CYTOLOGY AND PHYSIOLOGY OF GERMINATING BASIDIOSPORES AND OIDIA OF COPRINUS LAGOPUS

by

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SUMMARY

Cellular changes associated with the growth process have been studied in Coprinus lagopus. Changes in germinating basidiospores and oidia were studied with both phase contrast and electron microscopy. The development of living cells, as seen with phase contrast microscopy, consisted of the formation of a germ tube which provressively elongated and branched. Mitotic nuclear divisions within the germ tube took place by lengthening of the nucleus, followed by its fading from view. Within fifteen minutes, two nuclei were visually recovered in the cytoplasm. The formation of complex septa at the site occupied by the pre-division nucleus followed nuclear division.

Intracellular details of the process of germination were elucidated by electron microscopy. A greater degree of structural complexity was characteristic of basidiospores, as compared to oidia. The basidiospore protoplast was enclosed by six wall layers, each of which was of a different shape or thickness. In contrast, oidium walls were more simple, consisting of one structural and one amorphous layer.

The novel use of barium permanganate as a differential stain for cell wall material enabled the previously indistinct wall layer from which the germ tube arose to be clearly distinguished. Structural analysis of germinating cells showed the innermost wall of the basidiospore to be the one from which the germ tube was formed, while oidium germ tubes were formed as the extension of the outer walls of the parental cells. Additional ultrastructural features of germlings included endoplasmic reticulum, mitochondria, lipid,

glycogen, nuclei with nucleoli, ribosomes, hypertrophied membrane systems, lomasomes, vacuoles with dense contents, apical vesicles and vesicles containing intracisternal granules.

The substructure of the complex septa delimiting the germ tube into cellular units depended on the method of preparation. In aldehyde-fixed cells poststained with lead citrate or barium permanganate, a dense material was demonstrated at the terminus of the septal plates. In cells fixed similarly but poststained with uranyl acetate, this material was not obvious which suggested it was carbohydrate in nature.

The endogenous respiratory capacity, measured as Q_{O_2}, of both basidiospores and oidia was low. Following exposure of the intact cells to temperatures of 50 C and above, the respiration of basidiospores was decreased, whereas that of oidia was enhanced. The respiration of oidia was more than doubled following exposure of cell suspensions to 50 C for five to ten minutes or 60 C for one minute. The endogenous respiration of both spore types was not stimulated by carbohydrates, but short chain fatty acids increased the respiration of oidia. The latter was correlated with an increase in the volume of lipid droplets during early stages of germination.

Cell-free extracts of both basidiospores and oidia contained conventional soluble enzymes for carbohydrate utilization and particulate enzymes associated with terminal respiratory sequences. Pyridine nucleotide-linked dehydrogenases for glucose-6-phosphate, 6-phosphogluconate and sugar alcohols were examples of the former while cytochrome c oxidase and reductase were examples of the latter.

Apical vesicles, similar to those implicated in cell wall formation in other fungi, were detected in germ tubes of basidiospores

and oidia and in the apices of hyphal tip cells. These fused with and apparently contributed to the growth of the plasma membrane. Also seen in germlings and hyphal tip cells were vesicles containing intracisternal granules and lomasomes. Germination vacuoles with dense contents were seen in germlings, whereas smaller vesicles with contents of varying densities were found in hyphal tip cells. The latter, in hypertrophied form, were the most obvious ultrastructural feature of a slow growing mutant with morphologically aberrant hyphae.