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THE PHOTOENZYME WHICH REDUCES PROTOCHLOROPHYLLIDE : A MODEL FOR PHOTOACTIVE UNITS IN PHOTOSYNTHESIS.

E. DUJARDIN, Y. KUYPER and C. SIRONVAL,
Laboratory of Photobiology, Research Station of Gorsem and Liege University; Belgium.

It has been shown (Sironval and al; 1968) that the reduction of protochlorophyllide in the illuminated etiolated leaf involves an intermediate state of the pigment-lipoprotein complex. This intermediate state was trapped in liquid nitrogen after a millisecond polychromatic flash. It absorbs in the red at 676 nm; its low temperature emission shows a main band at 688 nm ($P_{688-676}$). We have the reaction sequence :

$$P_{657-647}\ (\text{initial protochlorophyllide-lipoprotein} \xrightarrow[(1\text{ms})]{h\nu} P_{688-676}$$
$$(\text{intermediate state}) \xrightarrow[\text{darkness}]{} \text{to chlorophyllide-lipoprotein complex.}$$

After a non-saturating 1 millisecond illumination the proportion of chlorophyllide in the leaf is lower than that of $P_{688-676}$, $P_{688-676}$ being defined as the pigment-lipoprotein 1) produced in a short time by light and 2) characterized by a principal low-temperature emission around 688 nm. Therefore, $P_{688-676}$ cannot be considered merely as a chlorophyllide-lipoprotein complex (Sironval and Kuyper; 1971). The following description fits in well with the experimental data :

When an etiolated leaf is illuminated, the absorption of a first photon by one protochlorophyllide molecule bound to one subunit of lipoprotein, reduces this molecule to chlorophyllide. At the same time, the protein subunit and similar neighbouring subunits are transconformed. The geometry of the arrangement of the pigments changes. As a result of this, an efficient energy transfer appears from neighbouring protochlorophyllide to chlorophyllide. This process increases the emission of $P_{688-676}$ excited with blue light; an energy transfer unit (the $P_{688-676}$ unit) is produced (Sironval and Kuyper; 1971). The energy transfer from protochlorophyllide to chlorophyllide inside the unit has been demonstrated *in vivo* at liquid nitrogen temperature by Brouers and al (see also the results obtained *in vitro* by Kahn and al; 1970).

The production of $P_{688-676}$ units is connected in the leaf with two kinds of protochlorophyllide reductions (Sironval and Kuyper; 1971).

1) reductions of the first kind are the only reductions which occur below - 100°C. They still occur at liquid nitrogen temperature and may be separated at this temperature from the light absorption acts. They initiate the formation of energy transfer units only when the temperature is kept above - 100°C.

2) reductions of the second kind occur in darkness after, or during the formation of the energy transfer units. They are only found above -100°C. They are dependent on the protein transconformation which produces the energy transfer units, as an indirect consequence of light absorption. This transconformation does not occur below - 100°C. In this respect the pigment-lipoprotein complex behaves essentially as a photoenzyme system (Sironval; 1971).

Lyophilisation of the etiolated leaf inhibits reductions of the second kind when illuminated at room temperature although energy transfer units are produced (2). This implies 1) that reductions of the first kind occur in lyophilized, illuminated leaves, and 2) that they occur in loci whose activity remains unaffected by the lyophilisation procedure. These loci are in some way endowed with specific properties. On the other hand, the lyophilized leaves show the same fluorescence at room temperature as at liquid nitrogen temperature (Sironval and al; 1968). This implies energy transfer at room temperature, as well as at liquid nitrogen temperature, inside the units.

These characteristic features of the protochlorophyllide-lipoprotein complex, and especially the presence of active loci endowed with specific properties as well as the transfer of absorbed energy to these loci, underline its suitability as an experimental model for the study of the functions of photoactive units in photosynthesis.

1) M. Brouers, Y. Kuyper and C. Sironval; (1971) Photosynthetica; in preparation.
2) E. Dujardin and C. Sironval; (1971) Photosynthetica; in preparation
3) A. Kahn, N.K. Boardman and S.W. Thorne; (1970) J. Mol. Biol. 48, 85-101.
4) C. Sironval (1971) in Biochemical Evolution, Ed. E. Schoffeniels Holland Publishing Co, Amsterdam.
5) C. Sironval and Y. Kuyper (1971); Photosynthetica, in preparation.
6) C. Sironval, M. Brouers, J.M. Michel and Y. Kuyper (1968); Photosynthetica, 2(4), 268-287.

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