite strain is significantly slower than that of the wild type. Thus there are fewer cells in the petite colonies. These petite colonies grow slowly because of low respiration due to defects in the mitochondrial electron transport protein.

When petites are crossed with the wild-type, three different types of petites are observed. The segregational, neutral and suppressive petites.

Haploid petite **x** **Haploid wild type (Grande)_**

______Diploid **Diploid** **Diploid**

(meiosis)	**(meiosis)**	**(Meiosis)**
1 petite: 1 wild type	**All wild type**	**mostly petite (90%)**
Segregational petite	**Neutral petite**	**Suppressive petites**

1. The segregational petite: It is caused by mutation of a chromosomal gene, exhibits normal Mendelian segregation. In a cross with wild type, the diploid progeny are normal, and if the diploids are allowed to undergo meiosis half of the spores in an ascus produce petite colonies and half form wild type colonies i.e., segregation of ascospores into 2 : 2 ratio.

2. The neutral petite: When a neutral petite is crossed with normal wild type cells, the resulting diploids all produce grand colonies. The name neutral, then, refers to that fact that this class of petites does not affect the wild type. The explanation for this result is that the majority of neutral petites lack most or all mitochondrial DNA in the resulting progeny spore.

3. The suppressive petites: The cross between suppressive petite and wild type producing all petite colonies. These types of petites are different from the neutrals because they do have an effect on the wild type. Most petite mutants are of the suppressive type. These types of petites also have deletions of mtDNA, but they are not nearly as extensive as deletions in the neutral petites.

Two major hypotheses have been given to explain suppresivencess. One hypotheses suggests that the mutant mitochondrial DNA replicates more rapidly, resulting in the mutant mitochondria dominating the phenotype by numbers alone. The second hypotheses consider the view that recombination occurs between the mutant and wild type mitochondrial DNA, introducing errors into normal mitochondrial DNA.

Cause of petite mutation: This type of mutation can be caused by using a variety of mutagens, including DNA intercalating agents, as well as chemicals that can interfere with DNA synthesis in growing cells. Mutagens that create petites are implicated in increased rates of degerative diseases and in the aging process.