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Review Article

An Overview on the Pharmacological Properties of *Ajuga Bracteosa*

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ABSTRACT

An overview about *Ajuga Bracteosa*, as it has many applications within medicinal purposes. It's an anti- inflammation, hepatoprotective, anticancer, antihypertensive, antidiarrhoeal, an antioxidant, and antibacterial agent. *Ajuga bracteosa* is an important plant in the pharmaceutical industry both nationally and internationally. It has been highly over exploited and if the current rate of depletion continues this would be endangered within the next few years. For this particular plant to be useful, the existence of *Ajuga Bracteosa* has to be protected as it possesses immense potential since its extremely robust plant. This paper reviews literature which has documented the different pharmacological activity of *Ajuga bracteosa* which can be useful in taking up further research.

INTRODUCTION

Ajuga Bracteosa is a perennial herb that grows from Kashmir through Tibet and Nepal, sub-Himalaya region, Punjab, and Upper Gangetic plains of India. It is for the relief of rheumatoid arthritis, gout, palsy, and amenorrhea in ayurveda medicine. Two thousand plants were recorded in Ayurveda, 700 in unani, 600 in Siddha, 450 in Homoeopathy and 3cm coverage boundary medication have been incorporated [1]. *Ajuga Bracteosa* is being prescribed as medicine in a broader spectrum in different regions including

Chinese medicine and Indian medicine. As an example, Artemisinin based therapy has recently been adopted for the treatment of malaria as a result an increasing number of strains has emerged that show resistance to most of the prescribed treatments [2]. It has been reported that *Artemisia* plants have been cultivated and used to treat fever effectively in Chinese traditional medicine even in the jungles [3]. The use of plants as drugs is common among numerous civilizations around the world, great examples being [4]. As new sources of drugs, more and more medicinal plants are discovered. *Ajuga Bracteosa* is estimated there are

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around 250 thousand breeds of blossom plant *Ajuga*. It is a non-deciduous woody perennial that possesses woven branched stems and twigs. Flowers are yellow in color and are carried on a spiral around the axil. *Ajuga bracteosa* has a woody root stock and leaves that may measure as much as 8.5 centimeters long and 3.5 centimeters wide but many are much smaller and have a more rounded margin. The calyces are 3.5 -4.5 mm long and are lobed [5-10]. The common name for *A.bracteosa* is Neelkanthi and it is a member of Family Lamiaceae; this plant. It The hilly regions and the open field in the temperate subtropical region of the world well adapted to the grassland [11-17].



Fig: *Ajuga Bracteosa*

Taxonomical Classification [18-20]:

Kingdom	Plantae
Phylum	Tracheophyta
Class	Magnoliopsida
Order	Lamiales
Family	Lamiaceae
Genus	<i>Ajuga</i>

Traditional Uses [21-30]:

Conditions	Methods of applications
Headache	Paste of the leaves
Abdominal pain	Powder of the whole plant
Indigestion	Powder of whole plant
Astringent	Whole plant is used as astringent
Bladder disease	Plant extract

Eye trouble	Plant extract
Bites of insects	Plant extract
Tonic	Whole plant
Internal colic	Whole plant
Pimples	Barks juice
Jaundice	Leaves extracts
Hypertension	Whole plant is used to treat hypertension
Sore throat	Whole plant
Cold	Decoction of root is taken
Leprosy	Root powder ingested
Blood purification	Leaves extract
Diabetes	Decoction of leaves
Fever	Decoction of leaves
Swollen wounds	Plant extract

Ethnomedical Significance: [31-34]

Drug powder has indicated a hypoglycemic activity. The herb's leaves in a decoction have been indicated in traditional medicine for diabetes mellitus and for other diseases like hypertension, fever, malaria, and stomach ache. Alcoholic fraction from the leaves has shown Cardiotonic action on the hearts of frogs, rabbit auricles, and rat ventricles. It was shown that an alkaloidal fraction stimulated the perfused frog heart. Ethanolic ext. of the plant has displayed as anticancer and spasmolytic in action. The ethanolic extract of the plant in an early biological screening demonstrated action on guinea pig ileum and exhibited Anticancer activity in sarcoma 180 in mouse and HS human sarcoma in the chick embryo. A dose of 2.4g/kg in normal saline administered intragastrically, demonstrated protection from liver-kidney damage as a result of carbon tetrachloride. A hepatoprotective action has been portrayed. The fried jawa garlic is considered as effective against diarrhea and dysentery as well. The juice of the plant is given in doses of three teaspoons twice a day to treat vegetable and great bile duct troubles. The mouth powder is used in the mouth to stimulate ulcer curing. The leaves are also used, two to three

times a day, in leaf decoctions for treatment purposes.

Pharmacological properties :

1. Anti-inflammatory activity: Inflammation is however, normal, but can involve the response of the body to anti-inflammatory processes that are still autoimmune in nature, or just mere inflammation of an organ of the body or even the organ in question which is the tissue transplanted (the graft) is rejected. Alcoholic extracts of 650 mg of *Ajuga bracteosa* extracts exhibited anti-inflammatory activity through the inhibition of cyclooxygenase enzymes (Cox I and Cox II). Such findings established the fact that active phytoconstituents (lupulin A, ajugarin I, deoxyharpagide withaferin A, reptoside) probably possessed anti-inflammatory action [35,36]. *Ajuga bracteosa*, belonging to the Lamiaceae family of plants, presented promising anti-inflammatory activity that stemmed from its triterpenoid, flavonoid, and phenolic derivatives, as well as saponin and tannin contents. A combination of diverse mechanisms explains this anti-inflammatory bioactivity. A reduction in such pro-inflammatory cytokines as TNF- α , IL-6, and IL-1 β is shown at the extract's level. Furthermore, *Ajuga bracteosa* acts as an inhibitor of several enzymes that play key roles in the production of pro-inflammatory mediators such as prostaglandins and leukotrienes. These include the inhibition of cyclooxygenase (COX) and lipoxygenase (LOX). In addition, it affects the NF- κ B signaling pathway, a central controller of inflammation, hence down-regulating the expression of several pro-inflammatory genes. Moreover, its antioxidant activities help scavenge ROS and decrease oxidative stress, which are known to potentiate inflammation.

In experimental studies, *Ajuga bracteosa* has shown a marked decrease in inflammation in both in vitro cell cultures and in vivo animal models, including arthritis and edema. Traditional uses of the plant in folk medicine, such as for treating arthritis and skin inflammations, further underscore its potential as a natural anti-inflammatory agent. These findings make *Ajuga bracteosa* a promising candidate for the development of novel anti-inflammatory therapies, although more clinical studies are needed to fully assess its safety and efficacy in humans.

2. *Ajuga bracteosa* as an analgesic agent: Mechanisms of action and epidemiology of analgesic properties . *Ajuga bracteosa* has gained some attention due to the possibility of it having analgesic effects. It has been used in many cultures to relieve pain and inflammation and interest into its use as a natural analgesic is growing [37]. The present review focuses on the evidence regarding the pain relieving effects of *Ajuga bracteosa*, the possible mechanisms that may be involved and therapeutic uses [38]. Besides inflammation, the plant *Ajuga bracteosa* has been known for its analgesic activity. These have shown the modulation of the pain pathway; hence, the plant can be used as a natural analgesic agent. Studies were conducted where extracts of *Ajuga bracteosa* produced significant anti-pain responses in animal models. The plant is supposed to exert its analgesic effects through the inhibition of pro-inflammatory cytokines and pain-associated mediators, such as prostaglandins, that are produced during inflammation by the action of cyclooxygenase (COX) enzymes. Its antioxidant activity may also mitigate oxidative stress that is often seen in chronic pain. The involvement of neurotransmitter modulation, such as the

reduction of central nervous system sensitization, also contributes to the analgesic activity of *Ajuga bracteosa*. Traditional uses of *Ajuga bracteosa* include relief from various types of pain, such as joint pain, muscle aches, and headaches, further supporting its potential as a natural alternative to conventional analgesic drugs. Its analgesic effect is promising, but more rigorous clinical research needs to be done to validate its efficacy and safety in human pain management.

3. Antiarthritic activity: This plant is an important medicinal plant and the literature acknowledges it with some biological activities among which is anti-arthritic activity. Lack of literature regarding the *Ajuga bracteosa* is apparent and thus while establishing the efficacy of the present study, it can be viewed that plants of the *Ajuga* genus have antiarthritic properties, which include anti-inflammatory, antioxidant, and analgesic effects [39]. *Ajuga bracteosa*, a medicinal plant with traditional values, has proven its potential towards anti-arthritic activity due to the presence of its rich diversity of bioactive compounds, which includes flavonoids, terpenoids, alkaloids, and phenolic compounds. These bioactive compounds possess significant anti-inflammatory, analgesic, and antioxidant properties. This is what can be associated in the context of arthritis, and *Ajuga bracteosa* may potentially contribute to the alleviation of these symptoms by multiple mechanisms: chronic inflammation, joint pain, and oxidative stress. This probably stems from its ability to suppress the production of pro-inflammatory cytokines like TNF- α , IL-1 β , and IL-6 and the inhibition of cyclooxygenase-2 (COX-2) activity that is involved in the synthesis of inflammatory prostaglandins. *Ajuga bracteosa*

may also reduce oxidative stress due to free radicals through scavenging reactions and the enhancement of antioxidant defense systems, which prevent oxidative damage of joint tissues. These actions both reduce inflammation and provide pain relief by modulating both inflammatory pathways and pain receptors. Other studies suggest that the plant may influence immune function, allowing it to be used to perhaps restore balance to an immune system gone awry and reduce the autoimmune component contributing to conditions such as rheumatoid arthritis. Although these mechanisms suggest promising anti-arthritic activity, further pharmacological studies and clinical trials are required to confirm its therapeutic efficacy and safety in the treatment of arthritis.

4. Antitumor and Anticancer Activity: It has been reported that different cancer cell lines could be affected by extracts obtained from *Ajuga bracteosa*. The complex separated from the plant possess cytotoxic activities and may assist in keeping the multiplication of tumors in check. These effects can be partials to the effect of phytochemicals such as flavonoids and some other secondary metabolites [40]. *Ajuga bracteosa* has drawn interest due to its antitumor and anticancer activities attributed to the range of bioactive compounds it encompasses, such as flavonoids, terpenoids, alkaloids, and phenolic acids. According to research, such compounds may inhibit cancer cell lines significantly through different mechanisms. In fact, the primary mechanism of inhibiting the growth of tumor cells by *Ajuga bracteosa* might be through inducing apoptosis, or programmed cell death, in cancerous cells. This is probably mediated through the activation of intrinsic signaling pathways, such as the mitochondrial pathway,

which results in the release of pro-apoptotic factors like cytochrome c, leading to caspase activation and cell death. Moreover, *Ajuga bracteosa* has been found to inhibit the proliferation of cancer cells through the modulation of key pathways, which regulate cell cycle progression through cyclins and cyclin-dependent kinases, thereby rescuing the cell from wild division or uncontrolled cell division, a feature of cancerous cells. Inhibitions of angiogenesis by plant compounds could also help in downregulating vascular endothelial growth factor (VEGF) expression, by which tumors get new blood vessels to sustain their growth. Moreover, antioxidant activities of *Ajuga bracteosa* have the potential to suppress oxidative stress that is a driver of cancer initiation and progression. It could scavenge free radicals, which in turn, would minimize oxidative damage to DNA, thus not leading to mutation of healthy cells into cancerous cells. The other compounds of *Ajuga bracteosa* can modulate the immune response by helping the body in recognizing and destroying tumor cells. Despite promising in vitro and preclinical evidence, more clinical studies are needed to validate its full anticancer potential, establish optimal dosages, and assess safety in human use.

5. **Antimutagenic Properties:** A number of studies show that *Ajuga bracteosa* to contain compounds that may shield the body's cells against mutagens thereby lowering the predisposition towards cancerous cell formation. It may be due to the antioxidant effect which it exhibited, and this makes it remove free radicals thus not allowing for damage to DNA [41]. *Ajuga bracteosa* is noted to have potential antimutagenic properties, mainly as a result of bioactive compounds such as flavonoids, alkaloids, terpenoids, and

phenolic acids. Mutagenesis can be characterized as the process or mechanism that causes genetic mutations to arise, which can result in cancer and other diseases. The designation of the antimutagenic effect of *Ajuga bracteosa* is strongly characterized as a neutralization and prevention of DNA damage due to its mutagenic effects. The major mechanism whereby the plant acts is through antioxidant activity. In this regard, by scavenging reactive oxygen species and free radicals, *Ajuga bracteosa* reduces oxidative stress. This contributes much to DNA strand breaks and mutations. Polyphenolic compounds in the plant, for example, flavonoids are potent in the inhibition of ROS formation that causes mutations in genetic material. Furthermore, other compounds in *Ajuga bracteosa* may exert their action as modulators for phase II detoxifying enzymes, particularly glutathione S-transferase (GST), which are involved in neutralizing carcinogenic and mutagenic substances before these can induce genetic damage. Studies have demonstrated that extracts of *Ajuga bracteosa* decrease the frequency of mutations induced by known mutagens, such as chemicals and radiation, in both bacterial and mammalian cell models, indicating protective effects at the genetic level. Moreover, the plant may help in the repair of DNA damage caused by external mutagenic agents, which may contribute to the maintenance of genetic stability. Though promising, the antimutagenic effects of *Ajuga bracteosa* would still need further research and clinical studies in order to be established as its practical applications and the safety of its compounds for human use.

6. **Anti – oxidant activity :** *Ajuga bracteosa*, a plant grown in different areas of Asia, has been of interest in exploring its antioxidant ability,



which may hold potential for preventing health conditions. Antioxidants are substances capable of inhibiting harmful free radicals from the human body and also reducing oxidative stress, which develops most chronic diseases, including cancers, diabetes mellitus, and heart diseases. The bioactive compounds present in *Ajuga bracteosa*, including flavonoids, phenolic acids, and tannins, have been reported to possess high antioxidant activity. These compounds are known to scavenge free radicals, reduce lipid peroxidation, and protect cellular components from oxidative damage. The extracts of the plant have been found to improve the body's natural defense systems, and thus, it is a promising candidate for use in traditional medicine as well as for developing natural therapeutic agents to combat oxidative stress and related ailments. *Ajuga bracteosa* contains a variety of bioactive compounds that are responsible for its antioxidant properties, including:

Flavonoids: These compounds are well known for their strong antioxidant activity, neutralizing free radicals and reducing oxidative stress. Flavonoids like quercetin, kaempferol, and luteolin are common in the *Ajuga* species.

Tannins: Tannins are another class of polyphenolic compounds in *Ajuga bracteosa* that contribute to antioxidant properties. They scavenge free radicals and chelate metal ions, which can prevent oxidative damage.

Terpenoids: These compounds, particularly in their triterpenoid form, also show antioxidant effects. They can help in reducing oxidative stress by interacting with reactive oxygen species (ROS).

Phenolic Acids: Polyphenolic compounds such as phenolic acids also play a major role in scavenging free radicals and reducing oxidative damage [42].

7. Anti-thrombotic and Antiplatelet Activity : Aggregation of platelets and the resultant formation of thrombus leads to a situation of heart attacks and strokes. *Ajuga bracteosa* has shown minor antiplatelet activities which prevent the formation of clots, and this mechanism is one more addition to its cardioprotective profile. *Ajuga bracteosa* has shown promise in anti-thrombotic and antiplatelet activities, thus making it a potential candidate for cardiovascular health. The bioactive compounds of the plant, such as flavonoids, terpenoids, and phenolic acids, are believed to be responsible for the inhibition of platelet aggregation and the prevention of blood clotting, which are the two main events involved in thrombosis. The occurrence of thrombosis is an abnormally formed clot in the blood vessels, and this can result in heart attacks, strokes, or deep vein thrombosis. *Ajuga bracteosa* may affect its anti-thrombotic action by disrupting platelet activation and aggregation. Its flavonoids have been established to inhibit the cyclooxygenase (COX) enzyme pathway that catalyzes the synthesis of thromboxane A₂, which promotes platelet aggregation. Some of these compounds in the plant may also cause a modulation of pro-thrombotic factors; this would subsequently reduce the coagulation abilities of platelets, which would otherwise group together and develop harmful clots. In addition, *Ajuga bracteosa* may regulate the fibrinolytic system, which allows for the destruction of fibrin clots, leading to the avoidance of excessive clots. Its antioxidant properties contribute to reducing oxidative stress, which is known to be involved in

endothelial dysfunction and initiation of thrombosis. Extracts of *Ajuga bracteosa* have demonstrated a significant inhibition of platelet aggregation in preclinical studies, indicating that this plant could serve as a potential natural therapeutic for the prevention of thrombotic events. However, further clinical research is needed to confirm its efficacy and safety for use in managing thrombotic conditions in humans [43].

CONCLUSION:

While *Ajuga bracteosa* holds excellent promise as a cardioprotective herb due to antioxidant, anti-inflammatory, and anti-hypertensive potential, more research is indicated, especially in human clinical trials, to better understand its mechanisms and therapeutic effect [44]. It should be used very cautiously, especially in relation to other cardiovascular drugs combined with it, and, of course, under direct supervision by a healthcare professional like any herbal supplement [45]. *Ajuga bracteosa*, being one of the most widely used traditional medicinal plants, possesses promising healing properties through its bioactive compounds, which include antioxidant, anti-inflammatory, and antimicrobial activities. All these properties suggest it to be useful in a wide variety of health disorders, including wound healing, skin infections, and inflammatory disorders. While preliminary studies and ethnobotanical evidence support its therapeutic potential, further clinical trials and pharmacological studies are required to confirm its efficacy, safety, and optimal usage. Moreover, research into its molecular mechanisms and synergistic effects with other treatments could unlock new possibilities for its integration into modern

medicine. With such a rich history in traditional healing, *Ajuga bracteosa* is promising as a valuable natural resource for future therapeutic application [46]

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