

The Potential of Red Watermelon Extract as Teeth Whitening Toothpaste

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ABSTRACT

Introduction – The teeth are composed of enamel, dentine, pulp, and cementum. The enamel of the tooth contains hydroxyapatite crystals [Ca₁₀(PO₄)₆(OH)₂] which are small in size and allow for the transfer of ions in chromogen substances causing discoloration of the teeth. Tooth discoloration will eliminate the aesthetic value of the individual's appearance. The use of chemicals and abrasive materials contained in conventional toothpaste in whitening teeth can cause side effects in the form of irritation of the oral mucosal tissue and abrasion of the surface of the teeth, so a safe natural treatment is required. Malic acid in red watermelon (*Citrullus lanatus*) is a powerful oxidizer that can be used to whiten teeth.

Methodology/Approach – Data source search is done using the Google Scholar, Pubmed, and Science Direct search engine with Medical Subject Headings and selected for publication in the past five years.

Findings – The principle of dental whitening is oxidation reaction between whitening agent and chromogenic factor, regardless red watermelon has a malic acid as a powerful oxidizer and can be used to whiten teeth.

Implication – Home and office dental whitening with carbamide or hydrogen peroxide can cause dental sensitivity. There is a new bleaching proposal without the use of chemical ingredients, thus reducing post-treatment sensitivity. Red watermelon has such a whitening toothpaste with natural ingredients.

Keywords: red watermelon, whitening toothpaste, dental whitening

INTRODUCTION

Teeth are part of the body that is composed of enamel, dentin, pulp, and cementum. Enamel is composed of several inorganic substances such as solid enamel prisms in which there are hydroxyapatite crystals [Ca₁₀(PO₄)₆(OH)₂], protein matrix, and other microstructures. The presence of small hydroxyapatite crystals allows ion transfer in the enamel (Baranova et al., 2020). This results in discoloration of the tooth enamel.

The original color of teeth is colorless/white with some translucency. However, due to some factors, the enamel of a tooth will become thinner and more translucent, the dentin becomes more visible and the tooth color will become darker. Furthermore, the original color of teeth is often considered due to stains and anything resulting in tooth discoloration (Epple et al., 2019). Tooth discoloration can be classified as intrinsic discoloration and extrinsic discoloration (Kansal et al., 2020). Intrinsic discoloration is a type of stain that can be found on the internal surfaces of teeth.

This type of discoloration can be defined as discoloration that is incorporated into the structure of either enamel or dentine which cannot be removed prophylaxis, toothpaste,

or pumice. Intrinsic discoloration is caused by medications, nutritional deficiencies, and infections (Tabassum, 2021). Extrinsic discoloration is a type of discoloration caused by agents resulting in staining of enamel or causing some kind of damage to the enamel. This type of discoloration penetrating the deep enamel by tobacco chewing or frequent intake of tea and coffee (Kansal et al., 2020). Tooth discoloration can be managed with bleaching techniques or teeth whitening. Toothpaste is becoming available with a whitening effect that can be called whitening toothpaste (Nam et al., 2017). Whitening toothpaste contains chemical content such as hydrogen peroxide (H₂O₂) that reported resulting irritation to oral cavity tissue. Whitening toothpaste often contains harder abrasives and a higher amount that can remove the outer part of the enamel including the attached and the incorporated stains (Epple et al., 2019). Furthermore, this raises concerns about the use of conventional whitening toothpaste that contains synthetic whitening ingredients.

Natural ingredients of whitening toothpaste are being carried out by many studies which are considered safer than chemical or synthetic whitening ingredients (Setyawati & Nur, 2020). One of the natural ingredients that can be used to whiten teeth is red watermelon (*Citrullus lanatus*). According to a previous study, it was found that red watermelon extract with a concentration of 100% was effective in providing whiten tooth discoloration due to its malic acid content (Setyawati & Nur, 2020). The malic acid acts as a substance that will scrape and remove some stains on the tooth surface (Yulita et al., 2019). The purpose of this review is to summarize studies related to teeth whitening pastes made from red watermelon fruit extract with a concentration of 100% from the available literature.

LITERATURE REVIEW

• Whitening toothpaste

Whitening toothpaste has two actions, there are: 1) bleaching intrinsic stain with oxidation agent to damage bonded between organic molecules and chromogen in teeth. This action results in changes in the perception of the color of the teeth can be divided into three different phases: first, the movement of the whitening agent into the structure of the teeth; second, the interaction of bleaching agents with stain molecules; and third, changes the surface of the structure of the teeth so that it reflects light differently. The result of this sequence of events will be the final discoloration of the teeth after bleaching. Ideally, the whitening procedure will optimize bleaching and at the same time minimize simultaneous damage to the structure of the teeth (Jorge, 2016) and 2) remove and control the extrinsic stain with the abrasive agent (Bortolatto et al., 2016).

The use of toothpaste is an appropriate step in extrinsic discoloration. The role is performed by abrasive materials in toothpaste (Hamza et al., 2020). The abrasives concentration range is about 9- 13% in toothpaste formulations (Divya et

al., 2021). Abrasive toothpaste formulations can be used to provide benefits in preventing and removing extrinsic stains that form, as well as whitening teeth. Ideally, the material performs cleaning of the surface of the teeth without causing enamel or dentin wear. The use of abrasive toothpaste that is insoluble in water provides several benefits such as safe to use, time-saving, low cost, and can mechanically clean stains on the surface of teeth between teeth and abrasive elements such as aluminum hydroxide, calcium carbonate, and silica (Lippert et al., 2017). Aside from abrasive materials in the formulation, there are humectants (37-45%) that providing moisturization and preventing the formation of the plug-in nozzle tube; binding agents (0.8-2.5%) maintained the stability and consistency of the toothpaste; preservatives (0.05-0.5%) that prevent the growth of microorganisms and provides stability to the toothpaste; foaming agents (1-2%) supporting plaque deposition's penetration and enabling dispersion; flavors (1-6%) that impact on consumer acceptability; colors (1-2%) granting the color; and sweeteners (18-24%) that supply succulent taste (Divya et al., 2021).

Chemical agents are added to toothpaste formulation since it is difficult to remove intrinsic stains mechanically with abrasive ingredients. Hydrogen peroxide is one of the chemical agents, but for the firm and tight use that can risk damage to oral tissues concentrations, especially of $\geq 3\%$ should not be considered (Değer & Müjdeci, 2020).

- **Red Watermelon (*Citrullus lanatus*)**

Watermelon is a fruiting plant that lives in the tropics. The leaves of this plant measuring 5-20 x 3.5-19 cm. The diameter of the watermelon fruit is 15-20 cm, has dark green spots, and has a fruit stalk 2-5 cm long. The acid content in watermelon can whiten the teeth. This is a process that involves oxidative materials in changing the absorption or reflection properties of light from dental materials to make the color of the teeth lighter. The process uses a mechanical approach with an abrasive paste that is used precisely in removing stains on the tooth surface (Li, 2017). Red watermelon (*Citrullus lanatus*) consists of 55.3% fruit juice, 31.5% fruit peel, and 10.4% pomace with a sweet taste resulting from the combination of sucrose, glucose, and fructose in red watermelon (Maoto et al., 2019). In addition, there are content that is beneficial for the body, including water, potassium, protein, carbohydrates, vitamins A, and C, as well as a high content of malic acid, which is 99% of the total acid in the fruit (Setyawati & Nur, 2020; Verma & Tomar, 2017).



Figure: watermelon

Based on plant taxonomy, red watermelons are classified as follows:

Kingdom	: Plantae
Superdivisio	: Spermatophyta
Divisio	: Magnoliophyta
Class	: Magnoliopsida
Ordo	: Cucurbitales

Family	: Cucurbitaceae
Genus	: Citrullus
Species	: <i>Citrullus lanatus</i> (Thunb)

(CABI, 2019).

According to a previous study, it is known that malic acid is a substance that will scrape and remove some stains on the tooth surface (Yulita et al., 2019). Malic acid is a carboxylic acid group that has the ability as a natural enamel whitener by oxidizing the surface of tooth enamel and causing a whitening effect. In addition, malic acid can increase saliva production and function as an anti-cariogenic agent. Hydrogen peroxide is a strong oxidizing agent to degrade tooth color-producing agents that cause discoloration by releasing reactive oxygen into the enamel and dentin structures so that the bond between tooth structure and dye is damaged. Research conducted by Setyawati & Nur (2020) showed that red watermelon extract (*Citrullus lanatus*) with a concentration of 100% was used as a whitening agent in the bleaching process of 15 permanent incisors and canines could whiten teeth. This is evidenced by a greater change in the value of the spectrophotometer measurement. This change in value means that the teeth absorb color on a large scale and produce a whiter effect.

- **Watermelon Extract Effectiveness as Tooth-Whitening**

Tooth discoloration with red watermelon extract was carried out with laboratory experimental in ex vivo. The samples used in the study Setyawati & Nur (2020) were 15 incisors and canines with inclusion criteria; (1) teeth with an intact crown, (2) no root perforation, (3) no caries or other anomalies. The tooth samples were numbered and painted with clear colored nails starting from the cervical to the root of the tooth. The tooth was soaked in a tea solution as a process of tooth discoloration and the color was measured using a shade guide and spectrophotometer.

The research process was conducted by dividing the samples into three treatment groups: (1) soaked in red watermelon extract as the treatment to be studied; (2) soaked in 10% carbamide peroxide as a positive control; and (3) soaked in a sterile solution of aquades as a negative control. Each treatment is carried out for 56 hours. After the second measurement with a shade guide and spectrophotometer, the result was conducted by data analysis using a one-way ANOVA test. This study obtained the results that the application of watermelon extract with a concentration of 100% can change the color of teeth to be whiter.

Aesthetics become very important for human needs, including teeth. The trend to whiten teeth has become a common thing that is done with bleaching methods using whitening agents such as hydrogen peroxide and carbamide peroxide. In addition, teeth whitening can be done by using whitening toothpaste that has abrasive material to remove stains. But both methods can cause sensitivity and injury to the tissue around the teeth. So, the use of natural ingredients with acid content is considered safer and economical, one of which is red watermelon with malic acid content that can cause teeth to become brighter due to damage to color bonds between teeth and chromogenic substances.

METHOD

This literature review focuses on the chemical content of red watermelon extract, toothpaste formulation, mechanism of teeth whitening with whitening toothpaste, and study of the effectiveness of tooth whitening paste. The research used in this review was searched with Medical Subject Headings

sourced from Google Scholar, Pubmed, and Science Direct search engine from 2016 – 2021, each searched electronically with the keywords "Citrullus lanatus", "discoloration", and "toothpaste".

RESULT AND DISCUSSION

Extrinsic discoloration is a type of discoloration caused by agents resulting in staining of enamel or causing some kind of damage to the enamel. This type of discoloration penetrating the deep enamel by tobacco chewing or frequent intake of tea and coffee (Kansal et al., 2020). On the extrinsic discoloration, compounds from food or beverages consumed daily will merge with pellicle and produce staining due to the process of chemical interaction on the surface of the teeth (Prskalo et al. 2017). Tooth discoloration can be managed with bleaching techniques or teeth whitening.

Toothpaste is becoming available with a whitening effect that can be called whitening toothpaste (Nam et al., 2017). The whitening toothpaste has two actions, there are bleaching intrinsic stain with oxidation agent and chromogen in teeth and remove and control the extrinsic stain with the abrasive agent (Bortolatto et al., 2016; Jorge, 2016). Moreover, tooth whitening agents in some form usually contain hydrogen peroxide, including whitening toothpaste. In the oxidation process, hydrogen peroxide breaks down into oxygen and water. The oxygen molecules will penetrate the tooth deliver the pigment molecule and the tooth became whiter (Greenwall, 2017). On the other hand, fruit with high acid content potentially becomes a potent oxidizer as well as hydrogen peroxide and can bleach teeth owing to external discoloration (Aprilianti, 2018).

According to a previous study, it is known that malic acid is a substance that will scrape and remove some stains on the tooth surface (Yulita et al., 2019). Furthermore, malic acid is one of the main organic acids in ripe watermelon fruit (Gao et al., 2018). The study from Setyawati & Nur (2020) obtained the results that the application of watermelon extract with a concentration of 100% can change the color of teeth to be whiter. This is parallel with research by Lumuhu et al., (2016) that apples containing malic acid which can whiten teeth. This research result shows apple juice can whiten teeth soaked for one, three, and five days.

Red watermelon has a content of 99% malic acid which is a group of carboxylic acid that can cause a whitening effect on the surface of teeth with the oxidation process (Setyawati & Nur, 2020). In the oxidation process, the malic acid will release electrons that can bind to the chromophore substances in the teeth. Acids have corrosive properties that will react with metals and produce H₂ and H⁺ ions in water. The detached H⁺ ions will then bind to molecules contained in the tooth enamel that undergo discoloration, resulting in changes in the structure of unsaturated organic enamel molecules. In addition, the release of H⁺ ions also results in the disruption of the unsaturated enamel structure into saturated structures that have a light color. This is due to the release of 4OH⁻ radicals from malic acid (Yuniarti, 2016).

The oxidation action results in changes in the perception of the color of the teeth can be divided into three different phases: first, the movement of the whitening agent into the structure of the teeth; second, the interaction of bleaching agents with stain molecules; and third, changes the surface of the structure of the teeth so that it reflects light differently. The result of this sequence of events will be the final discoloration of the teeth after bleaching. Ideally, the

whitening procedure will optimize bleaching and at the same time minimize simultaneous damage to the structure of the teeth (Jorge, 2016).

CONCLUSION AND RECOMMENDATION

Home and office dental whitening with chemicals such as carbamide or hydrogen peroxide can cause dental sensitivity. Red watermelon has such a whitening toothpaste with natural ingredients. Toothpaste formulation with red watermelon extract has the potential to change the color of teeth that are discolored to be brighter.

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