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The Potential of Catechin-Containing Plants as Antihyperlipidemic Treatment: A Review

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ABSTRACT

Hyperlipidemia is a condition characterized by elevated levels of cholesterol and triglycerides. Hyperlipidemia can lead to vascular disorders affecting the heart and brain, potentially resulting in severe complications such as coronary heart disease and stroke. A range of treatment strategies are employed to manage this condition encompassing the use of drugs as well as traditional medicinal approaches. Among these, the use of medicinal plants presents a promising option which considering relatively safe owing to their natural origin and minimal risk of significant side effects, as well as their bioactive compounds. Catechin is one of secondary metabolites commonly found in plants which showed various biological activities that potential for medicinal use. The aim of this review was to provide a comprehensive review of existing literature regarding the catechin-containing plants in lowering cholesterol and triglyceride levels. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) was employed to select literature obtained from reputable online databases such as Google Scholar, PubMed and Science Direct which were published from 2015 to 2025. A narrative analysis was performed to assess the selected literatures. Based on literature screening, 200 articles were identified of which 14 were selected for inclusion in the review based on predefined criteria. This study highlighted the therapeutic potential of medicinal plants containing catechins which exhibit efficacy in reducing cholesterol and triglyceride levels. Medicinal plants may offer an effective herbal remedy for reducing cholesterol and triglyceride levels, with catechins may have a contribution to this activity.

Keywords: Hyperlipidemia, Cholesterol, Triglyceride, Catechin, Medicinal Plants

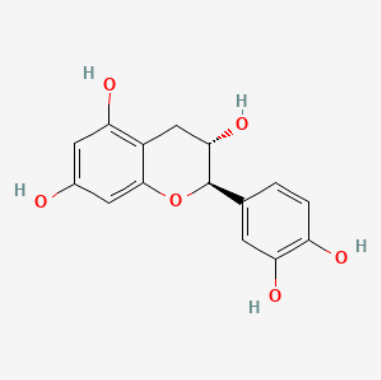
INTRODUCTION

Cholesterol is a lipid substance in the blood crucial to various bodily functions. In contrast, triglycerides are a fat formed from excess dietary calories, serving as a energy storage reservoir. Elevated levels of both cholesterol and triglycerides can lead to hyperlipidemia and causing significant damage to blood vessels due to plaque accumulation, blood clot formation and decreased flexibility of arteries. These pathological changes can result in severe health complications, including coronary heart disease and stroke, which may be pose life-threatening risks (Setiyawati et al., 2021). Dietary habits play a critical role in the development of cholesterol-related diseases, with diets high in saturated fats and low in dietary fiber as primary contributors (Ampangallo et al., 2021). Additionally, high triglyceride levels are influenced by several factors, including aging, consumption of fatty foods, a sedentary lifestyle, tobacco use, and irregular sleep patterns (Setiyawati et al., 2021).

The management of hyperlipidemia treatments typically involve a combination of lifestyle changes and dietary adjustments. Medication is generally recommended when these approaches are insufficient to control cholesterol and triglyceride levels, or when a person is at high risk for cardiovascular disease. Statins and other drugs are commonly used in hyperlipidemia treatment; however, they may cause side effects such as muscle pain, depression, sleep disturbance and in rare cases, can lead to liver damage (Thompson et al.,

2016). Alternatively, medicinal plants which applications are primarily grounded in long-standing traditional practices, have emerged as a viable option because the side effects associated with medicinal plants are either lower or non-existent compared to those linked to chemical drugs. This reduced risk contributes to the reputation of medicinal plants as a safer option for healthcare, further encouraging their use among those seeking natural therapies, thus enhancing the appeal of these traditional remedies (Deeng & Mulianti, 2023). The bioactive compounds present in medicinal plants are recognized to have diverse pharmacological properties that potentially alleviate a range of diseases.

Catechins are a group of natural polyphenolic compounds that are part of the flavonoid family, commonly found in a variety of plant-based foods and beverages. Catechin has molecular formula $C_{15}H_{14}O_6$ and has a role as an antioxidant and a plant metabolite.



Pic 1. Structure of Catechin access from PubChem

Catechins are flavan-3-ols which structure possess various types namely catechin, epicatechin, epicatechin gallate, epigallocatechin, epigallocatechin gallate, gallocatechin, catechin gallate and gallocatechin gallate (Mita et al., 2024). These compounds are known for their diverse physiological activities and health benefits, making them a subject of significant scientific inquiry. Catechin have been shown to demonstrate various biological activities. This review provides catechin-containing plants with a particular emphasis on their potential efficacy in enhancing lipid profiles, specifically in reducing cholesterol and triglyceride levels.

METHODS

The method employed for this review is a narrative analysis, which involves examining articles from previous research. The study focuses on a collection of scientific articles pertinent to the topic of this review article, all of which are in online formats. PRISMA diagrams was used for the literature selection process.

Search Methodology

The literature is from reputable databases, including Google Scholar, PubMed, and Science Direct. The search utilized various terms and keywords, including "catechin," "hyperlipidemia," "cholesterol and triglycerides," and "catechin to lower cholesterol and triglycerides levels." The selected articles are from national and international journals published within the last decade, specifically from 2015 to 2025.

Data Extraction

Non-scientific articles, articles in non-English/Indonesian languages without translation, and research irrelevant to the topic covered. The procedure is carried out to obtain valuable literature relevant to review. The authors implemented standardized protocols to collect and evaluate articles relevant to their study. The selected articles provided insights into hyperlipids and included information on various plant species that exhibit the capacity to overcome hyperlipidemia.

The criteria for data extraction included the following: 1) the presence of catechin in the plant, 2) publication dates spanning from 2015 to 2025, 3) evidence that extracts or fractions of the plant can effectively combat hyperlipidemia, 4) open-access articles, and 5) articles published in either English or Indonesian. Ultimately, 14 articles were selected for this review.

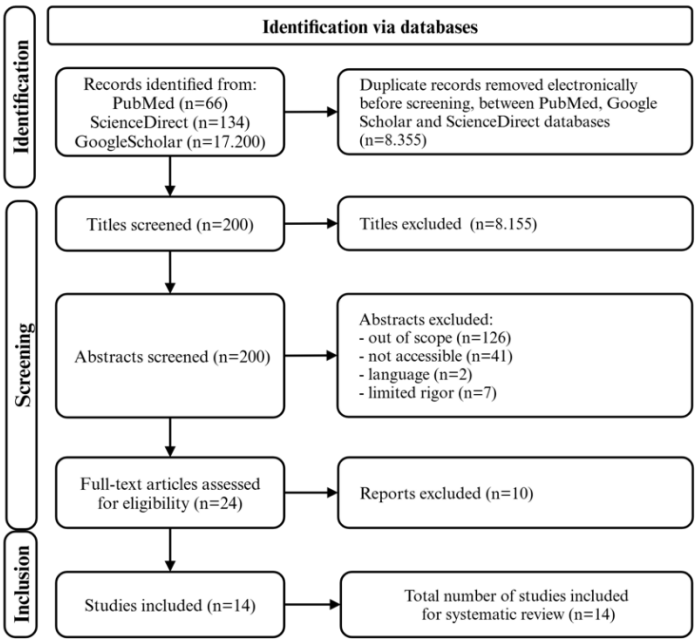
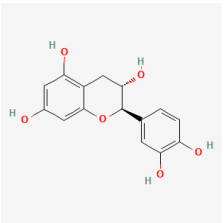
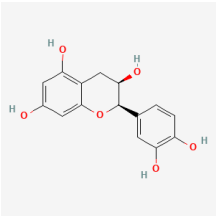


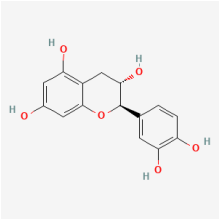
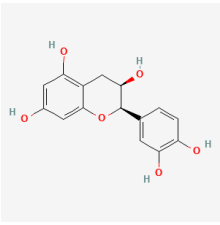
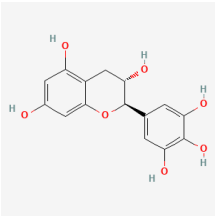
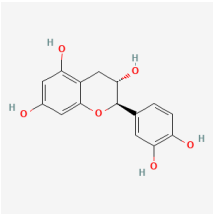
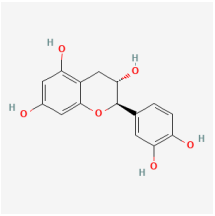
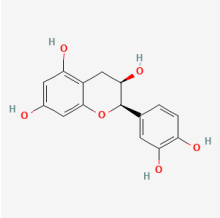
Figure 1. Flow chart of PRISMA in Article Selections

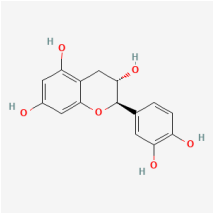
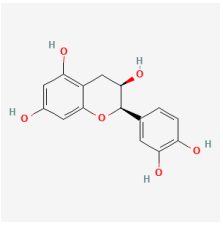
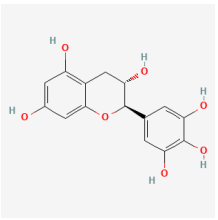
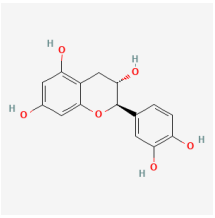
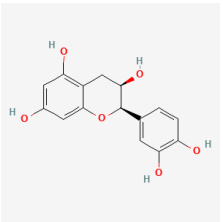
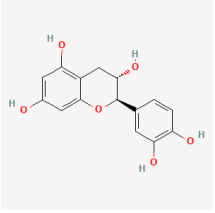
RESULTS AND DISCUSSION

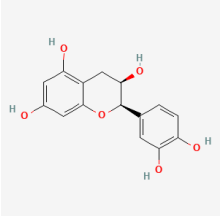
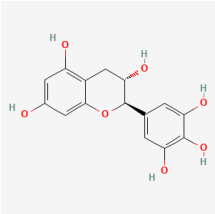
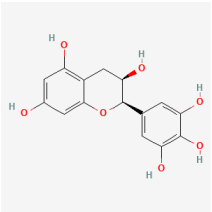
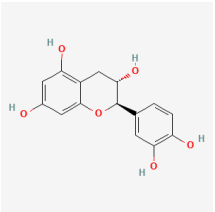
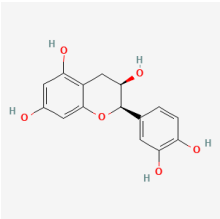
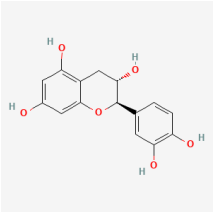
Research has shown that numerous plants containing catechins, as detailed in Table 1, may help to reduce cholesterol and triglyceride levels.

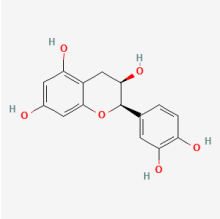
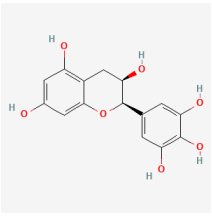
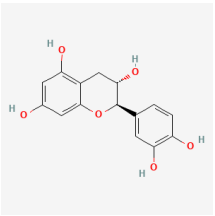
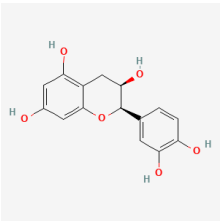
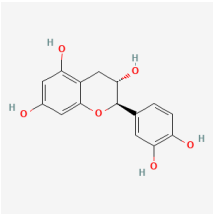
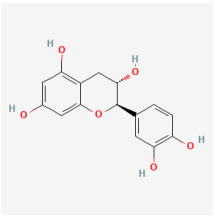
Table 1. Plants species containing catechins potentially to lower cholesterol and triglyceride levels.

No	Species	Types of Catechin	Instrument	Activity	Reference
1.	*Litsea coreana*	Catechin  Epicatechin 	Literature review	Lowers Cholesterol and Triglyceride level with 200 mg/kg total Flavonoid of *L. coreana*	(Jia et al., 2017)

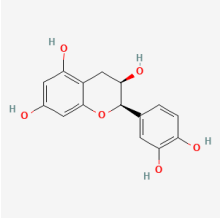
2.	*Salvia hispanica*	Catechin  Epicatechin  Gallocatechin 	Literature review	Lowers total Cholesterol level with 2.6% chia seeds per-meal	(Gabal, 2024)
3.	*Morus nigra*	Catechin 	In vitro and In vivo research	Lowers Cholesterol Level with 100, 200 or 400 mg/kg of *Morus nigra* serum	(Zeni et al., 2017)
4.	*Ulmus macrocarpa*	Catechin 	Double-blind placebo-controlled randomized clinical trial	Lowers total Cholesterol and LDL-c level	(Lee et al., 2022)
5.	*Pyrus malus*	Epicatechin 	Literature review	Lowers total Cholesterol with 5–10 g of soluble fibre from the intake of apple	(Naseer et al., 2021)

6.	*Manilkara zapota*	Catechin  Epicatechin  Gallocatechin 	Literature review	Lowers total Cholesterol and Triglyceride level with concentration of 0.2 mg/mL	(Rivas-Gastelum et al., 2023)
7.	*Momordica charantia*	Catechin  Epicatechin 	Literature review	Lowers Triglyceride level	(Fan et al., 2019)
8.	*Uncaria gambir*	Catechin  Epicatechin	Literature review	Lowers total Cholesterol and Triglyceride level	(Yunarto et al., 2021)

		 Gallocatechin  Epigallocatechin 			
9.	*Camellia sinensis*	Catechin  Epicatechin 	Literature review	Lowers total Cholesterol and increase HDL level	(Yazdanpanah et al., 2022)
10.	*Psidium guajava*	Catechin  Epicatechin	Literature review	Lowers total Cholesterol and Triglyceride level	(Kumar et al., 2021)

		 Epigallocatechin 			
11.	*Vitis vinifera*	Catechin  Epicatechin 	Literature review	Lowers total Cholesterol, LDL and Triglyceride level	(Insanu et al., 2021)
12.	*Vigna radiata*	Catechin 	Literature review	Lowers total Cholesterol, non-HDL-c and Triglyceride level	(Hou et al., 2019)
13.	*Theobroma cacao*	Catechin 	Literature review	Lowers total Cholesterol and inhibit LDL	(Edo et al., 2023)

Epicatechin



Uncaria gambir known as a rich source of catechin (Yunarto et al., 2021) which have demonstrated pharmacological effects on cholesterol and triglyceride levels. An in vivo study by Yunarto et al. (2015) reported that the ethyl acetate fraction of *U. gambir* was able to significantly decrease the total cholesterol, triglycerides and LDL (Low Density Lipoprotein) levels as well as increasing the HDL (High Density Lipoprotein) level of hyperlipidemic rats (Yunarto et al., 2015). These activities were attributed to catechin via two main mechanisms namely by inhibiting the HMG-CoA reductase enzyme and by increasing the number of LDL receptors, as evidenced by in silico study catechins inhibit HMG-CoA reductase and LDL receptors, thus inhibiting the formation of cholesterol. (Adelina, 2018).

Camellia sinensis, known is tea, is believed to have health beneficial effects due to the bioactive polyphenol compounds such as catechins and epicatechins (Samanta, 2022). The consumption of black tea compound may have effect in lowering the LDL/HDL ratio, triglyceride and plasma cholesterol levels due to its polyphenol compounds (Samanta, 2022). Moreover, epigallocatechin gallate (ECGC), the most abundant catechins in green tea contributed in decreasing the level of cholesterol and triglycerides. The proposed mechanisms of EGCG containing in green tea are include the inhibition of cholesterol biosynthesis, interference with lipid absorption and enhancement of fecal cholesterol excretion (Samavat et al., 2016). ECGC structure, particularly the gallate group and hydroxyl-rich aromatic rings, enables high-affinity interactions with biological targets. Another study suggested that catechins attribute to reduced lipid absorption in the intestines by inhibiting pancreatic lipase activity and decreasing lipid hydrolysis and emulsion formation (Chen et al., 2020). Other plant species containing catechins also exhibit pharmacological activity in lowering cholesterol and triglyceride levels.

Litsea coreana has been shown to reduce triglyceride and LDL levels, while *Vitis vinifera* has demonstrated the ability to inhibit lipid absorption and enhance lipoprotein lipase activity. Both plants contain catechin and epicatechin, which are likely responsible for these effects (Insanu et al., 2021; Jia et al., 2017). *Salvia hispanica*, rich in catechins, epicatechins, and gallocatechin, was reported to decrease PPARα (Peroxisome Proliferator-Activated Receptor Alpha) activity and reduce plasma fatty acids decrease PPARα activity (Gabal, 2024). Additionally, *Manilkara zapota*, with its catechin, epicatechin, and gallocatechin content, not only inhibits the expression of pro-inflammatory cytokines but also enhances lipid metabolism. The inhibitory effect could reach up to 90, at 8 µg/ml, with low IC_{50} values of 4.20 ± 0.20 and 16.6 ± 0.30 µg/ml, respectively (Rivas-Gastelum et al., 2023). Ulmus macrocarpa supplementation could improve lipid profiles in adults with high LDL-C concentrations without toxicity or severe adverse effects (Lee et al., 202). Meanwhile, *Vigna radiata*, containing catechins, effectively reduce triglyceride levels and non-high-density lipoprotein cholesterol total cholesterol (Hou et al., 2019). *Psidium guajava*, rich in catechins, epicatechins, and epigallocatechin gallate, has been shown to lower total cholesterol and triglycerides while increasing high-density lipoprotein (HDL) levels (Kumar et al., 2021).

For reducing triglyceride level, *Pyrus malus*, a plant species rich in epicatechin, demonstrated fat oxidation promotion and fat accumulation reduction (Naseer et al., 2021). Similarly, *Momordica charantia*, which contains both catechin and epicatechin, enhances the activity of adenosine monophosphate-activated protein kinase (AMPK), a key regulator

of fatty acid oxidation, thereby promoting fat breakdown, reducing overall fat storage, and improving lipid metabolism (Fan et al., 2019).

Regarding cholesterol management, a plant species containing catechin, *Morus nigra*, has been exhibited to normalize hyperlipidemic disturbances, effectively lowering elevated cholesterol levels (Zeni et al., 2017). Additionally, *Theobroma cacao*, in which catechin and epicatechin were presence, has demonstrated the ability to inhibit LDL oxidation while elevating HDL levels (Edo et al., 2023). The finding from this review collectively emphasizes the therapeutic potential of plants containing catechins in managing hyperlipidemia by reducing cholesterol and triglyceride levels.

CONCLUSION

This review suggests that tea and cocoa (dark chocolate) may serve as effective herbal treatments for lowering cholesterol and triglyceride levels, with catechins may have contributions in this process. However, further research is essential to evaluate the safety, optimal dosages, potential side effects, and possible interactions with other medications associated with the long-term use of catechin compounds.

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