Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

J P P Journal of Pharmacognosy and Phytochemistry

E: ISSN 2278-4136
P: ISSN 2349-8234
JPP 2014; 3 (3): 71-79
Received: 16-05-2014
Accepted: 09-06-2014

R. Aruna
Senior Research Fellow, (Pharmacognosy), Siddha Central Research Institute, Arumbakkam, Chennai – 106

P.Sathiyarajeswaran
Research Officer (Siddha), Central Council for Research in Siddha, Arumbakkam, Chennai - 106

K.Gopakumar
Research Officer Incharge, Siddha Central Research Institute, Arumbakkam, Chennai – 106

R.S.Ramaswamy
Director General, Central Council for Research in Siddha, Arumbakkam, Chennai - 106

Correspondence:
R. Aruna
Senior Research Fellow, (Pharmacognosy), Siddha Central Research Institute, Arumbakkam, Chennai – 106

Cardioprotective effects of kitchen culinaries mentioned in Siddha literature

R. Aruna, P.Sathiyarajeswaran, K.Gopakumar, R.S.Ramaswamy

Abstract
Health in the conception of the World Health Organization is a state of complete physical, mental and social well-being not merely an absence of disease or infirmity. Aviztham (Drug) as per Siddha medicine is a substance, or a procedure or restriction which wipes off the sorrow of the patient and reinstates happiness to him and the society. As per Siddha, thamaragam (Heart) occupies the seat of Pitta i.e: situated between navel and throat. Pranan and Viyanan are the functional vaayus responsible for its motor functions. Ranjaka pitham (Haemoglobin) and Sathaka pittam (Heart beat) are behind its physiological functions. Avalambakam is the kapham responsible for breathing functions and along with Pranan it helps in purification of blood. When there is excessive accumulation of Kapham – i.e. Athermatous plaques (Koluppu) Viyanan is affected, causing loss of blood supply due to which ranjagam i.e.the tissue nourishment deprives causing reduction in Pranan and causes death. In this review the common kitchen culinaries Turmeric (*Curcuma longa* L.), ginger (*Zingiber officinale* Roscoe), garlic (*Allium sativum* L.), fenugreek (*Trigonella foenum-graecum* L.), onion (*Allium cepa* L.*)*, black pepper (*Piper nigrum* L.), cumin (*Cuminum cyminum* L.*)*, cinnamon (*Cinnamomum verum* J. Presl), coriander (*Coriandrum sativum* L.), that are mentioned in the Siddha literature, used for their cardio protective nature are discussed.

Keywords: Cardio protective, Siddha medicine, kitchen culinary.

1. Introduction
Health in the conception of the World Health Organization is a state of complete physical, mental and social well-being not merely an absence of disease or infirmity. Aviztham (Drug) as per Siddha medicine is a substance, or a procedure or restriction which wipes off the sorrow of the patient and reinstate happiness to him and the society. Natural products have played a significant role in drug discovery and development, especially for agents against cancer and infectious disease. Plant-based remedies are regularly hailed by the popular media and the conservation community to support the notion that the tropics' diverse floral resources are an invaluable and largely untapped source of new pharmaceutical products. More than 80% of thedeveloping world continues to rely on traditional medicines, predominantly plants, for primary health care [1].

As per Siddha, thamaragam (Heart) occupies the seat of Pitta i.e: situated between navel and throat. Pranan and Viyanan are the functional vaayus responsible for its motor functions. Ranjaka pitham (Haemoglobin) and Sathaka pittam (Heart beat) are behind its physiological functions. Avalambakam is the kapham responsible for breathing functions and along with Pranan it helps in purification of blood. When there is excessive accumulation of kapham – i.e. Athermatous plaques (Koluppu) Viyanan is affected causing loss of blood supply due to which ranjagam i.e. the tissue nourishment deprives causing reduction in Pranan and causes death. Cardiovascular disease refers to a spectrum of illnesses that includes heart disease, vascular diseases of the brain, kidney, and peripheral arterial disease [2], According to an estimate by the World Health Organization, approximately 17.3 million people died out of CVDs in 2008, representing 30% of all global deaths. Out of these deaths, 7.3 million occurred secondary to coronary heart disease and 6.2 million as a consequence of stroke [3]. It is anticipated that by 2020 cardiovascular diseases are predicted to be the major cause of morbidity and mortality in most developing nations around the globe [4]. Dietary factors play a key role in the development of some human diseases, including cardiovascular disease. Epidemiologic studies indicate that diets rich in fruits, vegetables, and spices are associated with lower risk of all-cause, cancer, and cardiovascular-disease death [5, 6].

2. Turmeric

Turmeric (*Curcuma longa* L.) called as Manjal in Siddha, belonging to the family Zingiberaceae, a common Indian dietary spice has been shown to possess a wide range of therapeutic utilities in the traditional Indian medicine. It is widely used as a spice in South Asian and Middle Eastern cooking. It lends curry its distinctive yellow color and flavor. Turmeric is used as an herbal medicine for rheumatoid arthritis, chronic anterior uveitis, conjunctivitis, skin cancer, small pox, chicken pox, wound healing, urinary tract infections, and liver ailments. In Siddha literature, it is given to treat vaatham (diseases related with circulation and neurological involvement) [7]. In a natural mutant model of obesity, turmeric (at 1 and 5% of the diet) had significantly reduced cholesterol and triglyceride concentrations while increasing HDL cholesterol, within 4 weeks. Further evidence indicates that it reduces the oxidation of LDL, blood glucose and renal lesions in diabetes. In addition, it has been demonstrated to reduce platelet aggregation, cyclooxegenase, thromboxane, smooth muscle cell proliferation and endothelial dysfunction. Both turmeric and curcumin, due to their antioxidant and anti-inflammatory activity, have been demonstrated to counteract several disorders such as myocardial infarctions, chronic inflammatory lung diseases, pancreatitis, inflammatory bowel diseases, neurodegenerative diseases, hepatic and lung damages as well as muscle injuries and cystic fibrosis [8]. Curcumin can also impact on the process of cataractogenesis and delays galactose-induced cataracts formation in rats [9].

3. Ginger

Ginger, the rhizome of *Zingiber officinale* Roscoe, called as Inji in Siddha is one of the most widely used species of the family Zingiberaceae, is a common condiment for various foods and beverages. Ginger has been used traditionally for varied human ailments, to aid digestion and to treat stomach upset, diarrhoea and nausea. Ginger rhizome is generally consumed as a fresh paste, dried powder, slices preserved in syrup, candy (crystallized ginger) or for flavoring tea. In Siddha literature it is given to treat azhalkutram and vaatham (Hypertension and diseases related with circulation) [7].

In a placebo controlled clinical trial, patients administered with a single dose of 10 g powdered ginger administered to Coronary artery diseased patients produced a significant reduction in platelet aggregation induced by the two agonists, but did not affect the blood lipids and blood sugar [10]. *Zingiber* extract feeding in diabetic rats increased the fecal excretion of cholesterol, thus suggesting a modulation of absorption. Ethanolic extract of ginger can protect the tissues from lipid peroxidation. The extract also exhibits significant lipid lowering activity in diabetic rats [11]. Hyperlipidemic rabbits when challenged with a 50% ethanolic extract of ginger showed a reduction in total cholesterol and serum LDL-cholesterol. A reduction in HDL ratio was seen in atherofed rabbits compared with controls which were restored when challenged with the *Zingiber* extract. An atherogenic index of 4.7 was brought down to 1.2 using plant products. The tissue lipid profiles of liver, heart and aorta showed similar changes to those noticed in serum lipids [12].

Consumption of ginger extract inhibited the progression of aortic atherosclerosis in atherosclerotic, apolipoprotein- e deficient mice. This effect was associated with a significant reduction in the plasma and LDL cholesterol levels, with a parallel reduction in the oxidative response of macrophages, and reduced LDL atherogenic modifications (oxidation and aggregation). Feeding rats with ginger significantly elevated the activity of hepatic cholesterol- 7α-hydroxylase, the rate-limiting enzyme in bile acids biosynthesis, thereby stimulating cholesterol conversion to bile acids, resulting in elimination of cholesterol from the body [13].

Ghayur NM *et al*. [14] reported the hypotensive, endothelium-dependent and –independent vasodilator and cardio-suppressant and stimulant effects of aqueous extract (Zo. Cr) of ginger. Zo. Cr, which tested positive for saponins, flavonoids, amines, alkaloids and terpenoids, induced a dose-dependent (3.0–10.0 mg/kg) fall in the arterial blood pressure (BP) of anaesthetized rats, which was partially blocked by atropine (1 mg/kg). In isolated endothelium-intact rat aorta, Zo.Cr (0.01–5.0 mg/ml) relaxed the phenylephrine (1 μM)-induced contractions effect partially blocked by atropine (1 μM). An atropine-resistant vasodilator activity was also noted from ginger phenolic constituents 6-, 8- and 10-gingerol, while 6-shogaol showed a mild vasodilator effect. The data indicate that the aqueous ginger extract lowers BP through a dual inhibitory effect mediated via stimulation of muscarinic receptors and blockade of Ca2+ channels and this study provides a sound mechanistic basis for the use of ginger in hypertension and palpitations. Abdel-Aziz H et al. [15] reported the potential of different extracts (ethanolic, hexane and aqueous) of ginger and the essential oil in 5-HT3 receptor antagonistic effects [6]-Gingerol showed maximum potential.

4. Garlic

Garlic (*Allium sativum* L.) called as Vellai poondu in Siddha belongs to the family Alliaceae. It is used universally as a flavoring agent, traditional medicine, and a functional food to enhance physical and mental health. Over the centuries, garlic has acquired a unique position in the myths of many cultures as an appalling prophylactic and therapeutic medicinal agent. In Siddha literature, it is quoted to treat Muppini (Delirium) [7]. Garlic has been advocated for the prevention of heart disease [16]. Epidemiologic studies show an inverse correlation between garlic consumption and progression of cardiovascular disease.

There is level III-3 evidence (National Health and Medical Research Council levels of evidence) that consuming a half to one clove of garlic (or equivalent) daily may have a cholesterol- lowering effect of up to 9%. There is level III-1 evidence that 7.2 gm of aged garlic extract has been associated with anticlotting (in-vivo studies), as well as modest reductions in blood pressure (an approximate 5.5% decrease in systolic blood pressure) [17]. Warshafsky S et al. [18] showed that an average of 900 mg garlic/ day could decrease total serum cholesterol levels by approximately 9%. Its consumption has been shown to have antiatherosclerotic activity to increase high-density lipoprotein (HDL) levels, which may help to remove excess cholesterol from arterial tissue in animal models and human cell cultures. It has been reported to have lipid-

and blood pressure-lowering action, as well as antiplatelet, antioxidant, and fibrinolytic effects [19]. Garlic educes nitric-oxide-dependent relaxation in pulmonary arteries [20, 21]. Recently, [22] have observed that freshly crushed garlic exerts superior cardioprotective activity than processed garlic. Their results show that freshly crushed garlic fed rats displayed significantly greater phosphorylation of antiapoptotic ERK1/2 proteins, reduced Bax/Bcl-2 ratio, and reduced phosphorylation of proapoptotic p-38MAPK and JNK. It enhanced redox signaling by increasing p65 subunit of NFκB, Nrf2, and enhanced GLUT 4, PPARα, and PPARδ. Also the survival signaling network consisting of Akt-FoxO1 was increased in the freshly crushed garlic treated hearts. It could be stated that garlic has multiple properties in the prevention of cardiovascular diseases and has to be taken as a dietary supplement for prevention of CVD.

Fibrinolysis is also enhanced with garlic, resulting in dissolution of clots and thrombi. *In vitro* studies have demonstrated that aged garlic extract improves circulation and blood properties by preventing lipid peroxidation and hemolysis in oxidized erythrocytes [23]. A recent study has confirmed that garlic improves the fluidity of erythrocytes isolated from hypecholesterolemic rats [24]. In contrast, garlic oil extracts and the allyl sulfides were unable to protect isolated erythrocytes from *t*-butyl hydroperoxide-induced hemolysis.

5. Fenugreek

Fenugreek, (*Trigonella foenum-graecum* L.), called as Vendayam in Siddha belongs to the subfamily Papilionaceae of the family Leguminosae. The plant is an aromatic herbaceous annual, widely cultivated in Mediterranean countries and Asia. It is believed to have originated in southeastern Europe or south-western Asian countries; an independent centre of origin exists in Ethiopia. In Siddha literature the activity is diuretic, and so reduces blood pressure and it acts on kuruthiazhal (hyper tension), maarvali (chest pain) [7].

Fenugreek seeds have been shown to have hypocholesterolaemic activity in rats [25, 26, 27] and humans [28, 29]. Supplements of fenugreek seeds have been shown to lower serum cholesterol, tri glyceride and low-density lipoprotein in human patients and experimental models of hypercholesterolaemia and hypertriglyceridemia [30]. The ethanol extract from fenugreek seeds contain hypocholesterolaemic components, saponins which interact with bile salts in the digestive tract [31]. Fenugreek treatments reduced the ratio of total cholesterol to HDL-cholesterol as well as increasing the HDL-cholesterol to LDL-cholesterol ratio, which have been shown to be reliable risk assessment factors of coronary heart diseases [32].

6. ONION

Onions (*Allium cepa* L.) called as Vengayam in Siddha belonging to the family Alliaceae have been valued for their medicinal qualities by many cultures around the globe. Numerous health benefits have been attributed to the vegetable, including prevention of cancer and cardiovascular disorders. In Siddha literature it is given to treat kuruthiazhal (hyper tension) [7].

LDL oxidation and endothelial cell damage is believed to be involved in the early development of atherosclerosis [33, 34]. Researchers found that presence of quercetin significantly reduced LDL oxidation in vitro from various oxidases including 15-lipoxygenase, copper-ion, UV light, and linoleic acid hydroperoxide [35, 33, 36, 34]. Besides the direct antioxidant effect, quercetin also inhibited consumption of alpha-tocopherol [37, 33, 34] and protected human serum paraoxonase (PON 1) activities [36]. Thus, synergistic inhibition of oxidative stress was observed. McAnlis GT et al. [38] found that despite the rise in plasma antioxidant capacity from ingestion of onions, LDL oxidation was not affected. This *in vivo* research suggested that quercetin, having a high affinity for protein, was bound to albumin and never incorporated into the LDL particle. It is proposed that in vitro results are caused by flavonoids acting in an aqueous phase and do not give a true representation of *in vivo* effects. However, other research suggested that the protective effects of quercetin occur at the cellular level. Kaneko T et al. [34] found that the flavonoid protected cells from the cytotoxic effects of previously oxidized LDL. They suggested the mechanism of action was blocking of the intracellular transduction of the cytotoxic signal. Uchida K et al. [39] noted inhibition of transduction signals by quercetin on the lipid peroxidation-derived oxidative stress or 4-hydroxy-2 nonenal (HNE). Strokes and coronary heart disease can be caused by platelets in the blood adhering to the walls of blood vessels in the heart or brain and aggregating to the point of obstruction [40]. Research on *in vivo* effects of onion consumption in rats showed significant inhibition of serum thromboxane, an inducer of platelet aggregation, levels with high doses (500 mg/kg) [41].

Goldman I *et al*. [42] found that onions containing higher sulfur levels exhibited a greater antiplatelet effect than genotypes with low sulfur content.Janssen K et al. [43] performed both in vitro and *in vivo* studies. 2500 u mol/L quercetin was shown to inhibit platelet aggregation by 95-97%, but 18 human subjects ingesting 114mg quercetin/day from onions showed no significant effects. Therefore, it was concluded that necessary concentration levels of quercetin for beneficial effects were too high to be obtained dietarily. Rats fed 2 g/kg dry onion for six days while feeding on an atherogenic diet showed significant reductions in both serum cholesterol and triglyceride levels as compared to those only eating the atherogenic diet [44].

7. Black Pepper

Black pepper (*Piper nigrum* L.) called as Milagu in Siddha belonging to the family piperaceae, bears the royal pedigree, “King of Spices.” Pepper is an extensively used spice both in Eastern and Western food. It has an impressive antioxidant and antibacterial effect and helps with digestion and weight loss because it stimulates the breakdown of fat cells. Black pepper or its active principle piperine has been experimentally demonstrated by a number of independent investigators to possess diverse physiological effects. In Siddha literature it acts in removing cilethmam (increased factors of kapham here it means accumulation of fat) [7].

The methanolic extract of *Piper longum* exhibits a significant protection against adriamycin induced cardiotoxicity by virtue of its antioxidant and free radical scavenging capacity. Black pepper has been reported to

influence lipid metabolism predominantly by mobilization of fatty acids [45]. An *in vivo* study on hypolipidemic effect of black pepper in high fat diet fed rats treated with black pepper as well as piperine showed remarked decrease in the levels of cholesterol (both the free and ester cholesterol fractions), free fatty acids, phospholipids and triglycerides. Moreover, supplementation of the high fat fed rats with black pepper elevated the concentration of high density lipoprotein-cholesterol (HDL-c) and reduced the concentrations of low density lipoprotein-cholesterol (LDL-c) and very low density lipoprotein-cholesterol (VLDL-c) in the plasma as compared with the levels in unsupplemented high fat fed rats [46]. Vanadium compounds also promote cardiac function by activating Akt signaling through inhibition of protein tyrosine phosphatases. Black pepper, being rich in containing vanadium in it thus elicits cardiac functional recovery in myocardial infarction and pressure overload–induced hypertrophy [47].

8. Cumin

Cumin (*Cuminum cyminum* L.*)*, called a Seeragam in Siddha belongs to the family Apiaceae, has been used as a spice since ancient times and is native to the eastern Mediterranean, extending to East India. Cumin seeds are used for their unique aroma and are popular in North African, Middle Eastern, Western, Chinese, Indian and Mexican cuisine. In Siddha it is quoted as azhalpom (hyper tension) [7].

Cumin decreased significantly the plasma levels of cholesterol, triglycerides and phospholipids and activity of the enzymes, aspartate transaminase, alkaline phosphatase and gamma glutamyl transferase (enzymes that are non-specific indicators of tissue damage such as liver disease (alcoholic liver disease, chronic hepatitis, cirrhosis, obstructive jaundice, hepatic cancer), myocardial infarction, pancreatitis and muscle-wasting diseases) when compared with the normal control group [48]. The activity of phospholipases A and C (enzymes that catalyse the splitting of phospholipids into fatty acids and other lipophilic substances by the addition of water) also decreased significantly in the liver of treated rats. The results obtained indicated that cumin could decrease the lipid levels in alcohol and thermally oxidized oil-induced hepatotoxicity.

9. Cinnamon

Cinnamon (*Cinnamomum verum* J. Presl), called as Elavangam belongs *to* the family Lauraceae is distributed in India, Egypt, China, Srilanka and Australia. Cinnamon leaves and bark are used extensively as spices in food or to produce essential oils [49]. In Siddha the property of cinnamon is given as kulirchi (here it means reduces blood pressure) [7]. Sharma SR et al. [50] studied the effect of a 50% alcoholic extract of cinnamon on rats and reported a significant anti-hypercholesterolemic action and reduced serum triglyceride level at a single dose of 250 mg/kg body weight. Suppression of total serum cholesterol, triglycerides, phospholipids and low density lipoprotein levels was observed in another investigation using triton WR-1339-induced hyperlipidemic rats [51].

10. Coriander

Coriander (*Coriandrum sativum* L.) called as Kothamalli in Siddha is an annual and herbaceous plant, belonging to the family Apiaceae. Coriander is a culinary and medicinal plant. Native of southern Europe and the western Mediterranean region, this herb is cultivated worldwide. According to Siddha text, coriander seeds acts as irudhayam valimai (cardio tonic) [7].

Coriander has been documented as a traditional treatment for cholesterol and diabetes patients. It has a long history as a traditional medicine [52]. The seeds of coriander have a remarkable hypolipidemic action. The levels of total cholesterol and triglycerides decreased significantly in the tissues of the animals of the experimental group which received coriander seeds. Significant increases in -hydroxy, -methyl glutaryl CoA reductase and plasma lecithin cholesterol acyl transferase activity were noted in the experimental group. The level of LDL + VLDL cholesterol decreased while that of HDL cholesterol increased in the experimental group compared to the control group. The increased activity of plasma LCAT enhanced hepatic bile acid synthesis and the increased degradation of cholesterol to fecal bile acids and neutral sterols appeared to account for its hypocholesterolemic effect [53].

Table 1: List of cardioprotective kitchen culinaries

S. No	Botanical Name	Active Compound	Activity
1	*Curcuma longa* L. (Manjal)	1-(4-hydroxy-3- methoxyphenyl)-5-(4-hydroxyphenyl)-1, 4-pentadiene- 3-one [54]	antioxidant [60]
		1-(4-hydroxy-3- methoxyphenyl)-7-(3, 4-dihydroxyphenyl)-1, 6- heptadiene-3, 5-dione [54]	adaptogenic [60]
		1-(4-hydroxyphenyl)-7-(3, 4-dihydroxyphenyl)-1, 6- heptadiene-3, 5-dione [54]	anti-inflammatory [60]
		1,5-bis(4-hydroxyphenyl)-penta- (1E,4E)-1,4-dien-3-one [54]	anti-infectious [60]
		1,5-dihydroxy-1-(4-hydroxy-3-methoxyphenyl)-7-(4- hydroxyphenyl)-4,6-heptadiene-3-one [54]	reduce platelet aggregation [55]
		1,5-dihydroxy-1-(4- hydroxyphenyl)-7-(4-hydroxy-3- methoxyphenyl)-4,6-heptadiene- 3-one [54]	reduce cyclooxegenase [59]

		1,5-dihydroxy-1,7-bis(4- hydroxy-3-methoxyphenyl)-4,6- heptadiene-3-one [54]	decreases cardiomyocytic apoptosis [58]
		1,5-dihydroxy-1,7-bis(4- hydroxyphenyl)-4,6-heptadiene- 3-one [54]	antithrombotic [56]
		1,5-epoxy-3-carbonyl-1,7-bis(4-hydroxyphenyl)-4,6- heptadiene [54]	anti-proliferative [57]
		1,7-bis(4-hydroxy-3- methoxyphenyl)-1,4,6- heptatrien-3-one [54]	
		1,7-bis-(4-hydroxyphenyl)- 1,4,6-heptatrien-3-one [54]	
		1,7-bis(4-hydroxyphenyl)-1- heptene-3,5-dione [54]	
		3-hydroxy-1,7-bis-(4- hydroxyphenyl)-6-heptene-1,5- dione [54]	
		4"-(4"'-hydroxyphenyl)-2"-oxo- 3"-butenyl-3-(4'-hydroxyphenyl- 3'-methoxy)-propenoate [54]	
		4"-(4"'-hydroxyphenyl-3-methoxy)-2"-oxo-3"-butenyl-3- (4'-hydroxyphenyl)-propenoate [54]	
		5-hydroxyl-1-(4-hydroxy-3-methoxyphenyl)-7-(4- hydroxyphenyl)-4,6-heptadiene- 3-one [54]	
		5-hydroxyl-1,7-bis(4-hydroxy-3-methoxyphenyl)-4,6-heptadiene- 3-one [54]	
		5-hydroxyl-7-(4-hydroxy-3-methoxyphenyl)-1-(4- hydroxyphenyl)-4,6-heptadiene- 3-one [54]	
		Bisdemethoxycurcumin54	
		Calebin-A [54]	
		Curcumin [54]	
		Cyclocurcumin [54]	
		Demethoxycurcumin [54]	
		Tetrahydroxycurcumin [54]	
		Vanillin [54]	
2.	Zingiber officinale Roscoe (Inji)	6-dehydrogingerdione [61]	antioxidant [59]
		Bisabolene [61]	anticarcinogenic [59]
		Curcurmene [61]	atherosclerotic [59]
		Galanolactone [61]	anti-atherogenicity [59]
		Geraniol [61]	inhibiting thromboxane formation [59]
		Gingerglycolipids [61]	inhibition of platelet aggregability [59]
		Gingerols [61]	anti-inflammatory [62]
		Gingesulfonic acid [61]	antimicrobial [62]
		Monoacyldigalactosylglycerols [61]	anti thrombotic [62]
		Neral [61]	
		Paradols [61]	
		Sesquiphellandrene [61]	
		Shogaols [61]	
		Zingerone [61]	
		Zingiberene [61]	
		Zingiberol [61]	
3.	*Allium sativum* L. (Poondu)	1,2-vinyldithiin (1,2-DT) [63]	anti-inflammatory [69]
		Ajoene [63]	anti-atherosclerotic [70]
		Allicin [63]	anti-oxidant [5]
		Alliin [63]	anti-platelet [68]
		Allixin [63]	anti-thrombosis [41]
		Allyl polysulfides (APS) [63]	blood fibrinolytic [66]
		A-phellandrene [65]	inhibit angiotensin - converting enzyme [5]
		B Phellandrene [65]	inhibitor of cholesterol synthesis [67]
		Citral [65]	inhibits platelet
			Aggregation [5]
		Diallyl disulfude (DADS) [63]	prevent lipid peroxidation of oxidized erythrocytes and LDL [5]

		Diallyl sulfide (DAS) [63]	
		Diallyl trisulfide (DATS) [63]	
		Geraniol [65]	
		Linalool [65]	
		N-acetylcysteine (NAC) [63]	
		N-acetyl-S-allylcysteine (NASC) [63]	
		S-allylcysteine (SAC) [63]	
		S-allylmercaptocysteine (SAMC) [63]	
		S-ethylcysteine (SEC) [63]	
		S-methylcysteine (SMC) [63]	
		S-propylcysteine (SPC) [63]	
		Thiacremonone [63]	
4.	*Trigonella foenum-graecum* L. (Vendayam)	a-muurolene [76]	reduce total serum cholesterol and LDL cholesterol [74]
		b-elemene [76]	antioxidant activity [73]
		beta-sitosteryl glucopyranosides [75]	cardiotonic [71]
		D-3-O-methyl-chiroinsitol [75]	antiphlogistic [71]
		Dihydroactiniolide [76]	anticholesterolemic [72]
		Dihydrobenzofuran [76]	antimicrobial [72]
		Disogenin [76]	
		Ethyl-alpha-D-glucopyranoside [75]	
		Gitogenin [76]	
		Glycerol monopalmitate [75]	
		Heptanoic acid [76]	
		Homorientin saponaretin [76]	
		N,N'-dicarbazyl [75]	
		Neogigogenin [76]	
		Neogitogenin [76]	
		n-hexanol [72]	
		Pentadecane [72]	
		Stearic acid [75]	
		Sucrose [75]	
		Tetradecane [72]	
		Trigogenin [72]	
		Trigonelline [72]	
5.	*Allium cepa* L. (Vengayam)	Quercetin [77]	inhibition of LDL oxidation and platelet aggregation [77]
		1(F)-beta-fructosyl-sucrose [77]	antioxidant [77]
		1-(methylsulfinyl)-propyl- methyl-disulfide [77]	anti-inflammatory [77]
		Allicin [77]	antiatherosclerotic [77]
		Alliin [77]	antitriglyceride [77]
		alpha-amyrin [77]	antithrombotic [77]
		Arginine [77]	hypocholesterolemic [77]
		beta-sitosterol [77]	
		Campesterol [77]	
		Asparagine [77]	
		benzyl-isothiocyanate [77]	
		Pyrocatechol [77]	
		Rutin [77]	
6.	*Piper nigrum* L.(Milagu)	Piperine [59]	antioxidant [59]
		Camphene [79]	hypolipidemic [59]
		Myristicin [79]	hypocholestremic [78]
		Rhamnetin [79]	Anti-inflammmatory [78]
		Myrcene [79]	
		Ubiquinone [79]	
		Carvacrol [79]	
		Quercetin [79]	
		Bisabolone [79]	
		Borneol [79]	
		Sabinene [79]	
		Rutin [79]	

7.	*Cuminum cyminum* L. (Seeragam)	Cumin aldehyde [80]	antioxidant [80]
		α –pinene [80]	hypocholesterolemic [81]
		Myrcene [80]	anti-inflammatory [83]
		Limonene [80]	
		1-8-cineole -mentha-1, 3-dien-7 –ol [80]	
		cuminic aldehyde [80]	
		β –bisabolene [80]	
		Luteolin [81]	
		Apigenin [81]	
		Thymoquinone [83]	
8.	*Cinnamomum verum* J.Presl (Lavangam)	Coumaric acid [79]	anti-hypercholesterolemic [59]
		Gamma-terpinene [79]	reduce serum triglyceride level [59]
		Camphene [79]	antioxidant [59]
		Isoeugenol [79]	antiinflammatory [79]
		Mannitol [79]	cardioprotective [79]
		Epicatechin [79]	
		Eugenol [79]	
		Vanillin [79]	
		Myrcene [79]	
		Proanthocyanidins [79]	
9.	*Coriandrum sativum* L. (Kothamalli)	Quercetin [82]	antiatherosclerotic [82]
		Kaempferol [82]	hypocholesterolaemic [82]
		Acacetin [82]	hypolipidemic [82]
		Apigenin [82]	
		Vanillic acid [82]	
		Ferulic acid (cis and trans form) [82]	
		p -coumaric acid [82]	

11. Reference

1. Farnsworth NR, Akerele O, Bingel AS. Medicinal plants in therapy. Bulletin of the World Health Organization 1985; 63:965-981.
2. World Health Organization, Cardiovascular diseases, 2013. http://www.euro.who.int/en/what-we-do/health-topics/noncommunicable-diseases/cardiovascular-diseases/definition. 23 August, 2014.
3. Cardiovascular diseases (CVDs) key facts, 2013. http://www.who.int/cardiovascular_diseases/en/, 23 August, 2014.
4. Celermajer DS, Chow CK, Marijon E, Anstey NM, Woo KS. Cardiovascular disease in the developing world prevalence's, patterns, and the potential of early disease detection. Journal of the American College of Cardiology 2012; 60(14):1207-1216.
5. Rahman K, Lowe GM. Garlic and cardiovascular disease, a critical review. J Nutr. 2006; 136:736-0740.
6. Jeanine MG, Elizabeth A, Platz, Sandra C, Hoffman, George W *et al*. Fruit, Vegetable, and Antioxidant Intake and All- Cause, Cancer, and Cardiovascular Disease Mortality in a Community-dwelling Population in Washington County, Maryland. American Journal of Epidemiology 160, 12.
7. Murugesa M. Materia Medica (Part – I) Dept. of Indian Medicine & Homoeopathy, Book Publication division, Chennai, 2004, 570.
8. Krishnaswamy K. Turmeric-The Salt of the Orient is the Spice of Life. New Delhi, India: Allied Publishers Pvt. Ltd., 2006.
9. Suryanarayana P, Saraswat M, Mrudula T, Krishna TP, Krishnaswamy K, Reddy GB. Curcumin and turmeric delay streptozotocin-induced diabetic cataract in rats. Invest Ophthalmol Vis Sci 2005; 46: 2092–2099.
10. Bordia A, Verma SK, Srivastava KC. Effect of ginger (*Zingiber officinale Roscoe*) and fenugreek (*Trigonella foenum graecum L.*) on blood lipids, blood sugar and platelet aggregation in patients with coronary artery disease. Prostaglandins Leukot Essent Fatty Acids 1997; 56:379–384.
11. Bhandari U, Kanojia R, Pillai KK. Effect of ethanolic extract of *Zingiber officinale* on dyslipidaemia in diabetic rats. J Ethnopharmacol 2005; 97:227–223.
12. Sharma I, Gusain D, Dixit VP. Hypolipidaemic and antiatherosclerotic effects of *Zingiber officinale* in cholesterol fed rabbits. Phytother Res 1998; 10:517-518.
13. Srinivasan K, Sambaiah K. The effect of spices on cholesterol 7 alpha- hydroxylase activity and on serum and hepatic cholesterol levels in the rat. Int J Vitam Nutr Res 1991; 61:363-369.
14. Ghayur NM, Gilani HN, Afridi BM, Houghton JP. Cardio-vascular effects of ginger aqueous extract and its phenolic constituents are mediated through multiple pathways. Vascular Pharmacology 2005; 43(4):234-241.
15. Abdel-Aziz H, Nahrstedt A, Petereit F, Windeck T, Ploch M, Versphol EJ. 5HT3 receptor blocking activity of arylalkanes isolated from the rhizome of Zingiber officinale. Planta Med 2005; 71:609–616.
16. Mykolas A. In: Functional foods for chronic diseases. Danik M, Martirosyan Ed, editors. Vol. 4. D & A Inc/FF Publishing, 2009, 234-241.
17. Tapsell LC, Hemphill I, Cobiac L, Patch CS, Sullivan

DR, Fenech M *et al*. Health benefits of herbs and spices, the past, the present, the future. Med J Aust 2006; 185:4-24.
18. Warshafsky S, Kamer RS, Sivak SK. Effect of garlic on total serum cholesterol, a Meta - analysis. Ann Int Med 1993; 119:599-605.
19. Ebadi M. The Pharmacodynamic Basis of Herbal Medicine. BocaRaton: CRC Press; 2002.
20. Banerjee SK, Maulik SK. Effect of garlic on cardiovascular disorders, a review. J Nutr 2002; 1:1-14.
21. Kaye AD, De Witt BJ, Anwar M, Smith DE, Feng CJ, Kadowitz PJ, et al. Analysis of responses of garlic derivatives in the pulmonary vascular bed of the rat. J Appl Physiol 2000; 89:353-358.
22. Mukherjee S, Lekli I, Goswami S, Das KD. Freshly Crushed garlic is a superior cardioprotective agent than processed garlic. J Agric Food Chem 2009; 57:7137-7144.
23. Moriguchi T, Takasugi N, Itakura Y. The effects of aged garlic extract on lipid peroxidation and the deformability of erythrocytes. J Nutr 2001; 131:1016S–9S.
24. Kempaiah RK, Srinivasan K. Influence of dietary spices on the fluidity of erythrocytes in hypercholesterolaemic rats. Br J Nutr 2005; 93:81–91.
25. Singhal PC, Gupta, RK, Joshi LD. Hypocholestrolaemic effect of *Trigonella foenum graecum*. Current Sci 1982; 51:136±137.
26. Sharma RD. Hypocholesterolaemic activity of fenugreek (*Trigonella foenum graecum*). An experimental study in rats. Nutr Rep Int 1984; 30:221-231.
27. Khosla P, Gupta DD, Nagpal PK. Effect of Trigonella foenum-graecum (fenugreek) on serum lipids in normal and diabetic rats. Indian J Pharmacol 1995; 27:89-9.
28. Madar Z, Odes HS. Dietary fibre in metabolic disease: In, Dietary Fibre Research, ed. by R. Paoletti, 1990; 1-54. Karger, Basel.
29. Sharma RD, Raghuram TC, Dayasagar Rao V. Hypolipidaemic effect of fenugreek seeds. A clinical study. Phytother Res 1991; 5:145-147.
30. Basch E, Ulbricht C, Kuo G, Szapary P, Smith M, Therapeutic applications of fenugreek. Alternative Medicine Review 2003; 8:20-27.
31. Stark A, Madar Z. The effect of an ethanol extract derived from fenugreek (*Trigonella foenum graecum*) on bile acid absorption and cholesterol levels in rats. Br. J Nutr 1993; 69:277-287.
32. Kannel WB. High-density lipoprotein: epidemiological profile and risks of coronary artery disease. Am J Cardiol 1983; 52:9b.
33. Da-Silva E, Tsushida T, Terao J. Inhibition of mammalian 15-lipoxygenase- dependent lipid peroxide in low-density lipoprotein by quercetin and quercetin monoglucosides. Archives of Biochemistry and Biophysics 1998; 349(2):313-320.
34. Kaneko T, Baba N. Protective effect of flavonoids on endothelial cells against linoleic acid hydroperoxide-induced toxicity. Biosci Biotechnol Biochem 1999; 63(2):323-328.
35. Nègre-Salvayre A, Salvayre R. Quercetin prevents the cytotoxicity of oxidized LDL of lymphoid cell lines. Free Radical Biology and Medicine 1992; 12:101-106.
36. Aviram M, Rosenblat M, Billecke S, Erogul J, Sorenson R, Bisgaier C *et al*. Human serum paraoxonase is inactivated by oxidized low density liporotein and preserved by antioxidants. Free Radical Biology and Medicine 1999; 26(7/8):892-904.
37. Hertog M, Katan M. Quercetin in foods, cardiovascular disease, and cancer. Ch. 20 in: Flavonoids in Health and Disease 1998; 447-467.
38. McAnlis GT, McEneny J, Pearce J, Young IS. Absorption and antioxidant effects of quercetin from onions, in man. Eur J Clin Nutr 1999; 53(2):92-96.
39. Uchida K, Shiraishi M, Naito Y, Torii Y, Nakamura Y, Osawa T. Activation of stress signaling pathways by the end of lipid peroxidation. The Journal of Biological Chemistry 1999; 274(4):2234-2242.
40. Ali M, Bordia T, Mustafa T. Effect of raw versus boiled aqueous extract of garlic and onion on platelet aggregation. Prostaglandins, Leukotrienes and Essential Fatty Acids 1999; 10(1):43-47.
41. Bordia T, Mohammed N, Thompson M, Ali M. An evaluation of garlic and onion as antithrombotic agents. Prostaglandins, Leukotreines and Essential Fatty Acids. 1996; 54(3):183-186.
42. Goldman I, Kopelberg M, Devaene J, Schwartz, B. Antiplatelet activity in onion is sulfur dependent. Thrombosis and Haemostasis 1996; 450-452.
43. Janssen K, Mensink R, Cox F, Harryvan J, Hovenior R, Hollman P et al. Effects of the flavonoids quercetin and apigenin on hemostasis in healthy volunteers: results from an in vitro and a dietary supplement study. Am J Clin Nutr 1998; 2:255-262.
44. Lata S, Saxena K, Bhasin V, Saxena, R., Kumar A, Srivastava, V. 1991. Beneficial effects *Allium sativum, Allium cepa,* and *Commiphora mukul* on experimental hyperlipidemia and atherosclerosis - A comparative evaluation. Journal of Postgraduate Medicine 37(3):132-135.
45. Wakade SA, Shah SA, Kulkarni PM, Juvekar RA. Protective effect of *Piper longum* L. on oxidative stress induced injury and cellular abnormality in adriamycin induced cardiotoxicity in rats. Indian J Exp Biol 2008; 46:528-533.
46. Vijayakumar RS, Surya D, Senthilkumar R, Nalini N. Hypolipidemic effect of black pepper (*Piper nigrum* Linn.) in rats fed high fat diet. J Clin Biochem Nutr 2002; 32:31-42.
47. Shenuarin B, Fukunaga K. Cardioprotection by vanadium compounds targeting Akt-mediated signaling. J Pharmacol Sci 2009; 110:1-13.
48. Aruna K, Rukkumani R, Menon VP. Role of *Cuminum cyminum* on ethanol and preheated sunflower oil induced lipid peroxidation. J Herbs Spices Med Plants 2005; 11:103-14.
49. Jayaprakasha GK, Rao LJ, Sakaraiah KK. Volatile constituents from *Cinnamomum zeylanicum* fruit stalks and their antioxidant activities. J Agric Food Chem 2003; 51:4344-4348.
50. Sharma SR, Dwivedi SK, Swarup D. Hypoglycemic and hypolipidemic effects of *Cinnamomum tamala* Nees leaves. Indian J Exp Biol 1996; 34:372-374.
51. Kim NJ, Jung EA, Kim DH, Lee S. Studies on the development of antihyperlipidemic drugs from Oriental herbal medicine. Korean J Pharmacogn 1999; 30:368-374.
52. Burdock GA, Carabin IG. Safety assessment of

coriander (*Coriandrum sativum L*.) essential oil as a food ingredient. Food Chem Toxicol 2009; 47:22-34.
53. Chithra V, Leelamma S. Hypolipidemic effect of coriander seeds (*Coriandrum sativum*), mechanism of action. Plant Foods Hum Nutr 1997; 51:167-172.
54. Li S, Yuan W, Deng G, Wang P, Yang P, Aggarwal BB. Chemical composition and product quality control of turmeric (*Curcuma longa* L.). Pharmaceutical Crops 2011; 2, 28-54.
55. Krishnaswamy K. Turmeric-The Salt of the Orient is the Spice of Life. New Delhi, India: Allied Publishers Pvt. Ltd, 2006.
56. Srivastava R, Dikshit M, Srimal RC, Dhawan BN. Anti-thrombotic effect of curcumin. Thromb Res. 1985; 40:413-417.
57. Huang HC, Jan TR, Yeh SF. Inhibitory effect of curcumin, an anti-inflammatory agent, on vascular smooth muscle cell proliferation. Eur J Pharmacol 1992; 221:381-384.
58. Soni KB, Kuttan R. Effect of administration on oral curcumin serum peroxides and cholesterol levels in human volunteers. Indian J Physiol Pharmacol 1992; 36:273-275
59. Vasanthi, HR, Parameswari, RP. Indian Spices for Healthy Heart - An Overview Curr Cardiol Rev. Nov 2010; 6(4):274-279.
60. 60. Ipseeta Mohanty, Dharamvir Singh Arya, Amit Dinda, Sujata Joshi, Keval Kishan Talwar , Suresh Kumar Gupta. Protective effects of *Curcuma longa* on ischemia reperfusion induced myocardial injuries and their mechanisms. Life Sciences 2004; 75:1701-1711.
61. Kemper JK. Ginger (*Zingiber officinale*), Longwood Herbal Task Force, Available at: http://www.mcp.edu/herbal/default.htm. 1999. 1-18.
62. Afzal M, Al-Hadidi D, Menon M, Pesek J, Dhami MS. Ginger. An ethnomedical, chemical and pharmacological review. Drug Metabol. Drug Interact. 2001; 18:159-90.
63. 63. Antioxidants of Garlic, http://www.moondragon.org/health/nutritionbasics/antioxidants/garlic.html
64. Dirsch VM, Kiemer AK, Wagner H, Vollmar AM. Effect of allicin and ajoene, two compounds of garlic, on inducible nitric oxide synthase Atherosclerosis. 1998; 139(2):333-9.
65. Ranjani R, Ayya Raju M. Anticancer Properties of *Allium sativum* –A Review Asian Journal of Biochemical and Pharmaceutical Research 2012; 2(3):190-196.
66. Kleijnen J, Knipschild P, Terriet G. Garlic onions and cardiovascular risk factors. A review of the evidence from human experiments with emphasis on commercially available preparations. Br J Clin Pharmacol 1989; 28:535-544.
67. Yu-Yan Y, Liu L. Cholesterol lowering effect of garlic extracts and organosulfur compounds, Human and animal studies. J Nutr 2001; 131:989-993.
68. Ebadi M. The Pharmacodynamic Basis of Herbal Medicine. BocaRaton: CRC Press, 2002.
69. Tsai TH, Tsai PJ, Ho SC et al. Antioxidant and Anti-inflammatory Activities of Several Commonly Used Spices. Journal of Food Science 2005; 70(1):C93-C97.
70. Londhe VP, Gavasane AT, Nipate SS, Bandawane DD, Chaudhari PD. Role of Garlic (*Allium sativum*) In Various Diseases: An Overview Journal of Pharmaceutical Research And Opinion 2011; 1(4):129 - 134.
71. Duke JA, Ayensu ES. Medicinal Plants of China. Vol. 1, Reference Publications, Algonac, MI., USA, 1985, 705.
72. Atefeh Sheikhlar. *Trigonella foenum-graecum* L. (Fenugreek) as a Medicinal Herb in Animals Growth and Health. Science International 2013; 1(6):194-198.
73. Kaviarasan S, Vijayalakshmi K, Anuradha CV. Polyphenol-rich extract of fenugreek seeds protect erythrocytes from oxidative damage. Plant Foods Hum Nutr 2004; 59:143-147.
74. Sowmya P, Rajyalkshmi P. Hypocholeserolemic effects of germinated fenugreek seeds in human subjects. Plant Foods Hum Nutr 1999; 53:359-365.
75. Shang MY, Cai SQ, Lin WH, Wang MC, Park JH. Studies on chemical constituents from the seed of *Trigonella foenum-graecum*. Zhongguo Zhong Yao Za Zhi 2002; 27(4):277-9.
76. Girardon P, Bessiere JM, Baccou JC, Sauvaire Y. Volatile constituent of Fenugreek seeds. Planta Medica 1985; 6:533-534.
77. Dr. Christopher's Herbal Legacy, http://www.herballegacy.com/Peret_Chemical.html, 23 August, 2014.
78. Gupta AK. Quantitative analysis of medicinal aromatic plants, 2003, 3, 125-129.
79. Important Anti-Cancer & Cardio Protective Herbs and Spices, http://www.cosmicsolutions.org/health/docs/iaccphs.pdf, 23 August, 2014.
80. Muhammad Nadeem, Asad Riaz. Cumin (*Cuminum cyminum*) as a potential source of antioxidants Journal of Food Sciences 2012; 22(2):101-107.
81. Sarika S. Shirke and Aarti G. Jagtap. Effects of methanolic extract of Cuminum cyminum on total serum cholesterol in ovariectomized rats Indian J Pharmacol 2009; 41(2):92-93.
82. Suresh C. Joshi, Nidhi Sharma and Preeti Sharma. Antioxidant and lipid lowering effects of *Coriandrum sativum* in cholesterol fed rabbits International Journal of Pharmacy and Pharmaceutical Sciences 2012; 4(3):231-234.
83. Christine M. Kaefer and John A. Milner. Herbs and Spices in Cancer Prevention and Treatment in Herbal Medicine: Biomolecular and Clinical Aspects. 2nd edition.Editors Benzie IFF, Wachtel-Galor S. Boca Raton (FL): CRC Press, 2011.