Effects of Age, Storage Temperature and Duration on Total Phenolics, Flavonoids and Antioxidants in African Nightshade

Dinah Kirigia, Traud Winkelmann, Remmy Kasili, and Heiko Mibus-Schoppe

Introduction

African nightshade (*Solanum scabrum*) is one of the major indigenous leafy vegetables in Sub-Saharan Africa that plays a great role in food security and livelihood improvement. The vegetable is highly nutritious and contains antioxidants valuable in human diet. These secondary metabolites also play important roles in plant defense mechanism against various biotic and abiotic stresses.

Despite the importance of African nightshade, there are various constraints that affect their quality and quantity along the field to consumer chains. Physiological maturity and storage duration and conditions are some of the major factors affecting quality and quantity. Maturity indices at which phytonutrients are optimal remain unrevealed. The dynamics of various nutrients during development and storage at various conditions is one of our major research interest. The study´s ultimate goal is to identify the appropriate harvesting stages, storage duration and conditions for postharvest quality assurance of African nightshade.

Materials and Methods

Nightshade (*Solanum scabrum* accession Olevolosi) from World Vegetable Center, Tanzania was planted at JKUAT, Nairobi, Kenya.

The leaf samples (2-3) were picked from the middle part of the plant after 30, 60, 90 and 120 days. Storage of the samples was done at 5°C with (80-85 % relative humidity (RH) and at room temperature (RT) (20-25°C) with 55-60 % RH, for a duration of 0 (control), 2, 4, 6 and 8 days. After storage, the samples were freeze-dried, ground into fine powder, and methanol extractions were done on 20-30 mg for quantification of the three groups of metabolites.

Total phenolics contents (TPC) were analyzed using the Folin-Ciocalteu method and were expressed as Gallic acid equivalents. Catechin and quercetin flavonoids were analyzed with a calorimetric method and spectrophotometric absorbance was recorded at 510 nm and 415 nm. Trolox equivalent antioxidants capacity (TEAC) assay against ABTS (2,2'-azino-bis(3-ethylbenzothiazoline-6-sulphonic acid) radical cations was conducted for antioxidants.

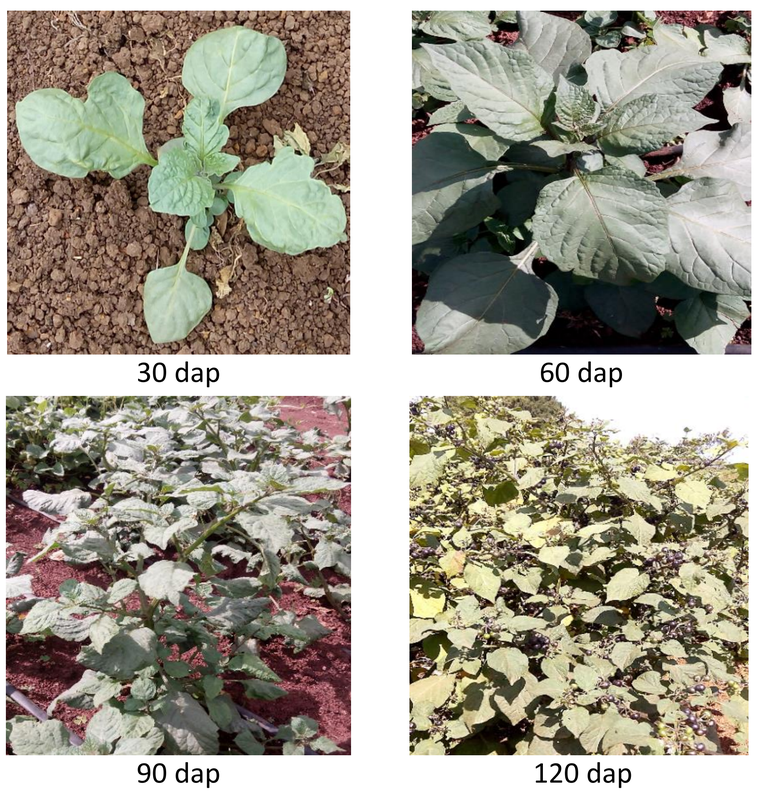


Fig 1: Nightshade images at 30, 60, 90 and 120 days after planting

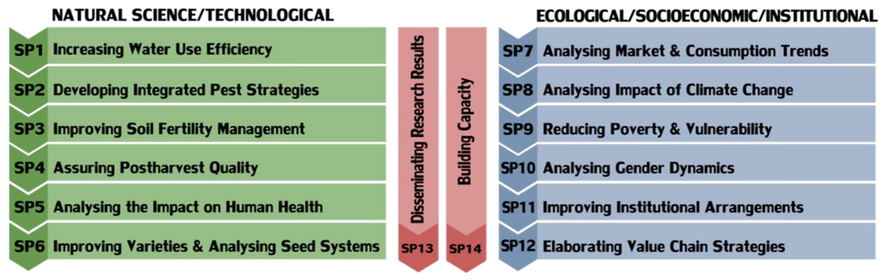
Literature

Akula, R. and Ravishankar, G. A. (20110): Influence of abiotic stress signals on secondary metabolites in plants, *Plant Signaling & Behavior*, 6(11), pp. 1720–1731. doi: 10.4161/psb.6.11.17613.

Spinardi, A., Ferrante, A., Spinardi, A. and Ferrante, A. (2012): Effect of storage temperature on quality changes of minimally processed baby lettuce , Journal of Food, Agriculture & Environment ,10 (1): 38-42.

HORTINLEA framework

This study was part of SP4 within the Project **HORTINLEA** (Horticultural Innovation and Learning for Improved Nutrition and Livelihood in East Africa)



Results

Total phenolics

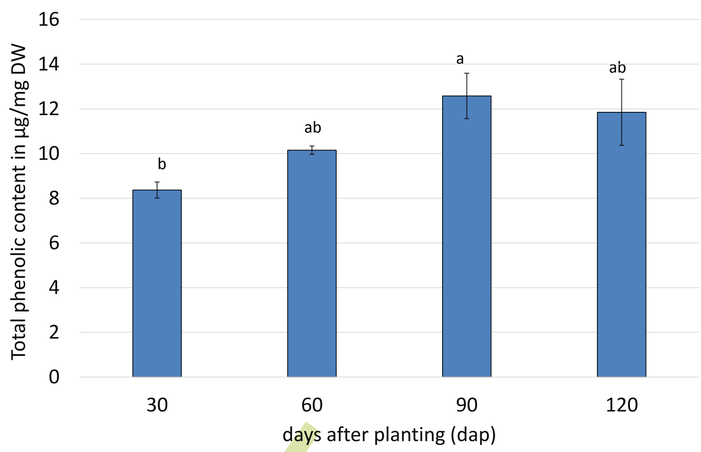


Fig 2: Total phenolics contents in nightshade leaves at 30, 60, 90 and 120 dap. Values represent means ± standard error (SE). Means with different letters indicate significant differences at p<0.05; Tukey test (n=6).

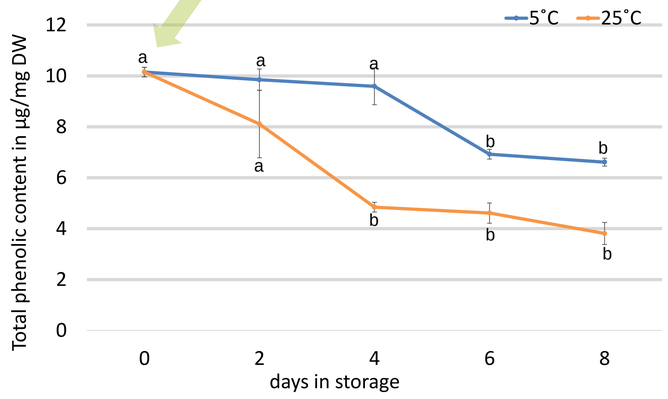


Fig 3: Total phenolics content in nightshade leaves harvested at 60 dap and stored at 5°C and RT for 0, 2, 4, 6 and 8 days. Values represent means ± SE. Within one storage temperature means with different letters indicate significant differences at p<0.05; Tukey test (n=6).

Antioxidants

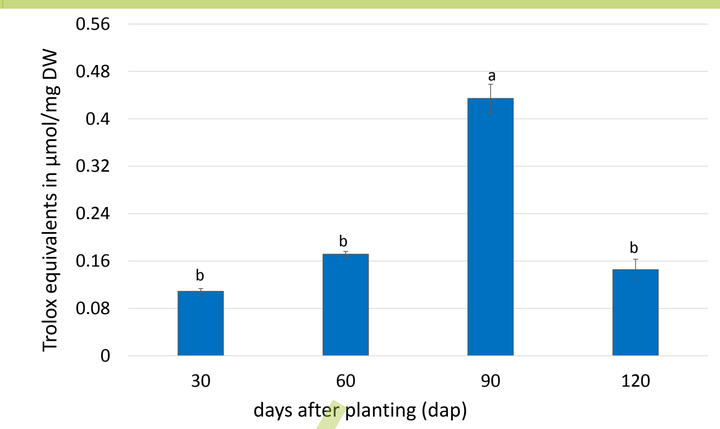


Fig 4: Antioxidants (Trolox equivalents) in nightshade leaves at 30, 60, 90 and 120 dap. Values represent means ± SE. Means with different letters indicate significant differences at p<0.05; Tukey test (n=6).

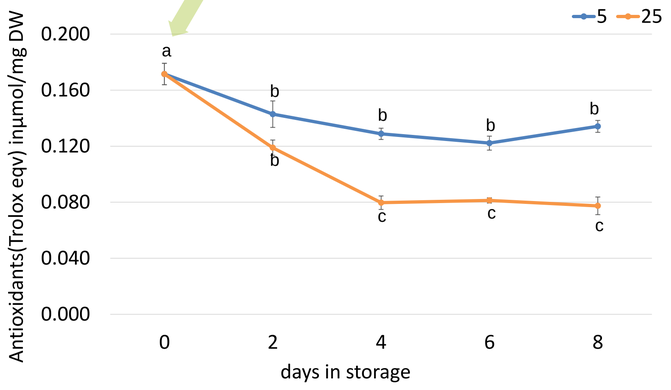


Fig 5: Antioxidants (Trolox equivalents) in nightshade leaves harvested at 60 dap and stored at 5˚C and RT for 0, 2, 4, 6 and 8 days. Values represent means ± SE. Within one storage temperature different letters indicate significant differences at p<0.05; Tukey test (n=6).

Flavonoids

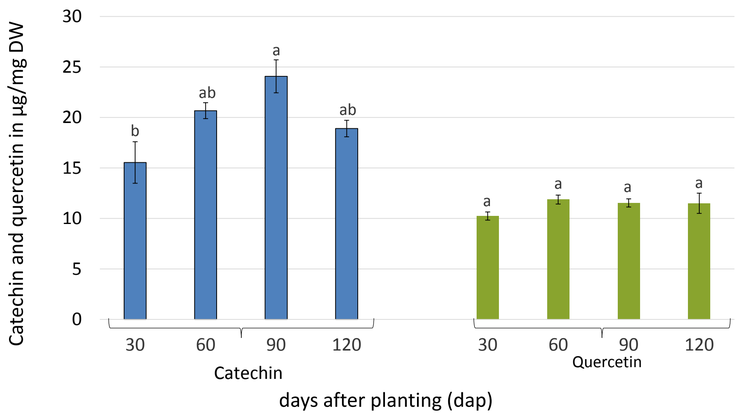


Fig 6: Flavonoids (catechin and quercetin) in nightshade leaves at 30, 60, 90 and 120 dap. Values represent means ± SE. Means with different letters indicate significant differences at p<0.05; Tukey test (n=6).

Table 1: Flavonoids (catechin and quercetin in µg/mgDW) in nightshade leaves harvested at 60 dap and stored at 5°C and RT for 0, 2, 4, 6 and 8 days. Values represent means ± SE. Within one storage temperature means with different letters indicate significant differences at p<0.05; Tukey test (n=6).

Days in storage	Catechin		Quercetin	
	5˚C	25˚C	5˚C	25˚C
0	20.7 ± 0.8 a	20.7 ± 0.8 a	11.9 ± 0.4 a	11.9 ± 0.4 a
2	20.0 ± 0.5 a	15.4 ± 1.0 b	11.3 ± 0.4 a	9.2 ± 0.2 b
4	17.3 ± 0.6 b	6.2 ± 0.2 c	10.3 ± 0.5 a	8.8 ± 0.1 b
6	15.1 ± 0.6 b	6.0 ± 0.3 c	11.2 ± 0.3 a	8.9 ± 0.5 b
8	14.9 ± 0.2 b	5.8 ± 0.3 c	10.8 ± 0.5 a	8.9 ± 0.1 b

Discussion and Conclusion

Production of secondary metabolites is influenced by various physiological, biotic and abiotic factors (Akula and Ravishankar, 2011). Total phenolics and catechin concentrations were highest after 60 dap, while antioxidants were highest at 90 dap. However, quercetin concentration did not show any significant difference with age. Thus, accumulation of secondary metabolites in nightshade was influenced by age. Storage temperature and duration also influenced the stability of the metabolites after harvesting. Higher decline percentage (55, 63, 72 and 25 %) for antioxidants, phenolics, catechin and quercetin, respectively, were observed after 4 days in storage at RT, compared to storage at 5°C (22-35 %). This signifies the importance of age, storage conditions and duration for optimal availability of beneficial nutrients and antioxidants. It is, therefore, recommendable to harvest nightshade between 60-90 dap and store at low temperatures, and more importantly only up to 4 days, to avoid losses of antioxidative properties.

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