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Literatur Review

Cardioprotective Effect of Basil Leaves (Ocimum sp.)

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Abstract

Background: Myocardial Infarction (MI) is a cardiovascular disorder that is a primary cause of death worldwide. According to the 2017 data from the World Health Organization, this disease can result in approximately 17.9 million deaths annually, constituting around 31% of the total global mortality rate. One of the treatments for cardiovascular disorder in addition to using conventional therapy are traditional treatments such as basil leaves (Ocimum sp.). The antioxidant activity in basil leave is believed to act as a cardioprotective agent. **Method:** This paper uses a literature study or literature review of research articles. Search articles through Google Scholar and Pubmed with keywords of "cardioprotective" and "basil leaves". The criteria for the articles used were published in the last 5 years, namely from 2019 to 2024. **Results:** Based on the literature search, there were 5 studies related to the cardioprotective effect of basil leaves in experimental animal models. Basil leaves used varies from extract form, gel, and oil. **Conclusion:** Based on the literature study, it was found that basil leave is a herbal plant that has a fairly effective cardioprotective effect.

Keywords: Cardioprotective, Ocimum sp.

INTRODUCTION

Myocardial Infarction (MI) is a cardiovascular disorder that is a primary cause of death worldwide. According to the 2017 data from the World Health Organization, this disease can result in approximately 17.9 million deaths annually, constituting around 31% of the total global mortality rate. [1]. The leading cause of death in the adult population in the United States is cardiovascular disease. Patients with hyperlipidemia have twice the risk of suffering from CVD (cardiovascular disease) than those who have normal cholesterol levels. [2].

The utilization of herbal antioxidants is on the rise as defensive agents against a spectrum of cardiovascular disorders. Bioactive compounds sourced from nature have garnered pivotal significance within modern medical frameworks, mitigating the risk of heart disease by eradicating the formation of free radicals. Herbal remedies hold substantial sway in healthcare, catering to a substantial portion of the global populace, and are revered as cultural heritage assets among diverse ethnic groups. Polyphenols, for instance, demonstrate cardioprotective properties by impeding the oxidation of low-density lipoproteins. A majority of pharmacologically significant medications trace their origins back to plants. Plant-derived compounds, serving as medicinal agents, play an indispensable role in healthcare systems worldwide, serving the needs of both animals and humans. Beyond managing disease conditions, they are also instrumental in maintaining optimal health.[3]

Reactive oxygen species are implicated in the pathogenesis of numerous human diseases, including atherosclerosis, ischemic heart disease, aging, inflammation, diabetes, immunosuppression neurodegenerative disorders, and other pathological conditions. Radicals and reactive oxygen species are continuously generated within the human body and are typically neutralized by the body's antioxidant defense mechanisms, both enzymatic and non-enzymatic. Oxidative stress arises when antioxidant defenses are insufficient, leading to damage to lipids, proteins, carbohydrates, and DNA. Free radical-induced peroxidation of membrane phospholipids and alterations in membrane permeability appear to be primary factors contributing to the cardiotoxic effects of toxic substances.[4]

Basil leaves (*Ocimum sanctum L.*), which belong to the Lamiaceae family, are rich sources of phytochemical compounds that exhibit

numerous pharmacological effects. Their constituents include carotenoids, terpenoids, alkaloids, saponins, flavonoids, tannins, and essential oils, which are beneficial as antioxidants, bacterial growth inhibitors, digestive aids, renoprotective agents, anticarcinogens, neuroprotective agents, cardioprotective agents, anticoagulants, immunomodulators, analgesics, anti-inflammatories, antidiabetics, hepatoprotective agents, hypolipidemic agents, anti-stress activities, and even fungistatic, insecticidal, and nematicidal properties. Spectroscopic analysis reveals that the isolated bioactive compounds described are triterpenoid tetracyclic compounds.[5]

METHODS

1. Study Design

This research is a research using literature study method or literature review. A literature review is a comprehensive overview of the research that has been done on a specific topic to show the reader what is already known about the topic and what is not known, in addition to seek rationale from research that has been done or for further research ideas.

The data used in this study comes from the results of research that has been carried out and published in national and international online journals. In conducting this research, the researchers searched for research journals published on the internet using the Google Schoolar and PubMed search engines.The keywords used in the search are Cardioprotective and Basil Leaves.

2. Population and Sample

This study uses a literature study where Google Scholar and Pubmed search engines are used. From the search results, 17 articles were identified, but only 5 entered the criteria and were discussed in this study. Inclusion and exclusion criteria can be seen in table 1.

3. Study Variabel

The dependent variable in this study was cardioprotective effect while the independent variable was basil leaves extract (*Ocimum Bacilium*).

4. Operational Definition of Variables

Cardioprotective effect is characterized by decreased levels of cardiac enzyme, including CK-MB (Creatinine Kinase Muscle Brain), troponin, and LDH (Lactate Dehydrogenase); and hemodynamic status. In the process of myocardial infarction, everything has an important role and is very closely related to one another.

Basil leaves (Ocimum sp.) is a plant which belongs to the *Lamiaceae* family. Basil leave known to have many therapeutic properties and believed to

have a cardioprotective effect in the form of extracts, gels and other processed forms.

5. Study Instruments

The strategy used to finding articles is the PICOS framework. *Population/problem* should be analyzed in alignment with the themes identified during the literature review. *Intervention* which is a management action on individual or community cases as well as an explanation of the management of the study in accordance with the themes that have been determined in the book literature review. *Comparison* intervention or alternative management is employed as a benchmark through the use of a control group in the selected study. *Outcome* namely the results or outcomes obtained in previous studies that are in accordance with the themes that have been determined in the literature review.

In this study, the problem was cardiovascular disorders, there was no intervention in this study, the comparison in this study was basil leaves, and the expected outcome was the cardioprotective properties of basil leaves. which then analyzed using the table for analyzed from tree discussion, results from studies so that know the similarities and differences of these journals (Table 2)

6. Data Analysis

This research uses literature review method design with identification, evaluation, and interpretation of all research results related to certain topics. The literature review method consolidates the findings of primary research, offering a more comprehensive and impartial presentation of facts.

7. Research Ethics

There is no ethical clearance in this study because it only uses literature study.

Table 1. Inclusion and Exclusion Criteria in *Literature Review*

Inclusion Criteria	
Period	The maximum time for publishing journals is the last 5 years from 2019 to 2024
Language	Indonesian and English
Subject	Hyperlipidemic Patients
Article Type	1. Original article 2. Not in abstract form 3. Full-text publication
Search time limit	1. The deadline starts from 15 January to 04 February 2024
Search location	1. PubMed 2. Google Scholar
Keywords	Cardioprotective, Basil Leaves
Exclusion Criteria	
Article Type	The research method is not descriptive because researchers need to identify relationships, not just descriptions.
Results	Research results that have been published and must have a p-value or must be read by statistics because researchers need to see whether there is a relationship.

Table 2. Study Description *Literature Review*

Name, Year, Title	Design	Sample	Measuring instrument	Results
Chetan, 2021 *Pharmacodynamic interaction of Tinospora cordifolia Willd. With Ocimum sanctum Linn. in isoproterenol-induced cardiac Toxicity*	Experimental control group design with post-test only methods	The study involved 42 males white Rattus norvegicus induced by a isoproterenol (ISO)for 2 consecutive days at an interval of 24h. Subjects were divided into 7 groups: placebo control (distilled water 1 mg/kg po), ISO control (ISO 85 mg/kg sc), 2 Tinospora group (250 and 500 mg/kg po), Ocimum group (50 mg/kg po, Tinospora + Ocimum group (250 mg/kg + 50 mg/kg po), and Tinospora + Ocimum group (500 mg/kg + 50 mg/kg po). Measure-	ECG and Mean Arterial Blood Pressure Kit	The normal control group animals showed normal patterns of ECG, whereas the rats treated with ISO exhibited a marked indication of MI. Animals treated with drug combination of SETC 500 mg/kg + SEOS 50 mg/kg showed a significant ($P < 0.001$) decrease in ST-segment and a marked ($P < 0.001$) increase in the R-amplitude as compared to electrocardiographs obtained from ISO-alone-treated rats. Whereas, animals treated with SETC 500

ment of ECG, hemodynamic, biochemical, and histopathological was carried out on day 22.

mg/kg showed a significant ($P < 0.01$) decrease in ST-segment and substantial ($P < 0.01$) increase in the R-amplitude. In addition, animals treated with SETC 250 mg/kg + SEOS 50 mg/kg showed a significant ($P < 0.05$) decrease in ST-segment and significant ($P < 0.05$) increase in the R-amplitude when compared to the ISO control group. The mean arterial blood pressure was significantly ($P < 0.001$) decreased in the ISO-treated group to 50.17 mmHg compared to the normal control group. The mean arterial blood pressure was increased significantly in animals treated with SETC 500 mg/kg + SEOS 50 mg/kg ($P < 0.001$). Whereas, animals treated with SETC 250 mg/kg + SEOS 50 mg/kg and SETC 500 mg/kg showed a significant ($P < 0.01$) increase in mean arterial blood pressure compared to the ISO-treated group. Animals treated with SETC 250 mg/kg and SEOS 50 mg/kg showed a significant ($P < 0.05$) increase in mean arterial blood pressure. Further, a significant ($P < 0.001$) increase in heart rate was observed in the ISO-treated control group compared to the normal control group. Animals

				treated with drug combination of SETC 500 mg/kg + SEOS 50 mg/kg showed a significant ($P < 0.001$) decrease in heart rate relative to the ISO-treated control group
Da-Som, 2022 *Olfactory Stimulation with Volatile Aroma Compounds of Basil (Ocimum basilicum L.) Essential Oil and Linalool Ameliorates White Fat Accumulation and Dyslipidemia in Chronically Stressed Rats*	Experimental control group design with post-test only methods	The study involved 45 males Sprague-Dawley rats. The rats were acclimated to a normal diet for a week and randomly classified into 4 groups. After classification, chronic stress was applied to all groups for 5 weeks. Chronic mild stress was applied in the first week. Chronic mild stress (CMS) is a complex stress that includes food deprivation, restricted access to food, water deprivation, roommate separation, overnight illumination, and tilting the cage by 45◦. From the second week, the rats were exposed to chronic stress with distilled water (DW) inhalation for 5 min/day in the control group (CON; n = 6), chronic stress with linalool inhalation for 5 min/day in the positive control group (POS; n = 6), chronic stress with basil essential oil (BEO) inhalation for 5 min/day in the third group (5 MIN; n = 6), and chronic stress with BEO inhalation for 20 min/day in the fourth group (20 MIN;	ELISA Kit and Blood Pressure Kit	During the initial period, no significant differences in pulse were observed between the groups (Table 4). In contrast, during the final measurement, inhalation of BEO for 5 min attenuated the pulse rate compared to that in the control group ($p < 0.05$). Inhalation of BEO for 20 min and of linalool only showed a tendency to decrease the pulse, and changes were not significant ($p > 0.05$). In the case of HDL levels, the control and linalool-inhaled groups had the lowest levels compared with BEO-inhaled groups, regardless of the BEO inhalation time ($p < 0.05$). Thus, BEO inhalation upregulated the HDL levels. The control group had the highest LDL levels among all groups ($p < 0.05$). BEO inhalation ameliorated the levels of LDL, and linalool ameliorated the LDL levels compared to the control group ($p < 0.05$). The TG level in the control group was relatively higher than in the other groups ($p > 0.05$). BEO and linalool

		n = 6) (Figure 1). Linalool and volatile compounds in BEO flowed at a rate of 8 mL/h, achieved by using a humidifier		inhalation were associated with a decreasing tendency of TG levels. Inhalation of BEO for 20 min showed lower TG levels compared to the control group ($p < 0.05$). Meanwhile, linalool was associated with a decreasing trend in TG levels compared to the control group; however, there were no significant changes between the control and the linalool-inhaled group. Regarding the atherogenic index (AI) and cardiac risk factors (CRF) in the control group, inhalation of BEO ameliorated the AI and CRF indices in a time-dependent manner ($p < 0.05$)
Teofilovic, 2021 *Pharmacological effect of novel microvesicles of basil, on blood glucose and the lipid profil: a preclinical study*	*Experimental studies on experimental animals*	Animals were treated with water extract of Ocimum basilicum in microvesicles and with combination of basil extracts and 3α,7αdihydroxy-12-keto-5-cholanate, also known as 12-monoketocholic acid (MKC) acid in microvesicles for 7 days. Alloxan was used to induce hyperglycemia. Pharmacological effect on glycemia were evaluated by measuring blood glucose levels in alloxan-induced diabetic rats.	Rats Blood Glucose kit And Lipid Profile Kit	The values of total cholesterol and LDL cholesterol were statistically higher with MKC alone (1.77±0.29 mmol/l; 0.56±0.12 mmol/l), combination of basil and MKC (1.88±0.20 mmol/l; 0.56±0.11 mmol/l) and basil extract applied in the form of microvesicles (1.63±0.37 mmol/l; 0.43±0.15 mmol/l) in comparison with groups treated with saline (1.17±0.20 mmol/l; 0.20±0.08 mmol/l) and basil extract alone (1.04±0.30 mmol/l; 0.20±0.10 mmol/l). Concentration of HDL cholesterol was greater in groups of normoglycemic animals treated with MKC alone

				(0.94±0.15 mmol/l), combination with basil and MKC (0.99±0.08 mmol/l) and basil in microvesicles formulation (0.89±0.21 mmol/l) compared to animals treated with basil alone (0.59±0.19 mmol/l)
Mahrous, 2019 *Cardioprotective effect of green tea extract and vitamin E on Cisplatin-induced cardiotoxicity in mice: Toxicological, histological and immunohistochemical studies*	*Experimental studies on experimental animals*	48 male albino Balb/c mice were randomly allocated into six groups, each comprising 8 mice (Gp). Gp1 served as control; Gp2 and Gp3 received oral Green Tea Extract (GTE) (400 mg/kg) and Vit-E (100 mg/kg) for 30 consecutive days respectively. Gp4 had received cisplatin (CP) (7 mg/kg i.p.) once on the 27th day; Gp5 had received GTE (400 mg/kg p.o.) for 30 days and CP (7 mg/kg i.p.) on the 27th day; Gp6 had received Vit-E (100 mg/kg p.o.) for 30 days and CP (7 mg/kg i.p.) on the 27th day. Blood were harvested for biochemical investigations.	ECLIA	The mean Troponin I concentrations were significantly higher in mice group injected with CP compared to the control group (1.26 ± 0.19 ng/ml vs 0.13 ± 0.04 ng/ml respectively ($p < 0.05$). Troponin I concentrations in GTE/CP-treated mice (Gp5) were significantly lower compared with the group treated with CP alone (Gp4); 0.34 ± 0.05 ng/ml vs 1.26 ± 0.19 ng/ml respectively; ($p < 0.05$). Similarly, Troponin I concentrations inVit-E/CP-treated mice (Gp6) were significantly lower in contrast from the group treated with CP alone (Gp4); 0.29 ± 0.05 ng/ml versus 1.26 ± 0.19 ng/ml respectively). However, there was no statistically significant difference between Gp5 (GTE/CP) and Gp6 (Vit-E /CP) regarding the Troponin I concentration ($p > 0.05$,). The mean CPK concentrations was significantly higher in the CP treated mice in comparison with the control group (652.6 ± 7.3 IU/L vs 191.58 ± 4.4 IU/L re-

				spectively; p < 0.05, Table 2). Administration of GTE before CP injection (Gp5) resulted in a substantial lower CPK concentrations in comparison with the CP-treated group (p < 0.05). A similar finding was observed after the administration of Vit-E before injecting the mice with CP (Gp6) resulted in a significantly lower CPK levels in comparison with CP-treated mice (240.12 ± 6.44 IU/L vs 652.66 ± 7.32 IU/L respectively; p < 0.05). Likewise, CK-MB levels were significantly higher in CP-injected mice as in comparison with normal control group (92.32 ± 2.74 IU/L vs 44.36 ± 3.66 IU/L respectively; p < 0.05, Table 2). Administration of GTE before CP (Gp5) injection resulted in a significantly lower in CK-MB value in comparison with the CP-treated mice (52.60 ± 2.50 IU/L versus 92.32 ± 2.74 IU/L, p < 0.05). The same finding was observed with administration of Vit-E before CP injection (Gp6) that resulted in a significantly lower CK-MB value in comparison with the CP-treated group (54.20 ± 4.26 IU/L versus 92.32 ± 2.74 IU/L, respectively; p < 0.05).
Olufunke, 2024	*Experimental studies on experimental animals*	75 adult male rats were randomly divided into 12 group. 24 h after the last TZM injection, the	ELISA kit	Using ELISA technique, Veh. + TZM treatment caused marked (p <

Anti-apoptotic and antioxidant mechanisms may underlie the abrogative potential of Ocimum gratissimum Linn. Leaf extract and fractions against trastuzumab-induced cardiotoxicity in Wistar rats	overnight fasted rats were humanely sacrificed under controlled, light inhaled halothane anesthesia and whole blood samples were collected directly from the heart with fine 21 G injectable needle and 5 ml syringe. The subject heart was carefully identified, harvested and weighed.	0.05) elevation in the total cardiac caspase-3 and caspase-9 levels when in comparison with Veh. only-treated (untreated normal) cardiac tissue, respectively). Treatments with Veh. + OG, Veh. + PEOG, Veh. + EAOG, Veh. + EOG and Veh. + VAL-LSP was associated with no significant ($p > 0.05$) changes in the cardiac tissue caspase-3 levels. However, with EAOG + TZM and EOG + TZM treatments, there were significant ($p<0.05$) attenuation in the elevated caspase-3 levels. Similarly, in groups treated with OG + TZM, PEOG + TZM, EAOG + TZM, EOG + TZM and VAL-LSP + TZM, there was profound ($p < 0.05$) decreases in caspase-9 levels when compared with the Veh. + TZM-treated values.

RESULT

Based on comprehensive literature review, we identified five experimental animal studies investigating the cardioprotective effects of basil leaves. These studies were sourced from both international and national journal through searches on PubMed and Google Scholar using the keywords "Cardioprotective" and "Basil leaves." The primary focus of the comparison in this research was centered on basil leaves, with the anticipated outcome being the assessment of their cardioprotective effects. The gathered literature underwent thorough analysis, organized systematically in a table for detailed discussion, enabling the identification of similarities and differences among these studies (Table 2).

DISCUSSION

Cardioprotective effect is characterized by decreased levels of cardiac enzyme, including CK-MB (Creatinine Kinase Muscle Brain), troponin, and LDH (Lactate Dehydrogenase); and hemodynamic status. In the process of myocardial infarction, everything has an important role and is very closely related to one another. Reactive oxygen species are implicated in the pathogenesis of numerous human diseases, including atherosclerosis, ischemic heart disease, aging, inflammation, diabetes, immunosuppression neurodegenerative disorders, and other pathological conditions. Basil leaves (Ocimum sanctum L.), which belong to the Lamiaceae family, are rich sources of phytochemical compounds that exhibit numerous pharmacological effects. Their constituents include carotenoids, terpenoids, alkaloids, saponins, flavonoids, tannins, and essential oils, which are beneficial as antioxidants, bacterial growth inhibitors, digestive aids, renoprotective agents, anticarcinogens, neuroprotective agents, cardioprotective agents, anticoagulants, immunomodulators, analgesics, anti- inflammatories, antidiabetics, hepatoprotective agents, hypolipidemic agents, anti-stress activities, and even fungistatic, insecticidal, and nematicidal properties.[6]

The findings of Chetan's (2021) research on the cardioprotective effects of basil leaf extract on a cardiotoxic male animal model indicated that the herb–herb combination of standardized extract of Tinospora cordifolia 500 mg/kg and standardized extract of Ocimum sanctum 50 mg/kg has shown increased cardioprotective activity in comparison with monotherapy. [6]

Research conducted by Da-Som (2022) regarding cardioprotective activity of basil leave in chronically stressed rats models conclude that basil essential oil (BEO) and linalool inhalation

suppresses stress responses, including dyslipidemia that alleviate cardiotoxicity condition. Nevertheless, these findings are limited to specific animal models of chronic stress. [7]

Research conducted by Teofilovic (2021) on the potential of pharmaceutical formula (microvesicles) on hyperlipidemia that aggravated cardiovascular disorder, as a pharmaceutical-technological formulation, potentiate the hypolipidemic action of basil extract and monoketocholic acid (MKC). The combination of fixed doses of basil extract and sodium salt of monoketocholic acid, applied in the form of microvesicles, showed the most notable decrease in the concentration of triglycerides in the serum of both normoglycemic and diabetic animals. Used in the form of microvesicles, increased the concentration of HDL cholesterol in the serum of diabetic animals that can reduced the cardiovascular complication in diabetic condition. Since MKC itself has produced hypoglycemic and hypolipidemic properties, this synthetic derivative of bile acids is a substance whose use prevents disorders present in the metabolic syndrome, such as atheroma. [8]

From the research conducted by Mahrouz (2019) regarding cardioprotective effects of antioxidant on cisplatin-induced cardiotoxicity model, showed findings of the present studies which clearly demonstrate that green tea extract (GTE) and Vit-E ameliorate the myocardial oxidative and histolopathological damage caused by cisplatin (CP). Consequently, Vit-E and GTE could potentially serve as cardioprotective agents against CP-induced cardiotoxicity without interfering with its antitumor efficacy [9]

The study conducted by Olufunke (2024) in the subject of antioxidant activity of basil leave on trastuzumab induced cardiotoxicity models has conclude the promising therapeutic potentials of OG and its fractions (especially EAOG fraction) in ameliorating TZM-induced cardiotoxicity that were probably mediated via anti-apoptosis and antioxidant mechanisms [10]

CONCLUSION

By the background of the problem and the purpose of the literature review from several journals, it can be concluded that there is a significant protective relationship between basil leave and cardiovascular system, as mention on several prior studies that have described the cardioprotective effect of basil leave (*Ocimum sp.*).

CONFLICT OF INTEREST

The author declares that there is no conflict of interest in this study.

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