# Traditional Sri Lankan Spices for Dyslipidemia

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***Abstract-*** Sri Lanka is a country where has efficacious food cultures related to their traditional life styles. In traditional food recipes native spices such as *Garcinia cambogia* or *Garcinia zeylanica* (Goraka or Malabar Tamarind), *Tamarindus indica* (Siyambala or Tamarind), *Piper nigrum* (Gammiris or Pepper), *Trigonella foenum-graecum* (Uluhal or fenugreek) and *Cinnamomum zeylanicum* (Kurundu or Cinnamon) are enriched. Recent advances in global perspectives on non-communicable diseases reconsidering traditional foods including spices for health prevention and promotion. Therefore, the current study aims to review ethnomedicinal value of aforementioned spices considering its biochemical effect on lipid profile including total cholesterols, triglycerides, low density lipoproteins and high density lipoproteins at cell biology and effect on biochemistry in cellular level. The study was designed as a literature review through primary and secondary literature sources which are available online with utmost attention to peer reviewed and indexed journal articles. Thirty articles were considered as references while reviewing fifty two related research studies. Biochemical modifications in cellular sites relevant to management of serum lipid values were identified in each of spices. Biochemical effect on lipogenesis and lipid metabolism in each variety were identified. The study suggests that the consumption of spices is beneficial in lipid level management.

***Index Terms***- Sri Lankan spices, lipid profile, traditional foods, cholesterol

## I. Introduction

Hyperlipidemia is a key risk factor for cardiovascular diseases1. According to the Katulanda et al, three in four Sri Lankan adults have some form of dyslipidemia due to some leading modifiable risk factors such as physical inactivity, obesity, hypertension, and diabetes etc. (Katulanda et al, 2018). A recent study has revealed that high plasma triglyceride concentrations, low HDL concentrations and elevation of small LDL cholesterol particle concentrations are characteristic of diabetes dyslipidemia because low HDL cholesterol followed by hypertriglyceridemia is the common onset lipid abnormality found in Sri Lankan patients with type 2 diabetes (Suganthan & Sivansuthan, 2016). Total 5% among Sri Lankan populations are affected by hypercholesteremic condition (Department of Census & Statistics, 2017).

Therefore, diet modification for dyslipidemia patients is much beneficial. In current trends, global perceptiveness in recent advances in traditional food cultures and life styles are mostly discussed. As a south Asian country, Sri Lanka carries rich bio diversity with expanded traditional food cultures correlate with native lifestyles. Traditional Sri Lankan cousins are enriched with spices which make a tastiest outcome. Other than the taste, aforementioned recipes are having positive evidences on health promotion and prevention. Hence, prevalence from non-communicable diseases through proper consumption of traditional spices is much beneficial with ecofriendly consumption.

Ayurveda Pharmacopeia of Department of Ayurveda, Sri Lanka describes number of spices and spices contained medicinal recipes for the management of dyslipidemia (Medo roga) and obesity (Sthaulya). *Garcinia cambogia* or *Garcinia zeylanica* (Goraka or Malabar Tamarind), *Tamarindus indica* (Siyambala or Tamarind), *Piper nigrum* (Gammiris or Pepper), *Trigonella foenum-graecum* (Uluhal or fenugreek) and *Cinnamomum zeylanicum* (Kurundu or Cinnamon) are extensively used spices among traditional Sri Lankan cuisines because of the taste and ethno-medicinal value. Aforementioned spices are commonly available in Sri Lankan market because of cost effect and wide popularity among all ethnic groups of Sri Lanka.

Both of vegan and non-vegan cousins are getting proper taste using spices, additionally medicinal value of spices elaborates prevention from both of communicable and non-communicable diseases. In communicable diseases, spices support in enhancement of the immunity and considerable antimicrobial effect as well in non-communicable diseases regulation of the physical metabolism is occurred with the support of aforementioned spices. Therefore, time tested, cost effective, widely available and health effective ingredients which are easily consumable much beneficial in routine practice for both of healthy and dyslipidemia affected individuals (Liyanage & Karunarathne, 2015).

### A. *General Objective*

To study the effect of traditional Sri Lankan spices in dyslipidemia condition.

### B. *Specific Objectives*

1. To study the biochemical effect of *Garcinia cambogia* and *Garcinia zeylanica* on lipid profile.
2. To study the biochemical effect of *Tamarindus indica* on lipid profile.
3. To study the biochemical effect of *Piper nigrum* on lipid profile.
4. To study the biochemical effect of *Trigonella foenum-graecum* on lipid profile

5. To study the biochemical effect of *Cinnamomum zeylanicum* on lipid profile.

## II. METHODOLOGY

The study based on a literature survey through primary and secondary literatures which were published online in peer reviewed or indexed journals in relevant field.

Fifty two research articles which discuss on ethnomedicinal value of aforementioned spices referring biochemical modifications over lipid profile were selected for the reviewing purpose. Out of 30 articles were considered for the study with highly assured scientific evidences. Biochemical modifications on lipid profile such as effect on total cholesterol level, triglyceride level, low density lipoprotein level (LDL) and high density lipoprotein level were reviewed.

Additionally, enzymatic actions and effect of hepatic-pathology were reviewed according to the availability of accepted scientific information.

## III. PHARMACOLOGICAL REVIEW

### *A. Garcinia cambogia or Garcinia zeylanica*

Both of *G. cambogia* and *G. zeylanica* are used in Traditional recipes specially taken for sour taste. *G. zeylanica* is endemic to Sri Lanka5. Chemical components of Garcinia extracts include xanthones, benzophenones, amino acids and organic acids. Most importantly Hydroxycitric acid is contained. The aforesaid ingredient is responsible in anti-inflammatory and appetite suppressant activity (Livertox, 2012).

*G. cambogia* mainly consists with Hydroxycitric acid which acts as an anti-obesity agent by functioning over nuro-endocrinal pathways producing an anorectic effect through inhibiting citrate lyase enzyme that suppress the appetite and increase the fat digestion. Therefore, the body increases the oxidation of carbohydrates and inhibits the lipogenesis. As well, *G. cambogia* responsible in reduction of lipid levels in blood such as triglycerides and cholesterol besides of increasing thermogenesis. Specially, Hydroxycitric acid inhibits extra-mitochondrial citrate lyase enzyme that catalyzes the cleavage of citrate to Acetyl-CoA and oxaloacetate, a key step in lipogenesis, necessary for the synthesis of fatty acids and cholesterols through appetite suppressing activity. *G. cambogia* has contributed to the anti-obesity effects via the release of serotonin in the brain, which has been considered as the main mechanism to decrease appetite and absorption of glucose and also in the increase of oxidation of fat with reducing lipogenesis (Fassina et al, 2015).

Similarly, Hydroxycitric acid reduces food consumption in humans and in rodents with obesity, by converting carbohydrates and fatty acids in the liver into hepatic glycogen (Kim et al, 2008). Hydroxycitric acid inhibits ATP citrate lyase an enzyme involved in fatty acid synthesis. *Garcinia* derivatives and Hydroxycitric acid have been shown to cause appetite suppression and weight loss in rats, but the effects of these organic acids and *Garcinia* extracts have not been consistently found in human studies (Livertox, 2012).

*G. cambogia* extract decreased both of leptin concentration and the sizes of adipocytes, which responsible in decrease of lipid accumulation in the visceral adipocytes of rodents (Kim et al, 2008), as well as modulation of the multiple genes associated with visceral adipogenesis such as mRNA expression of PPARγ2, SREBP1c, C/EBPα, and aP2 in the visceral fat tissue of mice, therefore, anti-obesity effects are available with the plant (Kim et al, 2008). Application of fruit rind of *Garcinia* effectively protects myocardial cells from lipid peroxidation (signs of inflammation and fatty degeneration). Administration of *Garcinia* according to a dose dependent manner, decrease elevated serum lipids including Triglycerides (TGL), Total Cholesterol (TCL), Low Density Lipoproteins (LDL) and serum Very Low Density Lipoproteins (VLDL) counts, as well as serum High Density Lipoprotein (HDL) count is getting increased (Datchanamurty et al, 2019).

### *B. Tamarindus indica*

The fruit of *Tamarindus indica* is rich in phytochemicals such as Alkaloids, saponins, steroids, phlobatannins, terpenoids, phenols, coumarins and leucoanthocyanins. *T. indica* depicts an expanded effect on human lipid profile. Significant reduction was observed in lowering total cholesterol level and LDL-cholesterol level in body without altering the level of HDL-cholesterol. Reduction in total TCL level is responsible in decrease of intracellular cholesterol which causes an upregulation of LDL-receptor (Iftekhar et al, 2006).

Tamarind seeds contain phenolic compounds such as phytosterols including β-sitosterols which responsible in decrease plasma lipoprotein and cholesterol levels via reducing the cholesterol solubility and absorption across the intestinal barrier as well excretion of unabsorbed cholesterol such as low density lipoproteins with stool are stimulated by hydrophobicity of phytosterols (Uchenna et al, 2018).

Administration of *T. indica* fruit pulp to hypercholesterolemic rodents significantly lowered serum TGL, TCL and LDL-C levels, even though none of effect on the HDL-C level was recorded. Significant increase in the expression of Apo A1, Abcg5 and LDL receptor genes and significant decrease in the expression of HMG-CoA reductase and Mtp genes was responsible in lipid lowering effect of the fruit. As well, protects against oxidative damage by increasing hepatic antioxidant enzymes, antioxidant activities and preventing hepatic lipid peroxidation (Lim et al, 2013).

### *C. Piper nigrum*

*Piper nigrum* contains with piperine, and oleoresin which are responsible in scavenge superoxide anion radicals and hydroxyl radicals, and resist linoleic acid lipid peroxidation (Kapoor et al, 2009). Prevent from oxidative damage, lowering lipid peroxidation and enhancing the bioavailability of some therapeutic drugs, reduces total cholesterol, free fatty acids, phospholipids and triglycerides in plasma and tissue of rats were reported with pepper and piperine due to the anti-oxidant effect. Pepper effectively inhibit cholesterol uptake into differentiated

Caco-2 cells as well as reduce plasma levels of TCL, LDL and VLDL. Translocation of cholesterol transporter NPC1L1 and SR-BI proteins to the cytosol is results in inhibition of cholesterol uptake (Duangjai et al, 2013).
Black pepper significantly elevates the plasma HDL-cholesterol levels due to increased activity of lipoprotein lipase and lecithin cholesterol acyl transferace enzymes (Vijayakumar et al, 2002). Additionally, lowers accumulated lipids in tissues via reducing extrahepatic circulation and increasing the peripheral excretion of lipids via HDL, which transports excess peripheral tissue lipids to liver for excretion. Antioxidant properties of pepper reduce the susceptibility of lipids to oxidation and stabilize the membrane lipids through reducing oxidative stress (Vijayakumar et al, 2002).
Administration of piperine as a supplement significantly reduces the levels of plasma TCL, LDL, VLDL tissue HMG CoA reductase. Lipogenic enzymes are inhibited at piperine. Simultaneous supplementation of piperine significantly enhanced further excretion of bile acids and neutral sterols in rodents. Therefore, piperine can prevent the accumulation of plasma lipids and lipoproteins significantly by modulating the enzymes of lipid metabolism (Vijayakumar & Nalini, 2006).
Piperine promotes cholesterol efflux in THP-1-derived macrophages and upregulates ATP Binding Cassete transporter A1 protein level, which is mediated at least in part by inhibition of calpain enzymatic activity (Wang et al, 2017).

### *D. Trigonella foenum-graecum*

Mostly bioactive compounds contain in fenugreek seeds are diosgenin, 4-hydroxyisoleucine (4-OH-Ile), and the soluble dietary fibers. Fenugreek is highly responsible in healthy fat cells, which are indispensable to robust metabolic health by virtue of their endocrine function and capacity to safely store lipids (Fuller & Stephens, 2015). As well, lysine and Ltryptophan-rich proteins, mucilaginous fiber and other rare chemical constituents, such as coumarin, fenugreekine, nicotinic acid, folic acid, sapogenins, phytic acid, scopoletin and trigonelline, which are effective in inhibition of cholesterol absorption and decrease blood sugar concentrations (Fedacko et al, 2016).
Knott et al, explained the importance of fenugreek at their metabolic health study as, fenugreek significantly developed HDL to LDL ratios in high fat-fed rodents without affecting circulating TCL, TGL or glycerol levels. Fenugreek decreased hepatic expression of fatty acid binding protein 4 and increased subcutaneous inguinal adipose tissue expression of adiponectin, even though not effect in prevention from hepatic steatosis. The study revealed that fenugreek promotes metabolic resiliency through significant and selected effects on glucose regulation, hyperlipidemia, and adipose pathology (Knott et al, 2017).
Fenugreek seeds and diosgenin both contains with anti-inflammatory properties while diosgenin inhibits expression of VCAM-1 (vascular cell adhesion molecule) and ICAM-1 (intracellular adhesion molecule), proteins involved in the pathogenesis of atherosclerosis, abolishes TNF-α induced production of intracellular ROS (Reactive Oxygen Species) and inhibits NF-κ Band IκB kinase activation, along with subsequent degradation of IκBα, and nuclear translocation of NF-κB. These findings show that diosgenin is a potent agent for inhibiting the formation and growth of atherosclerotic lesions (Szabo et al, 2018).
4-hydroxy isoleucine in fenugreek is highly responsible in hypolipidemic effect through action on the adipocytes and the liver cells, which leads to decreased triglycerides and cholesterol synthesis in addition to an enhanced LDL receptor mediated LDL uptake (Sharma & Choudhary, 2014).
Saponin in Fenugreek effects on ameliorating dyslipidemia are probably related to accelerated cholesterol metabolism, inhibited cholesterol synthesis, and facilitated reverse cholesterol transport, while not effective in cholesterol absorption (Chen et al, 2017).

### *E. Cinnamomum zeylanicum*

As active ingredients of cinnamon, it is enriched with trans-cinnamaldehyde or cinnamaldehyde (Mahmoodnia et al, 2017). Gullapalli et al, mentioned that intake of one, three, or six grammes of cinnamon per day reduces serum glucose, TGL, LDL and TCL in people with type 2 diabetes and suggest that the inclusion of cinnamon in the diet of people with type 2 diabetes will reduce risk factors associated with diabetes and cardiovascular diseases (Gullapalli et al, 2013).
Khan et al, revealed that cinnamon reduced blood serum TGL, LDL and TCL significantly in type 2 diabetic individuals while they recommended that who have type 2 diabetes mellitus, or hyperlipidemic or hypercholesterolemic conditions, they should use cinnamon on regular basis as 1-3 g cinnamon per day (Khan et al, 2003). Therefore, cinnamon supports in preventing increased levels of lipid profile in hyperlipidemia cases.
Cinnamate, a phenolic compound found in cinnamon reduces cholesterol level in high fat fed rodents by inhibiting hepatic HMG Co-A reductase activity (Amin & Abdel, 2009). Polyphenolics in cinnamon contain with antioxidant activity and have depicted positive effect in reduction of oxidative stress in dose dependent manner through inhibition of 5-lipoxygenase enzyme (Anderson et al, 2004).
Cinnamon responsible in lipid metabolism and prevent hypercholesterolemia and hypertriglyceridemia and reduce free fatty acids through a strong lipolytic activity. Dietary cinnamate inhibits the hepatic HMG Co-A reductase activity resulting in lower hepatic cholesterol content and suppresses lipid peroxidation through enhancement of hepatic antioxidant enzyme activity (Lee et al, 2003).
An another study reveals that the cinnamon powder equivalent to 6 gm/kg body weight responsible in a substantial reduction in triglycerides (41.81%) and LDL (80.37%) after supplementation of cinnamon powder equivalent to 6 gm/kg body weight demonstrates its importance in preventing cardiovascular diseases. Iqbal et al, demonstrated that the cinnamon responsible in hypolipidemic effect due to the presence of some hypolipidemic compounds which act as an inhibitor for some enzymes such as HMG Co-A reductase, which inhibits the cholesterol production in liver of rats or decrease the cholesterol absorption form intestine (Iqbal et al, 2016).

## IV. CONCLUSION

Phytochemicals and related other active ingredients in *Garcinia cambogia* or *Garcinia zeylanica*, *Tamarindus indica*, *Piper nigrum*, *Trigonella foenum-graecum* and *Cinnamomum zeylanicum* are highly responsible in dyslipidemia conditions, especially in hypercholesteremic condition, which elaborates positive evidences controlling TCL, TGL, HDL and LDL in lipid profile elaborating healthy lifestyle of native Sri Lankans through their traditional food cultures.

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