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Detection of Isocitrate Lyase in *Achlya flagellata*

JOANNE TONTZ ELLZEY and CHRISTINA D. CHAVEZ†


The colorimetric procedure of McFadden and Howes (1960) and the enzyme assay for isocitrate lyase (Shio, Shio, and McFadden, 1965) gave positive results for the presence of isocitrate lyase in *Achlya flagellata* oogonial cultures. This enzyme is an indicator of the glyoxylate pathway (metabolism of lipids to carbohydrates). Further work is in progress to determine if there is a correlation between isocitrate lyase and the microbodies of oogonial initials.

**Index Descriptors:** Isocitrate Lyase, *Achlya flagellata*, Achlya Isocitrate Lyase.

The glyoxylate cycle couples fatty acid degradation with carbohydrate synthesis. C₂ compounds enter the citric acid cycle as acetyl-CoA, which condenses with oxaloacetic acid, producing citric acid. The citric acid is converted to isocitric acid. The key enzymes of the glyoxylate cycle are (1) isocitrate lyase, which catalyzes the conversion of isocitrate ↔ succinate and glyoxylate and (2) malate synthase, which catalyzes the reaction, acetyl coenzyme A and glyoxylate → malate (Dixon and Kornberg, 1959).

Reports of isocitrate lyase in fungi have been primarily concerned with the higher fungi (Kornberg and Collins, 1958; Collins and Kornberg, 1960; Gottlieb and Ramachandran, 1960; Heberling, Berky, and Stone, 1960; Frear and Johnson, 1961; Turian, 1961; Duntze et al., 1969; Kohr, Van derhaeghe, and Combèpine, 1969; Szabo and Avers, 1969; Cotter et al., 1970; Perlman and Mahler, 1970; Selim and Sawsan, 1970; O'Sullivan and Casselton, 1973). McCurdy and Cantino (1960) discovered a metabolic route from glyoxylate to glycine in the chytridiomycete *Blastocladiella emersonii*. The following paper is the first report of the glyoxylate pathway in the oomycetes.

In unpublished ultrastructural data, Ellzey observed the association of microbodies with storage bodies. The contents of the storage bodies appeared to be converted from lipid to carbohydrate in *Achlya flagellata* Coker oogonial initials. Therefore, an assay was performed to determine if isocitrate lyase was present in oogonial cultures of *A. flagellata*.

**Materials and Methods**

Pure cultures of *Achlya flagellata* (ATCC #14566) were grown on autoclaved hemp seeds in sterile water, as well as on Barksdale Medium #5, containing 400 mg edamin, 2400 mg glucose, 80 mg calcium glycerophosphate, 1 ml 0.5 M MgSO₄ · 7H₂O, 0.5 ml 2.0 M KCl, 0.5 ml metal mix #4, and 100 mg Tris in 1000 ml distilled water (pH 6.8). After autoclaving, 400 mg of potassium bicarbonate in 10 ml of distilled water was added to Barksdale Medium #5. Five-day-old cultures containing hyphae, oogonia, antheridia, and oospores were harvested by centrifugation at 15,000 rpm for 15 min. A mortar and pestle were used to disrupt the fungal walls in 0.05 M Tris buffer containing 0.05 mM MgCl₂. After

**Figure 1.** Optical density at 520 nm as a function of glyoxylate concentration in 5 ml of solution.

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centrifugation at 15,000 rpm for 15 min, the supernatant from 1 gm wet wt. of fungus was assayed for isocitrate lyase, using the colorimetric procedure of McFadden and Howes (1960) and Shiio, Shiio, and McFadden (1965). The supernatant was preincubated with 55 µmoles of glutathione for 10 min at room temperature in a total volume of 5 ml containing 455 µmoles of Tris and 13.6 µmoles of MgCl₂. To initiate the enzymatic reaction, 0.45 ml of 0.04 M sodium DL-isocitrate was added and allowed to react for 10 min at 30° and 20 min at room temperature. The reaction was stopped with the addition of 2.3 ml of 10% (w/v) trichloracetic acid. The fungal reaction mixture was assayed for isocitrate lyase, using the colorimetric procedure of McFadden and O'Sullivan, Perlmans, and Neumann (1969).

RESULTS

The positive assay for isocitrate lyase in A. flagellata indicates the presence of the glyoxylate pathway. Further work is in progress to determine if microbodies of oogonial initials contain isocitrate lyase. Ultimately, we seek to determine if storage bodies of oogonial initials are the sites of conversion of lipids to carbohydrates.

REFERENCES CITED


Figure 1 compares the optical density of the control containing 0.025-0.2 µmoles glyoxylate/5 ml solution with the optical density of 5 ml fungal supernatant. A red-violet product was obtained from five-day-old cultures of A. flagellata grown on either hemp seeds or Barksdale Medium #5. Experimental solutions had 9.8 and 6.7% transmission. These readings were within the control range of 2.2-64.5% transmission.

The positive assay for isocitrate lyase in A. flagellata indicates the presence of the glyoxylate pathway. Further work is in progress to determine if microbodies of oogonial initials contain isocitrate lyase. Ultimately, we seek to determine if storage bodies of oogonial initials are the sites of conversion of lipids to carbohydrates.