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Physiological studies on the chemical constituents of three Lamiaceae species, Phlomis aurea, Ballota undulata, and Nepeta septemcrenata, growing in different circumstances in South Sinai, Egypt.

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Abstract

The goal of this study was to see how habitat differences affected chemical constituents of 3 different species: *Phlomis aurea*, *Ballota undulata*, and *Nepeta septemcrenata*. All analyses were conducted in the Saint Katherine Protectorate, South Sinai, Egypt, across four wadis (Wadi Gebal, Wadi Graginya, Wadi El-Arbae'en, and Wadi Abu-Tuweita) and the Musa's Gorge. In all species, there was a noticeable variance in the biochemical content of the examined plants across different habitats. *Phlomis aurea* in Wadi Gebal had the highest total soluble carbohydrate value, while *Nepeta septemcrenata* at Musa's Gorge had the highest water-soluble protein value. In the same period, *Phlomis aurea* reached its highest level of free proline at Musa's Gorge and total phenols at *Nepeta septemcrenata* plants reached their highest level (0.892mg/g dry wt) at Wadi El-Arbae'en.

Keywords*:* Different Circumstances, Lamiaceae, Physiological, Secondary metabolites, *Sinai peninsula*.

1. Introduction

In that it is the crossing point of Africa and Asia, the Sinai Peninsula is geographically significant and distinctive. its vegetation is influenced by both continents., such as Saharan-Arabic, Irano-Turanian, Mediterranean, and Sudanese components **[1].** The unique flora structure of Saint Katherine Protectorate (SKP) results from the diversity of both landforms and geologic structures, resulting in the differentiation of several microhabitats, each with its own set of environmental conditions. The unique flora structure is rich in medicinal, rare, and endemic plants. The dry area is devoid of these species.

SKP's diverse geomorphological and geological features result in a one-of-a-kind landscape. This geography includes six distinct landform types: wadis (valleys), terraces, slopes, gorges, and caves **[2].** The main water-bearing formations in South Sinai are**: (A)** the basement complex, which occupies the southern part of Sinai, particularly the highly fissured igneous rocks (Saint Catherine area, Wadi El-Sheik, and Wadi Feiran) and **(B)** the alluvial deposits, which are parallel to the Gulf of Suez and the Gulf of Aqaba **[3].**

Clarifying causal linkages that govern plant species distribution across vast geographical ranges is an important objective of ecology. Environmental factors, notably temperature, have long been assumed to have a significant role in defining the distribution of Earth's plant kinds **[4].** Climate is a major factor in wild plant distribution, operating either directly via physiological limits on growth and reproduction **[5,6].** or indirectly through ecological variables such as resource competition **[7].**

Plants create a wide range of chemical substances, and metabolites will aid in understanding them. Medicinal plants such as *Phlomis aurea*, *Ballota undulata*, and *Nepeta septemcrenata* belong to the Labiatae family, which includes a wide range of compounds and volatile oils. Diterpenoids, iridoids, phenolic chemicals, and flavonoids were discovered to be present **[8].** Sinai is home to this species **[9].**

Secondary metabolites in plants are organic substances that play a vital part in the plant's response to biotic and abiotic stressors. Phenolic acids, flavonoids, alkaloids, steroids, carotenoids, lignans, tannins, cardiac glycosides, and a variety of other compounds are among them **[10].** Several factors, such as age, season, and nutrition status, are determinants affecting the number of secondary metabolites in plants **[11, 12].**

A variety of environmental variables, such as temperature, altitude, and rainfall, as well as other factors, can impact the quality of herbal constituents in any given species, resulting in significant variances in bioactive chemicals **[13].**

Variation in height provides a wide range of environmental conditions in a mountainous setting. Temperature, pressure, light intensity, rainfall, and partial pressure of metabolic gases are known to alter plant metabolism as elevation rises **[14].**

The goal of this study is to investigate the biochemical constituents of three different species concerning five different habitats on Saint Katherine Mountain in natural conditions.

2. MATERIALS AND METHODS

2.1 Study Area

Saint Katherine Mountain, Egypt's highest mountain, was selected for this research (2641 meters above sea level) It is situated in the heart of the southern Sinai triangle. Shaq Musa and Wadi Garagneia are two big deep canyons, and three mountains of black volcanic granite stand out starkly against the surrounding cliffs. The Katherine pluton is part of a Precambrian basement complex that contains acid plutonic and volcanic rocks in the southern Sinai Peninsula.

2.2 Collection of Plant Samples

Plant samples were collected from five wadies (Wadi Gebal, Wadi Graginya, Wadi El-Arbae'en, and Wadi Abu-Tuweita) and Musa's Gorge in May 2019, for three plant species *Phlomis aurea*, *Ballota undulata*, and *Nepeta Septem crenata.*

2.3 Estimation of Total Carbohydrate

The anthrone sulphuric acid method was used to determine carbohydrates, as described by **[15].**

2.4 Estimation of Total Protein

The Lowry technique **[16].** which is the most commonly used, was employed to determine protein content.

2.5 Estimation of Proline

The content was measured according to the procedure **[17].**

2.6 Total phenols

Folin Ciocalteu reagent was used to calculate values **[18].**

2.7 Determination of photosynthetic pigments

The method used for the quantitative determination of photosynthetic pigments (chlorophyll A, chlorophyll B, and chlorophyll A+B) was that of **[19].**

2.8 Statistical analysis

The total number of experiments was conducted in different stages in a completely randomized design with 3 replicates. The comparison of means was done with the 'One Way Analysis of Variance' (ANOVA) using the SPSS 12.0 software with a probability level of 0.05%.

3. RESULTS

3.1 Plant chemical analysis

Chemical analysis of selected plant species demonstrated effectiveness that was displayed individually within and across sites. **(Musa's Gorge, Wadi Gebal, Wadi Graginya, Wadi Abu-Tuweita, and Wadi El-Arbae'en).**

The largest value was reported in *phlomis aurea* at Wadi Gebal, according to the averages of total soluble carbohydrate content presented in (**Table 1).** *Phlomis aurea* had the highest concentration (35.56 mg/g dry wt.) at Wadi Gebal and the lowest concentration (10.03 mg/g dry wt.) at Musa's Gorge. At season 2 (F = 4.21, P = 0.000), plants from various ecosystems showed significantly significant variances. (F = 4.21, P = 0.000); *Ballota undulata* It was quite valuable. (27.38mg/g. D.Wt) at Musa's Gorge and the lowest value (14.81mg/g dry wt.) at Wadi Abu-Tuweita; there were significant differences among plants of different habitats at season 1 (F = 4.556).

At season 3, there were significant variances across plants from various environments. (F = 3.898, P = 0.000), with the highest values (20.87 mg/g. D. weight) at Musa's Gorge and the lowest value (9.48mg/g dry wt.) at Wadi El-Arbae'en. The findings revealed substantial altitude disparities. This pattern varies from species to species. In this regard, *phlomis aurea* and *Ballota undulata* (Wadi Gebal and Musa's Gorge, respectively) demonstrated the highest total soluble carbohydrate content. Variation in total carbohydrate content across different wadies might be attributed to differences in water stress, which could be caused by a decrease in the photosynthetic process as well as an increase in respiration in various plant species.

(Table 2) shows the mean values of total soluble protein content, which reveal that the highest quantities were found in *Nepeta septemcrenata* Musa's Gorge. In Wadi El-Arbae'en, *phlomis aurea* had the highest maximum value (97.512 mg/g. D. weight) and the lowest minimum value (72.163 mg/g dry wt.).At season 3 (F = 7.795, P = 0.000) and season 1 (F = 4.821, P = 0.000), there are also highly significant differences among plants from different habitats; *Ballota undulata* had the highest value (97.783 mg/ g dry wt.) in Wadi Graginya, with significant differences among plants from different habitats at season 2 (F = 4.477, P =0.000).

In season 1, *Nepeta septemcrenata* plants had the highest value (102.783 milligram/g. D. weight) in Musa's Gorge and the lowest value (81.814 mg/g dry wt.) in Wadi Graginya, with significant differences between plants from various habitats (F = 3.85, P = 0.000).

(Table 3) shows that the maximum level of free proline content was found in *phlomis aurea* in Musa's Gorge. *Phlomis aurea* had the highest value (173.503 mg/g dry wt.) in Musa's Gorge and the lowest value (84.93 mg/g dry wt.) in Wadi El-Arbae'en at the species level.

There are also significant differences between plants from different environments in season 2. (F = 5.469, P = 0.000) ,season 1 and 3 showed significant differences among plants of the different habitats (F = 4.571, P = 0.000) and (F = 3.572, P = 0.000) respectively; *Ballota undulata* had the highest value. (69.98 mg/g D.wt.) in Wadi Graginya and minimum the (22.16 mg/ g dry wt.) In season 3, there were highly significant variances among plants from different habitats in Wadi Abu-Tuweita. (F = 32.401, P =0.000) and season 2 (F = 6.412, P =0.000).

The highest values (124.8 milligram/g dry weight) were found in *Nepeta septemcrenata* plants. and the lowest value (44.25 mg/g dry wt.) in Wadi Gebal, with highly significant differences between plants of the different habitats (F = 17.883, P = 0.000), (F = 19.707, P = 0.000), and (F = 32.229, P = 0.000), respectively.

The largest value was found in *Nepeta septemcrenata* in Wadi El-Arbae'en, as demonstrated by the mean values of total phenol content in **(Table 4).** *Phlomis aurea* had the highest value (0.797 mg/ g dry wt.) in Wadi El-Arbae'en and the lowest value (0.602 mg/ g dry wt.) in Wadi Graginya; *Ballota undulata* had the most valuable (0.843 milligram/gram dry weight.) in WadiGebal and the lowest value (0.577 mg/ g dry wt At season 2, *Nepeta septemcrenata* plants had the highest value (0.892 mg/ g dry wt.) in Wadi El-Arbae'en and the lowest value (0.443 mg/ g dry wt.). Significant variations between plants from various environments were found in Wadi Graginya (F = 3.795, P = 0.000).

3.2 Photosynthetic Pigments

3.2.1 Chlorophyll A

The greatest overall chlorophyll content at *Phlomis aurea,* the highest concentration was observed in W. Graginya (3.14 milligram /g. F. weight) and the lowest in W. Gebal (1.20 milligram /g. F. weight).

Total chlorophyll was found to be at a high level in *Ballota undulata.* and W. Gebal had the highest concentration (2.89 milligram /g. F. weight) while W. Graginya had the lowest value (1.22 milligram /g. F. weight).

The greatest value of total chlorophyll A concentration was found in Musa's Gorge (2.74 milligram/g. F. weight) while the lowest level was found in W. Abu-Tuweita (1.23 milligram /g. F.weight) at *Nepeta septemcrenata.*

3.2.2 Chlorophyll B

W. Graginya (0.55 milligram /g. F.weight) had the highest total Chlorophyll B concentration at *Phlomis aurea,* whereas Musa's Gorge (0.09 milligram /g. F.weight) had the lowest.

W. Gebal and Arbaeen (0.38 milligram /g. F.weight) had the highest total Chlorophyll B concentration in *Ballota undulata,* while W. Graginya (0.05 milligram /g. F.weight) had the lowest.

W.Gebal (0.28 milligram /g. F.weight) had the highest total Chlorophyll B concentration, whereas W. Abu-Tuweita (0.15 milligram /g. F.weight) had the lowest at *Nepeta septemcrenata.*

3.2.3 Chlorophyll A+B

W. Graginya had the highest total Chlorophyll A+B concentration (3.58 milligram /g. F.weight), while Musa's Gorge had the lowest (1.28 milligram /g. F.weight) at *Phlomis aurea.*

W. Gebal (3.28 milligram /g. F.weight) had the highest total Chlorophyll A+B content among the *Ballota undulata* species, while W. Graginya and W. Abu-Tuweita (1.25 milligram /g. F.weight) had the lowest.

Musa's Gorge (3.21 milligram /g. F.weight) had the highest total Chlorophyll A+B concentration, whereas W. Abu-Tuweita (1.25 milligram /g. F.weight) had the lowest at *Nepeta septemcrenata.* Plant biochemical activity may vary depending on elevation, aspect, and slope rank in different locations. In a broad area like the St. Katherine Protectorate, there may be significant habitat variation (approximately 4350km2). The findings might help with ecological protection.

Table 1 The total soluble carbohydrate content of plant species collected from Saint Katherine's five habitats was tested with a one-way analysis of variance (ANOVA).

Habitat	season 1			season 2			season 3		
Wadi Name	*Phlomis Aurea*	*Ballota undulata*	*Nepeta septemcrenata*	*Phlomis aurea*	*Ballota undulata*	*Nepeta septemcrenata*	*Phlomis aurea*	*Ballota undulata*	*Nepeta septemcrenata*
Musa's Gorge	10.03±1.88 e	8.80±2.90 e	20.87±0.43 a	27.18±1.98 b	16.87±0.46 c	8.74±2.20 d	18.95±1.72 e	27.38±2.35 b	13.19±2.60 b
W. Gebal	18.81±3.72 b	20.30±2.63 b	14.93±1.26 d	12.58±1.80 d	21.25±2.87 b	19.39±4.45 a	35.56±1.53 a	23.08±6.37 c	12.41±1.54 c
W. Graginya	15.85±1.15 c	23.56±1.67a	12.66±2.16 e	27.64±2.97 b	24.58±3.30 a	14.00±2.02 b	19.75±2.17 d	20.20±2.84 e	20.50±1.90 a
W.AbuTuweita	13.70±4.68 d	16.15±0.31c	15.44±2.67c	24.60±3.41c	14.81±4.82 d	14.29±3.10 b	28.22±4.47 b	29.93±0.06 a	12.91±1.84 d
W. El-Arbaeen	24.24±4.39 a	12.67±4.53d	18.41±2.63b	28.03±4.92 a	17.08±2.80 c	9.48±1.14 c	24.58±8.95 c	21.74±1.46 d	12.17±0.47 c
F_{ratio}	2.588	2.509	4.556	4.211	1.639	2.427	2.121	3.898	1.716
P_{value}	NS	NS	*	*	NS	NS	NS	*	NS

During the summer season (May, June and July 2019). The mean values are given in milligrams/g dry weight of the shoot. Each statistic represents the average of three replicates with standard errors. According to LSD, the meanings of similar letters in a column are not statistically different. NS= non significance, *=significant at P< 0.05.

Table 2 The total soluble protein content of plant species collected from Saint Katherine's five habitats was tested with a one-way analysis of variance (ANOVA)

Habitat	season 1			season 2			season 3		
Wadi Name	*Phlomis Aurea*	*Ballota undulata*	*Nepeta septemcrenata*	*Phlomis aurea*	*Ballota undulata*	*Nepeta septemcrenata*	*Phlomis aurea*	*Ballota undulata*	*Nepeta septemcrenata*
Musa's Gorge	87.744±1.80	80.729±4.3 c	102.783±5.7 a	78.403±2.13 e	87.318±3.04 b	83.675±3.72 e	78.570±2.9	83.868±4.2 c	92.047±3.80 a

	b						c		
W. Gebal	78.946±3.50 c	84.760±3.9b	82.705±2.4 d	82.589±2.89 d	97.783±0.83 a	95.341±3.91 b	74.837±1.3 d	93.637±3.3 a	90.341±0.22 b
W. Graginya	90.923±6.30 a	97.550±3.9 a	90.263±7.3 c	94.023±8.48 b	67.085±10.47e	91.581±6.18 c	84.341±1.9 b	83.791±10.6 c	81.814±5.13 d
W.AbuTuweita	90.961±0.44 a	84.566±8.5 b	96.814±4.4 b	92.512±6.99 c	82.085±4.70 c	99.140±2.01 a	93.093±3.2 a	77.674±3.58 d	83.946±4.28 c
W. El-Arbaeen	72.163±4.42 d	77.938±3.2 d	82.512±0.8 d	97.512±3.15 a	74.023±4.71d	85.380±1.13 d	92.360±4.4 a	85.302±2.07 b	83.481±4.9 c
F_{ratio}	4.821	2.238	3.85	2.394	4.477	2.837	7.795	1.022	1.443
P_{value}	*	NS	*	NS	*	NS	**	NS	NS

During the summer season (May, June and July 2019). The mean values listed are expressed as mg/g dry weight of shoot. Each value is a mean of 3 replicates ± standard errors. Means in a column with similar letters are not significantly different according to LSD. * = significant at $P < 0.05$,**=significant at $P<0.01$,NS=nonsignificance.

Table 3 The free proline content of plant species collected from Saint Katherine's five habitats was tested with a one-way analysis of variance (ANOVA).

Habitat	season 1			season 2			season 3		
Wadi Name	*Phlomis aurea*	*Ballota undulata*	*Nepeta septemcrenata*	*Phlomis aurea*	*Ballota undulata*	*Nepeta septemcrenata*	*Phlomis aurea*	*Ballota undulata*	*Nepeta septemcrenata*
Musa's Gorge	130.67±4.60 b	37.92±3.62c	101.313±7.79b	135.31±1.05b	51.79±10.25 b	56.547±2.46c	173.503±4.8a	26.24±1.53 d	85.51±7.44c
W. Gebal	139.587±8.8 a	31.513±3.07 d	112.60±0.97a	122.91±15.78c	52.707±5.85 b	44.25±2.39e	150.63±4.85c	31.49±1.31 b	124.8±3.80a
W. Graginya	88.597±4.6d	41.74±4.51b	84.14±9.27c	155.81±13.62a	58.083±5.69 a	101.81±5.52a	156.39±9.22 b	69.98±5.88 a	88.30±2.01b
W.AbuTuweita	87.143±23.3 d	61.707±5.97 a	54.86±1.42e	103.98±12.78d	22.16±3.08d	52.47±3.20d	151.53±10.9 c	27.77±1.53 c	75.68±3.45d
W. El-Arbaeen	126.113±2.3c	62.613±30.4 a	63.48±4.15d	84.93±9.43e	29.203±4.29 c	60.97±8.68b	127.78±11.1d	23.15±4.12 e	51.59±4.78e

F_{ratio}	4.571	1.089	17.883	5.469	6.412	19.707	3.572	32.401	32.229
P_{value}	*	NS	***	**	**	***	*	***	***

During the summer season (May, June and July 2019). The mean values listed are expressed as mg/g dry weight of shoot. Each value is a mean of 3 replicates ± standard errors. Means in a column with similar letters are not significantly different according to LSD. * = significant at P < 0.05,**=significant atP<0.01and***= significant at P<0.001,NS=nonsignificance.

Table 4 The total phenol content of plant species collected from Saint Katherine's five habitats was tested with a one-way analysis of variance (ANOVA).

Habitat	season 1			season 2			season 3		
Wadi Name	*Phlomis Aurea*	*Ballota undulata*	*Nepeta septemcrenata*	*Phlomis aurea*	*Ballota undulata*	*Nepeta septemcrenata*	*Phlomis aurea*	*Ballota undulata*	*Nepeta septemcrenata*
Musa's Gorge	0.672±0.05 d	0.809±0.06 8b	0.685±0.04b	0.706±0.05 d	0.577±0.02e	0.700±0.10 c	0.683±0.10 d	0.713±0.09 b	0.806±0.05a
W. Gebal	0.664±0.03 e	0.843±0.02 4a	0.528±0.06e	0.778±0.02 b	0.659±0.013c	0.726±0.03 b	0.707±0.04 c	0.691±0.05 c	0.735±0.08b
W. Graginya	0.768±0.10 b	0.630±0.10 e	0.672±0.11c	0.602±0.07 e	0.601±0.15d	0.443±0.15 e	0.660±0.02 e	0.650±0.03 d	0.797±0.04a
W.Abu Tuweita	0.698±0.03 c	0.735±0.07 d	0.744±0.05a	0.749±0.03 c	0.700±0.11b	0.617±0.01 d	0.784±0.06 a	0.740±0.06 a	0.638±0.03d
W.El Arbaeen	0.781±0.01 a	0.750±0.02c	0.644±0.06d	0.797±0.10 a	0.750±0.13a	0.892±0.00 a	0.723±0.07b	0.691±0.04c	0.685±0.06c
F_{ratio}	1.084	1.658	1.246	1.63	0.479	3.795	0.51	0.321	1.791
P_{value}	NS	NS	NS	NS	NS	*	NS	NS	NS

During the summer season (May, June and July 2019). The mean values listed are expressed as mg/g dry weight of shoot. Each value is a mean of 3 replicates ± standard errors. Means in a column with similar letters are not significantly different according to LSD. * = significant at P<0.05,NS=nonsignificance.

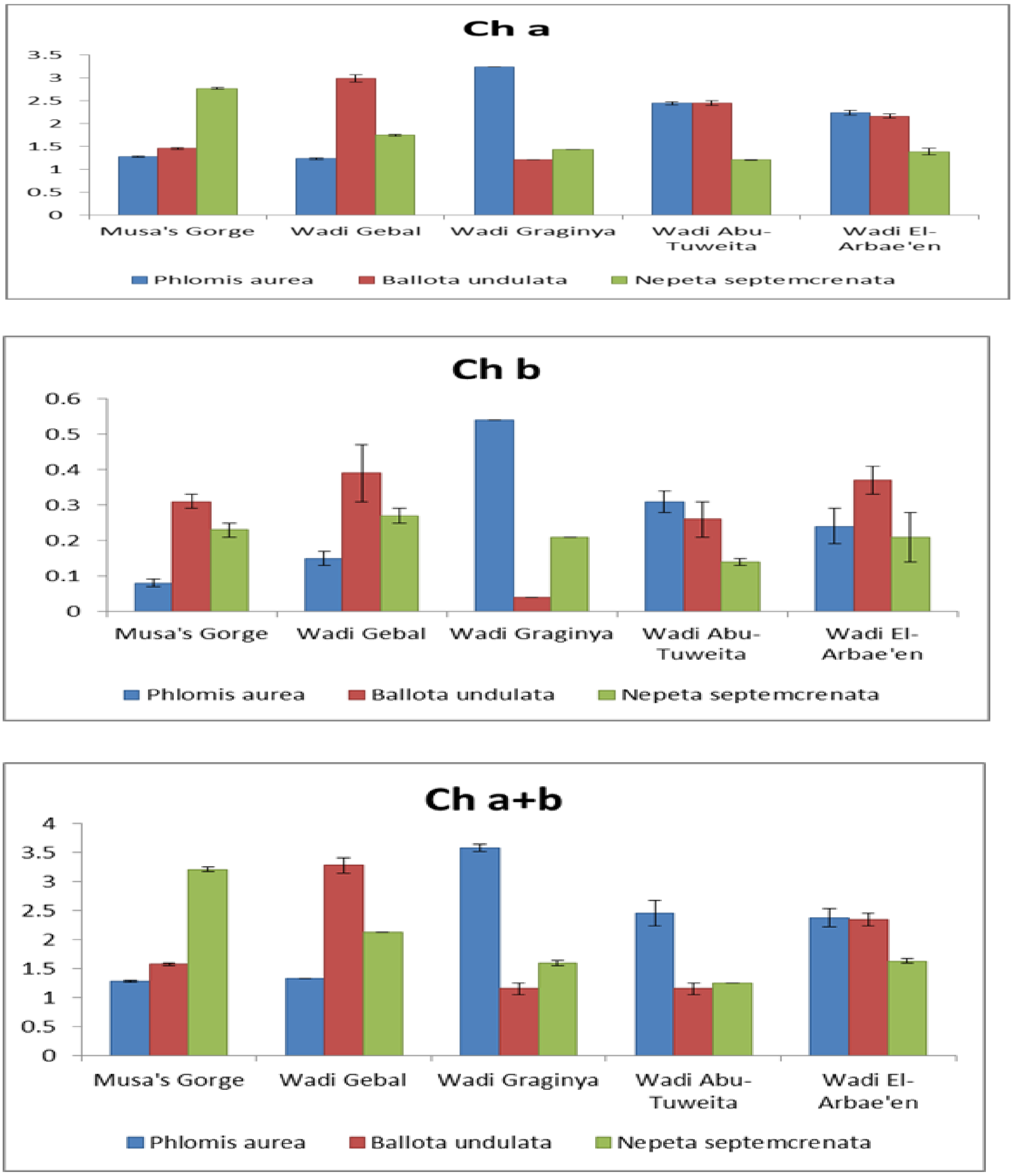

Fig. 1. Variation in total chlorophyll a, b, and a+b content of plant species collected from Saint Katherine's five habitats.

4. Discussion

The South Sinai Mountain's unique shape and structure result in higher climatic and vegetation changes than elsewhere. Plant growth and the lack of trees are apparent characteristics of desert vegetation; the combination of increasing aridity and human activity is causing the environment to become increasingly arid. Pastoral plant groupings are being wiped off due to overgrazing, overcutting, and uprooting, decreased plant cover, and soil erosion **[20].**

The Irano-Turanian steppe vegetation dominates the high highlands of southern Sinai. The strange plants can live because the smooth-faced granite outcrops offer ample runoff water. SKP is one of the most floristically diverse areas in the Mideast, with 44 percent of Egypt's unique plant species. In Sinai, a total of 1261 species have been identified **[21].**Geographic diversity is caused by a variety of variables, including geologic changes that affect soil type, variations in rainfall throughout the terrain **[22].**

Plant biochemical responses to environmental stresses have been studied and discussed **[23,24,25,26].** Differences in total carbohydrate content across various wadies might be attributed to differences in abiotic stress, which could be caused by a decrease in photosynthetic processes as well as an increase in respiration in different plant species. Materials such as soluble carbohydrates have a role in osmotic regulations and conservation mechanisms, these results matched with these obtained by **[27].** variation in total carbohydrate contents among different wadies and this may come from variation in water stress, which may be due to the decrease in photosynthetic process beside an increase of respiration in different plant species. These findings mirrored those obtained by other researchers who found that soluble carbohydrates have a function in osmotic control and conservation mechanisms **[28].**

Variability in total protein can also be attributed to differences in soil water content between different wadies, which can be attributed to attitudinal variation. Additionally, **[29,30].** discovered that changes in protein content can be attributed to altitudinal and seasonal variation. Temperature can impact the nitrogen content of plants and, as a result, its suitability as a source of food for herbivores. A prominent trait of certain plants is the negative association between nitrogen content and temperature **[31].**

Variation in height provides a wide range of environmental conditions in a mountainous setting. Stressors such as temperature, pressure, light intensity, rainfall, and partial pressure of metabolic gases are known to alter plant metabolism as elevation rises **[32].**Protein synthesis is also one of the most negatively affected anabolic processes by stress **[33]** together with photosynthesis and phenolic compounds **[34].**

the maximum level of free proline content was found in *phlomis aurea* in Musa's Gorge. *Phlomis aurea* had the highest value (173.503 mg/g dry wt.) in Musa's Gorge and the lowest value (84.93 mg/g dry wt.) in Wadi El-Arbae'en at the species level. Proline accumulation is one of the metabolic processes that occur in stressed plants **[35].**There was variation in proline content among different wadi systems, this could be due to spatial and altitudinal variation, this correlates with studies that have demonstrated that the proline content in higher plants increases under various environmental challenges, such as drought, and this might be caused by changes in climatic circumstances, putting the plants under different ecological stressors **[36].**

Semi-arid plants have a variety of physiological and morphological characteristics that allow them to adapt to challenging conditions drought and harsh light are examples of these types of conditions. **[37].**The first obvious reaction of a plant to any biotic or abiotic stressor is a decrease in its regular metabolic activity, which leads to a reduction in growth **[38].**

Most stress plays important roles either in **(A)** helping plants survive or **(B)** reducing the stress agent's efficacy from an eco-physiological standpoint **[39].**When leaves are rehydrated, the wilting-induced buildup of non-protein proline is avoided. Increased sugar content as osmoregulating has been described as one of the defense strategies against low-temperature adaptation at high elevations **[40].**

Environmental characteristics and considerable geographic variety can decrease subpopulations, resulting in increased persistence. This is due to the low possibility of all subpopulations of a population being hit by a disaster at the same time when there is a lot of geographical diversity. With limited geographical variation, on the other hand, the chances of a poor year affecting the whole population are considerable. In South Sinai, the influence of spatial variation related to altitude on plant community structure is substantially greater in the vertical situation than in the horizontal case **[41].**

The climatic condition in this area is considerably wetter than in the region of Sinai, which is influenced by the orographic influence of high-elevation mountains **[42].**

Plant community distribution was mostly determined by altitude, slope, exposure, soil moisture, soil organic matter, sand, silt, and clay fractions, and gravel percentage, rather than soil response (pH and EC) **[43].**

It is possible to deduce that phenols have a better relationship with plant survival adaptability, particularly at high elevations **[44].**This might be seen as higher elevations being subjected to more stressful conditions. Carbohydrate and protein content, on the other hand, are more regulating elements for plant growth rates at lower elevations. As defined by species plasticity, their availability is often commensurate with water stress.

From the results, During the investigation, the various plant species we chose (***Phlomis aurea*, *Ballota undulata,*** and ***Nepeta septemcrenata*.**) are very diverse in terms of their ideal surroundings, and a hard environmental state that is damaging to one plant species may not be stressful to another, as evidenced by the fact that **[45].**This is mirrored in the wide range of stress-response systems available.

Plant growth rate, as well as biological, physiochemical, and cellular behaviors, can be affected by abiotic factors such as water, temperature, salt, and mineral elements, according to previous studies **[46].** In this regard, **[47]** reported that there's a link between a species' mechanism of photosynthetic activity and its habitat's ecological circumstances.

Pigment concentration varied between places, and this drop in pigment richness might be due to the presence of plants under water-stressed conditions. In this regard, **[48]** have reported this. Among environmental stresses, water insufficiency is one of the main limitations to photosynthesis in mesophytic plants **[49].**

Drought resistance has been equated with the ability of a plant to maintain a positive carbon balance under desiccating conditions, primary components being the capacities to synthesize and utilize photosynthetic products as obtained by **[50].**Also, **[51]** have discovered that altitudinal variation causes changes in pigment content.

Plants are constantly exposed to variations in ambient temperature, and the temperature influences practically all physiological and metabolic activities, regardless of the method, the effect varies, as found by **[52,53].**

5. Conclusions

The environmental factors are owner the major role at variation in vegetation distribution and plant community structure, this variation in plant community structure output of notable difference to most environmental factors such as gradient on the elevation, temperature, and rainfall between different locations.

It was discovered that poor environmental circumstances caused by abiotic variables such as moisture, salinity, and mineral elements can induce plant growth and development to be stunted, as well as physiological and biochemical imbalances. Variations in total carbohydrate content across different wadies, for example, might be related to variances in water stress, which could be produced by a drop in photosynthetic activity as well as an increase in respiration in distinct plant species.

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