Pharmacology of the species Equisetum (Equisetum arvense)

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Abstract

The greater Equisetum arvense is an herbaceous plant from the family Equisetaceae commonly found in North America, Europe and Asia. The plant has been used since ancient times in medical practice because of its pharmacological applications, and the presence of many biologically active compounds, including flavonoids, alkaloids, carbohydrate, proteins and amino acids, phytosterols, saponins and sterols. Scientific data reveals the existence of 0.6 to 0.9% flavonoids including apigenin glucoside, genkwanin glucoside, kaempferol glucoside, kaempferol sophoroside, luteolin glucoside, quercetin glucoside. It also contained caffeic acid, 5-7.7% silicic acid and alkaloids.

Keywords: Kaempferol glucoside; Equisetum; Amino acids; Pharmacology; Saponins

1. Introduction

Searching for antitumor agents is the most intensive segment in the development of new drugs. Modern approach to the research focused on finding compounds which affect important processes in tumor development, progression and metastasis. Very important source of new drugs represents bioactive components of natural products. Nowadays, plants are known as a rich source of compounds with antioxidative and immunomodulatory properties [1]. Description and medicinal uses of Equisetum arvense are monographed in the European Pharmacopoeia and in a national pharmacopoeia, and reported in well-established documents. A number of pharmacological properties, e.g. anti-inflammatory [2], antioxidant [3], Antileishmanial [4], antimicrobial [5], Anti-platelet aggregation [6]. Cytotoxic and anticarcinogenic [7] have been reviewed and supported by clinical data. By virtue of these properties E. arvense is widely used in alternative medicine to treat liver diseases, eases the pain of rheumatism and stimulates the healing of chilblains, benefit for cardiovascular problems, stop bleeding, heal ulcers and wounds, treat tuberculosis and kidney problems [8-9-10-11]. Antitumor actions of this plant have been studied in many in vitro and in vivo experiments. Also, a few clinical trials suggested beneficial effect of E. arvanse in the management of human cancer [11-12-13-7].

2. Pharmacological activity of Equisetum arvense

Several studies have described different biological effects of Equisetum arvense L. extract or tea with natural extract, such as antioxidant, anti-inflammatory, antibacterial, antifungal, vasorelaxant, neuro and cardio protectors [14-10] and antiproliferative properties [11-15].

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2.1. Anti-inflammatory

*Equisetum arvense* have anti-inflammatory properties for the treatment of wounds or inflammatory diseases such as arthritis have been described [16-17]. However, to date, there are no studies on the impact of *Equisetum arvense* extracts on lymphocytes involved in inflammatory immune processes. Lymphocytes are the body's second line of defense and T cells are actively recruited to sites of inflammation where they maintain and activate fibroblasts or bystander dendritic cells and macro-phages, transforming them into tissue-destructive effector cells [18]. T-lymphocytes are the dominant cells in inflammatory immune diseases [19-20], and their proliferation and mediator release (IFN-γ, TNF-α) are targets for modern therapies [21]. Immunosuppressants such as glucocorticoids [22] or calcineurin inhibitors, e.g., cyclosporine A, which specifically down-regulate the immune system [21], are the established treatment of choice. Despite the availability of effective conventional medications, approximately 60-90% of patients with inflammatory immune disorders re-sort to alternative or complementary therapies to avoid side effects [23].

2.2. Antimicrobial activity

Worldwide, research has shown an increased interest in the phytochemical products of *E. arvense*, due to its various biological effect such as cytotoxicity, antibacterial, antifungal and antituberculosis potentials and treatment of many diseases [24]. Several studies have demonstrated that phytochemical compounds of *Equisetum arvense* L. are flavonoids, phenolic acids, alkaloids, phytosterols, tannins, triterpenoids saponins, aconite, oxalic and malic acid, resins, pectin, vitamin C, carotenoids and mineral substances [25-5]. Several studies have shown that polyphenols from *E. arvense* can be an alternative to antibiotics against microbial pathogens [26] and overcome to various microbial infections that associated with antibiotic failure, form biofilm, both are require more active of biochemical agents with complementary action or synergic effect with antibiotherapy. Starting from the previously obtained results, were shown The alcoholic and aqueous extracts of the aerial parts of *Equisetum arvense* displayed antibacterial activity against *Escherichia coli*, *Staphylococcus epidermidis*, *Staphylococcus aureus*, *Klebsiella pneumonia*, *Pseudomonas aeruginosa* and *Salmonella enteritidis* and anti-candida activity property against Candida species, such as *C. albicans*, *C. glabrata*, and *C. krusei*. Using disc diffusion technique. The mean inhibition zone of *Equisetum arvense* extract against Gram positive and Gram negative bacteria increased with the increasing concentration of the extract. The highest mean zone of inhibition 32 mm was recorded against *Escherichia coli* [27]. [28] evaluated the antibacterial activity of *Equisetum arvense* on urinary tract pathogens such as *Klebsiella pneumoniae*, *Proteus mirabilis*, *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Staphylococcus saprophyticus* by disc diffusion technique concentrations 250, 500 and 1000 μg/disc. The inactivated effects of *Equisetum arvense* against many microbes due to its composition rich with an essential oil which inactivated the microbial adhesion proteins and transport proteins and induced the rupture in the membrane of microbes [29]. In addition, the phenolic compounds in the plant extracts reduced the generation of ROS which induced by bacterial lipopolysaccharides or *Candida albicans* due to trapping free radicals directly or scavenging ROS by reactions with antioxidant enzymes [30]. Moreover, the alcoholic extract was found to be more effective than choloroform extracts, other hand, the extract prepared from plant from the summer season was more effective than from winter season [31]. Significant higher cytotoxic activity and antimicrobial activity capacity were processed with either extraction medium containing 90% ethanol for 12 hours, or ethanol 80% of *Equisetum arvense* [32].

2.3. Antioxidant or free radical scavenger

*Equisetum arvense* extract possess free radical scavenging activity. So, it acts as an antioxidant. Water extract and ethanol extract from top and body portions of field horsetail (tsukushi) were prepared and the antioxidative activity was investigated 8. The scavenger activity of *E. arvense*, *E. romossimun*, and *E. telmateia* aboveground parts phosphate buffer (pH 7) extracts were evaluated using three different methods: DPPH assay, ESR and NO radical inhibition assay.

Total reducing power was determined by FRAP assay. The free radical scavenging activity of some Mongolian herbs was also carried out using electron spin resonance (ESR) spectrometer and chemiluminescence (CL) analyzer [33].

3. Immunomodulatory activity

3.1. Anticancer

Plants and plant-derived compounds have been used since ages as a major source for treating diseases in human [34]. Considering their high efficacy and low side effects, they have become the first priority of pharmaceutical industries. Therefore, there is a growing demand for screening plant-derived compounds against many complicated diseases, including cancer, diabetes, and obesity and so on. Hence, for the treatment of disease states, wherein drug therapy is a rational approach, plant materials represent legitimate starting materials for the discovery of new agents. In the case of human cancers, thus far, nine plant-derived compounds have been approved for clinical use as anticancer drugs in the
United States [35]. However, still, most of the patients treated for cancer die from its treatment. Therefore, there is need of development of new and effective anticancer drugs. Nevertheless, there are many plant-derived anticancer drugs currently used for the treatment of cancer [36]. *Equisetum arvense* [horsetail] is widely used in Saudi Arabia for generations as a traditional medicine for kidney related disorders, diuretics, gastroenteritis and urinary infections. The plant belongs to family Equisetaceae and has been used throughout the world, particularly, in the Middle East, Canada, Europe, and some Asian countries [37]. In this study, the Anticancer, antidiabetic and antibacterial activities ethanolic extract of *Equisetum arvense* was evaluated.

### 3.2. Toxic potential

Tens of thousands of plant species are used medicinally [38] and a substantial portion of the world's population depends on traditional medicine. In recent decades, public interest in herbal products has grown [39-39-41] but these products are not always regulated. The safety of herbal products can be compromised through accidental adulteration, misidentification and deliberate contamination [42-43] which can lead to severe side effects due to the presence of toxic compounds [44].

Preclinical studies have revealed various pharmacological actions of *Equisetum arvense*, including antioxidant [9-45] and antidiabetic [46-47] properties, but no acute hepatotoxicity [48]. The health regulatory agencies of the Federal Republic of Germany established the German Commission E in 1974. This commission approved the use of *Equisetum arvense* for the treatment of posttraumatic and static edema and as a diuretic for bacterial and inflammatory diseases of the urinary tract presenting with urinary sediment [49]. Topical use as an adjuvant for the treatment of wounds that exhibit difficult healing has been reported [1-50]. However, *E. arvense* does not satisfy the requirements as a well-established medicine, despite an ancient tradition of use because clinical studies of its effects on renal function and safety are lacking. The "Assessment of Medicinal Products for Human Use" of the European Medicines Agencies concluded that clinical data on the absorption, distribution, and pharmacokinetics of *Equisetum arvense* are scarce or completely lacking [49-51].

### 4. Conclusion

The paper reviewed *Equisetum arvense* as promising medicinal plant with wide range of pharmacological activities which could be utilized in several medical applications because of its effectiveness and safety.

### Compliance with ethical standards

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**Disclosure of conflict of interest**

All authors of the manuscript have no conflict of interests to declare.

### References


