International Standard Serial Number : 0976-139X

*Deccan J. Pharmacology 2(1): Jan-March 2011*

DECCAN PHARMA JOURNAL SERIES

ARMS Online Publications

www.deccanpharmajournals.com

(Review Article)

Received; accepted

# A Global Review on Plants with Hypolipidemic Activity

Bidkar J.S.*, Ghanwat D.D., Dama G.Y., Bidkar S.J., Bhujbal M.D., Shende V.S.

1. SGMSPM's Sharadchandra Pawar College of Pharmacy, Otur, Pune, Maharashtra, India

**Keywords:**
Herbal medicine, hypolipidemic activity, traditional medicine, phytoconstituents

For Correspondence:

**Prof. Bidkar J.S.**

Dept. of Pharmacognosy,

SGMSPM's Sharadchandra Pawar College of Pharmacy, Otur, Pune, Maharashtra, India

E-mail:
jayantbidkar@yahoo.co.in

## ABSTRACT

In the last few years there has been an exponential growth in the field of herbal medicine and these drugs are gaining popularity both in developing and developed countries because of their natural origin and less side effects. There are a growing number of studies reporting hypolipidemic activity with traditional medicine. The present review constitutes on plant with hypolipidemic activity with some recently isolated phytoconstituents from this plants and special emphasis on those found in different regions all over the world, including mainly India. The information is recorded in alphabetical order of plant scientific name, family, part used, place (country where the study was developed), route of administration, dose given, method used (pharmacological screening method) and references. We also collect the information on isolated phytoconstituents.

## Introduction

Hyperlipidemia is one of the greatest risk factor contributing to prevalence and severity of cardiovascular diseases like coronary heart diseases (WHO, 1997). Numerous population studies have linked an elevated concentration of total cholesterol (TC), low density lipoprotein- cholesterol (LDL-C), and very low density lipoprotein-cholesterol (VLDL-C) in plasma with an increased incidence of atherosclerotic events (Goldstein et al, 1973, Keys-1975). Epidemiologic data is reported that almost 12 million people die of cardiovascular diseases and cerebral apoplexy each year all over world. Therefore it is very important to pay attention to early stage prevention and control of hyperlipidemia in a comprehensive way (Grundy SM 1986, Kris-Etherton PM et al., 2002). To reduce the rate of mortality, it is therapeutically recommended to undergo diet or/and drug therapy to lower lipid levels within the normal range (Raja Chattopadhyaya et al 1996). Allopathic hyperlipidemia drugs are available at large in the market but the side effects and contraindications of these drugs have marred their popularity (Annon, 1999, Brown S L., 1996). The herbal hypolipidemic have gained importance to fill the lacunae created by the allopathic drugs. A number of plants have been found to be useful in treatment of hyperlipidemia mentioned in Ayurveda (Sriram TV., 1998).

The world Health Organization (WHO) has listed 21,000 plants, which are used for medicinal purposes around the world. Among these 2500 species are in India, out of which 150 species are used commercially on a fairly large scale. India is the largest producer of medicinal herbs and is called as botanical garden of the world (Seth S.D., 2004). A plant-based diet that is rich in fruits, vegetables, and legumes and low in saturated fat, along with regular aerobic exercise program, is an effective prescription for anyone with elevated risks of cardiovascular diseases (Berliner JA., 1996). In this review paper information on plant species and some phytoconstituents that have been explored for their potential antihyperlipidemic profile using pharmacologically validated animal models have been complied and discussed. In future, the work on isolation and characterization of phytoconstituents and pharmacological action has high prospects. It is also important to develop various animal models for evaluation of toxicity and safety and also

need of conducting clinical research in plant based drugs.

**Materials and Methods:**

In this review we collected information from the Chemical abstracts, National & International journals, E-library, Internet & other research materials. The plants selection were based on the effects of phytoconstituents presented in specific animal models for evaluation of hypolipidemic activity, such animal models as: a)High Cholesterol diet induced method(HCD.), b)High Fructose diet induced method(HFrD.), c) Triton induced hyperlipidemic method(TI.), d)Streptozotocin induced diabetic method(SI.), e)Alloxan induced diabetic method(AlI.), f)Tylaxapol induced hyperlipidemic method(TyI.), g)High fat diet induced hyperlipidemic method(HFD.), h)Hydrocortisone induced hyperlipidemic method(HyI.), i)Atherogenic diet induced(AtDI), j)Normocholesterolemic method(NC.).

**Medicinal plants with Hypolipidemic activity:**

Number of plants species had been reported as antihyperlipidemic activity like *Abelomoschus esculentus, Achyranthus aspera, Acorus calamus, Allium cepa, Allium sativa, Apium graveolens, Arginia spinosa, Bauhinia variegata, Caesearia sylvestris, Curcuma longa, Cymbopogon citrates, Enicostemma littorale* and some other plants are described in table no.1.

**Some phytoconstituents of Medicinal plants which responsible for Hypolipidemic activity:**

**S-methyl cysteine sulfoxide (SMCS):**

It has been obtained from fresh bulbs of *Allium cepa* and shows hypolipidemic effects in high cholesterol diet-fed animal method. The lipid lowering activity due to lowering the total cholesterol and the (LDL+VLDL) cholesterol. The increase in the excretion of Bile acids and sterols might be one of the mechanisms for lowering the cholesterol. SMCS contains cysteine moiety, which has been reported to raise the level of hepatic cholesterol 7α-hydroxylase activity, a key enzyme in the synthesis of bile acids from cholesterol (K.Kumari et al, 2007).

**Argan oil:**

Chemical analysis of this oil contains mainly polyunsaturated fatty acids like oleic and linolenic acid obtained from *Arginia spinosa* L.Argan Oil shows significant lipid lowering activity in high

cholesterol diet rat's method. It had been acts as hypolipidemic action by various mechanism like low intestinal absorption, antioxidant activity etc (H.Berrougui.et al., 2003).

**Swertiamarin:**

It had been investigated the hypolipidemic activity of Swertiamarin an active lead isolated from *Enicostemma littorale* Blume. In high cholesterol fed diet rats. It was observed that Swertiamarin lowered the serum cholesterol and triglyceride level by the inhibition of Hepatic HMG-COA reductase and an increase in the fecal bile acid and sterols excretion. (H.Vaidya et al., 2009).

**Essential Oils from *Ocimum Sanctum* L.:**

Essential oil (EO) Obtained from leaves of *Ocimum Sanctum* L. had been investigated the lipid lowering effect in high Cholesterol diet .The EO is predominantly contain phenyl propanoids (65.31) eugenol and methyl eugenol. 9epi (E)-caryophyllene which is sesquiterpine compound .The antihyperlipidemic activity due to the suppression of liver lipid synthesis (T.Suanarunwat et al., 2010).

**Gugulipid:**

The oleoresin from *Commiphora mukul* is mixture diterpines sterols, steroids, esters and higher alcohols. The guggulosterone E and Z are the main phytoconstituents responsible hypolipidemic activity (Ruitang Deng., 2007).

Some other phytoconstituents are listed in table no.2.

**Results and Discussion:**

Current world-wide interest in traditional medicine has led to rapid development and studies of many remedies employed by various ethnic groups of the world. The information is recorded in alphabetical order of plant scientific name, family, part used, place (country where the study was developed), route of administration, dose and reference (table no. 1)and some phytoconstituents are also recorded in table no.2 . In this study we have enumerated 68 medicinal plants involving 34 families and some phytoconstituents in which hypolipidemic effect was reported. Most of the studies were carried out with crude extract and the oral route. The principal families in which such activity has been reported are Fabaceae, Asteraceae, Lamiaceae, Apiaceae, Cucurbitaceae, Euphorbiaceae, Myrtaceae, Rutaceae, Combretaceae, Azoaceae, Zingiberaceae, Malvaceae, Acanthaceae, Liliaceae and Rubiaceae. Several phytoconstituents

including Swertiamarin, Fixed oil, volatile oil, Essential Fatty acids, Sulphur containing compounds,Inulin,Pectin, , Triterpine,Glucomannan, guggul lipids, citrus flavonoids , saponins, polyphenolic compounds, flavonoids, fibers and others obtained from various plant species have proven hypolipidemic activity. In recent years from pharmacological studies carried out in various research centers in Brazil, Bangladesh, USA, China, Egypt, France, Hongkong, India, Iran, Jordan, Nigeria, Korea, Morocco, Pakistan, Spain, and Thailand.

**Conclusion**:

In conclusion all the 68 plant species listed and some phytoconstituents described appear to be promising as hypolipidemic agents with activity mediated through various mechanisms. However, further experiments will possibly define this pharmacological effect and active phytoconstituents. If confirmed it, may become of importance for human clinical treatments.

**Table no. 1.Plants having Hypolipidemic activity**

| PLANT NAME | FAMILY | PART USED | PLACE | ROUTE GIVEN | DOSE | MODEL/ S USED | REFERENCE |
|---|---|---|---|---|---|---|---|
| *Abelomoschus esculentus* | *Malvaceae* | Whole plant | China | P.O. | 30mg/kg | TyI. | T.H.Ngoc 2008 |
| *Achyranthus aspera* | *Amaranthaceae* | Roots | India | P.O. | 100mg/kg | NC; TI. | Ak khanna 1992 |
| *Aegle marmelos* | *Rutaceae* | Leaf | India | P.O. | 300mg/kg | SI. | Partha Ray 2007 |
| *Ajuga iva* | *Labiatea* | Whole plant | Morocco, USA | P.O. | 10mg/kg | NC; SI. | Badia Lyoussi 2006 |
| *Allium cepa* | *Liliaceae* | Fresh bulbs | India | P.O. | 200mg/kg | HCD. | K.Kumari 2007 |
| *Allium sativum* | *Liliaceae* | Fresh fruits | India | P.O. | 10mg/kg | TI. | Allenki Venkatesham 2009 |
| *Alpinia galanga* | *Zingiberaceae* | Rhizome | India | P.O. | 20mg/kg | HCD. | C.R. Achuthan 1997 |
| *Alstonia scholarin* | *Apocynaceae* | Leaves | India | P.O. | 100,200,400 mg/kg | SI. | S.Arulmozhi 2010 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| *Amaranthus viridis* | *Amaranthaceae* | Leaves | India | P.O. | 200,400mg/kg | AII. | B.S.Ashok Kumar 2010 |
| *Andrographis serpyllifolia* | *Acanthaceae* | Roots | India | P.O. | 100 ,200mg/kg | AtDI. | B. Chellubonia 2010 |
| *Anethum graveolens* | *Apiaceae* | Essential oil | Iran | P.O. | 45,90,180mg /kg | HCD. | V. Hajhashemi 2007 |
| *Anogeissus latifolia* | *Combretaceae* | Fresh gum | India | P.O. | 250,500, 750mg/kg | At.DI. | C.K. Ramesh 2009 |
| *Anthocephalus indicus* | *Rubiaceae* | Root | India | P.O. | 500mg/kg | AII. | R.K.Singh 2009 |
| *Apium graveolens* | *Apiaceae* | Seed | Jordan | P.O. | 213,425mg/kg | HCD. | Kamla mansi 2009 |
| *Arginia spinosa* | *Sapotaceae* | Fresh seed oil | Morocco, Spain | P.O. | 200mg/kg | HCD. | H. Berrougui 1989 |
| *Asparagus racemosus* | *Liliaceae* | Roots | India | P.O. | 10,20mg/kg | HCD. | N.P.Visavadiya 2005 |
| *Asystasia gangetica* | *Acanthaceae* | Leaves | India | P.O. | 100mg/kg | AII. | Pradeep Kumar R.2010 |
| *Bauhinia variegata* | *Ceasalpiniaceae* | Roots & Stems | India | P.O. | 200 & 400mg/kg | TI. | G.P.Rajani 2009 |
| *Caesearia sylvestris* | *Flacourtiaceae* | Leaves | Brazil | P.O. | 125,250,500 mg/kg | HCD. | T.Schoenfelder 2009 |
| *Capparis decidua* | *Capparidaceae* | Bark ,Flower Fruits | India | P.O. | 500mg/kg | SI. | N. Chahalia 2009 |
| *Capparis spinosa* | *Capparidaceae* | Fruits | France | P.O. | 20mg/kg | NC; SI. | M.Eddouks 2005 |
| *Carica papaya* | *Caricaceae* | Seed | Nigeria | P.O. | 100-400mg/kg | NC. | A.A.Adeneye 2007 |
| *Cassia fistula* | *Fabaceae* | Legume | India | P.O. | 100,250,500 mg/kg | HCD. | G.C.Jain 2009 |
| *Catharanthus roseus* | *Acanthaceae* | Leaves | Bangladesh | I.P. | 150mg/kg | NC; SI. | M.A.Islam 2009 |
| *Celastrus paniculatus* | *Celastraceae* | Seed | India | P.O. | 65mg/kg | HFD. | R.H.Patil 2010 |
| *Curcuma longa* | *Zingiberaceae* | Rhizome | India | P.O. | 300mg/kg | SI. | M.Alihussain 2002 |
| *Cymbopogon* | *Graminaceae* | Leaves | Nigeria | | 125- | NC. | A.A.Adeneye |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| *citratus* | | | | P.O. | 250mg/kg | | 2007 |
| *Coccinia indica* | *Cucurbitaceae* | Aerial parts | India | P.O. | 100 & 200mg/kg | SI. | A.K.Balaraman 2010 |
| *Crategus aronica* | *Rosaceae* | Fruits | Jordan | P.O. | 10mg/kg | HCD. | R. Khalil 2008 |
| *Dracocephalu m kotschyi* | *Lamiaceae* | Leaves | Iran | P.O. | 40,80,120 mg/kg | HFD. | S.E. Sajjadi 1998 |
| *Eclipta prostate* | *Asteraceae* | Leaves | India | P.O. | 100 and 200mg/kg | AtDI. | R.Dhandapani2007 |
| *Enicostemma littorale* | *Gentinaceae* | Whole plant | India | P.O. | 50 &75 mg/kg | HCD. | H.Vaidya 2009 |
| *Eugenia jambolana* | Myrtaceae | Seed | India | P.O. | 150mg/kg | SI. | P.Daisy 2007 |
| *Ficus racemosa* | *Moraceae* | Bark | India | P.O. | 100-500mg/kg | AlI. | D .Sophia.2007 |
| *Garcinia cambogia* | *Guttiferae* | Peel of matured fruits | India | P.O. | 5 & 10mg/kg | NC. | A.S.Koshy 2001 |
| *Glyccyrrhiza glabra* | *Fabaceae /papillionaceae* | Roots | India | P.O. | 100mg/kg | HFD. | A.K.Srivastava 2009 |
| *Hibiscus rosa sinesis* | *Malvaceae* | Root | India | P.O. | 500mg/kg | TI; HFD. | R.Singh 2009 |
| *Ipomoea aquatica* | *Convovulacea e* | Leaves | India | P.O. | 200 &400mg/kg | HCD. | Sirarama D.2010 |
| *Laegenaria siceraria* | *Cucurbitaceae* | Fruits | India | P.O. | 100,200,300 mg/kg | NC; HFD. | B.V.Ghule 2009 |
| *Leptadenia pyrotechnica* | *Asclepidaceae* | Aerial parts | India | P.O. | 250mg/kg | HCD. | G.C. Jain 2007 |
| *Lycium barbarum* | *solanaceae* | Fruit | China, Hongkon g | Oral infusion | 0.25 gm/kg d., 10mg/kg d. | AlI. | Luo 2004 |
| *Melothria maderaspatana* | Cucurbitaceae | Aerial parts | India | P.O. | 100 & 200mg/kg | SI. | A.K.Balaraman 2010 |
| *Moringa pterrryogosper ma* | *Morigaceae* | Leaves | India | P.O. | 200mg/kg | TI; NC. | Dhandapani R. 2008 |
| *Morus alba* | *Moraceae* | Leaves | China | P.O. | 7.5,15,30mg/ kg | TI. | Jingjing Chen M.D. 2007 |
| *Morus indica* | *Moraceae* | Leaves | India | P.O. | 400mg/kg | AlI. | Pradeep Kumar R. 2010 |
| *Mucuna prurines* | *Leguminoseae* | Leaves | India | P.O. | 200mg/kg | AlI. | MuruganM.2009 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| *Nelumbo nuficera* | *Nelumbonaceae* | Leaves | China | P.O. | 50mg/kg | AlI. | Taoying Zhou 2009 |
| *Orthosiphon stamnineus* | *Labiateae* | Bark | India | P.O | 500,750mg/kg | HCD. | Umbare R.P.2009 |
| *Ocimum basilicum* | *Labiateae* | Whole plant | France | P.O. | 20mg/kg | NC; SI. | M. Eddouks 2007 |
| *Ocimum sanctum* | *Labiateae* | Leaves (Essential Oil) | Thailand | P.O. | 4.45gm/kg body weight/day | HCD. | Thamolwan S. 2010 |
| *Peucedanum pastinacifolium* | *Apiaceae* | Aerial parts | Iran | P.O. | 25,250,mg/kg | SI. | Movahedian2009 |
| *Phyllanthus amarus* | *Euphorbiaceae* | Leaves | India | P.O. | 300,500mg/kg | HCD. | R.P. Umbare 2009 |
| *Plumeria rubra* | *Apocynaceae* | Flowers | India | P.O. | 250mg/kg | AlI. | V.Hazeen Bengum 2008 |
| *Pongamia pinnata* | *Leguminosaeae* | Pods flowers | India | P.O. | 300,100mg/kg | SI. | A.Semalty 2010 |
| *Pueraria tuberosa* | *Fabaceae* | Tubers | India | P.O. | 200 &400mg/kg | HCD. | K.G. Ramawat 2008 |
| *Rosa laevigata* | *Rosaceae* | Fruits | China | P.O. | 25 and50mg/kg | HFrD. | Y.T.Liu2010 |
| *Ruta graveolens* | *Rutaceae* | Leaves, Whole plant | India | P.O. | 125mg/kg | SI. | O.M.Ahmed 2010 |
| *Salacia reticulate & S.oblonga* | *Celestraceae* | Root & Barks | India | P.O. | 500mg/kg | HyI. | Rabbani S.I.2006 |
| *Salicornia herbacea* | *Chenopodiaceae* | Whole plants | Korea | P.O. | 0.25 ,0.5mg/ml | HFD; Type 2DM. | Jung-In Kim 2007 |
| *Salvadora oleoides* | *Salvadoraceae* | Aerial parts | India | P.O. | 1gm ,2gm/kg | NC; AlI. | J.P.Yadav 2008 |
| *Sapindus emarginatus* | *Sapindaceae* | Pericarp | India | P.O. | 100,200mg/kg | TI. | S. Jeyabalan 2009 |
| *Sesbania grandiflora* | *Fabaceae* | Leaves | India | P.O. | 200mg/kg | TI. | Saravankumar A.2010 |
| *Syzigium cumini* | *Myrtaceae* | Leaves | Brazil | P.O. | 125,250, 500gm/ kg | AlI. | V.Reus 2008 |
| *Syzigium alternifolium* | *Myrtaceae* | Seed | India | P.O. | 50,250mg/kg | SI. | R.B.Kastti 2010 |
| *Terminalia* | *Combretaceae* | Pericarp | India | | 1.05 , | AtDI. | V. Maruthappan |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| *chebula* | | Fruits | | P.O. | 2.10mg/kg | | 2010 |
| *Tribulus alatus & T.Terrestris* | *Zygophyllaceae* | Aerial parts with fruits | Egypt | P.O. | 50mg/kg | SI. | W.H.EI-Tantawy 2007 |
| *Trianthum portulacastrum* | *Azoaceae* | Whole plant | India | P.O. | 100,200 & 300mg/kg | NC; AII. | N.R.Yellu2010 |
| *Vernonia anthalmintica* | *Asteraceae* | Seeds | India | P.O. | 0.25, 0.50gm/kg | SI. | S.S.Fatima 2010 |
| *Withania somnifera* | *Solanaceae* | Roots and Leaf | India | P.O. | 100,200mg/kg | AII. | Chang Won Choi 2010 |
| *Zingiber officinale* | *Zingiberaceae* | Rhizome | India | P.O. | 200mg/kg | SI. | Bhandari 2009 |

**Table no.2.Some other Phytoconstituents having Hypolipidemic activity**

| BIOLOGICAL SOURCE | FAMILY | PHYTOCONSTITUENTS | REFERENCES |
|---|---|---|---|
| *Atrium lappa L.* | Asteraceae | Inulin | Iwakami et al 1992 |
| *Avena sativa L.* | Gramineae | Mono and oligosaccharide | Anderson et al 1984 |
| *Bupleurum chinense DC* | Umbelliferae | Triterpine | Der Marderosian et al 2002 |
| *Citrus lemon L.* | Rutaceae | Pectin ,citrus flavonoids | Potter 1995 |
| *Cyampopsis tetragonolobus(L) Taub* | Fabaceae | Gums | Todd et al 1990 |
| *Emblica officinalis* | Euphorbiaceae | Fixed oil and volatile oil | Mathur et al 1996 |
| *Ginkgo biloba L.* | Ginkoaceae | Polyphenolic compounds,Flvonoids | Desmet et al 1997 |
| *Hordeum vulgare L.* | Germineae | Fibers | Lupton et al 1994 |
| *Medicago sativa L.* | *Leguminosaeae* | Saponins | Malinow et al 1977 |
| *Plantago lanceolata L.* | Plantaginaceae | Metamucil | Greves et al 2000 |

**References:**

1. Goldstein JL, Schrott HG, Hazzard WR, Bierman EL, Motulsky AG.Hyperlipidemia in coronary disease. J Clin invest 1973, 52: 1544-1568.

2. Keys A. Coronary heart disease, the global picture. Atherosclerosis 1975, 22:149-192.
3. Grundy SM. Cholesterol and coronary heart disease: a new era. Journal of American Medical Association 1986; 256:2849-2858.
4. Kris-Etherton PM, Penny M, Hecker KD, Bonanome A, Coval SM, Binkoski AE, Hilpert KF, Griel AE, Etherton TD. Bioactive compounds in foods: their role in the prevention of cardiovascular disease and cancer. The American Journal of Medicine 2002; 113: 71-88.
5. Chattopadhyaaya R., Pathak D. and Jindal D.P. "Antihyperlipidemic agents a review" Indian drugs 1996; 33 (3):85-97.
6. Brown S L. Lowered serum cholesterol and low mood. Br. Med. J. 1996; 313: 637-638.
7. Annon. Drug index, passi publication pvt.ltd.New Delhi. 1999,482
8. Sriram TV. Home remedies; a handbook of herbal cures for common ailments. Penguin books, India, 1998: P.75.
9. Seth, S.D. and Sharma, B.: Medicinal plants of India. Indian. Med. Res. 2004, 120, 9–11.
10. Berliner JA, Heinecke JW. The role of oxidized lipoproteins in atherogenesis. Free Radical Biology. Med. 1996; 20: 707-727.
11. T. Huynh Ngoc, Q. Nguyen Ngoc, A. Tran T Van and N. Vo Phung. Hypolipidemic Effect of Extracts from *Abelmoschus esculentus* L. (Malvaceae) on Tyloxapol-Induced Hyperlipidemia in Mice Mahidol University Journal of Pharmaceutical Sciences 2008; 35(1-4): 42-46.
12. Khanna AK, Chander R, Singh C, Srivastava AK, Kapoor NK. Hypolipidemic activity of *Achyranthus aspera* Linn in normal and triton induced Hyperlipidemia rats. Indian J Exp Biol. 1992 Feb; 30(2):128-30.
13. C.Vijaya, M.Ramnathan and B Suresh. Lipid lowering effect of ethanolic extracts of leaves of *Aegel marmelos* in hyperlipidemic models of albino rats. Indian Journal of experimental Biology 2009 Vol.47 182-185.
14. Jaouad E-Hilaly, Adil Tahraoui, Zafar H. Israili and Badia Lyoussi. 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 Volume 105, Issue 3, Pages 441-448

15. Kumud Kumari, K.T. Augusti Lipid lowering effect of S-methyl cysteine sulfoxide from *Allium cepa Linn* in high cholesterol diet feed rats' .Journal of Ethnopharmacology 2007, Vol. 109, 367-371.
16. Vasu Keshetty, Srinivas Pabba, Rajyalakshmi Gudipati, Jagan Mohan Kandukuri, Venkatesham Allenki Antihyperlipidemic Activity of methanolic extract of Garlic (*Allium sativum* L.) in Triton X-100 induced hyperlipidemic rats *Journal of Pharmacy Research 2009, 2(5),777-780*
17. C. R. Achuthan and Padikkala. Hypolipidemic effect of *Alpinia galanga* (Rasna) and Kaempferia galanga (Kachoori) Indian Journal of Clinical Biochemistry Volume 12, Number 1, 55-58.
18. Sinnathambi Arulmozhi , Papiya Mitra Mazumder, Sathiyanarayanan Lohidasan , Prasad Thakurdesai Antidiabetic and antihyperlipidemic activity of leaves of *Alstonia scholaris* Linn. R.Br. European Journal of Integrative Medicine (2010) 2; 23–32
19. B.S.AshokKumara, K.Lakshmanb, K.N.Jayaveeac, D.SheshadriShekard, SaleemullaKhane, B.S.Thippeswamyf, VeereshP.Veerapurg, Antidiabetic, antihyperlipidemic and antioxidant activities of methanolic extract of *Amaranthus viridis* Linn in Alloxan induced diabetic rats Experimental and Toxicologic Pathology (2010).
20. Bharath Chelluboina and K Manga. Hypolipidemic activity of *Andrographis serpyllifoli*a Wt.Ic Journal of Pharmacy Research 2010, 3(4), 769-770.
21. Valiollah Hajhashemi, Naser Abbasi Hypolipidemic activity of *Anethum graveolens* in rats Phytotherapy Research2007 Volume 22 Issue 3, Pages 372 – 375.
22. K.M.M Parvathi, CK Ramesh, V Krishna, M Paramesha, IJ Kuppast Hypolipidemic activity of gum ghatti of *Anogeissus latifolia* Pharmacognosy magazine 2009 Volume 5 Issue 19; 11-14.
23. Vishnu Kumar, Sushma Singh, Ashok Kumar Khanna,Mohammad Mub in Khan,Ramesh Chander,Farzana Mahd i, Jitendra Kumar Saxena Ranjana Singh and Raj Kumar Singh. Hypolipidemic activity of *Anthocephalus indicus* (kadam) in hyperlipidemic rats Medicinal Chemistry Research 2008 Volume 17, 2-7.

24. Kamal Mansi, Adel M Abushoffa, Ahmad Disi, Talal Aburjai Hypolipidemic Effects of Seed Extract of Celery (*Apium graveolens)* in Rats. Pharmacognosy Magazine 2009 Volume 5 Issue 20, 301-305.
25. H. Berrougui, A. Ettaiba, M. D. Herrera Gonzalezb, M Alvarez de Sotomayorb, N. Bennani-Kabchi, and M. Hmamouchia. Hypolipidemic and hypocholesterolemic effect of argan oil *(Argania spinosa* L.) in Meriones shawi rats Journal of Ethnopharmacology 2003 Volume 89, Issue 1, 15-18
26. N.P.Visavadiya A.V.R.L. Narasimacharya. Hypolipidemic and antioxidant activities *Asparagus racemosus* in hypocholesterolemic rats.Indian J.Pharmacology 2005 vol.37 Issue 6 376-380.
27. Pradeep Kumar R, D. Sujatha, T.S. Mohamed Saleem, C. Madhusudhana Chetty, D. Ranganayakulu Potential hypoglycemic & hypolipidemic effect of *Morus Indica* and *Asystasia gangetica* in alloxan induced diabetes mellitus. Int. J. Res. Pharm. Sci. 2010, Vol-1, Issue-1, 51-56.
28. G.P.Rajani, Purnima Ashok In vitro antioxidant and antihyperlipidemic activities of *Bauhinia variegata Linn*. Indian J.Pharmacology 2009 vol.41 (5) 227-232.
29. Tatiana Schoenfelder , Claus T. Pich , Reginaldo Geremias , Silvio Ávila,Elaine N. Daminelli , Rozangela C. Pedrosa , Jane Bettiol Antihyperlipidemic effect of *Casearia sylvestris* methanolic extract Fitoterapia (2008) 79; 465–467.
30. Neelkamal Chahlia. Effect of *Capparis decidua* on hypolipidemic activity in Rats. Journal of Medicinal Plants Research, 2009, Vol. 3(6), 481-484.
31. M. Eddouks, A. Lemhadri, J.B. Michel. Hypolipidemic activity of aqueous extract of *Capparis spinosa* L. in normal and diabetic rats. Journal of Ethnopharmacology (2005) 98, 345–350
32. A. A. Adeneye, J .A. Olagunjub. Preliminary hypoglycemic and hypolipidemic activities of the aqueous seed extract of *Carica papaya* Linn. In Wistar rats. Biology and Medicine, 2009, Vol. 1 (1): 1-10.
33. Uttam Chand Gupta1 and G.C. Jain. Study on Hypolipidemic Activity of *Cassia fistula*. Legume in Rats *Asian J. Exp. Sci., Vol. 23, No. 1, 2009; 241-248.*

34. *M.* A. Islam, M. Afia Akhtar, M. R. I. Khan, M. S. Hossain, M. K. Alam, M. I. I. Wahed, B. M. Rahman, A. S. M. Anisuzzaman, S. M. Shaheen, and Maruf Ahmed. Antidiabetic and Hypolipidemic Effects of Different Fractions of *Catharanthus Roseus* (Linn.) on Normal and Streptozotocin-induced Diabetic Rats J. Sci. Res. 2009, 1 (2), 334-344.
35. R. H. Patil, K. Prakash and V. L. Maheshwari, Hypolipidemic Effect of *Celastrus paniculatus* in Experimentally Induced Hypercholesterolemic Wistar Rats, Indian Journal of Clinical Biochemistry.
36. Halim Eshrat M. Ali Hussain. Hypoglycemic, hypolipidemic and antioxidant properties of combination of *curcumin* from *curcuma longa*, linn, and partially purified product from *abroma augusta,* linn. in Streptozotocin induced diabetes *Indian Journal of Clinical Biochemistry, 2002, 17 (2) 33-43.*
37. Adejuwon Adewale Adeneye, Esther Oluwatoyin Agbaje Hypoglycemic and hypolipidemic effects of fresh leaf aqueous extract of *Cymbopogon citratus Stapf.* In rats Journal of Ethnopharmacology (2007) 112, 440–444.
38. Ashok Kumar Balaraman, Jagadish Singh, Sasmita Dash, Tapan Kumar Maity Antihyperglycemic and hypolipidemic effects of *Melothria maderaspatana* and *Coccinia indica* in Streptozotocin induced diabetes in rats. Saudi Pharmaceutical Journal (2010) 18, 173–178.
39. Raida Khalil, Nizar Abuharfeil, Barakat Shabsoug. The Effect of *Crataegus Aronica* Aqueous Extract in Rabbits Fed with High Cholesterol Diet, European Journal of Scientific Research (2008), Vol.22 No.3, 352-360
40. S. Ebrahim Sajjadi a,), A. Movahedian Atar b, A. Yektaian Antihyperlipidemic effect of hydroalcoholic extract, and polyphenolic fraction from *Dracocephalum kotschyi* Boiss Pharmaceutical Acta Helvetiae 1998, 73, 167–170.
41. R.Dhandapani, Hypolipidemic activity of *Eclipta prostata (L.)L*. leaf extract in atherogenic diet induced hyperlipidemic rats.Indian journal of experimental biology 2007, Vol.45, 617-619.
42. Hitesh Vaidya, Mandapati Rajani, Vasudevan Sudarsanam, Harish Padh, Ramesh Goyal, Swertiamarin: A lead from *Enicostemma littorale Blume*. For

anti-hyperlipidaemic effect, European Journal of Pharmacology 2009, 617 108–112

43. R.Jasmine, P.Daisy.Hypoglycaemic and Hypolipidemic activity of *Eugenia jambolina* in Streptozotocin -diabetic rats Asian Journal of Biochemistry 2007, 2(4), 269-273.
44. Sophia. D and Manoharan. S. Hypolipidemic activities of *Ficus racemosa* linn. bark in alloxan induced diabetic rats *Afr. J. Trad. CAM* 2007, 4 (3), 279 – 288.
45. Asha Sarah Koshy and N. R. Vijayalakshmi, Impact of Certain Flavonoids on Lipid Profiles Potential Action of *Garcinia cambogia* Flavonoids, Phytotherapy research 2001,15, 395–400
46. Santosh Kumar Maurya, Kanwal Raj and Arvind Kumar Srivastava, Antidyslipidaemic activity of *Glyccyrrhiza glabra* in high fructose diet induced dsyslipidaemic Syrian golden hamsters, Indian Journal of Clinical Biochemistry, 2009 , 24 (4), 404-409.
47. Vishnu Kumar, pradumn Singh, Ramesh Chander, Farzana Mahadi,Sushma Singh, Ranjana Singh,Ashok Kumar Khanna,Jintedra Kumar Saxsena,Abbas Ali Mahdi,Vinod Kumar Singh and Raj Kumar Singh. Hypolipidemic activity of *Hibiscus rosa sinensis* root in rats. Indian Journal of Biochemistry and Biophysics 2009, vol.46, 507-510.
48. Dhanasekaran.Sivaraman, Palayan.Muralidaran, Hypolipidemic activity of *Ipomoea aquatica* Forsk. Leaf extracts on lipid profile in hyperlipidemic rats. International Journal of Pharmaceutical & Biological Archives 2010; 1(2): 175 – 179
49. B.V. Ghule, M.H. Ghante, A.N. Saoji, P.G. Yeole Antihyperlipidemic effect of the methanolic extract from *Lagenaria siceraria* Stand. Fruit in hyperlipidemic rats, Journal of Ethnopharmacology 2009, 124, 333–337.
50. G.C. Jain, S. Jhalani, S. Agarwal and K. Jain, Hypolipidemic and Antiatherosclerotic Effect of *Leptadenia pyrotechnica* Extract in Cholesterol Fed Rabbits *Asian J. Exp. Sci. 2007, Vol. 21, No. 1, 115-122*
51. Luo, Yizhong Cai, Jun Yan, Mei Sun, Harold Corke, Hypoglycemic and hypolipidemic effects and antioxidant activity of fruit extracts from *Lycium*

*barbarum* Life Sciences 2004, 76 137–149.

52. Ashok Kumar Balaraman, Jagadish Singh, Sasmita Dash, Tapan Kumar Maity Antihyperglycemic and hypolipidemic effects of *Melothria maderaspatana* and *Coccinia indica* in Streptozotocin induced diabetes in rats. Saudi Pharmaceutical Journal (2010) 18, 173–178
53. Jingjing Chen MD and Xiangrong Li MD Hypolipidemic effect of flavonoids from mulberry leaves in triton WR-1339 induced hyperlipidemic mice Asia Pac J Clin Nutr 2007;16 (Suppl 1):290-294.
54. Pradeep Kumar R, D. Sujatha, T.S. Mohamed Saleem, C. Madhusudhana Chetty, D. Ranganayakulu Potential hypoglycemic & hypolipidemic effect of *Morus Indica* and *Asystasia gangetica* in alloxan induced diabetes mellitus. Int. J. Res. Pharm. Sci. 2010, Vol-1, Issue-1, 51-56,
55. M.Murugan, C.Uma Maheshwara Reddy, Hypoglycemic and hypolipidemic activity of leaves of *Mucuna pruriens* in alloxan induced diabetic rats Journal of Pharmaceutical Science and Technology 2009, Vol. 1 (2), 69-73
56. Taoying Zhou, Denghong Luo, Xingyuan Li and Yunbo Luo Hypoglycemic and hypolipidemic effects of flavonoids from lotus (*Nelumbo nuficera* Gaertn) leaf in diabetic mice, Journal of Medicinal Plants Research 2009, Vol. 3(4), 290-293 .
57. Umbare R.P., Patil S.M., Mate G.S., Dongare S.S. Hypolipidemic Activity of *Orthosiphon stamnineus* Benth bark Extract. Journal of pharmacy research 2009, 2(11), 1735-1738.
58. N.A. Zeggwagh, T. Sulpice and M. Eddouks, Anti-hyperglycemic and Hypolipidemic Effects of *Ocimum basilicum* Aqueous Extract in Diabetic Rats, American Journal of Pharmacology and Toxicology 2007, 2 (3): 123-129.
59. Thamolwan Suanarunsawat, Watcharaporn Devakul Na Ayutthaya, Thanapat Songsak,Suwan Thirawarapan and Somlak Poungshompoo Antioxidant activity and lipid-Lowering Effect of Essential Oils Extracted from *Ocimum sanctum L*. Leaves in Rats Fed with a High Cholesterol Diet. J. Clin. Biochem. Nutr, 2010, 46, 52–59,

60. Ahmad Movahedian, Behzad Zolfaghari, S.Ebrahim Sajjadi, Reza Moknatjou Antihyperlipidemic effect of *Peucedanum pastinacifolium* extract in Streptozotocin-induced diabetic rats clinics 2010;65(6):629-33
61. R. P. Umbare, G. S. Mate, D. V. Jawalkar, S. M. Patil, S. S. Dongare. Quality evaluation of *Phyllanthus amarus* (Schumach) leaves extract for its hypolipidemic activity Biology and Medicine*2009, Vol 1 (4): 28-33.*
62. A. John Merina, D. Sivanesan,V. Hazeena Begum and N. Sulochana, Antioxidant and Hypolipidemic Effect of *Plumeria Rubra* L. in Alloxan Induced Hyperglycemic Rats E-Journal of Chemistry 2010, 7(1), 1-5
63. R. Punitha and S. Manoharan Antihyperglycemic and antilipidperoxidative effects of *Pongamia pinnata* (Linn.) Pierre flowers in alloxan induced diabetic rats Journal of Ethnopharmacology 2006, Volume 105, Issues 1-2, 21, 39-46.
64. Tanwar, Y.S., Goyal, S. and Ramawat, K.G. Hypolipidemic effects of tubers of Indian Kudzu (*Pueraria tuberosa*) Journal of Herbal Medicine and Toxicology 2008, 2 (1) 21-25.
65. Yue-Tao Liu, Bi-Nan Lu, Li-Na Xu, Lian-Hong Yin, Xiao-Na Wang, Jin-Yong Peng, Ke-Xin Liu, The antioxidant activity and hypolipidemic activity of the total flavonoids from the fruit of *Rosa laevigata* Michx Natural Science 2010, Vol.2, No.3, 175-183 .
66. Osama Mohamed Ahmed, Adel Abdel Moneim, Ibrahim Abul Yazid, Ayman Moawad Mahmoud, Antihyperglycemic, antihyperlipidemic and antioxidant effects and the probable mechanisms of action of *Ruta graveolens* infusion and rutin in nicotinamide Streptozotocin induced diabetic rats Diabetologia Croatica 2010, 39-1.
67. Rabbani S.I., Asad M.and Asdaq S.M.B.Hypolipidemic activity of *Salacia oblonga* and *S.reticulata* Indian Drugs 2006, 43(10), 844-847.
68. Ji-Yeon Hwang, Soo-Kyung Lee, Ja-Rim Jo, Mi-Eun Kim, Hyun-Ah So, Chang-Woo Cho, Young-Wan Seo and Jung-In Kim Hypolipidemic effect of *Salicornia herbacea* in animal model of type 2 diabetes mellitus Nutrition Research and Practice 2007, 1(4), 371-375
69. JP Yadav, Sushila Saini, AN Kalia, AS Dangi, Hypoglycemic and

hypolipidemic activity of ethanolic extract of *Salvadora oleoides* in normal and alloxan-induced diabetic rats. Indian Journal of Pharmacology 2008 Vo.40 Issue 1 pp. 23-27

70. A. Saravanakumar, S. Vanitha, M. Ganesh, J.Jayaprakash, N. M. Ramaswamy, Hypolipidemic activity of *Sesbania grandiflora* in triton wr-1339 induced hyperlipidemic rats. International Journal of Phytomedicine 2010 , 2, 52-58
71. Tatiana Schoenfelder, Carolini Z. Warmlin, Michele S. Manfredini, Larissa L. Pavei, Juana V. Réus, Taciane C. Tristão, Marcelo S. Fernandes,Luciane Costa-Campos Hypoglycemic and hypolipidemic effect of leaves from *Syzigium cumini* (L.) Skeels, Myrtaceae. In diabetic rats Brazilian Journal of Pharmacognosy2010, 20(2): 222-227.
72. Ramesh Babu Kasetti, Maddirala Dilip Rajasekhar, Vinay Kumar Kondeti, Shaik Sameena Fatima, Ethamakula Guravaiah Tiruvenkata Kumar, Sirasanagandla Swapna, Bellamkonda Ramesh, Chippada Appa Rao. Antihyperglycemic and antihyperlipidemic activities of methanol: water (4:1) fraction isolated from aqueous extract of *Syzigium alternifolium* seeds in Streptozotocin induced diabetic rats Food and Chemical Toxicology 2010, 48, 1078–1084.
73. V. Maruthappan, K. Sakthi Shree. Hypolipidemic activity of Haritaki (*Terminalia chebula*) in atherogenic diet induced hyperlipidemic rats J. Adv. Pharm. Tech. Res. 2010 Vol. 1 (2).
74. WHE Tantawy & L.A.Hassanin. Hypoglycemic and Hypolipidemic effects of alcoholic extracts of *Tribulus alatus* in Streptozotocin- induced diabetic rats: A comparative study with *T.terrestris* (Caltrop) Indian journal of experimental biology 2007, Vol. 45, 785-790.
75. R.N.R.Anreddy, M.Porika, N.R.Yellu and R.K.Devrakonda. Hypoglycemic and hypolipidemic activities of *Trianthema portulacastrum Linn*. Plant in normal and Alloxan induced diabetic rats. International Journal of Pharmacology 6(2)
76. Shaik Sameena Fatima, Maddirala Dilip Rajasekhar, Kondeti Vinay Kumar, Mekala Thur Sampath Kumar, Kasetti Ramesh Babu, Chippada Appa Rao Antidiabetic and antihyperlipidemic

activity of ethyl acetate:Isopropanol (1:1) fraction of *Vernonia anthalmintica* seeds in Streptozotocin induced diabetic rats Food and Chemical Toxicology 2010, 48 , 495–501.

77. Rajangam Udayakumar , Sampath Kasthurirengan , Thankaraj Salammal Mariashibu ,Manoharan Rajesh , Vasudevan Ramesh Anbazhagan , Sei Chang Kim, Andy Ganapathi and Chang Won Choi , Hypoglycaemic and Hypolipidaemic Effects of *Withania somnifera* Root and Leaf Extracts on Alloxan-Induced Diabetic Rats *Int. J. Mol. Sci.* 2009, *10*, 2367-2382.
78. G. Unnikrishnan, K. M. Indu, K. Ozarkar. Hypocholesterolemic effect of *Zingiber officinale* (rosc) in high fat diet fed rats Journal of Herbal Medicine and Toxicology (2009), 3 (1) 19-22.
79. Ruitang Deng Therapeutic Effects of Guggul and its Constituent Guggulosterone: Cardiovascular Benefits, cardiovascular Drug Reviews 2007 Vol.25, No. 4, 375-390.
80. Iwakami, S., Wu, J.B., Ebizuka, Y., and Sankawa, U. Platelet activating factor (PAF) antagonists contained in medicinal plants: lignans and sesquiterpenes. Chem. Pharm. Bull. (Tokyo) 1992, 40(5), 1196–1198.
81. Anderson, J.W., Story, L., Sieling, B., Lin Chen, W., Petro, M.S., and Story, J.Hypocholesterolemic effects of oat-bran or beanintake for Hypercholesterolemic men. Am.J. Clin. Nutr. 1984, 40, 1146–1155
82. Der Marderosian, A. and Beutler, J.A. "The Review of Natural Products". Facts & Comparisons, St Louis, USA, 2002.
83. Potter, S.M. Overview of possible mechanism for hypocholesterolemic effect of soy protein. J. Nutr. 1995 125, 606s–611s
84. Todd, P.A., Benfield, P., and Goa, K.L. Guar gum. A review of its pharmacological properties, and use as a dietary adjunct in hypercholesterolaemia. Drugs 1990, 39(6), 917–928.
85. Mathur, R., Sharma, A., Dixit, V.P., and Varma, M. Hypolipidaemic effect of fruit juice of Emblica officinalis in cholesterol-fed rabbits. J. Ethnopharmacology. 1996 50, 61–68.
86. Desmet, P.A.G.M., Keller, K., Hansel, R., and Chandler, R.F. "Adverse Effects of Herbal Drugs". Springer-Verlag 1997, Berlin, Germany.

87. Lupton, J.R., Robinson, M.C., and Morin, J.L. Cholesterol-lowering effect of barley bran flour and oil. J. Am. Diet. Assoc. 1994, 94(1), 65–70.
88. Malinow, M.R., McLaughlin, P., Papworth, L., Stafford, C., Kohler, G.O., Livingston, A.L., and Cheeke, P.R. Effect of alfalfa saponins on intestinal cholesterol absorption in rats. Am.J. Clin. Nutrion 1977, 30(12), 2061–2067.
89. Greaves, K.A., Willson, M.D., Rudel, L.L., Williams, J.K., and Wagner, J.D. Consumption of soy protein reduces cholesterol absorption compared to casein protein alone or supplemented with an isoflavone extract or conjugated equine estrogen in ovariectmized cynomolgus monkeys. J. Nutr. 2000, 130, 820–826.