Cardioprotective Plant Extracts

Sankarganash Arunachaalam, Umapriya, Selvaraj Kunjiappan

Abstract: ***Cardiovascular disease is assumingas a major cause of morbidity and mortality worldwide. In traditional Indian medicinal system, many plants were used for thetreatment of cardiac failure. Medicinalplants are used in various ailments due to efficacy,low cost, ease availability and safety.Because of these advantages the usage ofmedicinal plant increased by the medicinal practitioners in their day to day practice. Inthis review article, we discuss about the plant extracts from various part of the plantwhich is used to cure or protect against the cardiomyopathy induced by many inducingfactors.***

Keywords: Plant extract, Medicinal Plant, Cardiovascular disease.

I. INTRODUCTION

Cardiovascular disorder refers as the diseases in related to heart and blood vessels. The most common ones are the heart muscle, strokes, heart attacks, heart failure and those caused by high blood pressure. In Worldwide, cardiovascular disease is assuming as a major cause of morbidity and mortality [1]. Approximately 16.7 live per annum were estimated in worldwide by WHO report 2003. In 2020 it may be raised to 36.3% [2]. Moreover, the cardiovascular diseases expected to jump inranking from fourth to first, due to premature death and disability [3]. The predisposing factors to cardiovascular diseases include cigarette smoking, elevated cholesterol, hypertension, obesity, physical inactivity and diabetes.

In traditional Indian medicinal system, many plants were used for the cardioprotection [4]. Because it does not produce any harmful effect and does not cause any side effects. The discovery of many important modern drugs has the starting point as natural products. ThePotential source of drugs as a medicinalplant because there were rich in secondary metabolites and essential oil of therapeutic medicines [5]. Medicinal plants were used in various ailments are due to being economical, effective, their ease availability and due to their safety [5]. Because of these advantages the usage of medicinal plant were increased by the medicinal practitioners in their day to day practice [6].

Phytochemicals that are synthesized by plants for their defence and for other biological functions however, foods obtained by plants contain a wide range of non- nutrient phytochemicals [7]. From the ancient days, plants were used for the medicinal purposes as a therapy against diseases and ailments. The Plants contain phytochemicals, they act as an antioxidant and they supply necessary nutrients, for various function of the human body and it reduce the occurrence of many diseases. The plant parts (herbs, leaves, stem, root, etc.,) also have a medicinal values, used to prevent alleviate or cure several human diseases [8]. We ingest these plant foods to meet our nutritional needs; we also ingest a wide variety of these non-nutrient phytochemicals. These phytochemicals have the potential for preventing chronic diseases and also non-toxic [7]. Today, the world consumes plants as a traditional medicine. In developing countries, the traditional medicine is directed to the socio-economic status and well being of the rural communities [9]. This has led to the increasing search for plants with medicinaluse.

The "Magic Bullet Theory" suggests that the only pure compounds are the most efficacious. So the emerging new field of nutrigenomics and pharmacogenomics will play an important role in determining the interaction of these complex substances with the genetic variability of individuals and will determine the individual response and its magnitude to phytochemicals [10]. In this review article, we are discussing about the plant extract from various part of the plant which is used to cure or protect against the cardiomyopathy induced by many inducing factors.

II. CARDOMYOPATHY INDUCING FACTORS

Cardiomyopathy is a disease which was refers to the heart related diseases. It was induced by different inducing factors. Some of as follow as

A. Carbon Tetrachloride-Induced Cardiotoxicity (CCl4)

CCl4 is a renowned model compound. It is used to producing chemical toxicity by creation of free radicals in liver, kidney, heart, lung, testis, brain and blood. After the intake of CCL4, the liver was transformed by cytochrome P450 which could leads to the formation of trichloromethyl free radicals. Because of this lipids modication, is to form of peroxidation of polyunsaturated fatty acids in the cell membrane. For protection against cardiomyopathy, the most important is antioxidant activity or the inhibition of the generation of free of radicals [11].

B. Diabetics induced and cardiomyopathy

Diabetes is one of the alarming diseases in the developing and developed world. It affects a number of organ systems including kidneys, liver, eyes, reproductive system, heart etc. Diabetic cardiomyopathy is one of the leading causes of death compared to other complications of diabetes.

Revised Manuscript Received on December 15, 2019.

Dr. Sankarganash Arunachaalam*, Department of Biotechnology, School of Bio and Chemical Engineering, Kalasalingam Academy of Research and Education, Krishnankoil, Virudhunagar Dt., Tamilnadu PIN 626126, India. Email: sankarganesh@klu.ac.in

Umapriya M., Department of Biotechnology, School of Bio and Chemical Engineering, Kalasalingam Academy of Research and Education, Krishnankoil, Virudhunagar Dt., Tamilnadu PIN 626126, India. Email: umapriya.m@klu.ac.in

Selvaraj Kunjiappan, Department of Biotechnology, School of Bio and Chemical Engineering, Kalasalingam Academy of Research and Education, Krishnankoil, Virudhunagar Dt., Tamilnadu PIN 626126, India. Email: selvarj@klu.ac.in

The oxidative stress is a key factor in etiology of diabetic complications like cardiomyopathy and nephropathy. Theincidence of diabetic heart failure is correlated with increase in age, blood pressure, weight and cholesterol levels. It is characterized by a series of alterations in structure and functions of the heart, without a exclusion of references, it should be less than 5%. coronary artery disease and hypertension, ultimately leading to heart failure. Pathophysiology includes left ventricular hypertrophy, systolic and diastolic dysfunctions.

C. Isoproterenol induced myocardial Infarction

Isoproterenol (ISO), a synthetic adrenoceptor agonist. It has been found to induce myocardial injury in rat as a result of disturbance in physiological balance between production of free radicals and antioxidative defense system [12].

D. Doxorubicin Induced Cardiomyopathy

Doxorubicin (DOX) is an anticancer drug which belongs to anthracycline antibiotics. It is being used widely for treatment of various types of tumor malignancies. But in the clinical use, it causes serious and undesirable side effects especially dose-dependent myocardial injury, leads to heart attack [13]. DOX induced cardiomyopathy by free radical generation and mitochondrial dysfunction iron-dependent oxidative damage of biological macromolecules, and protein oxidation [14].

E. Streptozotocin induced cardiotoxicity

Streptozotocin is a naturally occurring chemical. It is toxic to the insulin-producing beta cells of the pancreas in mammals. In medical research, it is used to produce Type 1 diabetes in a large dose as well as Type 2 diabetes with multiple low doses in test animal. It is a glucosaminenitrosourea compound and it is toxic to cells by causing damage to the DNA. The activation of poly ADP-ribosylation, induced by DNA damage which leads to the formation of diabetes induction than DNA damages itself [15].

F. Catecholamine Induced Myocardial

In the cellular mechanism of cardiomyopathy, catecholamines which are highly oxidative metabolites lead lipid peroxidation. Catecholamines accelerates rate of peroxidation in membrane phospholipids and releases free fatty acids into plasma. Because of this the phospholipase A2, catecholamines-induced hyperlipidemia [16].

G. Isoprenaline-induced cardiotoxicity

Isoprenaline is a syntheticcatecholamine and b adrenergic agonist known to cause oxidative damage andcardiac dysfunction in rats. It is considered as the most authenticated model for theevaluation of drugs in Cardiomyopathy (Mohanty et al., 2004).

H. Plant Extract

The fresh leaves/fruits/ root/ tubers/ bark/ herb/ peels/ seeds/ pollen grains or whole plant were extracted with ethanol or methanol or aqueous or hydrochloric acid or alcohol were used to determine the cardioprotective activity.

Table I: 1 Extracts Of Roots &Tubers For Cardiomyopathy Activity

S.No	Plant Name	Parts of Plant	Extract	CMP Inductiion	Concentartion	Reference
1	*Diosgenin (Dioscorea opposita)*	Tuber	Aqueous	Doxorubicin		Chih-Tai Chen *et al*., 2015
2	*Daucus carota Linn.*	Tuberous Root	Aqueous	Isoproterenol	250 and 500mg	P.Muralidharan *et a*l 2008

Table II. Extract of Leaves/Leaf for cardiomyopaty activity

S. No	Plant Name	Parts Of Plant	Extract	CMP Induction	Concentration	Reference
1	*Euphorbia hirta*	Leaves	Ethanol	Normal		Md Reyad-Ul-Ferdous *et al*., 2017
2	*Costus Afer*	Leaf	Methanol	Carbon Tetrachloride	100, 200, 300 and 400mg	U. O. Njoku *et al.*, 2017
3	*Andrographis paniculata*	Leaves	Methanol	isoproterenol	200mg	Dipendra Kumar Sah and Nagarathana

						P.K.M. 2016
4	*Abroma augusta L.*	Leaves	Aqueous	Diabetics	100mg and 200mg	Ritu Khanra *et al*., 2016
5	*Cassia alata (L.)*	Leaves	Methanol	Doxorubicin	100mg 200mg and 400mg	Vishnu Neharkar et al., 2016
6	*Ipomoea batatas*	Leaf	Ethanol	Doxorubicin	600mg and 900mg	Balakrishna Somashekar *et al*., 2015
8	*Newbouldia laevis*	Leaf and Root	Water	Carbon Tetrachloride	800mg	K. N. Agbafor *et al*., 2015
9	*Moringa Oleifera*	Leaf	Ethanol	Doxorubicin	500mg and 1000mg	Fikriansyah *et al*., 2015
10	*Carissa opaca*	Leaves	Water	CCl4	50mg and 200mg	Sumaira Sahreen *et al*., 2014
11	*Parkia Biglobosa*	Leaf	Methanol	Doxorubicin	50-75mg	Komolafe K *et al*., 2013
12	Ocimum basilicum L.	Leaves	Ethanol	Isopreterenol	10,20 and 40mg	Fatemeh Fathiazad *et al*., 2012
13	*Parkia Biglobosa*	Leaf	Methanol	Doxorubicin	25, 75 and 100mg	Komolafe K *et al*., 2013
14	*Aegle marmelos*	Leaf	Ethanol	Alloxan	200mg	Rajbir Bhatti *et al*., 2011
15	*Spinacia oleracea Linn.*	Leaf	Methanol	isoproterenol	100 and 200mg	Shivaranjani Vutharadhi, *et al*., 2016
16	*Viscum album L.*	Leaf	Methanol	Normal		Eylem Suveren *et al*., 2017

Table III: Extract of Fruits for cardiomyopathy activity

S. No	Plant Name	Parts Of Plant	Extract	CMP Induction	Concentration	Reference
1	*Parmentiera cereifera Seem*	Fruits	Methanol	Normal	500mg	Md. Reyad-ul-Ferdous *et al*., 2015
2	*Pithecellobium Dulce*	Fruit Peel	Ehanol	isoproterenol	200mg	PakutharivuThangarajan *et al*., 2014
3	*Garcinia indica*	Fruit	Ethanol	Isoproterenol	400mg and 800mg	Vandana Panda et al., 2014
4	*Momordica Dioca* Roxb.	Fruit	Methanol	Doxorubicin		S. Shamala and K.L. Krishna 2013
5	*Andrographis paniculata*	Leaves	Methanol	Isoproterenol	200mg	Dipendra Kumar Sah and Nagarathana P.K.M. 2016

6	*Cassia alata (L.)*	Leaves	Methanol	Doxorubicin	100mg, 200mg and 400mg	Vishnu Neharkar *et al*., 2016
5	*Vaccinium meridionale*	Fruit	NonAlcholic			Yasmin E. Lopera *et al*., 2013
6	*Punica granatum* L.	Fruit	Water	Doxorubicin	100mg	Mohammad Hassanpour Fard *et al*., 2011
7	Aristotelia chilensis	Fruits	Phenolic	Normal		Carlos L. Ce´spedes *et al*., 2008
8	*Zingiber officinale*	Fruit	Ethanol	Diabetics	50mg	Behrouz Ilkhanizadeh *et a*l., 2016.
9	*Citrus macroptera*	Fruit	Ethanol	Isoproterenol	500mg	Sudip Paul *et al*., 2017
10	*PhoenixdactyliferaL.*	Pulp	Aqueous	Isoproterenol	250 and 500mg	MohammedAl-Yahya *et al*., 2016

Table IV: Extract of Seed for cardiomyopathy activity

S. No	Plant Name	Parts of Plant	Extract	CMP Induction	Concentration	Reference
1	*Caesalpinia crista* Linn.	Seed	Achol & Aqueous	Isoproterenol	400mg	Sharma Rajesh Kumar, Sharma Ashish Kumar 2013
2	*Grapeseed Proanthocyanidin*	Seed	Water	Doxorubicin	200mg	M. Abirami and U. Kanagavalli 2013

Table V: Extract of Flower for cardiomyopathy activity

S. No	Plant Name	Parts Of Plant	Extract	CMP Induction	Concentration	Reference
1	Marigold	Flower	Hydrocholic	Diabetics	250 and 500mg	Esmaeel Ebrahimi *et al*., 2016
2	*Tecoma stans*	Flower	Ethanol	isoproterenol	200mg	Shanmukha Ittagi *et al*., 2014
3	*Tecoma stans*	Flower	Ethanol	Streptozotocin	120mg	Kameshwaran Sugavanam *et al*., 2013

Table VI: Extract of Bark for cardiomyopathy activity

S. No	Plant Name	Parts Of Plant	Extract	CMP Induction	Concentration	Reference
1	Terminalia Paniculata Roth	Bark	Ethanol	Doxorubicin	200mg and 400mg	Davey., M.S and Atlle., C.V 2011

2	*Cassia Fistula*	Bark	Methanol	Normal	400mg	Khatib N. A. 2010
3	*Terminalia arjuna*	Bark	Aqueous	Normal	750mg	Subir K Maulik *et al*., 2016

Table VII: Extract of Herb for cardiomyopathy activity

S. No	Plant Name	Parts Of Plant	Extract	CMP Induction	Concentration	Reference
1	*Solanum surettense*	Herb	Ethanol	Isoprotenol	200 and 400mg	Chitikela P Pullaiah *et al., 2015*
2	*Bacopa monnieri*	Herb	Ethanol	Normal	30, 100 µg/ml	Sirintorn Srimachai *et al*., 2016.
3	*Nepeta deflersiana*	Herb	Ethanol	isoproterenol	2000mg	Areej Mohammad Al-Taweela *et al*., 2017

Table VIII: Extract of Whole Plant for cardiomyopathy activity

S. No	Plant Name	Parts Of Plant	Extract	CMP Induction	Concentration	Reference
1	Green Combination Terminalia arjuna and Piper nigrum	Whole Plant	Aqueous	Catecholamine	100mg	Fatiqa Zafar *et al*., 2015
2	*Sida Rhombifolia Linn*.	Whole Plant	Ethanol	Isoproterenol	100mg and 200mg	Ramadoss S *et al*., 2012
3	*Evolvulus Alsinoides* Linn	Whole Plant	Methanol	Isoproterenol	100mg and 200mg	Sudhakumari *et al*., 2012
4	*Aerva lanata (Linn.)*	Whole Plant	Aqueous & Ethanol	Doxorubicin	200mg	Paramasivam Ragavendran *et al*., 2012
5	Commiphora Mukul	Whole Plant	HCL	Isoprenaline	100, 200 and 400mg	Shreesh Ojha *et al*., 2011
6	*Hybanthus Enneaspermus (Linn.)*	Whole Plant	Aqueous	Isoproterenol	500mg	Radhika S *et al*., 2011
7	*Tephrosia Purpure*	Whole Plant	Aqueous	Streptozotocin	300 and 500mg	Shraddha V. *et al*., 2015

Table No IX: Extract of Other parts of plant for cardiomyopathy activity

S. No	Plant Name	Parts Of Plant	Extract	CMP Induction	Concentration	Reference
1	*Chonemorpha fragrans*	Root	Ethanol	Normal	100mg and 200mg	Mathew George *et al.*, 2017
2	*Tinospora cordifolia*	Root	Alchol	Streptozotocin	200mg	Arshiya Shamim *et al.*, 2015
3	*Newbouldia laevis*	Leaf and Root	Water	Carbon Tetrachloride	800mg	K. N. Agbafor *et al.*, 2015
4	*Marrubium vulgaria L.*	Aerial Part	Methanol	Isoproterenol	40mg	Keyvan Youshifi *et al.*, 2013
5	*Tecoma stans*	Flower	Ethanol	Streptozotocin	120mg	Kameshwaran Sugavanam *et al.*, 2013
6	Coconut Water			Doxorubicin	3ml	*Nnodim*
						Johnkennedy *et al., 2013*
7	*SolanumNigrum Linn.*	Berries	Methanol	Normal	2.5 and 5mg	Bhatia Nitish *et al.*, 2011
8	*Moringa oleifera Lam.*	Stem & Bark	Aqueous	Isoproterenol	500mg	Mahendra A Gunjal *et al.*, 2010
9	*Picrorhiza kurroa*	Root	Ethanol	Adriamycin	50mg	D. Rajaprabhu., *et al.*, 2007
10	*Date Palm*	Pollen	Ethanol	isoproterenol	400mg	Amal Daoud *et al.*, 2017

III. CONCLUSION

The review reveal that the natural products as plant extract gives more protection against cardiomyopathy. From this we can clear that the cardiomyopathy were induced by many different inducing factors but it was treated mostly by medicinally important traditional plants only, because it doesn't cause very serious side effects or no side effects. For reversing heart diseases and also preventing diet and lifestyle plays an important role in our healthy life.

REFERENCES

1. S. Krisela, "The heart and stroke foundation South Africa heart disease in South Africa Media data document," ed, 2007.
2. J. Gowri, A. V. Anand, S. Achiraman, G. R. Archunan, and S. Kalavathy, "Redemptive benefit of atorvastatin in the risk factors of coronary artery disease," Int J Cur Biomed Phar Res., vol. 1, pp. 15-19, 2011.
3. C. Hennekens, "Clinical and research challenges in risk factors for cardiovascular diseases," European heart journal, vol. 21, pp. 1917-1921, 2000.
4. D. Rajaprabhu, R. Rajesh, R. Jeyakumar, S. Buddhan, B. Ganesan, and R. An, "Protective effect of Picrorhiza kurroa on antioxidant defense status in adriamycin-induced cardiomyopathy in rats," Journal of Medicinal Plants Research, vol. 1, pp. 080-085, 2007.
5. Kumar, G. Krishna, and P. Hullatti, "Indian Plants with Cardioprotective Activity-A Review," Systematic Reviews in Pharmacy, vol. 8, p. 8, 2017.
6. S. Parasuraman, G. S. Thing, and S. A. Dhanaraj, "Polyherbal formulation: Concept of ayurveda," Pharmacognosy reviews, vol. 8, p. 73, 2014.
7. N. Rao, "Bioactive phytochemicals in Indian foods and their potential in health promotion and disease prevention," Asia Pacific Journal of clinical nutrition, vol. 12, 2003.
8. U. Dhar, R. S. Rawal, S. S. Samant, S. Airi, and J. Upreti, "People's participation in Himalayan biodiversity conservation: a practical approach," Current Science, vol. 76, pp. 36-40, 1999.
9. Pattanaik, "Some phytotherapeutic claims by tribals of Rayagada district, Orissa, India," Ethnobotanical Leaflets, vol. 2006, p. 20, 2006.
10. G. B. Mahady, "Medicinal plants for the prevention and treatment of coronary heart disease," Ethnopharmacology-Volume II, p. 75, 2009.
11. R. A. Khan, "Protective effects of Sonchus asper (L.) Hill,(Asteraceae) against CCl 4-induced oxidative stress in the thyroid tissue of rats," BMC complementary and alternative medicine, vol. 12, p. 181, 2012.

12. SAH AND P. NAGARATHANA, "SCREENING OF CARDIOPROTECTIVE ACTIVITY OF LEAVES OF ANDROGRAPHIS PANICULATA AGAINST ISOPROTERENOL INDUCED MYOCARDIAL INFARCTION IN RATS," INT. J. PHARMACOL. RES, VOL. 6, PP. 23-28, 2016.
13. E. H. Choi, H.-J. Chang, J. Y. Cho, and H. S. Chun, "Cytoprotective effect of anthocyanins against doxorubicin-induced toxicity in H9c2 cardiomyocytes in relation to their antioxidant activities," Foodand chemical toxicology, vol. 45, pp. 1873-1881, 2007.
14. Hiona, A. S. Lee, J. Nagendran, X. Xie, A. J. Connolly, R. C. Robbins, et al., "Pretreatment with angiotensin-converting enzyme inhibitor improves doxorubicininduced cardiomyopathy via preservation of mitochondrial function," The Journal of thoracic and cardiovascular surgery, vol. 142, pp. 396-403. e3, 2011.
15. Z. Wang and H. Gleichmann, "GLUT2 in pancreatic islets: crucial target molecule in diabetes induced with multiple low doses of streptozotocin in mice," Diabetes, vol. 47, pp. 50-56, 1998.
16. S. Panda and S. R. Naik, "Evaluation of cardioprotective activity of Ginkgo biloba and Ocimum sanctum in rodents," Alternative Medicine Review, vol. 14, p. 161, 2009.

AUTHORS PROFILE

Dr. Sankarganash Arunachaalam, currently works at the Faculty of Bio-Technology, Kalasalingam Academy o Research and Education. He does research in Bioinformatics, Cancer Research and Cell Biology.

Umapriya. M, is a PhD Scholar in Kalasalingam Academy of Research and Education. She completed her UG and PG degree in Microbiology at ANJAC, Sivakasi. Her area of Research in Drug Toxicology and Adverse Drug Reactions.

Dr. Selvaraj Kunjiappan currently works at the Department of Biotechnology, Kalasalingam University. Their current project is 'Design, Graph Theoretical Identification and Comparative Molecular Docking Analysis of Biologically Important Nanoparticles .

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication