



PHYTOCHEMICAL AND BIOLOGICAL ACTIVITIES OF *EPHEDRA ALATA*: A REVIEW

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ABSTRACT

Ephedra alata plant is from Ephedraceae family and it is an important source of several pharmaceutical compounds such of cardiac glycosides, reducing sugars, flavonoids, phenolic compounds, and alkaloids; and as medicinal properties of this genus were reported such as antimicrobial, antioxidant, antidiabetic, hepatoprotective, cardiovascular, and anticancer effects. Previous studies have reported that *Ephedra* Herb may have applications in cancer therapy and suppressed cancer metastasis by inhibiting cancer cell motility and prevented hepatocyte growth factor (HGF)-induced cancer cell motility by inhibiting phosphorylation of the c-Met receptor.

Keywords: *Ephedra alata*, chemical compounds, plants, bioactivities.

INTRODUCTION

Herbal medicine is the oldest form of medicine known to mankind. It was the mainstay of many early civilizations and still the most widely practiced form of medicine in the world today. Ephedra is one of the largest genera of the Ephedraceae family, which is distributed in arid and semiarid regions of the world. In the traditional medicine from several countries some species from the genus are commonly used to treat asthma, cold, flu, chills, fever, headache, nasal congestion, and cough. The chemical constituents of Ephedra species have been of research interest for decades due to their contents of ephedrine-type alkaloids and its pharmacological properties. Other chemical constituents such as phenolic and amino acid derivatives also have resulted attractive and have provided evidence-based supporting of the ethnomedical uses of the Ephedra species. In recent years, research has been expanded to explore the endophytic fungal diversity associated to Ephedra species, as well as, the chemical constituents derived from these fungi and their pharmacological bioprospecting [1]. Ephedra alata is distributed in Africa: Algeria; Egypt, Libyan, Morocco, Tunisia, Mauritania, Chad, Mali and in Asia: Saudi Arabia, Iraq, Iran, Palestine, Lebanon, Jordan and Syria [2]. The preliminary phytochemical analyses of Ephedra alata indicated the presence of cardiac glycosides, reducing sugars, flavonoids, phenolic compounds and alkaloids [3]. Phenolic compounds included chlorogenic acid, rutin, catechin, quercetin, coumaric acid were obtained from callus of *Ephedra alata* maintained in the media containing casein hydrolysate [4]. Different parts of *Ephedra alata* plant showed many of biological effects as Antioxidant effect, Hypoglycemic effect, Hepatoprotective effect, antimicrobial effects. The present review provides phytochemistry, and pharmacological properties of *Ephedra alata*.

Chemical Compounds:

Flavonoid isolated from *Ephedra alata* were included Vicenin II, lucenin III, kaempferol 3-rhamnoside, quercetin 3-rhamnoside, herbacetin 7-glucoside, herbacetin 8-methyl ether 3-O- glucoside-7-O-utinoside and herbacetin 7-O-(6''-quinynglucoside [5]. Total flavonoid contents of *Ephedra alata* were determined by using rutin reference standard method and total phenols were determined by using Folin Ciocalteu method. The total phenolic content was highest in the methanolic extract (47.62 mg gallic acid equivalent/g of extract powder), while in ethanolic extract, the total phenolic content was 19.175 mg gallic acid equivalent/g of extract powder. The total flavonoid content of the plant was 0.519 mg rutin /g in the aqueous extract and 5.44 mg RU/g in the ethanolic extract while was the highest in the methanolic extract 54.66 mg rutin /g [3]. Furanofuran lignan (\pm)-syringaresinol, digalloylglucose, nilocitin, p-coumaric acid and a new natural alkaloid, ephedrone were obtained from the *Ephedra alata* [6]. Many acids including: 2-propenoic acid, 3-phenyl (18.19%), benzoic acid (7.60%), 2-propenoic acid, 3-phenyl- methy, (2.17%), benzene- acetic acid, alpha.-hydrox (1.43%), benzene -dicarboxylic acid, diis 1.2- (1.41%), hexadecanoic acid - (1.21%), benzoic acid 4-hydroxy, acid ethyl ester (1.17%) and benzene - propanoic acid (1.15%), were isolated from dichloromethane extract of *Ephedra alata* leaves [7]. The dichloromethane extracts of aerial parts from *Ephedra alata* afford 52 compounds in leaves and 65 compounds in flowers. The main compounds of the leaves are: 2-propenoic acid, 3-phenyl (18.194%); phenol, 4-(3-hydroxy-1-propenyl) (7.881%), benzoic acid (8.521%), benzaldehyde, 4-hydroxy-3,5-dimethyl

(7.036%); benzaldehyde, 4-hydroxy- 3-methoxy (4.381%). On the other hand the flowers contain some important compounds such as benzoic acid (16.874%), 2- propenoic acid, 3- phenyl (11.453%), 1,2-benzenedicarboxylic acid, diis (5.112%), benzenemethanol (3.675%) and benzeneethanol (3.645%) [8].

Bioactivities:

Antioxidant effect:

The antioxidant activity of *Ephedra alata* was evaluated by 2, 2-diphenyl-1-picryl-hydrazyl-hydrate assay. *Ephedra alata* methanolic extract showed high antioxidant activity and powerful oxygen free radical scavenging abilities, the IC₅₀ for the plant was almost equivalent to the Trolox standard antioxidant [3].

Hypoglycemic effect:

Alcoholic extract of *Ephedra alata* exerted hypoglycemia, one hour after administration to fasting rats. The same extract failed to reduce blood glucose levels in alloxanized rats compared to the positive control, glibenclamide [9].

Antimicrobial effects:

Antimicrobial activity of different extracts of *Ephedra alata* stem was investigated against bacteria, yeast and fungi. Four bacteria, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Bacillus subtilis*, and *Escherichia coli* and four fungi, *Aspergillus fumigatus*, *Penicillium italicum*, *Syncephalastrum racemosum*, and *Candida albicans* were used as test microorganisms. Acetonitrile extracts exhibited the most potent antimicrobial effect with a broad spectral range. Thin layer chromatographic separation of active constituents in acetonitrile extracts revealed the presence of seven fractions. All fractions showed antimicrobial activities with four fractions having a potent inhibitory effect [10].

Diuretic effect:

It was reported that alkaloids from *Ephedra* stem have the function of clearing and regulating the distribution and excretion of water in vivo to exert the diuretic and antioncotic effects, and D-pseudoephedrine shows the strongest pharmacological activity among all the alkaloids. Experiment results showed that urine volume can be extended to two to five times that of pre-dose when anesthetized dogs are intravenously injected with D-pseudoephedrine (0.5–1.0 mg·kg⁻¹), and the pharmacological time of single administration can reach 30–60 min [11]

Analgesic and Hypolipidaemic Effects:

The histological study confirmed the biochemical results. According to the results of the analgesic activity, the extract of *E. alata* induced a significant decrease in abdominal writhings compared to the control group and the values obtained are very close to those obtained with indomethacin [12].

CONCLUSION

Ephedra alata plant is an important source of different phytochemical constituents and of various biological effects.

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