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BIOLOGICAL ASPECTS AND PHYTOCHEMISTRY OF THREE DESERT PLANTS GROWING IN WESTERN DESERT, EGYPT.

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ABSTRACT

The present study aims to investigate morphology, and anatomy of *Astragalus vogelii*, *Bassia muricata* and *Morettia philaeana* growing in Abu Tartur region, that lies between Kharga and Dakhla Oases in Western Desert of Egypt. Polyphenols, flavonoids, fatty acids, protein-amino acids as well as antioxidant activity of these plants were detected. The stems, leaves and roots have the general anatomical features of dicotyledons and the aerial surface of the epidermal cells covered by thick protective cuticle. Multicellular trichomes could be distinguished. The root of *A. vogelii* exhibited anomalous secondary thickening with rough surface periderm while those of *Bassia* and *Morettia* possess normal secondary thickening and have well-defined periderm. The highest values of polyphenols and flavonoids content were recorded in *Bassia* and *Astragalus*, respectively. Six essential and seven non-essential amino acids were identified in *Astragalus* shoot. GLC analysis of fatty acids revealed the presence of ten fatty acids in *Bassia* and twelve in *Morettia* shoots. The methanolic extracts of the plants showed antioxidant activity.

Keywords: Anatomy, Germination, Fatty acids, Desert plants.

INTRODUCTION

The medicinal plants in Egypt represent a new promising resource as there is a relatively high representation of medicinal species in the native flora (Batanouny, 1999; Asmeda, 2008). It is already seen the need to shed light on some medicinal plants because of their significance.

Several studies have been focused on the biological and phytochemical properties of different species of *Astragalus*, the largest genus of the flowering plants (Massoumi, 1998). Species of this genus were used in folk medicine due to their hepatoprotective, antioxidative and antiviral properties (Türker *et al*., 2009; Abbas and Zayed, 2005; Lie *et al*., 2003 and Jassbi *et al*., 2002). The root is well-known drug in traditional Chinese medicine (Yen *et al*., 2006). *A. vogelii* is useful plant of west Tropical Africa, Mouritania to Niger and in the central Sahara (Boulos, 1999).

Bassia muricata is a chenopod herb common in Egyptian deserts. It's ether and benzene extracts showed antimicrobial activity (Al-Yahya *et al*., 1990). *Bassia* was found to contain triterpenoidal saponins and acetyl flavonoid glycosides (Shaker *et al*., 2013 and Kamel *et al*., 2001).

Essential oils were obtained from the aerial parts of *Morettia philaeana* growing in central Sudan, by GLC analysis. Seven compounds were identified (El-Egami *et al*., 2011). The plant is used by Sudanese local people to nourish the sheep and chocken. Burham (2008**)** reported the presence of flavonoids in the methanolic extract in the flowering parts of *M. philaeana*. Nine flavonoids were isolated from the whole plant (Kawashy *et al*., 2012).

The present study directed towards outlining morphological and anatomical description of the three selected plants. Also, recording details information about polyphenols, flavonoids, protein-amino acids and fatty acids contents as well as the antioxidant activity.

MATERIALS AND METHODS

Study area : The Abu Tartur plateau is a part of the New Valley in Western Desert of Egypt. It is located at 600 km southwest of Cairo and occupied an area of about 1200 km^2 . It extends between Kharga and Dakhla oases in east-west direction with altitude varies from 500 to 600 m above sea level.

Climate is arid to hyper arid characterized by practically nil value of rainfall coupled with high rate of evaporation . Daily mean temperatures vary between 13.9^o C in winter to 32.2^o C in summer with June being the hottest month . Rainfall is generally low and tends to fall between November to February . The low values of relative humidity (21 – 46 %) showed that atmosphere is dry allover the year .

Morphology of the whole plant, using descriptive terminology based on Heywood, 1978 and the texts of Flora of Egypt (Boulos, 2002) .

For anatomical investigation, cross – section of the plant parts were prepared as described by Peacock and Hard bury (1973).

The total polyphenols content was determined as described by Sadasivam and Manickam (2008). The content of flavonoids was determined as described by Boham and Kocipai-Abyazan, (1994). The protein amino acids were determined in *A. vogelii* aerial parts using GLC / MS as described by Magomya *et al*. (2014). Investigation of fatty acids was according to Tsuda *et al*., 1960 and Finar, 1967.

Determination of antioxidant activity using the free radical scavenging activity DPPH (1,1-diphenyl-2-picryl hydrazyl) according to the method employed by Kitts *et al*. (2000) with slight modification Liyana-Pathirana and Shahidi (2005).

RESULTS AND DISCUSSION

Biological aspects

1. Morphology

A. vogelii is grey-crescent annual herb with minute yellowish papilionaceous flowers and stem is white-villous, long and prostrate or ascending. Leaves are petiolate, stipulate and compound imparipinnate (leaflets 5-8 pairs); legume is small straight, oblong-ovoid, under 1 cm with globose, dark-brown seeds which are compressed, 1-1.5 mm and wingless, Plate (1).

B. muricata is an annual herb with flat subsessile leaves, densely villous ; stem is slightly frutescent with woody base ; leaves are simple entire, linear-lanceolate and covered by silky hairs ; flowers greenish in axillary clusters. Fruit is nut, compressed, with permanent perianth forming yellowish 5-armed disc. Seed is discoid, 1mm, smooth and greyish, Plate (2).

Plate (1) . Close- up view of *Astragalus vogelii* plant.

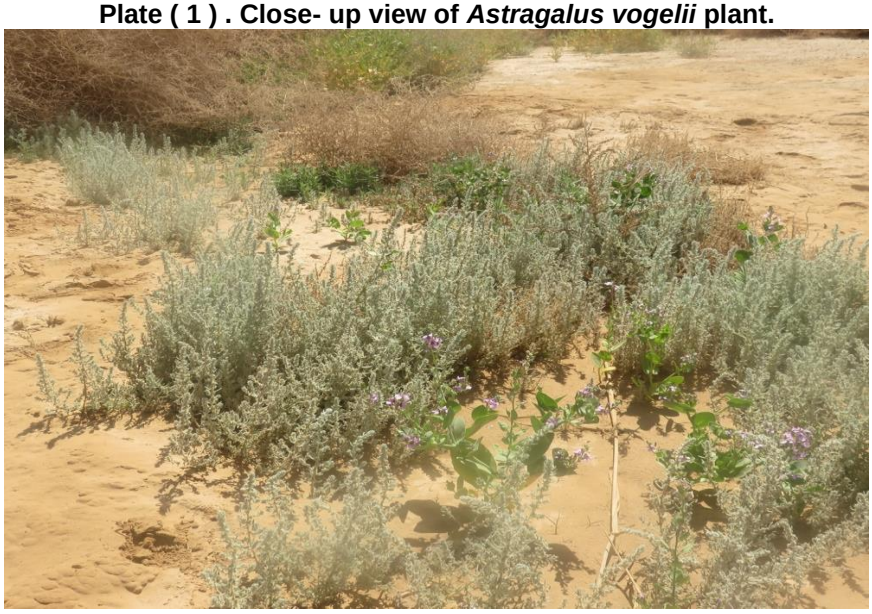


Plate (2) . A close - up view of *Bassia muricata* plants.

M. philaeana is a yellowish-green, densely woolly perennial plant ; stem ascendant, herbaceous, much branched with woody base ; leaves simple, elliptic, short petiolate, estipulate ; inflorescence is simple raceme with condensed yellow tetramerous flowers ; fruit is simple dry dehiscent siliqua, 7-12 mm long, slightly curved, tetragonous in cross section. Seeds are very small, brown and flattened, Plate (3).

Plate (3) . A close - up view of *Morettia philaeana* plants.

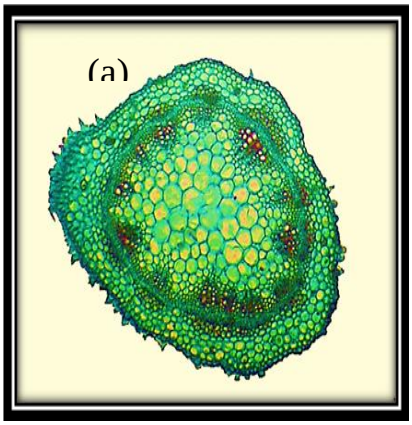
2. Anatomy

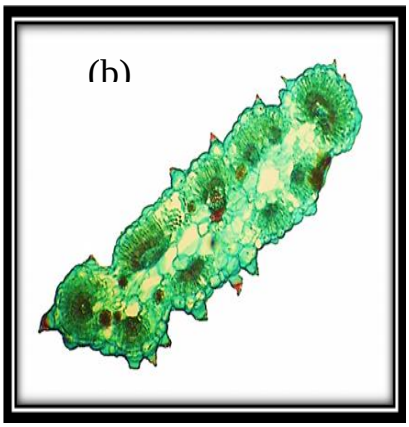
Microscopic examination of the cross-sections in stems of *A. vogelii*, *B. muricata* and *M. philaeana* revealed that, the stems of the three plants have the general characters of herbaceous dicotyledons (Fahn, 1982). They have the same tissue types, epidermis of a single layer of cells with the outer wall covered by thick protective cuticle and possess multicellular trichomes, serve mainly for restricting the rate of transpiration. The inner most layer of the cortex constitutes easily distinguishable endodermis surround the stele. The vascular bundles are a ring. The pith occupied the central portion and formed of thin-walled, hexagonal parenchymatous cells, (Plates 4a , 5a and 6a).

Transversal section of leaves of the three species showed that both upper and lower epidermis composed of tightly - packed cells with the outer walls thick cutinized and possess visible hairs. *Astragalus* leaf is isobilateral (Plate 4b) while those of *Bassia* and *Morettia* are befacial or dorsiventral. (Plates 5b and 6b).

The root of *A. vogelii* exhibits anomalous secondary thickening with rough surface periderm and the stele is triarch (Plate 4c), while those of *Bassia* and *Morettia* have normal secondary thickening and characterized by well-defined periderm. Their steles forming central solid core (Plate 5c and 6c).

The anatomical examination showed that the Cuticularization and extreme cutinization of the epidermal cells of the leaves in addition to the sheltered location of the stomata in furrows, greatly reduce are movement over stomatal areas thus prevent water loss. Also abundant hairs over entire aerial parts prevents rapid transpiration through the stomata.These xerophyte features enable these plants to survive under the extreme climatic aridity prevailing the study area.





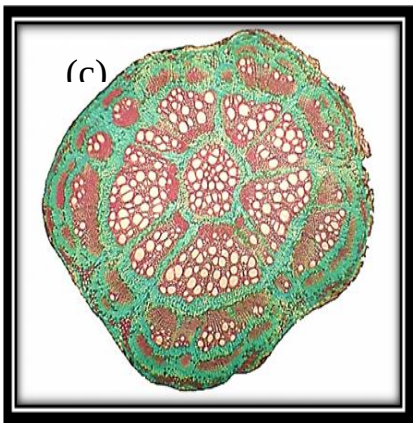
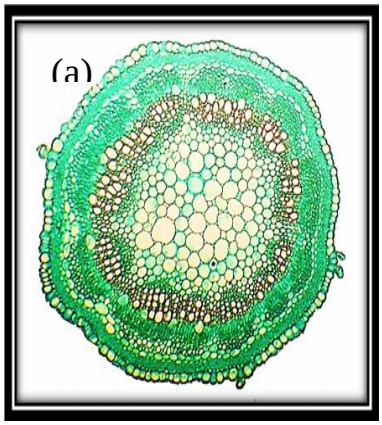
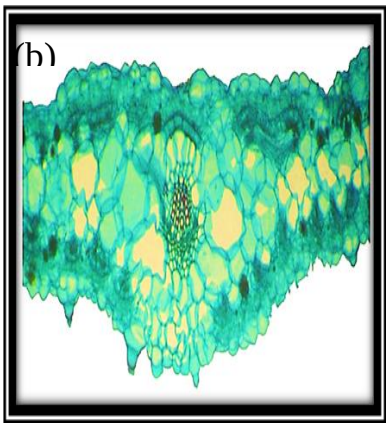


Plate (4): Light microscopy of transverse section in *A. vogelii* stem (a), leaf (b) and root (c)





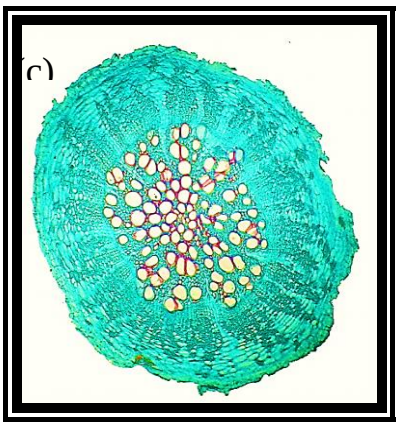


Plate (5): Cross section in stem (a), leaf (b) and root (c) of *B. muricata*

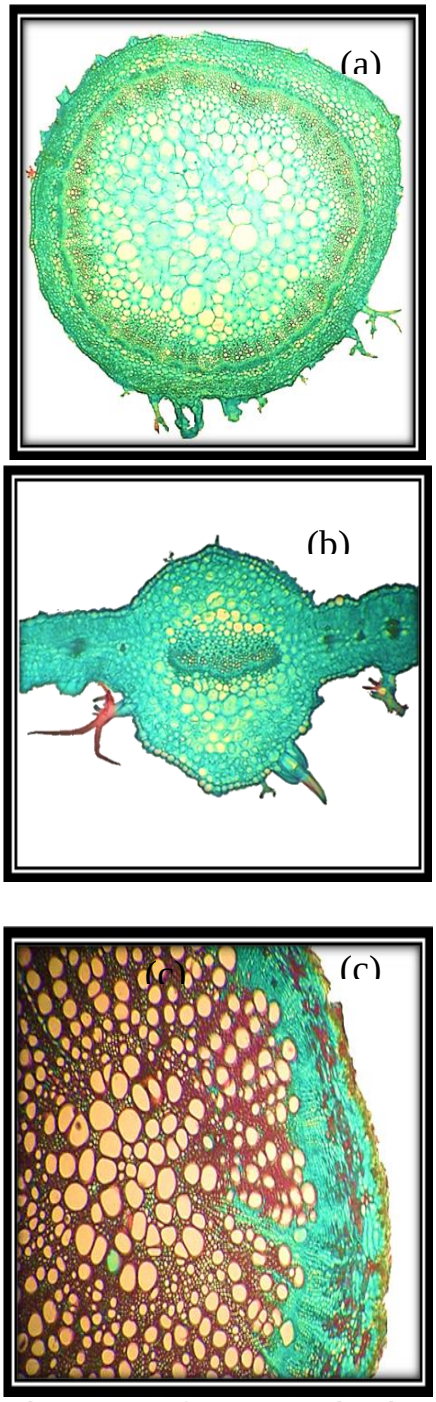


Plate (6):Light microscopy of cross section in stem (a), leaf (b) and root (c) of *M. philaeana*.

Phytochemical Investigation

Quantitative estimation of flavonoids and polyphenols

As shown in Fig.(1) the highest value of Flavonoids content (1.81 ± 0.013 %) was recorded in *Bassia*, while *Morettia* shoots attained intermediate value of 1.09 ± 0.008 %. The lowest value was that of *Astragalus* shoot (0.86 ± 0.008 %). El-Sayed *et al*. (1998) reported that, two flavonoids were extracted from aerial parts of *B. muricata*. Burham (2008) reported the presence of flavonoids in flowering parts of *M. philaeana* and nine flavonoids were identified.

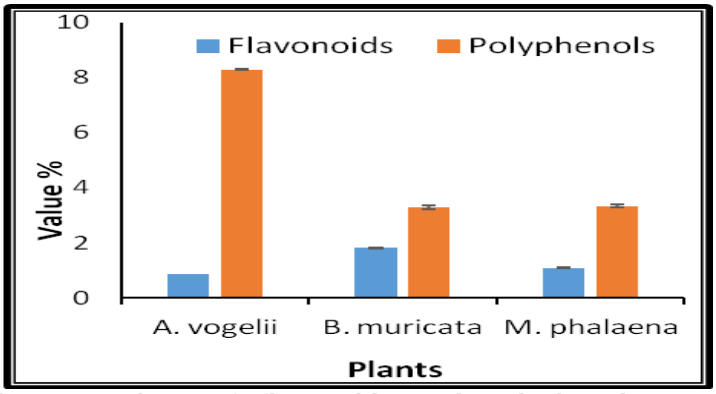


Fig.(1):Mean values of flavonoids and polyphenols contents of *Astragalus vogelii, Bassia muricata* and *Morettia philaeana* shoots.

The total polyphenols content of *A. vogelii* aerial parts was relatively higher (8.29 %) than those of *Bassia* and *Morettia* (3.28 and 3.33 %, respectively. Several beneficial properties (anti-inflammatory and anti-carinogenic) have been attributed to phenolic products and flavonoids (Kamel, *et al*., 2001).

The results of protein-amino acids investigation (Table 1) showed that, six essential amino acids were identified in aerial parts of *A. vogelii*. Among them Histidin, Lysine, Leucine, valine and threonine. Also, seven non-essential amino acids including Glutamic acid, Alanine, Glycine, Arginine, Aspartic acids and Tyrosine were detected.

Table (1): The protein amino acids content (%) of *Astragalus vogelii* shoot.

Essential amino acids	Concentration g / 100g	Non-essential amino acids	Concentration g / 100g
Histidine	0.520	Glutamic acid	11.380
Lysine	0.400	Alanine	2.480
Leucine	0.310	Glycine	1.720
Valine	0.260	Arginine	1.480
Threonine	0.043	Aspartic acid	0.850
Phenyl alanine	0.030	Tyrosine	0.460
-	-	Serine	0.100

Table (2) gives the results of the GLC analysis of fatty acids. Ten fatty acids were detected in *Bassia* shoot. The most important of these acids were Undecanoic, Linoleic, Lauric, Myristic, Palmitic and Oleic acid. On the other hand, investigation of the fatty acids content of *M. philaeana* showed the presence of twelve identified fatty acids including Tridecanoic, Myristic acid, Lauric acid, Linolenic acid, Stearic acid and Palmitic acid.

Evaluation of the antioxidant scavenging activity (DPPH) revealed that the extract of *A. vogelii* shoot has the highest antioxidant activity through other tested extracts of the studied plants (Table 3). As the rate of antioxidant activity of the plant extract rise with the rising of the phenolic content of the extract, the obtained results are in coherence with those reported by Miser-Saliboglu *et al*. (2013); Ahmed *et al*. (2012) and Cai *et al*. (2004).

Table (2): GLC analysis of fatty acids of *Bassia muricata* and *Morettia philaeana* shoot.

Fatty acids	*Bassia muricata*	*Morettia philaeana*
Undecanoic acid	0.0523	0.0205
Linoleic acid	0.0455	0.0184
Lauric acid	0.0434	0.0810
Myristic acid	0.0428	0.0923
Palmitic acid	0.0218	0.0270
Oleic acid	0.0217	0.0240
Pentadecanoic acid	0.0146	0.0145
Linolenic acid	0.0073	0.0364
Arachidonic acid	0.0054	0.0009
Lignoceric acid	0.0034	0.0020
Tridecanoic acid	-	0.1144
Stearic acid	-	0.0310

Table (3):Antioxidant scavenging activity of *Astragalus, Bassia* and *Morettia* shoots methanolic extracts using DPPH.

Plants	DPPH assay $EC_{50\%}$
Astragalus vogelii	0.815
Bassia muricata	0.191
Morettia philaeana	0.105

REFERENCES

Abbas, F. and Zayed, R. (2005): Bioactive saponins from Astragalus suberi L. growing in Yemen. Z Naturforsch 60: 813-820.

Ahmed, M. F. ; Rao, A. S. ; Ahemad, S. R. and Ibrahim, M. (2012): Phytochemical studies and antioxidant activity of *Melia azedarach* Linn leaves by DPPH scavenging assay. Int. J.Pharm. Appl., 3(1): 271–276.

Al-Yahya, M. A. ; Al-Meshal, I. A. ; Mosa, J. S. ; Al-Badr, A. and Tariq, M. (1990): Saudi plants, a phytochemical and biological approach, Vol. 64. King Saud University Press.

Asmeda, A. A. (2013): Ecology and Phytochemistry of some Taxa of Family Labiatae (Lamiaceae) M. SC. Thesis, Fac. Sci. Mansoura Univ. Egypt, P. 145.

Batanouny, K. H. (1999): Wild medicinal plants in Egypt. Acad. Sci. Res. Techn. , Egypt. Internat. Union Conservation. Egypt.

Boham, B. A. and Kocipai-Abyazan, R. (1994): Phytochemical evolution of some weeds. Pac. Sci., 48: 458-463.

Boulos, L. (1999): Flora of Egypt. (Azollaceae-oxalidaceae) Al Hadara Publishing, Cairo, Egypt. V. I, 419 pp.

Boulos, L. (2002): Flora of Egypt. (Verbenaceae-Compositae). Al Hadara Publ. Cairo, Egypt. V. IV.

Burham, B. O. (2008): Chemical constituents of selected Sudanese medicinal and aromatic plants. M.Sc. Thesis, Sudan Academy of Sciences, SAS.

Cai, Y. Z. ; Luo, Q. ; Sun, M. and Corke, H. (2004): Antioxidant activity and phenolic compounds of 112 traditional Chinese medicinal plants associated with anticancer. Life Sci., 74(17): 271–276.

El-Egami, A. A. ; Burham, B. O. and El-Kamali, H. H. (2011): Essential Oil Composition of the Flowering Aerial Parts of Sudanese *Morettia phillaeana* (Del.) DC. Current Res. J. Bio. Sci., 3(2): 100-103.

El-Sayed, A.A.M.; Saber, S.A.; El-Damhougy, K.A. and Fouda, M.M.A. (1998): The reproductive biology of grapsid crab, *Metopograpsus messor* (Forskal, 1775) from Ain Sukhna, Gulf of Suez. Egypt. J. Aquat. BioL, Fish., 2: 359-377.

Fahn, A. (1982): Plant anatomy, Ed. 3. Pergamum Press, Toronto.

Finar, I. L. (1967): Organic chemistry, 5th ed. Vol. 1, P. 212, Longmans Green & Co. Ltd., London.

Heywood, V.H.(1978):Flowering plants of the world.Mayflower Books:New York.

Jassbi A. R. ; Zamanizadehnajari S. and Azar P. A. (2002): Antibacterial diterpenoids from *Astragalus brachystachys*. Z Naturforsch, 57: 1016-1021.

Kamel, M. S. ; Mohamed, K. M. ; Hassanean, H. A. ; Ohtani, K. ; Kasai, R. and Yamasaki, K. (2001): Acylated flavonoid glycosides from *Bassia muricata*. Phytochemistry, 57(8): 1259 - 62.

Kawashty, S. A. ; Hussein, S. R. ; Marzouk, M. M. ; Ibrahim, L. F. ; Helal, M. M. I. and El Negomy, S. I. M. (2012): Flavonoid constituents from *Morettia philaeana* (Del.) DC. and their antimicrobial Activity. J. Applied Sci. Res., 8(3): 1484-1489.

Kitts, D. ; Yuan, Y. ; Wijewickreme, A. N. and Hu, C. (2000). Antioxidant properties of a North American ginseng extract. Molecular Cellular Biochem., 203: 1-10.

Lei, H. ; Wang, B. and Li, W. P. (2003): Anti-aging effect of astragalosides and its mechanism of action. Acta Pharmacol. Sin., 24: 230-234.

Liyana-Pathirana, C. M. and Shahidi, F. (2005): Antioxidant activity of commercial soft and hard wheat (*Triticum aestivum* L.) as affected by gastric pH conditions. *J. Agric. Food Chem., 53*, 2433–2440.

Maassoumi, A. A. (1998): *Astragalus* L. in the World, check list. Research Institute of Forests and Rangelands, Tehran, Iran. 618 pp.

Magomya, A. M. ; Kubmarawa, D. ; Ndahi, J. A. and Yebpella, G. G. (2014): Determination of Plant Proteins via The Kjeldahl Method And Amino Acid Analysis: A Comparative Study. International Journal of Scientific and Technology Research. 3(4): 68-72.

Miser-Salihoglu, E. ; Akaydin, G. ; Caliskan-Can, E. ; Yardim-Akaydin, S. (2013): Evalution of antioxidant activity of various herbal folk medicines. J. Nutrition and Food Sci. 3(5): 2-9.

Peacock, P. and Hradbury, S. (1973): Peacock's Elementary Micro-technique, 4th Ed., Edward Arnold.

Sadasivam, S. and Manickam, A. (2008): Biochemical Methods. 3rd ed. New Age International Limited, New Delhi.

Tsuda, K.; Sakani, K.; Tanabe, k. and Kishida, Y. (1960): Isolation of 22 dehyrocholesterol from *Hypnea japonica*. *J. Chem. Soc.,* 82:1442-1443.

Turker, H. ; Birinci Yıldırım, A. and Pehlivan Karakaş, F. (2009): Antibacterial activities of extracts from some Turkish endemic plants on common fish pathogens. Turk. J. Biol., 33: 73-78.

Yin, X. ; Zhang, Y. and Yu, J. (2006): The antioxidative eff ects of *Astragalus* saponin I Protect against development of early diabetic nephropathy. J. Pharmacol. Sci., 101: 166-173.

السمات البيولوجية والفيتوكيميائية لثلاثة أنواع نباتية بالصحراء الغربية بمصر

محمد السيد ابو زيادة ، مها محمد عبد المنعم الشامي و مصطفى جمال جلال *

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شملت الدراسة التعرف على السمات المورفولوجية والتشريحية لثلاثة انواع نباتية صحراوية تنمو بمنطقة ابو طرطور بالصحراء الغربية بمصر, وتقدير قيمة الفلافونيدات والفينولات والاحماض الامينية والاحماض الدهنية وتأثير المستخلص الميثانولي للمجموع الخضري لتلك النباتات كمضادات اكسدة .

أوضحت الدراسة المورفولوجية والتشريحية الصفات الجفافية لنباتات القتاد *Astragalus* , والغبيرة *Bassia* والتغاغا *Morettia* , حيث الشعيرات الكثيفة والادمة السميكة التي تغطي سطح الاعضاء الهوائية لتمنع تبخر الماء.

أظهر الفحص المجهري للسيقان تميزها بالصفات العامة للنبات ذوات الفلقتين , كما تميز جذر نبات القتاد بالنمو الثانوي الشاذ ووجود بريديرم سطحي رقيق بينما جذور الغبيرة و التغاغا كانت ذات نمو ثانوي عادي وبها بريديرم واضح وسميك.

كانت اعلى قيمة للمحتوى النباتي من الفلافونيدات والفينولات في الغبيرة و القتاد ,على التوالي. وتم التعرف على ستة احماض امينية اساسية و سبعة احماض امينية غير اساسية بالمجموع الخضري لنبات القتاد. و فصلت عشرة احماض دهنية من المجموع الخضري لنبات الغبيرة واثنا عشرة حمض دهني من المجموع الخضري لنبات التغاغا. كذلك أظهرت النتائج تأثير المستخلص الميثانولي للنباتات كمضادات للأكسدة.