



Impact of Different Environmental Temperature on Chemical Composition of *Asparagus densiflorus sprengeri* L. Collected from Different Areas of Punjab, Pakistan

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Rec date: January 23, 2018; Acc date: January 29, 2018; Pub date: February 10, 2018

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Abstract

A research work was conducted to find out the chemical composition of *Asparagus densiflorus sprengeri* under the influence of different agro-climatic conditions of Punjab province, Pakistan. Experiment conducted with Complete Randomized Design (CRD). Triplicate samples of shoots and roots collected from various localities were analyzed for each treatment. Fresh plants of *A. densiflorus sprengeri* were collected from seven different sites of Punjab. Time of sampling is from March to April. After air drying, samples were analyzed for their Malondialdehyde (MDA), Ascorbic Acid (AsA) and Total Phenolic (TPhe). MDA, AsA and TPhe concentrations differed significantly ($p < 0.05$) from locality to locality. As the contents of MDA concerned the maximum concentrations were recorded from the shoot ($4.54 \pm 0.027 \text{ mg g}^{-1}$) and root ($3.03 \pm 0.307 \text{ mg g}^{-1}$) of plants selected from University of Agriculture, Faisalabad (UAF) and TT Singh respectively while the lowest from shoot ($1.13 \pm 0.165 \text{ mg g}^{-1}$) and root ($0.94 \pm 0.120 \text{ mg g}^{-1}$) collected from Multan and UAF respectively. The highest AsA concentrations of shoot ($0.436 \pm 0.0023 \text{ mg g}^{-1}$) and root ($0.424 \pm 0.0035 \text{ mg g}^{-1}$) were recorded from UAF and Govt. College University, Faisalabad (GCUF) respectively whereas minimum of AsA of shoot ($0.206 \pm 0.0008 \text{ mg g}^{-1}$) and root ($0.224 \pm 0.0093 \text{ mg g}^{-1}$) from TT Singh. The highest TPhe were present in the shoot ($0.451 \pm 0.019 \text{ mg g}^{-1}$) and root ($0.529 \pm 0.019 \text{ mg g}^{-1}$) of plants collected from UAF and Nursery (Faisalabad) respectively while minimum of shoot ($0.165 \pm 0.0065 \text{ mg g}^{-1}$) and root ($0.265 \pm 0.012 \text{ mg g}^{-1}$) from Multan and TT Singh respectively. On the basis of results obtained it can be concluded that environmental conditions significantly ($p < 0.05$) influenced the chemical composition of *A. densiflorus*.

Keywords: *A. densiflorus*; Abiotic factors; Locality; Chemicals; Temperature

Introduction

Asparagus is a perennial garden plant belonging to the Lily family, Liliaceae. Approximately 300 varieties of *Asparagus* have been noticed and only 20 are edible. The genus name *asparagus* is thought to be derived from the Greek *asparagos* for cultivated *asparagus* and is possibly derived from an intensive and sparassa to tear; referring to sharp spines of many species and *densiflorus* refers to the way the small flowers are densely packed along the stem of plant [1]. Fleshy green spears are succulent and tender which appears with coming of spring [2]. It can use as mass planting, cascading down a wall, container or above ground planter, border, ground cover and suitable for growing indoor [3]. It can grow in soil which is deficit in moisture; we can call it fairly drought tolerant. But can be performed very well in well watered and organic rich soil [4]. It is also shade loving and grow well under shade [5].

Medicine

It has epicurean delicate property and for its medicinal properties since 2000 years ago. It is cultivated in subtropical and temperate parts of the world [6]. It is used as the diuretic treatment because it is the good source of potassium and contains quite low sodium. *Asparagus* has been used as for the treatment of swelling (Arthritis, rheumatism) and has water retention quality [7]. Medicinal plants like *Aspilia*

africana and *Bryophyllum pinnatum* have sufficient amounts of ascorbic acid, riboflavin, thiamine and niacin [8]. The *Hypericum brasiliense* is an important medicinal herb and have several compounds with several important pharmacological properties [9].

Ascorbic acid (Vitamin C)

Ascorbic acid is a small water soluble antioxidant molecule act as a primary substrate in the cyclic pathway for enzymatic detoxification of hydrogen peroxide and acts directly to neutralize super oxide radical's [10]. The peel and arils of pomegranate has vitamin C and antimicrobial quality. Peel has more quantity of Vitamin C than in arils [11]. The quantity of Vitamin C is greatly affected by the light periods. Plants grown in light have more Vitamin C contents than grown in the dark [12]. It works as antioxidant under oxidative stress [13,14]. Many of the medicinal plant like *Aspilia africana* and *Bryophyllum pinnatum* contained Ascorbic acid as antioxidant molecule [8]. Amount of ascorbic acid is strongly correlated with the seasonal changes and agro-climatic conditions [15].

Total Phenols (TPhe)

Phenolic contents of peanut seedlings decreased at low temperature and increased highest at 40°C [16]. Phenolic contents and superoxide scavenging activity of *Cynara cardunculus* are directly affected by the salinity. Phenolic contents increased by increasing temperature [17]. Many of the studies revealed that seasonal variations influence on the total phenolic contents of wild and cultivated populations of *Carqueja*.

Higher contents were found between May and October for cultivated populations and from June to September for wild species [18]. Phenolic compounds in a medicinal plant *Hypericum brasiliense* are directly related to environmental temperature [9]. Phenolic compounds alleviate the oxidative stress performing role model as antioxidant [13,14]. Seasons and agro-climatic locations strongly affect the total phenolic contents and their antioxidant activity of many of the plants [15].

Temperature

Air temperature of 80 and 90°C resulted significant variations in the physicochemical, antioxidant capacity and nutritional properties of *Aloe barbadensis* and caused decrease in the antioxidant capacity of gel [19]. Environmental factors strongly effects the phenolic ingredients and antioxidant activities of plants [20]. Abiotic factor like light period greatly influences the vitamin C contents of plants [21]. Many of the studies revealed that low light intensity might have influenced the levels of phenolic compounds in a medicinal plant *Hypericum brasiliense* [9]. Heat shocks also increased the amount of phenolic compounds as well as ascorbic acid in cabbage sprout [22]. Keeping in view the medicinal, antimicrobial activity and pharmaceutical importance of *A. densiflorus*, a research activity was planned to investigate the variations in the quantity of chemicals

collected from different agro-climatic zones of province Punjab, Pakistan. It was also planned to study the influence of different agro-climatic conditions on antioxidants status of *A. densiflorus*.

Materials and Methods

The experiment was conducted to carry out the variations in chemical composition of medicinal plant *Asparagus densiflorus sprengeri* L (*A. densiflorus*). Plants were collected from different areas of province Punjab with respect to their temperature in the month of May-June (45-50°C) viz., Govt. College University Faisalabad (GCUF), University of Agriculture, Faisalabad (UAF), Chenab Nursery, Faisalabad (CNF), Lahore (LHR), Toba Tek Singh, Multan (MTN) and Dera Ghazi Khan. Plants were collected during early summer season. Each plant included stem, leaves and roots. Plant samples were harvested with the help of scissor, put in 4 × 6 cm paper envelopes, stapled and air dried at temperature 30-35°C in a shade condition. The chemical components determined in the current research work were, Malondialdehyde (MDA), concentration of Ascorbic acid (AsA), Vitamin C and Total Phenolic Contents (TPhe). MDA, TPhe and AsA were determined by following the methodology determined by Dhinsa et al. [23-25]. Multiple Range Test was used to compare treatment at 1 and 0.1% probability levels with the help of a CoStat Computer Package (CoHort, CA, USA) (Table 1).

SOV	Mean sum of squares						
	Df	<i>A. densiflorus sprengeri</i>					
		Shoot	Root	Shoot	Root	Shoot	Root
	MDA	AsA	TPhe				
Location	6	4.6800***	1.302**	0.017000000	0.0120***	0.02600***	0.013**
Error	7	0.177	0.10900	0.000035429	0.0001040	0.00031364	0.00100
Total	13	-	-	-	-	-	-

Table 1: Showing mean some of squares related to Malondialdehyde (MDA), Ascorbic acid (AsA) and Total Phenols (TPhe) in *Asparagus densiflorus sprengeri* L. shoot and root.

Results

The concentration of MDA (Table 2) varied significantly ($p < 0.001$) in shoot of *A. densiflorus* growing in different sites. The highest concentration of MDA 4.54 mg g⁻¹ was recorded for plants growing at Lahore and Faisalabad, while it was minimum 1.13 mg g⁻¹ in plants collected from Multan and DG Khan. The plants collected from TT Singh had intermediate values of MDA contents. Similarly the concentration of MDA varied significantly ($p < 0.001$) in roots of *A. densiflorus* growing in different sites. The highest concentration of MDA 3.031 mg g⁻¹ was recorded for plants growing at TT Singh while it was minimum 0.9405 mg g⁻¹ in plants collected from University of Agriculture, Faisalabad (UAF).

Location	Shoot	Root
Lahore	4.54 ^a ± 0.152	1.47 ^{bc} ± 0.138
UAF	4.54 ^a ± 0.027	0.94 ^c ± 0.1200
GCUF	4.48 ^a ± 0.023	1.41 ^{bc} ± 0.008

Chenab Nursery (Faisalabad)	3.57 ^a ± 0.220	2.95 ^a ± 0.2010
TT Singh	2.46 ^b ± 0.163	3.03 ^a ± 0.3070
DG Khan	1.23 ^c ± 0.013	1.73 ^b ± 0.0950
Multan	1.13 ^c ± 0.165	1.51 ^{bc} ± 0.115
LSD%	0.995	0.78

Table 2: Mean ± SD of different concentrations of Malondialdehyde (MDA) in shoot and root of *Asparagus densiflorus sprengeri* (mg g⁻¹ dry weight). Note: Values having different superscripts differ significantly.

Analysis of Variance (ANOVA) regarding AsA (Table 3) in shoots clearly indicated that concentration of AsA (Vitamin C) significantly ($p < 0.001$) differed in *A. densiflorus* collected from different sites of Punjab. All sites differed significantly ($p < 0.001$) for AsA contents. The highest AsA concentration 0.4365 mg g⁻¹ was in shoots collected from Lahore and UAF while minimum 1.2065 mg g⁻¹ in material collected from TT Singh. Similarly the Analysis of Variance (ANOVA) for AsA

in roots clearly indicated that concentration of as (Vitamin C) significantly ($p < 0.001$) differed in *A. densiflorus* collected from different sites of Punjab. All sites differed significantly ($p < 0.001$) for AsA contents. The highest AsA concentration 0.4245 mg g^{-1} was in roots collected from Govt. College University Faisalabad (GCUF)

while it was minimum 0.224 mg g^{-1} in plants collected from TT Singh. However, the samples collected from Multan (0.253 mg g^{-1}), D.G. Khan (0.3595 mg g^{-1}), Lahore (0.3095 mg g^{-1}) and Nursery (1.508 mg g^{-1}) differed significantly ($p < 0.001$) for AsA contents.

Location	Shoot	Root
Lahore	$0.436^a \pm 0.0020$	$0.309^c \pm 0.0020$
UAF	$0.436^a \pm 0.0023$	$0.423^a \pm 0.0020$
GCUF	$0.253^e \pm 0.0037$	$0.424^a \pm 0.0035$
Nursery(FAISALABAD)	$0.421^b \pm 0.0064$	$0.253^d \pm 0.0021$
TT Singh	$0.206^f \pm 0.0008$	$0.224^e \pm 0.0093$
DG Khan	$0.389^c \pm 0.0005$	$0.359^b \pm 0.0110$
Multan	$0.363^d \pm 0.0020$	$0.377^b \pm 0.0062$
LSD%	0.014	0.021

Table 3: Mean \pm SD of different concentrations of ascorbic acid (AsA) in shoot and root of *Asparagus densiflorus sprengeri* (mg g^{-1} dry weight). Note: Values having different superscripts differ significantly.

Analysis of Variance (ANOVA) regarding with reference to TPhe (Table 4) in shoots clearly indicated that concentration of (Vitamin C) significantly ($p < 0.001$) differed in *A. densiflorus* collected from different sites of Punjab. All sites differed significantly ($p < 0.001$) for TPhe contents in shoot. The highest AsA concentration 0.4365 mg g^{-1} was in shoot collected from Lahore and UAF while it was minimum 1.2065 mg g^{-1} in shoot collected from T.T. Singh. Similarly Analysis of

Variance (ANOVA) for TPhe in roots showed that there were significant ($P < 0.01$) variations in the root samples collected from the different sites under research studies. The highest quantity of TPhe in roots was $0.529 + 0.0190 \text{ mg g}^{-1}$ detected from plant samples collected from Chenab Nursery, Faisalabad whereas, its minimum quantity $0.265 = 0.0060 \text{ mg g}^{-1}$ found in the roots of *A. densiflorus* collected from TT Singh.

Location	Shoot	Root
Lahore	$0.398^b \pm 0.0110$	$0.360^c \pm 0.0180$
UAF	$0.451^a \pm 0.0190$	$0.451^{ab} \pm 0.0110$
GCUF	$0.342^c \pm 0.0180$	$0.442^{abc} \pm 0.019$
Chenab Nursery (FAISALABAD)	$0.421^{ab} \pm 0.0026$	$0.529^a \pm 0.0190$
TT Singh	$0.246^d \pm 0.0040$	$0.265^d \pm 0.0120$
DG Khan	$0.193^e \pm 0.0053$	$0.393^{bc} \pm 0.0060$
Multan	$0.165^e \pm 0.0065$	$0.411^{bc} \pm 0.0005$
LSD%	0.042	0.088

Table 4: Mean \pm SD of different concentrations of total phenolics (TPhe) in shoot and root of *Asparagus densiflorus sprengeri* (mg g^{-1} dry weight). Note: Values having different superscripts differ significantly.

Discussion

The MDA contents were higher in *A. densiflorus* tissues collected from different locations that have relatively high temperature. An experiment performed by Savicka and Skute [26] found that MDA content become increased under heat stress. The MDA quantity also varies with exposure time and parts of plant exposed to stress. The results were in accordance with some recent findings [27-30] that have shown high temperature affected the concentration of MDA contents

in different plants. Contents of MDA were directly proportional to the relative humidity of the all selected sites.

Present findings were in collaboration with the findings of Abreu and Mazzafera [9], who stated that changes in relative water contents could affect chemical composition of *Hypericum brasiliense*.

Total phenolics were varied from site to site in current research findings. Similar results were also endorsed by Iqbal and Bhangar [15], who reported that chemical composition of phenolic contents varied from locality to locality in the plants of same species. Variation in the

chemical compositions was due to the climatic conditions like rain fall, humidity and temperatures. Present results revealed that minimum and maximum temperatures mainly effect the total phenolic concentrations in root and shoot materials. Many of the reports which confirmed that phenolic compound in *A. densiflorus* changed due to variations in the sample collection sites and environmental variations [15,18,31]. According to Yang et al. [22] heat shock treatment (40, 50 and 60°C) increased phenolic compounds as compared to control.

Similarly AsA composition also significantly varied with the changes in the environmental conditions. Vitamin C in *A. densiflorus* also significantly affected by the abiotic factors at various localities. Finding of present studies were also confirmed by many investigators in the literature [5,8,11]. Various sites selected for the current investigation were having different environmental factors which significantly affected by chemical composition of AsA. Maximum values of AsA were recorded from Lahore and UAF whereas minimum from TT Singh. AsA varied from site to site with the changes in the environmental conditions. The results were in agreement with the results of Iqbal and Bhanger [15,21,19] also reported that concentrations of vitamin C were significantly affected by the net sunshine and temperature. Yang et al. concluded that heat shock also increased AsA content in cabbage sprout with increasing temperature intensity [22].

In the current research work few of antimicrobial medicinal and pharmaceutical activities *A. densiflorus* were worked out under various agro-climatic conditions of Province Punjab, Pakistan. It was also investigated with influence of different agro-climatic conditions on antioxidants activity of *A. densiflorus*. Further studies are required to explore the different aspects of *A. densiflorus sprengeri* for medicinal point of view under different environmental conditions in Pakistan.

Funding Source

There is no funding source.

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