Modified Hydrocooling and Optimized Postharvest Handling Practices can Improve the Shelf Life of Water Spinach During Summer in Humid Subtropical Regions

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Abstract. In an effort to improve the shelf life of water spinach (*Ipomoea aquatica* Forsk.) and amaranth (*Amaranthus tricolor* L.) during summer in humid subtropical regions like northern Taiwan, the study investigated the effectiveness of modified hydrocooling and optimized postharvest handling practices. Most farmers in Taiwan often compromised postharvest vegetable quality due to uneven cooling. The first trial implemented a modified hydrocooling system using a 10-minute 5°C (41°F) shower with a multi-hole perforated pipe and smaller baskets for precooling to substitute the conventional method. The results showed that the modified hydrocooling improved cooling uniformity and reduced vegetable loss rates. Meanwhile, for some farmers needed to meet the specialized market requirement which extend vegetable shelf life, the second trial conducted optimized postharvest handling practices including storage vegetables at 11°C (52°F), consistently clean 10°C (50°F) water for washing/hydrocooling, and wrapping vegetables in plastic film. These practices revealed significantly decreased the water spinach quality loss for longer duration but less effective for amaranth. Even with the addition of hypochlorous acid in washing/hydrocooling water, the shelf life of amaranth was difficult to extend due to severe pre-harvest leaf disease. In conclusion, the study showed that modified hydrocooling offers benefits for most conventional farmers by reducing vegetable loss rates. On the other hands, for farmers needed to meet the specialized market requirement, optimized postharvest handling practices significantly improves the quality of water spinach in longer shelf life. Also, the research emphasized the importance of disease management in amaranth cultivation for postharvest quality.

Introduction. Water spinach (*Ipomoea aquatica* Forsk.) and amaranth (*Amaranthus tricolor* L.) are major essential short-term leafy vegetables grown in northern Taiwan during summer. While vegetable farms often face challenges in maintaining vegetables postharvest quality due to **uneven hydrocooling** (trial 1), **poor washing/hydrocooling water quality** and **inappropriately storage temperature (**trial 2**)**.

Materials and Methods

Trial1

Conventional methods

1. Vegetables packed in each 100 kg (220 lb) basket
2. Hydrocooling with a 15°C (59°F) water shower for 2 minutes using a pipe

Improve

Modified hydrocooling

1. Vegetables packed in each 15 kg (33 lb) basket
2. Hydrocooling with a 5°C (41°F) water shower for 10 minutes using a perforated pipe

Trial2

Conventional methods

1. Washing with 25°C (77°F) recycled water
2. Hydrocooling with 10°C (50°F) recycled water
3. Storage at 7°C (45°F)
4. Unwrapped packaging

Improve

Optimized postharvest handling

1. Washing and hydrocooling with clean 10°C (50°F) water in a compact washing sink
2. Storage at 11°C (52°F)
3. Wrapped the packaging in plastic film

Results and Discussion

Trial1

Conventional methods **Modified hydrocooling**

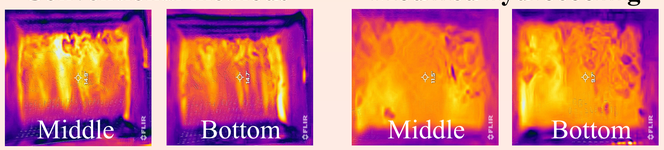

Fig. Thermogram of each layer in the vegetable basket after applying different hydrocooling methods. **Modified hydrocooling** (at the same water temperature) resulted in more uniform precooling throughout the basket. Smaller temperature gradients within each layer indicate a more uniform temperature distribution.

Table1. Effect of modified hydrocooling on the rejection rate of water spinach after 4 days of storage.

Hydrocooling method	Rejection rate (%)		
	Water-soaked	Yellowing	Total
Conventional	17[X]	11	28
Modified	2	0	2

[X]Each datum represents one replicate. A 100 kg (220 lb) basket was used in each replicate.

Trial2

Table2. Effect of optimized postharvest handling practices on the rejection rate of different vegetables after 6 days of storage.

Vegetable	Postharvest handling practices	Rejection rate (%)			
		Wilting	Water-soaked	Diseased	Total
Water spinach	Conventional	2±3 a[X]	92±2 a	0±0 a	94±4 a
	Optimized	10±3 a	12±6 b	4±2 a	26±7 b
Amaranth	Conventional	8±11a	0±0 a	62±2 b	70±9 a
	Optimized	0±0 a	3±4 a	86±1 a	88±3 a

[X]Each datum represents the average of 2 replications ± SE. A 15 kg (33 lb) basket was used in each replication. Means followed by the same letter within each treatment of vegetables are not significantly different by least significant difference (LSD) test at $P<0.05$.

Table3. Effect of optimized postharvest handling practices and hypochlorous acid addition on rejection rate in amaranth after 6 days of storage.

Postharvest handling practices	Hypochlorous acid (+/-)	Rejection rate (%)		
		Water-soaked	Diseased	Total
Conventional	-	8±1 a	75±0 a	83±1 a
Optimized	+	0±0 b	73±7 a	73±7 a

[X]Each datum represents the average of 2 replications ± SE. A 15 kg (33 lb) basket was used in each replication. Means followed by the same letter within each treatment are not significantly different by least significant difference (LSD) test at $P<0.05$.