EFFECTIVENESS OF *GINGER* EXTRACT *(ZINGIBER OFFICINALE ROSC)* ON REDUCTION OF BADNESS OF *MOOTAL ODOR (HALITOSIS)*

(Research Conducted at Hasanuddin University Faculty of Dentistry Makassar City, South Sulawesi 2022-2023)

THESIS

Submitted as One of the Requirements to Achieve
Bachelor's Degree in Dentistry

Meyke Theresia Gracia Eden Wattimena

J 011201160

DENTISTRY STUDY PROGRAM

FACULTY OF DENTISTRY

HASANUDDIN UNIVERSITY

2023

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MAKASSAR

2023'

VALIDATION SHEET

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Stating that the thesis with the title as mentioned above has been examined, corrected and approved by the supervisor to be printed and/or published.

MOTTO

"Believing in yourself is the most beautiful way to live life"

PREFACE

Praise and gratitude to Allah for all His blessings and companionship which always give the ability and smoothness to the author so that the thesis entitled "The Effectiveness of *Ginger* Extract *(Zingiber officinale rosc)* on Reducing Breath bad Levels *(Halitosis)* at Hasanuddin University Faculty of Dentistry Makassar City, South Sulawesi" as one of the requirements can be completed.

During the process of preparing this thesis, it certainly did not escape the guidance, support and assistance of various parties. On this occasion, the author would like to express his gratitude to those who have helped complete this thesis, namely to:

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All parties who cannot be mentioned one by one who have provided support and assistance so that I can complete this thesis.

ABSTRACT

Effectiveness of *Ginger* Extract *(Zingiber officinale rosc)* on
Reducing Bad Breath Levels *(Halitosis)*
(Research conducted at Hasanuddin University Faculty of Dentistry
Makassar City, South Sulawesi 2022-2023)

Background: Halitosis is a common problem that manifests as an unpleasant and bothersome odor emanating from the mouth. The unpleasant odor is mainly caused by the putrefactive action of microorganisms on endogenous or exogenous proteins and peptides. The causes of pathological halitosis are diverse but can be classified as extra-oral halitosis and intra-oral halitosis. Factors contributing to the occurrence of halitosis include periodontal disease, dry mouth, smoking, alcohol consumption, dietary habits, diabetes, and obesity. Ginger (*Zingiber officinale roscoe*) is one of the medicinal commodities and spices included in traditional medicine in Indonesia. Ginger contains anti-microbial compounds from the phenol, flavonoid, terpenoid and essential oil groups which are bioactive compounds, so that they can inhibit microbial growth. **Purpose:** Knowing the role of ginger extract (*Zingiber officinale rosc.*) on reducing halitosis levels at student of Dentistry, Hasanuddin University in Makassar City, South Sulawesi. **Methods:** This type of research is Laboratory Experimental, obtained a sample of 60 respondents. Data collection using Consecutive Sampling. Data processing and analysis techniques were performed with Independent Sample T-Test. **Results:** The results showed that there was a significant difference in halitosis values between before and after gargling and after gargling with 2%, 4% and 6% ginger concentration solutions. **Conclusion:** Ginger Extract *(Zingiber officinale rosc)* can cause a decrease in bad breath (halitosis) levels.

Keywords: *Bad Breath, Halitosis, Gargle, Ginger (Zingiber officinale rosc).*

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CHAPTER I

INTRODUCTION

1.1 Background

Halitosis is a common problem that manifests as an unpleasant and bothersome odor emanating from the mouth. The unpleasant odor is mainly due to the decaying action of microorganisms on endogenous or exogenous proteins and peptides. Halitosis is an unpleasant condition that affects a large proportion of the human population. It often results in nervousness and social difficulties such as a lack of confidence to approach and talk to others. Halitosis has become a concern for a large proportion of the population and is a difficult problem to diagnose due to multi-factorial causes.[2] Halitosis affects approximately 15% to 60% of the human population worldwide.

The causes of pathological halitosis are diverse but can be classified as extra-oral halitosis and intra-oral halitosis. Factors contributing to the occurrence of halitosis include periodontal disease, dry mouth, smoking, alcohol consumption, dietary habits, diabetes, and obesity. Halitosis can also be affected by general body hygiene (i.e., dehydration, starvation, and high physical activity), advanced age, bleeding gums, decreased brushing frequency, but also by stress.[1]

Volatile Sulfur Compounds *(*VSCs) are found in the gingival crevice and are released mainly from deep periodontal pockets and where there is attachment loss.

Volatile Sulfur Compounds (VSCs), such as hydrogen sulfide (H2S) and methyl mercaptan (CH3SH) are mainly responsible for the odor associated with intraoral halitosis. Dimethyl sulfide ([CH3]2S) is mainly associated with cases of extra-oral halitosis. The formation of VSCs in the oral cavity results from the degradation of organic substrates by anaerobic bacteria and may be influenced by saliva secretion, reduced oxygen concentration, and bacterial metabolism. The micro flora of the tongue coating is thought to play an important role in intra-oral halitosis, the exact microbiological causative factor of intra-oral halitosis remains unclear. A recent study showed that the metabolic profile of the tongue coating microbiome of patients with intra-oral halitosis was significantly different from that of healthy controls. Branched chain fatty acids (BCFAs), 3-fumaryl pyruvate, and acetyl phosphate, are potential key substances in intra-oral halitosis, with BCFAs, the main metabolites in intra-oral halitosis, shown to possibly underlie tongue coating formation. In addition, acetyl phosphate has clear links to H2S-producing metabolic pathways and anaerobic metabolism. Evidence for the possible role of *Candida species* in intra-oral halitosis is conflicting, with some authors reporting a positive correlation between VSCs measurements and candida culture test results, whereas others report no association between candida presence and oral halitosis.

Ginger (*Zingiber officinale roscoe*) is one of the medicinal commodities and spices included in traditional medicine in Indonesia. The use of ginger as a medicinal plant in Indonesia is growing rapidly over time with the development of the use of natural ingredients for treatment. Ginger contains anti-microbial compounds from the phenol, flavonoid, terpenoid and essential oil groups which are bioactive compounds, so that they can inhibit microbial growth. Ginger also has active substances in the form of essential oils and gingerol which have physiological actions and inhibit the development of microorganisms such as bacteria and fungi. Essential oils amount to 0.6%, 0-3% have antiseptic effects, and the most important anti-oxidant active substance in ginger is gingerol. Gingerol is a class of phenols that have the most effect as anti-bacterial and anti-fungal. According to research, ginger concentrations of 2%, 4% and 6% provide effective anti-fungal and antibacterial effects against *Candia labicans, Streptococcus mutans, Enterococos faecalis.*[3,4]

Based on the efficacy of ginger as anti-bacterial and anti-fungal, the authors assume that it is likely that ginger has an effect in reducing halitosis levels. The author proposes a study on how the effectiveness of ginger extract (*Zingiber officinale rosc.*) on reducing levels of bad breath (halitosis).

1.2 Problem Formulation

Based on the background description above, the following problem formulation can be made:

1. Is Ginger extract (*Zingiber officinale rosc.*) cause a decrease in halitosis levels?
2. What concentration of ginger (*Zingiber officinale rosc.*) extract is effective in reducing halitosis levels in this study?
3. Is there a difference between several concentrations of ginger extract (*Zingiber officinale rosc*) in reducing halitosis levels?

1.3 Research objectives

The objectives of this research are as follows:

1. To determine the role of ginger extract (*Zingiber officinale rosc.*) on reducing halitosis levels.
2. To determine the effective concentration of ginger extract (*Zingiber officinale rosc*) on reducing halitosis levels.
3. To determine the difference between several concentrations in ginger extract (*Zingiber officinale rosc*) in reducing halitosis levels.

1.4 Research Hypothesis

Ginger extract (*Zingiber officinale rosc*) can be able to reduce the level of bad breath (halitosis).

1.5 Research benefits

1. Adding insight to the science in the field of dentistry, especially about the importance of the efficacy of extracts in ginger (*Zingiber officinale rosc*) to reduce bad breath (halitosis) levels.
2. Make it easier for people to reduce the prevalence of bad breath (halitosis) in a natural way.
3. As input for the community to increase awareness in maintaining oral health.
4. Reducing the prevalence of halitosis in the Hasanuddin University environment, especially at the Faculty of Dentistry.

CHAPTER II

LITERATURE REVIEW

2.1 Halitosis

2.1.1 Definition of Halitosis

Halitosis is generally defined as an unpleasant or offensive odor emitted from the oral cavity. The word halitosis comes from Latin, where *halitus* means inhaled air and *osis* means pathological change. It is one of the most frequent complaints patients come to the dentist with, after dental caries and periodontal disease. Halitosis is mostly caused by putrefactive bacteria living on the dorsum of the tongue and Volatile Sulfur Compounds (VSCs) produced from food debris. The main compounds considered to be the main causes of halitosis are hydrogen sulfide, methyl mercaptan, and dimethyl sulfide.[3]

Based on the source of VSC production, halitosis is divided into extra-oral (or non-oral) halitosis and intra-oral (or oral) halitosis. The composition of oral resident micro biota is more than 700 species, and the physico-chemical properties of saliva play an important role in microbial balance. One milliliter of saliva contains approximately 108 microorganisms. Poor oral hygiene and restoration defects lead to the accumulation of food debris and dental bacterial plaque on the teeth and tongue; the degradation of this retained debris by bacteria causes oral halitosis. Therefore, 90% of halitosis is related to intra-oral halitosis, and only about 10% of cases are related to extra-oral. However, there is no clear relationship between halitosis and specific bacterial infections, suggesting that halitosis reflects the complex interaction between multiple oral bacterial species.[4]

Genuine halitosis is further sub-classified into physiological halitosis and pathological halitosis. Physiological halitosis is described as an unpleasant odor that arises through the process of decay in the oral cavity without a specific disease or pathological condition that can cause halitosis. The origin of physiological halitosis is mainly the dorsoposterior region of the tongue. Pathological halitosis is classified into oral pathological halitosis (caused by oral diseases) and extra-oral pathological halitosis (e.g. originating from the nasal, paranasal region, larynx, pulmonary tract and upper gastrointestinal tract).[5]

2.1.2 Etiology of Halitosis

Halitosis has a multi-factorial etiology. Understanding the etiology of halitosis is not only important for diagnosis but also for formulating multi-disciplinary treatment. Another classification of halitosis reveals the complex etiology of this disease, which can be divided into non-pathological/physiological causes, pathological causes, and psychiatric causes.[6]

However, in most cases, the etiology of halitosis is intra-oral. Causes include certain types of food, poor oral hygiene, periodontal disease, pericoronitis, ulcers, low salivary flow, food impaction, ill-fitting dental fillings, abscesses, prostheses, alcohol and nicotine consumption, infections in the oral cavity, and microbial metabolism in the tongue dorsum. As they exhibit characteristics that facilitate proteolytic/decomposing microbial activity, the tongue and subgingival environment are considered to be major sources of Volatile Sulfur Compounds (VSCs), and high concentrations of these gases in the oral cavity may indicate respiratory abnormalities. However, it is important to note that each of these locations produces a different proportion of VSCs. Mechanical cleaning of these areas appears to significantly lower VSC levels and, consequently, improve halitosis. It is likely that most adults will suffer from halitosis, at least occasionally, the prevalence of which explains the increasing interest of patients in seeking professionals to diagnose and treat halitosis.[7]

1. Digestive diseases associated with halitosis:

   Many digestive diseases are traditionally associated with halitosis. Esophageal reflux is hiatal hernia, zencker's diverticulum, associated achalasia. Actually, steatorrhea or other malabsorption syndromes, which cause excessive flatulence, are the most important causes of halitosis in gastrointestinal diseases. Specialists and internists often require a gastroenterological assessment when faced with complaints of halitosis.

2. Temporary halitosis:

   It results from hot/spicy foods, certain beverages, alcoholic beverages, coffee and most commonly from garlic, onions, salty foods, spices, curries, preserved foods like salamis and cooked foods like kippers.

Tobacco consumption causes moldy odor and hypo salivation/xerostomia (dry mouth) also causes halitosis.

3. Morning breath:

   Everyone has a degree of halitosis, first thing in the morning. There are physiological reasons for this. During sleep, saliva flow is drastically reduced and the tongue and cheeks move very little. This allows food debris to be retained in the mouth and dead cells that normally shed from the surface of the tongue and gums and from the inside of the cheeks to accumulate. As bacteria start to work on them and digest them, an unpleasant odor is produced. This process is biologically known as putrefaction. Although normal, anyone suffering from nasal congestion whose mouth breathes is more likely to suffer from this action. Fortunately, this morning breath generally goes away after breakfast and after brushing teeth as saliva starts flowing again and the remaining debris is washed away and swallowed.

4. Smoking (cigarettes/cigars):

   Breath smells like an ash tray. Smoking also reduces saliva flow and therefore further exacerbates the problem.

5. Strict diet/fasting:

   When the body is no longer supplied with energy providing carbohydrates it first breaks down glucose which is stored in the muscles and liver in the form of glycogen. But this doesn't last long. After a few hours, the body begins to break down its fat stores and the waste products of its metabolism, ketones, give the breath a distinctive sweet and sickly odor. This can be seen in those who have worked hard and exercised and not consumed enough carbohydrates before or after. People on a strict caveman diet or high-protein diet experience the same effect for the same reason.

6. Volatile Sulfur Compounds (VSC)

   Volatile Sulfur Compounds (VSCs), namely hydrogen sulfide (H2S) and methyl mercaptan (CH3SH) are the main causes of halitosis. These substances are by-products of bacterial action on proteins. Gram-positive bacteria produce little or no unpleasant odor; most Gram-negative bacteria are strong producers of odorous compounds.

2.1.3 *Oral & Non Oral Halitosis*

a. Extra-oral halitosis.

   Based on the source of VSC production, halitosis is divided into extra-oral (or non-oral) halitosis and intra-oral (or oral) halitosis. The composition of oral resident micro biota is more than 700 species, and the physicochemical properties of saliva play an important role in microbial balance. One milliliter of saliva contains approximately 108 microorganisms. Poor oral hygiene and restoration defects lead to the accumulation of food debris and dental bacterial plaque on the teeth and tongue; the degradation of these retained debris by bacteria causes oral halitosis. Therefore, 90% of halitosis is related to intra-oral halitosis, and only about 10% of cases are related to extra-oral However, there is no clear relationship between halitosis and specific bacterial infections, suggesting that halitosis reflects the complex interaction between multiple oral bacterial species. It is generally believed that Gram-negative anaerobic bacteria digest proteins from food residues, desquamated cells of oral mucosal leukocytes and other saliva debris into amino acids that accumulate in the oral cavity and originate oral halitosis.[8]

These bacteria can be isolated from sub-gingival plaque in individuals with gingivitis or periodontitis, and saliva and tongue dorsum in healthy individuals. Some microorganisms recovered from gingivitis and periodontitis periodontal lesions can produce large amounts of VSCs. The odor yield was significantly correlated with the total number of bacteria and the diversity of each type. As epithelial cells desquamate and debris becomes available, decay occurs. However, during the bacterial decay process, compounds other than sulfur compounds are also formed. Peptides are hydrolyzed into amino acids, which can be further metabolized into amines or polyamines. The researchers concluded that halitosis is the result of multifaceted interactions between diverse bacterial species. In this case, the cleavage of certain amino acids leads to the production of bacterial metabolites, mainly VSCs (H2S, CH3SH and dimethyl sulfide [CH3]2S), organic acids (butyric acid), aromatic complexes (indole, skatole) and amines (putrescine, cadaverine). In vitro and in vivo studies have shown that oral surfaces are colonized by several bacterial species associated with halitosis and are responsible for the production of malodorous compounds known as VSCs. [8]

Oral halitosis is caused by bacteria that settle in the mouth. VSCs such as H2S and methyl mercaptan, are halitosis metabolites produced by oral bacteria, especially the tongue coating area. Most cases of halitosis are related to oral halitosis, which is caused by different species of oral bacteria. In the oral cavity, the tongue coating, in particular, its dorsal surface, is considered the main area for halitosis production. This area is the best residential location for the accumulation of various bacteria. Studies show that the dorsal tongue has a special capacity to bind various bacteria. In this region, each epithelial cell can bind more than 100 bacteria-in comparison, the binding capacity of other types of oral epithelium is about 25 bacteria per cell. In addition, the gap in the dorsal surface of the tongue provides a hypoxic environment for the growth of VSC-producing anaerobic bacteria. Typically, VSCs and other odor compounds are derived from the interaction of bacteria with specific amino acids.

b. Non-oral halitosis.

As mentioned above, 10% of halitosis cases are related to non-oral halitosis. halitosis from the ear, nose, and throat region, pulmonary pathology, gastrointestinal tract and blood-borne halitosis. In blood-borne halitosis, malodorous compounds in the bloodstream are carried to the lungs where they evaporate and enter the breath.

Several systemic diseases are the basis of blood-borne halitosis, including liver pathologies and endocrinological diseases, metabolic disorders, medications, and certain foods.

2.1.4 Mechanism of Halitosis

Many researchers have focused on the mechanism of halitosis formation and found that VSC-producing microorganisms mainly contribute to it. It was shown that the dominant composition of halitosis is VSC and that about 82 species of commensal microorganisms in the oral environment referred to as VSC-producing bacteria can produce H2S, CH3SH and acid in the metabolic process, which ranks first in the VSC composite. Among them, some have close links with halitosis, especially *Fusobacterium, Veillonella, T. denticola (T.D), Porphyromonas gingivalis (P.G), Bcteroides forsythus (B.F),* and *Peptostreptococcus*, etc. In the oral cavity of the elderly, *Fusobacterium* and *P. melaninogenica* are described as being involved in H2S production. Furthermore, oral gram-negative anaerobes were verified to be responsible for halitosis, such as P.*g, veillonella parvula, Prevotella intermedia (P.i), Actinomycetes (A.a), Peptostreptococcus, Eubacterium, Selenomonas, Centipeda, Bacteroides, Fusobacterium*, and all halitosis pathogens can secrete VSCs when they metabolize by utilizing their major enzymes such as *Trypsinlike, collagenic hydrolase, L-cysteine desulfhydrase,* and *L-methionine-α-deamino-γ-mercaptomethane-lyase (METase).* Halitosis-associated bacteria metabolize protein, cysteine, Lmethionine, and other amino acids as substrates to produce H_2S and CH_3SH that are converted to VSC, but some authors indicate that the ratio of methionine to intact free amino acids is significantly higher than that of cysteine. There are remarkable differences of anaerobic bacteria between halitosis patients and healthy people, especially those that can use sulfur-containing amino acids as substrates to produce a lot of H_2S with collagen hydrolase and gingivain. Persson, Edlund. reported that the genus *Peptostreptococcus, Eubacterium, Selenomonas, Centipeda, Bacteroides,* and *Fusobacterium* formed large amounts of H_2S from L-cysteine while CH_3SH from L-methionine was formed by some members of the genus *Fusobacterium, Bacteroides, Porphyromonas,* and *Eubacterium*. The enzymatic reactions involved in the formation of H_2S and CH_3SH are thought to be as follows:

L-cysteine→L-cysteine desulfhydrase→pyruvate. [9]

2.1.5 Classification of Halitosis

Halitosis is defined as an unpleasant odor exhaled through the mouth and upper airway, caused by biofilm accumulation on the tongue dorsum, interdental spaces or due to periodontal disease, although the condition is multi-factorial and can involve both oral and non-oral conditions Although this classification has not been universally accepted by all experts in the field, there is general agreement that halitosis can be categorized as genuine halitosis, pseudo-halitosis and halitophobia. Genuine halitosis has been further sub-classified as physiological halitosis where there is no readily apparent disease or pathological condition, or pathological halitosis that occurs as a result of an infectious process in the oral tissues. Pseudo-halitosis is a condition where there is no halitosis but the patient believes that they have halitosis. Halitophobia may occur when there is no physical or social evidence to suggest that halitosis is present and which may persist after treatment either for genuine halitosis or as pseudo-halitosis.[10]

1. Types of halitosis

   a. Halitosis

      Real halitosis can be further divided into physiological and pathological halitosis. Physiological halitosis includes halitosis caused by dietary components, bad habits, morning breath, secondary to xerostomia caused by physiological factors. Pathological halitosis occurs due to pathological conditions or oral tissues such as gingival disease and periodontal disease such as periodontitis, acute necrotizing ulcerative gingivitis, postoperative residues. blood, debris under dental appliances, ulcerative lesions of the oral cavity, Halitosis can be related to coated tongue, can occur due to secondary xerostomia due to salivary gland disease, tonsilloliths.

   b. Pseudohalitosis

      Patients suffering from pseudohalitosis complain of halitosis even though it is not perceived by others. This condition can be effectively managed with counseling (using literature support, education and explanation of examination results) and simple oral hygiene measures.

c. Halitophobia

Some individuals continue to insist that they have halitosis even after they have been treated for genuine halitosis or pseudo-halitosis. Such individuals are categorized as halitophobic. Halitophobia may be considered when there is no physical or social evidence to suggest the presence of halitosis.

d. Psychogenic Halitosis

Psychogenic halitosis is the only one imagined. In this case a person believes that their breath smells bad when it actually does not. This problem can occur in people who tend to overestimate normal bodily sensations. Sometimes this is caused by serious mental disorders such as schizophrenia. A person with obsessive thoughts may feel overwhelmed by feeling dirty. Someone who is paranoid may have delusions that their organs are rotting. Both these people feel their breath smells bad. Such people can be helped by having a doctor or dentist reassure them that they do not have halitosis. If the problem persists, the person may benefit from seeing a psychotherapist.[11]

2.1.6 Halitosis Measurement

There are many different methods for measuring halitosis. Organoleptic measurement, which involves using the human nose to assess the intensity of odors coming from the patient's mouth at varying distances, is considered the gold standard for halitosis measurement. Testing should be done in the morning before meals and hygiene procedures performed to get the correct measurement conditions. The patient should also count aloud from 1 to 10 before the measurement begins to promote drying of the mucosa of the palate and tongue and facilitate the release of VSCs.

The use of a panel of judges is also recommended to increase the reliability of results but this may increase the cost for the test and may be difficult in a practice setting. The most common reasons why this method is not used are the unattractiveness of the measurement method to the examiner and the socially uncomfortable positioning of the patient. In addition, patients need to avoid consuming odorous foods or liquids for 48 hours that may affect clinical readings, prior to measurement, to ensure that the results collected by the Organoleptic Score method are accurate.

Objective measurements of halitosis can be obtained with electrochemical meters or gas chromatography. Electrochemical meters such as halimeter (Interscan Corp., Chatsworth, LA, USA) and breathtron TM (New Cosmos Electric, Osaka, Japan) directly measure the level of VSC in breath samples. The sensitivity and specificity of halimeter have been reported to be 92.2% and 91.7%, respectively. The electrochemical reaction with sulfur-containing compounds produces an electric current proportional to the VSC concentration. These portable sulfide monitors are currently being used in many clinical practices, mainly due to their ease of use in generating quantitative measures of VSCs chairside. It must be noted, however, that this monitoring method on sulfide has a major drawback in being able to accurately measure dimethyl sulfide. In addition, the presence of compounds such as alcohols and phenyl and polyamine compounds can interfere with the readings. With recent technological advancements, the use of gas chromatography to measure VSC is becoming more popular.

It separates and analyzes vaporized compounds using gas chromatography equipped with a flame photometric detector. This provides the ability to differentiate between the different compounds that cause halitosis. It is therefore one of the most accurate tests available today, both in terms of its objectivity and sensitivity in detecting low molecular concentrations. However, this technique is not easily applied clinically using traditional chromatography due to the relatively high cost of the equipment, the requirement for highly trained operators, and the extensive procedures involved.

There are also a number of indirect methods to measure halitosis. For example, the benzoyl-DL-arginine-nine-naphthylamide (BANA) assay, 62 which uses test strips containing the synthetic trypsin substrate benzoylDL-arginine-2-naphthylamide. This allows detection of anaerobic bacteria

Proteolytic obligate Gram-negatives, such as *Treponema denticola, Porphyromonas gingivalis,* or *Bacteroides forsythus,* which produce enzymes that hydrolyze substrates and produce a blue color. The test results, it has been demonstrated - show a strong positive correlation with periodontal disease activity. However, the specific role of the different types of bacteria present cannot be fully determined. Saliva incubation is another indirect method of measuring halitosis. Saliva samples are incubated in a sealed container at 37°C and the headspace of the container is analyzed for VSC by chemical detection or organoleptic assessment.[12]

2.1.7 Halitosis Management

One must remember that patients suffering from halitosis are help-seeking, often anxious and suspicious of any treatment, due to bad experiences using traditional approaches. An accurate diagnosis of halitosis must be achieved in order to manage it effectively. Available methods can be divided into mechanical reduction of microorganisms, chemical reduction of microorganisms, use of masking products, and chemical neutralization of VSC. Professional oral health care examinations should be provided to all patients regardless of the type of halitosis.

Mechanical removal of biofilms and microorganisms is the first step in halitosis control. A systemic review by Van der Sleen et al. showed that tongue brushing or tongue scraping can potentially be successful in reducing breath odor and tongue coating. Tongue scrapers were molded according to the anatomy of the tongue and reduced 75% of VSC compared to only 45% using a toothbrush. However, a Cochrane review in 2006 compared randomized controlled trials for different tongue cleaning methods to reduce halitosis in adults with halitosis. It concluded that there were faint indications that there were small but statistically significant differences in the reduction of VSC levels when scrapers or cleaners rather than toothbrushes were used to reduce halitosis in adults. In a recent systematic review, there was no evidence of dietary modification, use of sugar-free chewing gum, tongue cleaning by brushing, tongue scraping or use of zinc-containing toothpaste producing clinically significant results for the management of intra-oral halitosis.

Antibacterial mouthwashes including Chlorhexidine (CHX), Cetylpyridinium Chloride (CPC), and triclosan act on halitosis-producing bacteria. A systematic review, published by Cochrane, compared the effectiveness of mouthwashes in controlling halitosis.

The researchers concluded that mouthwashes containing CHX and CPC can inhibit VSC production while mouthwashes containing chlorine dioxide and zinc can neutralize sulfur compounds that produce halitosis. CHX is considered the gold standard mouthwash for the treatment of halitosis. CHX in combination with CPC resulted in a greater reduction in VSC levels, and aerobic and anaerobic bacteria counts showed the lowest survival percentage in a randomized, double-blind, cross-over study design. Oxidation of VSC and sulfur-containing amino acids by oxidizing agents such as chlorine dioxide (chlorodioxide) reduced the onset of bad odor in 29% of test subjects after 4 hours. Positively charged metal ions bind to sulfur radicals that inhibit VSC expression.

Patients with halitophobia require referral for clinical psychology investigation and treatment. Patients, who attribute their emotional state to a possible cause of their halitosis, would benefit more from an early referral to a clinical psychologist for mental assessment and appropriate treatment. Treating delusional halitosis requires a multi-disciplinary approach from health care practitioners, psychologists and psychiatrists. When treating patients with halitosis, clinicians should relate not only to physiological odors and associated parameters but also to the nature of subjective complaints. In the management of halitosis, a good understanding between the patient and the primary healthcare physician can bring about a successful outcome. A primary healthcare physician should demonstrate an attitude of acceptance, sympathy, support, and reassurance to reduce the patient's anxiety. Professionals can improve the patient's overall quality of life, enhancing their social interactions and relationships. Ongoing encouragement and reassurance needs to be provided by the patient's primary healthcare physician, family, and friends. Due to the multi-factorial complexity of halitosis, patients should be treated individually, not categorized. [13]

2.2 Ginger

Ginger is a pseudo-stemmed plant, 30 cm to 1 m tall, upright, unbranched, composed of leaf midrib sheets, round in shape, pale green in color, and reddish at the base of the stem. The root of ginger is often called the rhizome of ginger, which smells fragrant and tastes spicy. The rhizome is irregularly branched, coarsely fibrous, creeping horizontally, and pale yellow inside.[14]

Ginger (*Zingiber officinale rosc*) is a popular type of rhizome plant known as a spice and medicinal ingredient. This plant has been used in medicine in several Asian countries since 1500. In general, there are two types of ginger rhizomes, namely red ginger (*Zingiber officinalevar rubrum*) and white ginger (*Zingiber officinalevar amarum*). Red ginger rhizome contains high volatile oil, oleoresin and gingerol substances, so it is more widely used as a medicinal raw material. Essential oils include volatile oils and produce a fragrant aroma in ginger. Ginger essential oil consists of zingiberol, zingiberen, methyl heptanone, sineol, stral, borneol, linalool, n-nonyl aldehyde, d-camphen, d-bphellandren, acetate, caprylate, phenol, and chavicol. Zingiberol and zingiberen are the main components that produce the fragrant aroma. Ginger also contains oleoresin, which has non-volatile components that form the spicy flavor of ginger. Oleoresin is a combination of essential oils and terpenoid compounds. Oleoresin is composed of gingerol, zingeron, shogaol, and resin. Gingerol and shogaol are phenol-derived compounds. The older red ginger rhizome will have a greater oleoresin content.[15] Treatment of headaches, diarrhea, constipation, warts, worms, kidney damage cardiovascular disease and to relieve stress. The commonly used part of the basil plant is the leaves. Basil leaves have a strong aroma so they can be used as a fragrance and flavoring agent for food, beverages, condiments and oral care products.

2.2.1 Classification of Ginger

Division	: *Spermatophyta*
Subdivision	: *Angiosperms*
Class	: *Monocotyledoneae*
Subclass	: *Zingiberidae*
Order	: *Zingiberales*
Family	: *Zingiberaceae*
Genus	: *Zingiber P. Mill*

Figure 2. 1 Ginger

Based on the shape, size, and color of its rhizome, ginger is divided into:

a. Red Ginger

Red ginger (*Zingiber officinale var. rubrum*) is 42-43 mm in diameter, 52-104 mm in height and 123-126 mm in length. Red ginger has small rhizomes that are reddish yellow and smaller than small ginger and coarse fibers. It is also very spicy and has a very sharp aroma.

b. Large White Ginger

Large white ginger or elephant ginger (*Zingiber offchinale var. officinarum*) is 48-85 mm in diameter, 62-113 mm in height and 158 - 327 mm in length. This ginger has a much bigger and fatter rhizome but its flavor and aroma are less sharp than red ginger and small white ginger.

c. Small White Ginger

Small white ginger or emprit ginger (*Zingiber offichinale var. amarum*) has small internodes, 32.7 - 40 mm in diameter, 63.8 - 111 mm in height, and 61 - 317 mm in length. This ginger is flat and white-yellow in color. The fiber is soft and has a sharper aroma than large white ginger.[17]

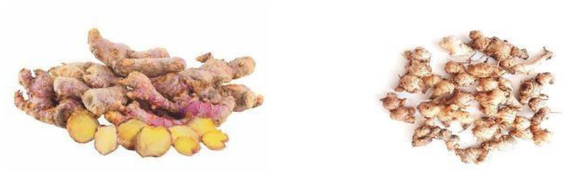

Figure 2. 2 Ginger Rhizome (a. Red Ginger; b. White Ginger)

2.2.2 Ginger Utilization in the Health Sector

Ginger has been used as a traditional medicine for various diseases. It can be used as herbal medicine because ginger contains many substances that are very beneficial for the health of the body. Calories: 4.8, carbohydrates: 1.07 gr, fiber: 0.12 gr, protein: 0.11 gr, fat: 0.05 gr, sugar: 0.1 gr. This content depends on how the ginger is processed, the content above is the pure content of ginger when eaten directly without being processed first, if processed for example into ginger milk or *wedang jahe*, of course, the content will change depending on how we process the ginger.

In addition, ginger also contains various vitamins and minerals that are good for the body, such as: iron, potassium, vitamin B3 and B6, vitamin C, magnesium, phosphorus, zinc, folate, riboflavin (vitamin B2), niacin (vitamin B3). The most important content of ginger is zingiberol which functions as an anti-inflammatory and contains very high antioxidants.

There are many benefits of ginger, such as anti-inflammation, preventing skin problems, preventing cancer, boosting the immune system, cold medicine, helping to lose weight, reducing nausea, reducing pain, detoxifying the body from toxins, and so on. How to use ginger as a medicine, usually many people make ginger as a drink, such as *sekoteng* drinks that are added with ginger, there are also those who burn the ginger to remove essential substances from ginger and add it to drinks or as aroma therapy, in China ginger itself is dried and made into herbal medicine which will be brewed and drunk, ginger can also be dried and mashed and put into capsules, as an alternative to getting the health benefits of ginger without having to feel the taste of ginger which is quite spicy, today many also process ginger into sachet drinks such as ginger coffee, ginger tea, *wedang jahe*, and so on.[18]

2.2.3 Chemical Content of Ginger

The chemical content of ginger consists of 2 - 3% essential oil, starch, resin, organic acids, malic acid, oxalic acid and gingerin. In addition, ginger rhizomes also contain fats, waxes, carbohydrates, vitamins A, B and C, minerals, flavonoids and polyphenols. Ginger rhizomes also contain a proteolytic enzyme called zingibain. The active ingredients in ginger rhizome consist of: essential oil 2-3%. zingiberin, kamfena, limonene, borneol, sineol, zingiberal, linalool, geraniol, and gingerin.

Essential oil is a mixture of volatile organic compounds (volatile oil), insoluble in water and has a distinctive odor. The essential oil content in dried ginger is about 1-3 percent. These oils mostly contain terpenes, fellandren, dextrocamphen, sesquiterpene material called zingiberen, zingeron resin, starch. The main components of ginger essential oil that cause the fragrant odor are zingiberene (35%), curcumin (18%), farnesene (10%) and small amounts of bisabolene and b-sesquiphellandrene. There are also at least 40 different monoterpenoid hydrocarbons such as 1,8-cineole, linalool, borneol, neral, and geraniol.

The content of volatile oil in red ginger is about 2.58-3.90%, calculated based on dry weight. The essential oil content of white ginger is 0.82-1.68%, while that of small white ginger is 1.5-3.3%. Essential oil compounds are generally yellow, slightly viscous and are the compounds that give ginger its aroma. The content of essential oil in ginger is strongly influenced by the age of the plant and the age of harvest. The older the ginger, the higher the essential oil content. However, during and after flowering, the percentage of essential oil content decreases so it is not recommended that ginger be harvested at that time.

The non-volatile component of ginger, oleoresin, is a phenol compound with side carbon chains consisting of seven or more carbon atoms. This component forms the non-volatile spicy flavor of ginger. The components in ginger oleoresin consist of gingerol, gingerdiols, gingerdiones, dihydrogingerdiones, shagaol, paradols, and zingerone which give a spicy taste in the mouth.

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