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Evaluation of Antioxidant Activity and Phenol Compounds under the Effect of Treatment withUV-C Irradiation

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ABSTRACT

Basil (*Ocimum basilicum* L.) Lamiaceae is the most important medicinal plants. Much of the essential oils of basil essential oil phenylpropanoids which 90% are included. Important phenylpropanoid compounds include. The experiment was done in a randomized complete block design (RCBD) with factorial arrangements with 3 levels of UV-C Radiation (1/5- 4/5- 10 KJ M-2S-1) and Changes in Antioxidant activity and phenolic compounds were evaluated during five different stages. The amount of Antioxidant activity the gene expression was not affected by ultraviolet radiation treatment, and the expression level increased in control samples compared to other samples Furthermore, phenolic compounds were tested. UV-C treatment at the level of 10 kJ M-2S-1their expression levels increased.

Keywords*:* Ultraviolet radiation, Antioxidant, Phenol, Basil

INTRODUCTION

Basil (*Ocimum basilicum* L.) Lamiaceae is the most important medicinal plants (Javanmardi *et al.*, 2002) Since the UV-C ray induces a kind of non-biological and at the same time, physical stress on the plant without leaving specific chemical residues in the plant tissue, it is a safe and healthy method to increase the production of secondary metabolites and also improve antioxidant systems. Antioxidants have been widely used as food additives to avoid the degradation of the foods. Also, antioxidants have an important role in preventing a variety of lifestyle-related diseases and aging because these are closely related to active oxygen and lipid peroxidation (Shi *et al*, 1999).

It appears in the plant. So far, no research has been done on the effect of this radiation on the amount of antioxidant activity and phenolic compounds of the native Iranian basil plant and improving its nutritional-medicinal value.

MATERIAL AND METHODS

The experiment was done in the greenhouse of the College of Agriculture, Azad University of Isfahan. Basil seedlings at the 2-leaf stage for treatment exposed to two UV-C lamps (30 W, Philips, Amsterdam, Netherlands) at a distance of 50 cm with 3 levels of 1.5, 4.5, 10 kJ/m2/s. The experiment was done in a randomized complete block design (RCBD) with factorial arrangements with 3 replicate.

Antioxidant activity

The stable free radical DPPH was dissolved in methanol to give a 200 _mol/L solution; 10 _L of the essential oil and extract samples in methanol (or methanol itself as blankcontrol) was added to 175 _L of the methanol DPPH solution. For each test compound, different concentrations were tested (20, 10,5, 2.5 and 1.25 mg/mL for extracts. 100, 50, 25, 12.5 and 6.25 mg/mLfor oils) (Kang *et al*., 2011). After further mixing, the decrease in absorbance was measured at 515 nm after 20 min. The actual decrease in absorption induced by the test compound was calculated by subtracting that of the control. The antioxidant activity of each test sample was expressed as an IC50value, i.e. the concentration in mg/mlthat inhibits DPPH absorption by 50% and was calculated from the concentration-effect linear regression curve. BHT was used for positive control. The DPPH radical scavenging activity of each sample was calculated as the percentage inhibition.

Where: A0is the absorbance of the DPPH itself; A1is the absorbance of sample and the positive control. % Inhibition of DPPH radical activity = $[(A0 - A1)/A0] \times 100\%$.

Phenol compounds

The contents of total phenolic in basil samples extracts and oils were determined spectrophotometric ally according to the Folin-Ciocalteau method with slight modification.The diluted extract and oil (1.25 and 5 mg/mL methanol), respectively were used in the analysis. A 0.2 mL aliquot of the diluted extract was mixed with 2.5 mL of 10% Folin-Ciocalteu's reagent in water. The mixture was covered and incubated for 2 mints in darkplace then 2 mL of 7.5% Na2CO3dissolved in water was added. The mixture was incubated for 1 h at room temperature. The absorbance was measured at 765 nm against blank. The blank had the same con-stituents except that the extract was replaced by distilled water. Pyro catechol was used as standard for preparing the calibration curve. The total phenolic content was expressed as mg pyrocatecho equivalents (PE) per g of extract (Ahmed *et al.,* 2016).

RESULTS AND DISCUSSION

The results of variance analysis of the studied data showed that the effect of UV-C irradiation treatment on antioxidant activity was significant at the 1% and total phenol was significant at the 5% probability level (Table 1). The results of the investigation of the effect of ultraviolet ray treatment on antioxidant activity showed that the expression of this gene was not affected by ultraviolet ray treatment, and the level of expression in control samples increased compared to other samples (Figure 1).

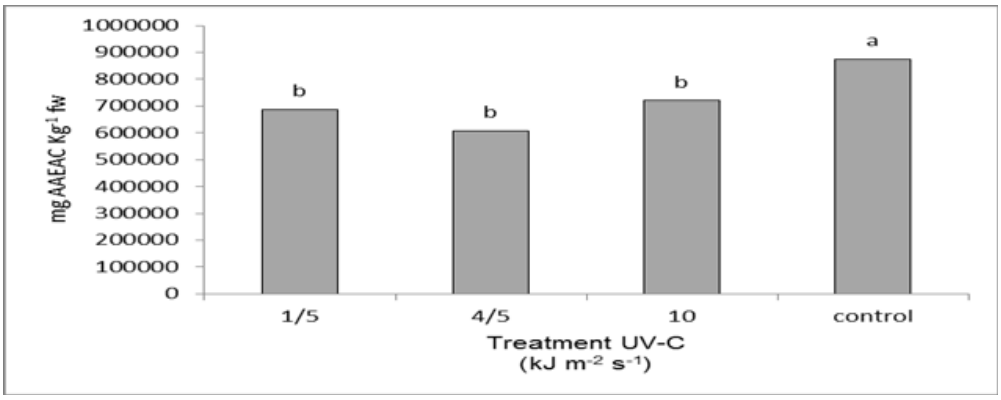

Figure 1. The expression of antioxidant activity under UV-C treatment
Columns with common letters do not have statistically significant differences.

The results of examining the effect of ultraviolet ray treatment on the amount of total phenol showed that the expression of this gene was significantly affected by ultraviolet ray treatment, and the expression level increased compared to the control samples. The highest amount of total phenol was observed at the level of 10 kJ (Figure 2).

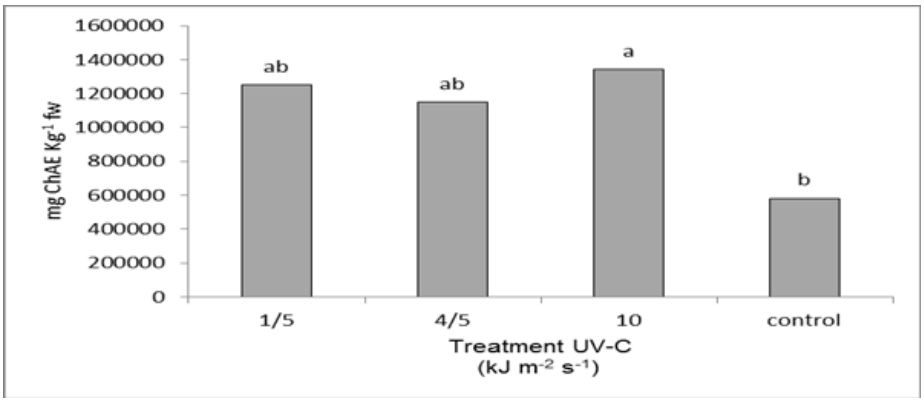

Figure 2. The expression of total phenol under UV-C treatment
Columns with common letters do not have statistically significant differences

The results of studies by Kim *et al.* (2006) and Shiga *et al*. (2009) indicate that the antioxidant activity of basil is mainly due to the presence of phenolic compounds. Their results showed that UV-B irradiation can significantly improve the amount of these compounds.

Research has shown that the amount of non-enzymatic antioxidants such as ascorbic acid increases in response to UV-B stress. Kumari *et al.* (2010) and Costa *et al*. (2002) and Nasibi and Kalantari (2005).

Antioxidants protect cell components from serious damage by inhibiting free radicals produced under the influence of UV-B radiation. This protection mechanism against UV rays is related to the activity of enzymes involved in the phenylpropanoids pathway, which indicates that these compounds can protect the plant well against UV rays. Ziyai *et al*. (2012).

The results of the research of Maffei and Scarini (2011) showed that UV-B had a positive and significant effect on the amount of essential oil and total phenol in the peppermint plant. According to the results obtained from this research, it seems that UV-C irradiation provides suitable conditions for strengthening defense mechanisms against free radicals mainly by reducing phenolic compounds and improving the expression of genes encoding antioxidant enzymes has brought.

Table 1. Analysis of variance and mean squares of Antioxidant activity and Total phenol

Source of Variation	Degree of freedom	Antioxidant activity	Total phenol
Treatment UV-C	3	3755696590**	351676176764*
Error	8	1997627709	57325489263
C.V%	-	6.18	22.15

- **,*,ns Significantly shows 1% probability level, 5% probability level and non-significant level, respectively

CONCLUSION

The results of the investigation of the effect of ultraviolet ray treatment on antioxidant activity showed that the expression of this gene was not affected by ultraviolet ray treatment, and the level of expression in the control samples was increased compared to other samples. The results of examining the effect of ultraviolet ray treatment on the amount of total phenol showed that the expression of this gene was significantly affected by ultraviolet ray treatment, and the expression level increased compared to the control samples. The highest amount of total phenol was observed at the level of 10 kJ.

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REFERENCES

Ahmed A.F., Attia F.A., Liu Z., Li C., Wei J. and Kang W. 2019. Antioxidant activity and total phenolic content of essential oils and extracts of sweet basil (*Ocimum basilicum* L.) plants. Food Science and Human Wellness, 8(3), pp.299-305.

Costa H., Gallego S.M. and Tomaro M.L. 2002. Effect of UV-B radiation on antioxidant defense system in sunflower cotyledons. Plant Science, 162(6), pp.939-945.

Javanmardi J., Khalighi A., Kashi A., Bais H.P. and Vivanco J.M. 2002. Chemical characterization of basil (*Ocimum basilicum* L.) found in local accessions and used in traditional medicines in Iran. Journal of agricultural and food chemistry, 50(21), pp.5878-5883.

Kim H.J., Chen F., Wang X. and Rajapakse N.C. 2006. Effect of methyl jasmonate on secondary metabolites of sweet basil (*Ocimum basilicum* L.). Journal of Agricultural and Food Chemistry, 54(6), pp.2327-2332.

Kang W.Y., Song Y.L. and Zhang L., 2011. α-Glucosidase inhibitory and antioxidant properties and antidiabetic activity of *Hypericum ascyron* L. Medicinal Chemistry Research, 20(7), pp.809-816.

Kumari R., Singh S. and Agrawal S.B. 2010. Response of ultraviolet-B induced antioxidant defense system in a medicinal plant, *Acorus calamus*. Journal of environmental biology, 31(6), pp.907-911.

Nasibi F. and Kalantari K.M. 2005. The effects of UV-A, UV-B and UV-C on protein and ascorbate content, lipid peroxidation and biosynthesis of screening compounds in Brassica napus.

Noguchi N. and Niki E. 2019. Chemistry of active oxygen species and antioxidants. In Antioxidant status, diet, nutrition, and health (pp. 1-20). CRC Press.

Shi H., Noguchi N. and Niki E. 1999. Comparative study on dynamics of antioxidative action of α-tocopheryl hydroquinone, ubiquinol, and α-tocopherol against lipid peroxidation. Free Radical Biology and Medicine, 27(3-4), pp.334-346.

Shiga T., Shoji K., Shimada H., Hashida S.N., Goto F. and Yoshihara T. 2009. Effect of light quality on rosmarinic acid content and antioxidant activity of sweet basil, *Ocimum basilicum* L. Plant biotechnology, 26(2), pp.255-259.

Ziaei M., Sharifi M., Behmanesh M. and Razavi K. 2012. Gene expression and activity of phenyl alanine amonialyase and essential oil composition of *Ocimum basilicum* L. at different growth stages. Iranian Journal of Biotechnology, 10(1), pp.32-39.