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Water movement through the berry surface

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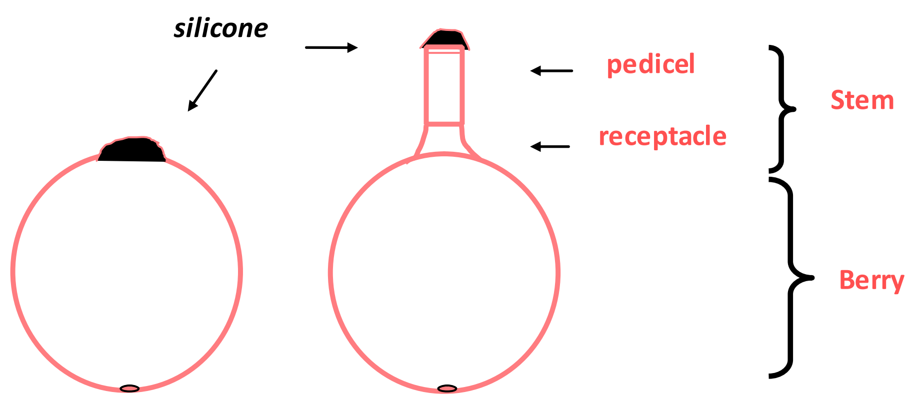
• We are all familiar with the movement of water in the berry through its *vascular system* – the xylem and the phloem. In contrast, we have no information on the potential uptake of water through the berry *surface (skin).* The goal of this study was to demonstrate that water moves through the surface of the berry, and to identify the pathways of such movement. The authors believe that getting to know these pathways - and the influence of various external factors - can help us understand phenomena such as berry cracking, often associated with rot and important yield losses.

• To get an idea of the rates of *water uptake* and *water loss* (transpiration) by the berry, the authors worked with individual berries that had been severed from the stem at the receptacle/pedicel transition, and then sealed at the cut end with water-impermeable silicone. To assess **water uptake**, the berries were weighed, submerged in deionized water (2 hr), blotted, and reweighed. The gain in weight was the amount of water absorbed. To assess **water transpiration**, the individual berries were incubated in beakers containing silica gel (a desiccant). The amount of water loss was then established by periodic berry weighing. Researchers conducted their experiments on berries at various phenological stages, and belonging to three varieties (Riesling, Chardonnay, and Muller-Thurgau).



• In order to gain more insight about water flow in the berry, the authors superimposed a number of experiments to the above general experimental set-up, as follows:
- to assess if the pedicel had any role in water movement, they compared berries that had been sealed including or not including the pedicel (see figure);
- to assess the role of the external cuticle as a barrier to water movement, they abraded or not the cuticle of the berry with sand paper;
- to assess whether one end of the berry absorbed more water than the other end, they compared water movement on the bottom half of the berry (stylar scar end) against that of the top half (called

the *cheek*);

- to assess the role of lenticels or russeting on water movement, they compared half berries rich or not on these structures;
- finally, the authors incubated the berries in solutions of compounds of various molecular weights, various mineral salts, and various temperatures, to see if any of these factors played any role. (See original paper for full details).

• Results.

1) Water **uptake** occurred mainly **through the stem surface** (including the receptacle and receptacle/berry junction), while **transpiration was limited to the berry surface**. This was surprising to the authors, who expected water uptake to also take place through the berry surface.

2) Rates of water transpiration in the berry exceeded those of water uptake.

3) Both water uptake and transpiration decreased in the course of berry development, reaching a minimum at maturity.

4) Abrading the berry cuticle increased the rates of uptake and of transpiration, indicating that the cuticle is a primary barrier in water movement through the berry surface.

5) Transpiration through the berry surface occurred at a higher rate at the stylar end of the berry compared to the cheek. In contrast, the presence of russeted areas or the amount of lenticels did not affect the rate of transpiration.

6) Water uptake decreased when the berries were incubated in solutions of increasing concentration of osmotica (more negative water potentials). In contrast, various mineral salts had no effect on uptake. Finally, rates of water uptake increased proportionally when temperature increased.

7) Based on the high permeability to water of the small stem region, the authors proposed a mechanism of *viscous flow* for water entry. In contrast, the low permeability of the large berry surface area to water loss suggests that transpiration takes place through a mechanism of *diffusion*.

The current study is interesting in terms of clarifying how water moves in and out of the berry through its skin and pedicel. Practical implications? Even though water transpiration exceeds water uptake under normal conditions, the authors believe that this process can be reversed in humid climates. In compact Chardonnay and Riesling clusters, transpiration is likely to be limited to the surface of the berry facing the outside of the cluster, as well as to the day time. In contrast, the stem is an easy-to-wet surface likely to form a liquid film from which rapid and continuous (day and night) water uptake can occur. The result would be a net gain of volume, and thus a cracking of the berry. In a follow-up article the authors are able to reveal the exact location within the stem region of water uptake in the berry.

You can find the full article at: http://ajevonline.org/content/62/3/340.full.pdf+html

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