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Review Article

A Review on *Equisetum ramosissimum*

Mohd. Yusuf^{1*}, Alankar Shrivastav², Mayur Porwal², Najam Ali Khan¹¹ Department of Pharmacology, School of Pharmaceutical Science, IFTM University, Moradabad, India² Department of Pharmacology, Pharmacy Academy, IFTM University, Moradabad, India

ABSTRACT

Equisetum ramosissimum (Roxb. Ex Voucher) Hauke commonly known as field horsetail is a plant with wide prospectus. In folk medicine, *Equisetum ramosissimum* is used for tuberculosis, as a catarrh in the kidney and bladder regions, as a hemostatic for profuse menstruation, nasal, pulmonary and gastric hemorrhages, for brittle fingernails and loss of hair, for rheumatic diseases, for CNS system, for diuretics, HIV and immune system, for cytotoxic, vasorelaxant, hepatoprotective, cosmetics, astringents and anti-cancer disease, swelling and fractures and for frostbite (PDR for herbal Medicines) etc. The plant is reported to contain a number flavonoids, alkaloids, phenolic proteins, triterpenoids, saponins, phytosterols; the present review is an attempt to generate interest among the masses regarding its immense potential in preventing and treating several disorders.

Keywords *Equisetum ramosissimum*, Diabetic, flavonoids, Plant

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*Address for Correspondence:

Mohd. Yusuf, Department of Pharmacology, School of Pharmaceutical Sciences, IFTM University, Moradabad, India

Introduction

Around 80% of the world population uses the herbal medicines for primary health care mostly in the developing countries ¹. Because of their safety, efficacy, cultural acceptability, better compatibility with human body and lesser side effects, they stood still. There will be mention about the usage of herbal medicines for age-related diseases such as memory loss, diabetic wounds, osteoporosis, and immune and liver disorders in various ancient literatures, for which no modern medicine or only palliative therapy is available. Some of the life-saving and essential drugs discovered from medicinal plants such as digoxin, morphine, emetine, aspirin, and ephedrine will be known to modern therapeutics several centuries ago. There will be a statement described by Namdeo about secondary metabolites derived from plants; he stated that about a 1/4th of all suggested pharmaceuticals in developed countries containing compounds that are directly or indirectly derived from plants. There is a belief that green medicine is safe and trustworthy ²

Today, there is a wide spread curiosity in drugs derived from plants. At present, many pharmaceutical companies are concentrating extensive research on plant materials for their potential medicinal value. As per the World Health

Organization, 4 billion people (80%) of the world population are using plant-derived products as medicine for some aspect of primary health care. Out of 119 plant-derived medicines, approximately 74% are used nowadays that are directly correlated with their traditional practice as plant medicines by native cultures ³.

Hyperlipidemia is one of the major risk factors causing cardiovascular diseases (CVDs). CVDs accounts for one third of total death around the world, it is believed that CVDs will turn out to be the main cause of death and disability worldwide by the year 2020. Hyperlipidemia is an increase plasma lipid profile levels, including cholesterol, cholesterol esters, triglycerides and phospholipids and or plasma lipoproteins including very low-density lipoprotein and low-density lipoprotein, and reduced high density lipoprotein levels. Hypercholesterolemia and hypertriglyceridemia are the main cause of atherosclerosis which is strongly related to ischemic heart disease (IHD). There is a strong relation between IHD and the high mortality rate. Furthermore elevated plasma cholesterol levels cause more than four million deaths in a year ⁴

Atherosclerosis is one of the leading causes of death in the world both in developed countries and as well as developing countries like India. The elevated levels of low-density lipoprotein (LDL) and very LDLs (VLDLs) associated with

cholesterol and triglycerides (TGs) are one of the primary risk factors for atherosclerosis. B targeting the atherogenic process, we can treat hyperlipidemia is one of the palliative treatment approaches for atherosclerosis (Moss and Dajani, 1971) ⁵

A wide number of allopathic antihypolipidemics are available in the market, but they will be not popularized due to their side effects and contraindications. To overcome that recently herbal hypolipidemics have gained importance to fill the voids. ⁶

The use of the synthetic medicines however, has some negative effects. Side effects of these synthetic medicines have also been reported. Despite the availability of useful non-drug therapy and potent medications, treatment is too often ineffective, mainly as a consequence of the patient's lack of compliance with therapeutic regimens. Moreover, because of limited resources, synthetic drug treatment may not be affordable to the majority of hyperlipidemic patients.

Equisetum, commonly known as horsetail and scouring rushes, is the only living genus of the class Equisetopsida. *Equisetum* comprises more than 15 species worldwide except Australasia and Antarctica of which 4 species are reported from India till date. The westernmost state, Gujarat accounts only one species. ⁷

Performed Scientific Name ⁸

International Common Names

Arabic: kinbat, kinbat -el-hokol, thail-el-faras, thanbel-faras;

English: common horsetail;

French: prele des champs;

German: akerschachtelhalm

Japanese: sugi-na, tsukushi;

Spanish: cola de an caballo;

Swedish: akerfraken

Trade Name: *Equisetum ramosissimum*

Chemical Constituents

The diversity of species increases from the equator to the temperate zone in the northern hemisphere, whereas there are only four species in the southern Hemisphere. In Bangladesh, *E. debile* widely distributed in Chittagong and Jessore, mostly in shady hills and stream banks. This plant is administered as a cooling medicine; given for the treatment of gonorrhoea and bone fractures. Decoction of plant is used for nasal polypus, various cancers of breast, liver, intestine, stomach, kidneys and tongue. Previous phytochemical investigations resulted in the isolation of pinocembrin, chrysin, β -sitosterol, β -Diglycosylsitosterol, β -D-glucose, flavonoid glycosides and fatty acids, flavonoid, glycosides (kaempferol 3-O-sophorose, kaempferol 3,7-O- β -D-diglucoopyranoside, kaempferol 3-O-sophorose-7-O- β -D-glucoopyranoside, kaempferol 3-O-sophorose and Caffeoyl-methylate-4- β -gluco-puranoside), megastigmane diglucoide(3S,5R,6S,7E,9S)- megastigmane-7-ene-5, 6-epoxy-3,9 diol 3,9 diol, 3,9-O- β -D-diglucoopyranoside, (6R,9S)-3-oxo-a-ionol 9-O- β -D-gluopyranoside, (3S,5R,6S,7E,9S)-9-[(β -D-glucoopyranosyl)oxy] megastigmane-7-ene-3,5,6-triol), phenylethyl-O- β -D-glucoopyranoside, (Z)-3-hexenyl-O- β -D-glucoopyranoside, L-tryptophan and debilosides A-C; Blumenol A, corchoinoside C, sammangaoside A15 ⁸.

In vivo Pharmacological Activities

1. Activity on the central nervous system

The research of influence at 5th plant collections on nervous system is carried out. They consist of *Equisetum arvense* (grass), *Galium verum*, *Plantago major* (leaves), *Achillea millefolium* (grass), *Leonurus quinquelobatus* and/or cardiac (grass) *Rubus caesius* (leave), *Filipendula hexepetala* (flowers), and *Calendula officinalis* (flowers).

The collection No.1 consisting from a grass of *Equisetum arvens*, grass of *Galium verum*, leaves of *Plantago major* grass of *Achillea millefolium*, and grass of *Leonurus*, will be the most active. It has the greatest synergism to barbiturates, more than others it increases barriers of emotional response at animals and also has the greatest anticonvulsive effect. ⁹

The hydroalcoholic (HAE) extract of *Equisetum arvense* reverse the cognitive impairment in aged rats. Chronic administration of (HAE) at dose of 50mg/kg, i.p, improved both short and long term retention of inhibitory avoidance task and ameliorated the cognitive performance in reference and working memory version of the Morris water maze. ¹⁰

2. Activity in benign prostate hyperplasia

The extracts of *Chimaphila umbellata*, *Populus tremula*, *Pulsatilla pratensis* and *E. arvense* and a traditional formulation composed of these four plants, called Eviprostat popularly used in Japan in vivo to evaluate their anti-inflammatory and anti-oxidant effects. ¹¹

The researchers observed anti-inflammatory activities in the formulation and in the pure extracts, justifying its therapeutic use in BPH. ¹²

3. Cytarizing activity

A 5% aqueous extracts of *E. ramosissimum* accelerated dermal wound contractions in rabbits, which will be more effective than the control treatment (0.9% sodium chloride and 10% povidone iodine solution) after 14 days of local administration. In another study, ointments prepared with 5% and 10% powder from the stems of *E. ramosissimum* shows significant dermal wound healing activity in rats with 95.26% (5% ointment) and 99.96% (10% ointment) contraction of wound area, suggesting higher dermal and epidermal regeneration, angiogenesis and increased thickness in the granulation tissue after 14 days of treatment prepared with controls. ¹³

4. Analgesic and anti-inflammatory activity

It is a widely used anti-inflammatory agent. Anti-inflammatory effect as evaluated in mice by applying hydroalcoholic extracts of horsetail to mice. Due to its anti-inflammatory property it is used to treat, arthritis, chilblains, cystitis, gout, inflammation of the lower urinary tract, renal gravel. It is considered as a specific remedy in cases of inflammation or benign enlargement of the prostate gland. The makes a good will be for wounds, sores, skin problems and a gargle for mouth and gum inflammations. ¹⁴

5. Remineralizing activity

A study evaluating the level and distribution of calcium, magnesium, iron and copper in 6 species of medicinal plants, including *E. arvense*, concluded that a small fraction of these minerals can be considered bioavailable when an infusion of the herbal drug is administered orally. ¹⁵

Another study showed that the concentration of silicon in *E. arvense* is approximately 5% w/w, whereas water extractable silicon will be 0.3% w/w. The authors concluded that this

mineral does not contribute to the medicinal benefits of *E.arvense*.¹⁶

However, low and exley demonstrated the presence of silicon in all parts of *E. arvense plants*. The deposition sites of this mineral mimicked the places and structure where beta-glucan hemicellulose is found, suggesting that this polysaccharide could be the basis for silicon deposition in *E. arvense*. Beta glucan hemicellulose induced the formation and precipitation of silicon, suggesting that beta-glucan, and perhaps other similar carbohydrates, might be key molecules in biological signification.¹⁷

6. Diuretics

While 1st acts as a mild diuretic, its toning and astringent action make it of value in the treatment of incontinence and bed-wetting in children. As a diuretic it is particularly suited to metabolic or hormonal oedema during the menopause. It possesses a great capacity to eliminate water from the body; in such a point to increase urination up to 30% more than what is habitual. This fact makes that its scientific name *Equisetum arvense* generally appears in the composition of most of its property is due to the action of several components, among which it is necessary to highlight equisetin and potassium, but there are other ones that also take part such as calcium, magnesium, ascorbic acid and caffeic acid.¹⁸

In-vitro Pharmacological activity

1. Anti-platelets

Reported that the aqueous extract of *E.arvense* inhibited thrombin and ADP-induced aggregation in vivo, indicating slight inhibition of platelet aggregation. The authors suggest that this effect might be associated, in part, with the polyphenolic compounds present in the extracts.¹⁹

In another study, 38% and 84% anti-thrombin activity will be reported in ethanolic and dichloromethane extracts of *E.arvense* respectively.²⁰

2. Anti-microbial

Several microbial agents (bacteria, fungi and viruses) will be used to evaluate the in vitro antimicrobial activity of *E.arvense* extracts obtained using different solvents (water, ethanol, methanol and dichloromethane), with conflicting results. In a recent study conducted in Brazil, the glycolic extract of *E. arvense* exhibited effective antimicrobial activity against *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Streptococcus mutans*, *Candida albicans*, *Candida tropicalis* and *Candida glabrata*.²¹

3. Cytotoxic

Different *E.arvense* extracts produce cell growth inhibition depending on the cell line and on the type and concentration of the extract used. An extract containing ethyl acetate showed a prominent antiproliferative effect, without inducing cell growth in human tumor cell lines (HeLa, HT-29 and MCF7) ²² A Dose dependent cytotoxic effect on human leukemia cells (U937) will be reported for the aqueous extract of this plant. ²³

A protein obtained from the crude extract of *E. arvense* inhibited the growth of L1210 leukemia cells, HMV-I melanoma and 3T3 fibroblasts by 32-55%, 31-36% and 6-84% respectively. Studies conducted with rat leukemia cells (L1210) reported 38% cytotoxic activity for the ethanol extract and 99% activity for the dichloromethane extract of *E. arvense* ²⁴

4. Cosmetics

Wide range of skin and hair cosmetics contains *Equisetum arvense* extract. In skin cosmetics it acts as anti-aging, moisturizer, antiwrinkle, anti-ance, antiperspirant conditioner. It prevents grey hair, strengthens the hairs and maintains hair tone. Horsetail extract is also used as anti-dandruff agent ²⁵

5. Astringent

Equisetum arvense is an excellent genito-urinary system astringent. It may be applied to such conditions as urethritis or cystitis with haematuria, reducing haemorrhagic and healing wounds thanks to the high silica content ²⁶

6. Anaemia

The juice of the plant is good for anaemia resulting internal bleeding such as stomach ulcers, since it promotes the coagulation of blood. Because of its mineral content horsetail is recommended for anemia and general debility. It has platelet. Anti-aggregant property²⁷

7. HIV

Screening of some plant extracts for inhibitory effects on HIV-I and its essential enzymes shows that water extract of aerial parts of *Equisetum arvense* possesses inhibitory effect on HIV-I induced cytopathy²⁸

8. Vulnerary

High silica content helpful in healing wounds. Externally it may also be applied as a compress to fractures and sprains. The effect of strengthening and regenerating connective tissues has been described to the silica acid content²⁹

9. Anti-Haemorrhagic

The local astringent and antihemorrhagic effect explains the application of *horsetail* to such conditions as bleeding from the mouth, nose and vagina, its use to check diarrhea, dysentery and bleeding from the bowel, and for slow-healing wounds, chilblains and conjunctivitis³⁰

10. Cancer

The water extract from sterile stems of *Equisetum arvense L.* has dose dependent cytotoxic effects on human leukemic U 937 cells. DNA fragmentation, externalization phosphatidylserine, the collapse of mitochondrial transmembrane potential, will be all observed in cells cultured for 48 h with the herb extract. Taken together these results suggest that the cytotoxicity of *equisetum arvense L.* water extract against U 937 cells is due to apoptosis ¹⁸ From ancient times, the broth of *equisetacea* has been used in wet compresses and a variety of folk medicines. It has been reported that crude proteins extracted from *Equisetum arvense L.* inhibit the proliferation of cultured cells ³¹

11. Anti-Oxidant activity

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) will be prepared and the anti-oxidative activity will be investigated ³²

12. Vasorelaxant

The vasorelaxant activity of dicaffeoyl mesotartaric acid extracted from *E. arvense* will be investigated on isolated rat aorta tissue. This substance exhibited slow relaxant activity against norepinephrine (NE) induced contractions in the aorta, with and without endothelial; however, the dicaffeoyl mesotartaric acid extract did not high potassium (60 mM)

induced contractions, suggesting that the inhibition of NE-induced vasoconstriction resulted from reduced calcium influx from the extracellular space.³³

13. Hepatoprotective

Hepatoprotective activity guided fractionation of the MeOH extract of the *E.arvense* L. resulted in the isolated of two phenolic petrosins, onitin-9-O-glucoside, along with four flavonoid, apigenin, luteolin, kaempferol-3-O-glucoside, and quercetin-3-O-glucoside³⁴

14. Effect on immune system

The influence of crude *Equisetum arvense* protein on immune responses will be investigated by measuring interleukin-2(IL-2) and interferon- γ (IFN- γ) produced by Th 1 cells. After 24-hour culture with 0.2 mg/ml of crude *Equisetum arvense* protein in the presence of 5 μ g/ml ConA, 1,434.5 pg/ml of IL-2 will be produced, showing 1.7 times greater production than that in the control. In cells cultured for 48 hours, 2130.9 pg/ml will be produced by cells treated with 0.2 mg/ml of crude *Equisetum arvense* protein in the presence of 10 μ g/ml ConA, showing 1.9 times greater production than that in the control. Regarding the IFN- γ production-enhancing effect, 929.30 pg/ml will be produced by cells cultured for 24 hours with 0.2 mg/ml of crude *Equisetum arvense* protein in the presence of 5 μ g/ml ConA, suggesting that Th 1 cells will be activated³⁵

15. Effect on urinary system

The diuretic effect of EADE will be assessed clinically by monitoring the volunteers' water balance over a 24 h period. The dried extract of *Equisetum arvense* (900mg/day) produced a diuretic effect that will be stronger than that of the negative control and will be equivalent to that of hydrochlorothiazide without causing significant changes in the elimination of electrolytes. Only rare minor adverse events will be reported. The mechanism of action by which ethanol root extract of *Equisetum arvense* (EA) influences urinary bladder activity in rats will be studied. The plant will be extracted by hot ethanol (95%). Rats in EA group will be treated with a standard diet containing 0.2% of the extract, while rats in the control group will be fed with the diet only. After 3 weeks, cystometry with 0.2 % acetic acid solution and bladder activity will be recorded, blood pressure, body weight and adenosine triphosphate will be measured and 0.2 % acetic acid solution will be infused into the bladder and urinary adenosine triphosphate will be determined before and after the stimulation. The results showed that during cystometry with acetic acid, the time interval between urinary bladder contractions will be shorter and maximum bladder contraction pressure will be much greater in rat in the control group, but in the *E. arvense* group, the changes will be much lower. Furthermore, in the *E. arvense* group plasma adrenaline and noradrenaline levels will be lower than for the control group. In addition, increase in the levels of urinary adenosine triphosphate will be smaller in *E. arvense* group than in control group. The authors concluded that *E. arvense* ethanol root extract influences urinary bladder activity by decreasing adenosine triphosphate release³⁵

16. Anti-leishmanial

Equisetum arvense water extract showed anti-leishmanial effects. The number of *Leishmania tropica* decreased gradually by using 0.5 to 2.5 μ g/ml concentrations of *E. arvense* extract, moreover, the extracts affected the number and time of generation, an inverse relationship will be established between concentration of the extract and growth mean of the parasite. Inhibitory concentration of 50% of promastigotes(IC₅₀) will be 1.5 μ g/ml, at logarithmic

phase(96 hrs of cultivation) The *E. arvense* dissolve in cold and hot water found to cause reduction in protein, carbohydrates and total nucleic acid contents in *Leishmania tropica* promastigotes that will be treated with IC₅₀ of the tested extracts³⁶

17. Hyaluronidase inhibitory activity

The hyaluronidase inhibitory activity of *Equisetum arvense* extracts was investigated. The inhibitory effect of hyaluronidase was assayed using a Morgan microplate assay. The anti-oxidant activity of the *Equisetum arvense* extracts was measured on the basis of the scavenging activity of the stable 1, 1-diphenyl 2-picrylhydrazyl (DPPH) free radical. Hyaluronidase inhibition of foliage and central stalk was 24.3% at 4.0 mg/ml and that of rhizomatous stem root was 27.3% at same concentration.³⁷

18. Effect on RBC membrane stability

The effect of hydroalcoholic stem extract of *Equisetum arvense* on male rat RBC membrane stability was studied. Rats blood samples were exposed to 6, 8 and 10 mg/kg/body weight of hydroalcoholic horsetail extract. Membrane stabilizing activity was significantly decreased after exposure to extract compared to control group (P< 0.0001)³⁸.

19. Effect on bones

The effects of hydromethanolic extract of *Equisetum arvense* was evaluated in human osteoclastogenesis *in vitro*. The extract reduced human osteoclast development and function, both in osteoclast precursor cell cultures and in cocultures of osteoclastic and osteoblastic cells. In studying of the effect of hydromethanolic extract on behavior of human bone marrow cells for osteoblastic modulation *in vitro*, the extract promoted osteoblastic response while preventing risk of infection at the biomaterial/ bone interface by local delivery system.³⁹⁻⁴⁰

20. Antidiabetic effect:

The methanolic extract of *Equisetum arvense* (50, 100, 250 and 500 mg/ kg daily for 5 weeks) was investigated for antidiabetic activity in streptozotocin-induced diabetic rats. The results showed that different doses of methanolic extract significantly lowered blood glucose. Also the weights of methanolic-extract treatment group were significantly higher. Concurrent histological studies of the pancreas of these animals showed comparable regeneration by methanolic extract which were earlier, necrosed by streptozotocin⁴¹⁻⁴²

Conclusion

The plant is reported to contain a number flavonoids, alkaloids, phenolic proteins, triterpenoids, saponins, phytosterols; the present review is an attempt to generate interest among the masses regarding its immense potential in preventing and treating several disorders.

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No conflict of Interest

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