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Autecology and Bioactive Metabolites of *Stellaria pallida* Growing in North East Nile Delta, Egypt

¹M.E. Abu-Ziada, ¹G.A. El Sherbeny and ²H.M. Al-Jubawy

¹Department of Botany, Faculty of Science, Mansoura University, Egypt

²College of Education, Thi Qar University, Iraq

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Corresponding Author:

M.E. Abu-Ziada

Department of Botany,

Faculty of Science,

Mansoura University, Egypt

ABSTRACT

This study focused on ecological characteristics and bioactive metabolic products of *Stellaria pallida* (Dumort.) Piré. Twenty eight vascular plants related to 16 families were recorded in *S. pallida* community type. Poaceae, Barassicaceae and Asteraceae were the most important families. *Chenopodium murale*, *Rumex dentatus* and *Euphorbia helioscopia* were the common associates. Therophytes were the most frequent life-form (85.7%). The floristic composition of this community was strongly influenced by the Mediterranean elements (15 species). *S. pallida* preferred wet, loamy sand textured, non-saline, fertile and neutral-slightly alkaline soils. The aerial fraction of this Caryophyllaceous weed showed high nutritive value of 276.17 cal./100 g. The polyphenols and flavonoids contents have been detected with mean values of 1.95 and 5.85%, respectively. The yield of volatile oils of the flowers was 143 mg/100 g. Twenty compounds were identified in the volatile oils of *Stellaria pallida* flowers.

Key words: Ecology, polyphenols, flavonoids, volatile oils, *Stellaria*

INTRODUCTION

Stellaria pallida is a delicate herbaceous winter-spring active weed. It is native to Europe with Mediterranean-continental type of geographic range (Wittig, 2004). The genus *Stellaria* is common in the Northern hemisphere (Chinnappa and Morton, 1984). Taxonomically, *Stellaria* belongs to family Caryophyllaceae, subfamily Alsinoideae and tribe Alsineae (Bittrich, 1993). The members of this subfamily are distinguished by their free sepals and exstipulate leaves (Charter and Heywood, 1993). Members of the family Caryophyllaceae are best known to contain many bioactive metabolic constituents (Arora and Sharma, 2012; Sindhu and Manorama, 2012; Mamadaliyeva *et al.*, 2010).

In Egypt, the genus *Stellaria* is represented by two species namely; *S. media* (L.) Vill. and *S. pallida* (Dumort.) Piré. The comparative diagnostic features of the two species are: Flowers are smaller and have no petals in *S. pallida*. Seeds are smaller, thinner and paler in colour in *S. pallida* as compared with those of *S. media*. *Stellaria media* has been used as traditional Chinese medicine for over 200 years; it has been used as an anti-viral agent (Ma *et al.*, 2012; Kokate, 2003). The second species, *S. pallida* is well known as an invasive

weed in cultivated fields (Shan *et al.*, 2010). This plant is reported to be useful in inflammation of the digestive, renal, respiratory and reproductive tracts. It also possesses diuretic, expectorant and anti-asthmatic properties (Kirtikar and Basu, 2006; Kitanov, 1992). Due to the high nutritional value, it is used as a leaf vegetable, often raw in salads (Kirtikar and Basu, 2006).

The present study is an attempt to throw further light on morphology, anatomy and autecology of *S. pallida* in addition to evaluation of the primary metabolites, polyphenols, flavonoids and volatile oils of this plant.

MATERIALS AND METHODS

Morphological description: Fresh specimens were described according to Foster and Gifford (1974) and LAWG (1999).

Anatomical investigation: Plant materials were collected and immediately immersed in fixative solution of formalin-acetic acid-alcohol (10:5:85 v/v). Thin cross-sections of stem, leaf and root were made as described by Jensen (1962) and Peacock and Bradbury (1973). The sections were examined using light microscope and were photographed.

Ecological characteristics

Vegetation analysis: Twenty stands dominated by *S. pallida* were studied in detail including: Total coverage, a list of species, phenological aspect of growth and cover-abundance estimate of each species. Identification and nomenclature of the species were followed Tackholm (1974) and Boulos (1995). Techniques of floristic analysis based on the methods given in Kent and Coker (1992), Muller-Dombois and Ellenberg (1974) and Poole (1974).

Habitat conditions: One soil sample was collected from each stand (depth 0-20 cm), air dried and sieved through a 2 mm sieve to remove gravel and debris. The procedures followed in estimating their variables were according to the methods recommended by Carter and Gregorich (2008), Pansu and Gautheyrou (2006), Margesin and Schinner (2005), Baruah and Barthakur (1997) and Klute (1986).

Phytochemical analysis

Quantitative estimation of the primary metabolites: Fine powdered aerial parts of *S. pallida* were used to determine the mean values of moisture content, total ash, acid-insoluble ash, crude fibers, total lipids, protein, total carbohydrates and soluble sugars were determined as described by Van Handel (1968), Sadasivam and Manickam (2008) and AOAC (2000). The nutrient value was calculated as cited from Indrayan *et al.* (2005).

Qualitative estimation of the secondary metabolites: The phytochemical screening of sterols, terpenes, flavonoids, phenols, tannins, saponins and alkaloids was carried out using the procedures described by Harborne (1973), Sofowara (1993) and Trease and Evans (1989).

Quantitative estimation of polyphenols and flavonoids: The polyphenols content was determined using the method described by Sadasivam and Manickam (2008). The flavonoids were extracted and subjected to column chromatograph according to Boham and Kocipai-Abyazan (1994).

Volatile oils investigation: Qualitative and quantitative analysis of the volatile oils of *S. pallida* flowers was performed using Gas Chromatography (GC) and Gas Chromatography Coupled with Mass Spectrometry (GC-MS) (Adams, 2007).

RESULTS AND DISCUSSION

Morphology: *Stellaria pallida* (Fig. 1) is an annual herbaceous weed, decumbent or ascending, 10-20 cm to a maximum 40 cm long, much-branched and yellowish-green in colour. Leaves are cauline, pale-green, exstipulate, margin entire and apex acuminate. Leaves are pinnately veined with actinodromous primary vein category and reticulodromous secondaries. Veins spacing smoothly increasing towards the base. Flowers in late winter and self-pollinated because the



Fig. 1: Close up view of *S. pallida* plant showing flowers in terminal cymes

flowers never open widely (cleistogamous). Flowers are borne in terminal 3-6 flowered cymes. Sepals are 5 free, persistent, hairy and lanceolate. Petals are absent. Stamens are 3 with grey anthers, longitudinally dehiscent and inserted on annular disc. Ovary is superior with many ovules. The fruit is simple dry dehiscent capsule, dehiscent by valves, straw coloured and ovoid (2-3 mm). The seeds are pale brown, reniform, 7-11 seeds/fruit and possess phanerocotylar germination. *Stellaria pallada* possesses survival strategies through seasonality and seeds dimorphism. The findings of the present morphological study are relatively correlated to the earlier reports (Chinnappa and Morton, 1984; Harbaugh *et al.*, 2010; Miller and West, 2012).

Anatomy: The stem anatomy of *S. pallida* is presented in (Fig. 2a). It is a typical herbaceous dicot stem with normal secondary thickening and produced a small amount of secondary tissues. The epidermis is a single layer of quadrangular cells. Adjacent to the epidermis, the cortex starts with two layers of collenchymas then a wide zone composed of 4-9 layers of parenchymatous cells. The outer few layers of the cortical cells are assimilatory in nature due to the presence of chloroplasts. The vascular bundles were eleven and situated in a ring. The pith in the central part and comprised a hollow space.

The leaf cross-section (Fig. 2b) showed that, it is of the bifacial type and some spongy cells possess druses crystals of Ca-oxalate. The lower epidermal cells were larger than the upper epidermal cells. The midrib showed arc shaped vascular bundle.

The root cross-section (Fig. 2c) is circular. Beneath the epidermis there is 3-5 layered cortex of parenchyma cells, followed by multilayered periderm. The epidermal and outer cortical cells become fractured and disintegrated due to increasing pressure from the developing secondary tissues. A complete cylinder of secondary xylem is formed under the

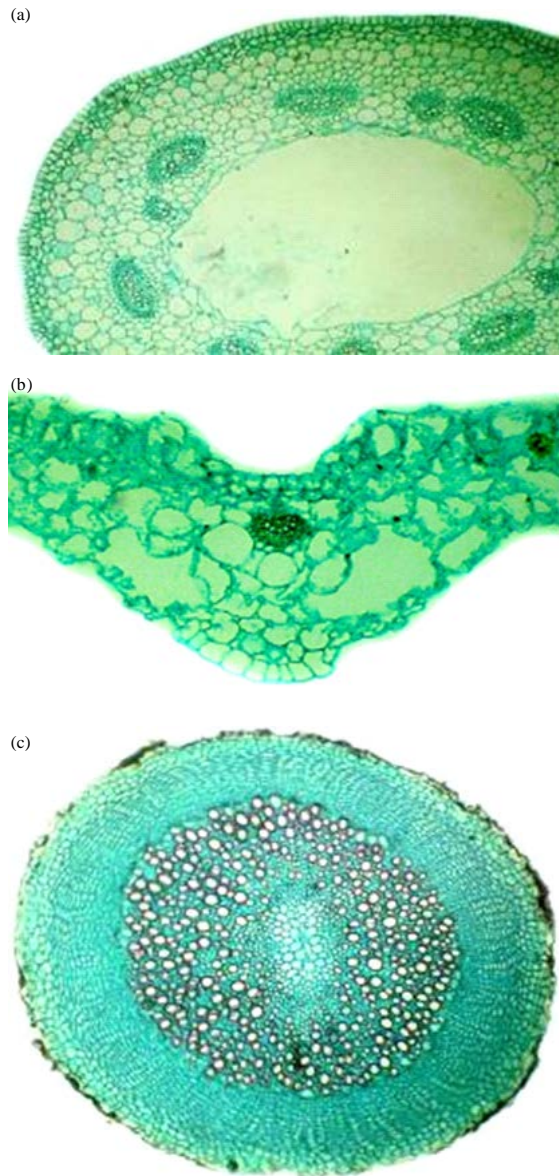


Fig. 2(a-c): Cross section in (a) Stem of *S. pallida*, (b) Leaf of *S. pallida* and (c) Root of *S. pallida*

cambium ring with xylem vessels are wide arranged irregularly. The primary phloem strands are forced outward and digested. The pith is narrow and formed of parenchymatous ovoid cells. The obtained results are in accordance with those of Fahn (1982), Arora and Sharma (2012) and Abu Ziada *et al.* (2013).

The chromosomes count revealed that, the chromosome number of *S. pallida* was found to be $2n = 22$. This agrees with the results reported by Ghaffari and Kelich (2006).

Autecology

Vegetation: Table 1 gives the floristic composition of twenty stands representing *Stellaria pallida* community type. It is

obvious that *S. pallida* consistently the dominant, present in all the stands and has the highest cover-abundance estimate. This community has only (22 dicots and 5 monocots) belong to 16 families. Poaceae, Brassicaceae and Asteraceae are the most important. *Chenopodium murale* is the most abundant associate species ($p = 100\%$). *Rumex dentatus*, *Euphorbia helioscopia* and *Capsella bursa-pastoris* are common, have presence estimates of 95% each. Beside the above mentioned associates, nine species have presence estimates of 30-80% in addition to other 13 with presence estimates 5-25%.

Regarding the life-span, the recorded species are classified into 23 annuals and 5 perennials. The dominance of the annuals could be attributed to the fact that, annuals have high reproductive capacity; ecological, morphological and genetic plasticity under high levels of environmental disturbance (Sadek, 2008).

According to the life-forms, these species are grouped under three types: therophytes (24 species = 85.7%), Geophytes (2 species = 7.1%) and hemicryptophytes.

The life-forms provide information which may help in assessing the response of vegetation to variations in certain environmental factors. The life-form spectra are important physiognomic attributes which have been widely used by ecologists in vegetation studies. The present study showed that therophytes are the most frequent type, followed by geophytes and hemicryptophytes. This trend is similar to spectra reported in the Egyptian weed flora (Mussa, 2002; Al-Sodany, 1992; El-Fahar, 1989).

Dealing with chorotypes (Table 2), the floristic components of this community belong to 7 categories: Mediterranean taxa (15 species), Irano-Turanian taxa (13 species), Cosmopolitan and Euro-Siberian taxa (9 species each) and other three categories are poorly represented. From the floristic point of view, Egypt is meeting point of floristic elements belonging to at least four phytogeographical regions, namely; the African Sudano-Zambesian, the Asiatic Irano-Turanian, the Afro-Asiatic Saharo-Sindian and the Euro-Afro-Asiatic Mediterranean (El-Hadidi, 1993). It is clear that in *Stellaria* community type, the Mediterranean taxa are represented by a relatively high percentage of plant species (53.5%). The other floristic elements are representing by varying numbers of species, reflecting their different capability to penetrate the region. This can be attributed to the influence of human action and the history of agriculture.

Habitat conditions: The data analysis of twenty profiles representing the soil conditions associated with *S. pallida* are showed in Table 3. The soil was loamy sand in texture with the dominance of fine sand fraction. The percentage of silt was relatively high with mean value of 25.85%. The clay particles ranged between 1.92 and 11.46%. The soil moisture content attained high values and varied from 12.3-22.6%. The soil pore-space ranged between 38.8 and 60.2%. The water holding capacity was also high (42.0-59.7%).

Table 1: Floristic composition of twenty stands representing *Stellaria pallida* (Dumort.) Piré community type

Stands	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	P(%)
Total plant cover (%)	70	60	80	60	70	80	90	90	80	90	70	90	90	90	60	95	80	70	70		
<i>Stellaria pallida</i> (Dumort.) Piré.	5r	5r	6r	4r	5r	5r	4r	5r	5r	5g	7f	8f	6f	7f	6f	5g	8f	4r	5r	5r	100
<i>Chenopodium murale</i> L.	2r	3r	2r	2r	2r	3g	4g	2g	2g	2g	2f	3f	3f	3f	3f	4f	3g	1r	1r	2r	100
<i>Rumex dentatus</i> L.	4g	3g	2g	2g	2g	3g	2g	2g	2g	2g	2f	5f	4f	-	3g	3g	3g	2r	2r	1r	95
<i>Euphorbia helioscopia</i> L.	3r	2r	3r	2g	2g	2g	3g	2g	3g	2g	2f	5f	4f	-	5f	4f	3r	2r	1r	1r	95
<i>Capsella bursa-pasternis</i> (L.) Medik.	2r	2r	3r	2r	2r	2r	3r	2g	2g	3g	2f	1f	2f	4f	3f	3f	5f	2r	2r	-	95
<i>Lamium amplexicaule</i> L.	2f	2f	1g	2g	2g	2f	2f	2g	2g	-	3g	3g	-	3g	3g	+g	2g	-	2f	-	80
<i>Cyperus rotundus</i> L.	-	-	-	1g	2g	3g	2g	2g	2g	-	3g	2g	1g	3g	3g	2g	3g	-	-	-	65
<i>Euphorbia peplis</i> L.	-	2r	-	-	1r	2r	2r	2r	2r	-	2g	-	1g	3f	3g	3f	-	1r	-	-	60
<i>Convolvulus arvensis</i> L.	-	2g	-	1g	2g	2g	2g	2g	-	-	2g	-	1g	3g	3g	2g	-	-	-	-	55
<i>Anthemis cotula</i> L.	2f	-	-	-	-	2g	-	3g	-	1g	-	4f	4f	2f	-	-	-	-	1f	1f	45
<i>Anagallis arvensis</i> L.	3r	1f	-	-	2f	1f	1f	-	-	-	3f	2g	-	1g	-	-	-	-	-	-	40
<i>Apium leptophyllum</i> (pers.).	3g	2g	3g	1g	-	-	1g	-	-	-	-	-	-	-	-	-	-	1g	1g	1r	40
<i>Urtica urens</i> L.	-	-	-	-	-	-	-	+g	1g	3g	-	2g	2g	1g	1g	-	1g	-	-	-	40
<i>Coronopus squamatus</i> (Forssk.) Asch.	1r	-	-	-	-	2g	1g	1g	1g	1g	-	-	-	-	-	-	-	-	-	-	30
<i>Sisymbrium irio</i> L.	-	-	-	-	-	-	-	-	-	-	1f	-	1f	2f	3f	-	3f	-	-	-	25
<i>Poa annua</i> L.	-	2f	-	-	1f	-	-	-	-	-	-	2g	-	-	-	-	-	-	-	1f	20
<i>Cynodon dactylon</i> (L.) pres.	-	2g	-	1g	-	-	-	-	-	-	2g	-	-	-	-	-	-	-	1f	-	20
<i>Senecio aegyptius</i> L.	-	-	-	1f	2f	-	2f	-	-	-	-	-	-	1g	-	-	-	-	-	-	20
<i>Phalaris minor</i> Retz.	1r	-	-	-	1r	-	-	-	-	-	-	-	-	-	-	-	-	1f	-	-	15
<i>Sonchus oleraceus</i> L.	-	1g	-	1f	-	-	-	-	-	-	-	-	-	1f	-	-	-	-	-	-	15
<i>Echinochloa colona</i> (L.) link.	-	-	-	-	-	-	-	-	-	-	-	3f	2g	-	-	-	-	-	-	-	10
<i>Silene rubella</i> L.	-	-	-	-	-	-	1f	-	-	-	-	-	-	-	3f	-	-	-	-	-	10
<i>Malva parviflora</i> L.	-	-	-	-	-	-	-	-	-	-	-	-	3g	-	-	-	-	-	-	-	5
<i>Brassica tournefortii</i> Gouan.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3g	-	-	-	5
<i>Cynanchum acutum</i> L.	-	-	-	-	-	-	2f	-	-	-	-	-	-	-	-	-	-	-	-	-	5
<i>Setaria verticillata</i> (L.) P. Beauv.	-	1r	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
<i>Torilis arvensis</i> (Huds.) link.	-	-	-	-	-	-	-	-	-	-	-	-	1f	-	-	-	-	-	-	-	5

Domin scale (1-10) g = in foliage, f: Flowering and r: Fruiting, P: Presence (%)

Table 2: Life-span, life-forms and chorotypes of the floristic components of *Stellaria pallida* community type

Species	Life span	Life form	Floristic category (chorotypes)
<i>Stellaria pallida</i> (Dumort.) Piré.	An.	Th	ME+ER-SR
<i>Chenopodium murale</i> L.	An.	Th	COSM
<i>Rumex dentatus</i> L.	An.	Th	ME+IR-TR+ER-SR
<i>Euphorbia helioscopia</i> L.	An.	Th	ME+IR-TR+SA-SI
<i>Capsella bursa-pastoris</i> (L.) Medik.	An.	Th	COSM
<i>Lamium amplexicaule</i> L.	An.	Th	ME+IR-TR+ER-SR
<i>Cyperus rotundus</i> L.	Per.	G	PAN
<i>Euphorbia peplis</i> L.	An.	Th	ME+IR-TR+ER-SR
<i>Convolvulus arvensis</i> L.	Per.	H	COSM
<i>Anthemis cotula</i> L.	An.	Th	ME
<i>Anagallis arvensis</i> L.	An.	Th	COSM
<i>Apium leptophyllum</i> (Pers.).	Per.	Th	COSM
<i>Urtica urens</i> L.	An.	Th	ME+IR-TR+ER-SR
<i>Coronopus squamatus</i> (Forssk.) Asch.	An.	Th	ER-SR+IR-TR+ME
<i>Sisymbrium irio</i> L.	An.	Th	ME+IR-TR+ER-SR
<i>Poa annua</i> L.	An.	Th	COSM
<i>Cynodon dactylon</i> (L.) pres.	Per.	G	PAN
<i>Senecio aegyptius</i> L.	An.	Th	ME+IR-TR+ER-SR
<i>Phalaris minor</i> Retz.	An.	Th	COSM
<i>Sonchus oleraceus</i> L.	An.	Th	ME+IR-TR
<i>Echinochloa colona</i> (L.) link.	An.	Th	COSM
<i>Silene rubella</i> L.	An.	Th	PAN
<i>Malva parviflora</i> L.	An.	Th	PAL
<i>Brassica tournefortii</i> Gouan.	An.	Th	ME+IR-TR
<i>Cynanchum acutum</i> L.	An.	Th	ME+IR-TR+SA-SI
<i>Setaria verticillata</i> (L.) P. Beauv.	Per.	H	ME+IR-TR
<i>Torilis arvensis</i> (Huds.) link.	An.	Th	COSM

Life-span: An.: Annuals, Per.: Perennials. Life-form: Th: Therophytes, G: Geophytes, H: Hemicyptophytes. Floristic categories: ME: Mediterranean, ER-SR: Euro-Siberian, COSM: Cosmopolitan, IR-TR: Irano-Turanian, SA-SI: Sahara-Sindian, PAN: Pantropical, PAL: Palaeotropical (2 species = 7.1%)

The organic carbon content varied from 0.6-1.6%. CaCO₃ content was low and fluctuated between 3.5 and 12.0%. The electric conductivity showed wide range of variation

fluctuated between 174 and 374 μmohs cm⁻¹. Most of the soluble anions were sulphates (0.021-0.086%) and bicarbonates (0.031-0.091%). Chlorides were present in low

Table 3: Analysis of soil samples collected from twenty representative stands of *Stellaria pallida* (Dumort.) Préd. Community inhabiting El Dakahlia Governorate (Jan-Feb., 2014)

Physical characteristics										Chemical characteristics									
Mechanical analysis										Analysis of 1:5 water extract									
Samples No.	>2.057	2.057-1.003	1.003-0.500	0.500-0.211	0.211-0.104	0.104-0.053	<0.053	M.C. (%)	Por. (%)	W.H.C. (%)	Org.C (%)	CaCO ₃ (%)	E.C. (µmols cm ⁻¹)	Cl ⁻ (%)	SO ₄ ⁻² (%)	CO ₃ ⁻ (%)	HCO ₃ ⁻¹ (%)	TDS (g/100 g)	pH
1	0.00	5.19	13.49	23.89	21.39	28.82	7.23	20.80	38.80	55.60	0.90	8.80	174.00	0.005	0.076	0.0	0.076	91.00	7.41
2	0.81	2.86	14.54	29.23	24.68	23.04	5.53	18.20	48.30	56.30	1.10	11.00	193.00	0.005	0.045	0.0	0.091	101.00	7.06
3	0.00	5.96	17.74	28.20	22.00	21.37	4.68	17.30	46.10	42.00	1.30	10.00	227.00	0.005	0.066	0.0	0.061	119.00	7.05
4	0.38	3.73	11.68	29.00	28.35	25.45	1.92	19.10	60.20	43.90	1.30	12.00	273.00	0.007	0.086	0.0	0.061	144.00	6.94
5	0.14	1.19	2.04	19.21	33.56	40.90	3.09	13.40	42.40	58.70	1.20	5.50	224.00	0.005	0.033	0.0	0.061	119.00	7.05
6	0.00	1.27	3.26	25.39	30.16	35.69	5.23	19.50	45.00	49.30	1.30	8.50	192.00	0.005	0.041	0.0	0.061	100.00	6.76
7	0.38	1.82	6.11	23.93	28.57	30.18	9.48	12.30	39.10	58.60	0.70	9.50	214.00	0.005	0.042	0.0	0.061	110.00	6.94
8	1.06	2.66	15.69	29.18	25.75	23.35	2.28	18.40	55.00	43.60	1.50	3.50	197.00	0.005	0.049	0.0	0.046	101.00	6.92
9	0.00	3.09	14.38	28.49	28.98	22.96	3.00	22.60	42.40	40.60	1.10	6.50	197.00	0.003	0.025	0.0	0.031	103.00	7.03
10	0.32	2.43	13.80	29.87	24.85	22.37	6.84	16.00	46.40	56.40	1.40	8.00	252.00	0.007	0.041	0.0	0.061	132.00	8.50
11	2.18	4.02	18.09	23.78	21.34	22.02	8.74	21.60	41.90	53.90	1.30	6.00	187.00	0.005	0.037	0.0	0.046	99.00	7.02
12	0.60	5.27	14.86	28.39	21.76	22.42	6.80	18.90	48.90	52.80	0.80	6.00	205.00	0.005	0.021	0.0	0.061	108.00	6.77
13	1.03	2.05	8.23	28.15	26.26	27.52	6.39	17.60	49.80	55.80	1.50	8.00	372.00	0.008	0.021	0.0	0.076	189.00	7.14
14	0.12	2.25	13.15	29.03	27.76	25.70	2.44	18.80	42.50	50.90	1.30	5.00	374.00	0.007	0.025	0.0	0.091	194.00	7.15
15	0.96	1.47	11.22	32.19	25.59	22.43	6.29	16.30	47.10	48.80	0.70	6.50	216.00	0.005	0.024	0.0	0.046	113.00	6.75
16	0.24	3.00	9.84	25.55	26.96	29.35	5.31	17.80	45.20	50.20	0.60	10.00	214.00	0.004	0.037	0.0	0.061	112.00	7.04
17	0.60	3.09	13.33	28.21	25.13	24.11	5.84	19.10	46.20	49.80	1.40	7.50	234.00	0.005	0.052	0.0	0.049	109.00	6.97
18	1.38	3.75	12.83	26.09	22.78	21.75	11.46	17.00	46.90	59.70	1.10	9.50	257.00	0.008	0.062	0.0	0.061	135.00	7.14
19	1.15	2.08	14.79	27.94	24.81	23.43	5.85	15.30	40.30	42.60	1.60	8.50	219.00	0.005	0.038	0.0	0.076	114.00	7.08
20	1.34	2.82	15.96	27.72	23.34	24.21	5.10	17.70	43.90	49.50	0.60	5.50	188.00	0.005	0.049	0.0	0.061	97.00	6.87
Mean	0.63	2.95	12.25	27.17	26.99	25.85	5.67	17.88	45.82	53.09	1.13	7.80	230.50	0.005	0.043	0.0	0.061	119.50	7.07
S.E	0.13	0.29	0.98	0.64	0.72	1.13	0.54	0.55	1.15	1.34	0.07	0.49	12.27	0.0002	0.004	0.0	0.003	6.26	0.08

M.C: Moisture content, Por: Porosity, W.H.C: Water holding capacity, Org. C: Organic carbon, E.C: Electrical conductivity, TDS: Total dissolved salts

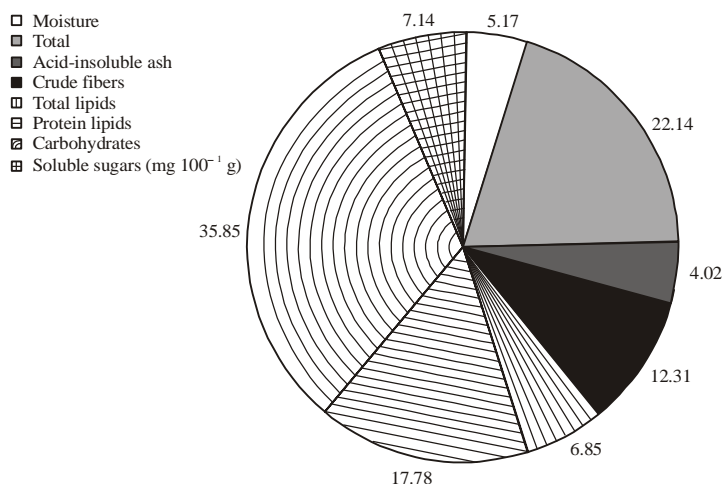


Fig. 3: Mean values of the primary constituents of *S. pallida* aerial parts

Table 4: Qualitative estimation of the secondary metabolites

Metabolites	Results
Sterols	+ve
Terpenes	+ve
Flavonoids	+ve
Phenols	+ve
Tannins	+ve
Saponins	Traces
Alkaloids	-ve

Table 5: Quantitative estimation of phenolic and flavonoids compounds

Parameters (%)	<i>Stellaria pallida</i>
Polyphenols	1.948
Flavonoids	5.849

Table 6: Phytochemical composition of the volatile oil of *Stellaria pallida* fruits, determined by GC/MS analysis

No.	Compound	Concentration (mg/100 g)
1	Z-β-Farnesene	28.31
2	Butanoic acid butyl ester	20.22
3	Tetrahydrocitronellene	17.79
4	Pentadecanone,6,10,14 trimethyl	13.66
5	Phytol	11.85
6	Isophytol	8.87
7	Apiole	7.02
8	α-Bisabololone oxide A	5.89
9	Methyl-hexadecanoate	3.95
10	Dillapiolene	3.35
11	α-Bisabolol oxide B	3.16
12	Sclareol	3.16
13	Epi-catalponol	3.02
14	Warburganal	2.72
15	Kaurene	2.19
16	δ-Decalactone	2.06
17	α-Santonine	1.99
18	Furoselagone A	1.77
19	Trans-β-Ionone	1.73
20	E-α-Atlantone	1.32

amounts and varied from 0.003-0.008%. The soluble carbonate content was nil. The soil nature was neutral to slightly alkaline with pH value varied from 6.75-8.5. Consequently, it may be concluded that *S. pallida* flourished in moist loam sandy soil,

non-saline, fertile and slightly-moderately alkaline and this plant is unable to survive drought conditions, thus thrive during the rainy seasons.

The observations, may be give an indication that this Caryophyllaceae herb is well-adapted and thriving in the Mediterranean type of climate which is characterized by a long hot dry season and a short cold mild one. Many species of community are short-lived annuals and restrict germination until mild temperature occur which coincides with water availability from late autumn rains. Temperature is thought to be the main factor affecting the occurrence of these weeds. Comparable plant communities have been described in the Nile Delta by Abu El-Shyokh (2013) and El-Shazly (2013).

Phytochemical characteristics: The data in Fig. 3 showed the primary metabolic constituents and the nutritive value of *S. pallida* aerial parts. The mean values of: moisture content (5.17%), total ash (22.14%), crude fibers (12.31%), total lipids (6.85%), proteins (17.78%), carbohydrates (35.85%) and soluble sugars (7.14%), with a nutritive value was 276.17 cal./100 g.

Testing of the secondary metabolic products of *S. pallida* indicates the presence of sterols, terpenes, flavonoids, phenols, tannins and saponins while alkaloids were absent (Table 4). The absence of alkaloids in *Stellaria pallida* in the present study is in accordance with *S. media* (Arora and Sharma, 2012).

Polyphenols and flavonoids were detected in *S. pallida* with mean values of 1.95 and 5.85%, respectively (Table 5).

The yield of colourless volatile oils isolated from flowers of *S. pallida* was 143 mg/100 g dark-dried powder. Twenty components were identified (Table 6) and Z-B-Farnesene, Butanoic acid butyl ester, Tetrahydrocitronellene, Pentadecanone, Phytol and Apiole were the most important compounds. Balamurugan *et al.* (2013) reported that Caryophyllaceae is best known for the volatile oils common to many members and many biologically active oils have been isolated from various species.

From the aforementioned results, it may be concluded that *S. pallida* has relatively high content of lipids, proteins, soluble sugars and a reasonable nutritive value. Thus it may be useful as a leaf vegetable or as an animal feed. The medicinal value of this caryophyllaceous plant lies in the bioactive phytochemical constituents such as sterols, terpene, flavonoids and volatile oils.

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