How CAM Plants Open and Close Stomata

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C3 plants open their stomata depending on blue light absorbed by phototropins during the daytime to get CO2 for photosynthesis and close stomata at night. By contrast, CAM plants like cacti and crassulacean plants living in arid regions, open stomata at night and store CO2 as malic acid, a conjugate of CO2 with phosphoenolpyruvic acid (PEP), to use it for photosynthesis in the daytime, and close stomata in the daytime in order to prevent water loss under strong sunlight. We were curious why stomata opening and closing in CAM plants during the day and night were opposite to what C3 plants do. We studied the mechanisms using a CAM plant Kalanchoe daigremontiana. We established an experimental system of epidermal peels obtained from abaxial side of leaves, allowing us precise experiments without the influence of mesophyll cells. Measurements of stomata sizes under microscopy and calculation of stomata open areas were performed using Image J. Since the concentration of malic acid increases but that of PEP decreases during the night in CAM leaves and vise versa in the daytime, we tested the influence of malic acid and PEP on the stomata opening and closing in the night and in the daytime. We found that the stomata opening during the day was inhibited by malic acid and the stomata closing in the night was inhibited by PEP. Conclusively, phototropin-mediated stomata opening in CAM plants are basically the same as that in C3 pants but reversed by malic acid and PEP.