Ziplock packaging film for reducing quantitative and qualitative losses of vegetable amaranth leaves (*Amaranthus cruentus* L.)

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Background Information

- Recently, the demand for African indigenous leafy vegetables (AIVs) such as vegetable amaranth (*Amaranthus cruentus* L.) has been steadily increasing amongst rural, peri-urban and urban dwellers in developing countries due to their high nutritive and medicinal values.
- Vegetable amaranth has a great potential in creating job opportunities especially for youth and women.
- However, it suffers significant postharvest losses, owing to its high physiological activity and thus, fast rate of deterioration.
- To address this, a study was conducted to determine the effect of ziplock packaging film bags on reducing quantitative and qualitative losses of vegetable amaranth leaves cv. Madiira.

Experimental set-up

- The vegetable was grown under greenhouse conditions (15-27 °C, 60-80% RH, 400-630 µmol m^{-2} s^{-1} PAR) (Fig. 1).
- Eight weeks after planting (Fig. 2), leaves were harvested and either packed in ziplock bags or unpacked (control) (Fig. 3).
- The leaves were stored for 4 days (evaluated at 0, 2, and 4 days) and 7 days (evaluated at 0, 2, 4 and 7 days) at 20 °C (65% RH) and 5 °C (85% RH), respectively.
- The nutritional parameters studied were fresh weight loss, selected mineral elements (Ca, Mg, Fe and Zn), , chlorophylls, and carotenoids.
- Results on mineral elements, chlorophylls and carotenoids are presented on dry matter basis.

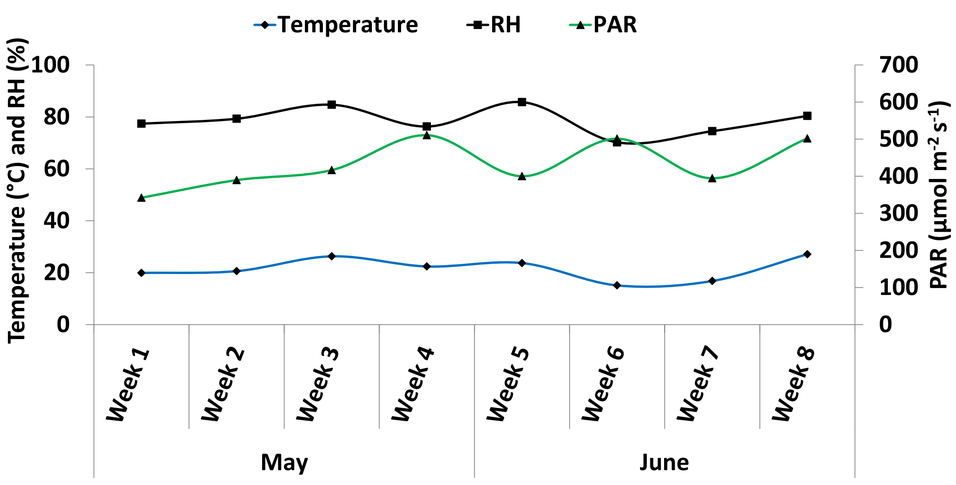

Fig. 1: Greenhouse microclimate conditions during the production of vegetable amaranth at Humboldt-Universität zu Berlin, Germany.

Fig. 2: Vegetable amaranth ready for harvest (8 weeks after sowing).

Fig. 3: Unpacked (control, left) and packed (right) vegetable amaranth leaves (2 days after storage).

Results

Fresh Weight loss

- Fresh weight loss was reduced only after 2 days of storage (at 5 °C) and throughout the storage (at 20 °C) under ziplock bags compared with the unpacked control leaves (Fig. 4).
- The effect was more pronounced at retailer's simulated storage condition (20 °C) compared with low temperature storage (5 °C).

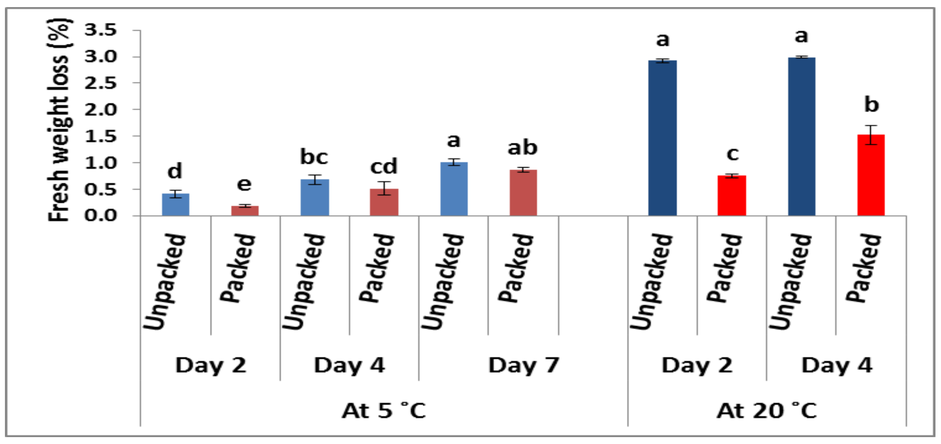

Fig. 4: Effect of ziplock packaging film bags on fresh weight loss of vegetable amaranth leaves during storage. Means ± standard deviations followed by the same letter within a storage temperature are not significantly different according to Tukey's test (p<0.05).

Mineral elements

- Ziplock packaging bags helped to preserved the mineral contents throughout storage, however only to a limited extent (Table 1).
- At 5 °C, Ca, Mg and Fe were not affected by ziplock packaging bags, while Zn content was higher in ziplock bags throughout the storage compared with the unpacked vegetable amaranth leaves.
- Similarly, at 20 °C, Ca and Mg contents were not affected by ziplock bags, while Fe and Zn contents remained significantly higher throughout the storage compared with unpacked vegetable amaranth leaves.

Table 1. Effect of ziplock packaging film bags on selected mineral element contents of vegetable amaranth leaves during storage.

Storage days	Packaging	Ca (g/kg)	Mg (g/kg)	Fe (mg/kg)	Zn (mg/kg)	Ca (g/kg)	Mg (g/kg)	Fe (mg/kg)	Zn (mg/kg)
		At 5 °C				At 20 °C			
Day 0	At harvest	23.0±2.6a	6.4±1.6a	109.8±3.7a	63.5±4.2a	23.0±2.6a	6.4±1.6a	109.8±3.7a	63.5±4.2a
Day 2	Unpacked	22.2±2.7a	5.5±0.9a	104.0±4.9a	55.3±2.3b	22.3±1.2a	5.5±1.2a	95.5±4.3b	55.8±1.7b
	Packed	22.3±2.5a	5.7±1.1a	107.9±1.8a	62.7±3.9a	22.8±0.7a	5.8±0.9a	109.5±4.5a	62.0±1.9a
Day 4	Unpacked	21.0±3.5a	5.2±1.3a	103.2±3.5a	53.5±1.4b	21.6±1.2a	5.3±1.1a	93.0±3.2b	52.3±3.7b
	Packed	22.0±1.9a	5.5±0.9a	107.3±4.3a	61.5±4.3a	22.5±1.9a	5.5±1.3a	106.4±2.9a	61.5±1.8a
Day 7	Unpacked	20.3±2.2a	5.1±1.0a	102.2±5.5a	52.8±2.8b				
	Packed	21.6±1.6a	5.4±0.8a	107.5±3.9a	60.4±3.5a				

Means ± standard deviations followed by the same letter within a column and storage temperature are not significantly different according to Tukey's test (p<0.05).

Chlorophylls and Carotenoids

- At both storage temperatures, loss of chlorophylls and carotenoids could be prevented within 4 days of storage using ziplock bags compared with the unpacked leaves (Fig. 5A and B).

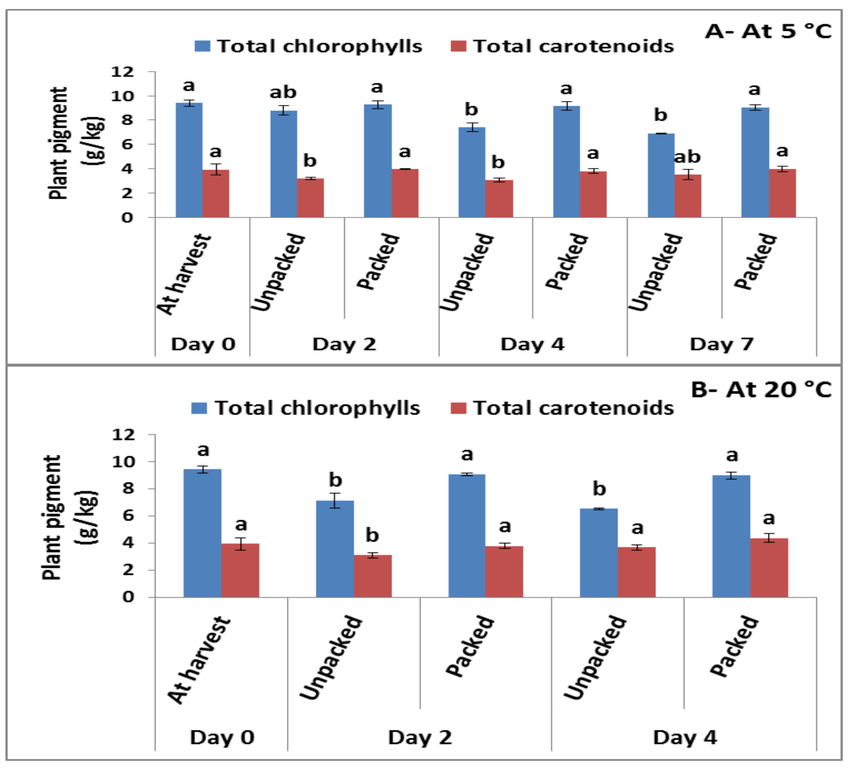

Fig. 5: Effect of ziplock packaging film bags on vegetable amaranth leaves pigments during storage (A- at 5 °C and B- at 20 °C). Means ± standard deviations followed by the same letter within a plant pigment and storage temperature are not significantly different according to Tukey's test (p<0.05).

Conclusion

- Ziplock packaging film bags helped to reduce fresh weight loss to a great extent, and retained mineral elements (i.e. Fe and Zn) as well as maintained chlorophyll and carotenoid contents during storage at both temperatures (5 °C and 20 °C). These effects are attributed to changes in the modified atmosphere concentrations (CO_2 and O_2) within the ziplock bags. Thus, using ziplock bags contribute to reducing quantitative, nutritional and health promoting compounds losses as well as to improve shelf life of vegetable amaranth leaves during marketing and storage.

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