INHIBITION OF ENZYMIC COLOR FORMATION IN POTATO BY ADENOSINE TRIPHOSPHATE

by

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Extracts and macerates of potato tubers, in common with those of many other plant tissues, darken as an end result of tyrosinase or polyphenoloxidase activity. The color formation is enhanced by the addition of suitable substrates such as dihydroxyphenyl alanine (DOPA), catechol, or other phenols[1,2], and is delayed or prevented by appropriate reducing agents, copper combining agents, and phenolic competitive inhibitors[2,3]. We have now observed that ATP (adenosine triphosphate) also has the property of retarding color formation in potatoes.

The inhibition or delay of enzymic color formation in buffered potato extracts, macerates, and slices by the addition of neutralized ATP was studied in two varieties of potato under several experimental conditions. The results of three quantitative experiments are summarized in Table I. In a typical experiment (A), with potato extracts, appreciably lower colorimetric values were obtained in the presence of ATP than in its absence. Thus ATP appears to act as an inhibitor of enzymic color formation in the potato extract.

TABLE I

INHIBITION BY ATP OF ENZYMIC COLOR FORMATION IN POTATO*

Experiment	*Preparation*	*Optical density*		*% Inhibition*
		Control	*0.08 M ATP*	
A	Extract**	0.234	0.155	33.7
B	Mitochondria***	0.155	0.012	92.3
C	Mitochondria + DNP§	0.100	0.098	2.0

* All preparations were carried out at 0–2°; 60 g potato + 30 ml 1 *M* phosphate buffer pH 6.2, + 30 mg ascorbic acid were blended 2 min at low speed, passed through cloth and centrifuged 5 min at 500 × *g*. Final pH of all digests was 6.2–6.3; optical densities at 0.5 ml digest + 9.5 ml formamide were determined in a photoelectric colorimeter with a 440 mμ filter.

** As in * containing 0.33 g potato per ml of digest; phosphate = 0.2 *M*. Incubated 6 hours at 1–2° with $2.4 \cdot 10^{-3}$ *M* DOPA; total vol. = 1.2 ml.

*** Mitochondria were prepared in 0.25 *M* phosphate buffer + 0.25 *M* mannitol, as in *. Ultracentrifuged twice at 15,000 × *g*. Incubated 20 hours at 1–2° with $8.5 \cdot 10^{-4}$ *M* DOPA. Digest contained the equivalent of 4.2 g potato per ml; volume = 1.2 ml.

§ As in B, but in the presence of approximately $4 \cdot 10^{-4}$ *M* 2,4-dinitrophenol.

However, conditions necessary for the demonstration of this inhibition indicated that the presence of active tissue mitochondria was essential. The addition of ATP had no inhibitory effect when potato extracts had first been subjected to the following conditions known to remove or destroy active mitochondria: (a) dilution with distilled water; (b) holding at 25–30° for 3 or more hours; (c) holding at 2° for 16 or more hours; (d) filtration through a thick pad of diatomaceous earth; (e) centrifuging at 15,000 × *g*. Neither did ATP inhibit the formation of color from catechol by purified mushroom catecholase. Moreover, preliminary experiments with mitochondria-like particles isolated from potato showed an enhancement of the ATP effect. This strong inhibition of color development, with DOPA as substrate, is shown in Table I, B. That the effect of ATP in this system may be related to oxidative phosphorylation and/or the recently described pyridine nucleotide-quinone reductase system[4] is indicated by failure of ATP inhibition in the presence of the "uncoupling" agent, 2,4-dinitrophenol[5,6], as shown in Table I, C. Inorganic ortho- or pyro-phosphate, 5′-adenylic acid and adenosine diphosphate cause little or no change in amount of color formed in potato macerates. Further studies are in progress.

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FORMATION INDUITE DE CYTOCHROME PEROXYDASE CHEZ LA LEVURE

par

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EPHRUSSI ET SLONIMSKI[1,2] ont montré que la levure cultivée en anaérobiose est dépourvue d'un certain nombre d'enzymes d'oxydoréduction, notamment du système WARBURG-KEILIN, et qu'il suffit d'aérer la levure en milieu glucosé pour qu'elle acquière tous les enzymes et transporteurs d'électrons de ce système.

A la liste des enzymes dont la formation est induite par l'oxygène dans la levure, nous avons ajouté récemment la catalase[3]; nous pouvons y joindre maintenant la cytochrome peroxydase.

Cet enzyme, que nous avons dosé selon ABRAMS *et al.*[4] dans les autolysats de levure, n'existe qu'à l'état de traces ($Q = 0.02$) dans la levure cultivée en anaérobiose, et il apparaît en quantités considérables au cours de l'aération. ($Q = 1.63$ après 6 heures d'aération en milieu glucosé sans source d'azote assimilable.)

Le mutant "petite colonie" d'EPHRUSSI[5] forme la cytochrome peroxydase dans les mêmes conditions*.

On se souviendra que l'aération fait apparaître le cytochrome c[1,2] et la catalase[3] chez ce mutant, sans qu'il se forme jamais de cytochrome oxydase. La formation de cytochrome c sous l'action de l'oxygène dans ces cellules dépourvues de cytochrome oxydase semblait paradoxale[2]; elle s'explique peut-être par la formation de cytochrome peroxydase qui établirait le lien manquant entre le cytochrome c et l'oxygène, par l'intermédiaire de l'eau oxygénée qui se forme toujours dans des cellules exposées à l'air.

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THE EFFECT OF DRYING AT 110° ON SODIUM DEOXYRIBONUCLEATE

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It was established some years ago[1] that drying of sodium deoxyribonucleate (DNA) over phosphoric oxide caused irreversible changes which brought about a decrease in its solution viscosity. These changes were generally regarded as physical in nature and elemental analyses[2-4] of DNA have usually been made on samples which have previously been dried over phosphoric oxide at 110° *in vacuo* for periods long enough to obtain constant weight. That changes other than physical were possibly involved in such drying might have been indicated by the phosphorus contents which were almost always less than the theoretical value of 9.3% and rarely greater than 8.9%.