World Journal of Pharmaceutical and Life Sciences
WJPLS
www.wjpls.org
SJIF Impact Factor: 3.347

PHYTO- PHARMACOLOGICAL REVIEW OF *MEDICAGO SATIVA* (ALFALFA)

Khan Kalimuddin. S*, Padmaja Rao, Arifa Sangle and Abdul Sayeed Mateen

M. Pharmacy, Dept of Pharmacology, Oriental College of Pharmacy, Sanpada Navi Mumbai – 400705, Maharashtra, India.

Article Received on 25/05/2016 Article Revised on 16/06/2016 Article Accepted on 05/07/2016

***Corresponding Author**
Khan Kalimuddin. S
M. Pharmacy, Dept of Pharmacology, Oriental College of Pharmacy, Sanpada Navi Mumbai – 400705, Maharashtra, India.

ABSTRACT

The world presently is shifting towards organic products. In the current scenario organic medication or herbal medication is need of the hour. So, in this case herbal drugs with multiple therapeutic activities are being encouraged greatly. One such herbal product is *Medicago sativa* commonly known as alfalfa. Alfalfa is a plant with many therapeutic applications and most of them target the prevailing disorders like Diabetes, Obesity, Inflammation etc. The following review emphasizes on various therapeutic uses of plant parts of alfalfa highlighting its potential and scope in the field of herbal medicine.

KEYWORDS: *Medicago sativa*; Alfalfa seed; Anti Inflammatory; Anti Diabetic; Anti Bacterial.

INTRODUCTION

Medicago sativa(MS) (alfalfa) is an important feed crop. It is also known as Lucerne and has been given the title of "The queen of forage crops". It is rich in proteins and nutrients and can grow in wide range of soil and climatic conditions.[1] This has resulted in the utilisation of alfalfa for human purpose Lucerne has been used traditionally as ayurvedic and homoeopathic medicine in various disorders involving kidney pain, diabetes, CNS, inflammation , obesity etc.[2] Many infectious diseases have been known to be treated with herbal remedies throughout the history of mankind using alfalfa.[2]

Fig. 1: Medicago sativa[3]

Fig 2: *Medicago sativa.*[4]

Scientific Classification

Kingdom : Plantae

Subkingdom : Tracheobionta

Superdivision : Spermatophyta

Division : Magnoliophyta

Class : Magnoliopsida

Subclass : Rosidae

Order : Fabales

Family : Fabaceae

Genus : Medicago L.[5]

Collection and cultivation

Description

Height: 1 m

Growth rate: fast

Growth duration : Annual-Perennial

Growth form : herb

Propagated by : Seeds

Alfalfa is a very adaptive plant and can grow in variety of climatic conditions like high mountain valleys, rich temperate agriculture regions, Mediterranean regions and hot deserts. The sowing season for alfalfa can be spring or fall. It grows best in well drained soil with neutral pH of 6.8 – 7.5andrequires potassium for its growth.It bears brilliant bluish purple flowers arranged in groups called racemes. The seeds are kidney shaped and yellowish brown in colour measuring 1-1.25mm.The production of alfalfa in irrigated Mediterranean areas, where it is a conventional crop, is characterized by a summer water shortage, long growing seasons and concentrated production systems.[6] Alfalfa growers are under increasing demands from the feed and dehydration industry to increase forage quality. This trend is modifying the conventional harvest management systems of the Ebro Valley, causing an increase of yield frequency.[7]

General use and Ethanopharmacology

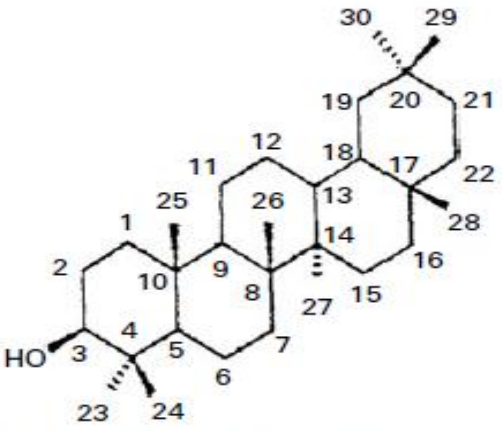
Table no 1: Ethnopharmacology of *Medicago sativa.*

S.No	Name of the country	Uses
1.	India	Arthritis Fluid Retention Ulcers
2.	China	Kidney Stones Fever Gravel Dysuria Fluid retention decreases Swelling
3.	Mexico	To improve memory Sore muscles Inflammation
4.	America	Arthritis Boils Cancer Scurvy Urinary and Bowel

		disorders
5.	Iraq	Arthritis
6.	Turkey	Cardiotonic Scurvy Arthritis
7.	General	Bladder disorders Blood clotting disorders Boils Cough Diuretic GIT disorders Breast cancer Cervical cancer Kidney disorders Prostate disorder Appetite stimulator Anti inflammatory Anti oxidant Anti atherosclerotic Galactogogue CNS disorders

Phyto-chemistry of the plant

Alfalfa saponins are tri-terpenoids composed of a thirty carbons,aglycone linked to one or more sugar moiety as shown in Fig. 1.[8] Alfalfa has more than 33 different saponins, those are containg one or more sugar chain units have been identified.[9]



1. Chemical skeleton structure of sapogenins.

Figure 3: Chemical structure of sapogenin.

The aerial parts of alfalfa contain chemical compounds, composed of mainly aglycones like Medicagenic acid, hederagenin, zanhic acid and soyasapogenols A and B.[9, 10]

Medicagenic acid is the primarysapogenin synthesised in germinating seeds and the other sapogeninsare derivatives of medicagenic acid.[10]

Table no. 2: Phyto-constituents of *Medicago sativa.*

S.no	Category	Substance	Quantity
1.	Moisture Protein Fat Fibre Ash		80% 5.2g 0.9g 3.5g 2.4g
2.	Purines	Adenine Guanine Xanthine Hypoxanthine	
3.	Pyrmidine	Isocytosine	
4.	Triglycerides	Linoleic acid Linolenic acid Oleic acid Saturated fatty acid A Spinasterol	16.9% 32.2% 39.0% 19.4% 25mg
5.	Xanthophylls	Lutein Violaxanthin Neoxanthin Cryptoxanthin Zeaxanthin	40% 34% 19% 4% 2%
6.	Volatile compounds	Acetone Butanone Propanol Pentanol 2- methyl propanol 3- methyl butanol	
7.	Tannins		2.7-2.8
8.	Coumestans	4-o- methyl coumesterol 3- methoxycoumesterol Lucernol Medicagol Sativol Trifoliol 11,12 – dimethoxy -7-hydroxyl coumesterol	
9.	Minerals	Ca, P,K,Na, Mg, Trace : Ba, Cr, Co, Cu, Fe, Pb, Mn,Mo, Ni, Ag, Sr,Ti, Sn.	
10.	Vitamins	Beta carotene Thiamine Riboflavin Niacin Alpha tocoferol Vitamin C Biotin Vitamin – D	

		Vitamin – K	
11.	Enzymes	Amylase Coagulase Emulsin Peroxide Erepsin Lipase Invertase Pectinase	
12.	Saponins		0.5 – 0.2 %
13.	Alkaloids	Stachydine	
14.	Ketones (Seeds)s	Myristone Alfalfone	

Pharmacological uses of the plant

Medicago sativa is pharmacologically a very important plant and many activities have been screened and reported. The following are the reported activities of *Medicago sativa* extract.

Anti bacterial

Doss Aet al. have performed the antibacterial evaluation and phytochemical analysis of *Medicago sativa* extract and have reported that methanolic, chloroform and ethanolic extracts have shown significant anti bacterial activity. Especially the effect was high on *Staphylococcus aureus* and *Streptococcus pyogens.* Other bacteria like *Klebeseilla pneumonia, E.coli, Pseudomonas areginosa, Salmonella typhii, Proteus mirabilis* were also susceptible to the chloroform and methanolic extracts. It was also reported that majorly the Gram positive bacteria were susceptible and the possible phytochemical constituent responsible for anti bacterial activity is tannins. Tannins tend to disintegrate the bacterial colonies and interefere with bacterial cell wall.[2]

Estrogenic Effect

The extract of M.sativa in combination with Salvia officinalis shows estrogenic effect in mature fermale mice. Adday et al. have reported this effect and the phyto–constituents responsible for this activity are Steroid and Isoflavinoid namely – Coumesterol, Daidzen, Genistein. These are phyto-estrogens and the metabolism of these compounds results in estrogenic activity which ultimately stimulates the growth and cell division of the female animal genital tract.[11] This estrogenic activity has a potential use in menstruation and menopause related problems.[12]

Anti scorbutic activity

Scurvy is a disease that results due to the deficiency of Vitamin C. It is rarely seen in the developed countries but it is still prevalent in developing countries and under developed countries. Anti scorbutic food supplements can help in managing scurvy which is characterised by bleeding, swollen gums, opening of previously healed wounds etc. Alfalfa is a very rich source of vitamin C. Apart from vitamin C it also rich in Vitamin A, B and E. The anti scorbutic activity was measured using the indophenol method proposed by Birch et al. It was found that the Vitamin C content was significant. The alfalfa can be used to manage scurvy by introducing it in the diet.[13]

Anti-inflammatory

Anti-inflammatory activity of leaves extract of *Medicago sativa* were carried out based on colorimetric NO assay. Inhibition rate of NO production in LPS/IFN-γ stimulated RAW 264.7 cell line and can be classified into four ranks which are: strongly active (70% and above), moderately active (50 to 69%), weakly active (30 to 49%) and very weak active (29% or less). Alfalfa exhibited moderate anti-inflammatory activity where the 50% of the NO production was inhibited by Alfalfa crude extract. This activity is possibly due to the presence of various detected phenolic and flavonoid as active compounds.[14] Bi-Fong Lin et.al have demonstrated that the alfalfa seed extract have significantly lowered the inflammatory response. The ethyl acetate extract of alfalfa seed was used to study the anti inflammatory activity *in vitro* and *in vivo*. The seed extract considerably increased the survival of mice where inflammation was induced using lipo-polysaccharide.[15]

Anti-diabetes

Leaves of *Medicago sativa* (lucerne) are used traditionally as a tea to treat diabetes in South Africa Compared with normal mice, STZ administration resulted in significant ($P < 0.05$) weight loss, polydipsia and hyperglycaemia (Table 1). Administration of lucerne in the diet and drinking water significantly decreased the hyperglycaemia by study day 12. Plasma glucose concentrations of STZ-treated mice receiving lucerne were comparable to those of normal mice at days 12 and 20.[16]

Cardioprotective effect

The cardio protective effect was observed in the ethanolic extract of *Medicago sativa* stem. It was observed that this extract has the ability to reduce the elevated levels of cardiac enzyme markers, and lipid profile. The cardioprotective effect can be probably due to the presence of

phytochemicals and antioxidants in the ethanolic extract of *Medicago sativa* stem. Hence, extract of *Medicago sativa* stem proved to be effective in reducing the myocardial damage.[17]

Anti hyperlipidemic

Alfalfa saponins (AS) are naturally bioactive compounds, which consist of a sugar moiety glycosidically linked to a hydrophobic aglycone (sapogenin), mainly pentacyclic triterpenoid. The alfalfa saponins reduce serum or plasma cholesterol in several species of experimental animals and evidence indicate that they have anti hyperlipidemica ctivity.The alfalfa saponin extract significantly reduced the serum TG, TC and LDL-C levelsl.[18]

Anti-oxidant

The *Medicago sativa* leaves extract contains phenolics and flavonoids with isoflavonoids.[14] Various tests related to the evaluation of Anti-oxidant activity in vitro like DPPH radical scavenging assay, ABTSradical scavenging assay, Iron chelating activity assay etc were performed on series of concentrations ranging from 2–1,000µg/ml of the alcoholic root extract of *Medicgo sativa*. The results of the present study show that the extract of *M. sativa* contains considerable amount of polyphenol compounds and exhibits the greatantioxidant activity which will be useful in many diseased conditions including ageing.[19]

Neuroprotective Effect

The extract *Medicago sativa* was found to possess neuroproctective effect. This effect is due to its anti oxidant properties. The causative agents of cerebral ischemia are reactive oxygen species. This leads to oxidative stress which ultimately leads to the cell death of neurons. Hence the herbs containing antioxidant potential can also act as neuro-protective agentsby relieving oxidative stress. Studies have been conducted on mice where global cerebral ischemia was induced which results in neurological abnormality. *Medicago sativa* extract was found to decreases the neurological abnormality, cerebral damage and ultimately help in conditions like cerebral stroke which is one of the main causes of death throughout the world.[20]

Protective effects in iron overload conditions

Physiological overload of iron usually occurs in conditions like thalassemia, Hereditory Hemochromatosis or Transfusional iron overload. Physiological iron overload can result in many problems like hepatic cirrhosis, Cardiac failure, Osteoporosis Metabolic syndrome, Hypothyroidism, Hypoparathyroidism etc. Iron overload also worsens various neuro-

degenerative like Alzeihmer's disease, Huntington's disease, Parkinsonism etc. These conditions can be reduced by using chelating agents which can form complexes with the excess iron and relieve the patient from the toxic effects. The chelating agents and the synthetic drugs currently used for the treatment of this condition are desferrioxamine and deferiprone. They have many side effects and the route of administration is parenteral which might not be feasible. Hence herbal drug alternatives are under research. Experiments suggest that the iron chelating capacity of *Medicago sativa* extract is similar to that of the synthetic drug Desferrioxamine. The chelation and reduction in excess iron in the body is found to be by excretion of the excess iron through urine and feces. Hence *Medicago sativa* extract serves as a protective agent in Iron overloaded conditions.[21, 22]

Anti Ulcer and Anti Coagulant Activity

Medicago sativa also helps in severe peptic ulcers which lead to internal bleeding. It reduces and reacts against the internal bleeding in ulcers hence shows gastro protective effect.[23]

DISCUSSION

The above information clearly states that *Medicago sativa* is a herbal drug with many utility values and can be used as a nutritional supplement during many health conditions like diabetes hyperlipidemia inflammation etc. Some of the pharmacological activities like contraceptive activity are still under pre clinical trials. But on the whole *Medicago sativa* has many applications in both human and veterinary medicine.With the increasing inclination towards the herbal and organic medicine in the present generation *Medicago sativa* i.e. Alfalfa entire plant is a kind of wonder herb.

REFERENCES

1. Askarian M, Chapter 1. Pg No. 1, Seed production studies in lucrene, thesis, thesis presented for partial fulfilment degreee of doctor of philosophy in plant science(seed technology), Massey University, New Zealand, 1993; ch-1: p-1.
2. Doss.A, Parivuguna.V, Vijayasanthi M and Surendran S, Antibacterial evaluation and phytochemical analysis of Medicago sativa L. against some microbial pathogens Department of Microbiology, RVS College of Arts and Science, Sulur, Coimbatore–641 402, Tamil Nadu, Indiaandrodoss@gmail.com, 2011; 550: 0974- 6846.
3. Spice and Medicinal Herbs http://www.spicesmedicinalherbs.com/alfalfa-medicago-sativa.html (Accessed on March 2nd, 2016)
4. Atlas des plantes de France. 1891.

5. United States Department of Agriculture, National Resources Conservation Sevice, Plants database http://plants.usda.gov/java/ClassificationServlet?source=display&classid=MEDIC (Accessed on December, 2015)
6. Del Pozo M. and Ibáñez M., *La Alfalfa*. Ediciones Mundi-Prensa, Madrid, Spain, 384 pp. Delgado, I. (1993). Respuesta al pastoreo de ochocultivares de alfalfa. *Investigación Agraria: Producción y SanidadAnimales*, 1984; 8: 223-231.
7. Lloveras.J, Ferran J, Álvarez A, and Torres L,. (Harvest management effects on alfalfa (*Medicago sativa*L.) production and quality in Mediterranean areas. *Grass and Forage Sci*., 1998; 53: 88-92.s
8. Navarro P, Giner RM, Recio MC, et al. In vivo anti-inflammatory activity of saponins from Bupleurumrotundifolium. Life Sci (Pharmacology letters, Acceleratedcommunication)., 2001; 68: 1199–2306.
9. Massiot G, Lavaud C, Guillaume D, et al. Reinvestigation of the sapogenin s and prosapogenins from alfalfa (Medicagosativa). J Agric Food Chem., 1988; 36: 902–909.
10. Nowacki E, Jurzysta M &Dietrych-Szstak D (1976) Biosynthesis of medicagenic acid in germinating alfalfa. Biochem Physiol Pflanzen., 1976; 156: 183–186.
11. Adaay Mohaisen H 1*, Al-Dujaily. S S, Khazzal F K. -Effect of aqueous extract of *Medicago sativa* and *Salvia officinalis* mixture on hormonal, ovarian and uterine parameters in mature female mice - 1PhD, Institute of Embryo Researches and Infertility Treat ment, Al-Nahrain University, Baghdad, Iraq. 2High Diploma, Ministry of Health, Iraq., 2013; 424-433.
12. Chevallier. A, *The Encyclopedia of Medicinal Plants* Dorling Kindersley. London., 1996; 9-780751-303148
13. Levy L.F And Fox F.W, Antiscorbutic Value Of Lucerne - .From the Biochemical Department, South African Institute for Medical Research, Johannesburg, South Africa, 1935; 884-887.
14. Karimi. E, Oskoueian E *, Oskoueian A , Omidvar V , Hendra R and Nazeran H , Insight into the functional and medicinal properties of *Medicagosativa* (Alfalfa) leaves extract, 2013; 1996-0875: 290-297.
15. Hong Y, Chao W , Chen M and Lin B *,Ethyl acetate extracts of alfalfa (*Medicago sativa* L.) sprouts inhibit lipopolysaccharide-induced inflammation in vitro and in vivo, Journal of Biomedical Science., 2009; 16: 64. doi:10.1186/1423-0127-16-64 .

16. Gray. M. A * and Flatt. R. P., pancreatic and extra-pancreatic effects of the traditional anti-diabetic plant, Medicagosativa (lucerne)., 1997; 78; 325-334.
17. Gomathi. R, Vijipriya. M, Usha.K, Cardioprotective effect of ethanolic extract of *Medicagosativa* stem on isoproterenol induced Myocardial Infarction in Wistar Albino rats Department of Biochemistry, Biotechnology and Bioinformatics, Avinashilingam institute for home science and higher education for women, Coimbatore 43, Tamil Nadu, India., 2014; 0975-1491.
18. Shi Y *, Guo R, Wang X, Yuan D, Zhang S, Wang J, Yan X, Wang C *, The Regulation of Alfalfa Saponin Extract on Key Genes Involved in Hepatic Cholesterol Metabolism in Hyperlipidemic Rats College of Animal Science and Veterinary Medicine, Henan Agricultural University, Zhengzhou, Henan, China; 2014; PLoS ONE., 9(2): e88282. doi:10.1371/journal.pone.0088282.
19. Rana L. M. G, Katbamna R.V, Padhya A.A., Dudhrejiya A.A, Jivani N.P, Sheth N.R, *In Vitro* Antioxidant and Free Radical Scavenging studies Of Alcoholic Extract OF *Medicago sativa.*, 2010; 265481855.
20. Bora. K S.and Sharma. A, Evaluation of Antioxidant and Cerebroprotective Effect of *Medicagosativa* Linn. against Ischemia and Reperfusion Insult L.R. Institute of Pharmacy, Solan 173 223, India ,University Institute of Pharmaceutical Sciences, Panjab University, Chandigarh, India, Hindawi Publishing Corporation, 2011; 792167.
21. Patel R* and Tirgar P, Evaluation of Beneficial Effects of *Medicagosativa* (Alfalfa) In Iron-Overload Conditions Department of Pharmacology, School of Pharmacy, RK University, Rajkot, Gujarat, India., 2013.
22. Mirzaei A, Abbasi M, Sepehri S, Mirzaei M, The Effects of Allium porrum and Medicagosativa on Iron Concentration in Thalassemia Serums. Life Sci., J 2013; 10(11s): 27-31; 1097-8135.
23. Detoxification by Page Linda N.D. PhD, Materiamedica of detoxification of herbs, Traditional Wisdom, Inc., 1999; 1-884334-54-7; p-179.