Current Research in Pharmaceutical Sciences
Available online at www.crpsonline.com

ISSN: 2250 – 2688

Received: 16/03/2023
Revised: 26/03/2023
Accepted: 30/03/2023
Published: 08/04/2023

Sarita Yadav, Bindu singh yadav, Nandini Chaudhary, Rajneesh Kumar
Department of Pharmacy, Goel Institute of Pharmacy and Sciences, Lucknow, India 226001

Ravi Yadav
Rama University, Kanpur (U.P), India 208001

Shashwat Pandey
Babasaheb Bhimrao Ambedkar University, Lucknow, India 226001

Correspondence

Sarita Yadav
Department of Pharmacy, Goel Institute of Pharmacy and Sciences, Lucknow, India 226001

Email: bindusinghyadav785@gmail.com

DOI: 10.24092/CRPS.2023.130103

Website: www.crpsonline.com

Quick Response Code:

A Review Article on Current Pharmacological Status of Cardioprotective Plant

Sarita Yadav, Bindu singh yadav, Nandini Chaudhary, Rajneesh Kumar, Ravi Yadav, Shashwat Pandey

ABSTRACT

Cardiovascular diseases involve abnormalities of the heart and blood vessels, such as coronary heart disease, hypertension, and cerebrovascular disease, and are the main cause of the increase in mortality rate in the world. Herbal plants tend to be very useful to prevent cardiovascular disease. The phytoconstituents of herbal medicinal plants like tannins, alkaloids, saponins, flavonoids, and glycosides that have the ability to prevent cardiovascular diseases. Examples such as *Nerium oleander*, *Amaranthus viridis*, *Ginkgo biloba*, *Daucus carota*, *Gingerol*, *Tinospora cordifolia etc.* Many studies investigated the cardioprotective effect of these natural products against experimentally-induced myocardial damage, and their results revealed that their potential phytochemicals exhibited significant antioxidant, anti-apoptotic, anti-inflammatory, anti-atherosclerotic activities. The review highlights the promising mechanisms and probable applications of various herbal plants, and their phytochemicals in the prevention and treatment of cardiovascular diseases. The cardioprotective plants contain a wide- variety of bioactive compound involve with diosgenin, isoflavones, sulforaphane, carotinized, catechin and quercetin are increasing the cardio protection and decreases the chances of cardiac abnormalities.

Key words: Cardiovascular diseases, herbal products, phytochemicals, cardioprotective plant, Trichopus zeylanicus, cardiotoxicity.

1. INTRODUCTION

Cardiovascular disease are the group of disorder of the heart and blood vessel, such as cerebrovascular disease, coronary heart disease, peripheral heart disease, rheumatic heart disease, and congenital heart disease, and it increases the mortality and morbidity rate. The risk factors are heart disease, stroke for unhealthy diet, and tobacco. It increases the blood pressure, blood glucose level, and obesity.[1] The use of herbal plants as an antioxidant is increasing as a defensive agent to the various cardiovascular abnormalities.[2] Herbal medicine plays an important role in health care to the large population of the world. The polyphenols are cardioprotective because they inhibit the oxidation of low-density lipoprotein, they decrease the oxygen demand in the patient with myocardial infarction.[3,4] The herbal medicine is used for the treatment of congestive heart failure, systolic hypertension, angina pectoris, atherosclerosis, cerebral insufficiency, and arrhythmia. The medicinal plants that are employed as cardioprotective are *Cichorium intybus*, *Ginkgo biloba*, *Amaranthus Viridis*, Gingerol, *Nerium oleander, Daucus carota, Tinospora cordifolia, Mangifera indica, Hydro cotyle Asiatica Linn.* The oldest medicinal plant which is used for cardiac disease is *digitalis lanata* because the active constituent is present in the steroid glycoside called digoxin. It is also used in the treatment of arrhythmia.[5] *Atropa belladonna* is a plant that contains atropine, used to cure slow heart rate [bradycardia].[6] It contains the soluble phenolic compound is the caffeoyl shikimic acid [CFA]' other, phenolic acid include caffeic acid, protocatechuic acid [PCA], and p- hydroxybenzoic acid [PHBA].[7]

The OPP (1,2 Organophosphate poisoning) has an effect on the prevention and treatment of cardiovascular disease or metabolic pathway.[8] The hydrophilic phenols are shows antioxidant capacity and it suppress the (ROS) Reactive oxygen species because it developed the pathogenic response to the cardiovascular disease.[9,10]The anticancer drug causes cardiovascular disease i.e., doxorubicin, and epirubicin belonging to the anthracycline family, paclitaxel, docetaxel [plant alkaloid], and cyclophosphamide [alkylating agent] these drugs are included in the 5- fluorouracil. The OPP exhibit anti-inflammatory property, and prevent the cardiovascular mechanism include metabolic pathway and modulation of biochemistry. OPP has indicated its effect on atherosclerosis on the atherogenic rabbit models.[11,12]

1.1 Natural Products: A Promising Approach

Natural products are obtained from animal, plant, and mineral origin. It is a reliable source of the new chemical entities [NCEs] to treat some various disorders, it is used either directly or it may also provide the conversion into the more potent and more selective compound.[13,14] The herbal medicines are available in different forms of remedies such as plant extract, plant derivative phytochemicals, and polyherbal formulation. The constituent of the plant is extracted into a different solvent such as water, alcohol, etc. They can increase the popularity of natural products with their pharmaceutical industries it also combines natural product screening with the method of high-throughput selection the (NCE) new chemical entities treat to the various disorder, it is more potent and more selective to the original molecules. They can increase the popularity of natural products with their pharmaceutical industries it also combines natural product screening with the method of high-throughput selection.[15] A conventional drug such as herbal medicine is sought for their widespread availability and it has reported to the patient with a lower incidence of the side effect to the conventional drug. Natural products have been reported to have various biological activities shown in Figure 10.[16]

1.2 Medicinal Plant with Cardioprotective Potential

Herbal medicine is used to treat cardiovascular disease. Medicinal plants show the pharmacotherapeutic potential against cardiovascular ailments in-vitro and in animal studies. The cardioprotective potential of the herbal plant or medicinal plant in cardiovascular diseases is demonstrated to the attenuating by the damage of cardiac muscle cell, endothelial cell, vascular smooth muscle cell, and the macrophage or monocytes. The result of the herbal medicinal plant is opening to the K/ATP channel and they increase the secretion of the atrial natriuretic peptide, oxidative stress hypertrophy, and apoptosis. The herbal products have been shown by the inflammation inhibition, oxidation stress endothelial nitric oxide synthase nitric oxide [NOS-NO], and apoptosis to their signaling pathway activation, or angiogenesis induction, and endothelial permeability suppression. The medicinal plants are prepared the many drugs, phytochemicals compounds are the plant material is safer and less side effect. The medicinal plants are providing the good therapeutic potential against the cardiac disease. Cardioprotective Potential of Plant are shown in Figure 11.

2. NERIUM OLEANDER

Nerium oleander belongs to the family Apocynaceae. It is a green shrub or a small tree, it grows in the Eastern Mediterranean region, Anatolia, and Northern America. They produce boosting antioxidant components against oxidative stress. It shows the cardioprotective effect.[17] Plant parts used in the pharmaceutical preparation are flower, root, leaves, and root bark. The plant is utilized to treat the patient with malignancies. *Nerium oleander* plant is used to treatment of ulcer, hemorrhoids, leprosy, herpes, abscesses, and ringworm. It is also used for a heart condition, leprosy, malaria, asthma, and cancer.

Figure 1(a): Nerium Oleander Plant

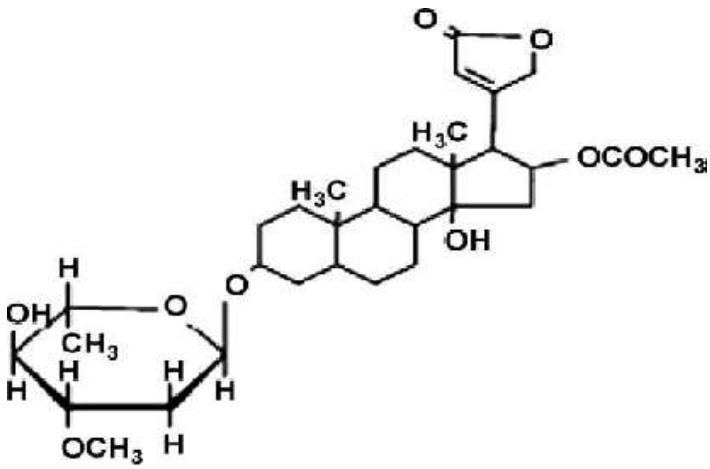

Figure 1(b): Chemical Structure of Nerium Oleander

2.1 Phytochemical Present in Plant Nerium Oleander

- Carbohydrate test
- Tannin test
- Saponin test
- Steroid test

2.2 Mechanism of Action

Nerium oleanders contain cardenolides that show positive inotropic effect on the cardiac muscle. They inhibit the plasmalemma of sodium, potassium, ATPase. It also inhibits the protein assembly. It increases the intracellular sodium level.

Nerium Oleander Leaves

↓

Methanolic extract [ME]

LC 50 :7.4 ug/ml

↓

Ethyl Acetate soluble fraction [EA]

LC50: 0.75ug/ml

↓

Odoroside A (LC50 :0.14ug/ml)

Oleandrin LC50:0.5 ug/ml

↓ Od A>Oleandrin = EA >ME

Induce morphological changes in MCF- 7 cells

↓

Antiproliferation

2.3 Functions

It contains cardiac glycosides, odoroside, flavonoids, steroids

↓

Anti-bacterial property (It can be either bacteriostatic or bactericidal interaction with target bacteria).

↓

Anti-helminthic property (it is used to treat infection of animals with parasitic worms.)

↓

Anti-inflammatory property (it reduces the inflammation - redness, swelling etc.)

↓

Hepatoprotective property (the drug can improve the liver function, promote liver cell.)

↓

Immune potential property (it represents the shifting to increase the immune response.)

↓

Anti-pyretic property (it blocks or reverse fever cytokines mediated rise in temperature.)

↓

Anti-fungal property (to stop the growth of fungi that cause infection.)

↓

Anti-oxidant property (it may prevent or delay some type of damage)

↓

Anti-cancer property (any drug that is effective in the treatment of malignant disease.)

↓

Anti-HIV activity property (Human immunodeficiency infects only cell of the immune system.)

2.4 Formulation of this Plant in Different Dosage Form

The extract of *Nerium oleander* were obtained after the depletion course with menthol at room temp.

↓

The resulting liquid is evaporated under vacuum

↓

Dry residue dissolve in 300ml of distilled water

↓

Solvents of increasing polarity (hexane, dichloro methane)

↓

Decoction of Nerium oleander extract

2.5 Bioavailability of Nerium Oleander

- *Nerium oleander* first absorbed in the oral mucosa by simple diffusion having maximum serum concentration c max = 20 min, bioavailability approx. 30%.
- Low bioavailability of oleandrin may be due to its poor H2O solubility. Its rapid binding to plasma protein or p-gp - mediate efflux and first pass effect.

3. AMARANTHUS VIRIDIS

Amaranthus Viridis Linn is also called as slender amaranth in English it is also called a never-fading flower. It belongs to family Amaranthaceae. It is an annual herb and light green stem.[13,20] *Amaranthus Viridis* parts used are leaves, roots, and whole plant used for the pharmacological purpose. The active constituent is present to the rutin and quercetin.[21] The leaves and seeds contain lysine and essential amino acid. This plant also includes the amino acid, lysine, arginine, histidine, valine, tryptophan, phenylalanine, and tyrosine.[22] *Amaranthus Viridis* is used for the treatment of fever, pain, asthma, diabetes, dysentery, eye disorder, urinary disorder, and venereal disease, this plant

shows the antimicrobial property. And the leaves are used for the diuretic and purgative. The plant-rich in soda and used to make soap.

Figure 2(a): Amaranthus

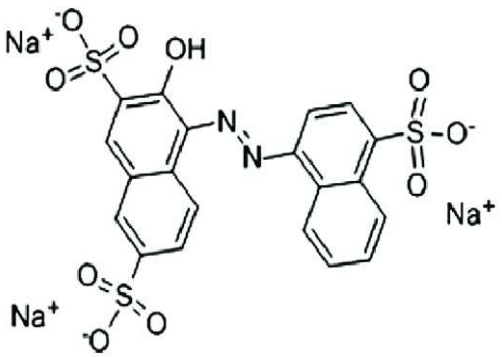

Figure 2(b): Chemical Structure of Amaranthus Viridis

3.1 Phytochemical Present in Plant Amaranthus Viridis

- Flavonoids
- Saponin
- Phlobatannin
- Tannin
- Cardiac glycosides

3.2 Functions

Analgesic and anti-pyretic (ability to lower body temperature in fever (pyrexia).

↓

Anti-oxidant (it may prevent or delay some type of damage)

↓

Anti-microbial (kill and slow the spread of microorganism.)

↓

Hepatoprotective (the drug can improve the liver function, promote liver cell)

↓

Anti-inflammatory (it reduces the inflammation - redness, swelling etc.)

↓

Nociceptive (it is a type of pain caused by damage to body tissue.)

↓

Hypolipidemic (reduces the level of lipids and lipoprotein in the blood)

↓

Anti-hyperglycemia (lower glucose level in the blood.)

4. GINKGO BILOBA

Ginkgo biloba belongs to family Ginkgoaceae. This plant is also called living fossils because this is the oldest seed plant. It is most helpful components are flavonoids, they are most strong antioxidant and terpenoids. It also helps to improve the dilating blood vessel and it reduces the stickiness of platelets, it is available as an oral tablet, capsule, extract, and tea. The active constituent is flavones, glycosides, ascorbic acid, diterpene lactones, catechin, flavanol. The plant shows biological activity such as antioxidant, antimicrobial, memory enhancer, anti-inflammatory, antidepressant, anticoagulant, antiulcer, cytotoxic, and anti-stress. It is used in the treatment for Alzheimer related dementia, Raynaud disease.

Figure 3(a): Ginkgo Biloba

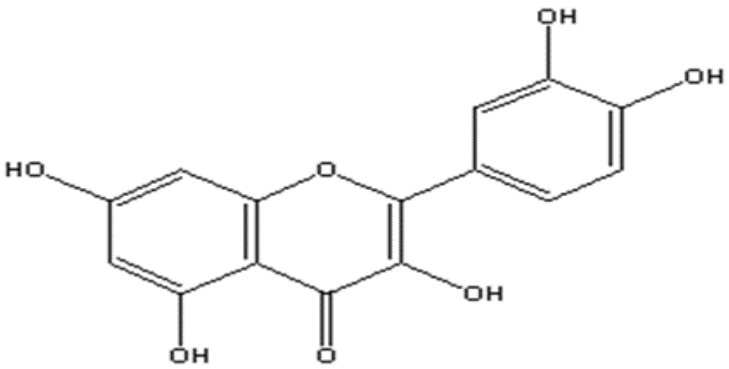

Figure 3(b): Chemical Structure of Ginkgo Biloba

4.1 Phytochemical Present in Plant Ginkgo Biloba

Ginkgolide A, Ginkgolide B, Ginkgolide C, Ginkgolide J, Bilobalide, Quercetin, Quercetin 3- beta-D glucoside.

- Flavonoids
- Glycosides

- Steroids
- Saponin
- Anthraquinone
- Triterpenes

4.2 Mechanism of Action

The important mechanisms are anti-inflammatory, antioxidant, cerebral glucose utilization, inhibition of platelet aggregation is reduced the neurotransmitter regulation and the vasomotor effect.[23] Mechanism of Action of *Ginkgo Biloba* are shown in Figure 12.

4.3 Functions

Inhibit the lipid peroxidation
↓
mediate the 5 HT uptake
↓
induces the PBR [peripheral benzodiazepine receptor] downregulation
↓
activate the anti-platelet activity
↓
increases the ACTH [adrenocorticotropic hormone] concentration.

5. DAUCUS CAROTA

Daucus carota belongs to family Apiaceae, it is a white flower herb. This plant is native to temperate regions of South Asia and Europe. The part that is used in medicinal preparation is seeds and root. The phytochemical is present in this plant is xanthophylls, carotene, daucosol, sesquiterpenoids, the active constituent present are carrots contain carotenes, alpha and beta carotenes, dietary fiber, and vitamin A.[24,25] It is generally known as wild carrot. In clinical trials such as ingestion of carrot juice. *Daucus carota* may present the seeds are aromatic, diuretic, carminative, stimulant, emmenagogue. The fruits are oval and flattened, with short style or hooked spines. It is very small, dry, and bumpy, it also protective to hair, to the surrounding. It is used for a kidney ailment, chronic dysentery, dropsy, and worms. And it is also used as the aphrodisiac for a nervine tonic and uterine pain. The roots are used for the insertion of threadworm.

Figure 4(a): Daucus Carota

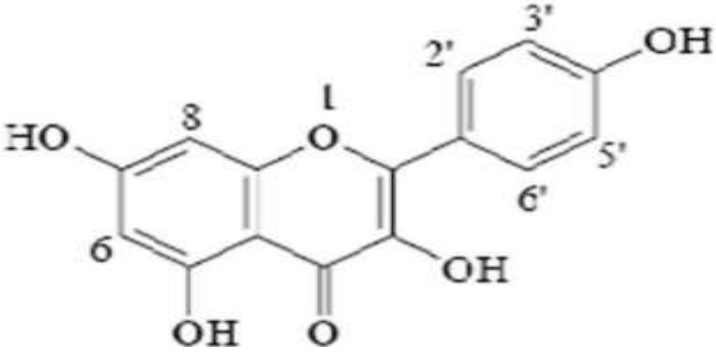

Figure 4(b): Chemical structure of Daucus Carota

5.1 Phytochemical Present in Plant Daucus Carota

- Saponin
- Tannin
- Steroids
- Phlobatannin
- Alkaloids
- Phenolics

5.2 Mechanism of Action

The regulation of gene controlled the carotenoid biosynthesis and carotenoids degradation. It regulates the structures [chromoplast], it also increased the carotenoid level of lipoprotein and feces, increased the antioxidant capacity.

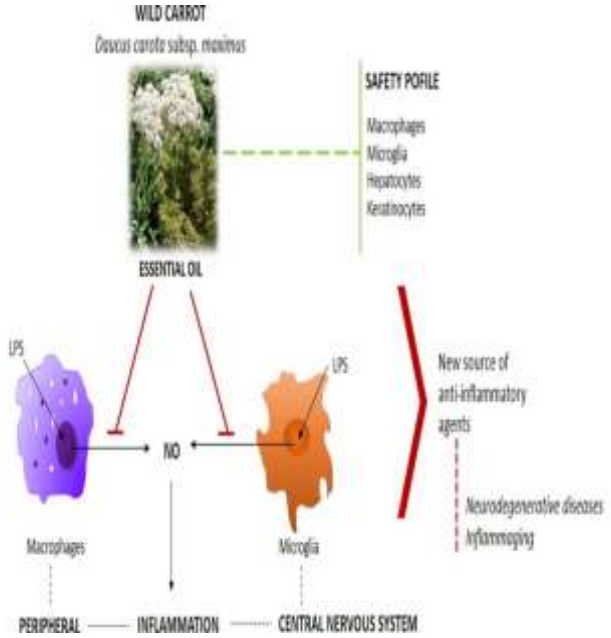

Figure 4(c): Mechanism of action of Daucus Carota

5.3 Functions

Beta - carotene
↓ Change into
Vitamin A
↓ Helps to keep your eye
Protect your eyes
↓
Yellow Carrot
↓ Present lutein
Good for eye

6. GINGEROL

gingerol belongs to family Zingiberaceae. The biological compound is isolated to the *gingerol* is *Zingiber officinale*, they produce the perennial herb, and the herb is found in Malaysia and Asia.[26] The rhizome is used for the spice condiments as a flavor enhancer in dishes, it is also used for the medicinal purpose for more than 20 years.[27] The *gingerol* is the ketone type, it is also used for medicine of the insolubility of the water because it is very helpful to various human ailments that is a tumor, inflammation, and hypertension. The active constituent is present in ginger, ginger rhizome. The aromatic constituents are zingiberene and bisabolene. It can dissolve the ginger capsule 8.4% bicarbonate suspension; it can produce good stability and bioavailability. In children, they are unable to swallow pills. Ginger used as the carminative, appetite stimulant, and choleretic. It is used in a typical dose, at high dose, the side effect is abdominal discomfort, heartburn, and diarrhea. It shows the antiplatelet effect. It increases the bleeding in some people. Ginger is an anti-inflammatory effect, it is used in the treating of rheumatoid arthritis, muscle pain or joint, and osteoarthritis.

Figure 5(a): Gingerol

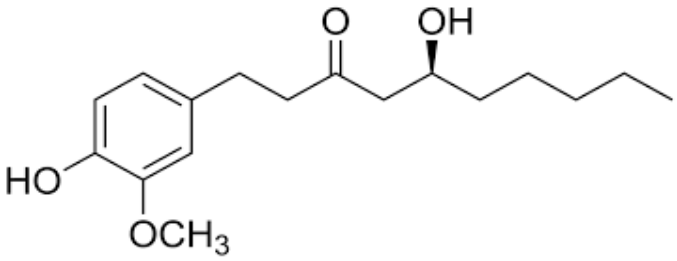

Figure 5(b): Chemical structure of gingerol

6.1 Phytochemical Present in Plant Gingerol

- Alkaloids
- phlobotannin
- flavonoids
- terpenoids
- cardiac glycosides
- Saponin
- quinone, phenolic and terpenes compound or *6- gingerol, 6-shogaol,* and *6- paradol*.

6.2 Mechanism of Action

The ginger extract has been reported to the ameliorate doxorubicin-induced cardiotoxicity in rats, and they show the positive effect.[28] They can improve gastric motility and shows the antispasmodic effect. They sensitize the A549 cell to the TNF apoptosis and induced the TRAIL by inhibiting the autophagy flux. Mechanism of Action of gingerol are shown in Figure 13.

6.3 Functions

It induces apoptosis
↓
Anti-oxidant
↓
Anti-inflammatory
↓
Anti-mutagenic
↓
Kymoprotective
↓
Anti-tumor

7. TINOSPORA CORDIFOLIA

Tinospora cordifolia belongs to family Menispermaceae. It is commonly known as “amrita” in Sanskrit, and Hindi while “amudamor chindle” in Tamil. The plant part is used are roots and stem. It is a very important plant in ayurvedic and the medicinal system because it is useful for jaundice, diabetes, respiratory,

fever, rheumatism, respiratory disorder, and neurological abnormalities.[29] It shows the cardioprotective activity to the roots, stem, leaves, and fruits. The active phytoconstituents are gilosterol, tinosporol, tinosporic acid, tinosporin, palmarin, diterpenoid lactone, giloinin, columbin, chasmanthin.[30,31] It is useful for the *Tinospora cordifolia* for high cholesterol, high diabetes, lymphoma, upset stomach, allergic rhinitis, peptic ulcer disease, fever, syphilis, gonorrhea, and these are boosting the immune system. Tinospora is used for various diseases, the clinical research there is no quality scientific effect, and it is not for the prescription drug. *Tinospora cordifolia* shows the antimicrobial activity to the different solvent on different microorganisms because it is a good anti-fungal and antimicrobial activity. The aqueous extract of *Tinospora cordifolia* is a potent activity show against the *Aspergillus flavus* and *Aspergillus nigar*. The root part of Guduchi shows a hyperglycemic effect by inducing the diabetic model by decrease the glucose level in urine.

Figure 6(a): Tinospora cordifolia

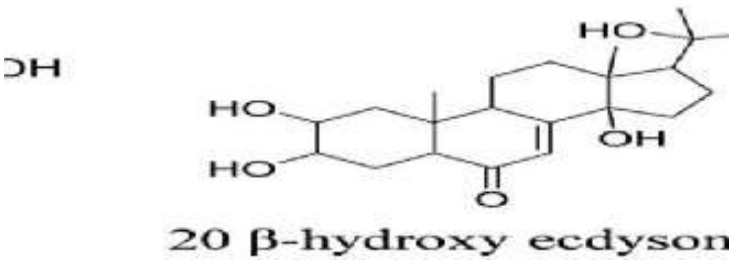

Figure 6(b): chemical structure of Tinospora cordifolia

7.1 Phytochemical Present in Plant Tinospora Cordifolia

- Anthraquinone
- Flavonoids
- Tannin
- Protein
- Alkaloids
- Glycosides

7.2 Mechanism of Action

It shows anti-inflammatory, antihyperlipidemic, antidiabetic, antineoplastic, antioxidant, and hepatoprotective. Itexpand the stimulation of neuroendocrine-immune. They restoring the growth of osteoblast, increases the bone like matrix and differentiate the cell into the osteoblastic lineage. The root part of Guduchi shows a hyperglycemic effect by inducing the diabetic model by decrease the glucose level in urine. Mechanism of action of Tinospora Codifolia are shown in Figure 14.

7.3 Functions

Immune Booster

↓

Anti - oxidant [It is a chemical that are prevent the effect of free radical.]

↓

Control fever [Rest and drink plenty of fliuds.]

↓

Boost Liver function [Maintain healthy weight, exercise regularly.]

↓

Anti-ageing

↓

Anti-Diabetic [to control the blood glucose level]

↓

Improve digestion [drink more water]

7.4 Formulation of this Plant in Different Dosages Form

Upto 5kg of fresh giloy stem taken from the bark, crushed in mortal and pestle.

↓

Kept for soaking in H2O overnight (12 hour)

↓

Macerated pass through mesh 150, to remove the impurities.

↓

Liquid is filter by filter paper, collect the whole smooth starchy sediment, deposite on the filter paper.

↓

Starchy sediment kept under sunlight for drying

↓

With the process 2.24gm powder obtained from 5kg of giloy stem

7.5 Bioavailability of Tinospora Cordifolia

Very low bioavailability, due to low permeability.

8. CICHORIUM INTYBUS

Cichorium intybus belongs to family Asteraceae. It is herbaceous plant usually bright blue in flower. They were found in Asia and Europe. The medicinal importance of phytocompound are vitamins, lactone, flavonoids, inulin, volatile compound, esculin.[32] It contains the various compounds of volatile oils, alkaloids, tannins, fatty acid, saponins, glycosides, triterpenoid, and anthracene.[33] The ancient Egyptians many people have used the chicory because this plant can purify the blood as well as the liver, the herb is most power to cure, then it is called a passion of the heart. The roots are used to make tea and for jaundice and the syrup is used for the tonic and purifying medicine. The chicory plant flowers are used to the gallstones, sinus problem, cuts, gastroenteritis. It is used for decorative purposes. It is used in the treatment of headache, insomnia, fever, and debility. The chemical constituents are 60% inulin, lactones, and coumarin. The chicory root contains citric acid and tartaric acid.

Figure 7(a): Cichorium Intybus

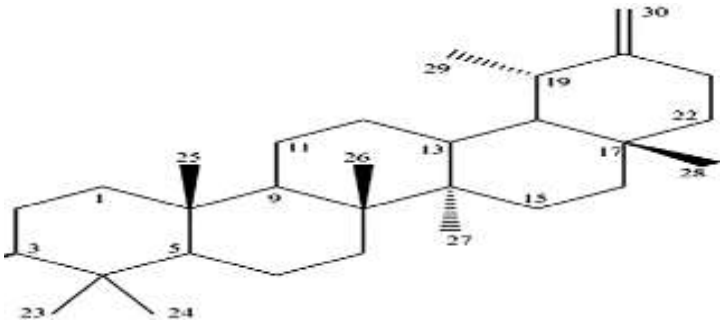

Figure 7(b): Chemical structure of Cichorium Intybus

8.1 Phytochemical Present in Cichorium Intybus

- Glycosides
- Gums and mucilage
- Carbohydrate
- Phenolics
- Saponin

8.2 Mechanism of Action

It inhibits the mast cell-mediated allergic reaction in vivo and in vitro. In hyperlipidemic effect: inulin can decrease the serum triglycerides by decreasing fatty acid synthesis because they can decrease the production of low-density lipoprotein. They increase the taurine and the glutathione level while decreases the activity of the heart. It is used in the treatment of ameliorated oxidation damage and increases the injury of the heart. Mechanism of action of *Cichorium Intybus* are shown in Figure 15.

8.3 Function

Used in digestive disorder
↓
Loss of deficiency
↓
Anti-microbial activity
↓
Anti helmintic
↓
Anti-malarial activity
↓
Hepatoprotective activity
↓
Anti-diabetic
↓
Gastroprotective
↓
Analgesic

9. PICRORHIZA KURROA

Picrorhiza kurroa belongs to family Scrophulariaceae. It is also known as kutki. This plant is found in Kashmir in the northern western Himalayan region. The genus Picrorhiza are shows promising role of many chemical and the pharmacological effects.[34] The chemical constituents are kurrin, kutkisterol, sesquiterpene, apocynin, cathartic, cathartic acid and kutkin.[35] It hampers the lipid peroxidation, free radical scavenging. It is used to treat the liver and upper respiratory tract, reduce fever. The root and rhizome used for the cardioprotective effects of ethanol extract, it prevails upon the myocardial infarction in rats with lipid metabolism in serum and heart tissue has been explore.[36]

Figure 8(a): Picrorhiza kurroa

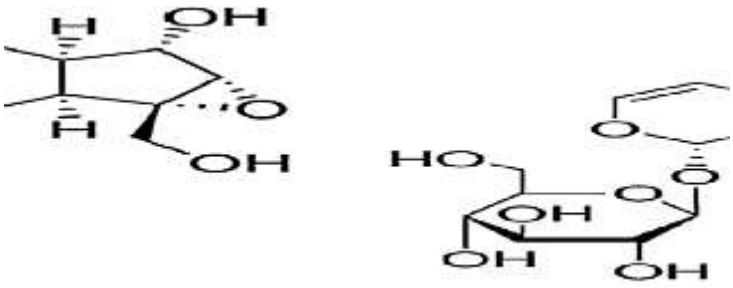

Figure 8(b): Chemical structure of Picrorhiza Kurroa

9.1 Phytochemical Present in Plant Picrorhiza Kurroa

- Glycosides
- Sterols
- Phenolic Compound
- D-Mannitol
- Kutkiol
- Apocynin

9.2 Mechanism of Action

The biological activity shows the antioxidant, anti-inflammatory, antischolastic, immunomodulary, hepatoprotective activities, anti-allergic, anti- asthmatic, anti- cancerous iridoid glycosides are present in *Picrorhiza Kurroa* plant. The total 22 iridoid glycosides are present. The hepatoprotective action in this plant not fully recognize, it also allocates the plant ability to inhibit the origination of oxygen anion and produce free radical. Mechanism of action of *picrorhiza kurroa* are shown in Figure 16.

9.3 Function

Helps to increase contraction of gall bladder
↓
Take out the secretion
↓
Help to improve digestion, regulation of fat, protein
↓
Improve metabolism
↓
To leads so many diseases

10. SALVIA MILTIORRHIZA

Salvia miltiorrhiz belongs to family Lamiaceae. It is used for cardiovascular abnormalities and it can be used in treatment and prevention of the disease. It is mainly found in China and Japan. The plant part used is rhizome and root. It can be used in treatment of cerebrovascular and cardiovascular disease.[37] It can be formulated in different form like a tablet, solution, oral liquid, slow-release formulation, and capsule.[38] If *picrorhiza* taken with other medication, then decreases in immune system and decreases in effectiveness of the medication is observed.[35] The chemical constituents are berberine, kutkisterol, picrorhizetin, sesquiterpene, apocynin, kutkin, and cathartic acid. The active ingredients of the plant are both lipid-soluble and water-soluble substances. The lipophilic substance is tanshinone I, dihydrotanshinone I, tanshinone IIA, cryptotanshinone, and tanshinone IIB.[39] The water-soluble constituents are phenolic acids

such as danshenu, caffeic acid, salvianolic acid A, and salvianolic acid B, and rosmarinic acid. It shows the biological activities include antioxidant, anti-tumor, anticoagulant, anti-HIV, antithrombotic, and anti-blood coagulation.[38]

Figure 9(a): Salvia Miltiorrhiza

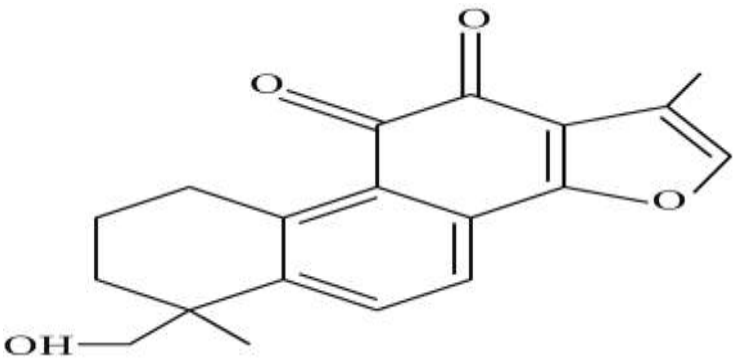

Figure 9(b): Chemical structure of Salvia Miltiorrhiza

10.1 Phytochemical Present in Plant Salvia Miltiorrhiza

- Protocatechuic aldehyde
- Caffeic acid
- Salvianolic acid A
- Salvianolic acid B

10.2 Mechanism of Action

The pharmacological activity is anti-inflammatory, antioxidant, hepatoprotective, anti-allergic, and anti-cancerous. The cardioprotective potential against the isoproterenol-induced MI. Salvianolic acid B from *salvia miltiorrhiza* repressed the tumor necrosis is part of alpha TNF induced MMP 2 upregulation in human aortic smooth muscle by the defeating of NADP oxidase derived reactive oxygen molecules. Mechanism of action of *salvia mitiorrhiza* are shown in Figure 17.

10.3 Functions

Function of *salvia miltiorrhiza* are shown in Figure 18.

11. CONCLUSION

The current review that is shows therapeutic and prophylactic potential and they manage the cardiovascular disease. The phytoconstituents of cardioprotective are inhibit the key enzyme, and scavenging the oxygen free radicals. The nutraceutical and pharmaceutical industries play the important role of drug designing by using the medicinal plant. The herbal products are more effective and safer to treat cardiovascular abnormalities. Phytoconstituents can help in the used for the prevention and treatment of cardiovascular disease. This may proper for the further evaluation of these plant as a successful drug treatment for the cardioprotective agent. The very promising preclinical findings of resveratrol as a cardio-protective agent, there are still several questions that need to be answered before advancing resveratrol into clinical trials.

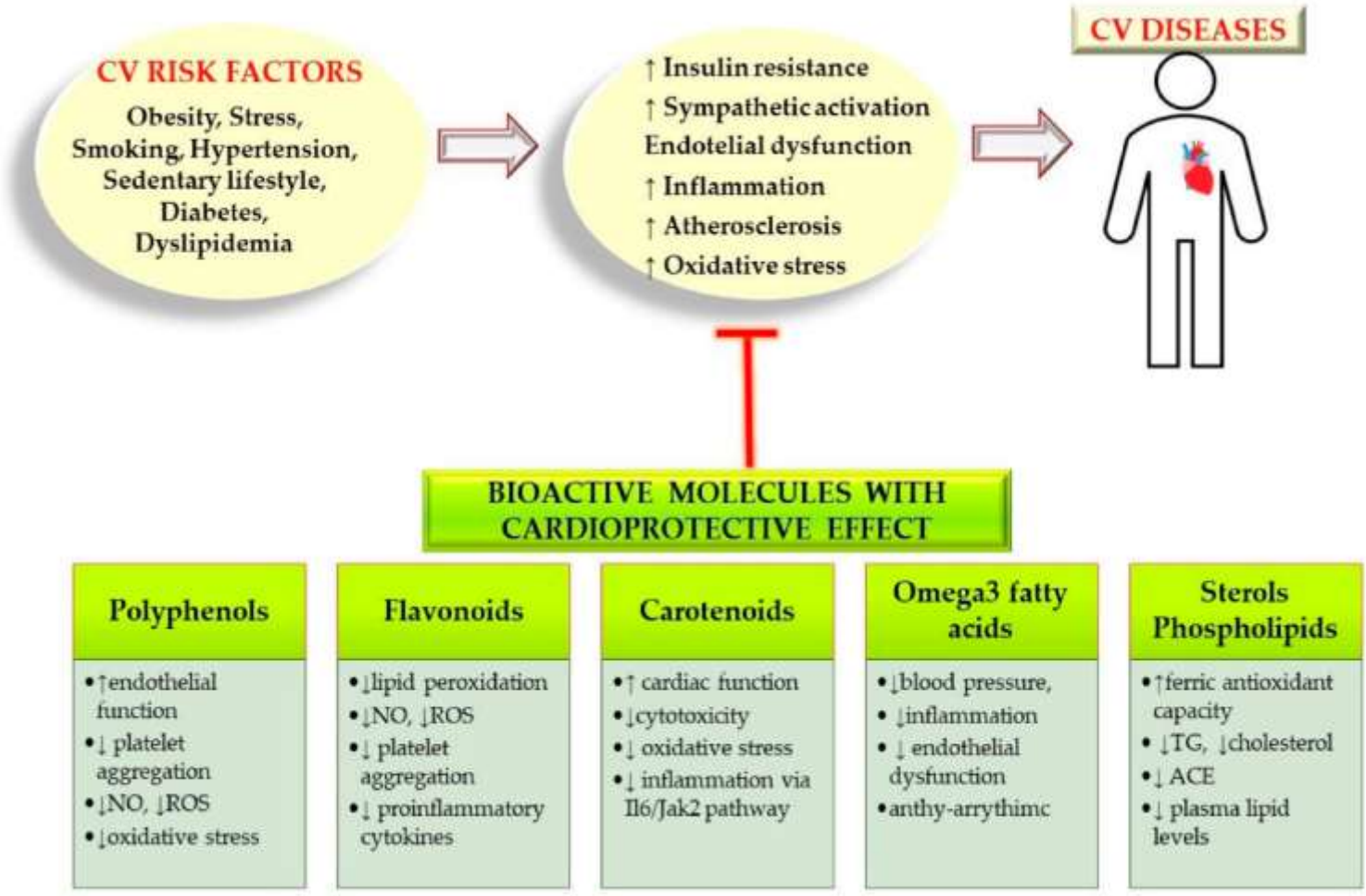

Figure 10: Diet, Lifestyle and Cardiovascular disease

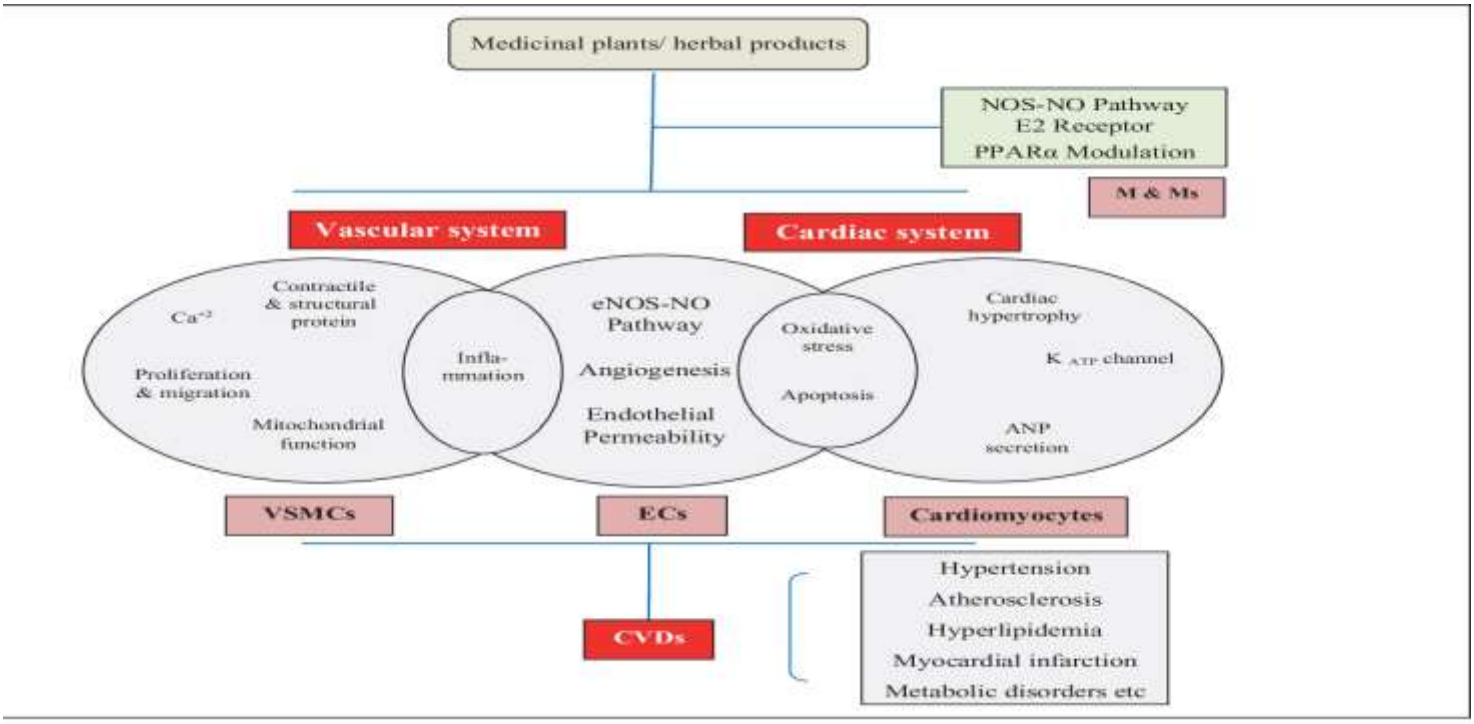

Figure 11: Cardioprotective Potential of Plant

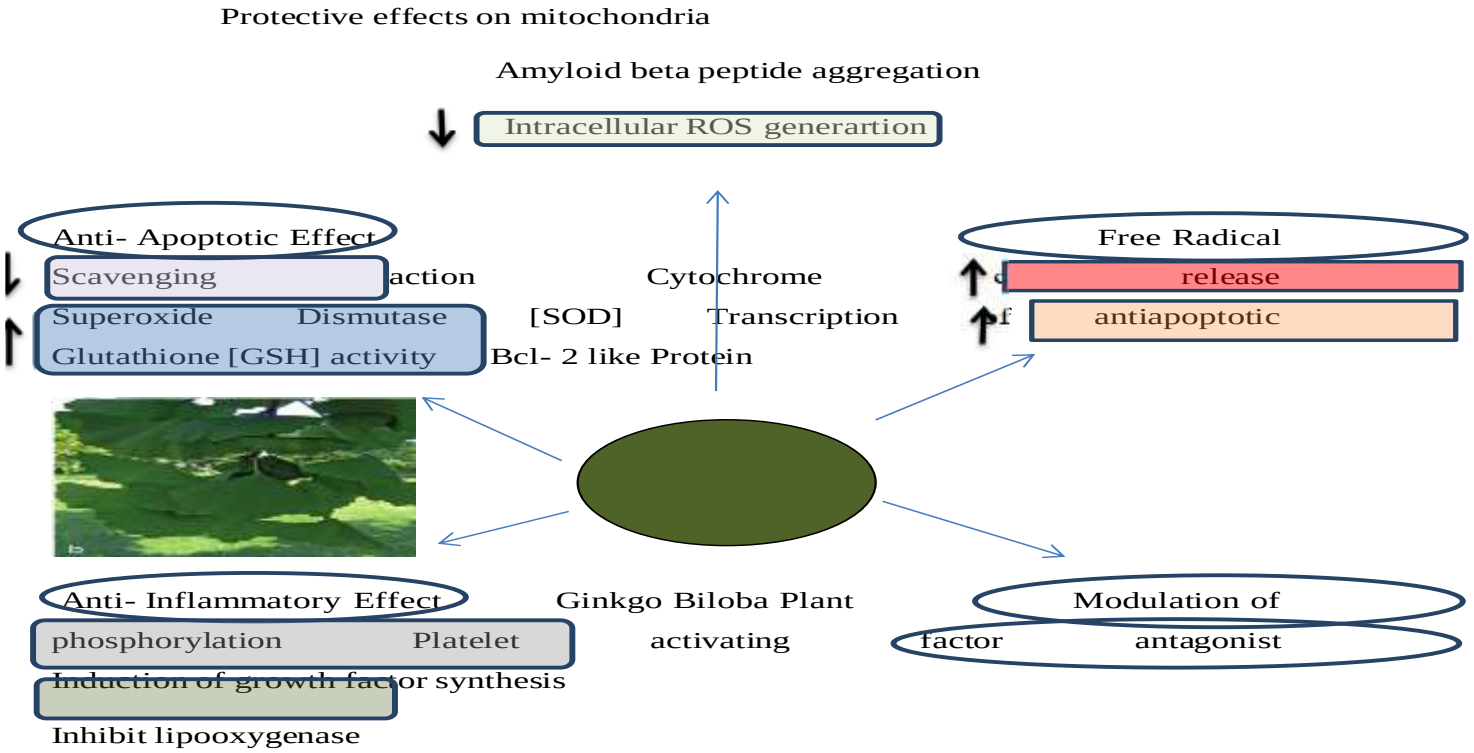

Figure 12: Mechanism of Action of *Ginkgo Biloba*

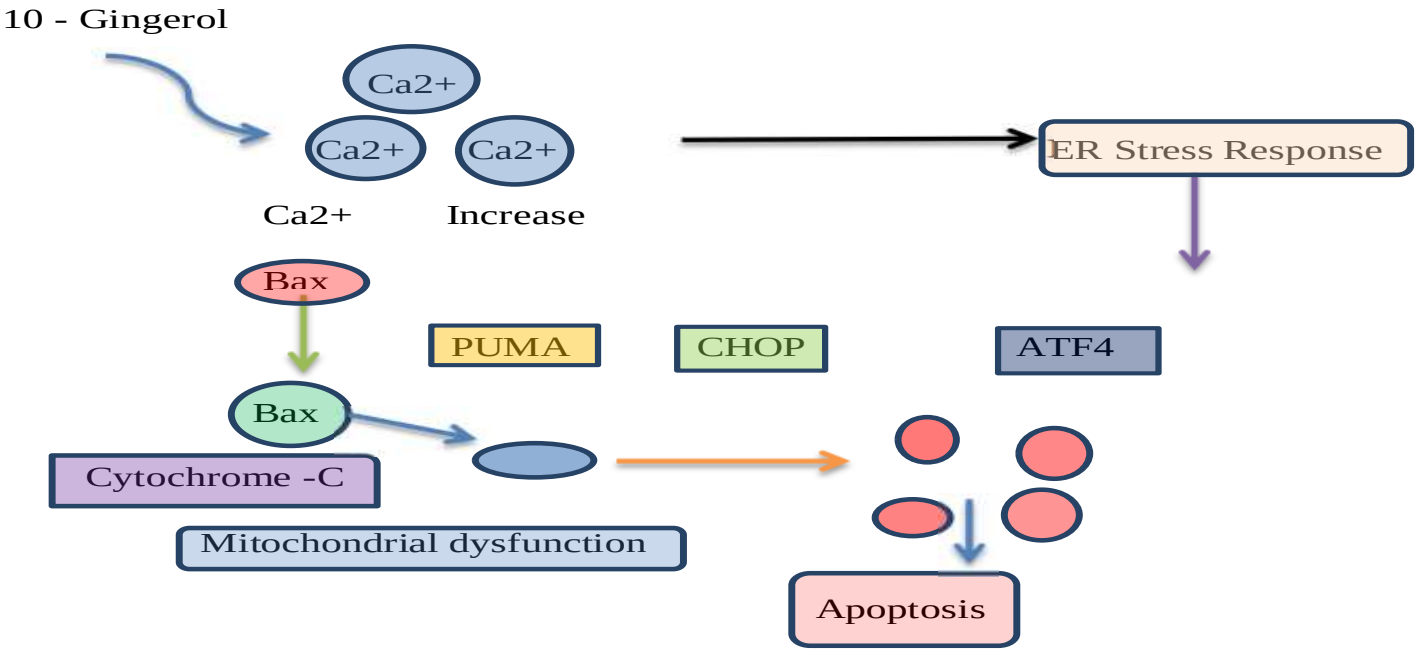

Figure 13: Mechanism of Action of *gingerol*

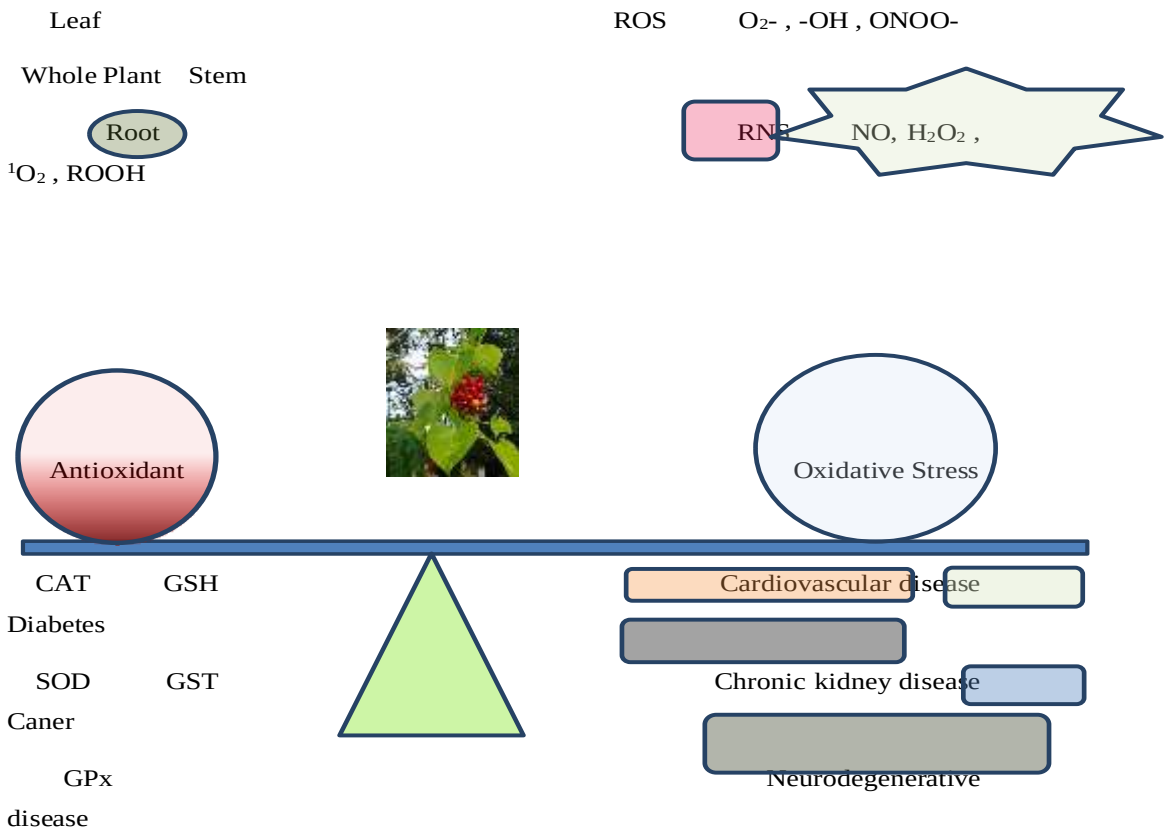

Figure 14: Mechanism of Action of *Tinospora Cordifolia*

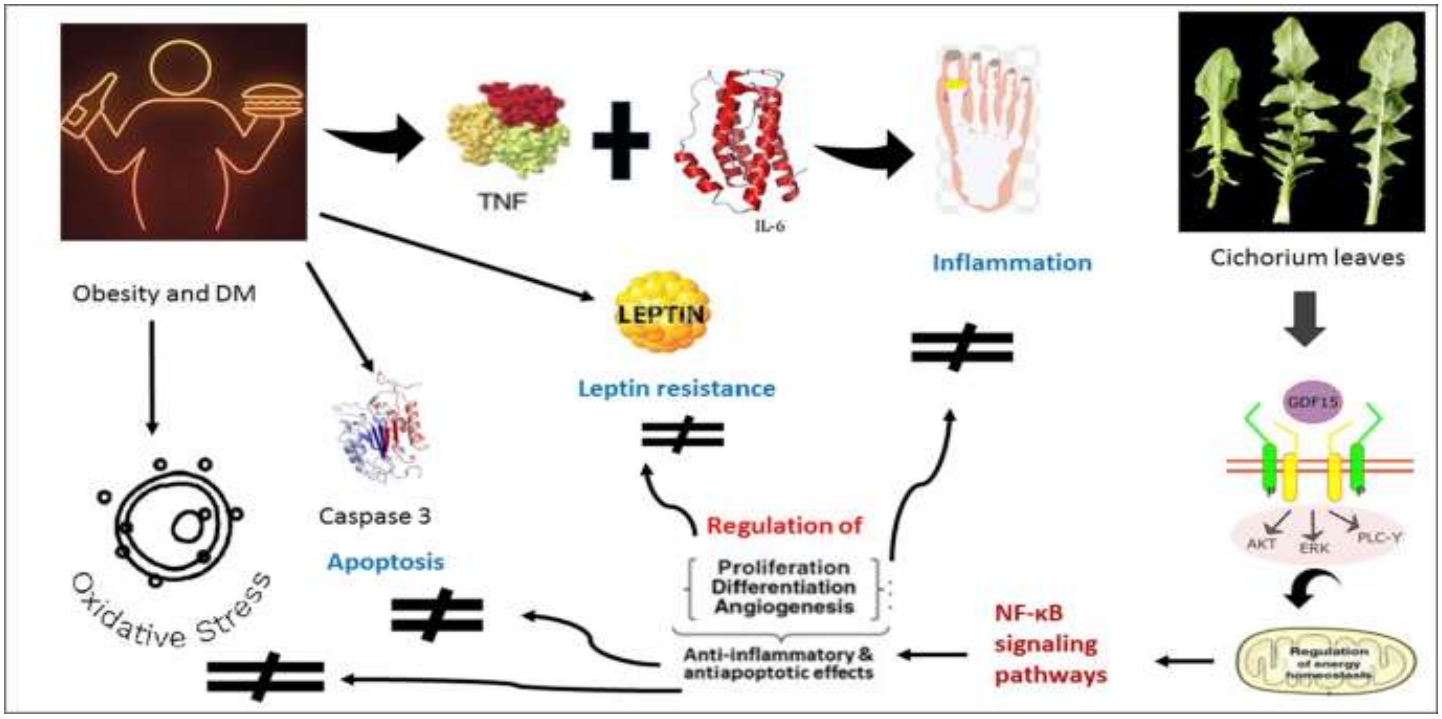

Figure 15: Mechanism of action of *Chichorium Intybus*

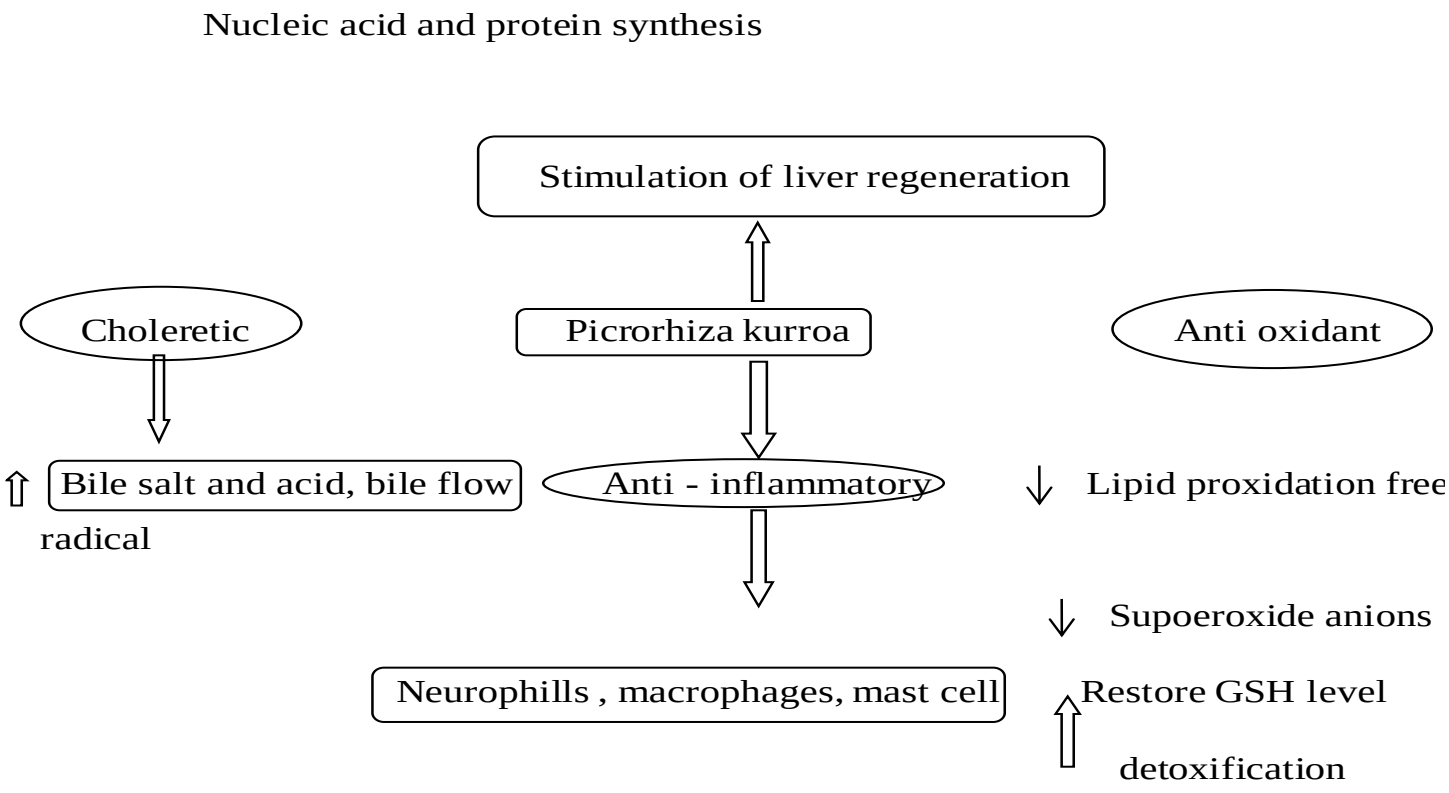

Figure 16: Mechanism of action *Picrorhiza Kurroa*

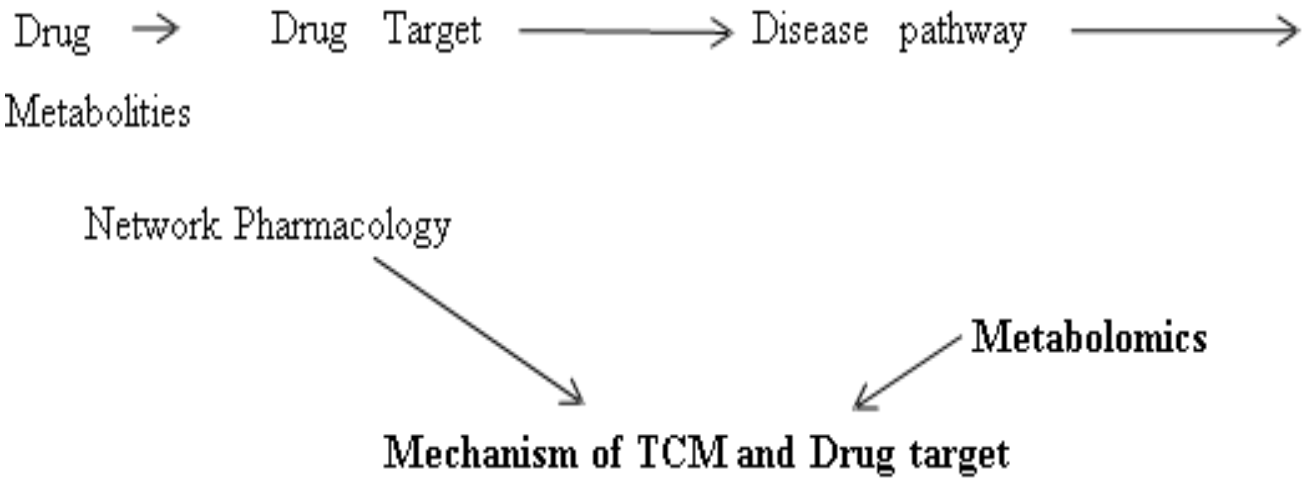

Figure 17: Mechanism of action of *salvia miltiorrhiza*

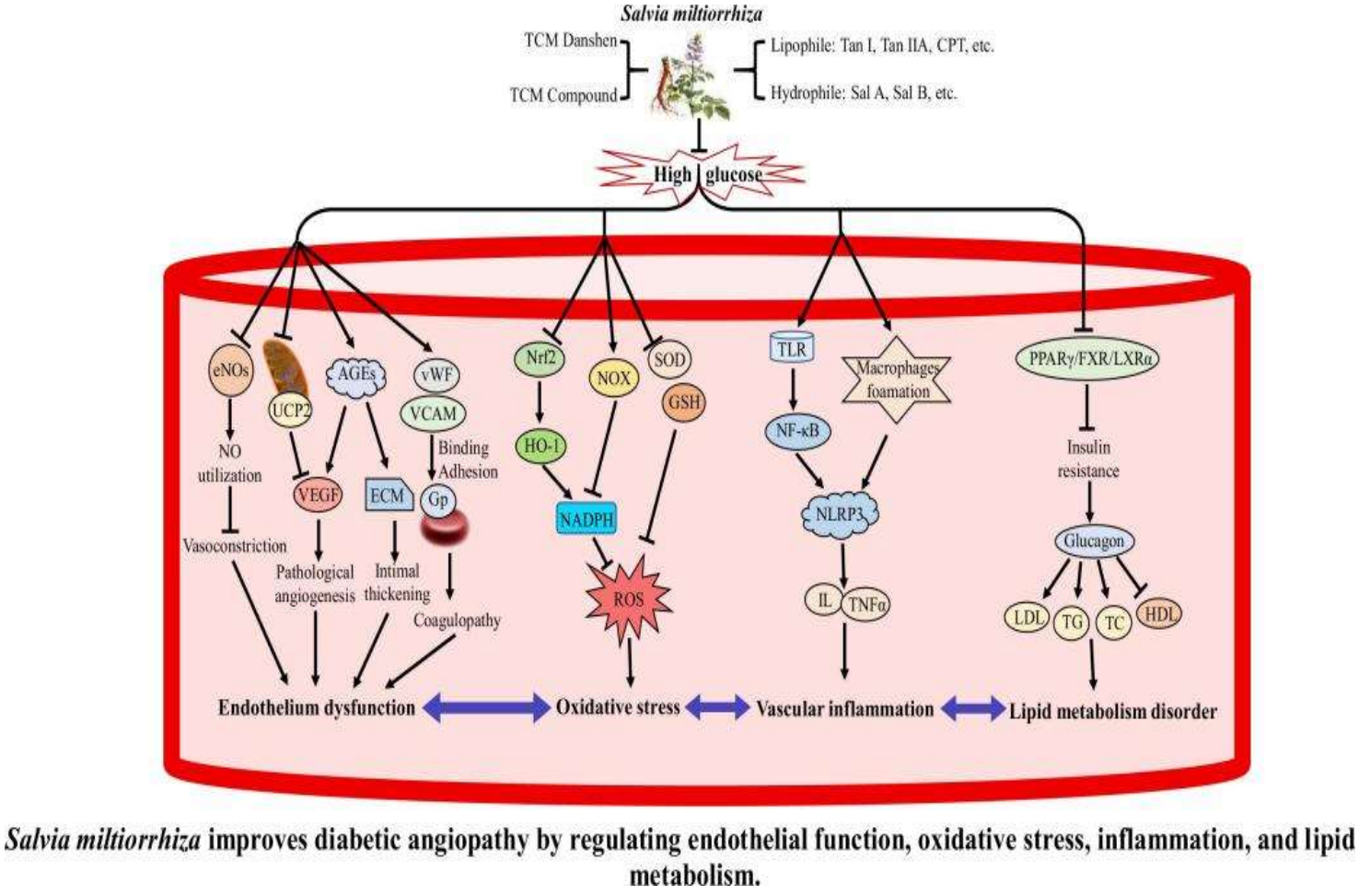

Figure 18: Function of *salvia miltiorrhiza*

REFERENCES

1. World Health Organization. Cardiovascular Diseases (CVDs). 2007. Available online: https://www.who.int/ newsroom/factsheets/detail/car.diovascular-diseases-(cvds) (accessed on 22 July 2007).
2. Wang CZ, Mehendale SR, Yuan CS. Commonly used antioxidant botanicals: active constituents and their potential role in cardiovascular illness. Am J Chin Med. 2009;35(04):543-558
3. Zern TL, Fernandez ML. Cardioprotective effects of dietary polyphenols. J Nutr. 2009; 135(10):2291-2294.
4. Silverstein DC, kate H. Myocardial Infarction, Small Animal Critical Care Medicine. Ch 41. St Lowis, MO: Saunders; 2009.p. 174-6
5. Dec GW. Digoxin remains useful in the management of chronic heart failure. Med Clin. 2010;87(2):317-337
6. . Vukajlovic DD, Guettler N, Miric M, Pitschner HF. Effects of atropine and pirenzepine on heart rate turbulence. Ann Noninvas Electro. 2010;11(1):34-37
7. Zern TL, Fernandez ML. Cardioprotective effects of dietary polyphenols. J Nutr. 2010;135(10):2291-2294
8. Sambanthamurthi, R.; Tan, Y.A.; Sundram, K.; Abeywardena, M.; Sambandan, T.G.; Rha, C.; Sinskey, A.J.; Subramaniam, K.; Leow, S.S.; Hayes, K.C.; et al. Oil palm vegetation liquor: A new source of phenolic bioactives. Br. J. Nutr. 2011, 106, 1655–1663. [CrossRef]
9. Leow SS, Sekaran SD, Tan YA, Sundram K Sambanthamurthi R. Oil palm phenolics confer neuroprotective effects involving cognitive and motor functions in mice. Nutr. Neurosci. 2013, 16, 207–217. [CrossRef]
10. . Curigliano G, Cardinale D, Dent S, Criscitiello C, Aseyev O, Lenihan D, et al. Cardiotoxicity of anticancer treatments: epidemiology, detection, and management. CA: A Cancer Journal for Clinicians. 2013; 66:309-25.
11. Che Idris, C.A.; Karupaiah, T.; Sundram, K.; Tan, Y.A.; Balasundram, A.; Leow, S.S.; Nasruddin, N.S.; Sambanthamurthi, R. Oil palm phenolics and vitamin E reduce atherosclerosis in rabbits. J. Funct. Foods 2014, 7, 541–550. [CrossRef]
12. . Leow, S.S.; Sekaran, S.D.; Sundram, K.; Tan, Y.A.; Sambanthamurthi, R. Differential transcriptomic profiles effected by oil palm phenolics indicate novel health outcomes. BMC Genom. 2014, 12, 432. [CrossRef].
13. C. Katiyar, A. Gupta, S. Kanjilal, S. Katiyar, Drug discovery from plant sources: an integrated approach, Ayu 33 (2014) 10–19, doi: http://dx.doi.org/10.4103/ 0974-8520.100295.
14. Sharma, P.K. Mediratta, K.K. Sharma, M. Fahim, Lipotab, a polyherbal formulation, attenuates isoprenaline-induced left ventricular remodeling and heart failure in rats, Hum. Exp. Toxicol. 30 (2014) 1000–1008, doi:http:// dx.doi.org/10.1177/0960327110384529
15. S.N. Goyal, C. Sharma, U.B. Mahajan, C.R. Patil, Y.O. Agrawal, S. Kumari, D.S. Arya, S. Ojha, Protective effects of cardamom in isoproterenol-induced myocardial infarction in rats, Int. J. Mol. Sci. 16 (2015) 27457–27469
16. H.S. Ghelani, B.M. Patel, R.H. Gokani, M.A. Rachchh, R. Linn, Evaluation of polyherbal formulation (SJT-HT-03) for antihypertensive activity in albino rats, Ayu 35 (2015) 452–457, doi: http://dx.doi.org/10.4103/0974- 8520.159034.
17. Hitit M, Corum O, Corum DD, et al. A cardioprotective role of Nerium oleander with the expression of hypoxia inducible factor 2A mRNA by increasing antioxidant enzymes in rat heart tissue. Acta Sci Vet. 2017; 46(1):1560.
18. Dey P, Roy S, Chaudhuri T. A quantitative assessment of bioactive phytochemicals of Nerium indicum: an ethnopharmacological herb. Int J Res Pharm Sci. 2018;3(4):579-587
19. Khan M, Musharaf S, Ibrar M, Hussain F. Pharmacognostic evaluation of the Amaranthus viridis L. Res Pharmaceut Biotechnol. 2018; 3(1):11-16.
20. Vakili SA, Talageri A, George A, Mathai B. Acute toxicity of petroleum ether extracts of Amaranthus viridis L. Int J Pharma Res Health Sci. 2018;6(3):2591-2593.
21. Bierman EL, Amaral JA, Belknap BH. Hyperlipemia and diabetes mellitus. Diabetes. 2019; 15(9):675-679.
22. Kumar B, Lakshman K, Swamy V, et al. Hepatoprotective and antioxidant activities of Amaranthus viridis linn. Macedonian J Med Sci. 2019; 4(2):125-130.
23. Badore NS, Das PK, Pillai S, Thakur A. Role of Ginkgo biloba extract, against isoproterenol induced cardiac toxicity in rats. Indian J Pharm Educ. 2019; 51(4): S691-S699.
24. Fu HW, Zhang L, Yi T, Feng YL, Tian JK. Two new guaiane-type sesquiterpenoids from the fruits of Daucus carota L. Fitoterapia. 2019; 81(5):443-446.

25. Zaini R, Clench MR, Le Maitre CL. Bioactive chemicals from carrot (Daucus carota) juice extracts for the treatment of leukemia. J Med Food. 2019; 14(11):1303-1312.
26. Jiang Y, Huang M, Wisniewski M, Li H, Zhang M, Tao X, et al. Transcriptome analysis provides insights into gingerol biosynthesis in ginger (Zingiber officinale). The plant genome. 2019; 11:1-11.
27. Yusof YAM. Gingerol and its role in chronic diseases. Drug Discovery from Mother Nature: Springer, pp; 2019.
28. Wang Q, Wei Q, Yang Q, Cao X, Li Q, Shi F, et al. A novel formulation of [6]-gingerol: Proliposomes with enhanced oral bioavailability and antitumor effect. International Journal of Pharmaceutics. 2019; 535:308-15
29. Mridula K, Parthibhan S, Kumar TS, Rao M. In vitro organogenesis from Tinospora cordifolia (Willd.) Miers—a highly valuable medicinal plant. S Afr J Bot. 2019; 113:84-90
30. Mridula K, Parthibhan S, Kumar TS, Rao M. In vitro organogenesis from Tinospora cordifolia (Willd.) Miers—a highly valuable medicinal plant. S Afr J Bot. 2019; 113:84-90.
31. Upadhay A, Kumar K, Kumar A, Mishra H. Tinospora cordifolia (Wild) Hook. F and Thoms. (Guduchi)–validation of the ayurvedic pharmacology through experimental and clinical studies. Int J Ayurveda Res. 2019; 1:112-121.
32. Saxena R, Sulakhiya KB, Rathore M. Cichorium intibus Linn: a review of pharmacological profile. Int J Curr Pharmaceutl Res. 2020; 6(4):11-15.
33. Abbas ZK, Saggu S, Sakeran MI, Zidan N, Rehman H, Ansari AA. Phytochemical, antioxidant, and mineral composition of hydroalcoholic extract of chicory (Cichorium intybus L.) leaves. Saudi J Biol Sci. 2020;22(3):322-326
34. Bantawa P, Ghosh SK, Bhandari P, et al. Micropropagation of an elite line of Picrorhiza scrophulariiflora, pennell, an endangered high valued medicinal plant of the Indo-China Himalayan region. Med Aromat Plant Sci Biotechnol. 2020; 4:1-7
35. Sultan P, Rasool S, Hassan QP. Picrorhiza kurroa Royle ex Benth. A plant of diverse pharmacological potential. Ann Phytomed. 2020;6(1):63-67
36. Shukla B, Visen P, Patnaik G, Dhawan B. Choleretic effect of picroliv, the hepatoprotective principle of Picrorhiza kurroa1. Planta Medica. 2021; 57(01):29-33.
37. Wang L, Li Y, Deng W, et al. Cardio protection of ultrafine granular powder for Salvia miltiorrhiza Bunge against myocardial infarction. J Ethnopharmacol. 2021; 222:99-106.
38. Shi M, Huang F, Deng C, Wang Y, Kai G. Bioactivities, biosynthesis, and biotechnological production of phenolic acids in Salvia miltiorrhiza. Crit Rev Food Sci. 2021;59(6):953-964
39. Zhou W, Huang Q, Wu X, et al. Comprehensive transcriptome profiling of Salvia miltiorrhiza for discovery of genes associated with the biosynthesis of tanshinones and phenolic acids. Sci Rep U K. 2021;7(1):10554
40. Li XM, Yang PL. Research progress of Sonchus species. Int J Food Prop. 2022;21(1):147-157
41. Helal AM, Nakamura N, El-Askary H, Hattori M. Sesquiterpene lactone glucosides from Sonchus asper. Phytochemistry. 2021; 53(4):473-477
42. Kavitha C, Thangamani C. Amazing bean Mucuna pruriens: a comprehensive review. J Med Plants Res. 2021;8(2):138-143
43. Sathyanarayana N, Pittala RK, Tripathi PK, et al. Transcriptomic resources for the medicinal legume Mucuna pruriens: de novo transcriptome assembly, annotation, identification, and validation of EST-SSR markers. BMC Genomics. 2021;18(1):409
44. Intararuchikul T, Teerapattarakan N, Rodsiri R, et al. Effects of Centella asiatica extract on antioxidant status and liver metabolome of rotenone-treated rats using GC–MS. Biomed Chromatogr. 2021;33(2): e4395
45. Hamid K, Ng I, Tallapragada VJ, et al. An investigation of the differential effects of ursane triterpenoids from Centella asiatica, and their semisynthetic analogues, on GABAA receptors. Chem Biol Drug Des. 2021;88(3):386-397
46. Mahendran, S. Molecules of interest - Mangiferin - A review. Annual Research & Review in Biology 2021; 5:307-20.
47. Nunez Selles AJ, Daglia M, Rastrelli L. The potential role of mangiferin in cancer treatment through its immunomodulatory, anti-angiogenic, apoptopic, and gene regulatory effects. Biofactors. 2021; 42:475-91.
48. Bhatt L, Sebastian B, Joshi V. Mangiferin protects rat myocardial tissue against cyclophosphamide induced cardiotoxicity. Journal of Ayurveda and integrative medicine. 2021; 8:62-7
49. Mozos I, Stoian D, Caraba A, Malainer C, Horbańczuk J, Atanasov A. Lycopene, and vascular health. Frontiers in Pharmacology. 2021; 9:521.
50. Ojha S, Al Taee H, Goyal S, Mahajan UB, Patil CR, Arya D, et al. Cardioprotective potentials of plant-derived small molecules against doxorubicin associated cardiotoxicity. Oxidative Medicine and Cellular Longevity. 2021; 2016:1-19.

51. Sharma BK. Rauwolfia: Cultivation and collection. 2011, URL: http://www.biotecharticles.com/Agricultur e-Article/Rauwolfia-Cultivation-andCollection-892.html (Date of Visit: September 05, 2021; Time of Visit: 7:30PM).
52. Werner G. The central control of the blood pressure, Indian M. Gaz. 1953; 88: 111p
53. Ahmad N, Fazal H, Abbasi BH, Farooq S, Ali M, et al. (2021) Biological role of Piper nigrum L. (Black pepper): A review. Asian Pacific J Trop Biomed: S1945-S1953
54. Acharya SG, Momin AH and Gajjar AV (2021) Review of Piperine as A BioEnhancer. Am J Pharm Tech Res 2:32-44
55. Sivarajan VV, Pushpangadan P, Kumar PKR (2022) A Revision of Trichopus (Trichopodaceae). Kew Bull 45: 353-360.
56. Pragada R, Veeravalli KK, Chowdary K, Routhu K. Cardioprotective activity of Hydrocotyle asiatica L. in ischemia–reperfusion induced myocardial infarction in rats. J Ethnopharmacol. 2022;93(1):105-108
57. edes C, Yousef GG, Robert P, Grace MH, Lila MA, Gómez M, Gebauer M and Montenegro G, Anthocyanin profiling of wild maqui berries (Aristotelia chilensis [Mol.] Stuntz) from different geographical regions in Chile. J Sci Food Agric 94: 2639–2648 DOI:10.1002/jsfa.6602 (2022)
58. Cespedes C, alarcon J, Avila J and Nieto A, Anti-inflammatory Activity of Aristotelia chilensis Mol. (Stuntz) (Elaeocarpaceae). BLACPMA, 9 (2), 91 - 99 (2022)
59. Sahidi F and Naczk M, Phenolics in Food and Nutraceuticals. This edition published in the Taylor & Francis e-Library ISBN 0-203-59485-1, International Standard Book Number 1-58716- 138-9 pp. 1-58 (2022)
60. Subramoniam A, Madhavachandran V, Rajasekharan S, Pushpangadan P. Aphrodisiac property of Trichopus zeylanicus extract in male mice. J. Ethnopharmacology. 2022; 57(1):21 -7.
61. Subramoniam A, Evans DA, Rajasekharan S, Pushpangadan P. Hepatoprotective activity of Trichopus zeylanicus extract against paracetamol - induced hepatic damage in rats. Indian. J Experimental Biol. 2022; 36(4):385 - 9.
62. Subramoniam A, Evans DA, Rajasekharan S, Pushpangadan P. Inhibition of antigen -induced degranulation of sensitized mast cells by Trichopus zeylanicus in mice and rats. J Ethnopharm. 2022; 68(1):137 -43.
63. Singh B, Chandan BK, Sharma N, Singh S, Khajuria A, Gupta DK. Adaptogenic activity of glyco -peptido -lipid fraction from the alcoholic extract of Trichopus zeylanicus Gaerten. (Part II). Phytomedicine. 2022; 12(6):468 -81.
64. Velavan S, Selvarani S, Adhithan A. Cardio protective effect of Trichopus zeylanicus against myocardial ischemia induced by isoproterenol in rats. Bangladesh J Pharm. 2022; 4(2):88 -91.
65. Rishikesh RS, Kumar SR, Ravindranath SB, Vaibhav BV. Anti -ulcer potential of saponin fraction of Trichopus zeylanicus on various experimental animal models. Inter J Green Pharm. 2022; 11(1):11 – 6.