Effects of elevated ambient pressure and temperature on rates of net photosynthesis and dark respiration

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This study investigates effects of environmental conditions on net photosynthesis by using artificially controlled environment. Especially, the effects of elevated ambient pressure were focused. This study discussed about the CO2-exchange rates of aseptic-medium-cultured plants, *Arabidopsis thaliana*, which were observed under the conditions of elevated ambient pressures and controlled temperatures. The pressure chambers, which were made of acrylic and stainless, were used to enclose plants under elevated ambient pressure. Fluorescent lights and LED were used as light sources, PPFD (photosynthetic photon flux density) was controlled by the ambient range from 0 μmol $m^{-2}s^{-1}$ (dark period) to 200 μmol $m^{-2}s^{-1}$ (light period). The pressure was regulated to 0.1, 0.2 and 0.3 MPa. Compressed-air (CO_2; 400ppm, O_2; 21%,) was used for the experiments. The photosynthetic rate was measured by using an IRGA in the temperature range of 12°C - 36°C at an interval of 4°C.
Results show that, while the net photosynthetic rate was increased, the rate of dark respiration fluctuated little at all measurement temperatures under the elevated ambient pressures. Also, rates of net photosynthesis and dark respiration almost always increased with the rise of temperature. In exceptional condition that the temperature increased from 32°C to 36°C, they decreased with the rise of temperature. This result indicated that the temperature at the peak of net photosynthesis fell to 32°C under elevated ambient pressure. The optimal temperature of gross photosynthesis theoretically increases with raised CO_2 partial pressure, whereas this experiment suggests that raised CO_2 and O_2 partial pressures may shift the optimal temperature down by the different temperature dependency of carboxylation and oxygenation.