

**Physiological Aspects of Fresh-cut Fruits and Vegetables, and
Consequences for Product Quality and Shelf-life**

Respiration and Temperature

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Fresh-cut Vegetable Products

"Fresh-cut produce" is defined as any fresh fruit or vegetable or any combination thereof that has been physically altered from its original form, but remains in a **fresh state**. Regardless of commodity, it has been trimmed, peeled, washed and cut into 100% usable product that is subsequently bagged or prepackaged to offer consumers high nutrition, convenience and value while still maintaining freshness.

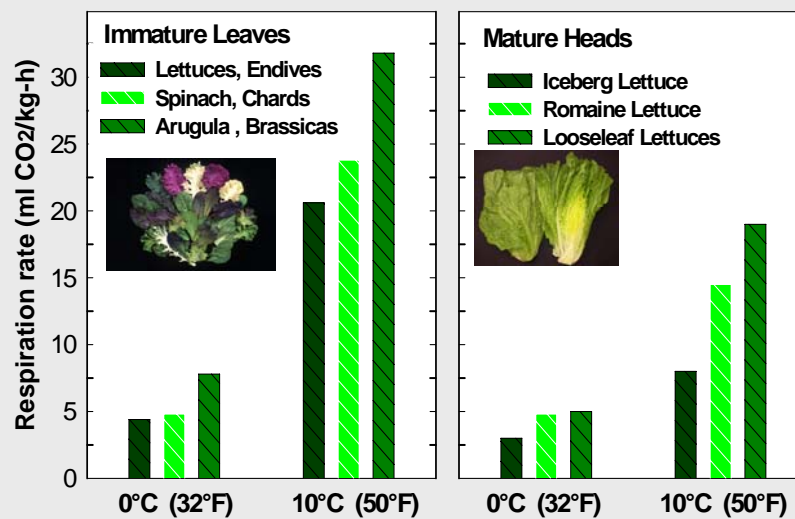
International Fresh-cut Produce Association
IFPA <http://www.fresh-cuts.org>

Physiological Effects of Fresh-cut Processing

- Increased respiration rates ←
- Increased ethylene production rates ←
- Increases in other biochemical reactions
 - Discoloration and Color
 - Texture
 - Aroma and Flavor
 - Nutritional quality

Main strategy to minimize changes in physiology is low temperature

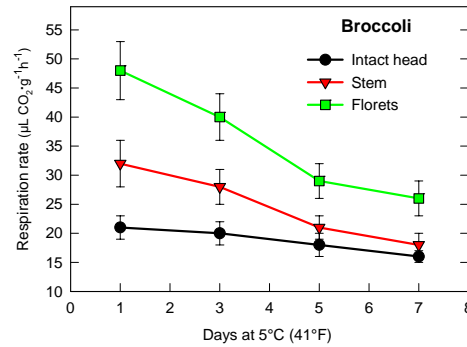
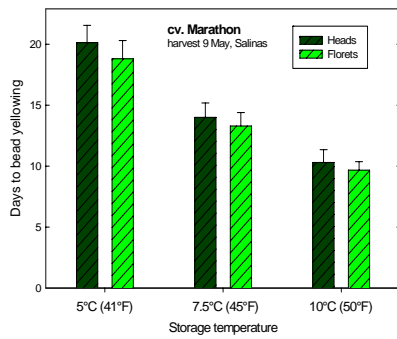
Respiration rates of specialty salad greens and full size lettuces.



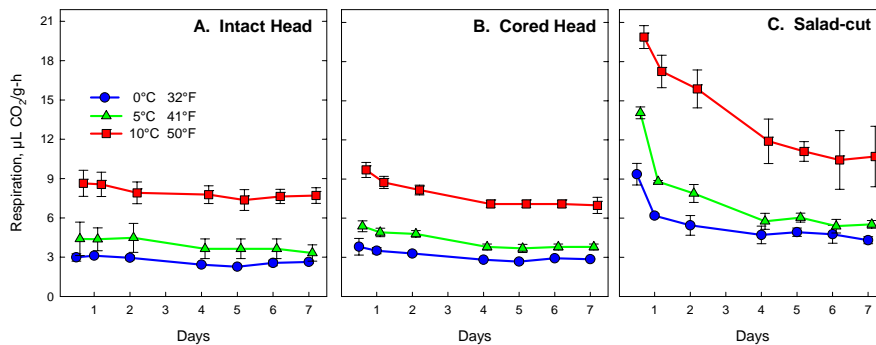
From M. Cantwell, UC Davis 1998

Broccoli Heads vs Florets

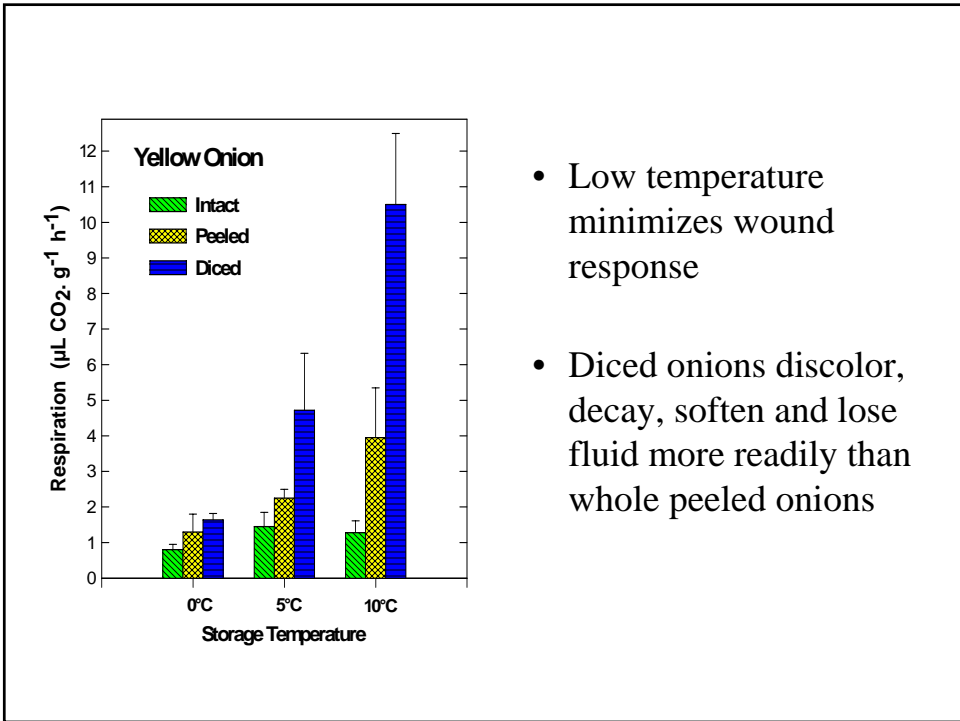
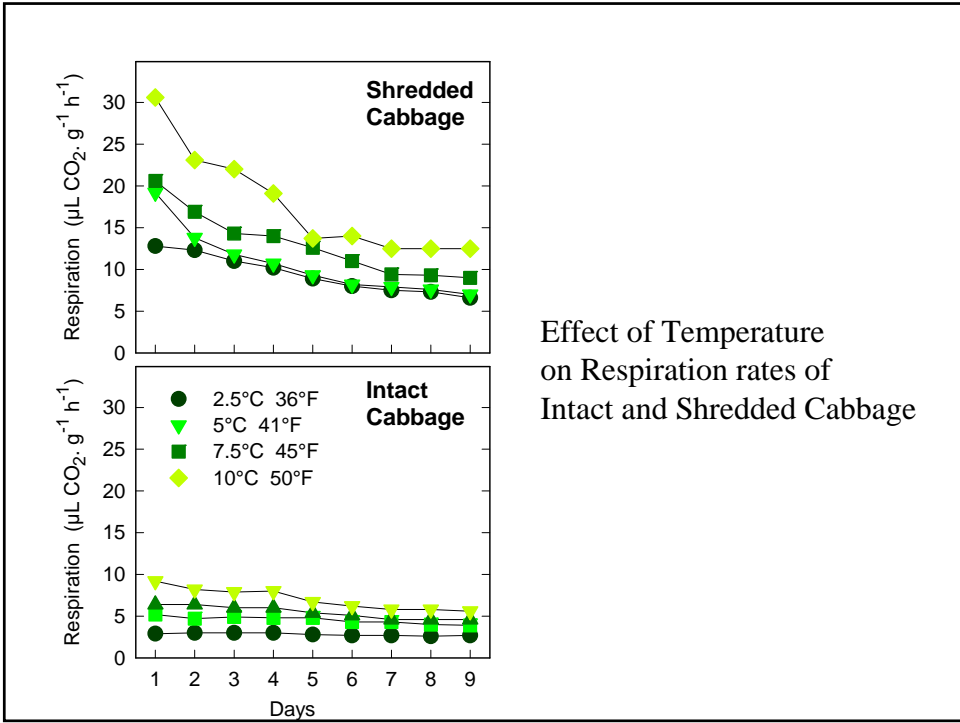
Florets have same or 20% less shelf-life than the intact head, although respiration rates are higher



Field processing, such as coring, does not affect respiration rates of Iceberg Lettuce



Cantwell and Srou, 2006



Intact and Fresh-cut Kale



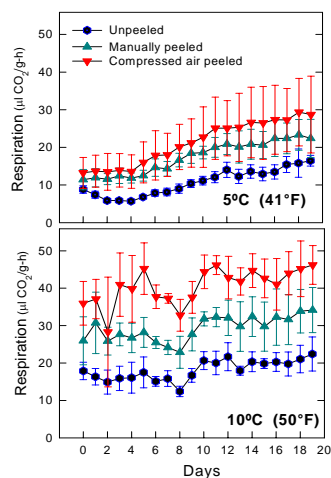
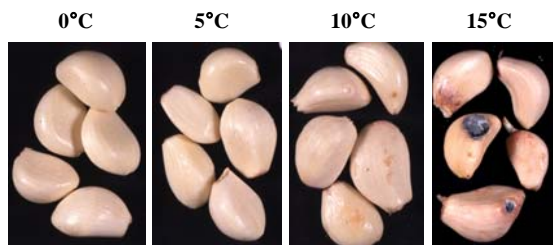
Respiration rate (mL CO₂ • kg⁻¹ h⁻¹)

Product	0°C	5°C	10°C	15°C
Full size leaves	8	12	29	33
Small leaves	14	21	42	57
Chopped (2 x 2 cm pieces full size leaves)	15	23	46	53
Shredded (0.3 cm pieces full size leaves)	17	18	59	68

Careful peeling causes a substantial increase in respiration rates. Mechanical compressed air peeling **doubles** rates. Rates are significantly less at 5°C. Quality best maintained at 0°C.

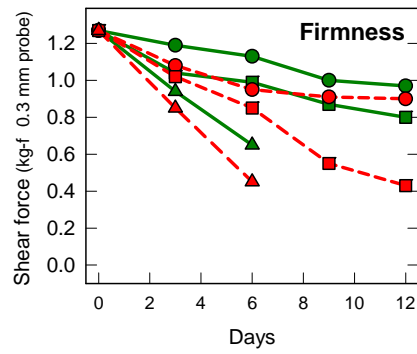
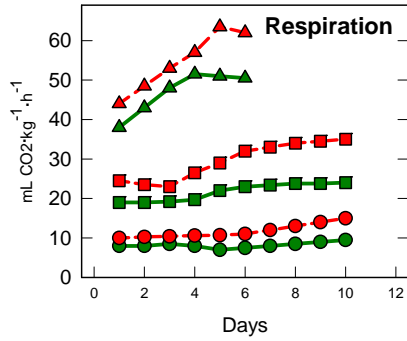
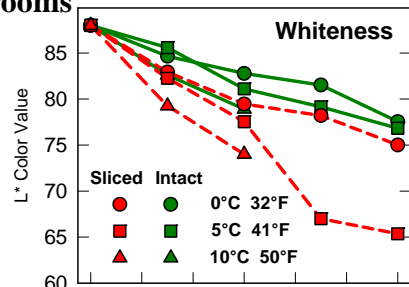
Average Respiration Rates (μL CO₂/g-h)

	Unpeeled Cloves	Manually Peeled	Compressed Air Peeled
5°C	10.6	17.4	21.2
10°C	18.1	29.3	40.6

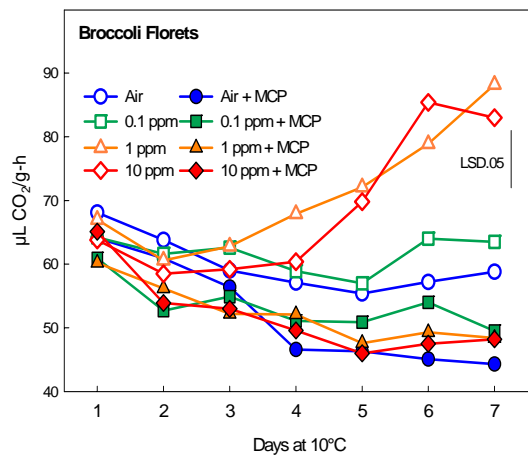


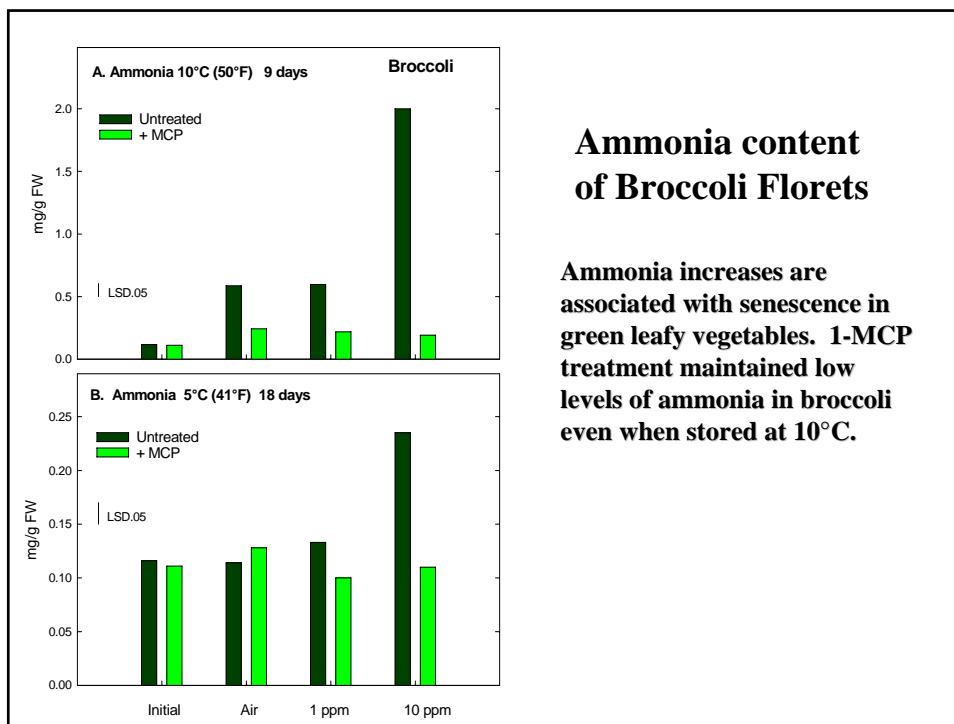
Commercially Peeled Garlic Stored 9 Days

Intact and Sliced *Agaricus* mushrooms



Broccoli, Ethylene and 1-MCP





Ammonia content of Broccoli Florets

Ammonia increases are associated with senescence in green leafy vegetables. 1-MCP treatment maintained low levels of ammonia in broccoli even when stored at 10°C.



Respiration and Ethylene Production Rates Intact and Fresh-cut Cantaloupe Melons

	Temperature (°C)			Q ₁₀	
	0	10	20	0-10	10-20
Respiration rate (mg CO ₂ ·kg ⁻¹ ·h ⁻¹)					
Intact	4.1 ^z	11.2	23.8	2.7	3.9
Fresh-cut^y	5.6	11.2	59.6	2.0	5.3
Ethylene production rate (μl·kg ⁻¹ ·h ⁻¹)					
Intact	1.2	2.0	15.7	1.7	7.8
Fresh-cut^y	0.8	1.7	16.5	2.1	9.7

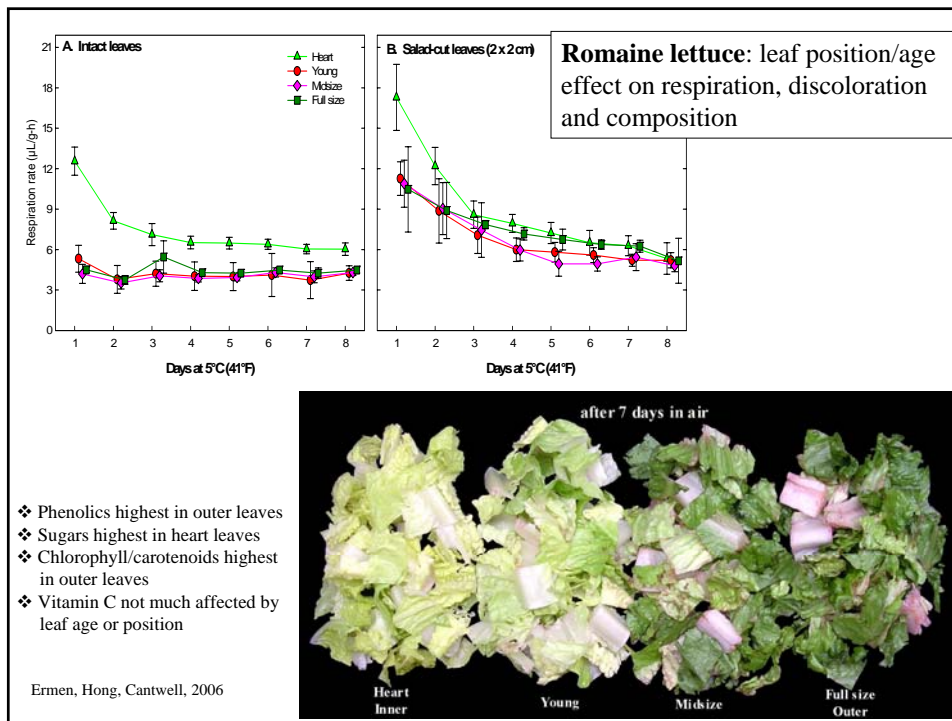
^y Prepared as cylinders (18 x 30 mm).

^z Data are the averages of 3 measurements after storage for 36 h.

Cantwell and Madrid, 1992

Fresh-cut and Ethylene Production

- For typical commercial size fresh-cut product, ethylene production rates may be similar to corresponding intact product, especially at typical fresh-cut storage temperatures of 0-5°C
 - Cantaloupe melon as example
- Important increases in ethylene production rates are usually associated with very small piece sizes and with warm temperatures



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