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The effect of active compounds in herbal plants on increasing salivary pH in patients with Type 2 Diabetes Mellitus

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Abstract

Background: Diabetes mellitus is a chronic disease caused by insulin dysfunction characterized by hyperglycemia. Diabetes mellitus can be classified into four, namely type I diabetes mellitus, type II diabetes mellitus, other specific types of diabetes, gestational diabetes. Diabetes mellitus can cause complications in the dental and oral area, such as Xerostomia, dental caries, periodontitis, periodontal abscesses, and fungal infections of the mouth.

Objective: This study aims to determine the effect of active ingredients in herbal plants on the pH of saliva in people with type II diabetes mellitus.

Methods: The research design used is a literature review.

Discussion: The literature studied states that the content of flavonoids in different types of herbal plants can increase the pH of saliva in patients with type II diabetes mellitus. The manifestation of type II diabetes mellitus is an increase in glucose levels in the saliva that can be metabolized by oral cavity bacteria so that it produces acid and lowers the pH of the saliva. Increasing the pH of saliva to neutral can be done by providing extracts from herbal plants that contain flavonoids.

Conclusion: The active ingredients of flavonoids in herbal plants can restore the pH of saliva to normal in people with type II diabetes mellitus.

Keywords: Diabetes mellitus type II; Saliva pH; Active ingredients of herbal plants; Flavonoids

1. Introduction

Diabetes mellitus is a common health problem in society. Diabetes mellitus is a chronic disease that shows an increase in blood sugar levels above normal limits. According to the American Diabetes Association (2012), diabetes is classified into four clinical types, namely type I diabetes, type II diabetes, other specific types of diabetes due to other causes, and gestational diabetes mellitus. Type I diabetes mellitus is caused by β-cell damage resulting in absolute insulin deficiency. Type II diabetes mellitus is caused by a progressive insulin secretion defect associated with insulin resistance. Diabetes mellitus due to other specific causes may include genetic defects in β-cell function, genetic defects in insulin action, exocrine pancreatic diseases (such as cystic fibrosis), and drug or chemical-induced (such as in HIV/AIDS treatment or after organ transplantation). Gestational diabetes mellitus is characterized by an increase in blood sugar during pregnancy and usually occurs in the 24th week of pregnancy.

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The pathophysiology of type II diabetes mellitus, namely the malfunction of the feedback between insulin action and insulin secretion results in abnormally high blood glucose levels. In the case of β-cell dysfunction, insulin secretion is reduced, limiting the body's capacity to maintain physiological glucose levels. Insulin *resistance* , on the other hand, contributes to increased glucose production in the liver and decreased glucose uptake in both muscle, liver, and adipose tissue. Even if both processes occur early in pathogenesis and contribute to disease progression, β-cell dysfunction is usually more severe than insulin *resistance.* However, when both β-cell dysfunction and insulin *resistance* are present, hyperglycemia is amplified leading to the development of Type II Diabetes Mellitus. β-cell dysfunction in type II diabetes mellitus is caused by complex network interactions between the environment and different molecular pathways involved in cell biology. In overnutrition, especially in obesity, hyperglycemia is often found which supports insulin *resistance* and chronic inflammation.

Excess FFA (*free fatty acid*) and hyperglycemia can induce endoplasmic reticulum stress through activation of the apoptotic open protein response (UPR) pathway. In addition, hyperglycemia can cause genetic susceptibility, ER stress, oxidative stress, amyloid stress that can eliminate β-cell integrity. Then, insulin resistance, which is a condition that refers to the metabolic decline of insulin-responsive cells. Insulin resistance can be categorized into three, namely reduced insulin secretion by β-cells, insulin antagonists in plasma, and impaired insulin response in target tissues. Defective insulin action in tissue will often lead to the development of systemic insulin resistance which will progressively result in type II diabetes mellitus [2].

Diabetes mellitus is a chronic disease caused by insulin dysfunction characterized by hyperglycemia. Chronic hyperglycemia leads to failure in different parts of the body such as the nervous system, eyes, kidneys, and cardiovascular system. Diabetes is also associated with various oral complications, consisting of dental caries, gingival problems, periodontal abscesses, and periodontitis, xerostomia, vesiculobullous lesions, oral fungal infections, increased risk of postoperative [7].

Data from the *World Health Organization* (WHO) in 2018 found that non-communicable diseases ranked first as the cause of death in the world, reaching 71%. In addition, there is an increase of 8.5% in Diabetes Mellitus patients in adults, which is recorded at 422 million people in the world suffering from Diabetes Mellitus. The increase in the prevalence of the sufferers will occur mainly in countries with middle and low economic status. The prevalence of death in patients with less than 70 years of age is 2.2 million people and it is estimated that the increase in prevalence will be more severe. Deaths will continue to occur until 600 million people in 2035.

In patients with DM, there can be an increase in glucose levels in saliva and blood. This glucose can be metabolized by bacteria in the mouth such as *Streptococcus mutans* so that it can produce acid and reduce salivary pH. In the oral cavity, PH is maintained at a neutral condition by saliva. Saliva can maintain the PH of the oral cavity through the mechanism of neutralizing acidity formed from food and beverages and from microbial activity. In addition, saliva can also remove carbohydrates metabolized by bacteria so that the acid produced by bacteria will come out. Based on a journal written by Lubis (2013), the acidity of salivary pH in patients with diabetes mellitus is caused by impaired salivary flow so that the supply of oxygen to the mouth is reduced. This causes anaerobic bacteria to multiply easily[8].

In patients with DM there is a decrease in salivary pH due to a decrease in bicarbonate buffers in body fluids which can result in metabolic acidosis. Low salivary pH will result in the growth of aciduric bacteria so that it can disrupt the normal flora in the oral cavity [9].

Saliva in patients with diabetes mellitus can be treated by giving extracts from herbal plants. Herbal plants are types of plants that are easy to find and obtain in tropical countries such as Indonesia. From the many types of herbal plants in Indonesia, people do not know in more detail the effect of the content and efficacy of herbal plants to restore the normal pH of saliva in patients with diabetes mellitus. This is the basis for researchers to conduct further studies related to the effect of giving active ingredients in herbal plants on increasing salivary pH in patients with type II diabetes mellitus. The purpose of this study is to examine changes in the increase in the degree of acidity (pH) of saliva after the administration of active ingredients from herbal plants in patients with type II diabetes mellitus.

2. Material and methods

The research design used is a literature review. Data was obtained from both national and international journal sources with information published in the last 10 years or after 2012. The data was obtained through previous research using databases such as Google Scholar and PubMed as well as several other relevant sources. The keywords we chose in this literature review are Diabetes Mellitus Type II, saliva pH, and the active ingredient of herbal plants, flavonoids.

3. Results

Research by Leny Pratiwi Arisandy and Meydistin Juwita Hondro states that red betel leaf extract with a concentration of 10% can increase salivary pH. Red betel leaf extract as a mouthwash is able to increase salivary pH because it is thought that there are mechanical stimuli and chemical stimuli from the active ingredients contained in red betel leaves which can result in increased salivary secretion so that salivary pH also increases. Active ingredients in red betel leaves include alkaloids, flavonoids, tannins, and essential oils. These active substances are able to change bacterial cell components resulting in disruption of membrane permeability in bacteria and also bacterial metabolism and cause cell death. The flavonoid content in red betel leaves can cause a bitter and astringent taste so that it can trigger cholinergic stimulation of salivary gland secretions which can result in an increase in salivary pH [4]. The increase in salivary pH occurs maximally due to chemical stimuli that require a chemical stimulus. Time varies in relation to salivary buffers. Salivary buffers have a role in regulating the pH of the oral cavity. Salivary buffers have a role in maintaining salivary pH and remineralizing teeth. The increase in salivary pH in the study is still categorized within normal limits because salivary pH that is too alkaline can also result in calcium and phosphate deposition, making it easier for calculus to occur. Thus, the content in a 10% concentration of red betel leaf decoction is able to maintain salivary pH in patients with type 2 diabetes mellitus [13].

Research by Sari *et al* showed that gargling with siwak solution can change the salivary pH of Diabetes Mellitus patients from acidic salivary pH conditions to neutral salivary pH. Gargling with siwak solution can increase salivary pH due to the content of essential oils in siwak. Essential oils can increase saliva production which causes an increase in the buffer capacity of saliva so that the saliva flow rate will also increase. Other contents in siwak are bicarbonate, flouride, flavonoids, alkaloids, phytochemicals which can increase the speed of salivary flow which causes an increase in the buffer system in saliva so that the pH of saliva will also increase [12].

Research by Sary states that there is an effect of giving chayote extract to reduce blood sugar levels in patients with type 2 diabetes mellitus. In chayote extract, there is flavonoid content that works as an important enzyme inhibitor that plays a role in the breakdown of carbohydrates into monosaccharides that can be absorbed by the intestine. In addition, flavonoids have hypoglycemic activity or lower blood glucose levels by increasing insulin secretion and increasing cell sensitivity to insulin. Chayote has the effect of lowering blood glucose levels. The effect is obtained from the active component of flavonoids [9].

4. Discussion

Diabetes Mellitus be chronic diseases due to dysfunction insulin. This situation causes various physiological conditions of the oral cavity change. Diabetes Mellitus is classified into four clinical types, namely diabetes type I, type II diabetes, type diabetes other specific causes due to other causes, and gestational diabetes mellitus.

Type II diabetes mellitus manifests in the form of increased glucose levels in saliva and blood. The glucose can be metabolized by Streptococcus mutans bacteria in the oral cavity to produce acid and reduce salivary pH. In patients with type II diabetes mellitus, bicarbonate buffer fluid decreases so that there is a decrease in salivary pH to acid. Acidic salivary pH will cause the growth of aciduric bacteria so that the normal flora of the oral cavity is disturbed.

Salivary pH in type II diabetes mellitus patients can be increased to normal salivary pH by giving extracts from herbal plants. Herbal plants that can increase salivary pH in patients with type II diabetes mellitus include red betel leaf, siwak, chayote, and honey. Giving betel leaf

can be done by gargling using red betel leaf decoction with a concentration of 10%. Meanwhile, the administration of siwak can be done by gargling with siwak solution. Of the several types of herbal plants, the three herbal plants have the same active ingredient content, namely flavonoids. Flavonoid active ingredients can increase the speed of salivary flow so that there is an increase in the buffer system in saliva which causes the pH of saliva to also increase and return to normal pH.

5. Conclusion

The active ingredient flavonoid in herbal plants can increase changes in the degree of acidity (pH) of saliva in patients with type II diabetes mellitus. Changes in the pH of acidic saliva to neutral saliva pH in patients with type II diabetes mellitus are caused because the active ingredient can increase the production and speed of saliva flow so that the pH of

saliva will automatically increase. It is hoped that the active ingredient flavonoid in herbal plants can be used as an alternative to restore saliva pH to normal in patients with type II diabetes mellitus.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this document.

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