GSC Biological and Pharmaceutical Sciences
eISSN: 2581-3250 CODEN (USA): GBPSC2
Cross Ref DOI: 10.30574/gscbps
Journal homepage: https://gsconlinepress.com/journals/gscbps/

(REVIEW ARTICLE)

Check for updates

Industrial *Cannabis sativa* (Hemp or fiber type): Cannabidiol (CBD) Prevents Heart Failure-An Updated Review

Raju K. Chalannavar [1], Hosmani PA [2] and Ravindra B. Malabadi [1,*]

[1] *Department of Applied Botany, Mangalore University, Mangalagangotri-574199, Mangalore, Karnataka State, India.*
[2] *Department of Botany, Bangurnagar Arts, Science and Commerce College, Dandeli-581325, Karnataka State, India.*

GSC Biological and Pharmaceutical Sciences, 2025, 33(03), 396-406

Publication history: Received on 31 October 2025; revised on 16 November 2025; accepted on 20 December 2025

Article DOI: https://doi.org/10.30574/gscbps.2025.33.3.0482

Abstract

Cannabis sativa L., commonly known as hemp, has been cultivated and utilized medically throughout the world. Humans and other mammals contain an Endocannabinoid system (ECS) within their bodies, which plays a significant role in maintaining homeostasis, or balance, in the body. Together with the CB1 and CB2 receptors, constitute the ECS, a complex and highly conserved neuromodulator network involved in regulating a wide array of physiological processes. Cannabidiol (CBD) and other phytocannabinoids are gaining attention for their therapeutic potential in cardiovascular disease (CVD), the world's leading cause of death. Heart failure (HF) is characterized by energy deprivation, calcium (Ca^{2+}) handling alterations, and inflammation: effects associated with mitochondrial dysfunction. One of the recent studies by García-Rivas et al., (2025) demonstrated that cannabidiol (CBD) offers cardio protection in a heart failure mouse model induced by L-NAME and ANGII administration. CB2 has emerged as a modulator of cardiovascular health, exerting potent anti-inflammatory and the protective effects while avoiding the psychotropic activity associated with CB1 activation. However, cannabinoids have not yet reached clinical maturity for broad implementation in cardiovascular therapeutics. One of the most pressing issues is the translational gap between experimental findings and clinical application.

Keywords: *Cannabis Sativa*; Cardiovascular Disease (CVD); Cannabidiol (CBD); Endocannabinoid System (ECS); Hemp; Heart Failure

1. Introduction

Cannabis sativa has been used for thousands of years for recreational, medicinal, or religious purposes. *Cannabis sativa* is a flowering plant from the *Cannabaceae* family and genus Cannabis [1-47-56]. Many historians believed that Indian Himalayan Region was the centre of origin of *Cannabis sativa* L. and *Cannabis indica* L. [1-50-56]. *Cannabis sativa* is a plant notorious for its psychoactive effect, but when used correctly, it provides a plethora of medicinal benefits [1-47-56]. *Cannabis sativa* is also a wild noxious weed with notorious psychoactive principle, Λ9-tetrahydrocannabinol (THC) found growing in India, China, Bhutan, Nepal, Pakistan, Afghanistan, Iran, and Morocco [1-45-56]. Cannabis has a long history in India, recorded in legends and religion. It was found in various habitats ranging from sea level to the temperate and alpine foothills of the Indian Himalaya Region from where it was probably spread over the last 10,000 years [1-25]. However, due to the presence of psychoactive molecules, Λ9-tetrahydrocannabinol (Λ9-THC) and Λ8-tetrahydrocannabinol (Λ8-THC), *Cannabis sativa* cultivation and its use is restricted/regulated in many countries [1-56]. Across diverse cultures, from India, China and Egypt to the Islamic regions, *Cannabis sativa* was used for pain management, antiemetic, anticonvulsant, and anti-inflammatory purposes [1-2-50].

* Corresponding author: Ravindra B. Malabadi

Introduced into Western medicine by William O'Shaughnessy in 1838 to treat a variety of conditions, including rheumatic pain and epilepsy, the use of cannabinoids (CBs) in clinical practice entered a period of latency and oblivion due to political barriers and problems in establishing quality control [1-56]. Cannabis was (re) introduced into British medical practice in the early 1840's by Irish physician Dr. William O'Shaughnessy, an army surgeon serving in Calcutta, India [1-40-56]. *Cannabis sativa* extracts were typically administered orally in the form of an alcoholic tincture and were commonly incorporated in proprietary medicines [1-45-56]. In the Victorian period, cannabis was widely used for a variety of ailments, including muscle spasms, menstrual cramps, rheumatism, the convulsions of tetanus, rabies, and epilepsy, and as a sedative [1-56].

Cannabis sativa L., is classified into two types as Industrial *Cannabis sativa*, hemp or fibre type and Medical *Cannabis sativa* L. (drug or marijuana) based on its THC content [1-55]. Medical *Cannabis sativa* (drug or marijuana) contains a very high levels of THC (above 0.3 to 38% of dry weight) [1-40-50]. On the other hand, Industrial *Cannabis sativa* L. (Hemp) contains very low levels of THC (0 to 0.3% of dry weight) [1-45]. Industrial *Cannabis sativa* (hemp), as a diverse plant, can be a revolutionary crop for a better future and for upcoming generations [1-48-54]. It is an eco-friendly and worthwhile crop that complements a sustainable growth system. Industrial hemp farming has the potential to dramatically minimize the amount of carbon impact on the environment and can be cultivated with a little or no usage of chemical pesticides or fertilizers [1-49]. The stalks, seeds, and leaves are converted into various construction materials, textiles, paper, food, furniture, cosmetics, and healthcare products [1-48-53]. Biochar, bioplastics, biofuels, and biopesticides are some of the innovative applications of the hemp plant, which are subjects of research and debate at present time [1-55]

Industrial *Cannabis sativa* (Hemp of fiber type) has been cultivated for millennia as a source of fiber, food, medicine and utilization of hemp for essential oils [1-48-54]. In addition to fiber and essential oils, the hemp plant produces hundreds of secondary metabolites including flavonoids, diterpenes, triterpenes, and cannabinoids [1-48-55]. Unlike primary metabolites such as proteins, nucleic acids, lipids, and carbohydrates that are essential for life, secondary metabolites benefit plants in other ways such as deterring predators, attracting pollinators, or preventing infection [1-48-56].

2. The Endocannabinoid system (ECS)

The Endocannabinoid system (ECS) (Figure-1) represented a critical part of understanding Δ9-tetrahydrocannabinol (THC), cannabidiol (CBD) and its potent effects on the human body [1-57-58]. Humans and other mammals contain an Endocannabinoid system (ECS) within their bodies, which plays a significant role in maintaining homeostasis, or balance, in the body [1-48-58]. This unique Endocannabinoid system (ECS) also influences regulatory processes as diverse as appetite, sleep, mood, stress, energy levels, and reproduction [3-48-58]. The Endocannabinoid system (ECS) produces endogenous cannabinoids (produced internally) and responds to exogenous cannabinoids (produced externally), like the ones found in *Cannabis sativa* which are called phytocannabinoids [1-3-48-58]. Endogenous cannabinoids are now generally referred to as and, together with cannabinoid receptors, constitute the 'Endocannabinoid system [3-48-58-65]. Evidence has also emerged that tissue concentrations of endocannabinoids, cannabinoid receptor density and/or cannabinoid receptor coupling efficiency increased in a range of disorders [3-48-58]. In some of these disorders, for example, multiple sclerosis, certain types of pain, cancer, schizophrenia, post-traumatic stress disorders, some intestinal and cardiovascular diseases, excitotoxicity and traumatic head injury, this upregulation of the Endocannabinoid system may cause a reduction in the disease [3-48-58]. However, there are other disorders, for example, impaired fertility in women, obesity, cerebral injury in stroke, endotoxemia shock, cystitis, ileitis and paralytic illness in which the unwanted effects appear to resulted from an upregulation of the endocannabinoid system, suggesting that this system has its own pathology and severity of symptoms or a slowing of disease progression possibly also that it sometimes mediates unwanted effects because it is being influenced by pathological events taking place in some other system from which it receives input [57-58-117]. The Endocannabinoid system (ECS) has been recently recognized as an important modulatory system in the function of brain, endocrine, and immune tissues [4-57-58-117]. ECS appears to play a very important regulatory role in the secretion of hormones related to reproductive functions and response to stress [3-57-58-117]. Some of the healthy and natural ways to boost endocannabinoid system: Increase the intake of Omega-3 Fatty Acids, exercise regularly, manage stress better, Lower alcohol consumption and increase the consumption of phytocannabinoids [1-57-58-117]. There are two main types of cannabinoid receptors in the body: CB1 and CB2 [2-57-58-117]. CB1 and CB2 receptors (Figure-1) are distributed throughout the central and peripheral nervous systems [2-57-58-117]. "In the brain, these receptors are located in the brain stem, cerebral cortex, hippocampus, cerebellum, basal ganglia, hypothalamus, and amygdala [2-57-58]. They are also found in the liver, kidneys, spleen, gonads, and heart [2-57-58-117]. Δ9-tetrahydrocannabinol (THC) is what's known as a partial agonist at both CB1 and CB2 receptors, meaning that it can partially bind to both receptor sites [2-57-58-117]. The psychoactive effects for which Δ9- tetrahydrocannabinol (THC) is famed arise from its affinity for the CB1 receptor [2-57-58-65-111]. The key endocannabinoids include anandamide (AEA; N-arachidonoylethanolamide),

2-arachidonoylglycerol (2-AG), N-arachidonoyl dopamine (NADA), and rhodamine (O-arachidonoylethanolamide) [2-58-100]. Together with the CB1 and CB2 receptors, uptake mechanisms, and associated metabolic enzymes, these lipid-derived signaling molecules constitute the ECS, a complex and highly conserved neuromodulator network involved in regulating a wide array of physiological processes [2-57-58-103].

THC exhibits a high binding affinity for cannabinoid receptors [57-58-110]. Activation of CB1 by THC is responsible for its psychoactive effects, manifesting as alterations in perception, mood, and anxiety, whereas CB2 activation is implicated in the regulation of inflammatory processes and immune function [2-30-58]. In contrast, CBD displays a relatively low binding affinity for both CB1 and CB2 receptors [2-30-58-68]. It functions as a negative allosteric modulator at the CB1 receptor, thereby attenuating the psychoactive effects of THC [2-30-59].

The defining feature of phytocannabinoids is their capacity to interact with the ECS, a complex network comprising endocannabinoids (e.g., anandamide, 2- rachidonoylglycerol), their receptors, uptake transporters, and associated metabolic enzymes responsible for synthesis and degradation [2-30-61]. The ECS plays a crucial role in maintaining systemic homeostasis, influencing diverse physiological processes, including nociception, appetite, immune responses, emotional regulation, and cardiovascular function [2-34-110]. Phytocannabinoids modulate the ECS via distinct mechanisms. THC acts as a partial agonist at CB1 and CB2 receptors, while CBD inhibits the enzymatic degradation of endocannabinoids, thereby increasing endogenous levels of anandamide and 2-AG [2-30-58-70]. This elevation may lead to physiological effects such as peripheral vasodilation or compensatory tachycardia [2-30-58-115]. CBD demonstrates a wide range of biological activities through interactions with multiple receptor systems, much of the supporting evidence is derived from *in vitro* or animal model studies [2-30-58].

CB2 has emerged as a modulator of cardiovascular health, exerting potent anti- inflammatory and osteoprotective effects while avoiding the psychotropic activity Assoc acted with CB1 activation [2-46-76]. Mechanistically, CB2 counteracts pro-atherogenic processes by modulating key signaling pathways [2-30-58]. In human monocytes, CB2 agonists downregulate chemokine receptors (CCR1, CCR2) and adhesion molecules, thereby reducing chemotaxis toward CCL2 and CCL3[2-30-58]. Furthermore, CB2 activation promotes the polarization of anti- inflammatory macrophages, downregulates NF-KB activity, and reduces the secretion of pro-inflammatory cytokines in foam cells [2-30-58]. In vascular smooth muscle cells, CB2 stimulation mitigates TNF-α-induced proliferation and migration via MAPK/ERK and PI3K/Akt signaling [2-30-58].

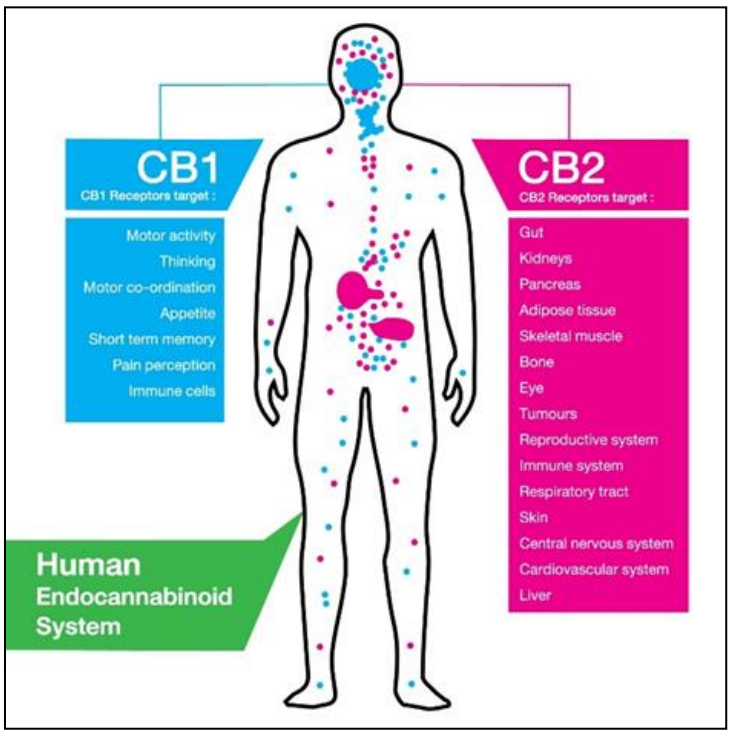

Figure 1 Human Endocannabinoid system (ECS) with CB1 and CB2 receptors

3. Heart Failure (HF): Role of Cannabidiol (CBD)

Heart failure (HF) remains a major clinical and public health problem [58-75-117]. Heart disease is the leading cause of death worldwide, with heart failure (HF) recognized as its most severe and debilitating manifestation [59-79-117]. Heart failure (HF) is characterized by energy deprivation, calcium (Ca^{2+}) handling alterations, and inflammation: effects associated with mitochondrial dysfunction [58-90-117]. Heart failure is a pathological condition in which the heart is unable to pump enough blood to the rest of the body, because it is either unable to fill with a sufficient volume of blood or unable to generate sufficient force to pump out enough blood; it is not a condition in which the heart has stopped pumping [59-79-117]. Heart failure (HF), also known as congestive heart failure (CHF), is a complex clinical syndrome characterized by the heart's inability to pump blood effectively due to structural or functional impairments [59-79-117]. The most common cause of HF is ischemic heart disease, but other factors, such as hypertension, valvular disease, and myocarditis, also contribute to its development [79-117]. Heart failure (HF) is classified based on left ventricular ejection fraction (LVEF) and clinical staging [59-79-117]. Common symptoms of HF include shortness of breath, fatigue, fluid retention, and edema. Heart failure (HF) progression is characterized by progressive fibrosis, inflammation, decreased contractile function and relaxation, as well as apoptosis [59-79-117]. Approximately half of all heart failure cases are attributed to reduced left ventricular systolic function—classified as heart failure with reduced ejection fraction (HFREF) [58-79-117]. Current guideline-directed medical therapy has markedly improved survival and quality of life for patients with HFREF [60-79-117]. The current management of HFREF requires the initiation and fast up-titration of the four pillars, namely a renin-angiotensin system inhibitor (RAS-i), a beta blocker, a mineralocorticoid receptor antagonist (MRA) and a sodium/glucose cotransporter 2 inhibitor (SGLT2) [59-79-117]. Historically, when conventional treatment of HF was mainly diuretics and digoxin, the CONSENSUS trial showed that RAS-i, namely Enalapril, was able to reduce by 40% all-cause mortality at 6 months [59-79-117]. Since then, RAS-i became one of the foundations of HF treatment [58-79-117].

One of the studies by García-Rivas et al., (2025) [57] demonstrated that cannabidiol (CBD) offers cardio protection in a HF mouse model induced by L-NAME and ANGII administration [57]. The results of this study by García-Rivas et al., (2025) [57] showed improved cardiac function and reduced cardiac hypertrophy, remodeling, inflammation, and cell death. In cardiomyocytes from the HF model, cannabidiol restored cell shortening, which was linked to improved calcium (Ca^{2+}) handling [57]. Additionally, it helped preserve cellular oxidative status, mitochondrial bioenergetics, and notably, modulated [Ca^{2+}] overload by affecting MCU expression [57]. This suggests that the cardioprotective effects of cannabidiol are caused by the preservation of excitation-contraction-energetic coupling [57]. The identified cellular mechanisms through which cannabidiol exerts its cardioprotective effects include reducing oxidative stress and the activation of PPAR- g, which helps prevent mitochondrial dysfunction by decreasing MCU hyperactivity [57]. Cannabidiol previously prevented mitochondrial dysfunction[57]. Thus, it may prevent HF progression [57]. In mice with HF, subcutaneous cannabidiol attenuated cardiac fibrosis, hypertrophy, loss of ejection fraction, and inflammation; isolated cardiomyocytes preserved cell shortening, (Ca^{2+}) handling, mitochondrial function and redox balance [57]. Hypertrophied ventricular cardio myoblasts suggested cannabidiol-mediated effects through peroxisome proliferator-activated gamma receptors [57]. Therefore, cannabidiol in HF limited cardiac hypertrophy and preserved contractile function by sustaining cardiomyocyte and mitochondrial function through redox balance maintenance, supporting cannabidiol role as a cardioprotective therapy in HF [57].

Cannabidiol (CBD) and other phytocannabinoids are gaining attention for their therapeutic potential in cardiovascular disease (CVD), the world's leading cause of death [57-79-117]. Evidence also supports the activation of CB2 in heart failure models. Agonists enhance diastolic function, mitigate ventricular remodeling, and suppress the expression of genes associated with fibrosis. Such effects are partly mediated through suppression of ROS generation, upregulation of nuclear factor erythroid 2-related factor 2 (Nrf2), and inhibition of caspase activation, collectively contributing to cardiomyocyte survival and mitochondrial stability [57-79-117]. Cannabidiol (CBD) exerts complex and pleiotropic actions through interactions with a range of molecular targets, including ECS receptors, non-cannabinoid receptors, and redox-sensitive transcription factors. In particular, increasing evidence indicates the beneficial effects of Cannabidiol (CBD) on the cardiovascular system [57-79-117]. Those effects include suppression of pro-inflammatory cytokine release, inhibition of macrophage activation, and attenuation of oxidative stress [56]. Such mechanisms contribute to the potential reduction in risk and progression of conditions such as atherosclerosis, arterial hypertension, and heart failure [57]. Although exogenous cannabidiol (CBD) may not precisely replicate the effects of endogenous cannabinoids, its regulatory influence on the cardiovascular system is evident [57-79-117]. CBD may improve endothelial function, reduce heart rate, and exert cardioprotective effects during stress exposure (possibly associated with anxiolytic effects), partially through modulation of autonomic tone and reduction in sympathetic drive [57-79-117].

Now a days, cannabidiol (CBD) has garnered attention for its vasodilatory, anti-inflammatory, and antioxidant effects on cardiovascular health [59-79-117]. With this growing body of evidence and focused scientific interest, it is essential

to contextualize these findings within the broader landscape of cardiovascular disease (CVD). García-Rivas et al (2025) [57] provided valuable insight by isolating the impact of the non-intoxicating cannabinoid, cannabidiol (CBD), on adverse cardiac remodeling in a murine model of heart failure [93-117]. The authors showed that 4 weeks of CBD administration prevents the progression of heart failure, with experiments linking in vivo cardiac function to molecular origins, through the intermediary processes of cellular energy production and inflammatory signaling[93]. Furthermore, the therapeutic potential of CBD shown by García-Rivas et al., (2025) [57] does not stand alone, because cannabidiol (CBD) has been demonstrated to reduce blood pressure in humans, adding to its therapeutic potential in heart failure [57, 58 93]. Overall, current evidence supports cannabidiol (CBD) promise as an adjunct in cardiovascular disease (CVD) treatment, but broader clinical use requires more rigorous, large-scale studies [57, 58, 93]. Ulric et al., (2025) [58] are of the opinion that cannabinoids have not yet reached clinical maturity for broad implementation in cardiovascular therapeutics, the underlying scientific evidence is promising, and preliminary findings are encouraging [58]. Bridging the translational gap prudently will demand methodologically rigorous, multidisciplinary research efforts, ensuring that any future clinical claims are grounded in robust human evidence [58].

4. Conclusion

Cannabidiol (CBD) and other phytocannabinoids are gaining attention for their therapeutic potential in cardiovascular disease (CVD), the world's leading cause of death. Heart failure (HF) is characterized by energy deprivation, calcium (Ca2+) handling alterations, and inflammation: effects associated with mitochondrial dysfunction. Common symptoms of HF include shortness of breath, fatigue, fluid retention, and edema. Heart failure (HF) progression is characterized by progressive fibrosis, inflammation, decreased contractile function and relaxation, as well as apoptosis. One of current evidence supports cannabidiol (CBD) promise as an adjunct in cardiovascular disease (CVD) treatment, but broader clinical use requires more rigorous, large-scale studies. However, cannabinoids have not yet reached clinical maturity for broad implementation in cardiovascular therapeutics. One of the most pressing issues is the translational gap between experimental findings and clinical application.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] Malabadi RB, Kolkar KP, Chalannavar RK. *Cannabis sativa*: Ethnobotany and Phytochemistry. International Journal of Innovation Scientific Research and Review. 2023; 5(2): 3990-3998.

[2] Malabadi RB, Kolkar KP, Chalannavar RK. *Cannabis sativa*: Industrial hemp (fiber type)- An *Ayurvedic* traditional herbal medicine. International Journal of Innovation Scientific Research and Review 2023; 5 (2): 4040-4046.

[3] Malabadi RB, Kolkar KP, Achary M, Chalannavar RK. *Cannabis sativa*: Medicinal plant with 1000 Molecules of Pharmaceutical Interest. International Journal of Innovation Scientific Research and Review. 2023; 5(2): 3999-4005.

[4] Malabadi RB, Kolkar KP, Chalannavar RK. Medical *Cannabis sativa* (Marijuana or Drug type); The story of discovery of Δ9-Tetrahydrocannabinol (THC). International Journal of Innovation Scientific Research and Review. 2023; 5 (3):4134-4143.

[5] Malabadi RB, Kolkar KP, Chalannavar RK. Δ9-Tetrahydrocannabinol (THC): The major Psychoactive Component is of Botanical origin. International Journal of Innovation Scientific Research and Review. 2023; 5(3): 4177-4184.

[6] Malabadi RB, Kolkar KP, Chalannavar RK, Lavanya L, Abdi G. *Cannabis sativa*: Botany, Cross Pollination and Plant Breeding Problems. International Journal of Research and Innovations in Applied Science (IJRIAS). 2023; 8 (4): 174-190.

[7] Malabadi RB, Kolkar KP, Chalannavar RK. *Cannabis sativa*: Industrial Hemp (fibre-type)- An emerging opportunity for India. International Journal of Research and Scientific Innovations (IJRSI). 2023; X (3):01-9.

[8] Malabadi RB, Kolkar KP, Chalannavar RK. Industrial *Cannabis sativa* (Hemp fiber type): Hempcrete-A plant based eco-friendly building construction material. International Journal of Research and Innovations in Applied Sciences (IJRIAS). 2023; 8(3): 67-78.

[9] Malabadi RB, Kolkar KP, Chalannavar RK, Lavanya L, Abdi G. *Cannabis sativa*: The difference between Δ8-THC and Δ9-Tetrahydrocannabinol (THC). International Journal of Innovation Scientific Research and Review. 2023; 5(4): 4315-4318.

[10] Malabadi RB, Kolkar KP, Chalannavar RK, Lavanya L, Abdi G. Hemp Helps Human Health: Role of phytocannabinoids. International Journal of Innovation Scientific Research and Review. 2023; 5 (4): 4340-4349.

[11] Malabadi RB, Kolkar KP, Chalannavar RK, Lavanya L, Abdi G, Baijnath H. *Cannabis* products contamination problem: A major quality issue. International Journal of Innovation Scientific Research and Review. 2023;5(4): 4402-4405.

[12] Malabadi RB, Kolkar KP, Chalannavar RK, Lavanya L, Abdi G. Medical *Cannabis sativa* (Marijuana or drug type): Psychoactive molecule, Δ9-Tetrahydrocannabinol (Δ9-THC). International Journal of Research and Innovations in Applied Science. 2023; 8(4): 236-249.

[13] Malabadi RB, Kolkar KP, Chalannavar RK, Mondal M, Lavanya L, Abdi G, Baijnath H. *Cannabis sativa*: Release of volatile organic compounds (VOCs) affecting air quality. International Journal of Research and Innovations in Applied Science (IJRIAS). 2023; 8(5): 23-35.

[14] Malabadi RB, Nethravathi TL, Kolkar KP, Chalannavar RK, Mudigoudra BS, Lavanya L, Abdi G, Baijnath H. *Cannabis sativa*: Applications of Artificial Intelligence and Plant Tissue Culture for Micropropagation. International Journal of Research and Innovations in Applied Science (IJRIAS). 2023; 8(6): 117-142.

[15] Malabadi RB, Nethravathi TL, Kolkar KP, Chalannavar RK, Mudigoudra BS, Abdi G, Baijnath H. *Cannabis sativa*: Applications of Artificial intelligence (AI) in Cannabis industries: In Vitro plant tissue culture. International Journal of Research and Innovations in Applied Science (IJRIAS). 2023; 8 (7): 21-40. International Journal of Science and Research Archive. 2023; 10(02): 860–873.

[16] Malabadi RB, Kolkar KP, Brindha C, Chalannavar RK, Abdi G, Baijnath H, Munhoz ANR, Mudigoudra BS. *Cannabis sativa*: Autoflowering and Hybrid Strains. International Journal of Innovation Scientific Research and Review. 2023; 5(7): 4874-4877.

[17] Malabadi RB, Kolkar KP, Chalannavar RK, Munhoz ANR, Abdi G, Baijnath H. *Cannabis sativa*: Dioecious into Monoecious Plants influencing Sex Determination. International Journal of Research and Innovations in Applied Science (IJRIAS). 2023; 8(7): 82-91.

[18] Malabadi RB, Kolkar KP, Chalannavar RK, Baijnath H. *Cannabis sativa*: Difference between Medical Cannabis (marijuana or drug) and Industrial hemp. GSC Biological and Pharmaceutical Sciences. 2023; 24(03):377–81.

[19] Malabadi RB, Kolkar KP, Chalannavar RK, Abdi G, Munhoz ANR, Baijnath H. *Cannabis sativa*: Dengue viral disease:Vector control measures. International Journal of Innovation Scientific Research and Review. 2023; 5(8): 5013- 5016.

[20] Malabadi RB, Kolkar KP, Chalannavar RK, Abdi G, Munhoz ANR, Baijnath H. *Cannabis sativa*: One-Plant-One-Medicine for many diseases-Therapeutic Applications. International Journal of Research and Innovations in Applied Science (IJRIAS). 2023; 8(8): 132-174.

[21] Malabadi RB, Nethravathi TL, Kolkar KP, Chalannavar RK, Mudigoudra BS, Abdi G, Munhoz ANR, Baijnath H. Fungal Infection Diseases- Nightmare for *Cannabis* Industries: Artificial Intelligence Applications International ournal of Research and Innovations in Applied Science (IJRIAS). 2023; 8(8):111-131.

[22] Malabadi RB, Kolkar KP, Chalannavar RK, Acharya M, Mudigoudra BS. *Cannabis sativa*: 2023-Outbreak and Re-emergence of Nipah virus (NiV) in India: Role of Hemp oil. GSC Biological and Pharmaceutical Sciences. 2023; 25(01):063–077.

[23] Malabadi RB, Kolkar KP, Chalannavar RK, Acharya M, Mudigoudra BS. Industrial *Cannabis sativa*: Hemp-Biochar-Applications and Disadvantages. World Journal of Advanced Research and Reviews. 2023; 20(01): 371–383.

[24] Malabadi RB, Kolkar KP, Chalannavar RK, Vassanthini R, Mudigoudra BS. Industrial *Cannabis sativa*: Hemp plastic-Updates. World Journal of Advanced Research and Reviews. 2023; 20 (01): 715-725.

[25] Malabadi RB, Sadiya MR, Kolkar KP, Lavanya L, Chalannavar RK. Quantification of THC levels in different varieties of *Cannabis sativa*. International Journal of Science and Research Archive. 2023; 10(02): 860–873.

[26] Malabadi RB, Sadiya MR, Kolkar KP, Chalannavar RK. Biodiesel production via transesterification reaction. Open Access Research Journal of Science and Technology. 2023; 09(02): 010–021.

[27] Malabadi RB, Sadiya MR, Kolkar KP, Chalannavar RK. Biodiesel production: An updated review of evidence. International Journal of Biological and Pharmaceutical Sciences Archive. 2023; 06(02): 110–133.

[28] Malabadi RB, Kolkar KP, Chalannavar RK. Industrial *Cannabis sativa*: Hemp oil for biodiesel production. Magna Scientia Advanced Research and Reviews. 2023; 09(02): 022–035.

[29] Malabadi RB, Kolkar KP, Chalannavar RK. Industrial *Cannabis sativa*: Role of hemp (fiber type) in textile industries. World Journal of Biology, Pharmacy and Health Sciences. 2023; 16(02): 001–014.

[30] Malabadi RB, Mammadova SS, Kolkar KP, Sadiya MR, Chalannavar RK, Castaño Coronado KV. *Cannabis sativa*: A therapeutic medicinal plant-global marketing updates. World Journal of Biology, Pharmacy and Health Sciences. 2024; 17(02):170–183.

[31] Malabadi RB, Kolkar KP, Sadiya MR, Veena Sharada B, Mammodova SS, Chalannavar RK, Baijnath H, Nalini S, Nandini S, Munhoz ANR. Triple Negative Breast Cancer (TNBC): *Cannabis sativa*-Role of Phytocannabinoids. World Journal of Biology, Pharmacy and Health Sciences. 2024; 17(03): 140–179.

[32] Malabadi RB, Sadiya MR, Kolkar KP, Mammadova SS, Chalannavar RK, Baijnath H. Role of Plant derived-medicine for controlling Cancer. International Journal of Science and Research Archive. 2024; 11(01): 2502–2539.

[33] Malabadi RB, Sadiya MR, Kolkar KP, Mammadova SS, Chalannavar RK, Baijnath H, Lavanya L, Munhoz ANR. Triple Negative Breast Cancer (TNBC): Signalling pathways-Role of plant-based inhibitors. Open Access Research Journal of Biology and Pharmacy, 2024; 10(02), 028–071.

[34] Fernando de C, Lambert C, Barbosa Filh, EV, Castaño Coronado KV, Malabadi RB. Exploring the potentialities of industrial hemp for sustainable rural development. World Journal of Biology Pharmacy and Health Sciences. 2024; 18(01): 305–320.

[35] Malabadi RB, Sadiya MR, Prathima TC, Kolkar KP, Mammadova SS, Chalannavar RK. *Cannabis sativa*: Cervical cancer treatment- Role of phytocannabinoids-A story of concern. World Journal of Biology, Pharmacy and Health Sciences. 2024; 17(02): 253–296.

[36] Malabadi RB, Kolkar KP, Chalannavar RK, Baijnath H. *Cannabis sativa*: Monoecious species and Hermaphroditism: Feminized seed production- A breeding effort. World Journal of Biology Pharmacy and Health Sciences. 2024; 20(03): 169-183.

[37] Malabadi RB, Kolkar KP, Chalannavar RK, Baijnath H. *Cannabis sativa*: Extraction Methods for Phytocannabinoids -An Update. World Journal of Biology Pharmacy and Health Sciences. 2024; 20(03): 018–058.

[38] Malabadi RB, Kolkar KP, Chalannavar RK, Baijnath H. *Cannabis sativa*: Polyploidization-Triploid and Tetraploid Production. World Journal of Biology Pharmacy and Health Sciences. 2024; 20(03), 567-587.

[39] Malabadi RB, Kolkar KP, Chalannavar RK, Baijnath H. Plant Based Leather Production-An update. World Journal of Advanced Engineering Technology and Sciences. 2025;14(01): 031-059.

[40] Malabadi RB, Kolkar KP, Castaño Coronado KV, Chalannavar RK. *Cannabis sativa*: Quality control testing measures and guidelines: An update. World Journal of Advanced Engineering Technology and Sciences. 2025;14(01): 110-129.

[41] Malabadi RB, Kolkar KP, Chalannavar RK, Munhoz ANR. In vitro Anther culture and Production of Haploids in *Cannabis sativa*. Open Access Research Journal of Science and Technology. 2025;13(01): 001-020. (https://doi.org/1.53022/oarjst.2025.13.1.0150).

[42] Malabadi RB, Chalannavar RK, Divakar MS , Swathi , Komalakshi KV, Kamble AA, Karamchand KS, Kolkar KP, Nethravathi TL, Castaño Coronado KV, Munhoz ANR. Industrial *Cannabis sativa* (Fiber or Hemp): 3D printing: Hempcrete-a sustainable building material. World Journal of Advanced Engineering Technology and Sciences. 2025;14(02): 253-282.

[43] Chalannavar RK, Malabadi RB, Divakar MS, Swathi, Komalakshi KV, Kamble AA Kishore S. Karamchand KS, Kolkar KP, Castaño Coronado KV, Munhoz ANR. Industrial *Cannabis sativa* (Fiber or Hemp): Hemp made Leather. World Journal of Advanced Research and Reviews. 2025; 25(02): 2207-2218.

[44] Kolkar KP, Malabadi RB, Chalannavar RK, Divakar MS, Swathi, Kamble AA, Karamchand KS, Castaño-Coronado KV, Munhoz ANR, Mammadova SS. Industrial *Cannabis sativa* (Fiber or Hemp): Hemp Cottonization-Advantages and Current Challenges. International Journal of Science and Research Archive. 2025;14(03): 1233-1267.

[45] Kolkar KP, Malabadi RB, Chalannavar RK. Role of *Cannabis sativa* on wound healing: An update. GSC Biological and Pharmaceutical Sciences. 2025; 32(03): 088–102.

[46] Chalannavar RK, Hosmani PA, Divakar MS, Malabadi RB, Kolkar KP. Industrial *Cannabis sativa* (hemp or fibre): Hemp Cellulose Based Bioplastic Production. Magna Scientia Advanced Biology and Pharmacy. 2025; 16(01): 055-065.

[47] Kolkar KP, Malabadi RB, Chalannavar RK. Industrial *Cannabis sativa* (Hemp) seeds used as Probiotic Energy Milk Drink-An Update. GSC Advanced Research and Reviews. 2025; 25(01): 074-086.

[48] Malabadi RB, Chalannavar RK, Kolkar KP. Plant cell totipotency: Plant tissue culture applications-An updated review. World Journal of Advanced Engineering Technology and Sciences. 2025; 16(02): 112-135.

[49] Chalannavar RK, Malabadi RB, Divakar MS , Swathi Komalakshi KV, Angitha B, Kamble AA, Karamchand KS, Kolkar KP, Castaño-Coronado KV, Munhoz ANR. Biodegradable plastics-advantages and challenges: An update. Open Access Research Journal of Science and Technology. 2025; 13(02): 042-056.

[50] Kolkar KP, Malabadi RB, Chalannavar RK, Divakar MS, Moramazi S. Probiotic hemp milk-market growth: An updated review. World Journal of Biology, Pharmacy and Health Sciences. 2025; 23(02): 133-143.

[51] Chalannavar RK, Divakar MS, Malabadi RB, Kamble AA, Swathi, Karamchand KS, Kolkar KP, Castaño- Coronado KV, Munhoz ANR, Mammadova SS. Plant derived Starch for the Production of Biodegradable Plastic. Global Journal of Engineering and Technology Advances. 2025; 22(03): 202-215.

[52] Malabadi RB, Chalannavar RK, Kolkar KP. WUCHEL Gene Family: Transcription Factor-WOX2 As A Early Genetic Marker of Gene Expression During Induction of Somatic Embryogenesis: An updated Review. World Journal of Advanced Engineering Technology and Sciences. 2025; 16(03): 552-582. Article DOI: https://doi.org/10.30574/wjaets.2025.16.3.1354.

[53] Chalannavar RK, Hosmani PA, Divakar MS, Malabadi RB. Industrial *Cannabis sativa* (Hemp of fiber type): Antiviral Activities-An updated Review. GSC Advanced Research and Reviews (GSCARR). 2025; 25 (2): 471-479.

[54] Malabadi RB, Kolkar KP, Chalannavar RK, Abdi G, Munhoz ANR, Baijnath H. *Cannabis sativa*: Dengue Viral Disease-Vector Control Measures. International Journal of Innovation Scientific Research and Review. 2023; 5(8): 5013-5016.

[55] Andre CM, Hausman JF, Guerriero G. *Cannabis sativa*: The plant of the thousand and one molecules. Front. Plant Sci. 2016; 7:19. Doi: 3389/fpls.2016. 00019.

[56] Nath MK. Benefits of Cultivating Industrial Hemp (*Cannabis sativa* ssp. sativa)—A Versatile Plant for a Sustainable Future. Chem. Proc. 2022; 10: 14. https://doi.org/10.3390/ IOCAG2022- 12359.

[57] **García-Rivas** G, Lozano O et al., Cannabidiol Prevents Heart Failure Dysfunction and Remodeling Through Preservation of Mitochondrial Function and Calcium Handling. JACC Basic Transl Sci. 2025;10(6):800–821.

[58] Urlic H, Kumric M, Pavlovic N, Dujc G, Dujic Ž, Božic J. Cardiovascular Effects of Cannabidiol: From Molecular Mechanisms to Clinical Implementation. Int. J. Mol. Sci. 2025; 26: 9610. https://doi.org/10.3390/ ijms26199610.

[59] Guimarães FS. Historical perspective on the therapeutic potential of cannabidiol. Int. Rev. Neurobiol. 2024; 177: 1–9.

[60] Hu SS, Mackie K. Distribution of the Endocannabinoid System in the Central Nervous System. Handb. Exp. Pharmacol. 2015; 231: 59–93.

[61] Pertwee RG. Endocannabinoids and Their Pharmacological Actions. Handb. Exp. Pharmacol. 2015; 231: 1–37.

[62] Di Marzo V, Piscitelli F. The Endocannabinoid System and its Modulation by Phytocannabinoids. Neurotherapeutics. 2015; 12: 692–69.

[63] Mock ED, Gagestein B, van der Stelt M. Anandamide and other N-acylethanolamines: A class of signaling lipids with therapeutic opportunities. Prog. Lipid Res. 2023; 89:101194.

[64] Rajesh M, Mukhopadhyay P, Bátkai S, Patel V, Saito K, Matsumoto S, Kashiwaya Y, Horváth B, Mukhopadhyay B, Becker L et al. Cannabidiol attenuates cardiac dysfunction, oxidative stress, fibrosis, and inflammatory and cell death signaling pathways in diabetic cardiomyopathy. J. Am. Coll. Cardiol. 2010; 56: 2115–2125.

[65] Montecucco F, Lenglet S, Braunersreuther V, Burger F, Pelli G, Bertolotto M, Mach F, Steffens S. CB2 cannabinoid receptor activation is cardioprotective in a mouse model of ischemia/reperfusion. J. Mol. Cell Cardiol. 2009; 46: 612–620.

[66] Garza-Cervantes JA, Ramos-González M, Lozano O, Jerjes-Sánchez C, García-Rivas G. Therapeutic Applications of Cannabinoids in Cardiomyopathy and Heart Failure. Oxid. Med. Cell. Longev. 2020; 2020: 4587024.

[67] Fulmer ML, Thewke DP. The Endocannabinoid System and Heart Disease: The Role of Cannabinoid Receptor Type 2. Cardiovasc. Hematol. Disord. Targets. 2018; 18: 34–51.

[68] Dhopeshwarkar A, Mackie K. CB2 Cannabinoid receptors as a therapeutic target-what does the future hold? Mol. Pharmacol. 2014; 86: 430–437.

[69] Stanley CP, Hind WH, O'Sullivan SE. Is the cardiovascular system a therapeutic target for cannabidiol? Br. J. Clin. Pharmacol. 2013; 75: 313–322.

[70] Haffner SM. The metabolic syndrome: Inflammation, diabetes mellitus, and cardiovascular disease. Am. J. Cardiol. 2006; 97: 3–11.

[71] Sultan SR, Millar SA, England TJ, O'Sullivan SE. A Systematic Review and Meta-Analysis of the Haemodynamic Effects of Cannabidiol. Front. Pharmacol. 2017; 8: 81.

[72] Flôr AFL, Duarte-Maia S, Fernandes-Costa F, de Souza RMP, Braga VdA, Amaral SLD, Mascarenhas SR, Brito- Alves JL, Colombari DSA, Cruz J.C. Chronic cannabidiol treatment induces cardiovascular improvement in renovascular hypertensive rats. J. Hypertens. 2025; 43: 98–108.

[73] Walsh SK, Hepburn CY, Kane KA, Wainwright CL. Acute administration of cannabidiol in vivo suppresses ischaemia- induced cardiac arrhythmias and reduces infarct size when given at reperfusion. Br. J. Pharmacol. 2010; 160: 1234–1242.

[74] Sadowska O, Baranowska-Kuczko M, Gromotowicz-Popławska A, Biernacki M, Kicman A, Malinowska B, Kasacka I, Krzy˙zewska A, Kozłowska H. Cannabidiol Ameliorates Monocrotaline-Induced Pulmonary Hypertension in Rats. Int. J. Mol. Sci. 2020; 21: 7077.

[75] Franco-Vadillo A et al. Cannabidiol-mediated RISK PI3K/AKT and MAPK/ERK pathways decreasing reperfusion myocardial damage. Pharmacol. Res. Perspect. 2021; 9: e00784.

[76] Jadoon KA, Tan GD, O'Sullivan SE. A single dose of cannabidiol reduces blood pressure in healthy volunteers in a randomized crossover study. J. Clin. Investig. 2017; 2: e93760.

[77] Sultan SR, O'Sullivan SE, England TJ. The effects of acute and sustained cannabidiol dosing for seven days on the haemody-namics in healthy men: A randomised controlled trial. Br. J. Clin. Pharmacol. 2020; 86: 1125–1138.

[78] Patrician, A et al., Examination of a New Delivery Approach for Oral Cannabidiol in Healthy Subjects: A Randomized, Double-Blinded, Placebo-Controlled Pharmacokinetics Study. Adv. Ther. 2019; 36: 3196–3210.

[79] Dujic G. et a. Chronic Effects of Oral Cannabidiol Delivery on 24-h Ambulatory Blood Pressure in Patients with Hypertension (HYPER-H21-4): A Randomized, Placebo-Controlled, and Crossover Study. Cannabis Cannabinoid Res. 2024; 9: 979–989.

[80] Kumric M et al., CBD supplementation reduces arterial blood pressure via modulation of the sympatho-chromaffin system: A substudy from the HYPER-H21-4 trial. Biomed. Pharmacother. 2023; 160:114387.

[81] Iffland K, Grotenhermen F. An Update on Safety and Side Effects of Cannabidiol: A Review of Clinical Data and Relevant Animal Studies. Cannabis Cannabinoid Res. 2017;2: 139–154.

[82] Landa E, Vigandt E, Andreev A, Malyshev Y, Sahni S. Cannabis-induced Acute Coronary Syndrome: A Coincidence or Not? Cureus. 2019; 11, e5696.

[83] Larsen C, Shahinas J. Dosage, Efficacy and Safety of Cannabidiol Administration in Adults: A Systematic Review of Human Trials. J. Clin. Med. Res. 2020; 12: 129–141.

[84] Huestis MA, Solimini R, Pichini S, Pacifici R, Carlier J, Busardò FP. Cannabidiol Adverse Effects and Toxicity. Curr. Neuropharmacol. 2019; 17: 974–989.

[85] Qian L, Beers JL, Jackson KD, Zhou Z. CBD and THC in Special Populations: Pharmacokinetics and Drug-Drug Interactions. Pharmaceutics 2024; 16: 484.

[86] Babayeva M, Loewy ZG. Cannabis Pharmacogenomics: A Path to Personalized Medicine. Curr. Issues Mol. Biol. 2023; 45: 3479–3514.

[87] Swenson K. Beyond the hype: A comprehensive exploration of CBD's biological impacts and mechanisms of action. J. Cannabis Res. 2025; 7: 24.

[88] Li J, Carvajal R, Bruner L, Kaminski NE. The current understanding of the benefits, safety, and regulation of cannabidiol in consumer products. Food Chem. Toxicol. 2021; 157: 112600.

[89] Naya NM, Kelly J, Hogwood A, Abbate A, Toldo S. Therapeutic potential of cannabidiol (CBD) in the treatment of cardiovascular diseases. Expert. Opin. Investig. Drugs. 2024;33: 699–712.

[90] Watanabe AH et al., A systematic review and meta-analysis of randomized controlled trials of cardiovascular toxicity of medical cannabinoids. J. Am. Pharm. Assoc. 2021; 61: e1–e13.

[91] Kicman A, Toczek M. The Effects of Cannabidiol, a Non-Intoxicating Compound of Cannabis, on the Cardiovascular System in Health and Disease. Int. J. Mol. Sci. 2020; 21:6740.

[92] Millar SA, Stone NL, Yates AS, O'Sullivan SE. A Systematic Review on the Pharmacokinetics of Cannabidiol in Humans. Front. Pharmacol. 2018; 9: 1365.

[93] Cheung CP et al., From Risk to Remedy? Importance of Cannabinoid Specificity When Considering Cannabis Associated Cardiovascular Risk. JACC: BASIC TO TRANSLATIONAL SCIENCE. 2025; 10; 11. https://doi.org/10.1016/j.jacbts.2025.101397.

[94] Serio L, Lee DI, Keceli G, Paolocci N. Cannabidiol, mitochondria, and PPAR- γ in heart failure. JACC Basic Transl Sci. 2025;10:822–825.

[95] Cheung CP, Coates AM, Baker RE, Burr JF. Acute effects of cannabis inhalation on arterial stiffness, vascular endothelial function, and cardiac function. J Am Heart Assoc. 2024;13:e037731.

[96] Jadoon KA, Tan GD, O'Sullivan SE. A single dose of cannabidiol reduces blood pressure in healthy volunteers in a randomized crossover study. JCI Insight. 2017;2:e93760.

[97] Jeffers AM, Glantz S, Byers AL, Keyhani S. Association of cannabis use with cardiovascular outcomes among US adults. J Am Heart Assoc. 2024;13: e030178.

[98] Benitah JP, Perrier R, Mercadier JJ, Pereira L, Gómez AM. RyR2 and calcium release in heart failure. Front Physiol. 2021;12:734210.

[99] Santulli G, Xie W, Reiken SR, Marks AR. Mitochondrial calcium overload is a key determi- nant in heart failure. Proc Natl Acad Sci U S A. 2015;112:11389–11394.

[100] Remiszewski P, Jarocka-Karpowicz I, Biernacki M, et al. Chronic cannabidiol adminis- tration fails to diminish blood pressure in rats with primary and secondary hypertension despite its effects on cardiac and plasma endocannabinoid system, oxidative stress and lipid metabolism. Int J Mol Sci. 2020;21(4):1295.

[101] Perticone M, Zito R, Miceli S, et al. Immunity, inflammation and heart failure: Their role on cardiac function and iron status. Front Immunol. 2019;10:2315.

[102] Dries E, Santiago DJ, Gilbert G, et al. Hyper- active ryanodine receptors in human heart failure and ischaemic cardiomyopathy reside outside of couplons. Cardiovasc Res. 2018;114:1512–1524.

[103] Shahbazi F, Grandi V, Banerjee A, Trant JF. Cannabinoids and cannabinoid receptors: the story so far. iScience. 2020;23:101301.

[104] Yu Z, Chen R, Li M, et al. Mitochondrial calcium uniporter inhibition provides cardioprotection in pressure overload-induced heart failure through autophagy enhancement. Int J. Cardiol. 2018;271: 161–168.

[105] Kicman A, Toczek M. The effects of cannabidiol, a non-intoxicating compound of cannabis, on the cardiovascular system in health and disease. Int J Mol Sci. 2020;21(18):6740.

[106] Olivas-Aguirre M, Torres-López L, Valle- Reyes JS, Hernández-Cruz A, Pottosin I, Dobrovinskaya O. Cannabidiol directly targets mitochondria and disturbs calcium homeostasis in acute lymphoblastic leukemia. Cell Death Dis. 2019;10:779.

[107] Ryan D, Drysdale AJ, Lafourcade C, Pertwee RG, Platt B. Cannabidiol targets mitochondria to regulate intracellular Ca2þ levels. J Neurosci. 2009;29:2053–2063.

[108] Durst R, Danenberg H, Gallily R, et al. Cannabidiol, a nonpsychoactive Cannabis constituent, protects against myocardial ischemic reperfusion injury. Am J Physiol Heart Circ Physiol. 2007;293: H3602–H3607.

[109] Walsh SK, Hepburn CY, Kane KA, Wainwright CL. Acute administration of cannabidiol in vivo suppresses ischaemia-induced cardiac arrhythmias and reduces infarct size when given at reperfusion. Br J. Pharmacol. 2010;160: 1234–1242.

[110] Feng Y, Chen F, Yin T, et al. Pharmacologic effects of cannabidiol on acute reperfused myocardial infarction in rabbits: evaluated with 3. 0T cardiac magnetic resonance imaging and his- topathology. J. Cardiovasc Pharmacol. 2015;66: 354–363.

[111] Fouad AA, Albuali WH, Al-Mulhim AS, Jresat I. Cardioprotective effect of cannabidiol in rats exposed to doxorubicin toxicity. Environ Toxicol Pharmacol. 2013;36:347–357.

[112] Garza-Cervantes JA, Ramos-González M, Lozano O, Jerjes-Sánchez C, García-Rivas G. Therapeutic applications of cannabinoids in cardiomyopathy and heart failure. Oxid Med Cell Longev. 2020;2020:4587024.

[113] Ruiz-Esparza GU, Segura-Ibarra V, Cordero- Reyes AM, et al. A specifically designed nano-construct associates, internalizes, traffics in cardiovascular cells, and accumulates in failing myocardium: a new strategy for heart failure diagnostics and therapeutics. Eur J. Heart Fail. 2016;18:169–178.

[114] Cordero-Reyes AM, Youker KA, Trevino AR, et al. Full expression of cardiomyopathy is partly dependent on B-cells: a pathway that involves cytokine activation, immunoglobulin deposition, and activation of apoptosis. J. Am Heart Assoc. 2016;5(1):e002484.

[115] Pacher P, Nagayama T, Mukhopadhyay P, Bátkai S, Kass DA. Measurement of cardiac function using pressure-volume conductance catheter technique in mice and rats. Nat Protoc. 2008;3: 1422–1434.

[116] Hoevelmann J, Markwirth P, Tokcan M, Haring B. What's new in heart failure? September 2025. Eur J Heart Fail. 2025 ;27(9):1603-1605. doi: 10.1002/ejhf.70054.

[117] Lala A et al., The continuum of prevention and heart failure in cardiovascular medicine: A joint scientific statement from the Heart Failure Society of America and the American Society for Preventive Cardiology. American Journal of Preventive Cardiology. 2025; 24: 101069.