Efficacy of whitening toothpastes: Integrative review

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ABSTRACT

Recently, there has been a growing interest in oral aesthetics, driving the demand for brighter smiles. In response to this demand, the market has introduced a variety of off-the-shelf teeth whitening products, such as toothpastes, increasing the interest and demand of the public. The aim of this study was to conduct an integrative literature review on the efficacy of whitening toothpastes. For data collection, searches were made in databases such as: PubMed, Scielo and LILACS. The following descriptors were used as search criteria: whitening dentifrices AND effectiveness. A total of 25 articles published between 2018 and 2023 were selected, in Portuguese and English, to refine the research and enable higher quality. Regarding the effectiveness of whitening toothpastes, it was possible to observe that most studies indicate such products as significantly effective in extrinsic teeth whitening, but with lower efficacy than other whitening methods.

Keywords: Activated charcoal, Teeth whitening, Toothpastes, Hydrogen peroxide.

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INTRODUCTION

In recent years, there has been a significant increase in the population's concern with oral aesthetics, reflected in the search for whiter and more harmonious smiles. Dental aesthetics plays a fundamental role in self-esteem and in the perception of one's own image, directly influencing the quality of life of individuals. In this context, teeth darkening emerges as one of the main complaints of patients seeking dental services, impacting their confidence and well-being.

To meet this demand, cosmetic dentistry has several procedures, ranging from less invasive interventions, such as teeth whitening and microabrasion, to more complex approaches, such as direct and indirect restorations. The choice of the most appropriate treatment depends on a careful analysis of the needs and conditions of each patient. The growing appreciation of aesthetics has led the market to launch OTC (Over-The-Counter) products, over-the-counter drugs that can be sold without a prescription, which have a low cost and promise whitening action. **(Justin et al., 2019).**

Home whitening is one of the most popular techniques for teeth whitening, and there are two main approaches: at-home whitening supervised by the Dental Surgeon and whitening done with OTC products.

In supervised home whitening, the patient is given whitening products with a low concentration of carbamide or hydrogen peroxide, usually between 10% to 22% and 1.5% to 10%, respectively. The patient applies the product in individualized trays for at least two weeks. However, it is crucial for the dental surgeon to guide the patient on the proper use of the products and to perform regular evaluations during and after treatment to ensure satisfactory and safe results.

The other approach is whitening done with products sold in pharmacies, supermarkets and applied by the patient himself without supervision of the dentist, being made available in different forms, such as gels, pastes, whitening tapes and even toothpastes. Its mechanism of action is based on the action of abrasive agents that remove surface stains and plaque during brushing.

Whitening toothpastes are easily available without a prescription. The ingredients of a whitening paste range from abrasives such as: hydrated silica, calcium carbonate to bleaching agents such as perlite, peroxides, activated charcoal, blue covarian, hydrogen peroxide, and microspheres **(Jamwal et al., 2022).** Whitening is the result of oxidation-reduction reactions, which reduce pigments into smaller molecules **(Tomás et al., 2022).**

Nowadays, many patients opt for at-home whitening techniques at the most affordable prices. Some alternatives, such as whitening toothpaste, promise whitening results in a short period of time. Therefore, they are one of the most sought-after options by the public **(Casado et al., 2018).**

Among off-the-shelf whitening products, whitening toothpastes represent more than 50% of consumer availability **(Meireles et al., 2020).** These products include surfactants, enzymes, citrates, pyrophosphates, and hexametaphosphates that aid in the degradation of stained biofilms, aid in

mechanical removal, and act on the chemical modification of stains on the surface of teeth **(Devila et al., 2020).**

However, despite the numerous commercial options, the efficacy of whitening toothpastes is still the subject of debate in the scientific literature. While some studies suggest that these products are able to remove extrinsic staining from teeth, others question their effectiveness and warn of the risk of excessive abrasion on the tooth structure. It is important that the whitening performance of these toothpastes is visibly noticeable to patients and professionals, because visual perception in everyday conditions is how the effectiveness of products is judged **(Vaz et al., 2018).**

In view of this scenario, this study aims to conduct an integrative review of the literature on the efficacy of whitening toothpastes, investigating their true potential in tooth whitening. Understanding these aspects is key to guiding both dental professionals and consumers in choosing the best treatments to achieve a whiter, healthier smile.

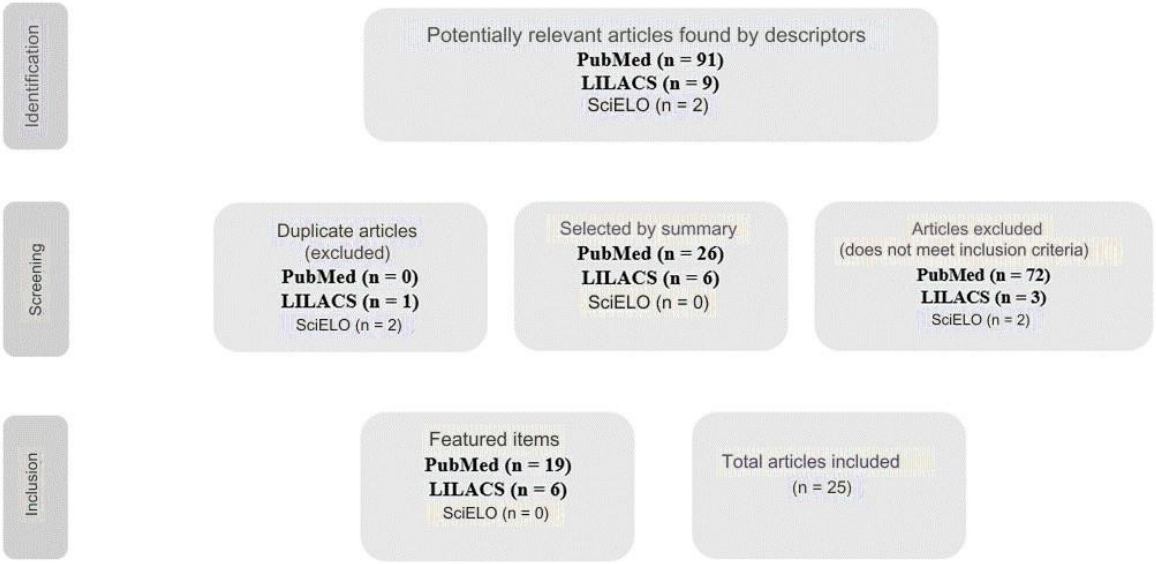
MATERIALS AND METHODS

The present study is an integrative review of the literature. The primary search was conducted in November 2023, using a qualitative and quantitative approach in the Scientific Electronic Library Online (SciELO), US National Library of Medicine National Institutes of Health (PubMed) and Latin American and Caribbean Health Sciences Literature (LILACS) databases, with the descriptors: whitening dentifrices AND effectiveness. Studies in English, Spanish and Portuguese, published in the last 5 years (2018-2023), were included to ensure the inclusion of recent and relevant research on the topic, the efficacy of the use of whitening toothpastes.

The eligibility criteria included the availability of the full text and the approach to contemporary aspects related to whitening toothpaste. After applying the selection criteria, the articles were submitted to the reading of the titles and abstracts to determine their relevance and adherence to the proposed theme. Studies that did not fit into the theme of the review were excluded, such as studies that addressed other bleaching methods or the action on composite resins, articles in other languages, and articles that did not have full text available.

Each selected article was then analyzed for its bibliographic parameters, including authors, year of publication, type of study, objective, and conclusions. The study types were categorized into systematic reviews, literature reviews, laboratory studies, and clinical studies, seeking to provide a comprehensive and up-to-date view of the available evidence on teeth whitening in the scientific literature. The initial search found 102 articles, of which 77 were excluded due to duplication and usage criteria, and then 25 articles were included in this study.

Figure 1: Flowchart for the selection of scientific articles.



RESULTS

Each selected article was then analyzed for its bibliographic parameters, including authors, year of publication, type of study, objective, and main results. The study types were categorized into systematic reviews, literature reviews, laboratory studies, and clinical studies, seeking to provide a comprehensive and up-to-date view of the available evidence on teeth whitening in the scientific literature.

Table 1: Main methodological data and results extracted from the included studies.

Author/Year	Type of Study	Objective	Main Results
Vaz et al; 2018	LABORATORY STUDY	Compare the whitening performance of toothpastes with different whitening technologies after initial and continued use.	All whitening toothpastes were effective in whitening teeth when compared to a toothpaste with no added bleaching agents.
Greenwal et al; 2019	LITERATURE REVIEW	Provide an overview of current knowledge and understanding about charcoal-based toothpastes and powders, including consideration of the strength of evidence to support the claims made by the manufacturers of these products.	Insufficient evidence to support the claims of teeth whitening, let alone any whitening effects associated with charcoal toothpastes.
Shamel et al; 2019	LABORATORY STUDY	To measure the effects of tooth whitening, surface roughness, and enamel morphology of six different types of toothpastes containing blue covariin and those without blue covarine, using in vitromodels.	It can be considered that blue covarian toothpastes are an effective and safe method to improve the whiteness of teeth in the tooth brushing routine at home.

Jiang et al; 2019	CLINICAL STUDY	To determine whether whitening toothpastes would improve the effectiveness of in-office teeth whitening procedures.	1. The use of whitening toothpaste containing blue covariin during in-office whitening procedures was associated with less color change compared to conventional and regular whitening toothpastes. 2. The use of whitening toothpastes after in-office whitening procedures produced a decrease in yellowing of the teeth, while regular toothpaste was associated with an increase in yellowing of the teeth.
Justin et al; 2019	CLINICAL STUDY	To evaluate, for 7 weeks, the efficacy of whitening toothpastes and patient satisfaction after use.	Based on the results obtained, it was observed that the toothpastes GB - Colgate® Luminous White Toothpaste and GC - Colgate® Luminous White Advanced showed a similar whitening effect. Regarding the patients' perception, they observed color changes only in the CG and not in the GB group.
Devila et al; 2020	SYSTEMATIC REVIEW	Verify that whitening toothpastes are as effective and safe as regular toothpastes and other at-home teeth whitening products, and verify the effect of application time on whitening effectiveness.	Whitening toothpastes are more effective at reducing extrinsic stains and producing a tooth-whitening-like effect than regular toothpastes. In addition, they produce more adverse effects. The effectiveness of whitening toothpaste does not seem to depend on the time of application.
Schwarzbold; 2020	LABORATORY STUDY	To evaluate in vitro the whiteness index and surface roughness of bovine enamel after simulated brushing with different commercially available whitening toothpastes.	Commercial and experimental whitening toothpastes with abrasive and enzymatic action, respectively, are equally effective in removing extrinsic stains. However, due to their potential to cause unwanted wear and tear, commercial whitening toothpastes need to be used with caution. Experimental formulations provided similar removal of extrinsic stains without unwanted abrasiveness; however, this effect may be due to the use of less aggressive abrasives in their formulations.
Torres et al; 2020	LABORATORY STUDY	To evaluate in vitro the effects of whitening toothpastes on enamel color, shear strength of orthodontic brackets, and adhesive remnant index (ARI).	Simulated brushing with whitening toothpastes containing mechanical and chemical agents was effective in modifying the visual perception of bovine enamel color.
Meireles et al; 2020	CLINICAL STUDY	To evaluate the efficacy and safety of a whitening toothpaste with blue covarian in teeth whitening.	Toothpaste was significantly less effective at teeth whitening than at-home whitening with 10% carbamide peroxide. The Blue Covarine whitening toothpaste did not show any improvement in tooth color compared to conventional toothpaste.

Schlafer et al; 2021	CLINICAL STUDY	To measure the effect of a single brushing with toothpaste containing blue covarina on tooth whiteness compared to the control treatment and to assess the satisfaction and visual perception of the treatment effect by the patients participating in the study.	Single use of a toothpaste containing blue covarina did not result in whiter teeth compared to a control silica-based whitening toothpaste, assessed by spectrophotometry. An upward trend in satisfaction with tooth color was observed in both treatment groups, despite the absence of a measurable whitening effect.
Vural et al; 2021	LABORATORY STUDY	To test the effects of three different commercial whitening toothpastes containing charcoal on the color, surface roughness, and microhardness of human permanent enamel compared to a common fluoridated toothpaste.	Within the limitations of this in vitro study, it can be concluded that the charcoal-based whitening toothpastes tested: (1) did not show clinically acceptable whitening performance (ΔE >3.7), (2) increased the surface roughness of the enamel except BW (Black is White) and (3) did not alter the microhardness of the enamel except CT (Colgate Total 12) after 12 weeks brushing.
Vladislavic et al; 2021	CLINICAL STUDY	To evaluate whitening efficiency and patient satisfaction after using commercially available toothpastes with the different whitening ingredients.	Whitening toothpastes can have a noticeable whitening effect after a short period of use, but without a lasting impact.
Dantas et al; 2021	LABORATORY STUDY	To compare the whitening effect of a new toothpaste containing blue Covarina with a conventional in-office teeth whitening treatment.	Blue covarian may be a viable option for extrinsically stained teeth. However, for severe spotting, covariin showed minimal bleaching effect and conventional HP-based bleaching agents proved to be the most effective treatment strategy in this clinical situation.
Toschi et al; 2021	LABORATORY STUDY	(1) Investigate the whitening and abrasive potential of different toothpastes in enamel; and (2) to evaluate the effect of Oral-B 3D White Perfection® (Oral-B) toothpaste on the prevention of darkening.	Only Sensodyne toothpaste showed greater whitening potential than conventional toothpaste. Prior brushing with Oral-B 3D White Perfection® toothpaste reduced tooth pigmentation, although without preventive action. No significant changes were observed in the roughness of the teeth after the application of the treatments with the different toothpastes, when compared to the non-whitening control toothpaste.
Silva et al; 2021	CLINICAL STUDY	The objective of this research was to evaluate the practice of brushing with toothpastes that have a whitening purpose, satisfaction, self-perception of the whitening response and the presence of hypersensitivity caused during its use.	Self-perception was negative regarding the whitening efficacy of these products, there was discontinuation and the main complaints were dental hypersensitivity and whitening efficacy, the use of toothpastes with whitening purpose was not recommended by the group studied.
Liu et al; 2021	CLINICAL STUDY	To evaluate the effects on extrinsic tooth stain control of a	The use for 8 weeks of a toothpaste containing 10% high-cleaning silica,

		whitening toothpaste containing 10% high-cleaning silica, 0.5% sodium phytate, and 0.5% sodium pyrophosphate, compared to a negative-control toothpaste.	0.5% sodium phytate, and 0.5% sodium pyrophosphate can effectively reduce extrinsic tooth staining compared to a negative control toothpaste. Additional studies with a similar design are needed, in which the observation time is prolonged or multiple control toothpastes are included to observe the possible long-term effects and relative efficacy.
Aydin et al; 2022	LABORATORY STUDY	To study in vitro the whitening effect of hydrogen peroxide, blue covarin and activated charcoal in whitening toothpastes on human teeth.	All toothpastes showed a whitening effect on teeth after one week (7 days) of use, while toothpaste containing activated charcoal produced the best whitening effect after 28 days. After 28 days of daily use, toothpaste containing activated charcoal showed "very good efficacy" in teeth whitening, while hydrogen peroxide, blue covarine, and traditional toothpaste showed "good efficacy."
Pinzan-vercelino et al; 2022	LABORATORY STUDY	To evaluate the efficacy of different products for whitening and whitening under orthodontic brackets.	Considering the results obtained for color changes and perception of tooth whiteness, tooth color changes were effective, in the presence of metal orthodontic brackets, for the use of whitening toothpaste containing hydrated silica.
Jamwal et al; 2022	SYSTEMATIC REVIEW	To evaluate the effect of whitening toothpastes on the surface roughness and microhardness of human teeth by identifying all relevant literature, systematically evaluating it, and synthesizing the data to integrate the results.	While whitening toothpastes can typically lighten the color of teeth by about one or two shades, there is some evidence to show that these toothpastes also affect the mineral content of the teeth by increasing surface roughness and reducing microhardness. Therefore, dental professionals need to educate their patients to be cautious about long-term use of at-home whitening toothpaste.

Vilhena et al; 2022	LABORATORY STUDY	It aims to investigate the whitening potential of commercially available and experimental toothpastes containing optical dyes in their formulations.	Whitening toothpastes containing optical dyes are efficient for enamel whitening, as whiter teeth were observed after treatment (higher ΔWID averages). In addition, these toothpastes were considered to have very good efficacy (grade 4) when the parameters ΔEab and ΔE00 were evaluated. The effect of teeth whitening after brushing with whitening toothpastes containing optical dyes seems to be favorably affected by the synergism between the chemical and physical characteristics studied.
Dursun et al; 2023	LABORATORY STUDY	To evaluate the effects of six contemporary whitening toothpastes with different whitening mechanisms on enamel color and shear bond strength (RUC).	The whitening toothpastes tested showed similar and acceptable efficacy in changing enamel color. In addition, no significant differences were observed in the RUC of the enamel samples brushed with the whitening toothpastes tested.
Tomás et al; 2023	SYSTEMATIC REVIEW	To carry out a qualitative synthesis of the available literature on the use of activated charcoal-based toothpastes for tooth whitening.	As for its whitening effect, the higher the concentration of activated charcoal, the greater the whitening. Compared to other whitening toothpastes, the whitening effect of activated charcoal is less effective than that of other toothpastes containing bleaching agents such as hydrogen peroxide or carbamide.
Fernandes et al; 2023	LABORATORY STUDY	To evaluate the effectiveness of a commercially available DBBC (charcoal-based white toothpaste) on coffee stains on tooth surfaces compared to a DSC (charcoal-free white toothpaste).	The charcoal-based whitening toothpaste used in the study was effective in reducing extrinsic stains caused by coffee consumption. However, the color change was not significantly different from that produced by charcoal-free whitening toothpaste. More rigorous future in vivo clinical trials will be needed to clarify the safety and efficacy of charcoal-based toothpastes before they are recommended as toothpastes for teeth whitening.
Santos et al; 2023	LITERATURE REVIEW	To carry out a scientific survey of the literature, through an integrative review, on the effectiveness of toothpastes referred to as whitening teeth.	It revealed that the toothpastes categorized as whitening did not present an intrinsic whitening action, but rather an action of removing extrinsic stains on the tooth enamel. Showing that the whitening action of these products does not promote the same aesthetic results as those obtained by the use of whitening gels.
Simionato et al; 2023	LABORATORY STUDY	Evaluate the color change, surface roughness, gloss, and microhardness of tooth enamel brushed with different over-the-counter toothpastes.	The toothpastes used in the present study did not alter the properties of tooth enamel, except for roughness. However, the perception of teeth whitening, presented by the whitening index, was greater than the color change itself. Toothpaste with an abrasive system based on baking soda and silica, and which contains sodium carbonate peroxide,

			increased the roughness of the enamel surface.

DISCUSSION

The findings of this integrative review indicate that most of the studies analyzed recorded a significant change in tooth color after the application of whitening toothpastes available on the market, when used for a period between 5 days and 8 weeks. The studies predominantly employed the VITA scale and a spectrophotometer to assess changes in staining. The latter is more useful in assessing surface color changes, as it is more objective and precise and does not depend on light conditions or the dentist's eye, according to the VITA scale **(Simionato et al., 2021)**. The most commonly used bleaching agents are mechanical (abrasives), chemical (peroxides) and optical (blue covarine) agents, which are analyzed in the studies.

ACTIVATED CHARCOAL

Charcoal, also called "black magic," has entered literature as a recent innovation. In fact, it has been used since ancient Greece by Hippocrates. It is a very light black hydrocarbon of carbon and ash residues. It is obtained through a method called "slow pyrolysis," eliminating water and other volatile components from carbon-rich materials. The composition of these creams is basically a fine powder of activated carbon that has been oxidized by controlled reheating or by chemical means **(Vural et al., 2021).** The bleaching effect of this compound is based on its ability to adsorb and retain chromophores **(Schwarzbold et al., 2020).**

During tooth brushing, activated charcoal particles act on the surface of the stained tooth, this abrasive agent is physically harder than the stain, the stain can be removed, leaving the tooth surface clean. By this mechanism, abrasive cleaning influences only extrinsic stains and does not influence intrinsic discoloration or the natural color of the tooth. Therefore, the ability of activated charcoal-rich toothpastes to whiten teeth comes from the removal of extrinsic stains, but never from modifying the intrinsic color of the dentin or enamel **(Greenwall et al., 2019).** Thus, the whitening effect attributed to activated charcoal comes from its abrasive effect, the higher the concentration of activated carbon, the greater the whitening.

Tomás et al., (2023) through a systematic review on the effect of activated charcoal, found that compared to other toothpastes, activated charcoal-based toothpastes are less safe and less effective than other whitening pastes with a much lower abrasive potential. In contrast, in the laboratory study by **Aydin et al., (2022)** toothpastes containing activated charcoal showed better efficacy in whitening teeth than toothpastes containing blue covariin and hydrogen peroxide. In the study by **Dursun et al., (2023),** the whitening effect of toothpaste with activated charcoal was considered sufficient.

Fernandes et al., (2023) in their study, concluded that charcoal-based whitening toothpaste was effective in reducing extrinsic stains caused by coffee consumption. However, the color change was not significantly different from that produced by the charcoal-free whitening toothpaste. For **Vural et al., (2021)** the ingredient charcoal alone did not show successful clinical performance for tooth whitening. **Greenwal et al., (2019)** in their study analyzed that there is insufficient evidence to support the claims of teeth whitening, let alone any whitening effects associated with charcoal toothpastes. Concluding that charcoal-based toothpastes can be considered more effective in terms of maintaining tooth color when used to delay the recurrence of surface stains on intact teeth after professional cleaning.

Numerous studies have produced consistent results on the teeth whitening effects of charcoal-based toothpastes. For example, some studies report an increase in teeth whitening due to the high degree of abrasion of toothpastes with charcoal **(Fernandes et al., Vural et al., Greenwal et al., and Schwarzbold et al.),** on the other hand, other studies highlight its abrasive potential, stating that it is harmful to the hard tissues of the teeth, increasing surface roughness and reducing microhardness **(Tomás et al., Jamwal et al., and Aydin et al.).**The discrepancy in whitening efficacy among some studies, in addition to the application of different staining protocols, can be attributed to the use of different types of charcoal toothpaste in the experiments.

COVARINA BLUE

The use of blue covarian and other pigments with an optical effect in whitening toothpastes modifies the perception of yellowish coloration in teeth by depositing a thin semi-transparent blue layer on the tooth enamel. Blue opposes yellow in the color spectrum, creating the visual appearance of whiter, brighter teeth by changing the color of the network to white (**Vaz et al; 2018).** The study by **Vilhena et al., (2022)** states that whitening toothpastes containing optical dyes are efficient for enamel whitening, as whiter teeth were observed after treatment. These toothpastes produce a decrease in yellow chroma and increase the whiteness of the teeth **(Simionato et al. 2023).**

Shamel et al., (2019) in their study measured the teeth whitening effects of six different types of toothpastes containing blue covariin and without blue covariin and found that toothpaste containing blue covariin had a statistically significant color difference compared to the non-whitening control (regular toothpaste) and a statistically significant difference with other types of whitening toothpastes without blue covarian.

Jiang et al., (2019) found that the use of whitening toothpaste containing blue covariin during in-office whitening procedures was associated with less color change compared to conventional and regular whitening toothpastes. **Dantas et al., (2021)** in their study found that blue covarian can be a

viable option for extrinsically stained teeth. However, for severe spots, blue covarina showed minimal bleaching effect.

Meireles et al., (2020) conducted a randomized clinical trial where they evaluated the whitening efficacy of brushing with silica and blue covarine-based whitening toothpaste, concluding that Blue Covarine whitening toothpaste did not show an improvement in tooth color compared to conventional tooth color. As well, **Schlaferet al., (2021)** stated that toothpaste containing blue covarina did not have a whitening effect on teeth in a single use. In addition, when compared to other whitening toothpastes, toothpaste containing blue covariin has a lower whitening effect (**Aydin et al., 2023).**

When referring to deleterious effects on tooth structure, the study by **Shamel et al., (2019)** shows that whitening toothpastes containing blue covarina produced less surface roughness compared to other whitening toothpastes.

HYDROGEN PEROXIDE AND CARBAMIDE

Peroxides are present in gels used for teeth whitening, with the main difference between them being the impact they have on the teeth. Both hydrogen peroxide and carbamide peroxide have a similar effect since they share the same active agent: hydrogen peroxide. When carbamide peroxide gel comes into contact with saliva, it converts to hydrogen peroxide and urea. In the case of hydrogen peroxide, the reaction results in water and oxygen. **(Tavarez et al., 2021)**

Hydrogen peroxide is a potent bleaching agent that can effectively remove extrinsic stains from enamel and lighten the intrinsic color of teeth. It also exhibits antimicrobial activity that can inhibit plaque formation, gingivitis, periodontitis, and halitosis. Hydrogen peroxide exerts its action by oxidizing the chromogens that cause the stains **(Dursun et al. 2023).** Generally used in in-office teeth whitening in high concentrations, ranging from 6% to 35%.

However, hydrogen peroxide toothpastes vary in concentration, formulation, and stability. Many of them contain insufficient amounts of hydrogen peroxide **(Pizan-Varcelino et al.2022)** or employ abrasive materials that can compromise the integrity of teeth and gums **(Justin et al.2019).** In addition, hydrogen peroxide is prone to degradation when exposed to light, heat, or other substances.

One of the main problems related to peroxide-based whitening toothpastes is their substantivity. In contrast to at-home teeth whitening, where the hydrogen peroxide agent remains in contact with the tooth structures for about one to 3 hours, and in-office teeth whitening, staying in contact with the tooth for about 45 minutes, the active ingredients of a whitening toothpaste act only during tooth brushing periods, which may vary, depending on the patient's capacity, from 2 to 3

minutes, and this time may not be sufficient for the toothpaste to demonstrate any effect (**Schwarzbold et al. 2020).**

Carbamide peroxide, usually used in home whitening at concentrations of 10%, 16%, and 22%, is another bleaching agent commonly found in whitening toothpastes. Its decomposition provides a slow and controlled release of oxygen, which helps break down stains on teeth **(Lilaj et al. 2019).** Carbamide peroxide is generally considered to be less potent than hydrogen peroxide, but it is also less likely to cause tooth sensitivity **(Dias et al. 2021).**

The results of the systematic review conducted by **Tomás et al., (2023)** indicate that toothpastes containing bleaching agents such as hydrogen peroxide or carbamide peroxide generated the highest whitening. However, the study by **Fernandes et al., (2023)** states that toothpaste with hydrogen peroxide produced an intermediate color change due to its synergistic action with silica abrasive particles.

The study by **Pizan-Varcelino et al., (2022),** which evaluates the effect of whitening products on orthodontic brackets, speculates that the low concentration of hydrogen peroxide did not produce enough free radicals to oxidize the organic component of dentin, concluding that in-office and home whitening showed statistically greater changes in color and similarity around the bracket area.

The study by **Schwarzbold et al., (2020)** evaluates the whitening efficiency of carbamide peroxide-based toothpaste, however it was shown to be effective only at concentrations above 10%, since it would contain enough hydrogen peroxide to produce enough free radicals. **Torres et al., (2020),** through a laboratory study, found that toothpastes with bleaching agents such as hydrogen peroxide showed significant color change over the initial 6 months and progressive change over the final 6 months.

In the laboratory study conducted by **Dursun et al., (2023)** Clevercool toothpaste, which contains hydrogen peroxide (5%–6%), was used and found that 2 weeks of tooth brushing with Clevercool was effective in teeth whitening and resulted in the greatest color change compared to the other whitening toothpastes tested.

On the other hand, in the study by **Silva et al., (2021)** it was concluded that the whitening action of toothpastes, containing peroxide, clinically evaluated is not proven, as their time is short for there to be effectiveness in the mechanism of action of the bleaching agent on the dental substrate, they produce a clean but rough surface and not the whitening itself, which can trigger the loss of tooth structure.

The results obtained with the study by **Justin et al., (2019)** showed that two whitening toothpastes (GB - Colgate® Luminous White and GC - Colgate® Luminous White Advanced), both containing hydrogen peroxide in their composition, statistically showed whitening action, and GB

dentifrice showed better results when compared to GC dentifrice, which may be related to its abrasiveness.

OTHERS

Some studies included in this research address other types of abrasive agents and substances present in whitening toothpastes. The study by **Toschi et al., (2021)** discusses hydrated silica and reports that it has a superior stain removal ability when compared to other abrasives found in alternative toothpastes tested. In the work by **Liu et al., (2021),** in addition to high-cleaning silica, 2 more abrasive agents are addressed, sodium phytate alone and sodium pyrophosphate isolate, however it was not possible to distinguish which of these ingredients was responsible for the whitening result or whether the combination of the 3substances made the toothpaste more effective.

With the study by **Vladislavic et al; (2021)** It was observed that whitening toothpastes containing a combination of abrasive and chemical agents, such as enzymes, achieved the greatest whitening effect, decreasing yellowing over time.

CONCLUSION

When analyzing the studies in this Integrative Review on the efficacy of whitening toothpastes, it is observed that they tend to provide a superficial whitening action. However, this action is significantly lower when compared to the other whitening methods available. In addition, it has been found that these toothpastes can have adverse effects on tooth structure.

While whitening toothpastes may have mild cosmetic benefits, there is a clear need for more research, especially in vivo studies, that employ accurate methodologies to provide more reliable data on their properties and clinical efficacy. This approach is essential to properly assess the potential of these products and ensure their safe and effective clinical application.

REFERENCES

1. Aydin, N., Karaoglanoglu, S., Oktay, E. A., & Ersöz, B. (2022). Determination of the whitening effect of toothpastes on human teeth. Odovtos International Journal of Dental Sciences, 24(1), 67-75.

2. Casado, B. G. S., Moraes, S. L. D., Souza, G. F. M., Guerra, C. M. F., Souto-Maior, J. R., Lemos, C. A. A., et al. (2018). Efficacy of Dental Bleaching with Whitening Dentifrices: A Systematic Review. International Journal of Dentistry, 2018, 7868531.

3. Dantas, A. A. R., Menegazzo, V. P., Silva, A. M., Besegato, J. F., Freitas Bortolatto, J., Floros, M. C., et al. (2021). Blue Covarine Toothpaste versus Office Whitening: Which is the Most Effective on Stained Teeth? Journal of Health Sciences, 23(3), 216-222.

4. Devila, A., Lasta, R., Zanella, L., Agnol, M. D., & Rodrigues-Junior, S. A. (2020). Efficacy and Adverse Effects of Whitening Dentifrices Compared With Other Products: A Systematic Review and Meta-analysis. Operative Dentistry, 45(2), E77-E90.

5. Dias, H. R., Bergami, P. P., & Finck, N. S. (2022). Comparison of sensitivity produced by technical whitening with substances carbamide peroxide and hydrogen peroxide in different strengths: literature review. DSspace doctum, T17, 34:07Z.

6. Dursun, M. N., Ergin, E., Tekce, A. U., & Gurgan, S. (2023). Which whitening toothpaste with different contents is more effective on color and bond strength of enamel? Journal of Esthetic and Restorative Dentistry, 35(2), 397-405.

7. Fernandes, A. J., & Agnihotri, R. (2023). Evaluation of the efficacy of a charcoal-based tooth whitening dentifrice on coffee stains: an in vitro study. Canadian Journal of Dental Hygiene, 57(2), 123-131.

8. Greenwall, L. H., Greenwall-Cohen, J., & Wilson, N. H. F. (2019). Charcoal-containing dentifrices. British Dental Journal, 226(9), 697-700.

9. Jamwal, N., Rao, A., Shenoy, R., Pai, M., Ks, A., & Br, A. (2022). Effect of whitening toothpaste on surface roughness and microhardness of human teeth: a systematic review and meta-analysis. F1000Research, 11, 22.

10. Jiang, N., Zhang, C., Agingu, C., Attin, T., Cheng, H., & Yu, H. (2019). Comparison of Whitening Dentifrices on the Effectiveness of In-office Tooth Bleaching: A Double-blind Randomized Controlled Clinical Trial. Operative Dentistry, 44(2), 138-145.

11. Justin, G. A. B., Dalmolin, I. C., Cançado, N. M., Szesz, A. L., & Martini, E. C. (2019). Clinical Evaluation of the Effectiveness of Whitening Dentifrices. Journal of Health Sciences, 21(1), 82-87.

12. Lilaj, B., Dauti, R., Agis, H., Schmid-Schwap, M., Franz, A., & Kanz, F., et al. (2019). Comparison of Bleaching Products With Up to 6% and With More Than 6% Hydrogen Peroxide: Whitening Efficacy Using BI and WI D and Side Effects – Na in vitro Study. Frontiers in Physiology, 10, 919.

13. Liu, H., & Tu, J. (2021). Reduction of extrinsic tooth stain by a toothpaste containing 10% high cleaning silica, 0.5% sodium phytate and 0.5% sodium pyrophosphate: an 8-week randomised clinical trial. BMC Oral Health, 21(1), 113.

14. Meireles, S. S., de Sousa, J. P., Lins, R. B. E., & Sampaio, F. C. (2021). Efficacy of whitening toothpaste containing blue covarine: A double-blind controlled randomized clinical trial. Journal of Esthetic and Restorative Dentistry, 33(2), 341-350.

15. Pinzan-Vercelino, C. R. M., Lima, S. N. L., Pereira, F. F. J. V., Gurgel, J. A., Silva, G. R. D., & Freitas, K. M. S. (2022). Efficacy of products for bleaching and whitening under orthodontic brackets. Dental Press Journal of Orthodontics, 27(5), e2220325.

16. Santos, A. dos, Miranda, A. da S., Oliveira, I. L. M. de, Barbosa, J. da S., Leite, J. V. C., & Wanderley e Lima, R. B. (2023). Efetividade Da ação Clareadora Dos dentifrícios No Clareamento Dental: Uma Revisão Integrativa. Arquivos Odontológicos, 59, 30-38.

17. Schlafer, S., Poulsen, P. N., Johansen, J., Trap, L., & Leite, F. R. M. (2021). The whitening effect of single brushing with blue-covarine containing toothpaste-A randomized controlled trial. Journal of Dentistry, 105, 103559.

18. Schwarzbold, C. G., Cuevas-Suárez, C. E., Pacheco, R. R., Ribeiro, J. S., Carreño, N. L. V., Lund, R. G., et al. (2021). In vitro efficacy of commercial and experimental proteolytic enzyme-based whitening dentifrices on enamel whitening and superficial roughness. Journal of Esthetic and Restorative Dentistry, 33(6), 849-855.

19. Shamel, M., Al-Ankily, M. M., & Bakr, M. M. (2019). Influence of different types of whitening toothpastes on the tooth color, enamel surface roughness and enamel morphology of human teeth. F1000Research, 8, 1764.

20. Silva, A. P. G., Alves, L. A. A., Tavares, M. A. C., & Feitosa, D. A. S. (2021). Autopercepción de los efectos en la utilizaciónde dentífricos con propuesta aclaradora. International Journal of Odontostomatology, 15(2), 484-491.

21. Simionato, A. A., Vivanco, R. G., Tonani-Torrieri, R., Arruda, C. N. F., & Pires-de-Souza, F. C. P. (2023). Whitening Effect of Different Toothpastes on Bovine Dental Enamel: an in situ study. Brazilian Dental Journal, 34(1), 61-70.

22. Tomás, D. B. M., Pecci-Lloret, M. P., & Guerrero-Gironés, J. (2023). Effectiveness and abrasiveness of activated charcoal as a whitening agent: A systematic review of in vitro studies. Annals of Anatomy, 245, 151998.

23. Tavarez, R. J., Lima, S. N., Malheiros, A. S., Menezes, L. L., Bandeca, M. C., de Miranda, R. C., et al. (2021). Assessment of the aesthetic impact and quality of life of home dental bleaching in adult patients. Journal of Clinical and Experimental Dentistry, 13(5), e440-e445.

24. Torres, V. S., Lima, M. J. P., Valdrighi, H. C., Campos, E. J., & Santamaria-Jr, M. (2020). Whitening Dentifrices Effect on Enamel with Orthodontic Braces after Simulated Brushing. European Journal of Dentistry, 14(1), 13-18.

25. Toschi, E. M., Münchow, E. A., Mercado, L. W., Melara, R., & Henz, S. L. (2021). Análise Da eficácia De dentifrícios Clareadores E Seus Efeitos Na superfície Dental: Um Estudo in Vitro. Revista da Faculdade de Odontologia de Porto Alegre, 62, 22-32.

26. Vaz, V. T. P., Jubilato, D. P., Oliveira, M. R. M., Bortolatto, J. F., Floros, M. C., Dantas, A. A. R., et al. (2019). Whitening toothpaste containing activated charcoal, blue covarine, hydrogen

peroxide or microbeads: which one is the most effective? Journal of Applied Oral Science, 27, e20180051.

27. Vilhena, F. V., Frederico de Oliveira Graeff, C., Svizero, N. D. R., & D'Alpino, P. H. P. (2022). Effectiveness of Experimental Whitening Toothpastes Containing Colorants on the Optical Properties of Enamel. The Scientific World Journal, 2022, 4576912.

28. Vladislavic, N. Z., Tadin, A., Gavic, L., Jerkovic, D., Franic, I., & Verzak, Z. (2022). In vivo evaluation of whitening toothpaste efficiency and patient treatment satisfaction: a randomized controlled trial. Clinical Oral Investigations, 26(1), 739-750.

29. Vural, U. K., Bagdatli, Z., Yilmaz, A. E., Yalçın Çakır, F., Altundaşar, E., & Gurgan, S. (2021). Effects of charcoal-based whitening toothpastes on human enamel in terms of color, surface roughness, and microhardness: an in vitro study. Clinical Oral Investigations, 25(10), 5977-5985.