

leafy green vegetables

Brassica spp.



Buk choy
Brassica rapa
subsp. *chinensis*



Pak choy
Brassica rapa
subsp. *chinensis*



Choy sum
Brassica rapa subsp.
parachinensis



Gai lan
Brassica oleracea
var. *alboglabra*



Wombok
Brassica rapa
subsp. *pekinensis*

Best practice

Leafy Asian vegetables are often growing rapidly at harvest, have a large surface area relative to volume and little protection against moisture loss. They are also susceptible to a number of leaf diseases which can develop after harvest.

To avoid wilting, they are best picked while cool and fully hydrated – such as early in the morning. They should be cooled below 5°C as quickly as possible after harvest. Vacuum cooling is the best cooling method, but hydrocooling or even forced air / room cooling with misting can also be effective.

Leaf diseases can be minimised by keeping leaves dry and clean during growth and applying pre-harvest fungicides as necessary.

Elastic bands used to secure bunches should not be too tight; the petioles of buk choy and pak choy in particular are easily damaged. Split areas are prone to developing bacterial rots, while broken leaves reduce marketability.

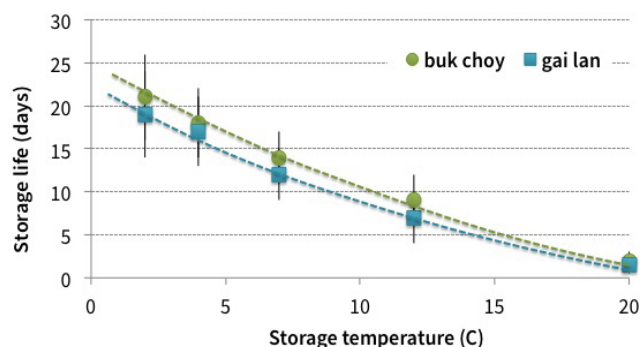
Leafy Asian vegetables can be packed while still wet. Cartons should preferably be lined to ensure relative humidity remains high. Packaging bunches inside plastic sleeves can provide significant benefits

Storage life

Storage life of Asian leafy greens is maximised as temperatures approach 0°C and relative humidity climbs to 100%.

Storage life can be affected by maturity. Bolting (flowering) during spring is a major issue for leafy Asian vegetables. Some groups prefer product with developing flower buds, however in most cases flowering makes the product unmarketable. Flowering plants tend to have shorter shelf-life due to leaf yellowing.

Storage life can also be shortened if plants have a large



Storage life of buk choy and gai lan at different temperatures. Bars indicate the likely range around each mean value

microbial load at harvest. For example, postharvest development of leaf diseases is more likely to shorten the shelf-life of products grown in the soil than similar products grown hydroponically on raised benches. Bacterial infections are a particular issue with buk choy and wombok.

Key points

- ▶ Most leafy Asian vegetables are highly perishable. They should be harvested when the weather is cool and plants are fully hydrated.
- ▶ Rapid cooling below 5°C is essential to maintain quality.
- ▶ Although storage life is maximised at 0°C, the risk of freezing is high. At 2°C + 90% RH leafy Asian vegetables can remain acceptable for 2-4 weeks.
- ▶ Maximum storage life is 2-3 weeks for most products, but can be up to 3 months for wombok.
- ▶ Ethylene production is low, but sensitivity is high. Exposure increases leaf yellowing and disease.

Asian leafy vegetables

Moisture loss also reduces storage life. Asian leafy vegetables grown in protected cropping structures (e.g. under hail netting or inside greenhouses) can be more susceptible to wilting than those grown in drier conditions outside. This is particularly the case for gai lan, which tends to develop a waxy cuticle when grown outdoors, but may not do so inside a structure.

Storage life of buk choy, pak choy and choy sum is a week or less at 12°C but can be up to 3 weeks at 2°C. Gai lan storage life is slightly shorter due to earlier leaf yellowing. In contrast, wombok can be stored for up to 3 months, especially if the outer leaves are removed.

Weight loss

- ▶ Asian leafy vegetables such as buk choy and choy sum can lose up to 5% weight and still remain marketable.
- ▶ Asian leafy vegetables that have lost 5–10% weight will be limp and unacceptable.

Summary - Buk choy, pak choy, choy sum, gai lan

Storage conditions	Optimum temperature	2°C
	Optimum RH	95–100%
	Storage life (best)	Gai lan 2–3 weeks Others 3–4 weeks
	Storage life at 5°C	Gai lan 7–10 days Choy sum 10–14 days Pak choy 10–14 days Buk choy 2–3 weeks
Cooling	Cooling method	Hydro-vacuum is highly recommended. Hydrocooling or forced air are also suitable
	Freezing point	-0.2°C
	Susceptibility to freezing	High
	Chilling sensitive?	No
Physiology	Respiration rate	Moderate
	Ethylene production	Moderate
	Ethylene sensitivity	Moderate - exposure increases leaf yellowing and diseases
Packing	Cleaning	Hydroponic - rinse only Field grown - shower/spray wash or tank wash
	Rate of water loss	Very high, good benefits from POS packaging
	Display	Can be displayed on ice, misting beneficial

Diseases

Bacterial soft rot - *Pectobacterium carotovorum*

A wet slimy rot, often starting in the leaf bases. Tissue becomes water-soaked and disintegrates, often with an unpleasant smell. Wombok and buk choy are particularly susceptible, symptoms sometimes developing rapidly after harvest.

Downy mildew - *Peronospora* spp.

Usually develops on older leaves first. Bleached or yellowish areas appear on the upper leaf surfaces with soft, whitish mould on the undersides. Affected areas become pale brown with black speckling as the disease progresses. Favoured by cool, moist conditions.

White blister - *Albugo candida*

Powdery white spots develop and spread on the undersides of leaves, with corresponding light green or yellow spots on upper leaf surfaces. Leafy Asian vegetables are highly susceptible to this disease, which is favoured by humid conditions.



Summary - Wombok

Storage conditions	Optimum temperature	0–2°C
	Optimum RH	95–100%
	Storage life (best)	3 months
	Storage life at 5°C	3–6 weeks
Cooling	Cooling method	Vacuum cooling is highly recommended. Hydrocooling or forced air are also suitable
	Freezing point	-0.9°C
	Susceptibility to freezing	Moderate
	Chilling sensitive?	No
Physiology	Respiration rate	Moderate
	Ethylene production	Moderate
	Ethylene sensitivity	Exposure increases leaf yellowing
Packing	Cleaning	Remove outer leaves, no washing required
	Rate of water loss	High, some benefits from POS packaging
	Display	Can be displayed on ice

Asian leafy vegetables

Disorders

Freezing injury

Freezing damage can occur if products are stored at 0°C, as the delivery air is necessarily colder than the room setpoint. Frozen tissue has a dark, water-soaked appearance and breaks down rapidly.



Gomasho / Pepper spot

A poorly understood disorder found on wombok, gomasho, is characterised by the development of small, dark oval spots about the size of sesame seeds. These appear on the mid ribs, most frequently on the outer leaves. Symptoms can appear mild at harvest, but worsen during storage, especially if temperatures are over 5°C.



Leaf yellowing

While leaf yellowing is an inevitable symptom of senescence, it can be triggered prematurely by exposure to ethylene and/or leaf diseases. Yellowing may be diffuse or localised, and occurs first on the older leaves.



Diffuse yellowing is caused by senescence, whereas localised yellowing can be triggered by leaf diseases.

Grading

	Buk choy	Choy sum	Gai lan	Pak choy	Wilting (pak choy)
Grade 1					
Grade 2					
Grade 3					

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