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Literature Review on Chemical Compounds from Natural Ingredients that Function as Anti-Hypertension

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ABSTRACT

Hypertension is one of the most common health problems worldwide and is a major risk factor for cardiovascular diseases such as coronary heart disease and stroke. Many synthetic drugs are available to manage hypertension, but they often have significant side effects. Research on chemical compounds from natural materials that have antihypertensive activity is very important. This literature review aims to evaluate various chemical compounds that are derived from natural materials and have potential as antihypertensive agents. Some of the plants that have been identified as having active chemical compounds include Hibiscus sabdariffa which contains anthocyanins, Allium sativum (garlic) which contains allicin, and Andrographis paniculata which contains andrographin. Recent studies have shown that these compounds are effective in lowering blood pressure through various mechanisms such as vasodilation, diuresis, and inhibition of angiotensin-converting enzyme (ACE). This study highlights the importance of using natural ingredients as a safer and more effective alternative to synthetic drugs for the management of hypertension. However, more research is needed to develop more effective drug formulations and to test their effectiveness clinically in human populations.

Keywords: Hypertension, natural chemical compounds, antihypertensive, Hibiscus sabdariffa, Allium sativum, Andrographis paniculata

I. INTRODUCTION

Cardiovascular is one of the non-communicable diseases that cause death in the world. Hypertension is one of the main risk factors for cardiovascular disease. In 2019 about 1.13 billion people in the world suffered from hypertension (WHO, 2019). Based on data from Basic Health Research (Riskesdas) in 2018, there are 34.1% of the Indonesian population with the age of ≥ 18 years old diagnosed with hypertension and there is a fairly high increase compared to the 2013 Riskesdas data of 25.8%. The population with more female sex is 36.9% and male sex is 31.3% (PDHI, 2019).

Hypertension is one of the most common medical conditions that is a major risk factor for various cardiovascular diseases, such as coronary heart disease and stroke. This condition often requires long-term treatment with the use of antihypertensive drugs. However, synthetic drugs often have significant side effects, so research on chemical compounds from natural ingredients that have antihypertensive activity is very important (Benjamin et al., 2019; WHO, 2021).

Natural compounds work through various mechanisms to lower blood pressure. One of the main mechanisms is the inhibition of angiotensin-converting enzyme (ACE), which plays

a role in regulating blood pressure through the renin-angiotensin-aldosterone (RAAS) system. In addition, some compounds increase the bioavailability of nitric oxide (NO) for vasodilation and reduce oxidative stress affecting vascular endothelial function (Zhang et al., 2018).

II. METHODS

The approach used in this research is descriptive qualitative with a multicriteria case study This literature review was carried out by collecting data from various nationally indexed journals, Sinta, and Scopus. The data collected included the results of laboratory research, clinical studies, and epidemiological studies that assessed the effectiveness of natural chemical compounds in managing hypertension. The analyzed research is selected based on relevance, and scientific validity.

III. RESULTS AND DISCUSSION

The results of the review show that chemical compounds from natural materials have great potential as antihypertensive agents. For example, a study by Anwar et al. (2020) found that Nigella sativa extract containing thymoquinone was effective in lowering systolic and diastolic blood pressure in animal models. In addition, research by Riaz et al. (2024) shows that Withania somnifera (ashwagandha) extract has a blood pressure-lowering effect through an oxidative stress-lowering mechanism.

Based on the literature, many plants that have been identified contain chemical compounds with antihypertensive potential. For example, Hibiscus sabdariffa contains anthocyanins that are known to lower blood pressure through vasodilation and diuresis effects (Mojiminiyi et al., 2007; Ali et al., 2020). The allicin compound in Allium sativum (garlic) has been reported to have a blood pressure-lowering effect by the mechanism of relaxation of vascular smooth muscles (Ried et al., 2013; Morakinyo et al., 2020).

Mechanism of Action of Natural Compounds as Antihypertensive Natural compounds have various mechanisms of action in lowering blood pressure. One of the most commonly reported mechanisms is the inhibition of angiotensin-converting enzyme (ACE), which plays a key role in the renin-angiotensin-aldosterone (RAAS) system (Zhou et al., 2021). Additionally, compounds such as flavonoids and saponins can increase nitric oxide (NO) production, which serves as a natural vasodilator to widen blood vessels and lower blood pressure (Wang et al., 2021).

Andrographis paniculata contains andrographin which has been shown to reduce blood pressure in animal models through an angiotensin-converting enzyme (ACE) inhibition mechanism (Zhang et al., 2018; Phrompittayarat et al., 2021). In addition, Apium graveolens (celery) extract showed significant antihypertensive activity, which is largely due to phytochemical compounds such as apigenin (Tsi & Tan, 2014; Jie et al., 2020).

Flavonoids are polyphenolic compounds found in a variety of fruits, vegetables, teas, and chocolates. A study by Liu et al. (2020) showed that quercetin, one of the main flavonoids, has a significant antihypertensive effect through inhibition of ACE and increased bioavailability of NO. Other studies found that regular consumption of flavonoids from green tea can reduce systolic and diastolic blood pressure in hypertensive patients.

The alkaloid derived from the *plant Rauvolfia serpentina*, has long been known as an antihypertensive. The mechanism of action is to inhibit the release of norepinephrine, which reduces sympathetic activity (Sharma et al., 2019). In addition, new alkaloids such as berbamin from *Berberis vulgaris* also show antihypertensive activity through inhibition of ACE (Rahimi et al., 2020).

Saponins found in plants such as ginseng (*Panax ginseng*) and garlic (*Allium sativum*) have significant antihypertensive effects. Research by Kim et al. (2020) shows that saponins

from ginseng can reduce peripheral vascular resistance and improve vasodilation through RAAS modulation.

Bioactive peptides from milk and fish proteins have been identified as natural ACE inhibitors. A study by Nakamura et al. (2021) found that peptides produced from fermentation of milk proteins had a blood pressure-lowering effect in hypertensive rats. This potential has also been tested in humans, with results showing a significant reduction in systolic blood pressure.

Some studies have also reported that the use of natural ingredients as antihypertensives can reduce the side effects often associated with synthetic drugs. For example, the use of Hibiscus sabdariffa did not show significant side effects in users, in contrast to some antihypertensive drugs that can cause hypokalemia and impaired kidney function (Ali et al., 2020; Al Disi et al., 2016).

Although natural ingredient compounds show great potential, the main challenges in the development of natural ingredients-based drugs include the isolation of active compounds, clinical efficacy, and large-scale production. In addition, more research is needed to understand the complex interactions of these compounds with synthetic drugs used by hypertensive patients (Wang et al., 2021)

IV. CONCLUSION

Based on a literature review, chemical compounds of natural medicinal substances have great potential as effective and safe antihypertensive agents. Compounds such as anthocyanins, allicin, andrographine, apigenin, and thymoquinone have shown significant antihypertensive activity in various studies. More research is needed to develop more effective drug formulations and test their effectiveness clinically, especially in the human population.

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