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Metabolism and conidiation in Neurospora crassa

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Abstract
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In wild type Neurospora crassa, a degree of control of conidiation can be achieved by altering the metabolic pathways. Thus, mere substitution of an ammonium salt for the nitrate in Westergaard-Mitchell synthetic perithecial (P) medium (1947 Am. J. Botany 34:573) enriched with 10^{-2} M potassium citrate leads to a practically complete suppression of the heavy conidiation produced on the nitrate-citrate formula (Turian 1962 Neurospora Newsl. 2:15).

From this initial observation, a mycelial or M medium was proposed (Turian 1964 Nature 202:1240), based on the P_s solution (Westergaard-Mitchell medium with 2% sucrose) in which KNO_3 0.1% is replaced by NH_4-citrate 10^{-2} M. As the alternative, the conidial or C medium contains K-citrate 10^{-2} M in addition to KNO_3 0.2% (N equivalence with 10^{-2} M diammonium citrate of M medium) as nitrogen source. In the C formula, the citrate can be effectively replaced by other Krebs cycle organic acid salts such as succinate or malate; salts of C_2 acids such as acetate and glycolate (recent observation of Combépine) are also conidiogenous in the presence of nitrate, while the C_3-compound pyruvate appears to have no effect in these conditions.

Interestingly enough, the ammonium M medium can become fully conidiogenous when supplemented with either glycine (the most active), Na glyoxylate, or glycolate at 10^{-2} M. Under the same conditions,

D,L-serine, Na acetate and Na formate are without effect, while $NaHCO_3$ at 2×10^{-2} M is approximately as conidiogenous as the previously mentioned C_2 acids. Moreover, D-xylose, a potential precursor of C_2 compounds, was tested and found to be very conidiogenous when replacing sucrose (2%) in the medium.

In first summary, C_2 compounds of the glycolate series are conidiogenous on both nitrate and ammoni[illegible] media; Krebs cycle organic acid salts are conidiogenous only in the presence of nitrate; pyruvate, as glycolytic intermediate, is inactive in both cases.

Finally, the inverse conversion, i.e., from C to M medium was recently achieved in the presence of a supplement of 0.1% $NaHSO_3$ (added aseptically, 24 hrs. after inoculation) as a trapping agent of acetaldehyde in the C medium. This anticonidiogenic effect of bisulfite was anticipated from a previous finding (Turian 1964 unpublished data) that the M medium favors a high degree of alcoholic glycolysis in N. crassa in contrast to the C medium. The bisulfite trap appears to orient the metabolism from pyruvate through acetaldehyde to the high ethanol production characterizing the mycelial phase. This is being substantiated by the detection of an accumulation of acetaldehyde in the filtrates of transformed C → M cultures, simultaneously with a sharp increase of their ethanol content (Turian and Matikan 1965). This last observation indicates that, as in some other fungi (Foster 1949 Chemical activities of fungi. Academic Press, New York), the formation of an acetaldehyde-bisulfite addition complex in N. crassa, while preventing pyruvate oxidation (through an acetaldehyde-TPP step (Holton 1960 Plant Physiol. 35:757)), still allows effective acetaldehyde reduction to ethanol (alcohol dehydrogenase activity).

Therefore, a simple induced metabolic shift from an oxidative activity to glycolysis is sufficient to prevent triggering of Neurospora development from its initial purely mycelial phase (1-2 days on C medium at 25°C) to its conidiating phase. Such a morphogenetic triggering is enhanced by the Krebs cycle intermediates of the C medium and, more interesting, is enforced in the M medium by the C_2 compounds of the glycolate series.

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