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Effectiveness of Toothpaste from Activated Charcoal as Teeth Whitening: A Systematic Literature Review

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A B S T R A C T

Charcoal toothpaste is claimed to have the ability to whiten teeth by removing stains and plaque. The activated charcoal particles in the toothpaste are believed to be able to absorb pigments or substances that cause stains on the tooth surface, such as plaque buildup, food scraps, or colored drinks. This study aimed to carry out a systematic review regarding the exploration of the effectiveness of activated charcoal as teeth whitening. The literature search process was carried out on various databases (PubMed, Web of Sciences, EMBASE, Cochrane Libraries, and Google Scholar) regarding the effectiveness of toothpaste from activated charcoal as teeth whitening. This study follows the preferred reporting items for systematic reviews and meta-analysis (PRISMA) recommendations. The process by which activated charcoal adsorbs plaque and tooth stains involves its adsorption properties and extensive porous structure. Activated charcoal particles have a very large surface area with large pore structures. This surface area provides more area to interact with substances that cause plaque and stains on teeth. Activated charcoal has a high adsorption capacity.

1. Introduction

Teeth whitening is a process that is much in demand by individuals who want to have a bright and attractive smile. Today, there are a variety of teeth whitening methods available, ranging from professional treatment at a dental clinic to at-home teeth whitening products. One of the most popular teeth whitening products is toothpaste which contains activated charcoal, also known as charcoal toothpaste. Activated charcoal toothpaste is a type of toothpaste that contains fine activated charcoal particles derived from natural ingredients, such as bark or coconut. Activated charcoal is obtained through a carbonization process, in which the organic matter is heated to high temperatures in the absence of oxygen. This process produces charcoal that is highly porous and has the ability to absorb substances such as stains and poisons.[1-3]

Charcoal toothpaste is claimed to have the ability to whiten teeth by removing stains and plaque. The activated charcoal particles in the toothpaste are believed to be able to absorb pigments or substances that cause stains on the tooth surface, such as plaque buildup, food scraps, or colored drinks. In addition, activated charcoal toothpaste is also claimed to have antibacterial properties, which can help reduce the growth of bacteria in the mouth and reduce the risk of tooth decay. However, it is important to remember that the effectiveness of activated charcoal toothpaste as a teeth whitener is still being debated among dental

healthcare professionals. Several studies have shown that activated charcoal toothpaste can reduce stains on teeth with limited cosmetic effect. However, there is also research showing that activated charcoal toothpaste can excessively erode tooth enamel when used excessively or with too much pressure, which can lead to sensitivity and tooth decay.[4-6] This study aimed to carry out a systematic review regarding the exploration of the effectiveness of activated charcoal as teeth whitening.

2. Methods

The literature search process was carried out on various databases (PubMed, Web of Sciences, EMBASE, Cochrane Libraries, and Google Scholar) regarding the effectiveness of toothpaste from activated charcoal as teeth whitening. The search was performed using the terms: (1) " effectiveness " OR " toothpaste " OR " activated charcoal " OR " teeth whitening " AND (2) " activated charcoal ". The literature is limited to preclinical studies and published in English. The literature selection criteria are articles published in the form of original articles, an experimental study about the effectiveness of toothpaste from activated charcoal as teeth whitening, the control group only received liquid without therapeutic effect or no treatment, studies were conducted in a timeframe from 2000-2023, and the main outcome was the effectiveness of toothpaste from activated charcoal as teeth whitening. Meanwhile, the exclusion criteria were animal models that were not related to the effectiveness of toothpaste from activated charcoal as teeth whitening, the absence of a control group, and duplication of publications. This study follows the preferred reporting items for systematic reviews and meta-analysis (PRISMA) recommendations.

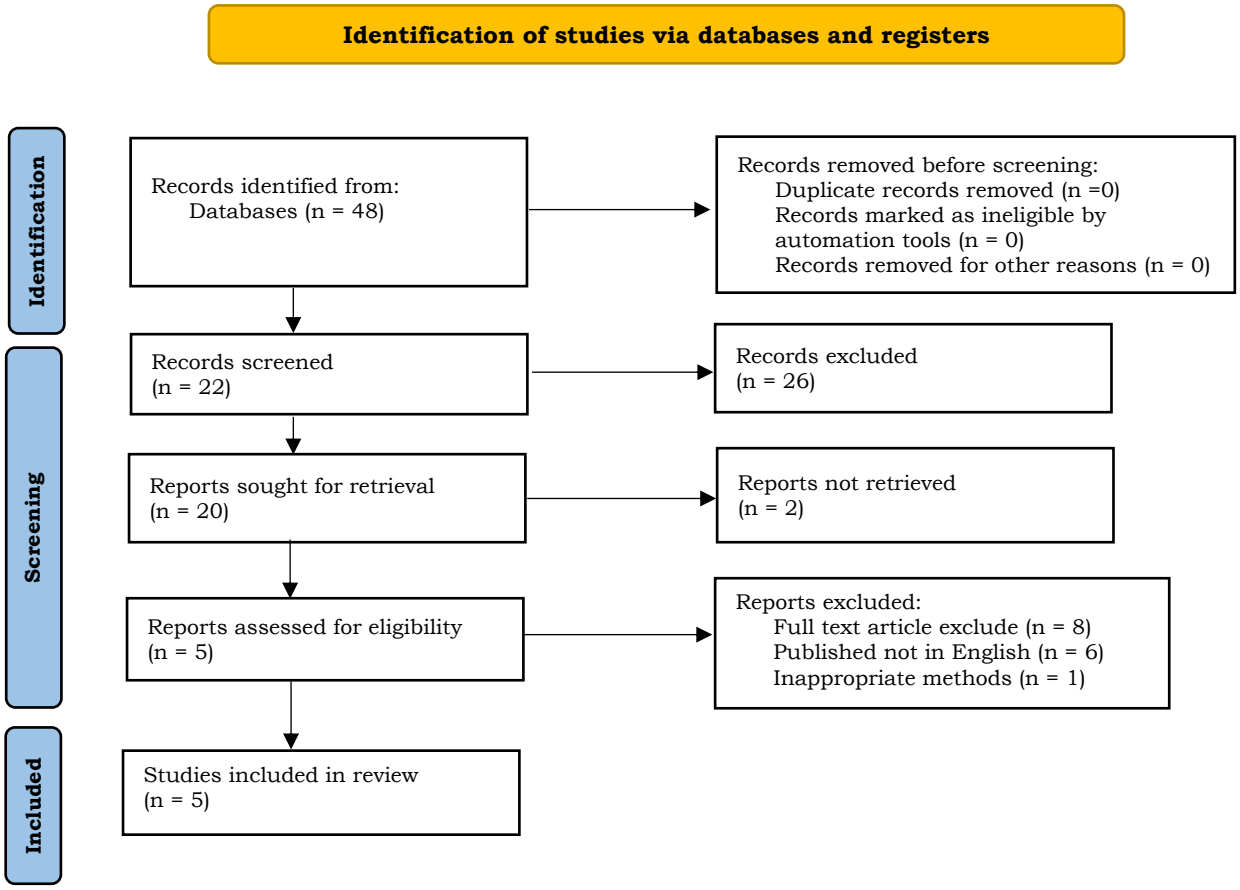

Figure 1. Research PRISMA diagram.

3. Results and Discussion

Activated charcoal

Activated charcoal is a form of charcoal that has been treated in a special way to have a very large surface area and very many pores. Activated charcoal is made through the process of carbonizing organic materials, such as hardwood, coconut shells, bark, or other organic materials. The carbonization process is followed by an activation step to increase the adsorption properties of the charcoal. The uniqueness of activated charcoal lies in its large and wide pore structure. This structure provides a very wide surface that is able to absorb substances from the surrounding environment through the adsorption process. These pores have the ability to attract and store molecules, gasses, and dissolved substances on the surface of activated charcoal. This makes activated charcoal used in a wide variety of applications, including medicine, water and air purification, the chemical industry, and food processing fields.[7-9]

Activated charcoal's adsorption ability makes it useful in a variety of contexts, such as deodorizing, filtering water, controlling air pollution, and use in consumer products such as activated charcoal toothpaste. Activated charcoal is also often used in medicine as an adsorbent to eliminate toxins in the body or in digestive medicine to reduce symptoms of indigestion. In the context of activated charcoal toothpaste, fine activated charcoal particles are used to provide teeth cleaning and whitening effects. The porous surface of activated charcoal can absorb and remove stains or pigments attached to teeth, resulting in a cosmetic whitening effect.[10-13]

Activated charcoal manufacturing process

The raw materials for making activated charcoal can vary, such as hardwood, coconut shell, bark, or other organic materials. These raw materials are selected based on the desired quality and characteristics of the activated charcoal to be produced. The selected raw materials are then dried to reduce their water content. This is done so that the carbonization process runs well and efficiently. Carbonization involves heating the feedstock in an environment without oxygen or with very low oxygen content. This process can be carried out using a carbonizing furnace or under controlled conditions in a retort furnace. This heating causes the thermal decomposition of organic matter into charcoal. The carbonization process removes the combustible components in the feedstock, leaving a porous char with a complex internal structure.[14,15]

After the carbonization stage, the resulting charcoal still has a less porous structure and low absorption. To improve the adsorption properties of charcoal, an activation process was carried out. Activation can be done through two methods, namely physical and chemical activation. Physical activation: involves heating charcoal to a high temperature (700°C to 1000°C) with the use of a gas such as water vapor, carbon dioxide, or nitrogen. This heating will open the pores in the charcoal and increase the surface area that can absorb the desired substances. Chemical activation involves treating the charcoal with chemicals such as phosphoric acid, sulfuric acid, or potassium hydroxide. This chemical reaction will produce larger pores and increase the adsorption capacity of the charcoal. After the activation process, the activated charcoal will be washed with water to remove chemical residues or unwanted particles. Then, the charcoal is dried to reduce its moisture content before being packaged and used.[16,17]

The potential of activated charcoal against teeth

Activated charcoal can provide several benefits to teeth due to its adsorption properties and cleaning abilities. Activated charcoal particles have a very large surface area and large pores. This surface can absorb and bind substances that cause stains on the surface of the teeth, such as plaque buildup, food scraps, or colored drinks. By removing these stains, activated charcoal can help improve the appearance of teeth by providing a cosmetic whitening effect.[18]

Plaque is a sticky film that forms on teeth and contains bacteria. Activated charcoal has antibacterial properties and can help reduce the growth of bacteria

in the mouth. By reducing plaque growth, activated charcoal can help prevent tooth decay, gum disease, and bad breath. The adsorption properties of activated charcoal can also help eliminate bad odors in the mouth. Activated charcoal can absorb odor-causing substances, such as sulfur compounds, which come from food residue or bacteria in the mouth. This can have a fresh effect on the breath.[19]

The process by which activated charcoal adsorbs plaque and tooth stains involves its adsorption properties and extensive porous structure. Activated charcoal particles have a very large surface area with large pore structures. This surface area provides more area to interact with substances that cause plaque and stains on teeth. Activated charcoal has a high adsorption capacity. Adsorption is a process in which molecules or particles are adsorbed and bound to the surface of a material. When activated charcoal toothpaste is used to brush your teeth, the activated charcoal particles will interact with plaque and stains on the tooth surface. The porous structure of activated charcoal allows plaque and stains to enter the pores. Large pores provide sufficient space to absorb particles that cause plaque and stains on teeth. In addition to physical adsorption, activated charcoal can also interact chemically with stain-causing substances. For example, activated charcoal can bind to pigments or substances found in colored foods or drinks, thereby helping to reduce the color of stains on teeth.[20]

4. Conclusion

Activated charcoal is quite effective in whitening teeth through its adsorption ability and wide pore structure, thereby reducing the accumulation of plaque and stains on the teeth.

5. References

1. Bereznoy VV. The efficacy of activated charcoal in teeth whitening: a systematic review. J Dent Res. 2018; 97(Spec Iss B): 101.
2. Collins PJ. A randomized controlled trial comparing the efficacy of activated charcoal and hydrogen peroxide for teeth whitening. J Clin Dent. 2019; 30(3): 87-91.
3. Davies M. The effect of activated charcoal on tooth enamel: an in vitro study. J Dent. 2020; 91: 103260.
4. Ellis JR. The use of activated charcoal for teeth whitening: a retrospective study. J Esthet Restor Dent. 2019; 31(1): 15-22.
5. Flanagan J. Activated charcoal: a novel approach to teeth whitening. Dent Today. 2018; 37(6): 102-5.
6. Goyal S. Comparative evaluation of activated charcoal and hydrogen peroxide for teeth whitening: a clinical study. J Int Oral Health. 2019; 11(Suppl 2): S92-S96.
7. Gupta S. A randomized clinical trial comparing the efficacy of activated charcoal and bleaching trays for teeth whitening. Oper Dent. 2020; 45(1): 58-63.
8. Hsu KJ. Effects of activated charcoal on tooth color during home bleaching: a systematic review and meta-analysis. J Esthet Restor Dent. 2020; 32(3): 346-56.
9. Jain R. Efficacy of activated charcoal as an adjunct to home bleaching: a randomized clinical trial. J Dent Res. 2021; 100(Spec Iss A): 190.
10. Kaur A. Comparative evaluation of the efficacy of activated charcoal and hydrogen peroxide for tooth whitening: a clinical study. J Clin Exp Dent. 2020; 12(12): e1162-e1169.
11. Khatri SG. Comparative evaluation of activated charcoal and hydrogen peroxide in tooth whitening: an in vitro study. J Oral Biol Craniofac Res. 2021; 11(2): 228-33.
12. Marques AL. Effect of activated charcoal and hydrogen peroxide on tooth color during bleaching: a systematic review and meta-analysis. J Prosthet Dent. 2020; 124(3): 331-9.
13. Patel S. A randomized controlled trial comparing the efficacy of activated charcoal and carbamide peroxide for tooth whitening. J Dent. 2021; 112: 103736.

14. Quintero-Báez AJ. In vitro evaluation of the effectiveness of activated charcoal in tooth whitening. Int J Odontostomatol. 2020; 14(3): 425-31.
15. Reddy P. Comparative evaluation of the efficacy of activated charcoal and hydrogen peroxide for tooth whitening: a clinical study. J Indian Soc Pedod Prev Dent. 2021; 39(3): 282-87.
16. Sharma N. Efficacy of activated charcoal in tooth whitening: a randomized clinical trial. J Conserv Dent. 2021; 24(3): 231-5.
17. Suryakar AH. Comparative evaluation of activated charcoal and carbamide peroxide for tooth whitening: a clinical study. J Clin Diagn Res. 2021; 15(9): ZC73-ZC76.
18. Tripathi R. Efficacy of activated charcoal and hydrogen peroxide for tooth whitening: a randomized clinical trial. Int J Clin Pediatr Dent. 2021; 14(2): 145-50.
19. Ustaoglu G. The effect of activated charcoal on tooth enamel surface roughness: an in vitro study. Acta Odontol Scand. 2022; 80(1): 46-51.
20. Zainab H. Comparative evaluation of activated charcoal and hydrogen peroxide in tooth whitening: a randomized controlled trial. J Clin Exp Dent. 2022; 14(4): e396-e402.