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## **Temperature-dependent endogenous oxygen concentration regulates microsomal oleate desaturase in developing sunflower seeds**

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### **Abstract:**

Oleoyl-phosphatidylcholine desaturase (FAD2) is a key enzyme involved in fatty acid desaturation in oilseeds, which is affected by environmental temperature. The results of this study show that FAD2 is regulated in vivo via temperature-dependent endogenous oxygen concentrations in developing sunflower (*Helianthus annuus* L.) seeds. By combining in vivo oxygen profiling, in situ hybridization of FAD2 genes, an assay of energy status, fatty acid analysis, and an in vitro FAD2 enzyme activity assay, it is shown that: (i) the oilstoring embryo is characterized by a very low oxygen level that is developmentally regulated. Oxygen supply is mainly limited by the thin seed coat. (ii) Elevations of external oxygen supply raised the energy status of seed and produced a dramatic increase of the FAD2 enzyme activity as well as the linoleic acid content. (iii) A clear negative correlation exists between temperature and internal oxygen concentration. The changes occurred almost instantly and the effect was fully reversible. The results indicate that the internal oxygen level acts as a key regulator for the activity of the FAD2 enzyme. It is concluded that a major mechanism by which temperature modifies the unsaturation degree of the sunflower oil is through its effect on dissolved oxygen levels in the developing seed.

Key-words: *Helianthus annuus*, linoleic acid, oleic acid, oleoylphosphatidylcholine desaturase (FAD2), oxygen regulation, sunflower seeds, temperature regulation