



Effect of melatonin on essential oil yield and phytochemical traits in lemon verbena

Marjan Sadat Hosseini^{1*}, Reza Shahhoseini²

¹Group of Medicinal Plants, Department of Agriculture, Iranian Research Organization for Science and Technology (IROST), Tehran, Iran

²Department of Medicinal Plants, Arak University, Arak, Iran

Abstract

Melatonin is a multifunctional biomolecule with various applications in plants. This study aimed to investigate the influence of foliar spraying application of melatonin at concentrations of 0, 100, and 200 μM on the antioxidant, phenolic content, ascorbic acid, and essential oil yield in lemon verbena. The obtained results demonstrated that melatonin application significantly increased the levels of phenolic, ascorbic acid, and antioxidant capacity compared with the control plants. Moreover, foliar treatment with melatonin remarkably improved essential oil content (32%) and yield (48%), with the highest values observed at 100 μM concentration.

Introduction

Tryptophan is the precursor to melatonin, which is a naturally occurring hormone-like substance (Wang et al., 2017). Melatonin performs a diverse range of functions related to physiology and biochemistry, including its various antioxidants, metabolizing other hormones, helping plants sprout and develop roots, allowing plants to conserve moisture and regulate their transpiration rates as they age, and facilitating osmoregulation in plants (Li et al., 2014). Lemon verbena is a medicinal plant valued for its flavoring uses and health benefits. In fact, the leaves and essential oils (EOs) of this verbena plant are a rich source of phenolic compounds that are mostly responsible for various pharmacological benefits and aromatic values (Carnat et al. 1999). In the current study, we explored the beneficial effects of exogenous melatonin on the phytochemical traits, essential oil content and yield of lemon verbena.

Materials and methods

Stem segments were cut to equal lengths prior to placing them in a sand plot. There were three different treatments with respect to melatonin concentration: 0 (control), 100, and 200 μM . The plants were harvested just before they started to flower (4 months and 15 days old). TAC was assayed using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) method reported by Deby and Magotteaux (1970). TPC, was measured by Folin Ciocalteu reagent (Singleton and Rossi 1965). Ascorbic Acid were measured based on the method reported by Mukherjee and Choudhuri (1983). Extraction of EOs from fully expanded leaves and determination of EO content (% w/w) and EO yield (g pot⁻¹) were carried out according to the methods reported by Dianat et al. (2016).

Results and discussion

The supplementation of 100 μM melatonin to plants increased TAC, TPC, and the amount of AsA, 15%, 19%, and 3%, respectively when compared to plants not treated with melatonin (Table 1). In addition, when plants were treated with 200 μM melatonin, the TAC levels increased by 6%, and the TPC and AsA levels rose by 27% and 5%, respectively, compared to those of untreated plants (Table 1).

Melatonin protects photosynthetic pigments, which in turn improve the growth of plants. Furthermore, melatonin increases the number of two groups of antioxidant compounds: TPC or AsA, thus helping plants scavenge free radicals and combat oxidative damage (Li et al., 2014).

When compared to those control plants that had been sprayed with water, the essential oil (EO) content of the melatonin-treated plants was 35% higher 100 μM and 19% higher 200 μM (Fig. 1). The yield of the EO was 52% higher (100 μM) and 36% higher (200 μM) in the melatonin-treated plant (Fig. 1). Melatonin plays a significant role in the growth, biochemical characteristics, and essential oil yield by enhancing many cellular functions (Ahanger et al., 2016).

Table 1. Effects of foliar application of exogenous melatonin on the antioxidant properties.

Melatonin (μM)	TAC (%)	TPC (mg GAL 100g ⁻¹ FW)	AsA (g GAL 100g ⁻¹ FW)
0	81.61±0.66 ^c	57.24±1.33 ^c	6.89±0.06 ^c
100	93.68±1.73 ^a	68.15±2.02 ^b	7.06±0.04 ^b
200	86.25±1.13 ^b	72.97±3.21 ^a	7.22±0.03 ^a

Different alphabetical letters within the column indicate statistically significant differences among the treatments by Duncan test ($p < 0.05$).

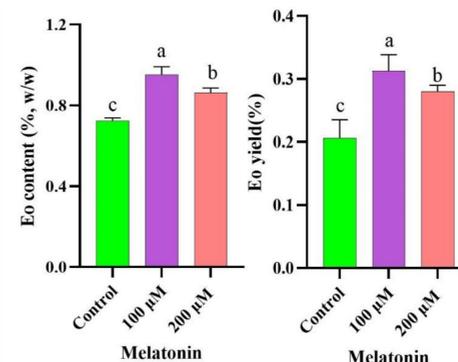


Fig. 1 Effects of foliar application of melatonin on essential oil (EO) content and yield

References

- Ahanger, M.A., Morad-Talab, N., and Abd-Allah, E.F. (2016). Plant growth under drought stress: significance of mineral nutrients. In: Ahmad, P. (Ed.). Water stress and crop plants: a sustainable approach. John Wiley and Sons, Ltd, pp 649–668.
- Wang, Y., Reiter, R.J., and Chan, Z. (2017). Phytomelatonin: a universal abiotic stress regulator. *Journal of Experimental Botany*, 69(5): 963-974.