Available online on www.ijcpr.com
International Journal of Current Pharmaceutical Review and Research; 7(6); 407-415

ISSN: 0976 822X

Review Article

A Comprehensive Review on Antihyperlipidemic Activity of Various Medicinal Plants

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Available Online: 25th December, 2016

ABSTRACT

Hyperlipidemia is the greatest hazard factor of coronary heart disease. At present allopathic antihyperlipidemic drugs have been associated with large number of side effects. Herbal treatment for hyperlipidemia has no side effects and is relatively contemptible and locally available. Medicinal plants are the "backbone" of traditional medicine so considered as good source of life for all people due to its wealthy therapeutic properties and being 100% natural. Medicinal plants are extensively used by majority of populations to treat various diseases and have high impact on the world's economy. Traditional therapeutic systems which mainly rely on plants, herbs and shrubs always played a fundamental role in the global health system. Natural products are generally less toxic, have less side effects and easily available so the requirement for herbal drugs is rising. The review article is undertaken to investigate the herbal Plants for antihyperlipidemic activity and various models use in this investigation. This review is specified on the anti- hyperlipidemic activity of the most recognizable therapeutic plants of medicine.

Keywords: Hyperlipidemia, Medicinal plants, Coronary heart disease.

INTRODUCTION

Hyperlipidemia is a disarray of lipid metabolism produced by elevation of plasma concentration of the diverse lipid and lipoprotein fractions, which are the source of cardiac disease. It is define as increase serum TC, TG, VLDL, LDL and HDL which are responsible for different complications like: heart attack, coronary artery syndrome, stroke, atherosclerosis, myocardial infarction and pancreatitis. Hyperlipidemia can be either primary or secondary type, the primary syndrome may be treated by hypolipidemic drugs, but secondary induced by diabetes, hypothyroidism or renal lipid nephrosis which treated by treating the original disease moderately than hyperlipidemia[1].Genetic disorders and lifestyle diet rich in calories, fat, and cholesterol play a vital role to cause dyslipidemia around the world[2]. The main factor which are responsible for hyperlipidemia includes changes in life style habits in which risk factor is mainly poor diet i.e. fat intake greater than 40 percent of total calories, saturated fat ingestion more than 10 percent of total calories; and cholesterol ingestion larger than 300 milligrams per day[3]. For hyperlipidemia large number of synthetic drugs available, not a bit is helpful for all lipoprotein disorders, and each drugs are linked with a number of adverse effects. Therefore, now a day other materials are search from natural sources with the intention of less toxic, less expensive, and provide superior safety and efficacy on a long term practice. Natural products from plants are a rich source of medicine used for centuries to treat various diseases[4].

Hyperlipidemia

Hyperlipidemia is a medical state characterized by an elevation of any or all lipid profile or lipoproteins in the blood[5]. The lipid metabolism is synchronized in many different ways. Enzymes are most important regulators of lipid metabolism. 3-Hydroxy-3-methylglutaryl coenzyme A reductase enzyme responsible for cholesterol biosynthesis[6].

While elevated low density lipoprotein cholesterol (LDL) is thought to be the best gauge of atherosclerosis. dyslipidemia (abnormal amount of lipids in the blood) can also express prominent total cholesterol (TC) or triglycerides (TG), or low levels of high density lipoprotein cholesterol (HDL[5]. Hyperlipidemia is a medical as well as social problem, especially associated with diabetes mellitus leading to increasing morbidity and mortality. The chief risk factors of hyperlipidemia are associated with atherosclerosis which predispose ischemic heart disease and cerebrovascular disease[7].

Many allopathic hypolipidemic drugs like statins are available in the market, but they cause many side effects like hyperuricemia, diarrhoea, myositis, hepatotoxicity, etc. As they are mainly enzyme inhibitors, so they may be inhibit other grave enzymes in the body. Moreover, statins are intake on a long-term basis so it cause chronic toxic effects over a life time use Therefore attention is now rewarded much to investigate natural hypolipidemic agents from plant sources[8].

Classification of hyperlipidemia

Hyperlipidemia may be classified as either familial (also called primary) caused by definite genetic abnormalities, or acquired (also called secondary) that leads to change in

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Diagnosis[3]

S.No	Test name	Normal values	Indicators
1	Total Cholesterol	Total Cholesterol: < 200 mg/dL (desirable) (< 180 optimal)	200-239 mg/dL = Borderline High (borderline risk for coronary heart disease > 240 mg/Dl Hypercholesterolemia
2	Total Cholesterol for children	< 180 mg/Dl	> 180 mg/dL may lead to Atherosclerosis
3	Triglyceride Levels	Less than 150 mg/dl	150-199 mg/dL is Border line High 200-499 mg/dL is High 500 mg/dL or above isVery High.
4	VLDL cholesterol	The VLDL normal range is between 0–40 mg/dL and the suggested optimum range is between 0–30 mg/dL	>40 suggest increase the risk of developing heart disease
5	C-reactive Protein (CRP)	CRP< 1 mg/dl	CRP> 1mg/dl (> 10mg/dl suggests inflammation
6	LDL Cholesterol	< 100 mg/dL (optimal) 100-129 mg/dL (near /above optimal)	130-159Mg/dL Borderline High 160-189 Mg/dL High ≥190 Mg/dL Very High
7	HDL Cholesterol	> 60 mg/dl is enviable	HDL levels < 40 Mg/dL increases risk for CHD. women with levels < 47 mg/dL and men < 37 mg/dL have increased risk.

Hyperlipoproteinemia		Occurrence	Imperfection	Elevated Lipoprotein	Symptoms	Appearance of Serum
Type I	A	Very rare	Reduce lipoprotein lipase	Chylomicrons	Stomach ache, retinalis, eruptive skin xanthomas	Creamy top layer
	B	Very rare	Distorted Apo c2		hepatosplenomegaly	
	C	Very rare	LPL inhibitor in blood			
Type II	A	Less ordinary	LDL receptor	LDL	Xanthelasma, tendon xanthomas	Apparent
	B	Usual	Reduce LDL receptor & augmented Apo B	LDL and VLDL		Lucid
Type III		Atypical	Imperfection in Apo E 2 synthesis	IDL		Opaque
Type IV		Average		VLDL		Cloudy
Type V		Ordinary		VLDL and Chylomicrons		Creamy top layer

plasma lipid and lipoprotein metabolism.

Familial (primary): Familial hyperlipidemia are classified as:

Type I - Raised cholesterol with high triglyceride
Type II - High cholesterol with normal level of triglyceride
Type III - High cholesterol and triglycerides
Type IV - Raised triglycerides, and raised uric acid
Type V - Raised triglycerides

Acquired (secondary)

Acquired hyperlipidemias (also called secondary dyslipoproteinemias) in which increased risk of atherosclerosis, when associated with marked hypertriglyceridemia, may cause pancreatitis and various complications of the chylomicronemia disease.

Most ordinary causes of acquired hyperlipidemia are:

Diabetes Mellitus (Type 2)
Use of drugs such as diuretics, beta blockers, and estrogens etc.

Animal models for evaluation of antihyperlipidemic activity[9]

High Cholesterol diet induced method
High Fructose diet induced method
Triton induced hyperlipidemic method
Streptozotocin induced diabetic method
Alloxan induced diabetic method
Tylaxapol induced hyperlipidemic method
High fat diet induced hyperlipidemic method
Hydrocortisone induced hyperlipidemic method
Atherogenic diet induced hyperlipidemic method

The other models which can be used[10]:

Medicinal plants with hypolipidemic activity

S. no.	Plant name	Family	Part used	Dose	Models used	Reference
1	*Abelomoschus esculentus*	Malvaceae	Whole plants	300mg/kg	Tylaxapol induced method	13
2	*Achyranthus aaspera* Linn	Amaranthaceae	Whole plant	250-500mg/kg	Alloxan induced method	14
3	*Aegle marmelos*	Rutaceae	Leaf	250 mg/kg	Oil fed hyperlipidemic rat	15
4	*Ajuga iva*	Labiatea	Whole plant	10mg/kg	Streptozotocin induced method	16
5	*Allium sativum*	Alliaceae	Fresh fruits	10mg/kg	TritonX 100 induced method	17
6	*Alpinia Galangal* L.	Zingiberaceae	Rhizome	200& 400mg/kg	Triton induced method	18
7	*Alstonia Scholarin*	Apocynaceae	Leaves	100,200,400mg/kg	Streptozocin induced diabetic rat	19
8	*Amaranthus Viridis*	Amaranthaceae	Leaves	200,400mg/kg	Streptozocin induced diabetic rat	20
9	*Andrographis paniculata*	Acanthaceae	Leaves	25mg/kg	Tyloxapol induced method	21
10	*Anethum Graveolens*	Apiaceae	Essential oil	45,90,180mg/kg	High cholesterol diet induced method	22
11	*Anogeissus Latifolia*	Combretaceae	Fresh gum	250,500,750mg/kg	Atherogenic diet induced method	23
12	*Anthocephalus Indicus*	Rubiaceae	Roots	500mg/kg	Tyloxapol induced method	24
13	*Apium Graveolens*	Apiaceae	Seed	213,425mg/kg	High cholesterol diet induced method	25
14	*Asparagus Racemosus*	Liliaceae	Roots	150mg/kg	Alloxan induced method	26
15	*Amaranthus caudatus* L.	Amaranthaceae	Leaves	200-400mg/kg	Triton induced method	27
16	*Bauhinia purpurea*	Fabaceaae	Leaves & unripe fruits	300mg/kg	Tylaxapol induced method	28
17	*Bauhinia variegate* Linn.	Ceasalpiniaceae	Roots & Stem	200 &400mg/kg	Triton induced method	29
18	*Commiphora mukul*	Burseraceaae	Resin part	250mg/kg	High fat diet induced method	30
19	*Caesearia sylvestris*	Flacourtiaceae	Leaves	300mg/kg	Streptozocin induced method	31
20	*Capparis Deciduas*	Capparidaceae	Bark,Flower,Fruit	500mg/kg	Streptozocin induced method	32
21	*Capparis spinosa*	Capparidaceae	Fruits	200& 400mg/kg	Tylaxapol induced method	33
22	*Carica papaya*	Caricaceae	Seed,Leaves	100-400mg/kg	Alloxan induced method	34
23	*Cassia fistula*	Fabaceae	Legume	100,250,500mg/kg	High cholesterol diet induced method	35
24	*Catharanthus roseus* Linn	Acanthaceae	Leaves	150mg/kg	Streptozocin induced method	36
25	*Celastrus paniculatus*	Celastraceae	Seed	65mg/kg	High fat diet induced method	37
26	*Curcuma longa*	Zingiberaceae	Rhizome	300mg/kg	Streptozocin induced method	38
27	*Cymbopogon citrates*	Graminaceae	Leaves	100&200mg/kg	Dexamethasone induced method	39

28	*Coccinia indica*	Cucurbitaceae	Leaf	200 mg/kg/b.w	Alloxan induced method	40
29	*Cassia auriculata*	Caesalpiniaceae	Flowers	150,300,450mg/ kg bw	Tylaxapol induced method	41
30	*Cynara scolymus*	Asteraceae	Leaves	150,300,600mg/ kg	Cholesterol diet induced method	42
31	*Eclipta prostate* (L.) L.	Asteraceae	Leaves	100&200mg/kg	Atherogenic diet induced method	43
32	*Elaeis guineensis*	Arecaceae	Root	250&500mg/kg	Olive oil induced method	44
33	*Eugenia Jambolana*	Myrtaceae	Seed Kernel	100mg/kg bw	Streptozocin induced method	45
34	*Ficus racemosa* Linn.	Moraceae	Bark	100-500mg/kg bw	Alloxan induced diabetic rat	46
35	*Garcinia cambogia*	Guttiferae	Peel of matured fruits	400mg/kg bw/day	High fat diet induced method	47
36	*Glyccyrrhiza glabra*	Fabaceae	Rhizome	250-500mg/kg	High fat diet induced method	48
37	*Gymnena sylvestre*	Asclepiadaceae	Leaf	200mg/kg	High cholesterol diet induced method	49
38	*Hibiscus rosa sinesis*	Malvaceae	Root	500mg/kg/day	Tylaxopol induced method	50
39	*Hibiscus Sabdariffa* Linn.	Malvaceae	Leaves & Calyces	500mg/kg/ day	High cholesterol diet induced method	51
40	*Icacina senegalensis*	Icacinaceae	Root	100,200& 400mg/kg	Alloxan induced method	52
41	*Lagenaria siceraria* Mol.	Cucurbitaceae	Fruits	200&400mg/kg bw	Triton induced method	53
42	*Luffa acutangula*	Cucurbitaceae	Fruit	200-400mg/kg	Streptozocin along with nicotinamide	54
43	*Lycium barbarum*	solanaceae	Fruits	250&500mg/kg	Alloxan induced method	55
44	*Morinda Citrifolia*	Rubiaceae	Fruits	0.25-1.00g/kg	Streptozocin induced diabetic rat	56
45	*Moringa oleifera*	Moringaceae	Leaf	100mg/kg/ bw	Cadmium exposed rat	57
46	*Melothria Maderaspatana*	Cucurbitaceae	Aerial parts	100&200mg/kg b.w	Streptozocin induced method	58
47	*Morus alba*	Moraceae	Leaves	30mg/kg	Tylaxopol induced method	59
48	*Morus indica* L.	Moraceae	Leaves	500mg/kg	Streptozocin induced method	60
49	*Mucuna Prurines*	Leguminoseae	Leaves	200mg/kg	Alloxan induced method	61
50	*Nelumbo Nuficera*	Nelumbonaceae	Fruit	100-1000mg/kg	Poloxamer407 induced method	62
51	*Ocimum basilicum*	Lamiacea	Whole plant	20mg/kg	Streptozocin induced method	63
52	*Ocimum Tenuiflorum*	Lamiaceae	Leaves	250-500mg/kg	Streptozocin+nicotinamide induced method	64
53	*Pipper longum*	Piperaceae	Root	200mg/kg	Streptozocin induced method	27
54	*Psidium guajava* linn	myrtaceae	leaves	200& 400mg/kg	Cholestrol diet induced method	27

55	*Piliastigma thonningii*	Musecea	leaf	50-200mg/kg	Serum lipid profile of male albino rat	27
57	*Peucedanum pastinacifoliu m* Boiss.	Apiaceae	Aerial parts	125,250,500mg/ kg	High cholesterol diet induced method	65
58	*Plumeria rubra* L.	Apocynaceae	Fresh flowers	250mg/kg b.w	Alloxan induced method	66
59	*Pterocarpus marsupium*	Fabaceae	Wood & bark	150-300mg/kg	Alloxan hydrate inducde method	27
60	*Rosa laevigata* Michx.	Rosaceae	Fruits	25and50mg/kg	High fat diet induced method	67
61	*Randia dumetorum*	Rubiaceae	Fruit	200-400mg/kg	Streptozocin & nicotinamide induced method	68
62	*Sphaeranthus indicus*	Asteraceae	Flower head	500mg/kg/day	Atherogenic diet induced method	69
63	*Sesbania grandiflora*	Fabaceae	Leaves	200mg/kg	Tylaxapol induced method	70
64	*Stevia rebaudiana*	Asteraceae	Leaves	150mg/kg/ bw	Alloxan induced method	71
65	*Salvodora persica*	Salvadoraceae	Root	250-500mg/kg	Streptozocin induced method	72
66	*Spergularia purpurea*	Caryophyllaceae	Whole plant	10mg/kg	Streptozocin induced diabetic rat	27
67	*Salvadora oleoides*	Salvadoraceae	Aerial Parts	1g,2g/kg	Alloxan induced method	73
68	*Syzigium alternifolium*	Myrtaceae	Bark	100,200mg/kg	High fat diet &Dexamethasone	74
69	*Terminalia arjuna*	Combretaceae	Bark	10-50mg/kg	High fat diet induced method	75
70	*Terminalia chebula*	Combretaceae	Pericarp fruit	1.05 ,2.10mg/kg	Atherogenic diet induced method	76
71	*Trianthum portulacastru m*	Azoaceae	Whole plant	100,200mg/kg	High fat diet induced method	77
72	*Urtica dioica*	Urticaceal	Leaves	50mg/kg	Alloxan induced method	78
73	*Withania somnifera*	Solanaceae	Roots and Leaf	100,200mg/kg	Alloxan induced method	79
74	*Zingiber Officinale*	Zingiberaceae	Rhizome	500mg/kg	Streptozocin induced method	80

Hereditary hypercholesterolemia in experimental animals like rats.
Hereditary hyperlipidemia in rabbits:
Transgenic animals- apoprotein E knock out model
Fructose induced hypertriglyceridemia in laboratory animals rats

Pathophysiology of hyperlipidemia

The pathophysiology of hyperlipidemia is deliberate beneath the two basic classifications of hyperlipidemia, i.e., primary and secondary hyperlipidemia.

Primary hyperlipidemia involve the hyperchylomicronemia in which defect in lipid metabolism lead to hypertriglyceridemia and hyperchylomicronemia cause by a imperfection in lipoprotein lipase activity or the lack of surface apoprotein CII. Further, in primary hyperlipidemia, the LDL cholesterol is elevated.

In secondary hyperlipidemia, absorption of chylomicrons from the G.I tract within a 30-60 min, after ingestion of a meal containing fat that may enhance serum triglycerides for 3-10 hours. The diabetes mellitus patients have been noted to acquire low LPL activity which caused high synthesis of VLDL cholesterol by the liver leading to hyperlipidemia. Moreover, hypothyroidism-induced low LPL activity and lipolytic activity responsible to reduce hepatic degradation of cholesterol to bile acids. Moreover, hyperadrenocorticism enlarged the synthesis of VLDL by the liver cause hypercholesterolemia and hypertriglyceridemia. Liver disease hypercholesterolemia caused by reduced seepage of cholesterol in the bile. Moreover, in nephritic syndrome, the common pathway

for albumin and cholesterol causes low pressure leading to improved cholesterol synthesis[11].

Primary disorders are classified into six categories. Lipoprotein elevations include the following: I (chylomicrons), IIa (LDL), IIb (LDL + VLDL), III (intermediate-density lipoprotein, or HDL); IV (VLDL), and V (VLDL + chylomicrons). Secondary hyperlipidemia also be present and various drugs may increase lipid levels (e.g., progestins, thiazide, glucocorticoids, protease inhibitors, cyclosporine, mirtazapine,). Primary defect in hypercholesterolemia is the inability to bind LDL to LDL receptor (LDL-R) or, a defect of LDL-R complex into the cell after binding. This leads to lack of LDL deprivation by cells and unfettered biosynthesis of cholesterol, with total cholesterol and low density lipoprotein being inversely proportional to the insufficiency in low density lipoprotein receptors[5].

Etiology/Causes of Hyperlipidemia

Acute intermittent porphyria
Acromegaly
Obesity
Anorexia nervosa
Autoimmune disease
Hypothyroidism and
Cushing's disease
Hepatitis[12]
Diabetes mellitus (type 2)
Glucocorticoids
Monoclonal gammopathies
Nephrotic syndrome

Other factors may include medications (eg, beta blockers and oral contraceptives, thiazide diuretics, glucocorticoids)[3].

Treatment[5]

Treatment therapy consist of two approaches, which are Non-pharmacological therapy and Pharmacological therapy.

Non pharmacological therapy

The aim of non pharmacological therapy is decrease the ingestion of total fat, saturated fatty acids and cholesterol. This therapy involves;

Decreased saturated fat intake to 7 percent of daily calories
Decreased total fat intake to 25 to 35 percent of daily calories
Inadequate dietary cholesterol less than 200 mg per day

Consumption of 20 to 30g of soluble fiber, which is found in oats, peas, beans, and certain fruits; and Increased ingestion of plant sterols, substances found in nuts, vegetable oils, corn and rice, to 2 to 3 g daily. Other foods that can assist to control cholesterol consist of cold-water fish, for example mackerel, sardines, and salmon. Soybeans found in soy nuts and many meat substitutes restrain a powerful antioxidant that can decrease LDL level.

Pharmacological therapy

HMG-CoA reductase inhibitors (Statins): Lovastatin, Simvastatin, Pravastatin, Atorvastin, Rosuvastin.

Bile acid sequestrants (Resins): Cholestyramine, Colestipol.

Activate lipoprotein lipase (Fibric acid derivatives): Clofibrate, Gemfibrozil,Benzafibrate and Fenofibrate.

Inhibit lipolysis and triglyceride synthesis: Nicotinic acid.

Others: Ezetimibe, Gugulipid

CONCLUSION

Hyperlipidemia is a crtical condition of elevated lipid levels in the body that ultimately lead to the development and progression of various CVDs. The link between hyperlipidemia and occurance of CVDs has already been established, the problem of enchanced cholesterol levels in blood is still prevailing and is being a cause for many coronary disorders. Studies reveal that an increase in HDL cholesterol and decrease in TC, LDL cholesterol and TG is associated with a decrease in the risk of ischemic heart diseases.Though many drugs are available to treat Hyperlipidemia. The antihyperlipidaemic activity of plants plays an important role in the reduction of CVD. Plant parts or plant extract are sometimes even more potent than known hypolipidemic drugs. Currently used hypolipidemic drugs are associated with so many adverse effects and withdrawal is associated with rebound phenomenon which is not seen with herbal preparations.

REFERENCES

1. Asija R, Sharma S, Sharma P K, Choudhary P, Kumar V et al, A review on antihyperlipidemic activity of various herbal plants and various experimental animal models, Journal of Drug Discovery and Therapeutics, 2014, 2(20), 71-77.
2. Dalwadi P D, Patani P V, Anti hyperlipidemic activity of *Tephrosia purpurea* plant extracts in poloxomer 407 induced hyperlipidemic rats, International Journal of Pharmacological Research, 2014, 4(4), 186-193.
3. Kumar K H, Altaf S A, Kumar K K, Ramunaik M, Suvarna CH, A Review on Hyperlipidemic, International journal of novel trends in pharmaceutical science,2013, Volume 3, 159-171.
4. Desu B S R, Saileela CH, Antihyperlipidemic activity of methanolic extract of *Rhinacanthu nasutus*, International journal of research in pharmacy and chemistry, 2013, 3(3), 708-711.
5. Onwe P E, Folawiyo MA, Anyigor -Ogah CS, Umahi G, Okorocha A E et al, Hyperlipidemia: etiology and possible control, IOSR Journal of Dental and Medical Sciences (IOSR-JDMS), 2015, 14(10), 93-100.
6. Dixit P K, Mittal S, Importance of herbal anti hyperlipidemics in crdiac disorder and hyperglycemia review at a glance, Journal of Drug Delivery & Therapeutics; 2013, 3(4), 142-150.
7. Hossain M S, Alam M B, Asadujjaman M, Islam M M, Rhaman M A et al, Antihyperglycemic and antihyperlipidemic effects of different fractions of Stevia rebaudiana leaves in alloxan induce diabetic rat, International journal of pharmaceutical science and research, 2011, 2(7), 1722-1729.
8. Kodali G, Seru G, Antihyperlipidemic activity of *Boswellia ovalifoliolata* Bal.Henry in atherogenic diet induced rats, International journal of phytotheraphy research, 2013, 3(3), 11-17.

9. Jain P G, Surana S J, A review of Indian medicinal plants with hypolipidemic activity and their medicinal importance, World journal of pharmacy and pharmaceutical sciences, 2015, 4(3), 1477-1493.
10. Konda V G R, Madhavi E, Ruckmani A, and Venkataramana Y, A review on medicinal plants with potentional hypolipidemic activity, International Journal of Pharma and Bio Sciences, 2013, 4(4), 729-740.
11. Rohilla A, Dagar N, Rohilla S, Dahiya A, Kushnoor A, Hyperlipidemia- A deadly pathological condition, International Journal of Current Pharmaceutical Research, 2012, 4(3), 15-18.
12. Panagiotis G X, Jörg M S, Lipid metabolism and hyperlipidemia in dogs, The Veterinary journal, 2010, vol 183, 12-21.
13. Trinh H N, Quynh N N, Anh Van T T, Nguyen V P, Hypolipidemic effect of extract from *Abelmoschus esculentus* L, Malvaceae on tyloxapol induced hyperlipidemia in mice, 13rd electronic conference of synthetic organic chemistry, 2009, 1-30.
14. Vidhya R, Jothi G, Evaluation of hypolipidemic activity of *Achyranthes aspera* Linn, on alloxan induced diabetic rats, world journal of pharmacy and pharmaceutical science, 2014, 3(11), 560-575.
15. Suriyamoorthy P, Mary M R F, Subrhamanian H, Kanagasapabathy D, Antihyperlipidemic effect of aqueous extract of *Aegle marmelos* and *camellia sinensis* in oil fed hyperlipidemic rats, International Journal of Pharmacy and Pharmaceutical Sciences, 2014, 6(2), 338-341.
16. Hilaly EI, Tahraoui A, Israili ZH, Lyoussi B, Hypolipidemic effects of acute and sub-chronic administration of an aqueous extract of *Ajuga iva* L. whole plant in normal and diabetic rats, Journal of ethnopharmacology, 2006, 105(3), 441-448.
17. Keshetty V, Pabba S, Gudipati R, Kandkuri J M, Allenki V, Antihyperlipidemic activity of methalonic extract of *Allium sativum* L. in triton X 100 induced hyperlipidemic rats, Journal of Pharmacy Research 2009, 2(5),777-780.
18. Iyer D, Sharma K B, Patil U K, Isolation of bioactive phytoconstituent from *Alpinia galangal* L, with antihyperlipideemic activity, Journal of Dietary Supplements, 2013, 10(4), 309-317.
19. Arulmozhi S, Mazumder P M, Lohidasan S, Thakurdesai P, Antidiabetic and antihyperlipidmic activity of leaves of *Alstonia scholaris* Linn R. Br, European journal of integrative medicine, 2010, 2(1), 23-32.
20. Krishnamurthy G, Lakshman K, Pruthvi N, Chandrika P U, Antihyperglycemic and hypolipidemic activity of methanolic extract of *Amaranthus viridis* leaves in experimental diabetes, Indian journal of pharmacology, 43(4), 450-454.
21. Lakshmia V, Srivastav S, Khana A K, Mahdi A A, Agarwal S K, Lipid Lowering potential of *Andrographis paniculata* (Nees), The journal of phytopharmacology, 2014, 3(2), 124-129.
22. Hajhashemi V, Abbasi N, Hypolipidemic activity of Anethum graveolens in rats, Phytotherapy research, 2008, 22(3), 372-375.
23. Parvathi K M M, Ramesh C, Krishna V, Paramesha M, Kuppast I J, Hypolipidemic activity of gum ghatti of *Anogeissus latifolia*, Pharmacognosy magazine, 2009, 5(19), 11-14.
24. Kumar V, Khan M M, Khanna A K, Singh R, Singh S, et al, Lipid Lowering Activity of *Anthocephalus indicus* Root in Hyperlipidemic Rats, Evidence based complementary and alternative medicine, 2010,7(3), 317-323.
25. Mansi K, Abushoffa A M, Disi A, Aburjai T, Hypolipidemic Effects of Seed Extract of Celery (*Apium graveolens*) in Rats, Pharmaognosy magazine, 2009, 5(20), 310-305.
26. Visavadiya N P, Narasimhacharya A V R L, Hypolipidemic and antioxidant activities of *Asparagus racemosus* in hypercholesteremic rats, Indian journal of pharmacology, 37(6), 376-380.
27. Konda V J R, Madhavi E, Ruckmani A, Venkataramana Y, A review on medicinal plants with potential hypolipidemic activity, International Journal of Pharma and Bio Sciences, 2013, 4(4), 729-740.
28. Lakshmi B V S, Neelima N, Kasthuri N, Umarani V, Sudhakar M, Antihyperlipidemic activity of *Bauhinia purpurea* extracts in hypercholesterolemic albino rats, International Journal of PharmTech Research, 2011, 3(3), 1265-1272.
29. Rajani G P, Ashok P, *In vitro* antioxidant and antihyperlipidemic activities of *Bauhinia variegata* Linn, Indian journal of pharmacology, 2009, 41(5), 227-232.
30. Siddiqui M Z, Mazumder P M, Comparative Study of Hypolipidemic Profile of Resinoids of *Commiphora mukul/Commiphora wightii* from Different Geographical Locations, Indian journal of pharmaceutical sciences, 2012, 74(5), 422-427.
31. Espinosa J, Medeiros L F, Souza A, Guntzel A R C, Rucker B, et al, Ehanolic extract of *Casearia sylvestris* Sw exhibits in vitro antioxidant and antimicrobial activities and in vivo hypolipidemic effect in rats, Revista Brasileira de Plantas Medicinais, 2015, 2(17), 305-315.
32. Chahlia N, Evaluation of Hypolipidaemic Activity of *Capparis deciduas*, International journal of biomedical science, 2009,5(1), 70-73.
33. Mishra P R, Panda K P, Chowdary K A, Panigrahi S, Antidiabetic and antihyperlipidemic activity of *Capparis spinosa* extract, International journal of pharmaceutical science review and research, 2012, 14(1), 38-43.
34. Radha K, Syed M, Rao S D, Evaluation of antihyperlipidemic activity of methanolic extract of *Carica papaya* seeds on wistar rats, Indo American journal of pharmaceutical sciences, 2014, 1(5), 328-332.
35. V ready suvarchala N V L, Pooja raj G B, Raju G, Anarthe S J, Antihyperlipidemic ativity of *cassia fistula* bark using high fat diet induced hyperlipidemia,

International journal of pharmacy and pharmaceutical sciences, 2015, 7(10), 61-64.
36. Islam M A, Akhtar afia M, Khan M R I, Hossain M S, Alam M K, et al, Antidiabetic and hypolipidemic effects of different fraction of *Catharanthus roseus* (Linn) on normal and streptozotocin induced diabetic rats, Journal of scientific research, 2009,1(2), 334-344.
37. Patil R H, Prakash K, Maheswari V L, Hypolipidemic Effect of *Celastrus paniculatus* in Experimentally Induced Hypercholesterolemic Wistar Rats, Indian journal of clinical biochemistry, 2010, 25(4), 405-410.
38. Babu P S, Srinivasan K, Hypolipidemic action of *curcumin*, the active principal of *turmeric (curcuma longa)* in streptozocin induced diabetic rats), Molecular and cellular biochemistry, 1997, 169-175.
39. Kumar santhosh V R, Inamdar naseeruddin M D, Nayeemunnisa, Viswanatha G L, Protective effect of *Cymbopogon citrates* (lemon grass oil) against dexamethasone induced hyperlipidemia in rats: possible role of decreased lecithin cholesterol acetyl transferase activity, Asian Pacific Journal of Tropical Medicine, 2011, 658-660.
40. Kishore L, Kaur N, Chauhan S, Singh R, Phyto-pharmacological review of *Coccinia indica*, World journal of pharmacy and pharmaceutical science, 2014, 3(2), 1734-1745.
41. Vijayaraj P, Muthukumar K, Sabarirajan J, Nachiappan V, Antiyperlipidemic activity of *Cassia auriculta* flowers in triton WR-1339 Induce hyperlipidemic rats, Experimental and toxologic pathology,2013, 1-2(65), 135-141.
42. Mocelin R, Marcon M, Santo G D, Zanatta L, Sachett A, Hypolipidemic and antiatherogenic effects of *Cynara scolymus* in cholesterol-fed rats, Brazillian journal of pharmacognosy, 2016, 233-239.
43. Dhandapani R, Hypolipidemic activity of *Eclipta prostrate(L) L.* leaf extract of atherogenic diet Induced hyperlipidemic rats, Indian journal of experimental biology, 2007, vol 45, 617-619.
44. Owolabi O J, Anaka O N, Innih S O, Jimba O, Evaluation of the Anti-Hyperlipidemic Activity of the Aqueous Root Extract of *Elaeis Guineensis*, Jacq (Arecaceae), Nigerian Journal of Natural Products and Medicine, 2013, Vol 17, 55-60.
45. Srivastava B, Sinha K A, Gaur S, Barshiliya Y, Study of hypoglycaemic and hypolipidemic activity of *Eugenia Jambolana* pulp and seed extract in Streptozotocin induced diabetic albino rats, Asian Journal of Pharmacy and Life Science, 2012, 2(1), 10-19.
46. Sophia D, Manoharan S, Hypolipidemic Activities of *Ficus Racemosa* Linn. Bark in Alloxan Induced Diabetic Rats, African journal of traditional, complementary and alternative medicines (AJTCAM), 2007, 4(3), 279-288.
47. Sripradha R, Sridhar M G, Maithilikarpagaselvi N, Antihyperlipidemic and antioxidant activities of the ethanolic extract of *Garcinia cambogia* on high fat diet-fed rats, Journal of Complementary and Integrative Medicine, 2016, 13(1), 9-16.
48. Shamim A, Mahmood T, Mukeem M, Siddiqui H H, Bagga P et al, Effect of ethanolic extract of *Glycyrizza glabra* against streptozocin and high fat diet induced diabetes and hyperlipidemia, International Journal of Pharmacy and Pharmaceutical Sciences, 2016, 8(4), 259-266.
49. Rachh P R, Rachh M R, Ghadiya N R, Modi D C, Modi K P et al, Antihyperlipidemic activity of *Gymenma sylvestre* R. BR. Leaf extract on rats fed with high cholesterol diet, International journal of pharmacology, 2010, 6(2), 138-141.
50. Kumar V, Singh P, Chander R, Mahdi F, Singh S et al, Hypolipidemic activity of *Hibiscus rosa sinensis* root in rats, International journal of biochemistry and biophysics, 2009, vol 46, 507-510.
51. Ochani P C, Mello P D, Antioxidant and hyperlipidemic activity of *Hibiscus sabdariffa* linn. Leaves and calyces extracts in rats, Indian journal of experimental biology, 2009, vol 47, 276-282.
52. Akuodor G C, Udia P M, Bassey A, Chilaka A C, Okezie O A et al, Antihyperglycemic and antihyperlpidemic activity of properties of aqueous root extract of *Icacina senegalensis* in alloxan induced diabetic rats, Journal of acute diseases, 2014, 3(2), 99-103.
53. Ghule B V, Ghante M H, Saoji A N, Yeole P G, Hypolipidemic and antihyperlipidemic activity of *Lagenaria siceraria* (Mol.) fruit extract, Indian journal of experimental biology, 2006, 44(11), 905-909.
54. Pimple B P, Kadam P V, Patil M J, Antidiabetic and antihyperlipidemic activity of *Luff acutangula* fruit extract in streptozocin induced NIDDM rats, Asian journal of pharmaceutical and clinical research, 2011, 4(2), 156-163.
55. Pai G P, Habeeba P U, Ullal S, Shoeb P A, Pradeepti M S, Evaluation of hypolipidemic effect of *Lycium barbarum* (goji berry) in murine model, Journal of natural remedies, 2013, 13(1), 4-8.
56. Hadijah H, Ayub M Y, Zaridah H, Normah A, Hypolipidemic activity of an aqueous extract of *Morinda citrifolia* in normal and streptozotocin induced diabetic rats, Journal of agricultural and food science, 2008, 36(1), 77-85.
57. Deokar Gitanjali S.1, Sadgir Priyanka, Kshirsagar Sanjay J., Kakulte Harshada D.1 Patil, Sushil M, Tulsi Oil Loaded Biocompatible, Stable Organogel with Improved Physical Stability and Prolonged Activity, International Journal of Drug Delivery Technology, 2016, 6(2), 30-46.
58. Balaraman A K, Singh J, Dash S, Maity T K, Antihyperglycemic and antihyperlipidemic effect of *Melothria maderaspatana* and *coccinia indica* in streptozotocin induced diabetes in rats, Saudi pharmaceutical science, 2010, 18(3), 173-178.
59. Jingjing Chen M D, Xiangrong Li M D, Hypolipidemic effect of flavonoids from *mulberry* leaves in triton-WR 1339 induced hyperlipidemic mice, Asia pacific journal of clinical nutrition, 2007, 16(1), 290-294.
60. Devi D V, Urooj A, Antihyperglycemic and hypolipidemic effect of *Morus indica* L. in

streptozotocin induced diabetic rats, Annals of phytomedicine, 2014, 3(2), 55-59.
61. Murugan M, Reddy C U M, Hypoglycemic and hypolipidemic activity of leaves of *Mucuna pruriens* in alloxan induced diabetic rats, Journal of pharmaceutical science and technology, 2009, 1(2), 69-73.
62. Subasini U, Thenmozhi S, Venkateswaran V, Pavani P, Diwedi S et al, Phytochemical Analysis and Anti Hyperlipidemic Activity of *Nelumbo Nucifera* in Male Wistar Rats, International Journal of Pharmacy Teaching & Practices, 2014, 5(1), 935-940.
63. Zeggwagh N A, Sulpice T and UFR PNPE Eddouks M et al, Anti-hyperglycaemic and Hypolipidemic Effects of *Ocimum basilicum* Aqueous Extract in Diabetic Rats, American Journal of Pharmacology and Toxicology, 2007, 2(3), 123-129.
64. Parasuraman S, Balamurugan S, Christapher P V, Petchi P R, Yeng W Y, Evaluation of Antidiabetic and Antihyperlipidemic Effects of Hydroalcoholic Extract of Leaves of *Ocimum tenuiflorum* (Lamiaceae) and Prediction of Biological Activity of its Phytoconstituents, Pharmacognosy research, 2015, 7(2), 156-165.
65. Darshpreet Kaur, Shyam Baboo Prasad, Surajpal Verma, Formulation and Evaluation Gel from Extract of *Plumbago indica* for Acne, International Journal of Drug Delivery Technology, 2016, 6(3), 95-98.
66. Merina A J, Sivanesan D, Begum V H, Sulochana N, Antioxidant and hypolipidemic effect of *Plumeria rubra* L. in allloxan induce hyperglycemic rats, E-journal of chemistry, 2010, 7(1),1-5.
67. Liu Y T, Lu B N, Xu L N, Yin L H, Wang X N et al, The antioxidant activity and hypolipidemic activity of flavonoids from the fruit of *Rosa laevigata* michx, Natural science, 2010, 2(3), 175-183.
68. Mishra P R, Panda P K, Chowdary K A, Panigrahi S, Antidiabetic and antihyperlipidemic activity of *Randia dumetorum*, International journal of research in pharmacy and chemistry, 2012, 2(3), 552-559.
69. Pande V V, Dubey S, Antihyperlipidemic activity of *Sphaeranthus indicus* on atherogenic diet induced hyperlipidemia in rats, International journal of green pharmacy, 2009, 159-161.
70. Saravanakumar A, Vanitha S, Ganesh M, Jayaprakash J, Ramaswamy N M, Hypolipidemic activity of *Sesbania grandiflora* in triton WR- 1339 induced hypeerlipidemic rats, International journal of phytomedicine, 2010, vol 2, 52-58.
71. Hossain M S, Alam B D, Asadujjaman M, Islam M M, Rahman M A et al, Antihyperglycaemic and antihyperlipidaemic effect of different fraction of *Stevia rebaudiana* leaves in alloxan induced diabetic rats, international journal of pharmaceutical science and research, 2011, 2(7), 1722-1729.
72. Khan M, Ali M, Ali A, Mir S R, Hypoglycaemic and hypolipidaemic activities of Arabic and Indian origin *Salvadora persica* root extract on diabetic rats with histopathology of their pancreas, International journal of health science, 2014, 8(1), 45-56.
73. Yadav J P, Saini S, Kalia A N, Dangi A S, Hypoglycaemic and hypolipidaemic effect of ethanolic extract of *Salvadora oleoides* in normal and alloxan induced diabetic rats, Indian journal of pharmacology, 2008, 40(1), 23-27.
74. Joydeep Mazumder, Devender Pathak, Rachna Kumria, Antacid Studies of Newly Developed Polyherbal Formulation, 2016, 6(1), 27-29.
75. Reddy D B S, Kumar P R, Bharavi K, Venketeswarlu U, Hypolipidaemic activity of methanolic extract of *Terminalia arjuna* leaves in hyperlipidemic rat models, Research journal of medical science, 2011, 5(3), 172-175.
76. Maruthappan V, Shree k s, Hypolipidaemic activity of haritaki *(Terminalia chebula*) in atherogenic diet induced hyperlipidemic rats, Journal of advanced pharmaceutical technology and research, 2010, 1(2), 229-235.
77. Anreddy R N R, Porika M, Yellu N R, Devarakonda R K, Hypoglycaemic and hypolipidaemic activities of *Trianthema portulacastrum* Linn. Plant in normal and alloxan induced diabetic rats, International journal of pharmacology, 2010, 6(2), 129-133.
78. Mahjoub S, Davari S, Moazezi Z, Qujeq D, Hypolipidaemic Effects of Ethanolic and Aqueous Extracts of *Urtica Dioica* in Rats, World Applied Sciences Journal, 2012, 17(10), 1345-1348.
79. Kumar U R, Kasthurirengan S, Mariashibu T S, Rajesh M, Anbazhagan V R et al, Hypoglycaemic and hypolipidaemic effects of *Withania somnifera* root and leaf extract on alloxan induced diabetic rats, International journal of molecular science, 2009, 10(5), 2367-2382.
80. Kazeem I M, Akanji M A, Yakubu M T, Ashafa A O, Antiglycation and hypolipidemic effects of polyphenols from *Zingiber officinale* roscoe(Zingiberaceae) in streptozotocin induced diabetic rats, Tropical journal of pharmaceutical research, 2015, 14(1), 55-61.