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## Pharmacological investigations and chemical constituents of some medicinal xerophytes of thal desert, Pakistan: A Mini Review

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Natural products, exclusively derivative of plants are rich reservoirs of health sustaining components, making foundation of plant-based medicines. Plants are foundation of medications since earliest times. Xerophytes have much importance in ethnobotany and pharmacological studies. They are used for curing a large number of diseases i.e., strangury, gastro-intestinal, inflammation, ananemia, liver dysfunction, emenagogue, headache, cough, diarrhea, epilepsy, dysentery, dropsy, hemorrhage, hysteria, snakebite, hypertension, sores, cramps, stones urogenital disorders, measles, warts, tumors rheumatism, anthelmintic, antispasmodic analgesic, antihaemorrhoidal and many more. They have many biological activities like antibacterial, antifungal, antitumor, antidiabetic, anti-inflammatory, analgesic, antiterminates, antidiuretic and anti-ulcer. The aim of present review was to elaborate the importance of medicinal xerophytes along with their biological activities.

**Keywords:** Xerophytes, biological activities, pharmacological, ethnobotany, chemical constituents

### INTRODUCTION

Medicinal plants are best source to cure human ailments; containing several components those have therapeutic worth. Much growing attention in herbal medicines is observed in almost all portions of world and numerous herbal medications are combined into traditional medicinal plant training (Sethi et al. 2020). The extensive rise of tumor and progress in resistance to chemotherapeutic sources has increased interest of scientists to ethnomedicinal preparations along with isolated plants extracts in handling and inhibition of ailment. Homoeopathic plants are used in Pakistan since primitive eras (Akhtar et al. 2019). Desert vegetations which belong to numerous botanic families, such as Asteraceae, Lamiaceae, Verbenaceae,

Berberidaceae, Fabaceae and Solanaceae demonstrate much important antitumor actions (Bouyahya et al. 2020). Primitive people were fully dependent on the plants and most of their needs were accomplished by usage plants (Ikram et al. 2015).

Desert is unfertile barren zone having slight rainfall. To a significant range, its sense is reduced to just two eye-catching imageries: sand dunes inhabitations and barren, cracked earth tops (Prince and Podwojewski, 2020). Xeric land is much productive area, having diverse ecological, economical and extensive terrestrial range (Khan et al. 2017).

Xerophytes are plant species having adaptations to live in little water conditions, like desert conditions (Figure 1). Xerophytes have

much importance in ethnobotany and pharmacological studies (Farcaş et al. 2019). There are several diseases cured by using xerophytes extracts. *Peganum harmala* L. seeds and roots extracts are used in traditional medicines, pain relief and has antiseptic activities (Iranshahy et al. 2019). *Cynodon dactylon* have many biological actions like antimicrobial, antiviral, antibacterial and also has wound healing property (Ashokkumar et al. 2013). *Capparis spinosa* L. have been used to cure various human disorders like strangury, gastro-intestinal, inflammation, diuretic; and common body stimulant in original, Ayurvedic, Unani and Chinese scheme of drugs (Sher and Alyemeni, 2010). *Fagonia cretica* L. is febrifuge, prophylactic against small-pox and used for treating fever, skin diseases and stomach pain (Baquar, 1989). *Aerva javanica* hold considerable anti-ulcer action (Khan et al. 2012). *Digera muricata* L. flowers along with seeds are used for treatment of Urinary discharges (Parrotta, 2001). *Ficus bengalensis* L. have uses in Ayurveda i.e., treating piles, diarrhea, teeth and disorders of skin (Warrier et al. 1995). *Acacia modesta* has been used to treat wounds, leprosy, dysentery, cough, venereal diseases, body weakness, backache and bacterial infections (Sarwar, 2016).

#### ***Peganum harmala* L.**

*Peganum harmala* L. extractions are one of important source of drugs initiation. There are number of reports that prove pharmacological activities of this plant in the Mid-East. Particularly in Egypt, India and Iran the seeds and roots extracts have usage in traditional medications, pain relief along with antiseptic activities.

Family; Zygophyllaceae. Plant parts used; Seeds and Roots. Chemical Constituents; The frequently identified phytochemicals from *P. harmala* are flavonoids, alkaloids along with anthraquinones (Bukhari et al. 2008). The best beta-carboline alkaloids in *P.harmala* extract are tetrahydroharmine, harmine, Harmaline and harmalol (Figure 3) Moreover, dipeganine, Peganine, deoxypeganine and isopeganine (Fathizad et al. 2007).

#### **Antibacterial and Antifungal activities;**

Best antibacterial activity against gram+ bacteria are shown by the seed extract and root extract of *P. harmala*. These gram-positive bacterial species are *Bacillus pumilus*, *Staphylococcus epidermidis*, *Bacillus anthracis*, *Staphylococcus aureus* and *Listeria monocytogenes*. Gram- bacterial species are

*Escherichia coli*, *Pseudomonas aeruginosa*, *Klebsiella pneumonia*, *Brucella melitensis* and *Proteus mirabilis* (Darabpour et al. 2011). Harmine alkaloid and polyphenols applies its antibacterial activity by intercalating to DNA (Cowan, 1999). Antifungal action of *P. harmala* on species of *Candida* and *Aspergillus*, was judged *in vitro*. Alcoholic seed extracts exhibited; MIC: 0.3119 mg/ml on *C. glabrata* and MIC: 1.245 mg/ml on *C. albicans* as maximum and lowermost inhibitory property, respectively. Additionally, least fungicidal concentration of extract on *Candida* isolates was determined ranging from 0.63 to 2.45 mg/ml (Diba et al. 2011).

#### **Antitumor effect;**

Seeds extracts of *P. harmala* are mixed with the leaf extracts of *Dracocephalum kotschyii* This mixture Spinal Z, is used in treating cancer in Iran. Spinal-Z shows cytotoxic effects against entire cell lines under experience, counting HL60, HFFF-P16, A172, A2780-cp, K562, A2780-s, MCF-7, Hela, A549 Saos-2, and A375. Harmine exhibited cytotoxicity against HL60 in addition with K562 cell lines directly proves cytotoxic outcome of *P. harmala*. Harmine also exhibited cytotoxicity against breast cancer, hepatocarcinoma, myelomaovarian cancer, fibrosarcoma, melanoma, etc., (Cao et al. 2005; Jahaniani et al. 2005).

#### **Antidiabetic properties;**

Ethanollic extractions, meaningfully dropped (P<0.001) bloods glucose, close to typical and diabetic effected rats at constant dose treatments (150 & 250 mg/kg). *P. harmala* ethanollic extract has significant enhancement to able rats to use external sucrose quantity. The data undoubtedly exhibited, that extract is active as well-known oral hypoglycemic agents like metformin in dropping bloods glucose absorption afterwards sucrose test in typical and streptozotocin-induced, diabetic rat species (Singh et al. 2008).

#### ***Cynodon dactylon* L.**

*Cynodon dactylon* is generally identified as Bermuda grass. *C. dactylon* have many biological actions like antimicrobial, antibacterial and antiviral properties. Furthermore, it is used widely for traditional drugs for treating diverse illnesses like headache, hemorrhage, dysentery, diarrhea, epilepsy, dropsy, hysteria, stones urogenital disorders, snakebite, hypertension, sores, cramps, measles, warts and tumors.

Family; Poaceae. Plant part used; Whole

plant. Chemical constituents; Carbohydrates, proteins, minerals, vitamin C, palmitic acid, terpenoids, and alkaloids. Some considerable phyto-constituents described are Flavonoids: apigenin, orientin, luteolin, (Annapurna et al. 2013), Phytosterols, saponins and glycosides, (Avvarai et al. 2011) phenolics (Chou and Young, 1975), and some volatile oils (Chapman et al. 1978).

#### **Pharmacological activity;**

The aqueous along with alcoholic extractions of aerial parts exhibited wound healing activity (Dande and Khan, 2012), Anti-inflammatory (Yogesh et al. 2013), Antidiabetic (Singh et al. 2009).

#### **Antioxidant activities;**

Ethanol extracts from shoot parts of *C. dactylon* have strong DPPH free radicals scavenging action and even nitric oxide (NO<sub>2</sub>) scavenging action (Bhalerao et al. 2011).

#### **Anticancer properties;**

The treatments of 0.625 mg/ml having ethanolic extractions reported from *C. dactylon* on HT-29 of humanoid colon tumor cells line exhibited 52.6% effective anti-tumor or anticancer action (Kanimozhi and Ratha Bai, 2013).

#### **Antidiuretic activities;**

The oral management of root aqueous extract of *C. dactylon* exhibited considerable rise in urine volume at 250, 500 and 750 mg/kg dosage levels, obviously representing diuretic action in Albino rats (Shivalinge et al. 2009).

#### **Anti-inflammatory activity;**

The 50% ethanolic extract from *C. dactylon* by 300mg/kg and 600mg/kg exhibited considerable anti-inflammatory action in rodent (Dhande, 2013).

#### **Acacia modesta Wall.**

*Acacia modesta* traditionally, has been used to treat wounds, leprosy, dysentery, cough, venereal diseases, body weakness, backache and bacterial infections. Family; Fabaceae. Plant parts used; Gum, Bark leaves. Chemical constituents; Terpenoids, tannins, flavonoids, fixed oils, alkaloids, non-protein amino acids and cyclitols have been extracted *Acacia modesta* (Sarwar, 2016).

#### **Anti-hyperglycemic activity;**

Ethyl alcohol or ethanol: water (1:1) extract of the *A. modesta* leaves was given to rats,

important dropping in bloods glucose level was observed. This effect was similar to glibenclamide. Ethanol extracts, at dosage of 100 mg per kg, were about 12.34% additional potent as compared to (glibenclamide 0.20 mg/kg). Even no harmfulness was noticed in experimental rat species (Jawla et al. 2011).

#### **Analgesic activity;**

*A. modesta* methanolic extract, made by usage of acetic acid, was significantly reduced by injecting (i.p) of extracts to mice. These results were associated with typical acting morphine (Bukhari et al. 2010).

#### **Antibacterial activity;**

Methanolic extract additionally its various sections exhibited a lesser amount of action against gram+ bacteria (*Streptococcus epidermidis*, *S. aureus* and *S. pneumonia*) and gram- bacterium *Enterobacter aerogenes*. Though reasonable action was realized against gram -ive (*S. typhi*, *P. aeruginosa* and *E. coli*) (Table 1). Direct association was detected among both bacterial development, inhibition and concentration of methanolic leaf extracts (Napar et al. 2012). **Antifungal activity;** Leaves extract of *A. modesta* on agar tube dilution assay, exhibited some growth inhibition of 0.80 and 11.53% against *A. fumigatus* and *A. niger* respectively (Napar et al. 2012). **Anti-termite activity;** Anti-termite property of *A. modesta* were tested counter to *Heterotermes indicola*, a considerable action was exhibited by methanol extract (Ahmad et al. 2009).

#### **Ficus bengalensis L.**

*Ficus bengalensis* generally identified as Banyan tree. Typically having usage in Ayurveda for treating piles, teeth, diarrhea and some disorders of skin (Warrier et al. 1995).

Family; Moraceae. Parts used; Barks. Chemical constituents; Main chemical components are steroids, tannins, flavonoids and saponins.

#### **Antibacterial effect;**

The barks extract of plant has antibacterial action contrary to Enterotoxigenic *E. coli* (ETEC) at 200mg/ml concentration. The reports showed that methanolic extracts of barks exhibit considerable action associated to other solvents like chloroform, ethanol and aqueous solution against diarrhoeal patients (Uma et al. 2009).

***Digera muricata* L.**

It is generally dispersed through India. This herb is used for cooling, caustic to bowels and as laxatives. Flowers along with seeds have been used for treatment of Urinary discharges (Parrotta, 2001). Family; Amaranthaceae. Plants Parts used; Flowers, seeds and leaves.

**Chemical constituents;**

Major chemical components are Tannins, flavonoids, terpenes, saponins, alkaloids and glycosides (Figure 2).

**Antidiabetic effects;**

Methanol extract of *Digera muricata* (MEDM) leaves were exposed to phytochemical study and assessed to know antidiabetic activity in alloxan made diabetic rats. The results showed that (MEDM 200mg/kg) exhibited antihyperglycemic activity to alloxan made diabetic rat species (Jagatha and Senthilkumar, 2011).

**Antibacterial study;**

The Soxhlet extracts of *D muricata* i.e., ethanol, chloroform, proved considerable sector of inhibition against bacterial strains. The growth of *K. pneumonia*, *E. coli*, *S. aureus*, *V. cholerae* and *S. typhi* was stopped mainly at higher dose (Mathad and Mety, 2010).

***Capparis spinosa* L.**

*C. spinosa* commonly known as Caper Bush is one of multiuse plant, for curing various human disorders counting problems, strangury, gastro-intestinal, inflammation, ananemia, liver dysfunction, emmenagogue, rheumatism, anthelmintic; aperient; deobstruent; depurative; expectorant; diuretic; and common body stimulant in original, Ayurvedic, Unani and Chinese scheme of drugs. Family; Capparidaceae. Parts used; Dried fruit, root bark, leaves and floral buds (Table 1).

**Chemical constituents;**

In addition to bitter flavonoids quercetin, glycosides, rutin (Figure 3) quercetin 3-O-glucoside, quercetin 3-O-[6"- $\alpha$ -L-rhamnosyl-6"- $\beta$ -D-glucosyl]- $\beta$ -D-glucoside and quercetin 3-O-glucoside-7-O-rhamnoside, (Sushila et al. 2010). Volatile oil from *C. Spinosa* having 145 chemical compounds were recognized (Figure 2) however, major constituents was sulfur containing compounds 8.42%, esters 21%, and aldehydes 22%. Presence of capric acid, sesquiterpenes and monoterpenes were also showed (Arena et al.

2008).

**Biological activities;**

*C. spinosa* exhibits antimicrobial and photoprotective action (Tlili et al. 2009). The extracts from *C. spinosa* along with *Capparis deciduas* hold noticeable anti-inflammatory action (Table 1) (Al-Said et al. 1988). Its extracts also have action against *Plasmodium falciparum* (Arena et al. 2008). In diabetic rats, *C. spinosa* action, meaningfully condensed triglyceride levels, plasma glucose and plasma cholesterolic level (Sher et al. 2010). The floral buds extract from *C. spinosa* exhibited capability to defend against histamine-induced bronchospasm (Gadgoli and Mishra, 1999).

***Aerva javanica* (BURM. F.) JUSS. EX JA SCHULTES**

*Aerva javanica* is shrubby perennial herb sized, from 50 cm to round about 1.6m. This plant is indigenous to Sudan and is traditionally used for a number of ailments some of its uses for dismissing inflammation, wound curative purpose, elimination of swelling and roots and flowers are used to dismiss rheumatism and problems of kidney. Family; Amaranthaceae. Plant parts used; Roots and Flowers.

**Chemical constituents;**

Antraquinones, flavonoids, coumarin, condensed tannins, diterpenes, saponins, triterpenes, alkaloids, and carbohydrates (Abbas et al. 2015).

**Biological activities;**

(Reddy and Reddy, 2009) determined that ethanolic extract of *A. javanica* have hypoglycemic action at dosage of 400mg/kg as well as prevents any harm in body weightiness of investigational mice. *A. javanica* exhibited important antibacterial activity as compared to typical- streptomycin (Srinivas et al. 2012). *A. javanica* hold considerable anti-ulcer action (Khan et al. 2012).

***Fagonia cretica* L.**

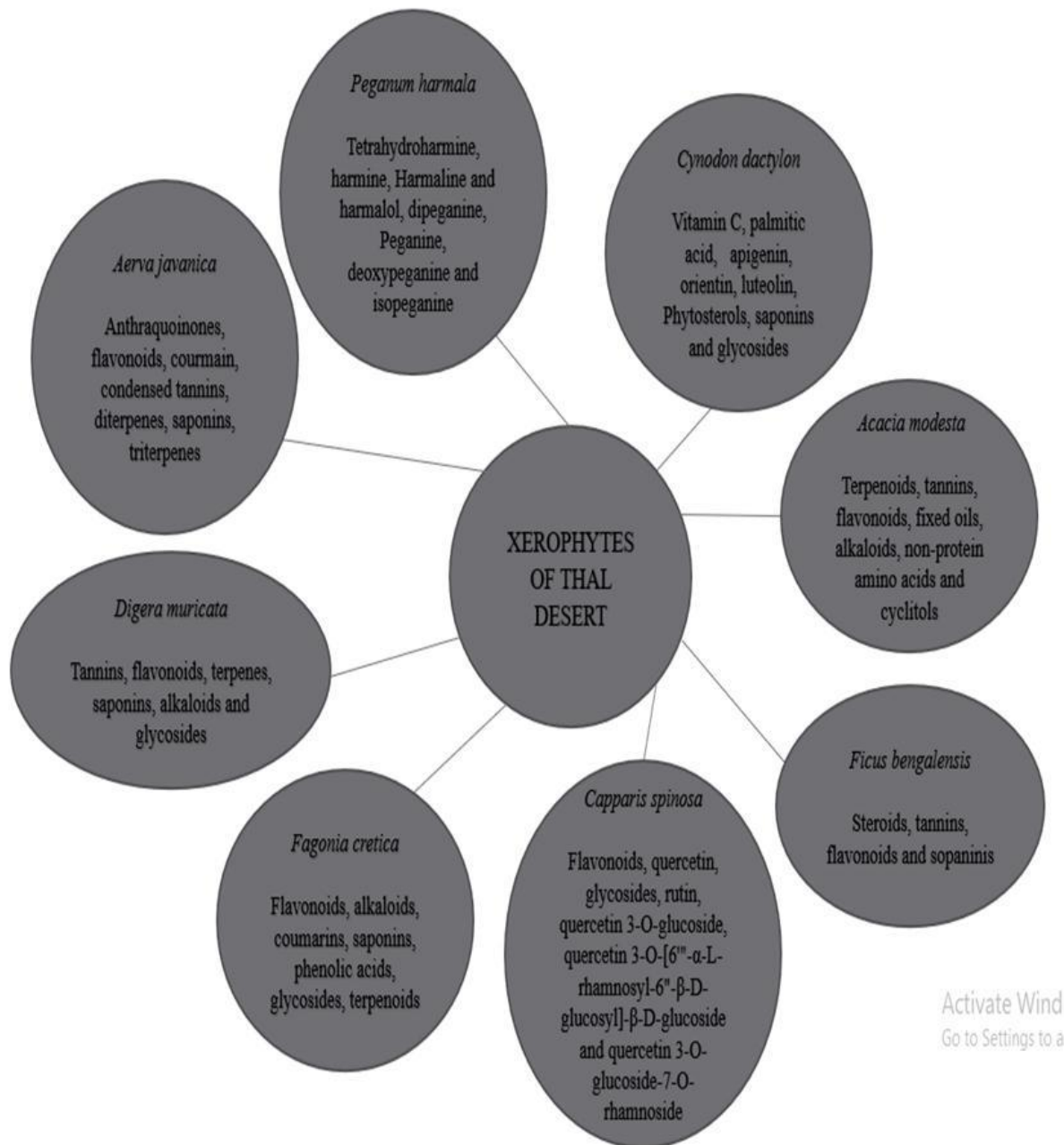
*Fagonia cretica* is febrifuge, prophylactic against small-pox and astringent. This plant is unpleasant in taste and used for treating fever, vomiting, thirst, asthma, dysentery, urinary discharges, typhoid, liver trouble, toothache, skin diseases and stomach pain (Baquar, 1989). Family; Zygophyllaceae. Plant parts used; Whole plant.

**Chemical constituents;**

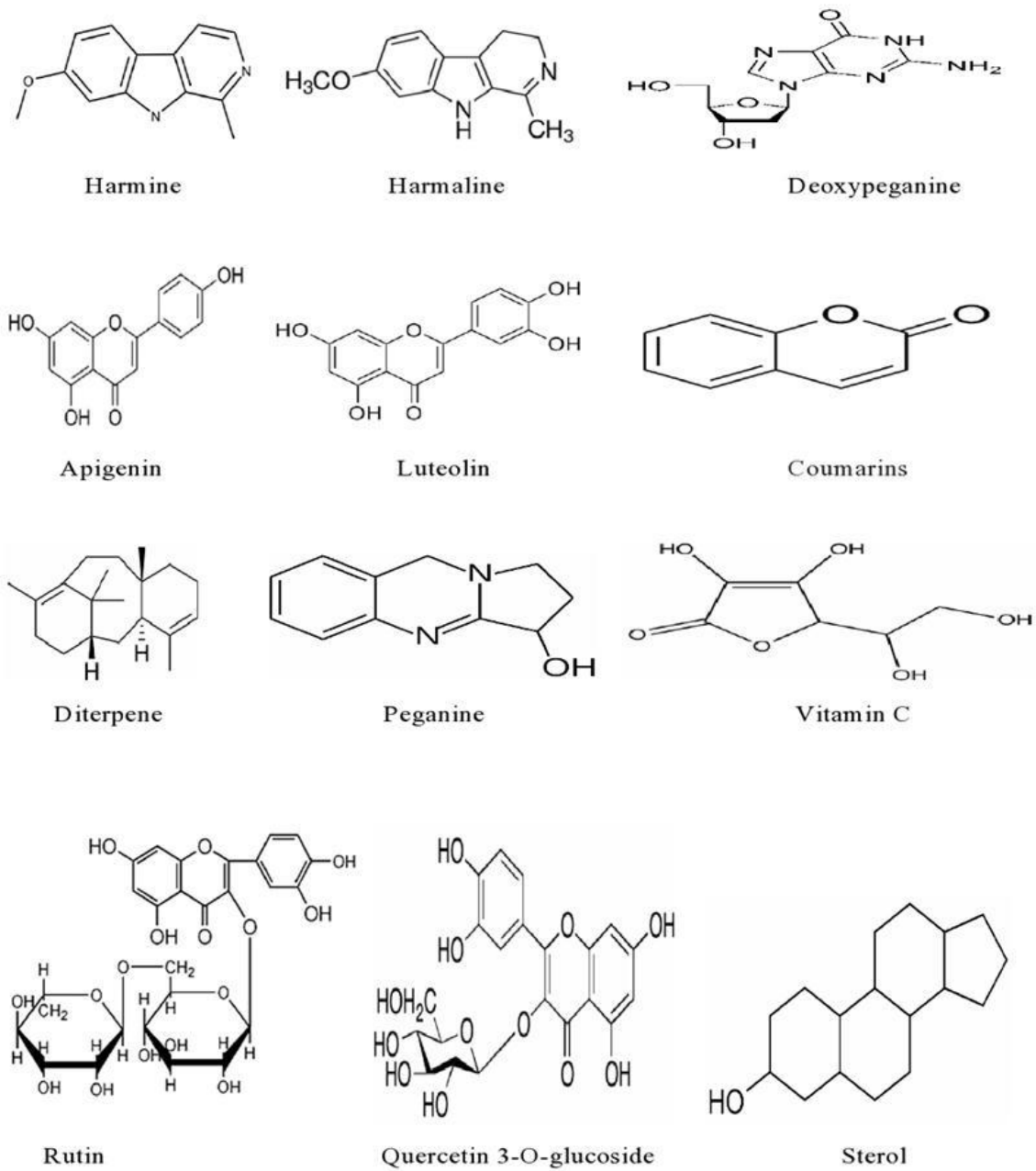
Flavonoids, alkaloids, coumarins, saponins, phenolic acids, glycosides, terpenoids, tannins and sterols.(Qureshi et al. 2016).



Figure 1: Selected Thal xerophytes grown in their natural habitat.



**Figure 2: Thal xerophytes with their main chemical constituents.**



**Figure 3: Unique chemical constituents of selected species with structural formulas.**

**Table 1: Reported Biological activities of selected Thal xerophytes.**

Xerophyte	Family	Plant parts used	Activity	References
<i>Peganum harmala</i> L.	Nitrariaceae	Seeds and Roots	Antibacterial Antifungal Antitumor Antidiabetic	(Darabpour et al. 2011) (Diba et al. 2011) (Jahaniani et al. 2005) (Singh et al. 2008)
<i>Cynodon dactylon</i> L.	Poaceae	Whole plant	Anticancer Antidiuretic Anti-inflammatory	(Kanimozhi and Ratha Bai, 2013) (Shivalinge et al. 2009) (Dhande, 2013)
<i>Acacia modesta</i> Wall	Fabaceae	Gum, Bark and leaves	Anti-hyperglycemic Anti-inflammatory Analgesic Antibacterial Antifungal	(Jawla et al. 2011) (Bukhari et al. 2010) (Napar et al. 2012)
<i>Ficus religiosa</i> L.	Moraceae	Barks	Antibacterial	(Uma et al. 2009)
<i>Ficus bengalensis</i> L.	Moraceae	Barks	Antibacterial	(Uma et al. 2009)
<i>Digera muricata</i> L.	Amaranthaceae	Flowers, seeds and leaves	Antidiabetic Antibacterial	(Jagatha and Senthilkumar, 2011) (Mathad and Mety, 2010).
<i>Capparis spinosa</i> L.	Capparaceae	Dried fruit, root bark, leaves and floral buds	Antimicrobial and photoprotective	(Tlili et al. 2009)
<i>Aerva javanica</i>	Amaranthaceae	Roots and Flowers	Hypoglycemic Anti-ulcer	(Reddy and Reddy, 2009) (Khan et al. 2012)
<i>Fagonia cretica</i> L.	Zygophyllaceae	Whole plant	Anti-cancer and cytotoxic	(Hussain et al. 2007)

**Anti-cancer and cytotoxic Activity;**

The extract of airborne parts is arranged from *Fagonia cretica* using methanol solvent. Considering traditional information, *F. cretica* has considerable antitumor action (Saeed, 1969). Poisonous effects on brine shrimps by *F. cretica* extract showed anticancer potential by (Sökmen, 2001). Weighty cytotoxic action was noticed against brine shrimps on LD50 118.89 ppm (Hussain et al. 2007).

**CONCLUSION**

As discussed in review xerophytes are important in medicines and have many chemical constituents that act against a huge number of ailments even tumors and cancer. But till now many chemical constituents of xerophytes are unknown that might be much useful. So, there is much need to do research on xerophytes.

**CONFLICT OF INTEREST**

The authors declared that present study was performed in absence of any conflict of interest.

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**AUTHOR CONTRIBUTIONS**

KA designed the manuscript. TM wrote the introduction, SJ wrote the chemical constituents portion, FA made all the illustrations, ZURM decided the title and helped in material search, YB supervised this work, MK did data analysis and reviewed the manuscript. All authors read and approved the final version.

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## REFERENCES

- Abbas NMO, El Imam YMA, Abdelmageed MA, 2015. The phytochemical analysis of the ethanolic extract of Sudanese *Aerva javanica* BURM. F. JUSS. EX JA SCHULTES. *World Journal of Pharmaceutical Research* 4 6: 2253-2263.
- Ahmad B, Ali N, Bashir S, Choudhary MI, Azam S, Khan I, 2009. Parasitocidal, antifungal and antibacterial activities of *Onosma griffithii* Vatke. *African Journal of Biotechnology* 819: 5084-87.
- Akhtar MF, Saleem A, Saleem M, 2019. A Comprehensive Review on Ethnomedicinal, Pharmacological and Phytochemical Basis of Anticancer Medicinal Plants of Pakistan. *Current cancer drug targets* 192: 120-151.
- Al-Said MS, Abdelsattar EA, Khalifa SI, El-Feraly FS, 1988. Isolation and identification of an anti-inflammatory principle from *Capparis spinosa*. *Pharmazie* 43: 640-641.
- Arena A, Bisignano G, Pavone B, Tomaino A, Bonina FP, Saija A, Cristani M, D'Arrigo M, Trombetta D, 2008. Antiviral and immunomodulatory effect of a lyophilized extract of *Capparis spinosa* L. buds. *Phytotherapy Research* 223: 313-317.
- Ashokkumar K, Selvaraj K, Muthukrishnan SD, 2013. *Cynodon dactylon* L. Pers.: An updated review of its phytochemistry and pharmacology. *J Med Plants Res* 748: 3477-3483.
- Avvarai SK, Kattamanchi G, Doni K, Anugu MR, Raju C, 2011. Anti-diabetic activity of ethanolic extract of *Cynodon dactylon* root stalks in streptozotocin induced diabetic rats. *International Journal of Advances in Pharmaceutical Research* 28:418-422.
- Aye MM, Aung HT, Sein MM, Armijos C, 2019. A review on the phytochemistry, medicinal properties and pharmacological activities of 15 selected Myanmar medicinal plants. *Molecules* 242: 293.
- Baquer SR, 1989. Medicinal and Poisonous Plants of Pakistan. *Printas Karachi* 198-199.
- Bhalerao SS, Vadnere GP, Patil AV, Chirmade HD, Patil SN, 2011. In Vitro antioxidant activity of over ground parts of *Cynodon dactylon* L. *Journal of Herbal Drug* 22:7-10.
- Bouyahya A, Belmehdi O, Benjouad A, El Hassani RA, Amzazi, S et al. 2020. Pharmacological properties and mechanism insights of Moroccan anticancer medicinal plants: What are the next steps. *Industrial Crops and Products* 147: 112-128.
- Bukhari IA, Khan RA, Gilani AH, Ahmed S, Saeed SA, 2010. Analgesic, anti-inflammatory and anti-platelet activities of the methanolic extract of *Acacia modesta* leaves. *Inflammopharmacology* 184 187-196.
- Bukhari N, Choi JH, Jeon CW, Park HW, Kim WH et al. 2008. Phytochemical Studies of the Alkaloids from *Peganum Harmala*. *Appl. Chem.* 121: 101-104.
- Cao R, Chen H, Peng W, Ma Y, Hou X, Guan H, Liu X, Xu A, 2005. Design, synthesis and *in vitro* and *in vivo* anti-tumor activities of novel beta carboline derivatives. *European Journal of Medicinal Chemistry*40: 991-1001.
- Chapman GW, Burdick D, Higman HC, Robertson JA, 1978. Steam volatiles from coastal Bermuda grass. *Journal of the Science of Food and Agriculture* 294:312-316.
- Chou CH, Young CC, 1975. Phytotoxic substances in twelve subtropical grasses. *Journal of Chemical Ecology* 12:183-193.
- Cowan MM, 1999. Plant products as antimicrobial agents. *Clinical Microbiology Revolution* 12: 564-582.
- Dande P, Khan A, 2012. Evaluation of wound healing potential of *Cynodon dactylon*. *Asian Journal of Pharmaceutical and Clinical Research* 53:161-164.
- Dhade SR, 2013. Anti-inflammatory and analgesic properties of the 50% ethanolic extract of *Cynodon dactylon*. *International Journal of Research in Pharmaceutical Sciences* 12:8-16.
- Diba K, Gerami Shoar M, Shabatkhori M, Khorshvand Z, 2011. Anti-fungal activity of alcoholic extract of *Peganum harmala* seeds. *Journal of Medicinal Plants* 523: 5550-5554.
- Farcaş AD, Moş AC, Pârvu AE, Toma V. A, Popa MA et al. 2019. In Vivo Pharmacological and Anti-inflammatory Evaluation of Xerophyte *Plantago sempervirens* Crantz. *Oxidative medicine and cellular longevity*.
- Fathizad F, Azarmi Y, Khodaie L, 2007. Pharmacological Effects of *Peganum harmala* Seeds Extract on Isolated Rat Uterus. *Iranian Journal of Pharmacological Science* 22: 81-86.
- Gadgoli C, Mishra SH, 1999. Antihepatotoxic activity of p-methoxy benzoic acid from

- Capparis spinosa*. Journal of Ethnopharmacology 66: 187-192.
- Hussain A, Zia M, Mirza B, 2007. Cytotoxic and Antitumor Potential of *Fagonia cretica* L. Turkish journal of biology 311: 19-24.
- Ikram NK, Zhan X, Pan X, King BC, Simonsen HT, 2015. Stable heterologous expression of biologically active terpenoids in green plant cells. Frontiers in plant science 6: 129.
- Iranshahy M, Bazzaz SF, Haririzadeh G, Abootorabi BZ, Mohamadi AM et al. 2019. Chemical composition and antibacterial properties of *Peganum harmala* L. *Avicenna journal of phytomedicine* 96: 530.
- Jagatha, G, Senthilkumar N, 2011. Evaluation of anti-diabetic activity of methanol extract of *digera muricata* L mart in alloxan induced diabetic rats. *International Journal of Pharmaceutical Sciences and Research* 26: 748-752.
- Jahaniani F, Ebrahimi SA, Rahbar-Roshandel N, Mahmoudian M, 2005. Xanthomicrol is the main cytotoxic component of *Dracocephalum kotschyii* and a potential anti-cancer agent. *Phytochemistry* 66: 1581-1592.
- Jawla S, Kumar Y, Khan MSY, 2011. Antimicrobial and antihyperglycemic activities of *Acacia modesta* leaves. *Pharmacologyonline* 22011 331-343.
- Kanimozhi D, Ratha BV, 2013. *In vitro* anticancer activity of ethanolic extract of *Cynodon dactylon* against HT-29 cell line. *International Journal of Current Science* 5:74-81.
- Khan A, Mehmood S, Khan RA, 2017. Ethnobotanical study of some wild herb medicinal Xerophytes of district Bannu, Khyber Pakhtunkhwa, Pakistan. *Journal of Wildlife and Ecology* 11: 37-51.
- Mathad P, Mety SS, 2010. Phytochemical and Antimicrobial Activity of *Digera Muricata* L. *Mart. Journal of Chemistry* 71: 275-280.
- Napar AA, Bux H, Zia MA, Ahmad MZ, Iqbal A et al. 2012. Antimicrobial and antioxidant activities of Mimosaceae plants; *Acacia modesta* Wall Phulai, *Prosopis cineraria* Linn. and *Prosopis juliflora* Swartz. *Journal of medicinal plants research* 615: 2962-2970.
- Parrotta JA, 2001. *Healing Plants of Peninsular India*. CABI Publishing CAB International, New York, USA 56.
- Qureshi H, Asif S, Ahmed H, Al-Kahtani HA, Hayat K, 2016. Chemical composition and medicinal significance of *Fagonia cretica*: a review. *Natural product research* 306: 625-639.
- Reddy KS, VM Reddy, 2009. *Antihyperglycaemic activity of ethanol extract of Aerva javanica leaves in alloxan-induced diabetic mice*. *Journal of Pharmacy Research*; 27: 1259-1261.
- Saeed MA, 1969. *Hamdard Pharmacopoeia of eastern medicine*. Hamdard Pharmacopoeia.
- Sarwar W, 2016. *Pharmacological and phytochemical studies on Acacia modesta Wall; A review*. *J. Phytopharmac* 5: 160-166.
- Sethi P, Gupta H, Ellakiya K, Kumar B, 2020. *Histology of a xerophytic leaflet: Cycas circinalis and Cycas revoluta Cycadaceae*. *Chemistry & Material Sciences Research Journal* 21: 6-14.
- Sher H, Al-Yemeni MN, Sher H, 2010. *Forest Resource utilization assessment for economic development of rural community, Northern parts of Pakistan*. *J. Med. Plants Res* 412: 1197-1208.
- Shivalinge GKP, Satish S, Mahesh CM, Vijay K, 2009. *Study on the diuretic activity of Cynodon dactylon root stalk extract in Albino rats*. *Research Journal of Pharmacy and Technology* 22:338-340.
- Singh AB, Chaturvedi JP, Narender T, Srivastava AK, 2008. *Preliminary studied on the hypoglycemic effect of Peganum harmala seeds ethanol extract on normal and streptozocine induced diabetic rats*. *Indian Journal of Clinical Biochemistry* 234: 391-393.
- Singh SK, Rai PK, Mehta S, Gupta RK, Watal G, 2009. *Curative effect of Cynodon dactylon against STZ induced hepatic injury in diabetic rats*. *Indian Journal of Clinical Biochemistry* 24:410-413.
- Sökmen A, 2001. *Antiviral and cytotoxic activities of extracts from the cell cultures and respective parts of some Turkish medicinal plants*. *Turkish Journal of Biology* 253: 343-350.
- Srinivas P, Reddy S, Ram, 2012. *Screening for antibacterial principle and activity of Aerva javanica Burm. f Juss. ex Schult*. *Asian Pacific Journal of Tropical Biomedicine* 22: S838-S845.
- Sushila R, Permender R, Dharmender R, Deepti R, Vikash K 2010. *Phytochemical and pharmacological Potential of Kair Capparis Decidua*. *International Journal Phytomedicine* 2: 10-17.
- Tlili N, Nasri N, Saadaori E, Khalidi A, Triki S, 2009. *Carotenoid and tocopherol composition of leaves, buds, and flowers of*

- Capparis spinosa* grown wild in Tunisia. Journal of Agricultural and Food Chemistry 5712:5381-5385.
- Uma B, Prabhakar K, Rajendran S, 2009. Invitro antimicrobial activity and phytochemical analysis of *Ficus religiosa* L. and *Ficus bengalensis* L. against Diarrhoeal Enterotoxigenic *E. coli*. Ethnobotanical leaflets 20094: 7.
- Warrier DK, Nambiar VPK, Ramankutty C, 1995. Indian Medicinal Plants 1-5 Orient Longman Ltd, Madras.
- Yogesh HS, Kidchadi SCK, Muchandi IS, Gopalakrishna B, 2013. Evaluation of Anti-Inflammatory activity of *Cynodon dactylon* Pers. On carrageenan induced paw edema in rats. Indian Journal of Natural Products and Resources 42:151-154