*Short Communication*

# Variations in the Delayed Luminescence in *Scenedesmus* induced by Phosphorus and Carbon Dioxide Deficiency*

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Low phosphorus availability induces changes in the photosynthetic activity,[1,2] and low $CO_2$ availability increases the cyclic photophosphorylation[3] in the unicellular green algae *Scenedesmus obtusiusculus* and *Chlamydomonas reinhardii,* respectively. Reversal of some Calvin cycle reactions produces changes in the ATP level during the first minutes in darkness after a previous excitation by light.[4] The aim of the present work was to investigate whether low phosphorus and low carbon dioxide availability could induce any changes in the delayed luminescence decay kinetics, since delayed luminescence is closely related to the energy status of the photosynthetic mechanism.

Cells of the unicellular green alga *Scenedesmus obtusiusculus* were starved of phosphorus for 24, 48, 72 and 96 h, and the kinetics of the delayed luminescence from the differently starved cells were monitored for several minutes. During cultivation the cell suspensions were flushed with air containing 5 % $CO_2$ (high-$CO_2$ cells) (Fig. 1). The delayed luminescence decay curve, after a 30 s excitation period, for cells starved of phosphorus for 24 h was similar to that for the controls. Two transient peaks in the decay curve with several components could be observed after 48 h of phosphorus starvation (Fig. 2). The amplitude of the transient peaks varied, depending on the length of the periods of excitation with white light and

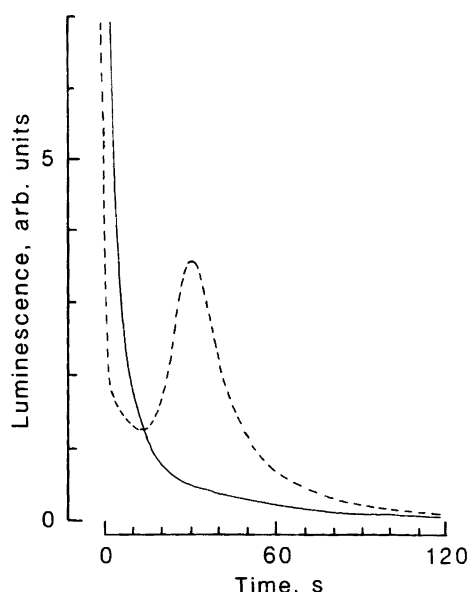


*Fig. 1.* Effects of $CO_2$ availability on the delayed luminescence decay kinetics in cells excited with white light for 30 s. (——) High-$CO_2$ cells and (– – –) low-$CO_2$ cells.

on the length of the dark period preceding light excitation. The late transient peak in the decay curve was increased on lowering the $CO_2$ availability by placing the sample in light without flushing (only stirring) for 2 h (low-$CO_2$ cells). The total output of photons after a 30 s excitation period was reduced when the pH was increased from 7.2 to 9.5, but a transient peak in the decay

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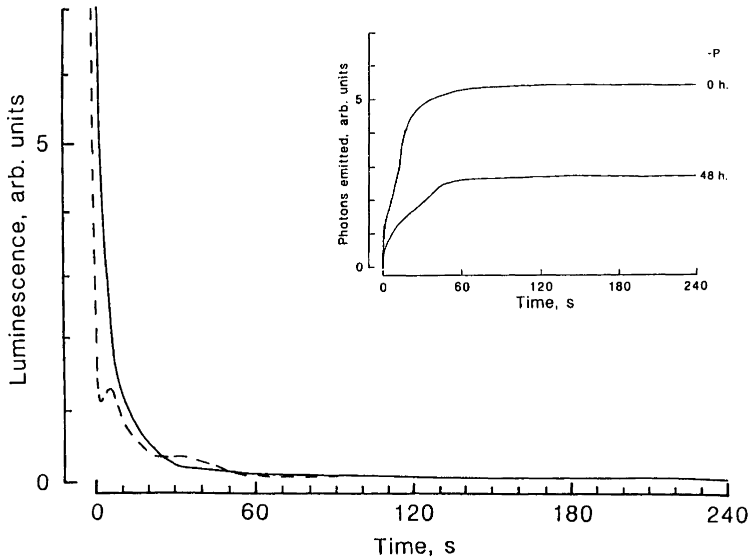


*Fig. 2.* Effects of phosphorus starvation on the delayed luminescence decay kinetics for high-$CO_2$ cells excited with white light for 30 s. (——) Controls, (– – –) cells starved of phosphorus for 48 h.
Insert: The measured accumulated output of photons after excitation for 30 s with white light. Controls and cells starved of phosphorus for 48 h.

curve was induced. When the pH was readjusted to 7.2 this change in decay kinetics was reversed, i.e. the capacity for formation of a transient peak was abolished.

*Conclusion.* The data indicate that a complicated metabolic pattern is involved in the mechanisms giving rise to the observed variations in the delayed luminescence. A reduction in the translocation of trioses from chloroplasts, a concomitant reduction in the Calvin cycle activities and changes in the amounts of reducing agents available are factors suggested to possibly be responsible for inducing the observed changes in the decay kinetics of delayed luminescence.

## References

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