HALITOSIS ACTIVITY AGAINST VOLATILE SULFUR COMPOUND OF METHYL MERCAPTAN COMPONENT FROM BURAHOL (STELECHOCARPUS BURAHOL) FRUIT EXTRACT

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ABSTRACT

Objective: This research was conducted to prove the activity of Stelechocarpus burahol fruit (SBF) extracts against volatile sulfur compound (VSC) of methyl mercaptan in anaerobic Gram-negative oral bacteria causing halitosis.

Materials and Methods: Burahol fruits were extracted by ethanol and partitioned by several solvents and then identified the chemical constituents of the extracts using phytochemical screening test and polyphenol content by spectroscopic ultraviolet instrument. The halitosis activity against VSC of methyl mercaptan component derived from anaerobic Gram-negative oral bacteria after administration of SBF extracts with a dose of 20 mg/ml was conducted in vitro using gas chromatography-oral chhma.

Results: All extracts (ethanol, ethyl acetate, butanol, water, and methanol) contain flavonoids and polyphenols, whereas saponin was found in all extracts except methanol. Halitosis activity shows the ethanol extract of SBF, has absorption capability against methyl mercaptan, and was higher than the other extracts, with catechins as control.

Conclusion: All extracts of SBF (ethanol, ethyl acetate, butanol, water, and methanol) can inhibit and reduce VSC of methyl mercaptan causing halitosis.

Keywords: Stelechocarpus burahol, Methyl mercaptan, Halitosis.

INTRODUCTION

Halitosis or oral malodor is a condition that describes the presence of smells or bed odor when breathing. Halitosis independently of the odoriferous substances and of their source, which can be oral or extraoral [1,2]. Approximately, the incidence of halitosis is about 30% worldwide [3]. In some participants, halitosis problem could cause social problems in confidence and shame when communicating with others. As a result, people affected by halitosis avoid social interaction and affected psychologically [4]. The main cause of oral malodor may be associated with health problems, such as diseases of the oral cavity, the accumulation of food debris and dental bacterial plaque on the teeth, or due to disorders of gastrointestinal tract, some of systemic diseases and metabolic disorders [2,5,6].

Approximately 85-90% of halitosis occurs in the oral cavity, caused by the production of volatile sulfur compounds (VSC) such as hydrogen sulfide (H₂S), dimethyl sulfide ((CH₃)₂S), and methyl mercaptan (CH₃SH), produced by oral anaerobic microbes [7,8].

Several herbals have been used as mouth deodorant to treat halitosis. Burahol fruit is one of the plants in Indonesia that has been empirically used by the princes of the palace of Jogjakarta as deodorant. Burahol fruits can make the body odor becomes fragrant, the breath becomes fragrant and even can also scent the smell of urine [9]. As an oral deodorant, burahol fruit serves as an adsorbent material and as a prebiotic. Burahol fruit also showed activity in reducing the levels of ammonia and methyl mercaptan for 62.9% and 77.8%, respectively [10]. The preliminary studies conducted by Munim, 2013, showed that the ethanolic extract of burahol having activity able to absorb methyl mercaptan as the highest at 83.3%, followed by butanol extract of 64.56% and 53.74% of water extracts [11].

This study was conducted to determine whether the burahol fruit extracts have the effect of eliminating halitosis using oral chroma (OC) [12].

MATERIALS AND METHODS

Material

Stelechocarpus burahol fruits (SBFs) were collected from Magelang District, Central Java, Indonesia. Determination of plant material was carried out by Indonesian Institute of Sciences, Center for Plant Conservation-Bogor Botanical Gardens, Bogor, Indonesia, under the code number 1557/JP.H.3/KS/IV/2014. Saliva from six healthy participants in physiologic halitosis (who has passed the Ethics Committee by Tim Ethics Dentistry, Faculty of Dentistry-University of Indonesia, Indonesia), Porphyromonas gingivalis bacteria strain American Type Culture Collection (ATCC) 33277, Fusobacterium nucleatum bacteria strain ATCC 25586 (Medimark C Europe, France), solvents (96% ethanol, methanol, n-hexane, and butanol) were purchased from Bratachem, Indonesia, gas pack anaerobic (Thermo Scientific), gallic acid reagent from Merck (Elo Karsa, Indonesia), catechin reagents from Sigma-Aldrich (gift from BPPT, Indonesia). Fionnor paper sterile with diameter of 12.7 mm, and physiological saline were used in the study.

Instrument

Gas chromatography-OC (GC-OC) (ATP), incubator (Memmert, German), dry oven (Memmert, German), rotary vacuum evaporator (IKA WERK RVOR), and ultraviolet visible (UV-Vis) spectrophotometer (Hitachi U-2000, Japan) were used in the study.

Extraction

S. burahol flesh fruit was sliced and put into oven-dried fruit. SBF was dried in an oven (Memmert, Germany) at 40°C for 1 week. The dried powdered plant material (50.02 kg) was extracted with 96%
ethanol in maceration vessel at room temperature. The extraction was done following the methods of the standardization of extract parameters [13]. The solution was filtered and evaporated in a rotary evaporator under reduced pressure at 50°C to yield a residue (5.2 kg) crude extract. The extract was partitioned in different solvents to separate the extract based on polarity. A total of 1002 kg of crude ethanolic extract was partitioned with n-hexane solvent to yield n-hexane (91.1 g), ethyl acetate (45.02 g), n-butanol (227.9 g), and water (189.7 g) extract. About 80 g water extract obtained then condensed and dispersed into methanol to obtain methanol extract with higher polarity. The yield of methanol extract obtained was 29.7 g. Each extract was then tested the halitosis activity against VSC of methyl mercaptan.

Phytochemical screening

The extracts were redissolved in distilled water and methanol, the each extract was used for the qualitative analysis of determination of secondary metabolites (alkaloids, flavonoids, tannins, saponins, steroids/terpenoids, and glycosides). The procedures for all chemical compounds were done according to the protocols described by Trease and Evans [14] and Tyler et al. [15].

Total polyphenolic content

The total phenolic content (TPC) of extracts was determined by Folin–Ciocalteu method as described by Singleton and Rossi [16] with some modifications. Each extract (50 mg/ml) was diluted with a suitable solvent and the volume up to 10 ml. 2 ml of each solution was taken and poured into the test tube, 1.6 ml of distilled water and 0.2 ml of Folin–Ciocalteu reagent (50% v/v) were added, was shaken to make homogeneous for 1 minute using a vortex and let stand for 4 minutes. Then, 4 ml of sodium carbonate (11% w/v) was added, centrifuged for 10 minutes, and incubated for 2 hrs in dark at room temperature. The TPC compound was expressed as milligram of gallic acid equivalents/gram dry extract. The absorbance was measured at 765 nm using a UV-Vis spectrophotometer. The mean values and standard deviations (±) results of triplicate analyses.

Halitosis activity assay against VSC of methyl mercaptan from SBF extracts

Halitosis activity test carried out in vitro by measuring the ability of the extract in inhibiting or reducing gas volatile methyl mercaptan causes of halitosis, which is produced by the Gram-negative anaerobic bacteria obtained from halitosis physiological participants’ saliva. Saliva from six participants of halitosis physiological who passed the Ethics Committee by Tim Ethics Dentistry, Faculty of Dentistry - UI with inclusion criteria: Male or healthy women, aged 20-45 years, halitosis of VSC of methyl mercaptan (average scores) was >2.4 ng/10 ml or 180 parts per billion stated halitosis [12].

Halitosis activity in vitro is done by measuring the gas of VSC of methyl mercaptan produced by bacterial culture, which is done before and after administration of the extract. Extract at a dose of 20 mg/ml was injected through a needle in the lid of the tube inoculation and allowed to stand at room temperature up to 6 hrs; then, methyl mercaptan VSC value was measured again at the GC-OC. Catechin used as a standard against the extracts.

RESULTS

SBF ethanolic extracts have been macerated, then partitioned with several solvent to separate the extract based on polarity, and obtained phytochemical identification by following data (Table 1), and TPC data are shown in Table 2.

Haltosis activity against VSC of methyl mercaptan of SBF extracts

Halitosis activity measured based on inhibition of methyl mercaptan gas that produced by anaerobic Gram-negative bacteria culture from saliva using GC-OC before and after the administration of the extracts of the SBF (Fig. 1).

DISCUSSION

S. burahol (Blume) Hook.f and Thomson tree is famous as kepel or burahol. Burahol fruit is one of the rare fruits in Indonesia. S. burahol is one of some Indonesian indigenous plants. The SBF powder was extracted with ethanol 96% using maceration method to avoid damage to thermolable compounds, which damage due to high temperatures. The ethanol solvent can attract chemical substances which are polar

<table>
<thead>
<tr>
<th>Chemical content</th>
<th>Extracts</th>
<th>Ethanol</th>
<th>Ethyl acetic</th>
<th>Butanolic</th>
<th>Water</th>
<th>Methanolic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alkaloid</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Saponin</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Flavonoid</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Terpenoid/sterol</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tannin</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Glycoside</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*: Detected, =: No detected, SBF: Stelechocarpus burahol fruit

<table>
<thead>
<tr>
<th>Extract</th>
<th>TPC (mg GAE/g-DE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethanol</td>
<td>4.359±0.011</td>
</tr>
<tr>
<td>Ethyl acetate</td>
<td>4.901±0.021</td>
</tr>
<tr>
<td>Butanolic</td>
<td>2.382±0.003</td>
</tr>
<tr>
<td>Water</td>
<td>6.953±0.102</td>
</tr>
<tr>
<td>Methanolic</td>
<td>1.284±0.006</td>
</tr>
</tbody>
</table>

mg GAE/g-DE: Milligram gallic acid equivalent/gram dry extract, SBF: Stelechocarpus burahol fruit, TPC: Total phenolic content
and non-polar contained in burahol fruit. High levels of sugar in the SBF make that the extract obtained is hard dried, to remove residual solvent in the extract, then the ethanol extract condensed in evaporation in a vacuum oven at a temperature of 60°C, a pressure of 15 atmospheric, for 2 weeks. The extract was partitioned using different solvents to separate the extract based on polarity. Ethanol crude extract was partitioned with n-hexane solvent which represents the non-polar solvent, to obtain non-polar extract, while ethyl acetate, butanol, water, and methanol were used to obtain the extract with polar chemical components.

The phytochemical screening test was not performed on the n-hexane extract because it does not provide a decrease in activity of methyl mercaptan compound (data are not published). The identification of chemical components of SBF extracts showed that saponins were found in the ethanol, ethyl acetate, and water extract. The presence of secondary metabolites such as tannins, flavonoids, glycosides, and terpenoid component was found in all SBF extracts.

Determination of total phenols content (tannins and flavonoids) are polyphenolic compounds that are classified performed using gallic acid as a standard and Folin-Ciocalteu reagent. TPC extracts were determined based on the ability of phenolic compounds in the extract with phosphomolybdic-phosphotungstic acid reagent, Folin-Ciocalteu reagent (yellow) will change the color to blue. The intensity of color formed was measured at a wavelength of 765 nm. Gallic acid was used for the calibration curve and was plotted at 0.05, 0.1, 0.15, 0.2, and 0.25 mg/ml, gallic acid that was prepared in methanol (70% v/v). Water extract showed the highest TPC than the other extracts; this is relevant to reference, the phenol include polar compound has high solubility in aqueous solvent. The higher the content of phenol (phenol hydroxyl group amount) in the sample, meaning the higher the absorbance of the solution. The polarity solvent level to determine the structure and the type of phenolic compounds extracted. Phenolic compounds which have more hydroxyl groups will result in a high TPC [17].

Halitosis activity in vitro is done by measuring the absorption of volatile methyl mercaptan using GC-OC; methyl mercaptan is produced by anaerobic oral bacteria from saliva of physiologic halitosis participants. Saliva of participants was taken in early morning when participants wake up (05.00 am) because the production of saliva decreases during sleep so that the growth of anaerobic oral bacteria such as P. gingivalis and F. nucleatum increased [18]. This is a favorable factor for the formation of VSC and the main cause of bad breath odor when the participants wake up (morning breath). Halitosis activity to inhibiting or reducing VSC of methyl mercaptan level was measured before and after administration of the extracts with dose of 20 mg/ml. The VCS of methyl mercaptan measurement results shows that the ethanol extract of SBF has absorption capability against methyl mercaptan which is higher than the other extract, with value of the average percentage reduction in methyl mercaptan is 64.95±0.82, which followed by methanolic extract is 60.51±0.03; butanol extract is 52.82±0.15, water extract is 51.49±0.43; and the ethyl acetate extract is 33.92±0.18 while catechin as control is 79.34±0.29. Data obtained in this study were calculated of statistical using Shapiro–Wilk method because the sample size is <50 and the calculation is continued using analysis of variance (ANOVA one-way). The VSC values between the treatment groups, before and after administration of a dose of the extract with a dose of 20 mg/ml were significantly different, whereas the treatment group compared with catechin as a standard also significantly different, with p<0.05.

The use of herbal medicine products to eliminate bad breath in works by: (1) Cover up the odor (masking effect), (2) eliminate or inhibit the activity of VSC-producing bacteria, (3) reduce or inhibit VSC compounds that cause bad breath, and (4) odor-neutralizing chemicals in mouth [19]. Our results showed that SBF extracts had also reduce or inhibit VSC that cause bad breath. The effect occurs because phenolic compound such as tannin, flavonoid, and glycoside in SBF extracts. Phenolic compound as like as catechin in green tea could reduce VSC concentration in the mouth air and could also inhibit VSC production in a saliva-putrefaction system [20]. Catechin can transform VSC to nonodorous compounds through the reaction with sulfhydryl and amino groups of VSC [21]. P.-anthonycyanidins (a flavonoid group) in grape have a potential as an adsorbent of methyl mercaptan that cause bad breath [22]. Phenol derivatives in some vegetables and fruits such as varigatic acid and cafeol cuinic acids have odor remover activity by binding to sulfhydryl compound [23,24]. The mechanism of the phenol compound is by conjugating of compounds with sulfhydryl groups [25-27].

CONCLUSION
All extract of SBF (ethanol, ethyl acetate, butanol, water, and methanol) can inhibit and reduce VSC of methyl mercaptan causes of halitosis. Our finding showed that S. burahol could be useful as a natural agent for the treatment of halitosis.

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REFERENCES