1 Introduction

In India, plants are being used by the large number of population (about 80%) living in rural as well as urban areas for various purposes such as food, medicine, healthcare, clothing, shelter, agriculture, etc. It is the most affordable and easily accessible source of treatment. It has been reported that about 2500 plant species serve as regular sources of medicine in India. During the last few decades there has been an increasing interest to the study of medicinal plants and their traditional use in distinct parts around the world. Among different medicinal plants M. annua are used in Indian traditional medicine and in folklore for many diseases. The leaves and fruits are the biologically active part of M. annua.

M. annua belongs to family Martyniaceae (or Pedaliaceae), is a well-known small herbaceous annual plant, distributed throughout India. It is commonly known as the Cat's claw or Devil's claw. In India, traditional healers used M. annua in the treatment of epilepsy, inflammation, sore throat, burns, itching, skin affections and tuberculosis. M. annua contains alkaloids, tannins, saponins, glycosides, flavonoids, anthocyanins, amino acid, steroids and phenols. The researcher scientifically documented various pharmacological activities such as anthelmintic, analgesic, antipyretic, antibacterial, anti convulsant, antifertility, antinociceptive, antioxidant, CNS depressant, anti diabetic and wound healing activity of this plant. The reported activities make the plant in great interest among scholars to determine the mechanism of pharmacological activities of crude extracts. Hence the review paper outlines the previous research done on M. annua.
Phytochemical investigation of acetone extracts of leaves indicates the presence of alkaloids, tannins, saponin, glycosides, flavonoids, anthocyanin, amino acid, steroids and phenols. During the phytochemical study, it has been observed that methanol extracts of leaves of *M. annua* contained higher amount of chemical constituents.

Flowers contain cyanidin-3-galactoside whilst p-hydroxy benzoic acid, snapic acid; and gentisic acids are present in leaves and fruits, respectively.

The leaves also contain chlorogenic acid; and fatty acids (such as palmitic acid, stearic acid and arachidic acid) are present in seeds. P-hydroxy benzoic acid, snapic acid and fatty acids such as palmitic acid and stearic acid present in leaves.

GC-MS studied on aqueous and alcoholic extract of *M. annua* showed the presence of 28 compounds in which oleic acid present in the high amount. Other major biological compounds include pelargonidin-3-5-diglucoside, cyanidin-3-galactoside, p-hydroxy benzoic acid, gentisic acid, arachidic acid, linoleic acid, palmitic acid, stearic acid, apigenin, apigenin-7-0-glucuronide.

7 Pharmacological activity of *M. annua*

1. **Analgesic and antipyretic activity**

Kar DM *et al.* (2004) evaluated the analgesic effect of petroleum ether, chloroform, ethanol and aqueous extracts of *M. annua* fruits in Swiss albino mice by using hot plate and tail flick methods, and for antipyretic effect against brewers-yeast induced hyperpyrexia in adult Wistar rats. The extracts show significant analgesic and antipyretic activity at 20 mg/kg. It has been also observed that the petroleum ether and chloroform extracts exhibits greater analgesic and antipyretic activities as compared to other extract.

7.2 **Wound Healing activity**

Lodhi and Singhai (2011) evaluated the wound healing potential of ethanol extract of *M. annua* leaves using excision and incision model on rats. They reported that fraction MAF-C from ethanol extracts of *M. annua* leave is found most effective in wound healing and histopathological study also showed better angiogenesis, matured collagen fibers and fibroblast cells as compared to the control group. Moreover, phytochemical studies demonstrated that the methanol fraction mainly contains flavonoid luteolin responsible for enhancement of the wound healing process due to the free-radical scavenging mechanism.

7.3 **Antibacterial activity**

Sermakkani and Thangapandian (2010) evaluated antibacterial activity of chloroform, ethyl acetate and methanol extract of *M. annua* leaves against six gram-positive and nine gram-negative bacteria. All the extracts show antibacterial activity against different
bacteria. Chloroform extract produces higher antibacterial activity against *Proteus vulgaris*, *Bacillus thuringiensis* and *Bacillus subtilis* while ethyl acetate extracts potentially effective against *Salmonella paratyphi* A, *Salmonella paratyphi* B, *Proteus mirabilis*, *Proteus vulgaris* and *Klebsiella pneumonia*, whereas the methanol extracts, shows greater antibacterial activity towards *Proteus vulgaris*, *B. subtilis*, *S. paratyphi* B and *Pseudomonas aeruginosa*.  

7.4 Anthelmintic activity

Nirmal SA et al (2007) have been demonstrated anthelmintic activity of the petroleum ether extract of *M. annua* roots against earthworms *Pheritima posthuma*. The finding of the result exhibited potent anthelmintic activity compared to standard drug Albendazole.

7.5 Anti-convulsant activity

Bhalke and Jadhav (2009) evaluated antinociceptive and CNS depressant activity of petroleum ether, ethyl acetate and methanol root extracts of *M. annua*. Among all extracts, petroleum ether extracts showed the significant increase in reaction time in hot plate method and also showed the more inhibitory effect on writhing induced by acetic acid against all extracts and standard drug Pentazocine and Paracetamol respectively. Apart from this, it further showed significant reduction in the locomotors activity when compared with standard drug diazepam, and it potentiates Pento barbitone sodium induced sleeping time.

7.6 Antioxidant activity

Nagda D et al (2009) documented antioxidant activity of the methanol and aqueous extracts of *M. annua* leaves by reducing power assay, DPPH radical-scavenging activity, nitric oxide scavenging activity, *H₂O₂* radical scavenging activity, superoxide radical scavenging assay, hydroxyl radical scavenging activity, and total antioxidant capacity method. The results revealed that the methanol extracts produced higher antioxidant activity than the aqueous extract.

7.7 Antifertility activity

Mali PC, et al (2002) reported antifertility activity of 50% ethanol extract of *M. annua* root. The finding of authors revealed significant decreases in the weights of testes, epididymides, seminal vesicle and ventral prostate. Moreover, reduction in the testicular sperm count, epididymal sperm count and motility, number of fertile males, the ratio between delivered and inseminated females and number of pups has been observed. Significant reduction in serum concentration of luteinizing hormone and testosterone support the anti-fertility activity of extracts. This plant is more beneficial as compared to other plants exhibiting anti-fertility activity because no alterations in hematological parameters recorded.

7.8 Antidiabetic activity

Saiyad and Gohil (2013) investigated the antidiabetic activity of methanol extracts of *M. annua* (MEMA) flower in streptozotocin (STZ) and Streptozotocin-Nicotinamide (STZ-NIC) induced diabetes in Wistar rats. MEMA showed excellent reductions in blood glucose, triglyceride and glycosylated hemoglobin levels and increased HDL levels in diabetic rats (after 21 days). A result revealed that the MEMA exhibited good antidiabetic activity in STZ and STZ-NIC induced diabetic rats.

7.9 Antinociceptive activity and Central Nervous System (CNS) depressant activity

Bhalke and Jadhav (2009) evaluated antinociceptive and CNS depressant activity of petroleum ether, ethyl acetate and methanol root extracts of *M. annua*. Among all extracts, petroleum ether extracts showed the significant increase in reaction time in hot plate method and also showed the more inhibitory effect on writhing induced by acetic acid against all extracts and standard drug Pentazocine and Paracetamol respectively. Apart from this, it further showed significant reduction in the locomotors activity when compared with standard drug diazepam, and it potentiates Pento barbitone sodium induced sleeping time.

8 Conclusions

The plant *M. annua* is commonly grown in wastelands throughout India, and also found in the tropical and sub-tropical region of America, Mexico, Burma, West Pakistan. The scientific investigation has indicated a significant pharmacological effect of *M. annua* extracts. This curative property of plant makes it to the object of various phytochemical researchers. In this review, we have tried to present the important and the most-recent findings on the therapeutic uses, and phytoconstituents of the *M. annua*.

References


Kenwat et al. Martynia annua