

## The Role of Cytotaxonomy in Fungal Classification

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**Abstract:** Diagnosis of fungal pathogens and its relatives at the level of chromosomes has been poorly studied in this part of the world. This review observed the potentials of cytotaxonomy in studying fungal chromosomes using different cytotaxonomic characters including cell division, somatic chromosome number and karyological details such as karyotype symmetry, total form percentage, total chromosome length, centromeric index and the coefficient of variation of the chromosome among other factors. In conclusion: cytotaxonomy could provide definite taxonomic evidence in fungal classification if its application is well optimized.

**Key words:** Cytotaxonomy • Fungi • Classification

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### INTRODUCTION

The last few decades of the twentieth century allowed for an increase in the number of techniques for the diagnosis of fungal organisms. This significant increase in the understanding of fungal classification rationalized the study of fungi at the chromosomal level. Fungal cytogenetics began with Barbara McClintock, who while sitting on a bench under the eucalyptus trees at Stanford University, realized that she could solve the problem of seeing the small chromosomes of *Neurospora crassa* [1]. Since then, numerous microscopists and geneticists have established a few fungi as an important experimental system for the study of meiotic chromosome behavior. However, the small size of most fungal chromosomes have precluded the analysis of many of their features [2, 3]. Cytotaxonomy is the branch of biology that deals with relationship and classification of organisms using comparative studies of chromosomes. The number, structure and behavior of chromosomes are of great value in cytotaxonomy, with chromosome number being the most widely quoted character [4, 5]. Other useful informative cytotaxonomic characters include cell division (mitotic and meiotic indices), somatic chromosome number, karyological details such as karyotype symmetry, total form percentage, total chromosome length or relative length of the shortest

chromosome, centromeric index and the coefficient of variation of the chromosome [5, 6]. So, the aim of this review was to elucidate on the role of cytotaxonomy as a source of taxonomic evidence in fungal classification.

**Cell Division:** It is the process by which a parent cell divides into two or more daughter cells. It usually occurs as part of a larger cell cycle. In eukaryotes, there are two distinct types of cell division: a vegetative division, whereby each daughter cell is genetically identical to the parent cell (mitosis) and a reductive cell division, whereby the number of chromosomes in the daughter cells is reduced by half, to produce haploid gametes (meiosis). Meiosis results in four haploid daughter cells by undergoing one round of DNA replication followed by two divisions. Homologous chromosomes are separated in the first division and sister chromatids are separated in the second division. Both of these cell division cycles are in sexually reproducing organisms at some point in their life cycle and both are believed to be present in the last eukaryotic common ancestor. All cell divisions, regardless of organism, are preceded by a single round of DNA replication [7].

**Mitotic Index:** This is defined as the ratio between the number of cells in a population undergoing mitosis to the number of cells not undergoing mitosis. Mitotic index can

be calculated using the following operation; cells observed with visible chromosomes ÷ total number of cells visible.

$$\text{Mitotic I} = \frac{(P+M+A+T)}{N} * 100\%$$

(P+M+A+T) - The sum of all cells in phase as prophase, metaphase, anaphase and telophase, respectively; N- total number of cells.

**Meiotic Index:** This is the percentage of cells undergoing meiosis in a population and it has been used as a means of identifying different organisms in relation to other parameters [8].

**Somatic Chromosome Number:** This refers to as the number of chromosomes in the somatic cells. The somatic cells have somatoplasm and do not take part in reproduction [8].

**Karyotype Symmetry:** A karyotype may be symmetrical or asymmetrical. A perfectly symmetrical karyotype has all metacentric chromosomes of the same size. It is considered that perfectly symmetrical karyotypes represent a primitive state from which more advanced asymmetrical karyotype have evolved through changes in chromosomes. The degree of asymmetry is generally estimated as the proportion of metacentric, acrocentric among others in the karyotype and as the ratio between size of the largest and the smallest chromosome. In general, the higher the proportion of acrocentric chromosomes and the greater the value of the size ratio, the more asymmetrical is the karyotype [8]. In karyotyping, the following formula are used

$$CV = SD \div X \times 100,$$

Where

CV = Coefficient of variation

SD = Standard deviation of chromosome

X = Mean chromosome length

$$CG = SX \div TLX \times 100,$$

Where

CG = Centromeric gradient

TLX = total length of median chromosomes

SX = length of the median short arm

$$\%F = S \div L \times 100,$$

Where %F = percentage form percentage [5]. In conclusion, cytotaxonomy could serves as a source of taxonomic evidence and their adoption will enhance both phenotypic and genotypic chromosomal studies in fungi but may never replace conventional methodologies, which continue to be the cornerstone of classical mycological methods. Indeed, such cytotaxonomic assays would be important in specialized research laboratories and It can be inferred that its integration with modern molecular techniques will simplify understanding of filamentous fungi at the chromosomal level.

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