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Dependence on ribosome production on protein sythesis

Abstract

Dependence on ribosome production on protein sythesis

Russell, P.J. and E.A. Hall. Dependence
on ribosome production on protein synthesis.

We have been interested for some time in the regulation of cytoplasmic ribosome biosynthesis in *N. crassa* and here we discuss some experiments which show that when protein synthesis is inhibited, the maturation of ribosomal RNA (rRNA) and the production of ribosomes is severely impaired.

In initial experiments we grew duplicate wild type cultures at 25°C to early-log phase and then added cycloheximide (100 µg/ml) to one. At various times thereafter, samples from both cultures were taken and incubated for 5 min in the presence of ³H-lysine. The sample was homogenized with an equal volume of ice-cold TCA, allowed to precipitate for 1 hr at 0°C, collected on a GF/C filter, washed with 5% ethanol and incubated overnight at 60°C in a scintillation vial with 0.2 ml 60% perchloric acid and 0.4 ml H₂O₂. After cooling, scintillation fluor was added and the radioactivity in the samples was determined by liquid scintillation counting. The rate of protein synthesis in the cycloheximide-treated culture was reduced to less than 5% of the control culture within 30 min after addition of cycloheximide.

We then studied the effects of cycloheximide-induced inhibition of protein synthesis on the kinetics of synthesis of the 2.4 x 10⁶ ribosomal-precursor-RNA (pre-rRNA) and the processing of this molecule to mature 25S and 17S rRNAs. (A proposed scheme for rRNA maturation is given in Russell et al. (1976) J. Bacteriol. 127:785. Here we grew wild type at 25°C to mid-log phase and then to the experimental culture we simultaneously added ³H-uridine and cycloheximide to final concentrations of 10 µCi/ml and 100 µg/ml, respectively. The control culture received only ³H-uridine. At specific time points samples of the cultures were taken, RNA was extracted and purified using phenol:chloroform:isoamyl alcohol and two ethanol precipitations. The RNA was analyzed by electrophoresis in 2.5% acrylamide-0.125% bisacrylamide-0.5% agarose gels as described by Russell et al. (J. Bacteriol. (1976) 127:785). After electrophoresis the gels were scanned spectrophotometrically, sliced into 1-mm fractions and the radioactivity determined by liquid scintillation counting. For the control culture we found that pre-rRNA was synthesized and processed normally to the 1.27 (25S) and 0.7 (17S) million dalton (Mdal) mature rRNAs. By contrast, in the cycloheximide-treated culture, we observed an apparent accumulation of the 2.4-Mdal precursor and of the 1.4-Mdal RNA that we showed previously to be an intermediate between the precursor and 25S rRNA. Very little 25S and 17S rRNA was produced in the presence of cycloheximide.

Since some mature rRNA was produced under protein synthesis inhibition conditions, we conducted experiments to show whether or not these molecules appeared in ribosomes. Here we added 100 µg/ml cycloheximide to a growing culture and after 30 min added 1 µCi/ml ³H-uridine. Eleven hours later the culture was harvested, ribosomes were isolated and purified and analyzed by sucrose density gradient centrifugation. The results are consistent with the fact that labeled rRNA become associated with ribosomal subunits albeit at a much reduced level than in a control culture.

In conclusion, the inhibition of protein synthesis by cycloheximide appears to block almost completely the production of mature rRNA from the 2-4-Mdal pre-rRNA. The few mature rRNAs that are produced do associate with ribosomal subunits. Thus continuing protein synthesis is necessary for ribosomal production in *N. crassa*, a conclusion that has also been drawn from work with other eukaryotes. - - - Department of Biology, Reed College, Portland, Oregon 97202.