

## Review Article

### Potencial of Various Natural Bleaching Ingridients on Teeth Discoloration

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#### ABSTRACT:

**Background:** Teeth whitening (Dental Bleaching) is currently one of the dental cosmetic procedures that are needed by the community. Bleaching is a safe and widely used procedure and is frequently requested by patients seeking appearance improvement. There are many ingredients that are sold in the market which are considered to have a bleaching effect on the teeth. But it certainly results in an unfavorable effect for humans. Currently, natural ingredients are widely chosen by the public and are used as natural bleaching agents for tooth discoloration such as banana peels, lemons, apples, rosella and green pears. **Aim:** The aim of this study was to analyse the potential of various natural bleaching agents to discoloration of teeth. through literature review. **Methods:** The data was collected through the Medline database (PubMed), Google Scholar, EBSCO, textbooks, accredited national journals. **Conclusion:** Natural whitening ingredients obtained from banana peels, lemons, apples, rosella and green pears can change the color of teeth. The natural ingredients of banana peels, lemons, apples, rosella and green pears contain compounds of saponins, malic acid, potassium, calcium, phosphorus, sodium, magnesium, and iron, while the phytochemical components of banana peels consist of alkaloids, flavonoids, phenols, tannins that can cause teeth whitening effect. Which results in less effective bleaching because the thickness of the enamel on each tooth is different. Natural materials are less effective on posterior teeth because premolars and molars have a thicker enamel layer than anterior teeth.

**Keys words:** Natural Bleaching, Teeth Discoloration

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#### INTRODUCTION

Teeth whitening (dental bleaching) is currently one of the dental cosmetic procedures that are needed by the community. Discolored teeth will reduce the beauty of appearance and reduce self-confidence. This causes the increasing need for dental aesthetic services, especially teeth whitening. Dental bleaching is an effort that has long been recognized in dentistry.<sup>1,2</sup> Bleaching is a safe and widely used procedure and is often requested by patients seeking appearance improvement.<sup>3</sup> The appearance of teeth and tooth color is a concern for many people in carrying out treatment. Tooth discoloration is an aesthetic problem therefore, it is important for dentists to have an understanding of the etiology and clinical features of tooth discoloration in order to make a diagnosis and select the most appropriate treatment for each case.<sup>4</sup> There are several causes that affect tooth

discoloration, namely intrinsic factors and extrinsic factors.<sup>5</sup> Intrinsic factors are related to the absorption and color of tooth enamel and dentin, while extrinsic factors are related to the absorption of various materials such as tea, coffee, and some mouthwashes into the tooth enamel surface.<sup>6</sup> Currently there are several products on the market that are considered to whiten teeth. Options include simple prophylaxis and a whitening gel on vital teeth that can be used at home or done by a dentist.

Bleaching gels usually consist of varying concentrations of hydrogen peroxide or carbamide peroxide. Furthermore, these different applications result in an activation mechanism that provides different dental bleaching effects through an oxy-reduction reaction, based on the partial oxidation of the active principle, wherein the whitening agent changes the molecular structure of the pigment

resulting in discoloration of the teeth.<sup>7</sup> Octarina (2017) stated that lemon juice contains 5% citric acid, ascorbic acid (vitamin C), gluaric acid, and polyphenols which are able to whiten teeth.<sup>8</sup> The same thing was also done by Puspasari (2012), by applying the juice apples on teeth that are able to restore the surface of the enamel color back to its original color.<sup>9</sup> Sugianti (2012) proved that rosella juice (*hibiscus sabdariffa*) can also be used as an alternative natural bleaching ingredient because it contains high levels of saponins and vitamin C.<sup>2</sup> The study conducted by Gian (2016) proved that lemon juice is not effectively used as a dental bleaching agent,<sup>10</sup> meanwhile Mala et al. (2017) stated that tomato juice (*lycopersicon esculentum* mill.) was effective in teeth whitening.<sup>11</sup> Diansari conducted the research (2019) by applying green pear juice and concluded that green pear juice was less effective in changing tooth color.<sup>12</sup> Astrid and Widi (2019) stated the research result showed banana peel extract (*musa paradisiaca* var. raja) can brighten teeth.<sup>13</sup> From several differences of opinion in these studies, the author would like to analyze the potential of various natural bleaching agents on tooth discoloration.

### DENTAL BLEACHING

Technological developments in dentistry have increased significantly, especially in tooth bleaching.<sup>14</sup> White teeth contribute to health and beauty and are considered part of the quality of life by modern society.<sup>15</sup> Dental bleaching is an option to reduce patient dissatisfaction with tooth discoloration. Bleaching is considered to have a relatively low cost and with a non-invasive approach when compared to other aesthetic procedures.<sup>16</sup> Teeth whitening procedures can have a negative impact on the hard and soft tissues of the oral cavity. In addition, some potential pulp damage can occur. However, if done properly the most common side effect of any whitening regimen is transient sensitivity followed by gingival irritation.<sup>17</sup>

### DENTAL BLEACHING INGREDIENTS

Here are teeth bleaching ingredients:

#### 1. Hydrogen Peroxide (H<sub>2</sub>O<sub>2</sub>)

Hydrogen Peroxide is a strong oxidizing agent which is readily available and decomposes into water and oxygen. Decomposition of hydrogen peroxide releases oxygen free radicals which react with extrinsic and intrinsic stains which then produce a bleaching effect. Hydrogen peroxide can inhibit activity pulp enzymes causing permanent changes in the pulp.<sup>18</sup>

#### 2. Carbamide Peroxide (CH<sub>6</sub>N<sub>2</sub>O<sub>3</sub>)

Carbamide peroxide is a secondary bond complex of two molecules, urea and hydrogen peroxide. It is applied to teeth in liquid or gel form with strengths ranging from 10% to 20%.<sup>18</sup> Carbamide peroxide is the most commonly used bleaching agent because its mechanism of action is based on the oxidizing capacity of the pigment molecule responsible for

discoloration. There is no substitute for the effectiveness of the bleaching process using carbamide peroxide as a bleaching agent. However, the use of carbamide peroxide is still being debated because of its effects on the oral cavity such as gingival irritation and sensitive teeth.<sup>19</sup>

### 3. Sodium Perborate

Sodium perborate is another weak oxidizing agent. Sometimes used in conjunction with hydrogen peroxide to whiten nonvital teeth. Sodium Perborate is the active ingredient specified in household fabric bleach because it is considered safe.<sup>18</sup>

### MECHANISM OF DENTAL BLEACHING

In-clinic and at-home bleaching gels contain hydrogen peroxide. Carbamide peroxide as the active ingredient in concentrations ranging from 3% to 40% equivalent to hydrogen peroxide.<sup>20</sup> The generally accepted mechanisms involved in teeth whitening are similar to those in textile and paper bleaching. Free radicals, generated by H<sub>2</sub>O<sub>2</sub>, interact with molecular pigments to produce a whitening effect. It is said that the H<sub>2</sub>O<sub>2</sub> in the whitening gel generates free radicals as it spreads. Through the enamel and dentin, the double bonds of the pigment molecule break and change the configuration and size of the pigment molecule. These changes alter the nature of the tooth structure, creating the perception of a whiter tooth color.<sup>20</sup>

### KINDS OF DENTAL BLEACHING

#### 1. Dental Bleaching Vital

For vital teeth, there are different whitening guidelines such as clinical treatment, home treatment and combination.<sup>21</sup> Patients with caries, periapical lesions, and sensitivity should be treated before bleaching.<sup>22</sup>

#### 2. Non-Vital Dental Bleaching

Prior to the bleaching procedure, endodontic treatment of non-vital teeth should be performed.<sup>23</sup> This technique was modified by a combination of 30% hydrogen peroxide and sodium perborate introduced into the pulp chamber for one week.<sup>24</sup> The bleaching procedure on non-vital teeth starts by placing hydrogen peroxide gel (30-35%) in the pulp chamber and activated by light curing at a temperature between 50 and 60°C for five minutes. Then, the gel is cleaned and the teeth are dried.<sup>24</sup>

### INDICATIONS AND CONTRAINDICATIONS DENTAL BLEACHING

Indication of dental bleaching are:

1. Yellowing of teeth due to age
2. Light tetracycline stain
3. Fluorosis
4. Stain from tobacco cigarettes
5. Stain caused by tea and coffee
6. Discoloration associated with pulp trauma or necrosis
7. Patients who want a little dental care

8. Young patients with displeased with grayish or yellow teeth.<sup>25</sup>

Contraindications of dental bleaching are:

1. Hypoplastic email
2. There is a carious lesion
3. Sensitive recession areas are found, or sensitive teeth
4. Patients undergoing radiation therapy or chemotherapy
5. Patients diagnosed with melanoma
6. Using photosensitive drugs or photosensitive herbal remedies
7. If nonvital teeth are extensively restored
8. Amalgam staining in dentinal tubules.<sup>26</sup>

#### **NATURAL INGREDIENT OF BANANA PEEL**

Banana peel contains organic and inorganic substances. The mineral content and calcium content in bananas are also quite high. In addition, the most abundant content in banana peels is water, calcium, phosphorus and vitamin C. These four ingredients are very useful for the body, especially teeth.<sup>27</sup> Banana peels also contain saponins which can whiten teeth. Saponins are glucosides with foam characteristics that can act as cleansers. Saponins consist of polycyclic aglycones and are bound to one or more sugar chains so that saponins can function as cleansers and whiten teeth.<sup>27</sup>

#### **LEMON**

Lemons are rich in vitamin C, magnesium, potassium, and calcium. lemon also has the ability to lighten the color of teeth. Lemon contains malic acid which is a dicarboxylic acid that has ability to whiten teeth by oxidizing the surface of tooth enamel. The acidity of lemons is at a pH of 2-3 which is very acidic and is below the critical pH of enamel (pH 5.5). This acidic nature causes demineralization, resulting in whiter teeth.<sup>8</sup>

#### **APPLE**

Apple (*Malus sly vestries* Mill) is a fruit that contains malic acid, malic acid is a substance that can help dissolve stains on the teeth. Besides being consumed directly, apples are also widely consumed in the form of juice.<sup>9</sup>

#### **ROSELLA**

Rosella (*Hibiscussabdariffa*) contains anthocyanins, ascorbic acid, salicylic extract, cardiac glycosides, flavonoids, saponins, alkaloids, cardenolide and anthocyanins. Rosella flower petals are also known to contain important substances that the body needs, such as vitamin C, vitamin A, essential proteins, calcium and 18 amino acids including arginine and lignin which are beneficial for the rejuvenation of body cells.<sup>2</sup> Rosella (*Hibiscussabdariffa*) is a bioactive compound where the foam produced by saponins can bind stains and the substance has the capacity to bind dyes so that it can be used to whiten

teeth. In addition, high Vitamin C is thought to help the dental bleaching process.<sup>2</sup>

#### **GREEN PEAR**

The acid content in *Pyrus communis* is malic acid, citric acid, oxalic acid, shikimic acid, fumaric acid, tartaric acid and lactic acid. The malic acid and oxalic acid found in green pears (*Pyrus communis*) are natural ingredients that can remove stains on the surface of the teeth and can whiten teeth.<sup>12</sup>

#### **DISCOLORATION TEETH**

Tooth discoloration is considered to be one of the key components in the perception of dental aesthetics and a person's personal attractiveness.<sup>28</sup> Stain has been defined as a discoloration of the tooth surface as a result of food and drink, the action of bacteria, tobacco, or other substances. Several factors that affect tooth color can be seen directly, namely the physiological components of the tooth (email, dentin and pulp).<sup>28</sup> The color of the teeth in each individual varies greatly which is influenced by the color of the dentin and the color of the enamel. Tooth discoloration is mostly caused by extrinsic and intrinsic stains.<sup>28</sup>

#### **CLASSIFICATION DISCOLORATION TEETH**

Knowledge of the cause of the discoloration will also help the dentist to explain the actual condition to the patient. Causes of tooth discoloration can be classified according to location, either as extrinsic or intrinsic. Extrinsic discoloration is located on the tooth surface or on an acquired pellicle. Meanwhile, intrinsic changes occur when chromogen is mostly deposited in the teeth.<sup>29</sup>

#### **EXTRINSIC COLOR CHANGE**

Extrinsic changes are defined as discoloration located on the outer surface of the tooth structure and caused by topical or extrinsic agents. Extrinsic staining on the other hand is caused by chemical interactions on the tooth surface.<sup>29</sup>

#### **INTRINSIC COLOR CHANGE**

There are several causes of intrinsic tooth discoloration of endogenous or exogenous origin. These changes can occur during or after odontogenesis.<sup>29</sup>

#### **COLOR CHANGE DUE TO TETRACYCLINE**

Tetracycline staining was first reported in the mid-1950s, less than a decade after widespread use of this antibiotic resulted in discoloration of the teeth most susceptible to tetracyclines during their formation with calcium and their incorporation into hydroxyapatite crystals. Different forms of tetracycline cause different types of tooth discoloration.<sup>30</sup>

## DISCUSSION

Dental bleaching is the procedure most frequently asked by patients because it is a very effective way to improve the appearance and aesthetics of the smile when compared to other treatments.<sup>31</sup>

Discoloration teeth can cause significant appearance change problems especially when it affects the anterior teeth that are visible when the patient smiles. Maesaroh (2018) tested banana peels as a natural inhibitor of tooth bleaching on tooth discoloration. The results showed that the teeth were soaked for 14 days in the banana peel extract which had previously been compared with the brand shade guide and changed color. It is proven that banana peels are able to provide tooth discoloration because banana peels contain several components including mineral and phytochemical components.<sup>32</sup> Banana peel mineral components consists of potassium, calcium, phosphorus, sodium, magnesium, and iron, while the phytochemical components of banana peel consist of alkaloids, flavonoids, phenols, tannins and saponins. In addition, banana peels also contain a pH of 6.7. Saponins contained in banana peels are bioactive compounds that can bind chromogens so that they can whiten teeth. In addition, the high levels of potassium and manganese in banana peels are also minerals that can whiten teeth.<sup>32</sup> This is supported by research conducted by Yudhit (2019) stated that banana peels contain several components, including mineral and phytochemical components. Banana peel also contains saponins and has the ability of cationic bio-sorbents that can lighten the color of teeth. Saponins is a glucoside with foaming characteristics, namely foam that can act as a cleaning agent. Moreover, saponins consist of polycyclic aglycones bound to one or more sugar chains. The foaming ability of saponins is due to the combination of hydrophobic (fat-soluble) sapogenins and part of the hydrophilic (water-soluble) sugar chain, which is a combination of polar and non-polar groups.<sup>13</sup>

According to Ariana (2015), lemons contain malic acid which is believed to be used to whiten teeth. Malic acid is a carboxylic acid group that has the ability to whiten teeth by oxidizing the surface of tooth enamel. These substances can penetrate the dentin and can release free oxygen on the double bonds of organic and inorganic compounds in the dentinal tubules. The results of the one way ANOVA test that have been carried out show that the difference in values obtained from each time has a difference of 8 hours, 24 hours, 48 hours, and 72 hours, each of which has a relatively different effect of changing tooth color.<sup>19</sup>

In contrast to the research conducted by Yunita (2012), said that the use of lemons did not result in discoloration of all teeth. Discolored teeth only occur on incisors and canines, on premolars and molars the use of lemon is less effective. This can happen because the premolars and molars have a thicker layer of enamel than the incisors and canines, so that the

premolars and molars do not change color when lemon is applied.<sup>10</sup>

According to Puspasari et al. (2012), apple cider has the ability to whiten the surface of tooth enamel that changes color due to immersion in coffee solution carried out in vitro. Soaking teeth with 75% apple cider is able to restore the color of the blackened tooth enamel surface back to its original color as before soaking in coffee solution.<sup>9</sup> This is reinforced by the theory of Greenwall L. in the book of Tooth Whitening Technique second edition in 2017, which states that the higher the concentration of an ingredient in food, the faster the reaction of the material in whitening teeth.<sup>30</sup> This study is also in line with research conducted by Rosidah (2017) which found that there was an increase in tooth color after immersion in apple juice. This tooth discoloration is due to the fact that apples contain malic acid.<sup>33</sup>

According to research Fauziah et al. (2012), malic acid is a carboxylic acid group that has the ability to whiten teeth by oxidizing the surface of tooth enamel to become neutral and causing a whitening effect on teeth. Malic acid has a very low molecular weight so that it can diffuse into the enamel and dentin and can oxidize tooth enamel by releasing free oxygen in the double bonds of organic and inorganic compounds in teeth. The oxidation process involves oxygen and the loss of hydrogen. In the oxidation process, the chromophore chain on the tooth is broken, which was previously attached to the pellicle, causing the tooth color to become darker and a reduction reaction taking place which makes the tooth color lighter.<sup>19</sup>

Sugianti (2012) conducted the study having aim to determine the effect of rosella extract (hibiscussabdariffa) as an alternative to natural teeth whitening agents. Rosella is a type of plant that contains saponin bioactive compounds which are foams that can bind coloring. Rosella can be used for whitening teeth because it has the ability to bind stains on the tooth surface. In addition, vitamin C (ascorbic acid) in rosella fruit can cause enamel erosion so that teeth become whiter. This can occur due to the release of hydroxyl along with electrons to various oxidants such as free radicals that spread through the enamel to reach the dentinal tubules which will function as oxidizing agents. This compound is able to damage the molecules of the substance to become neutral, become color, and cause bleaching.<sup>2</sup> Based on the 2016 book Tooth Whitening cited by Perdigão J stated that according to Croll's theory, the use of acidic or abrasive materials has been suggested as an excellent alternative solution to improve the appearance of teeth considering the texture or discoloration of tooth enamel.<sup>34</sup> The increase in color change was also influenced by the duration of immersion of rosella juice. The longer the immersion, the greater the change in heat. Tooth discoloration depends not only on the type of pigment color but also on the pH of the material. Pigment materials with an acidic pH can cause significant extrinsic discoloration compared to

neutral or basic materials. This is because the acid not only causes discoloration but also dissolves the hard tissues of the teeth because the pH is lower than the critical pH of enamel.<sup>35</sup> This is in accordance with the theory of Shannon et al. quoted by Perdigão J in the 2016 book *Tooth Whitening*, states that changes that occur in enamel occur in materials that have a lower pH.<sup>34</sup>

According to research conducted by Utami et al. (2016), green pears contain hydrogen peroxide, 100 mg of pear tissue contains about 2 grams of hydrogen peroxide when ripening begins. Tooth discoloration can be affected by the duration of application of pear juice on the teeth. Fruit juice pears can whiten teeth on application for 7 days and increase on application for 14 days. Time is an important factor in the bleaching process, the longer the teeth are in contact with hydrogen peroxide, the active oxygen will break the bond color continuously so that it becomes simpler and the color of the teeth becomes lighter.<sup>36</sup>

The research of Measaroh, Yudhit, Ariana and Utami is in accordance with the theory of Kwon et al.; Spalding et al.; Cavalli et al.; Faraoni Romano et al.; Forner et al. quoted by Perdigão J in the book *Tooth Whitening* in 2016, states that changes in tooth enamel that result in morphological changes, increased surface porosity, reduced hardness are the main changes that occur in enamel that is carried out by teeth bleaching. This change depends on the contact time of the material with the tooth substrate, the concentration of the material on the tooth, and pH.<sup>34</sup>

Based on several studies that have been carried out, according to the authors, various natural bleaching materials can cause discoloration of the teeth. After being studied by the author, this can happen because of several factors from natural ingredients, namely the concentration, time and pH of a natural material.

However, this factor needs to be reviewed as a natural bleaching agent for tooth discoloration, because there are natural ingredients that do not cause tooth discoloration due to differences in the enamel resistance of each tooth.

## CONCLUSION

Based on this literature study, several conclusions can be drawn, namely:

1. Natural bleaching ingredients can change the color of the teeth on the bananas' peel, lemons, apples, rosella and green pears.
2. Natural ingredients of bananas' peel, lemons, apples, rosella and green pears contain saponins, malic acid, potassium, calcium, phosphorus, sodium, magnesium, and iron, while the phytochemical components of banana peels consist of alkaloids, flavonoids, phenols, tannins. It can have a bleaching effect on the teeth.
3. The effectiveness of bleaching depends on the thickness of the enamel on each tooth. Natural materials are less effective on posterior teeth

because premolars and molars have a thicker enamel layer than anterior teeth.

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