CODEN [USA]: IAJPBB ISSN : 2349-7750

INDO AMERICAN JOURNAL OF
PHARMACEUTICAL SCIENCES

SJIF Impact Factor: 7.187

https://doi.org/10.5281/zenodo.17141453

https://www.iajps.com/volumes/volume12-september-2025/13-issue-09-september-25/

Available online at: http://www.iajps.com *Review Article*

A COMPREHENSIVE REVIEW ON THE MEDICINAL APPLICATIONS AND PHARMACOLOGICAL PROPERTIES OF CANNABIS

Aditya Anil Nagargoje[1],Nayan Raut[2],Dharmraj Ankush Kekan[3],Dr. Vivek Kashid[4]

M.A.B.D Institute of Pharmaceutical Education & Research, Babhulgaon, Tal:- Yeola, Dist:- Nashik, Maharashtra, India. Pin:- 423401

Abstract:

Cannabis is one of the oldest known medicinal plants, recognized for its extensive pharmacological and therapeutic potential. Its principal bioactive compounds, tetrahydrocannabinol (THC) and cannabidiol (CBD), modulate the endocannabinoid system, influencing pain, inflammation, neurological function, mood, and immune responses. Additional phytochemicals, including terpenes and flavonoids, enhance its therapeutic effects through the entourage effect. Cannabis has shown potential in managing chronic pain, epilepsy, neurodegenerative disorders, psychiatric conditions, cancer, and gastrointestinal ailments. Despite its medicinal benefits, cannabis also poses risks, such as psychoactive effects, dependence, cognitive impairment, and regulatory challenges. This review comprehensively examines the botanical, chemical, pharmacological, therapeutic, and safety aspects of cannabis while exploring current research trends and future prospects.

Keywords: *Cannabis, Cannabinoids, THC, CBD, Endocannabinoid System, Pharmacology, Medicinal Uses, Therapeutics, Safety, Future Prospects*

Corresponding author:

Aditya Anil Nagargoje,

M.A.B.D Institute of Pharmaceutical Education & Research, Babhulgaon, Tal:- Yeola, Dist:- Nashik, Maharashtra, India. Pin:- 423401

QR CODE

*Please cite this article in **press** Aditya Anil Nagargoje et al., **A Comprehensive Review On The Medicinal Applications And Pharmacological Properties Of Cannabis**, Indo Am. J. P. Sci, 2025; 12(09).*

INTRODUCTION:

Cannabis, commonly referred to as marijuana, has held cultural, spiritual, and medicinal significance for thousands of years. Archaeological evidence indicates its use in ancient China around 2700 BCE, primarily for treating pain, digestive disorders, and gynecological complaints. In India, cannabis has been utilized in Ayurveda in the form of *bhang* and other preparations for sedative, analgesic, and appetite-stimulating properties. Ancient Egyptian and Greek texts also mention cannabis in treatments for inflammation, edema, and other ailments. Traditionally, cannabis was valued not only for medicinal purposes but also for religious rituals and recreational uses.

Scientific exploration of cannabis began in the 19th century, with European and Asian researchers isolating various active components. The discovery of Δ^9-tetrahydrocannabinol (THC) in the 1960s marked a milestone, establishing its psychoactive properties. Subsequently, cannabidiol (CBD) and other cannabinoids were identified, expanding the therapeutic scope of cannabis, particularly due to CBD's lack of intoxicating effects and its anti-inflammatory, neuroprotective, and anxiolytic properties.

Cannabinoids exert their effects primarily through the endocannabinoid system (ECS), a physiological network comprising cannabinoid receptors (CB1 and CB2), endogenous ligands such as anandamide, and enzymes responsible for ligand synthesis and degradation. CB1 receptors, predominantly located in the central nervous system, mediate analgesia, appetite regulation, mood modulation, and psychoactive effects. CB2 receptors, found mainly in peripheral tissues and immune cells, regulate inflammatory responses and immune functions. THC directly activates CB1 receptors, producing both therapeutic and psychoactive effects, whereas CBD modulates ECS activity indirectly and interacts with serotonin receptors, transient receptor potential channels, and peroxisome proliferator-activated receptors, contributing to anxiolytic, neuroprotective, and anti-inflammatory actions.

Modern research has highlighted cannabis's potential in chronic pain management, multiple sclerosis, epilepsy, cancer therapy, and psychiatric disorders. The legalization of medical cannabis in several countries has further stimulated clinical research and formulation development. However, cannabis use remains controversial due to potential dependence, cognitive impairment, and variations in regulatory frameworks.

Figure 1: Botanical Structure of Cannabis Plant

This review aims to consolidate current knowledge on cannabis, encompassing its botanical characteristics, chemical composition,

pharmacological mechanisms, therapeutic applications, adverse effects, ongoing research, and emerging therapeutics. By integrating traditional knowledge with modern scientific insights, this review underscores the therapeutic promise of cannabis while emphasizing the importance of controlled and evidence-based usage.

2. BOTANICAL AND CHEMICAL PROFILE

Cannabis is a dioecious, annual, herbaceous flowering plant classified within the family Cannabaceae. It is widely cultivated for medicinal, industrial, and recreational purposes. The three major species of cannabis are *Cannabis sativa*, *Cannabis indica*, and *Cannabis ruderalis*. *Cannabis sativa* is tall, fibrous, and energizing, whereas *Cannabis indica* is short, bushy, and associated with sedative properties. *Cannabis ruderalis* is small, hardy, and produces minimal psychoactive effects, often utilized in hybridization programs due to its auto-flowering trait. Morphologically, cannabis plants possess palmately compound leaves with serrated edges and glandular trichomes on female flowers, which serve as reservoirs for cannabinoids and aromatic compounds.

Chemically, cannabis contains over 500 phytochemicals, including approximately 100 cannabinoids, terpenes, and flavonoids. The most extensively studied cannabinoids include tetrahydrocannabinol (THC), cannabidiol (CBD), cannabigerol (CBG), cannabichromene (CBC), and cannabinol (CBN). THC is primarily responsible for psychoactive effects, whereas CBD is largely non-intoxicating and exhibits anti-inflammatory, neuroprotective, and anxiolytic properties. Terpenes such as myrcene, limonene, and pinene contribute to the characteristic aroma of cannabis and modulate therapeutic effects. Flavonoids, including cannflavins, quercetin, and kaempferol, possess antioxidant and anti-inflammatory activities. The combined action of cannabinoids, terpenes, and

flavonoids produces the synergistic "entourage effect," enhancing therapeutic outcomes.

Table 1. Botanical Characteristics of Major Cannabis Species

Species	Morphology	Growth Habit	Psychoactive Effect	Uses
Cannabis sativa	Tall, fibrous, palmate leaves	Upright, long stem	Stimulating	Medicinal, industrial, recreational
Cannabis indica	Short, bushy, dense foliage	Compact, resinous	Sedative	Therapeutic, sleep disorders
Cannabis ruderalis	Small, hardy, auto-flowering	Low, resistant	Low psychoactive	Breeding/hybrid cultivation

Cannabinoids are biosynthesized in glandular trichomes through a process where cannabigerolic acid (CBGA) serves as the precursor for tetrahydrocannabinolic acid (THCA), cannabidiolic acid (CBDA), and cannabichromenic acid (CBCA). Upon decarboxylation by heat or light, these acidic forms are converted into active cannabinoids such as THC and CBD. This complex phytochemical diversity underpins the wide range of therapeutic activities associated with cannabis.

Table 2. Major Cannabinoids and Therapeutic Relevance

Cannabinoid	Psychoactive	Main Therapeutic Action
THC	Yes	Analgesic, antiemetic, appetite stimulation
CBD	No	Anti-inflammatory, antiepileptic, anxiolytic
CBG	No	Neuroprotective, antibacterial, anti-inflammatory
CBC	No	Anti-inflammatory, analgesic
CBN	Mild	Sedative, analgesic

3. Pharmacological Mechanisms of Cannabis

Cannabis exerts its pharmacological effects primarily via the endocannabinoid system (ECS), which regulates physiological processes such as pain perception, appetite, mood, cognition, and immune function. CB1 receptors are predominantly found in the central nervous system, including the cortex, hippocampus, basal ganglia, and cerebellum. THC binds to CB1 receptors, resulting in psychoactive effects such as euphoria and altered cognition, along with therapeutic outcomes such as analgesia and appetite stimulation. CB2 receptors, mainly located in immune cells and peripheral tissues, modulate inflammatory responses and immune function.

CBD exhibits low affinity for CB1 and CB2 receptors but modulates the ECS indirectly by inhibiting the enzyme fatty acid amide hydrolase (FAAH), which increases endogenous anandamide levels. Additionally, CBD interacts with serotonin 5-HT1A receptors, transient receptor potential vanilloid 1 (TRPV1) channels, and peroxisome proliferator-activated receptors (PPAR-γ), contributing to its anxiolytic, antiepileptic, and anti-inflammatory effects.

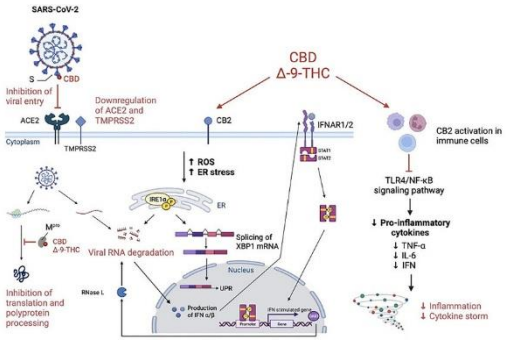

Fig.2. Pharmacological Mechanisms of Cannabis

The pharmacological diversity of cannabis is further enhanced by terpenes and flavonoids, which modulate receptor activity and contribute to the "entourage effect." Cannabis can be administered through inhalation, oral ingestion, sublingual sprays, transdermal patches, and novel drug delivery systems such as nanoparticles. Its metabolism occurs mainly in the liver via cytochrome P450 enzymes, and metabolites are excreted through urine and feces.

Table 3. Pharmacological Targets of Cannabis Components

Component	Primary Target	Therapeutic Effect
THC	CB1, CB2	Analgesia, appetite stimulation, antiemetic
CBD	FAAH, 5-HT1A, TRPV1, PPAR-γ	Antiepileptic, anxiolytic, anti-inflammatory
Terpenes	TRP channels	Analgesia, sedative, mood modulation
Flavonoids	COX, LOX	Anti-inflammatory, antioxidant

4. Medicinal Applications of Cannabis

Cannabis has been extensively studied for its therapeutic potential across multiple disease conditions. Its analgesic properties are among the most well-documented. THC and CBD interact with CB1 and CB2 receptors to modulate nociceptive signaling, reducing both chronic and neuropathic pain. Patients with conditions such as arthritis, fibromyalgia, and multiple sclerosis have shown significant improvement in pain scores with cannabis-based treatments. Unlike opioids, cannabinoids offer analgesia with a lower risk of respiratory depression, making them a valuable alternative in pain management.

In neurological disorders, cannabis exhibits considerable therapeutic promise. CBD has been demonstrated to reduce seizure frequency in treatment-resistant epilepsy, including Dravet syndrome and Lennox-Gastaut syndrome. In multiple sclerosis, cannabinoids help alleviate spasticity, tremors, and neuropathic pain. Preclinical studies have suggested neuroprotective effects in Parkinson's and Alzheimer's diseases, where cannabinoids reduce oxidative stress, inflammation, and neuronal death. These properties are linked to modulation of ECS activity as well as interactions with TRPV1 channels and PPAR-γ receptors.

Cannabis has also shown applications in psychiatric disorders. CBD demonstrates anxiolytic, antidepressant, and antipsychotic effects, primarily via serotonin receptor modulation. THC, on the other hand, must be administered carefully due to its psychoactive potential, which can exacerbate anxiety or trigger psychosis in susceptible individuals. Emerging research also suggests that cannabis may improve sleep quality in insomnia and other sleep-related disorders.

In oncology, cannabis is increasingly investigated as an adjunct therapy. Preclinical and some clinical studies suggest that cannabinoids inhibit tumor proliferation, induce apoptosis, suppress angiogenesis, and modulate immune responses. Cannabis is also effective in reducing chemotherapy-induced nausea and vomiting, improving appetite, and mitigating cancer-related cachexia.

Gastrointestinal applications of cannabis are supported by evidence showing regulation of gut motility and inflammation. Cannabinoids have been evaluated for inflammatory bowel diseases, such as Crohn's disease and ulcerative colitis, with promising results in symptom relief and improved quality of life. Additionally, topical applications of cannabinoids are gaining attention in dermatology for treating conditions such as psoriasis, eczema, and acne due to their anti-inflammatory and sebostatic properties.

Table 4. Medicinal Uses of Cannabis and Mechanisms of Action

Condition	Active Component	Mechanism of Action
Chronic Pain	THC, CBD	CB1/CB2 modulation, anti-inflammatory
Epilepsy	CBD	TRPV1 modulation, neuronal excitability regulation
Multiple Sclerosis	THC, CBD	Muscle relaxation, neuroprotection
Anxiety/Depression	CBD	5-HT1A receptor activation
Cancer	THC, CBD	Apoptosis induction, anti-proliferation, anti-angiogenesis
Chemotherapy-induced Nausea	THC	CB1-mediated antiemetic effect
Skin Disorders	CBD	Anti-inflammatory, antioxidant
Gastrointestinal Disorders	THC, CBD	Motility regulation, anti-inflammatory

5. Adverse Effects and Safety

Despite its therapeutic potential, cannabis use is associated with adverse effects. The most common include psychoactive effects such as euphoria, altered cognition, impaired memory, and coordination deficits. Chronic use may lead to dependence and, in some cases, cannabis use disorder. Cardiovascular effects such as tachycardia, hypotension, and increased risk of arrhythmias have been reported, particularly in patients with pre-existing heart conditions.

Respiratory issues are primarily associated with smoking cannabis, leading to bronchitis, chronic cough, and impaired lung function. Oral and sublingual routes generally reduce pulmonary risk but may result in delayed onset of effects and variable bioavailability. Cannabis may also interact with medications metabolized by the cytochrome P450 system, altering plasma drug levels and efficacy.

Neurocognitive effects, particularly in adolescents and young adults, are a significant concern. Prolonged exposure may impair attention, learning, and memory, and high THC concentrations can increase the risk of psychiatric disorders such as psychosis. Therefore, controlled dosing, patient monitoring, and careful selection of cannabinoid ratios (THC:CBD) are essential for minimizing adverse effects.

6. Current Research and Future Prospects

Current research on cannabis is focused on optimizing therapeutic efficacy, improving delivery systems, and minimizing adverse effects. Novel formulations, including nanoemulsions, liposomes, transdermal patches, and oral dispersible films, are being developed to enhance bioavailability and provide controlled dosing. Studies on synthetic cannabinoids and selective CB1/CB2 receptor modulators aim to achieve targeted therapeutic effects without psychoactive consequences.

Clinical trials are ongoing for a variety of conditions, including chronic pain, epilepsy, multiple sclerosis, anxiety, depression, and cancer-related symptoms. Researchers are exploring the benefits of combining cannabis with conventional pharmaceuticals to reduce side effects and improve efficacy. Personalized medicine approaches are also being investigated, taking into account genetic variations in cannabinoid receptor expression and metabolic profiles to optimize individual responses to cannabis therapy.

Future prospects include the use of cannabis in neurodegenerative diseases such as Alzheimer's and Parkinson's, where its antioxidant and anti-inflammatory properties may slow disease progression. Cannabis may also play a role in managing metabolic disorders, cardiovascular diseases, and autoimmune conditions, provided that regulatory frameworks and safety protocols are strictly followed. The integration of advanced drug delivery systems, standardized cannabinoid preparations, and evidence-based dosing guidelines will likely expand the clinical applicability of cannabis in the coming years.

7. Emerging Therapeutics

Emerging cannabis-based therapeutics are focused on addressing unmet medical needs while reducing risks associated with psychoactive effects. Neurodegenerative disorders are a major area of research, with cannabinoids showing potential in slowing neuronal degeneration and reducing inflammation in diseases such as Alzheimer's, Parkinson's, and Huntington's disease.

In oncology, cannabinoids are being investigated as adjuncts to conventional therapies to inhibit tumor growth, reduce chemotherapy-induced nausea, improve appetite, and enhance overall quality of life. Cannabis is also being formulated into advanced drug delivery systems such as cannabinoid-loaded nanoparticles, hydrogels, and topical gels, which improve absorption and reduce systemic side effects.

Dermatological applications are expanding, with cannabinoid-based creams and ointments showing efficacy in psoriasis, eczema, acne, and wound healing. The future of cannabis therapeutics is likely to involve precision medicine approaches that combine pharmacogenetics, novel formulations, and integrative treatment strategies to maximize therapeutic benefits and minimize risks.

8. SUMMARY AND CONCLUSION:

Cannabis is a versatile medicinal plant with extensive pharmacological and therapeutic potential. Its primary bioactive compounds, THC and CBD, modulate the endocannabinoid system and other molecular targets, producing effects across neurological, psychiatric, oncological, gastrointestinal, dermatological, and musculoskeletal conditions. Synergistic interactions between cannabinoids, terpenes, and flavonoids enhance therapeutic efficacy through the entourage effect.

Although cannabis offers numerous clinical benefits, safety concerns including psychoactive effects, dependence, cardiovascular risks, and neurocognitive impairment must be considered. Regulatory inconsistencies and limited long-term safety data necessitate cautious application. Advancements in formulation technology, synthetic cannabinoids, personalized therapy, and clinical research are expected to expand the safe and effective use of cannabis in modern medicine. With

continued research, standardized dosing, and evidence-based guidelines, cannabis holds significant promise as an integrative component of contemporary therapeutics.

9.REFERENCES:

1. Aher, K. B., Bhosale, S., Bhavar, G. B., Habeeb, M., & You, H. W. (2025). Development and optimization of polymeric nanosponges for enhanced delivery of diflunisal in rheumatoid arthritis. International Journal of Nano Dimension, 16(2), 145–158.
2. Basavarajappa, B. S., Shivakumar, M., & Subbanna, S. (2021). Endocannabinoid system: Emerging therapeutic target in neurodegenerative disorders. Progress in Neuro-Psychopharmacology & Biological Psychiatry, 105, 110158.
3. Blessing, E. M., Steenkamp, M. M., Manzanares, J., & Marmar, C. R. (2015). Cannabidiol as a potential treatment for anxiety disorders. Neurotherapeutics, 12(4), 825–836.
4. Di Marzo, V. (2008). Endocannabinoids: Synthesis and degradation. Reviews of Physiology, Biochemistry and Pharmacology, 160, 1–24.
5. ElSohly, M. A., & Slade, D. (2005). Chemical constituents of marijuana: The complex mixture of natural cannabinoids. Life Sciences, 78(5), 539–548.
6. Huestis, M. A., Solimini, R., Pichini, S., Pacifici, R., Carlier, J., & Busardò, F. P. (2019). Cannabidiol adverse effects and toxicity. Current Neuropharmacology, 17(10), 974–989.
7. Kogan, N. M., & Mechoulam, R. (2007). Cannabinoids in health and disease. Dialogues in Clinical Neuroscience, 9(4), 413–430.
8. Kumar, A., Kumar, V., & Sharma, A. (2020). Pharmacological overview of cannabis and cannabinoids: Therapeutic potentials and adverse effects. Journal of Pharmaceutical Sciences and Research, 12(6), 725–733.
9. Russo, E. B. (2011). Taming THC: Potential cannabis synergy and phytocannabinoid-terpenoid entourage effects. British Journal of Pharmacology, 163(7), 1344–1364.
10. Pertwee, R. G. (2008). The diverse CB1 and CB2 receptor pharmacology of three plant cannabinoids: Δ9-tetrahydrocannabinol, cannabidiol, and Δ9-tetrahydrocannabivarin. British Journal of Pharmacology, 153(2), 199–215.
11. Mechoulam, R., & Parker, L. A. (2013). The endocannabinoid system and the brain. Annual Review of Psychology, 64, 21–47.
12. Hill, K. P., Palastro, M. D., Johnson, B., & Ditre, J. W. (2017). Cannabis and pain: A clinical review. Cannabis and Cannabinoid Research, 2(1), 96–104.
13. Zuardi, A. W. (2008). Cannabidiol: From an inactive cannabinoid to a drug with wide spectrum of action. Revista Brasileira de Psiquiatria, 30(3), 271–280.
14. Grotenhermen, F., & Müller-Vahl, K. (2012). The therapeutic potential of cannabis and cannabinoids. Deutsches Ärzteblatt International, 109(29–30), 495–501.
15. Whiting, P. F., Wolff, R. F., Deshpande, S., et al. (2015). Cannabinoids for medical use: A systematic review and meta-analysis. JAMA, 313(24), 2456–2473.
16. Ashton, C. H. (2001). Pharmacology and effects of cannabis: A brief review. British Journal of Psychiatry, 178, 101.