



## Effect of ultraviolet radiation on internal structure and phenolic compounds of some medical seeds

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**Abstract:** Phenolic compounds have one hydroxyl group or more, where produced for protection against biotic or abiotic stress nascent from external force. The purpose of this study is to investigate the impact of ultraviolet C on chemical composition, phenolic and flavonoids content in *Salvia hispanica* seeds. The results show that, there is a significant change in molecular structure and chemical compositions for *Salvia hispanica* seeds such as arrangement or size or accumulated or interconnections of molecules and bond strengths or position after exposure to UVC, which is effect on all bio-properties. Phenolic content in *Salvia hispanica* seeds increased after exposure to UVC for one, two, three and four hours at 5 cm and 20 cm distances from UV source while flavonoids content was decreased in it at the same conditions. DPPH scavenging activity percent for *Salvia hispanica* seeds varied after being subjected to UVC for different periods of time and at different distances.

**keywords:** molecular composition, antioxidants, UVC, *Salvia hispanica* seeds

### 1.Introduction

Ultraviolet radiation has wavelengths ranging from 2000 to 4000 Å, where categorized into UVC (2000-2800 Å), UVB (2800-3200 Å) and UVA (3200-4000 Å). Phytochemical production relies on the utilization of UV light as an abiotic elicitor [1], while exposure to UV light stress activates defense mechanisms in plants that produce commercially relevant secondary chemicals [2]. Polyphenol compounds have several hydroxyl groups bonded to two or more benzene rings [3]. Tocopherols, flavonoids, phenolics, and glucosinolates have all been shown to accumulate more effectively when exposed to UVC [4]. Photochemical reactions triggered by broken chemical bonds in metabolic enzymes and the subsequent production of secondary metabolites are possible when ultraviolet light has sufficient energy [5–7]. As UVC exposure time and intensity vary, total phenolics, flavonoids, proline and vitamins for *Nigella Sativa* and garden cress were altered after exposure to UVC for different times and different distances [8, 9]. The purpose of this research was to investigate the impact of UVC

on molecular and chemical composition, non-enzymatic antioxidants for *Salvia hispanica* seeds.

### 2. Materials and methods

*Salvia hispanica* seeds were used as research samples. The ultraviolet irradiation system is comprised of one fluorescent lamp (type- C) that is covered totally with aluminum foil to ensure that the sample is illuminated from all sides. The Molecular Structure of *Salvia hispanica* is being investigated using Nicolet™ iS™ 10 FT-IR Spectrometer. The Folin–Ciocalteu method, as described by (Attard 2013) [10], was utilized in order to ascertain the total phenolic content of the sample. The blue complex color was measured at 630 nm at the end of the incubation time. Data are represented as means ± SD. The aluminum chloride method described by (Kiranmai, Kumar et al. 2011) [11] was used to determine the total flavonoids content. Finally, after incubation, the final yellow color was measured at 420 nanometers. Data are represented as means ± SD. To measure DPPH scavenging activity of *Salvia hispanica* seeds: With 100

$\mu\text{l}$  of each sample's extract dissolved in methanol and 100  $\mu\text{l}$  of 2Mm of DPPH radical dissolved in methanol, concentrations from 0.4g/100g to 2g/100g can be made. The mixture is stirred and set aside in the dark for 15 minutes. Then, the absorbance at 517 nm is compared to a blank and the result is recorded. Percentage scavenging effect is calculated as  $[(A_0 - A_1)/A_0] \times 100$  where  $A_0$  is the absorbance of the control (without sample) and  $A_1$  is the absorbance in the presence of the sample.

**Statistical analysis:** Data were analyzed by SPSS software using analysis of variance (ANOVA) and differences among means were determined for significance at  $P < 0.05$  using Tukey's test.

### 3. Results and Discussion

#### 3.1. Phenolic

A significant change,  $P < 0.001$ , in phenolic content in *Salvia hispanica* seeds after exposure to UVC for different periods time and dissimilar distances as listed in Table 1, where increased by 34.4% and 92.7% after exposed for 1 and 4 hours at 5 cm distance and by 32.4% and 75.6% after exposed for 1 and 4 hours at 20 cm distance from UV source. That is because UVC effected on accumulation of phenolic compounds, where capable for breaking hydroxyl bonds of poly phenols thereby releasing soluble phenols of low molecular weight. Also, chemical composition such as protein was changed after exposure to UVC which affected on phenolic content [13-17]. The change in hydroxyl group, O-H, which play an important role for carrying protein or for phenolic compounds transfer; it caused a variation on phenolic content.

**Table (1):** phenolic content in *Salvia hispanica* after UVC exposure at different times and from different distances

Exposure time (hour)	Total phenolic ( $\mu\text{g GA eq/mL}$ )	
Zero (Control)	81.58 $\pm$ 4.25	
	5 cm	20 cm
1	157.18 $\pm$ 12.30	125.96 $\pm$ 5.73
2	109.66 $\pm$ 7.07	108.0 $\pm$ 4.96
3	117.29 $\pm$ 8.46	143.24 $\pm$ 7.30
4	117.13 $\pm$ 8.23	125.16 $\pm$ 4.428

#### 3.2. Flavonoids

A significant effect,  $P < 0.001$ , in flavonoid, which is the chief group of phenolics, where decreased after exposed to UVC as shown in Table 2. It was decrease by 6.4% to 15.96%

and 6.1% to 58.3% after 1 and 4 hours of exposure at distances of 5 cm and 20 cm from the UV source. Ultraviolet own enough energy for broking the chemical bonds that cause photochemical reactions, where total flavonoid content for *Salvia hispanica* varied after exposed to UVC, because their effect on phenolic compounds and hydroxyl bonds in it, during absorbed. UV effected on bio compounds of seeds because of their water content and that affect the capacity of the ions to penetrate and reach the embryo then effect on their structure phenol compounds.

**Table (2):** flavonoids content in *Salvia hispanica* after exposed to UVC

Exposure time (hour)	Total flavonoids ( $\mu\text{g rutin eq/mL}$ )	
Zero (Control)	39.40 $\pm$ 0.64	
	5 cm	20 cm
1	28.66 $\pm$ 1.92	25.33 $\pm$ 2.93
2	27.18 $\pm$ 1.69	37.0 $\pm$ 2.12
3	33.11 $\pm$ 2.93	32.74 $\pm$ 2.56
4	33.11 $\pm$ 1.92	26.44 $\pm$ 1.57

#### 3.3. DPPH scavenging activity

DPPH scavenging activity of *Salvia hispanica* seeds varied, significant change, ( $P < 0.001$ ), after exposed to UVC at 5 cm distance for different periods time but it increased after exposed for different times at 20 cm distance from UVC source as presented in Table 3. Scavenging activity in *Salvia hispanica* varied because it represents stress against UV radiation or as a protection wall for biological cell from UV stress.

**Table (3):** DPPH scavenging activity of *Salvia hispanica* after exposed to UVC

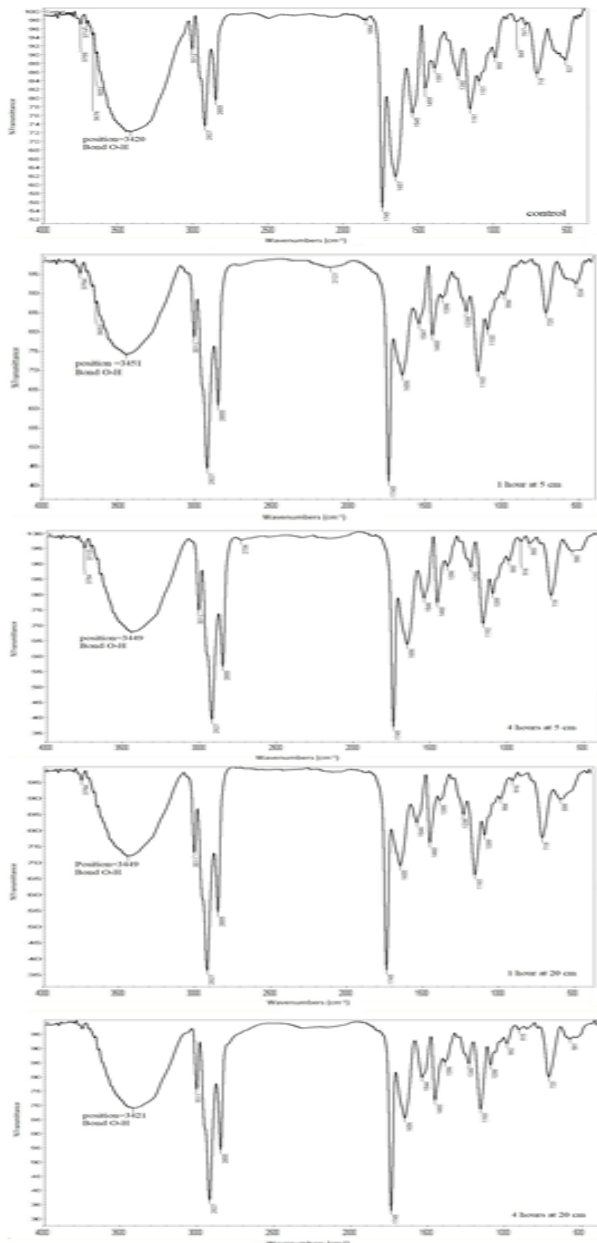
Exposure time (h)	DPPH scavenging activity ( $\mu\text{MTE/mL}$ )	
Zero (Control)	720.07 $\pm$ 48.58	
	5 cm	20 cm
1	1120.25 $\pm$ 24.69	746.80 $\pm$ 28.59
2	690.61 $\pm$ 27.32	786.36 $\pm$ 23.35
3	765.08 $\pm$ 20.06	893.56 $\pm$ 32.67
4	707.52 $\pm$ 20.78	804.36 $\pm$ 14.97

#### 3.4. Molecular structure

##### IR analysis

Figure 1 shows infrared spectrum for *Salvia hispanica* after it subjected to UVC for one and four hours at distances of five centimeters and twenty centimeters from the source. These graphs result from the relation between wavenumber (X axis) and transmittance (Y axis), and they are shown in the figure. IR

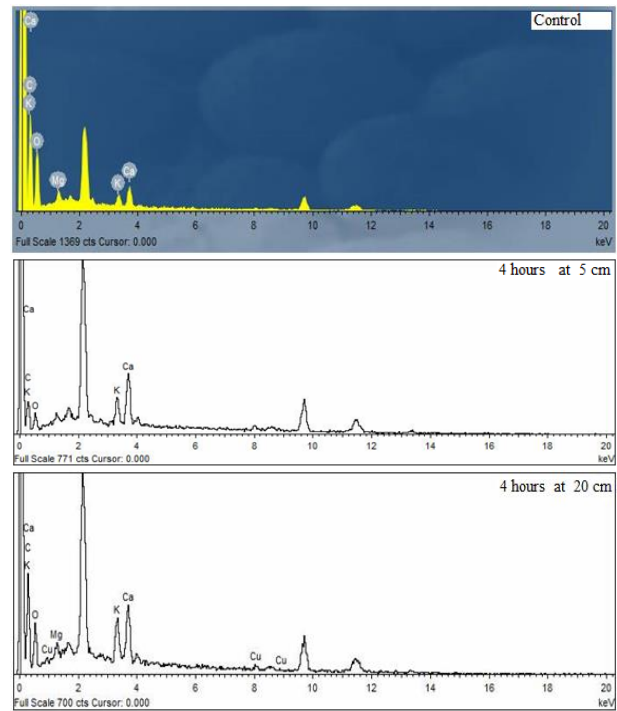
spectrum analysis of *Salvia hispanica* showed, % transmittance intensity, broadness and position at  $\cong 1745$ ,  $\cong 2925$  and  $\cong 3420$   $\text{cm}^{-1}$  varied after exposed to UVC. Because each interatomic bond vibrates in several different motions and absorbs at more than one IR frequency, the molecular bonds C- O bond at  $1745$   $\text{cm}^{-1}$ , C-H bond at  $2925$   $\text{cm}^{-1}$ , and O- H bond at  $3420$   $\text{cm}^{-1}$  for *Salvia hispanica* changed after exposure to UVC.



**Fig 1:** IR spectrum for *Salvia hispanica* after exposure to UVC

#### EDX analysis

X-ray dispersive energy (EDX) analysis for *Salvia hispanica* seeds after four hours of exposure to UVC at a distance of 5 cm and 20 cm as shown in Figure 2, a change in chemical elements such as carbon, C, and oxygen, O.



**Fig 2:** X-ray dispersive energy graphs for *Salvia hispanica* after exposed to UVC

#### 4. Conclusions

UVC radiation has a greatly effect on *Salvia hispanica* molecular and chemical structure such as shape, arrangement, orientation or interconnections or size of molecules, which caused a change in non-enzymatic antioxidants for it.

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