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Cacao, the origin of chocolate, can lower lipid profiles? A systematic review

Jofa Frizky Kandar [1], Maftuchah Rochmanti [2,*], Citrawati Dyah Kencono Wungu [3] and Ema Qurnianingsih [3]

[1] *Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia*
[2] *Division of Pharmacology and Therapy, Department of Anatomy, Histology, and Pharmacology, Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia*
[3] *Department of Physiology and Medical Biochemistry, Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia.*

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Abstract

Dyslipidemia is a non-communicable metabolic disorder characterized by abnormal blood fat levels, including total cholesterol, Low-Density Lipoprotein (LDL), High-Density Lipoprotein (HDL), and Triacylglycerol (TG). Dyslipidemia can lead to life-threatening complication. One of non-pharmacological treatment for dyslipidemia patient is healthy lifestyle such as nutritional modification. Cacao is a rich source of polyphenols with various health benefits. Polyphenols, mainly consisting of flavonoids, act as potent antioxidants. They contribute to increased blood flow, lowered blood pressure, elevated HDL, protection of LDL against oxidation, reduced cardiovascular disease risk, sun protection for the skin, and improved blood flow to the brain. This study aimed to investigate the impact of cacao product such as cocoa and chocolate on patients with dyslipidemia. The research employed the systematic literature review method of Randomized Control Trial (RCT). A total of 10 journal articles from the PubMed online journal system, Cochrane Library, and ScienceDirect were selected based on keywords using the PICO method and specific research criteria. The variables in this study included cocoa and chocolate administration and dyslipidemia, focusing on lipid profiles (total cholesterol, LDL, HDL, and TG). The study results conclude that several factors influence the effect of cacao products administration on changes in lipid profiles (total cholesterol, LDL, HDL, and TG). These factors encompass the type of active ingredient, duration, administration dosage, age, underlying diseases, patient compliance, and additional interventions.

Keywords: Dyslipidemia; Cacao; Lipid Profiles; Healthy Lifestyle

1. Introduction

Dyslipidemia is a non-communicable disease currently on the rise in Indonesia. Dyslipidemia is indicated by abnormal blood fat levels, including total cholesterol, Low-Density Lipoprotein (LDL), High-Density Lipoprotein (HDL), and triacylglycerol (TG). Its prevalence has reached 28.8% among individuals aged 15 and above. 72.8% have LDL levels above 100 mg/dL; 24.4% have HDL levels below 40 mg/dL, and 27.9% have triacylglycerol levels above 150 mg/dL [1]. One of the concerns associated with dyslipidemia is complications, especially cardiovascular diseases. The management of dyslipidemia involves not only pharmacological but also non-pharmacological therapies. One non-pharmacological therapy for dyslipidemia patients is nutritional modification [2]. Several types of nutrients that have been extensively studied and shown positive effects on lipid profiles include unsaturated fatty acids, dietary fiber, vegetable protein, phytosterols, and polyphenols [3].

Cacao is a plant rich in polyphenols believed to be the basis for its health benefits [4]. Cacao is known to have numerous benefits, extending even to the seed and fruit peel [5]. Cacao can be processed into cocoa powder, dark chocolate, and cocoa butter. Cocoa and chocolate are one of the most concentrated sources of procyanidin flavonoids, namely catechin, and epicatechin. Epicatechin has been proven to improve blood vessel function, insulin sensitivity, reduce blood

* Corresponding author: Maftuchah Rochmanti; Email: maftuchah-r@fk.unair.ac.id

pressure, platelet reactivity, and act as a potent antioxidant [6], [7], [8], [9], [10]. The flavonoid content, also present in dark chocolate, provides hydrogen atoms to neutralize free radicals in the flavonoid structure [11]. Studies suggest that catechin can increase vitamin E levels in LDL, preventing LDL from peroxidation [12], [13].

Therefore, this study will discuss the benefits of cocoa on the lipid profile of patients with dyslipidemia. With knowledge of these benefits, it is hoped to become an alternative treatment for dyslipidemia patients and serve as a basis for the development of clinical trials on cocoa products.

2. Methods

This research employs the systematic literature review method for Randomized Control Trial (RCT), with data sourced from the online journal systems PubMed, Cochrane Library, and ScienceDirect. The study is conducted in three stages: data retrieval, data compilation, and data interpretation. Before data retrieval, the initial appropriate step is to define PICO; P (Hyperlipidemia or Hyperlipidemias or Hypercholesterolemia or Lipid Metabolism Disorders), I (Cacao or Chocolate or Cacao Powder or Theobroma cacao), C (Placebo), and O (Lipid Profile or Total Cholesterol or LDL or HDL or Triglycerides). The inclusion criteria for this study are research studies aligned with PICO, RCT study design, the presentation of full-text articles, and the article is in English language. The exclusion criteria for this study are research that does not comprehensively discuss lipid profiles.

3. Results

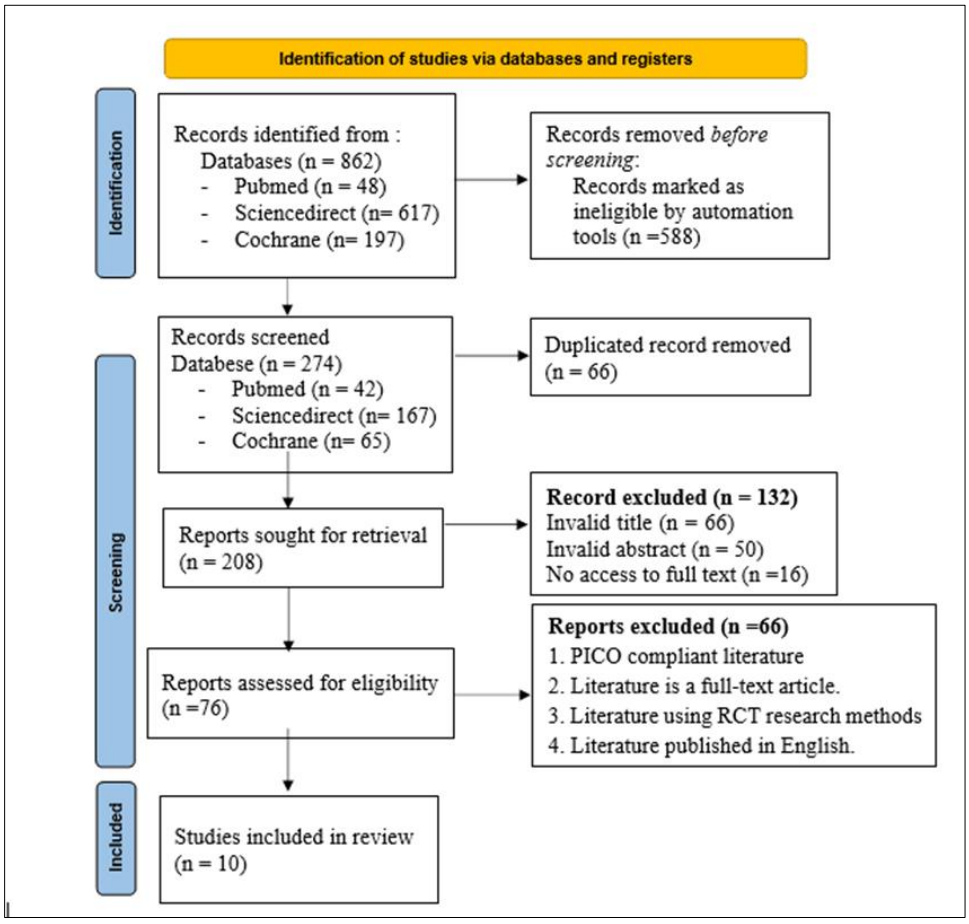

Figure 1 PRISMA flow diagram

In this research, after conducting a systematic search, 862 journals were identified. Following the completion of the search process, all journals were imported, and duplicate screening was performed using the Mendeley automation tool. Journals were then eliminated based on the predetermined inclusion and exclusion criteria (Figure.1). After going through a series of screening processes, in line with the pre-established inclusion and exclusion criteria, a total of 10 journals were identified for further analysis of their quality using RoB 2.

The results of the analysis of the 10 journals indicate that 3 journals report a significant effect of cocoa on total cholesterol [14], [15], [16], while 7 other journals state that there is no significant effect. Regarding the influence of cocoa on LDL, 5 journals report a significant effect [14], [15], [16], [17],[18] while 5 other journals state that there is no significant effect. The significant influence of cocoa on triglycerides also showed in 5 journals [14], [16], [18]. [19], [20]. In contrast to the results regarding the effect of cocoa on HDL, only 2 journals declare a significant effect [14]. [18]. There are 3 journals showed no significant result in any lipid profiles [21], [22], [23]. Detailed result shown in Table.1

Table 1 Mean change and P value result

Author	Sample	Total Cholesterol		LDL		HDL		TG	
		Mean Change	P value	Mean Change	P value	Mean Change	P value	Mean Change	P value
Jafarirad, 2018	n = 44	-6,95±25 (mg/dL)	0,01*	-15,6±21 (mg/dL)	0,004*	1,7±3.8 (mg/dL)	0,05*	-33,6±37 (mg/dL)	0,001*
Dicks, 2018	n = 42	-0,1±0.2 (mmol/L)	>0,05	-0,1±0.2 (mmol/L)	>0,05	0,1 (mmol/L)	>0,05	0,1 (mmol/L)	>0,05
León-Flores, 2020	n = 24	-10±0.6 (mg/dL)	0,18	-3,9±2.3 (mg/dL)	0,37	3±1.6 (mg/dL)	0,17	-54,9±5 (mg/dL)	0,003*
Rynarzewski, 2019	n = 12	0.01±0.01 (mmol/L)	>0.05	0.03 (mmol/L)	>0.05	-0.01 (mmol/L	>0.05	-0.01±0.03 (mmo l/L)	>0.05
Kirch, 2018	n = 48	-14±1 (mmol/L)	>0,05	-0.04±0.01 (mmol/L)	>0.05	-0.07± 0.01(mmol /L)	>0.05	0.01±0.08 (mmol/L)	>0.05
Lee, 2018.	n = 48	-9,3±3.6 (mg/dl)	<0.01*	-10,05±2,8 (mg/dl)	<0.01*	0.7 (mg/dl)	0.11	9,05 (mg/dl)	0.45
Smolders, 2018	n = 48	-0.09 (mmol/L)	>0.05	-0.21 (mmol/L)	0.006*	0.03 (mmol/L)	0.08	-0.06 (mmo l/L)	>0.05
Chatree, 2020	n = 30	1,46 (mg/dL)	0,167	-0.56 (mg/d L)	0.583	0.84 (mg/dL)	0.753	5 (mg/dL)	0.012*
Leyva-Soto, 2018	n = 84	-20,1±2.8 (mg/dL)	<0,05*	-33,62±2.7 (mg/dL)	<0,05*	-3,1±1.6 (mg/dL)	>0,05	-75,99±1.05 (mg/dL)	<0,05*
Munguia, 2019	n = 138	−11±26.4 (mg/dL)	>0,05	–11.5±18.6 (mg/dL)	0,01*	3.2±4.3 (mg/dL)	0,03*	−23.6±38 (mg/dL)	0,01*

Discussion

Total cholesterol is a significant factor in the occurrence of dyslipidemia, a metabolic disorder indicated by abnormal blood fat levels (total cholesterol, LDL, HDL, or triglycerides). Cocoa is one of the cacao products that contains several health-enhancing compounds. The main components of cacao include powerful antioxidants such as catechin, epicatechin, and procyanidins, which are reported to have a positive impact on lipid profiles, vascular endothelial function, blood pressure, and inflammation [24]. The influence of epicatechin in cacao inhibiting Sterol Regulatory Element-Binding Proteins (SREBP1c) is through the activation of Adenosine Monophosphate Protein (AMP)-activated protein kinase (AMPK). The activation of this enzyme can also inhibit the key enzyme in fatty acid synthesis, namely HMG-CoA reductase (HMGR). Similar roles are also possessed by quercetin, berberine, and metformin. The end result of inhibiting SREBP1c and HMGR is a reduction in the synthesis of long-chain fatty acids and cholesterol [25]

Cocoa fat contains saturated fatty acids, primarily palmitate and stearate, which are neutral in nature, and it also contains antioxidants. The antioxidants in cocoa fat can prevent the formation of free radicals that can lower bad cholesterol (LDL) [26]. Consuming cocoa with a high concentration of flavonoids has been proven to play a crucial role as a powerful antioxidant for the body. It includes increasing blood flow, reducing blood pressure, elevating HDL, protecting LDL from oxidation, lowering the risk of cardiovascular diseases, shielding the skin from sunlight, and enhancing blood flow to the brain [4].The study in Jafarirad, et al. [14] states that cocoa has benefits for maintaining cardiovascular health, including lowering blood cholesterol, reducing LDL oxidation, and confirming an increase in HDL-C levels in individuals with type 2 diabetes. This influence is suspected because individuals with type 2 diabetes, who also participated in the study, were included in a dietary program as well [14]. Cocoa consumption also affects the lipolysis process, which is the hydrolysis of stored triacylglycerols in adipocytes into glycerol (a lipolysis marker) and free fatty acids, leading to a decrease in lipid accumulation in adipocytes [20]

This study aims to examine the impact of cocoa consumption on patients with dyslipidemia. The research results show various outcomes. Several risk factors influence these differences: type of active ingredient, duration, administration dosage, age, underlying diseases, patient compliance, and additional interventions.

Age becomes a risk factor in research outcomes because in older patients, the course of dyslipidemia may have become chronic and stable over many years with routine medication use. This stability may impact the therapeutic effects of cocoa, making them more significant without being influenced by the acute nature of concurrent diseases [18].

A study conducted by Dicks, et al. [21] showed non-significant results regarding the reduction in overall lipid profiles after cocoa administration. This study used a cocoa portion with a dose of 2.5 grams and a duration of 12 weeks. Other studies indicating non-significant results in overall lipid profiles include Rynarzewski, et al. [22] and Kirch, et al. [23]. In Rynarzewski's study [22] the intervention was the administration of 2.5 g cocoa-rich flavonol capsules for 12 weeks to 12 patients with T2D, obesity, and hypertension. Kirch's study [23] used an intervention in the form of capsules containing pure epicatechin 25 mg. This may be due to administering a lower dose, resulting in minimal therapeutic impact and non-significant results.

There are researches that used a smaller dose compared to the studies by Dicks, Rynarzewski, and Kirch [21], [22], [23] but show a significant result. León-Flores, et al. [19] conducted a study using a cocoa dose of 12.5 mg with an 8-week duration, showing significant results in triglycerides (TG). This condition is also observed in Chatree's study [20] which used a 150 mg capsule containing Epigallocatechin twice a day for 4-8 weeks. . In Smolders' study [17], the intervention involved providing a beverage enriched with 500 mg of theobromine in a 20 ml drink showed significant result on LDL.

Research that showed significant results across all parameters of lipid profiles was conducted by Jafarirad, et al. [14] The cocoa dose used in this study was quite substantial, at 6 grams per day, with a duration of 8 weeks. This large dose contributes to the expected therapeutic effect of cocoa being significant. Similarly, a study by Lee, et al. [15], demonstrated significant results in cholesterol and LDL with a relatively large daily dose of 18 grams and a duration of 4 weeks. Another study conducted by Leyva, et al. [16] showed significant results for cholesterol, LDL, and triglycerides with a relatively small daily dose of 2g. However, this intervention was administered over a longer period (6 months) providing a more comprehensive depiction of cocoa's influence on lipid metabolic parameters. This condition is also observed in the study by Munguia [18], which showed significant results in LDL, HDL, and TG. In Munguia et al.'s study [18], the intervention involved a small dose of 179 mg of beverage powder for 12 weeks.

In this study, only 2 journals demonstrated significant results regarding the impact of cocoa on HDL. The two journals that showed significant results were Jafarirad et al. [14] and Munguia et al. [18]. The similarity between these two journals is that both research subjects are patient with type 2 diabetes. One of the studies with non-significant results is the study by Rynaezewski, et al. [22]. This may be due to the theobromine content from cocoa intake (52.5 mg) with a 2-week duration being possibly too low to induce beneficial changes in HDL [22].

Studies conducted by Jafarirad et al. [14], León-Flores et al. [19], Chatree et al. [20], and Munguia et al. [18], yielded significant results regarding the impact of cocoa on dyslipidemia patients. The significant impact of these five journals is likely due to the similarity in compliance among the study samples in adopting dietary patterns and food recalls. Adherence to physical activity was also implemented in the studies by Munguia et al. [18] and León-Flores [19], becoming one of the factors influencing the effectiveness of cocoa during the therapy.

In this study, various types of active ingredients, doses, and durations of intervention were used. For further research, an analysis should be within similar interventions to draw more comprehensive conclusions.

4. Conclusion

The administration of cocoa product interventions in patients with dyslipidemia shows varied results. There are several factors influencing the effects of cocoa administration on changes in lipid profiles (total cholesterol, LDL, HDL, and TG), namely the type of active ingredient, duration, dosage, age, underlying diseases, patient compliance, and additional interventions.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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