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The relationships of trehalose and its metabolism to conidiation in Neurospora

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Abstract

Relationship of trehalose to conidiation

Honks,* D. L. and A. S. Sussman. The relationships of trehalose and its metabolism to conidiotion in Neurospora.

When N. crassa, strain 69-I 113A, is grown in standing culture on liquid &i&medium at 24°C, the accumulation of trehalose in the vegetative mycelium begins during the second day. Rapid accumulation of this sugar follows, attaining a maximum on the third day. Conidiation begins during the third doy, following which a rapid decrease in the trehalose of vegetative mycelium occurs. That this decrease is closely related to conidiation is evident from the following observations. If conidial production is delayed, mycelial trehalose continues to accumulate until spores ore formed. Likewise, the trehalose concentration in aconidial strains steadily increases beyond the time when conidiation normally occurs in other strains. Moreover, trehalose levels in the conidia are much higher than those found in the vegetative mycelium as considered separately from the mycelium.

The trehalase activity per unit dry weight of the vegetative mycelium of strain 69-I 113A when grown under standard conditions remains low for three days. Beginning with the fourth doy, it increases rapidly until the tenth doy of growth. Concomitant with

the increase in mycelial trehalase activity on the fourth day is the cessation of myceliol growth and the rapid Production of aerial hyphoe and conidio. These events occur 24 hours prior to the depletion of the carbohydrate supply from the growth medium. In contrast, if the some strain is grown under conditions of suppressed conidiotion, treholose activity does not increase until the exogenous carbon supply has become depleted. Total treholose activity produced by heavily conidioting strains is six-to ten-fold greater than that produced by aconidial or slowly conidioting strains or strains in which conidiotion is suppressed. A comparison was made of the activities of 6 different enzymes from the myceliol fraction of strains 60-I 13A, B106a ond STL6A during the tendoy growth period, including treholase, ß-galactosidase, alkaline phosphatase, ornithine transcarbamylase, tryptophan synthetase ond invertase. The results indicate that treholase is the only enzyme of those studied that appears to be correlated with conidiotion.

The regulation of mycelial trehalose activity under the conditions of this study appears to be by catabolite repression. Evidence for this is as follows:

(1) The derepression of myceliol treholose which is associated with conidiotion occurs when the carbon supply is only partially depleted. However, this increase in activity coincides with a period of extremely ropid growth ond, presumably, results from the decreased concentration of the repressor at this time.

(2) The derepression of treholase in the absence of conidiotion does not occur until the complete exhaustion of the carbon source in the growth medium.

(3) An aconidial mutant, strain STL6A, grown in media containing various sugars or L-amino acids as the sole carbon source, exhibits varying levels of treholose activity. In each instance, a reciprocal relationship is found between the amount of derepression and growth rote upon the substrate used.

(4) The retardation of growth alone does not derepress treholose. When the growth rote of various strains is severely retarded by any of several methods which do not involve the depletion or limitation of the exogenous carbon supply, treholose remains repressed.

(5) The complete removal of exogenous carbon supply from rapidly growing mycelium of strain STL6A results in the rapid derepression of treholose.

(6) When sucrose is added to the growth medium of strain STL6A, in which the trehalose activity per unit weight is high as a result of previous growth in mannitol, rapid repression follows.

An indication thot treholose may ploy a major role in the development of conidia in Neurospora is its presence in higher quantity in young aerial hyphae before the appearance of conidia. Trehalase activity per unit weight in these structures is three- to four-fold greater than is found in the vegetative mycelium. The derepression of mycelial treholose during conidiotion does not oppeor to be a primory factor in the developmental process. Rather, it seems to arise as a consequence of the effects of conidiation upon the vegetative mycelium.

Labeling ond inhibitor experiments indicate that treholose derepression represents de novo synthesis of the enzyme rather than activation of existing protein. - - - Deportment of Botany, University of Michigan, Ann Arbor, Michigan 48104. * Present address: Deportment of Botany, Brigham Young University, Provo, Utah.