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EVALUATION OF THE CLINICAL EFFICACY OF GINGER (ZINGIBER OFFICINALE) AS AN ADJUNCT TO PERIODONTAL TREATMENT

AVALIAÇÃO DA EFICÁCIA CLÍNICA DO GENGIBRE (ZINGIBER OFFICINALE) COMO ADJUVANTE AO TRATAMENTO PERIODONTAL

EVALUACIÓN DE LA EFICACIA CLÍNICA DEL JENGIBRE (ZINGIBER OFFICINALE) COMO COADYUVANTE DEL TRATAMIENTO PERIODONTAL

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ABSTRACT

Aim: This systematic review evaluated the potential of ginger-containing products to support clinical periodontal treatment. Material and Methods: This study is reported according to the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) checklist and was registered in PROSPERO (CRD42025646576). Randomized clinical trials evaluating the use of ginger-based products in patients undergoing periodontal therapy were selected, with no limitation on year of publication. Electronic searches were performed in PubMed/MEDLINE, Scopus, Web of Science and Cochrane Library by two independent researchers. Forty-five records were identified of which seven studies met the inclusion criteria. Results: The selected studies evaluated five different presentations of ginger products, comparing them with ibuprofen and chlorhexidine with follow-up times ranging from seven days to eight weeks, and all agreed in affirming the efficacy of ginger use in aiding surgical and non-surgical periodontal therapy for patients with gingivitis and periodontitis, improving the periodontal clinical parameters evaluated and reducing the levels of inflammation, postoperative pain, gingival bleeding and probing depth. Conclusion: This systematic review based on randomized clinical trials showed that the use of ginger after periodontal therapy improves periodontal clinical parameters, suggesting potential as an adjunctive alternative to ibuprofen and chlorhexidine if necessary.

KEYWORDS: *Ginger. Periodontal Index. Periodontal Diseases. Randomized Controlled Clinical Trial.*

RESUMO

Objetivo: Esta revisão sistemática avaliou o potencial de produtos com gengibre em sua composição para auxiliar no tratamento periodontal clínico. Material e Métodos: Este estudo foi relatado de acordo com a lista de verificação PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses) e registrado no PROSPERO (CRD42025646576). Foram selecionados ensaios clínicos randomizados que avaliaram o uso de produtos à base de gengibre em pacientes submetidos à terapia periodontal, sem limitação quanto ao ano de publicação. As buscas eletrônicas foram realizadas nas bases de dados PubMed/MEDLINE, Scopus, Web of Science e Cochrane Library por dois pesquisadores independentes. Foram obtidos 45 artigos, dos quais sete foram selecionados de acordo com os critérios de inclusão. Resultados: Os estudos selecionados avaliaram cinco apresentações diferentes de produtos de gengibre, comparando-os com ibuprofeno e clorexidina, com tempos de acompanhamento variando de sete dias a oito semanas, e todos concordaram em afirmar a eficácia do uso de gengibre como auxílio na terapia periodontal cirúrgica e não cirúrgica para pacientes com gengivite e periodontite, melhorando os parâmetros clínicos periodontais avaliados e reduzindo os níveis de inflamação, dor pós-operatória, sangramento gengival e profundidade de sondagem. Conclusão: Esta revisão sistemática baseada em ensaios clínicos randomizados mostrou que o uso de

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gengibre após a terapia periodontal melhora os parâmetros clínicos periodontais, sugerindo potencial como alternativa coadjuvante ao ibuprofeno e à clorexidina, se necessário.

PALAVRAS-CHAVE: Gengibre. Índice Periodontal. Doenças Periodontais. Ensaio Clínico Randomizado Controlado.

RESUMEN
Objetivo: Esta revisión sistemática evaluó el potencial de los productos con jengibre en su composición para apoyar el tratamiento periodontal clínico. Material y métodos: Este estudio se reporta según la lista de verificación de Elementos de Reporte Preferidos para Revisiones Sistemáticas y Metaanálisis (PRISMA) y se registró en PROSPERO (CRD42025646576). Se seleccionaron ensayos clínicos aleatorizados que evaluaron el uso de productos a base de jengibre en pacientes sometidos a terapia periodontal, sin límite de año de publicación. Dos investigadores independientes realizaron búsquedas electrónicas en PubMed/MEDLINE, Scopus, Web of Science y Cochrane Library. Se obtuvieron 45 artículos, siete de los cuales fueron seleccionados según los criterios de inclusión. Resultados: Los estudios seleccionados evaluaron cinco presentaciones diferentes de productos de jengibre, comparándolas con ibuprofeno y clorhexidina, con un seguimiento de entre siete días y ocho semanas. Todos coincidieron en afirmar la eficacia del jengibre como complemento del tratamiento periodontal quirúrgico y no quirúrgico en pacientes con gingivitis y periodontitis, mejorando los parámetros clínicos periodontales evaluados y reduciendo los niveles de inflamación, el dolor postoperatorio, el sangrado gingival y la profundidad del sondaje. Conclusión: Esta revisión sistemática, basada en ensayos clínicos aleatorizados, demostró que el uso de jengibre después del tratamiento periodontal mejora los parámetros clínicos periodontales, convirtiéndose en una alternativa eficaz al ibuprofeno y la clorhexidina en caso de ser necesario.

***PALABRAS CLAVE**: Jengibre, Índice periodontal. Enfermedades periodontales. Ensayo clínico controlado aleatorizado.*

INTRODUCTION

Periodontal disease affects half of the world's population, affecting the supporting tissues of the teeth and can even lead to tooth loss in undiagnosed and untreated cases (Dahiya P *et al.*, 2013; Babaei H *et al.*, 2018; Sälzer S *et al.*, 2020; Sedghi L *et al.*, 2021). Effective measures to control bacterial biofilm are essential, since it is the primary etiological factor of periodontal disease (Listgarten MA, 1988).

Non-surgical periodontal therapy, mainly scaling and root planing, is the main choice for the treatment of periodontal diseases, focusing on reducing the microbial load and controlling inflammation (Alshehri FA, Javed F, 2015; Hashim NT *et al.*, 2025), in addition to improving periodontal clinical parameters: probing depth, clinical attachment level and bleeding on probing index (Hashim NT *et al.*, 2025).

The use of dental floss in conjunction with brushing does not seem to be effective for everyone, and complementary alternative methods are needed to help clean specific areas, such as interproximal areas. For this purpose, chemical agents such as chlorhexidine digluconate are used (Sowinski DM *et al.*, 2008; Cai H *et al.*, 2020; Parwani SR *et al.*, 2013). Given the adverse effects that prolonged use of these chemical agents can cause, studies have shown that natural antimicrobial agents inhibit bacterial

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growth in subgingival regions reduce the symptoms of gingivitis (Hiraishi N *et al.*, 2009; Pannuti CM *et al.*, 2003; Rassameemasmaung S *et al.*, 2007; Wan HC *et al.*, 2005).

Ginger, scientifically called *Zingiber officinale roscoe*, has proven anti-inflammatory and antibacterial properties, effectively combating periodontal pathogens such as *Porphyromonas gingivalis* and appears as a natural alternative that has been studied as a complement to periodontal therapy, whether surgical or non-surgical (Singh N *et al.*, 2016; Rashmi KJ *et al.*, 2016; Alshibani N *et al.*, 2022; Deshpande A *et al.*, 2021; Bauer Faria TR *et al.*, 2021; Zare Javid A *et al.*, 2019; Mahyari S *et al.*, 2016; Menon P *et al.*, 2021; Puri S *et al.*, 2021).

Since there is no other systematic review on the subject in the literature, the aim of this systematic review was to evaluate, from randomized clinical trials, the potential of ginger in improving clinical parameters in patients undergoing periodontal therapy. The null hypothesis of this study was that there is no efficacy in the use of ginger products compared to chlorhexidine or nonsteroidal anti-inflammatory agents in improving clinical parameters in patients undergoing periodontal treatment.

METHODOLOGY

Registration Protocol

This systematic review is reported according to the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) checklist (Moher D *et al.*, 2009). In addition, it has been registered in the International Prospective Register of Systematic Reviews (PROSPERO) under the number CRD42025646576.

Eligibility Criteria

The review question of the study was “Does the use of products with ginger in their composition help improve periodontal clinical parameters?" based on the PICOS criteria. Thus, Population (P) consisted of patients with periodontal disease; Intervention (I) was the use of products with ginger in their composition; Comparison (C) was the use of products with chlorhexidine or non-steroidal anti-inflammatory drugs and Outcome (O) evaluated was periodontal clinical indexes; the Study Type selected (S) were randomized controlled clinical trials (RCTs).

Inclusion criteria were studies published only in English, randomized controlled clinical trials that evaluated periodontal clinical parameters in patients who underwent surgical or non-surgical interventions using products with different formulations containing ginger in their composition. Exclusion criteria were *in vitro* studies, animal studies, retrospective studies, literature reviews, studies that did not evaluate periodontal clinical parameters, studies that did not use Chlorhexidine or Non-Steroidal Anti-Inflammatory Agents as a comparison group.

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Information sources and search strategy

The electronic literature search was performed by two researchers (A.R.J.S. and R.I.S.G.) working independently using the search strategy described in table 1. Studies were selected and included/excluded based on reading the title and abstract in the PubMed/MEDLINE, Scopus, Cochrane Library and Web of Science. To complement this review, the same researchers performed a manual search for articles published in the following journals: Periodontology 2000, Brazilian Oral Research, Journal of Applied Oral Science and Journal of Clinical Periodontology. The criteria for choosing these journals were peer-review of the articles and a high impact factor. This search was conducted until March 2025, with no year of publication limitation.

Studies were previously selected and classified according to eligibility criteria by reading the title and abstract, but those for which inclusion or exclusion was not clear were read in full so that the final decision could be made. A third researcher (M.H.C.V.C) analyzed all selection differences between the other two researchers and a consensus was reached.

Table 1. Search strategy

	PUBMED/MEDLINE
#1	(Gingivitis) OR (Gingivitides)) OR (Periodontal Diseases)) OR (Disease, Periodontal)) OR (Diseases, Periodontal)) OR (Periodontal Disease)) OR (Gingival Diseases)) OR (Disease, Gingival)) OR (Diseases, Gingival)) OR (Gingival Disease)) OR (Gingival Pocket)
#2	(Zingiber officinale) OR (Zingiberaceae)) OR (Ginger)) OR (Gingers)) OR (Ginger Extract)) OR (Ginger Powder)
#3	(Chlorhexidine) OR (Mouthwashes)) OR (Mouth Wash)) OR (Wash, Mouth)) OR (Mouth Rinse)) OR (Mouth Rinses)) OR (Rinse, Mouth)) OR (Rinses, Mouth)) OR (Anti-Inflammatory Agents, Non-Steroidal)) OR (NSAIDs)) OR (Antiinflammatory Agents, Non Steroidal)) OR (Non-Steroidal Anti-Inflammatory Agents)) OR (Non Steroidal Anti Inflammatory Agents)) OR (Nonsteroidal Anti-Inflammatory Agents)) OR (Nonsteroidal Anti Inflammatory Agents)
#4	(Dental Plaque Index) OR (Dental Plaque Indices)) OR (Index, Dental Plaque)) OR (Indices, Dental Plaque)) OR (Dental Plaque Indexes)) OR (Indexes, Dental Plaque)) OR (Dental Plaque)) OR (Plaque, Dental)) OR (Inflammation)) OR (Inflammations)) OR (Periodontal Index)) OR (Index, Periodontal)) OR (Indices, Periodontal)) OR (Periodontal Indices)) OR (Periodontal Indexes)) OR (Indexes, Periodontal)) OR (Gingival Index)) OR (Gingival Indices)) OR (Bleeding on Probing, Gingival)) OR (Gingival Bleeding on Probing)
	#1 AND #2 AND #3 AND #4
	SCOPUS
#1	(TITLE-ABS-KEY ("Gingivitis") OR TITLE-ABS-KEY ("Gingivitides") OR TITLE-ABS-KEY ("Periodontal Diseases") OR TITLE-ABS-KEY ("Disease, Periodontal") OR TITLE-ABS-KEY ("Diseases, Periodontal") OR TITLE-ABS-KEY ("Periodontal Disease") OR TITLE-ABS-

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	KEY ("Gingival Diseases") OR TITLE-ABS-KEY ("Disease, Gingival") OR TITLE-ABS-KEY ("Diseases, Gingival") OR TITLE-ABS-KEY ("Gingival Disease") OR TITLE-ABS-KEY ("Gingival Pocket"))
#2	(TITLE-ABS-KEY ("Zingiber officinale") OR TITLE-ABS-KEY ("Zingiberaceae") OR TITLE-ABS-KEY ("Ginger") OR TITLE-ABS-KEY ("Gingers") OR TITLE-ABS-KEY ("Ginger Extract") OR TITLE-ABS-KEY ("Ginger Powder"))
#3	(TITLE-ABS-KEY ("Chlorhexidine") OR TITLE-ABS-KEY ("Mouthwashes") OR TITLE-ABS-KEY ("Mouth Wash") OR TITLE-ABS-KEY ("Wash, Mouth") OR TITLE-ABS-KEY ("Mouth Rinse") OR TITLE-ABS-KEY ("Mouth Rinses") OR TITLE-ABS-KEY ("Rinse, Mouth") OR TITLE-ABS-KEY ("Rinses, Mouth") OR TITLE-ABS-KEY ("Anti-Inflammatory Agents, Non-Steroidal") OR TITLE-ABS-KEY ("NSAIDs") OR TITLE-ABS-KEY ("Antiinflammatory Agents, Non Steroidal") OR TITLE-ABS-KEY ("Non-Steroidal Anti-Inflammatory Agents") OR TITLE-ABS-KEY ("Non Steroidal Anti Inflammatory Agents") OR TITLE-ABS-KEY ("Nonsteroidal Anti-Inflammatory Agents") OR TITLE-ABS-KEY ("Nonsteroidal Anti Inflammatory Agents"))
#4	(TITLE-ABS-KEY ("Dental Plaque Index") OR TITLE-ABS-KEY ("Dental Plaque Indices") OR TITLE-ABS-KEY ("Index, Dental Plaque") OR TITLE-ABS-KEY ("Indices, Dental Plaque") OR TITLE-ABS-KEY ("Dental Plaque Indexes") OR TITLE-ABS-KEY ("Indexes, Dental Plaque") OR TITLE-ABS-KEY ("Dental Plaque") OR TITLE-ABS-KEY ("Plaque, Dental") OR TITLE-ABS-KEY ("Inflammation") OR TITLE-ABS-KEY ("Inflammations") OR TITLE-ABS-KEY ("Periodontal Index") OR TITLE-ABS-KEY ("Index, Periodontal") OR TITLE-ABS-KEY ("Indices, Periodontal") OR TITLE-ABS-KEY ("Periodontal Indices") OR TITLE-ABS-KEY ("Periodontal Indexes") OR TITLE-ABS-KEY ("Indexes, Periodontal") OR TITLE-ABS-KEY ("Gingival Index") OR TITLE-ABS-KEY ("Gingival Indices") OR TITLE-ABS-KEY ("Bleeding on Probing, Gingival") OR TITLE-ABS-KEY ("Gingival Bleeding on Probing"))
	#1 AND #2 AND #3 AND #4
	WEB OF SCIENCE
#1	Gingivitis (Topic) or Gingivitides (Topic) or Periodontal Diseases (Topic) or Disease, Periodontal (Topic) or Diseases, Periodontal (Topic) or Periodontal Disease (Topic) or Gingival Diseases (Topic) or Disease, Gingival (Topic) or Diseases, Gingival (Topic) or Gingival Disease (Topic) or Gingival Pocket (Topic)
#2	Zingiber officinale (Topic) or Zingiberaceae (Topic) or Ginger (Topic) or Gingers (Topic) or Ginger Extract (Topic) or Ginger Powder (Topic)

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#3	Chlorhexidine (Topic) or Mouthwashes (Topic) or Mouth Wash (Topic) or Wash, Mouth (Topic) or Mouth Rinse (Topic) or Mouth Rinses (Topic) or Rinse, Mouth (Topic) or Rinses, Mouth (Topic) or Anti-Inflammatory Agents, Non-Steroidal (Topic) or NSAIDs (Topic) or Antiinflammatory Agents, Non Steroidal (Topic) or Non-Steroidal Anti-Inflammatory Agents (Topic) or Non Steroidal Anti Inflammatory Agents (Topic) or Nonsteroidal Anti-Inflammatory Agents (Topic) or Nonsteroidal Anti Inflammatory Agents (Topic)
#4	Dental Plaque Index (Topic) or Dental Plaque Indices (Topic) or Index, Dental Plaque (Topic) or Indices, Dental Plaque (Topic) or Dental Plaque Indexes (Topic) or Indexes, Dental Plaque (Topic) or Dental Plaque (Topic) or Plaque, Dental (Topic) or Inflammation (Topic) or Inflammations (Topic) or Periodontal Index (Topic) or Index, Periodontal (Topic) or Indices, Periodontal (Topic) or Periodontal Indices (Topic) or Periodontal Indexes (Topic) or Indexes, Periodontal (Topic) or Gingival Index (Topic) or Gingival Indices (Topic) or Bleeding on Probing, Gingival (Topic) or Gingival Bleeding on Probing (Topic)
	#1 AND #2 AND #3 AND #4
	COCHRANE LIBRARY
#1	Gingivitis OR Gingivitides OR Periodontal Diseases OR Disease, Periodontal OR Diseases, Periodontal OR Periodontal Disease OR Gingival Diseases OR Disease, Gingival OR Diseases, Gingival OR Gingival Disease OR Gingival Pocket in Title Abstract Keyword
#2	Zingiber officinale OR Zingiberaceae OR Ginger OR Gingers OR Ginger Extract OR Ginger Powder in Title Abstract Keyword
#3	Chlorhexidine OR Mouthwashes OR Mouth Wash OR Wash, Mouth OR Mouth Rinse OR Mouth Rinses OR Rinse, Mouth OR Rinses, Mouth OR Anti-Inflammatory Agents, Non-Steroidal OR NSAIDs OR Antiinflammatory Agents, Non Steroidal OR Non-Steroidal Anti-Inflammatory Agents OR Non Steroidal Anti Inflammatory Agents OR Nonsteroidal Anti-Inflammatory Agents OR Nonsteroidal Anti Inflammatory Agents in Title Abstract Keyword
#4	Dental Plaque Index OR Dental Plaque Indices OR Index, Dental Plaque OR Indices, Dental Plaque OR Dental Plaque Indexes OR Indexes, Dental Plaque OR Dental Plaque OR Plaque, Dental OR Inflammation OR Inflammations OR Periodontal Index OR Index, Periodontal OR Indices, Periodontal OR Periodontal Indices OR Periodontal Indexes OR Indexes, Periodontal OR Gingival Index OR Gingival Indices OR Bleeding on Probing, Gingival OR Gingival Bleeding on Probing in Title Abstract Keyword
	#1 AND #2 AND #3 AND #4

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Data analysis

One of the researchers (A.R.J.S.) collected all the important information from the articles, specifically, the number of patients evaluated, the periodontal diagnosis, the periodontal therapy performed, the formulation of the product containing ginger, the periodontal indices evaluated and their timing, and the evaluation methodology and the second researcher (R.I.S.G.) reviewed all the information collected. A careful analysis was performed to verify disagreements between researchers and a third party (M.H.C.V.C) were consulted when no consensus existed.

Risk of bias

The two researchers (A.R.J.S. and R.I.S.G.) assessed the methodological quality of the studies using the Cochrane risk-of-bias tool Risk of Bias 2 (RoB 2) (Sterne J *et al.*, 2019) to assess the level of evidence from the included RCTs in this review.

Additional analysis

The Kappa test was performed to calculate the level of agreement between authors during the article selection process in the PubMed/MEDLINE, Scopus, Cochrane Library and Web of Science databases. Any disagreement was resolved through discussion among the authors until a consensus was reached.

RESULTS

Literature search

The initial electronic search provided 45 articles: 13 from Pubmed/Medline, 12 from Scopus, 6 from Web of Science, 13 from Cochrane Library and 1 from the manual search. After removing the duplicates, 23 articles were obtained for title and abstract reading and the eligibility criteria were applied, resulting in 18 studies for analysis. After reading these articles in full, 11 were excluded because they were literature reviews, or they didn't evaluate ginger or they were in vitro studies. Thus, seven articles (Alshibani N *et al.*, 2022; Deshpande A *et al.*, 2021; Bauer Faria TR *et al.*, 2021; Zare Javid A *et al.*, 2019; Mahyari S *et al.*, 2016; Menon P *et al.*, 2021; Puri S *et al.*, 2021) were included in this systematic review. Details of the search strategy are described in the form of a flowchart in Figure 1.

The values obtained by the Kappa test for the databases were: Pubmed/Medline (1.0), Scopus (1.0), Cochrane Library (0.9) and Web of Science (1.0), suggesting a high level agreement between the authors.

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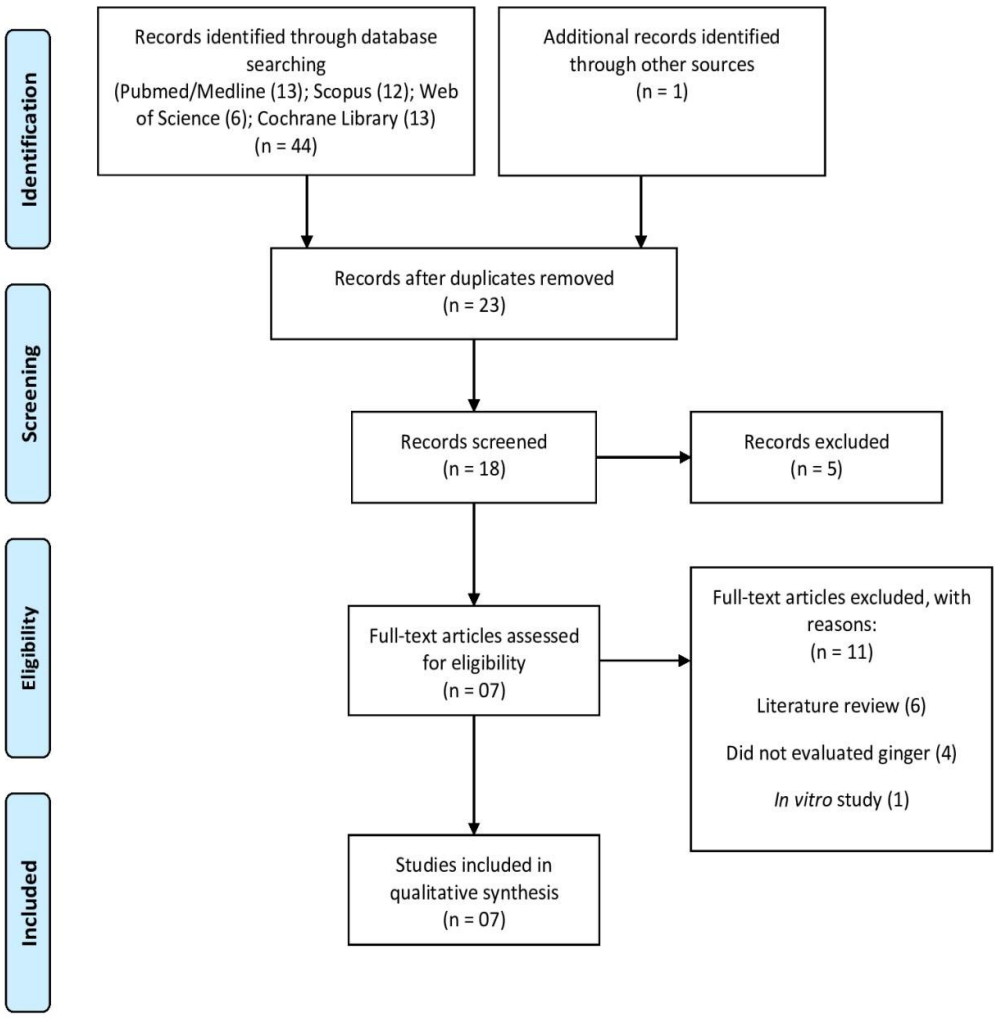

Figure 1. Flowchart describing the electronic search and selection of studies

Characteristics of included studies

The characteristics of each study, including all information collected from each study, are described in tables 2 and 3. A total of 281 participants were evaluated in all studies included in this review. Patients with gingivitis and periodontitis, associated or not with local and systemic predisposing factors, were monitored, with a follow-up time ranging from seven days to eight weeks.

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The presentation of ginger used in the studies varied between tablets, mouthwash, capsules and gel, always compared to a control in the same presentation. The substances used as controls were Ibuprofen 400mg, Chlorhexidine 0.12%, 1% and 2% and a placebo made with pea flour.

Periodontal parameters were properly evaluated in all studies, however, there were differences in the method used to evaluate the same outcome between different studies, as well as different evaluation times, which prevented a quantitative analysis from being carried out through meta-analysis, which could be pointed out as a limitation of this study.

Thus, the included studies indicate positive results for the use of products with ginger in their composition with the aim of assisting in surgical or non-surgical periodontal therapy, with specific conclusions to be described below: The use of ginger for three days after non-surgical periodontal therapy statistically significantly reduces the values of periodontal indices in patients with periodontitis, consequently reducing the levels of inflammation in patients (Alshibani N *et al*., 2022). Also for patients with periodontitis, the use of ginger tablets for eight weeks improved the inflammatory state of the periodontal tissues locally and also systemically, in association with non-surgical therapy (Zare Javid A *et al.*, 2019).

Regarding ginger-based mouthwash, studies agree in affirming its effectiveness as a complementary agent for mechanical control of dental biofilm, reducing gingival bleeding in a manner equivalent to or superior to chlorhexidine, especially for patients with gingivitis (Deshpande A *et al.*, 2021; Bauer Faria TR *et al.*, 2021; Mahyari S *et al.*, 2016). For patients undergoing surgical periodontal therapy, the use of ginger has been shown to be as effective as a commonly used NSAID in controlling post-surgical inflammation, and may be considered an effective alternative in cases of allergy or contraindication to NSAIDs (Menon P *et al.*, 2021).

Table 2. Characteristics of included studies

Author, Year	Type of study	Number of patients	Periodontal diagnosis of patients	Periodontal intervention performed	Ginger formulation	Control group medication	Instructions for use of tested products
Alshibani & others	RCT	44	Periodontitis stage 2, grade B	Non-surgical periodontal therapy – Use of ultrasound and sterile hand curettes	400mg ginger tablets (MEPACO Medifood, Product-code 11656; Beaver Dam, WI, USA)	Ibuprofen 400mg tablets (Motrin IB, McNeil Consumer Healthcare; Fort Washington, PA, USA)	After periodontal therapy, take the tablet every 12 hours for three days, and after that only in case of pain
Deshpande & others	RCT	60	Gingivitis and Dental plaque	Did not receive intervention	Rinse with 5% green tea and 5% ginger extract	0.12% chlorhexidine rinse	Use the mouthwash twice a day for a month
Faria & others	RCT	31	Not available	Received an oral hygiene kit with mouthwash,	Rinse made from 0.5% ginger essential oil	0.12% chlorhexidine rinse and flavored	Use 10mL of the mouthwash for 60 seconds, for one week

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				without hygiene instructions		distilled water as negative control	
Menon & others	RCT	10	Chronic Generalized Periodontitis (EEOS)	Open flap scaling in at least two quadrants with prior scaling and crown-root surface debridement	Ginger capsule containing 400 mg dried ginger rhizome powder (Sunthi - Z. officinale; Himalaya® Drug Co., India)	Ibuprofen Capsule 400 mg (Brufen® 400; Abbott Healthcare Pvt. Ltd., India)	After periodontal therapy, take the capsule three times a day for three days
Puri & others	RCT	30	Gingivitis	Professional prophylaxis, manual scaling and polishing of treated tooth surfaces	Honey-based gel with zingiber officinale	RexidineTM Gel 15g (chlorhexidine 1%, metronidazole 1%, lidocaine 2%)	Use 4 to 5 times a day, without permission to gargle or drink liquids for at least 20 minutes. They were instructed not to use any plaque control measures for 7 days
Javid & others	RCT	46	Chronic Mild or Moderate Periodontitis (EEOS)	Scaling and crown-root surface debridement and oral hygiene instructions	500mg ginger tablets with Zingiberene, Ar-curcumene, Geranial, Zingiberol and Z. officinale (Dineh Company, Iran)	500mg placebo tablets containing pea flour (Dineh Company, Iran)	Take four tablets a day, two before lunch and two before dinner for 8 weeks
Mahyari & others	RCT	60	Gingivitis	Did not receive intervention	Rinse with plant extract of 14g zingiber officinale, 14g calendula officinalis and 14g rosmarinus officinalis (School of Pharmacy (Mashhad, Iran)	0.2% chlorhexidine rinse and rinse without plant extract as negative control	Use 10mL of the rinse for 30 seconds twice a day for two weeks

Abbreviations: EEOS, Extracted Exactly as Original Study; RCT, Randomized Controlled Trials.

Risk of bias analysis

The complete analysis of the included studies regarding the risk of bias is described in table 4. The risk of bias was found to be low for four of the included studies (Deshpande A *et al.*, 2021; Zare Javid A *et al.*, 2019; Mahyari S *et al.*, 2016; Menon P *et al.*, 2021), while for three studies (Alshibani N *et al.*, 2022; Bauer Faria TR *et al.*, 2021; Puri S *et al.*, 2021) some concerns were noted, especially in the area of selection of the reported result.

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Table 3. Characteristics of included studies

Author, Year	Periodontal outcomes evaluated	Moments of evaluation of outcomes	Methods of assessing outcomes	Mean (Standard Deviation) Periodontal outcomes		Mean (Standard Deviation) Periodontal outcomes	
				Control Group		Experimental Group	
Alshibani & others	Plaque index Gingival bleeding index Probing depth Clinical attachment loss	Baseline, 7, 14, 21 days follow-up	UNC-15mm millimeter probe (Hu-Friedy) and X-rays	Not available		Not available	
Deshpande & others	Plaque index Gingival bleeding index	Baseline, 15, 30 days follow-up	Gingival index (Loe and Sillness, 1963) Plaque index (Sillness and Loe, 1964)	GBI Baseline: 1,87 (±0,35) 15 days: 1,60 (±0,32) 30 days: 1,36 (±0,32)	PI Baseline: 1,80 (±0,56) 15 days: 1,56 (±0,57) 30 days: 1,29 (±0,53)	GBI Baseline: 1,99 (±0,29) 15 days: 1,71 (±0,31) 30 days: 1,22 (±0,29)	PI Baseline: 1,76 (±0,55) 15 days: 1,35 (±0,56) 30 days: 0,89 (±0,38)
Faria & others	Plaque index Gingival bleeding index	Baseline, 7 days follow-up	Gingival Bleeding Index: WHO Probe 621mm Plaque Index: Bonded Bracket Index (Ciancio, 1985)	GBI Baseline: 40,00 (Not available) 7 days: 30,56 (Not available)	PI Baseline: 0,95 (Not available) 7 days: 0,70 (Not available)	GBI Baseline: 35,00 (Not available) 7 days: 25,00 (Not available)	PI Baseline: 1,35 (Not available) 7 days: 1,15 (Not available)
Menon & others	Modified gingival index	Baseline, 7 days follow-up	Modified gingival index (Lobene, 1986)	Baseline: 1,62 (±0,30) 7 days: 2,09 (±0,38)		Baseline: 1,66 (±0,24) 7 days: 2,18 (±0,28)	
Puri & others	Plaque index Gingival bleeding index	Baseline, 7 days follow-up	Gingival index (Loe and Sillness, 1963) Plaque index (Sillness and Loe, 1964)	GBI Baseline: 0,96 (±0,06) 7 days: 0,76 (±0,09)	PI Baseline: 0,87 (±0,06) 7 days: 0,72 (±0,16)	GBI Baseline: 0,87 (±0,10) 7 days: 0,71 (±0,14)	PI Baseline: 0,87 (±0,12) 7 days: 0,64 (±0,16)
Javid & others	Clinical attachment loss;	Baseline and 8 weeks follow-up	UNC-15mm millimeter probe	PD	CAL	PD	CAL

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			evaluating six sites per tooth	Baseline: 4,85 (±1,01)	Baseline: 3,00 (±0,70)	Baseline: 4,45 (±1,16)	Baseline: 3,04 (±0,86)
	Bleeding on probing;			8 weeks: 4,66 (±0,91)	8 weeks: 2,85 (±0,72)	8 weeks: 4,42 (±1,39)	8 weeks: 2,47 (±0,60)
	Pocket depth;						
	Plaque index						
Mahyari & others	Gingival Bleeding Index;	Baseline, 7, 14 days follow-up	Gingival Bleeding Index (Saxton & van der Ouderaa)	GBI	PI MGI	GBI	PI MGI
	Plaque Index;			Baseline: 1,5 (NA)	Baseline: 2,50 (NA)	Baseline: 2 (NA)	Baseline: 3 (NA)
	Modified Gingival Index		Turesky modified plaque index of the Quigley-Hein Plaque Index	7 days: 0 (NA)	7 days: 1 (NA)	7 days: 0 (NA)	7 days: 1 (NA)
			Gingival Bleeding Index	14 days: 0 (NA)	14 days: 0 (NA)	14 days: 0 (NA)	14 days: 0 (NA)
					Baseline: 2 (NA) 7 days: 1 (NA) 14 days: 0 (NA)		Baseline: 2,5 (NA) 7 days: 0,5 (NA) 14 days: 0 (N

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	A)
Abbreviations: UNC, University North Carolina; GBI, Gingival Bleeding Index; PI, Plaque Index; PD, Probing Depth; CAL, Clinical Attachment Loss; MGI, Modified Gingival Index; NA, Not Available.	

Table 4: Detailed Evaluation of RoB 2.0 Tool for RCT Included

Domain	Reference	Alshibani & Others	Deshpande & Others	Faria & Others	Menon & Others	Puri & Others	Javid & Others	Mahyari & Others
1. Randomization process	1.1	Y	Y	Y	Y	Y	Y	Y
	1.2	Y	Y	Y	Y	Y	Y	Y
	1.3	N	N	N	N	N	N	N
	Appraiser's Judgement	Low	Low	Low	Low	Low	Low	Low
2. Deviations from intended interventions	2.1	N	N	N	N	N	N	N
	2.2	N	N	N	N	N	N	N
	2.3	NA	NA	NA	NA	NA	NA	NA
	2.4	NA	NA	NA	NA	NA	NA	NA
	2.5	NA	NA	NA	NA	NA	NA	NA
	2.6	Y	Y	Y	Y	Y	Y	Y
	2.7	NA	NA	NA	NA	NA	NA	NA
	Appraiser's Judgement	Low	Low	Low	Low	Low	Low	Low
3. Missing outcome data	3.1	Y	Y	Y	Y	Y	Y	Y
	3.2	NA	NA	NA	NA	NA	NA	NA
	3.3	NA	NA	NA	NA	NA	NA	NA
	3.4	NA	NA	NA	NA	NA	NA	NA
	Appraiser's judgement	Low	Low	Low	Low	Low	Low	Low
4. Measurement of the outcome	4.1	N	N	N	N	N	N	N
	4.2	N	N	N	N	N	N	N
	4.3	N	N	N	N	N	N	N
	4.4	NA	NA	NA	NA	NA	NA	NA
	4.5	NA	NA	NA	NA	NA	NA	NA
	Appraiser's Judgement	Low	Low	Low	Low	Low	Low	Low
5. Selection of the reported result	5.1	NI	PY	NI	PY	NI	PY	PY
	5.2	PN	PN	PN	PN	PN	PN	PN
	5.3	PN	PN	PN	PN	PN	PN	PN
	Appraiser's Judgement	Some concerns	Low	Some concerns	Low	Some concerns	Low	Low
Overall	Appraiser's Judgement	Some concerns	Low	Some concerns	Low	Some concerns	Low	Low

Abbreviations: RCT, randomized clinical trials; Y, yes; N, no; NA, not applicable; PN, probably no; PY, probably yes.

DISCUSSION

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The results of this systematic review indicate that the use of products in different therapeutic presentations with ginger in the composition is effective in aiding the treatment of periodontal diseases as an adjunct to surgical and non-surgical periodontal therapy. Thus, the null hypothesis was rejected.

Periodontal therapy aims to treat the inflammation associated with periodontal diseases and which can also be exacerbated after treatment, requiring attention to control by the professional. The use of medications is being investigated for this purpose, especially NSAIDs such as ibuprofen, which has been shown to be effective after surgical periodontal therapy (Rashwan WAM, 2009; Gallardo FRE, Rossi E, 1990; Pearlman B *et al.*, 1997).

Two studies included in this systematic review compared the use of ginger with the use of ibuprofen (Alshibani N *et al.*, 2022; Menon P *et al.*, 2021) and showed positive and equivalent results between both, thus ginger being effective in controlling pain and inflammation after periodontal treatment, as verified for patients with osteoarthritis (Terry R *et al.,* 2011) and patients after third molar removal surgeries (Rayati F *et al*., 2017).

This anti-inflammatory action of ginger demonstrated by all studies included in this review is associated with its ability to reduce pro-inflammatory markers, including TNF-α, IL-6, IL-1B and TNF-γ, in addition to having a dual inhibition action on cyclooxygenase and lipoxygenase, inhibiting the synthesis of prostaglandins and leukotriene (Zare Javid A *et al.*, 2019; Rehman UM et al., 2019; Zhang F et al., 2017). The compounds in ginger responsible for these activities are numerous, such as curcumin, gingerols and beta-carotene (Araya-Quintanilla F *et al*., 2020; Grzanna R *et al*., 2005).

Although chlorhexidine is considered the gold standard in the mechanical removal of dental biofilm, it has adverse effects that have already been reported in the literature, in addition to having a greater effect only on the most superficial layers of dental biofilm (Filogonio CFB *et al*., 2011). Ginger in the form of mouthwash or gel is an effective alternative, as assessed by studies included in this review (Deshpande A *et al.*, 2021; Bauer Faria TR *et al.*, 2021; Mahyari S *et al.*, 2016; Puri S *et al.*, 2021).

On the other hand, this also leads to reflection on the possibility of combining the potential of the two agents with the reduction of the concentration of chlorhexidine by associating it in the same composition with essential oils such as ginger, which could minimize side effects and increase anti-inflammatory, analgesic and even antimicrobial activity (Bauer Faria TR *et al.*, 2021; Filogonio CFB *et al*., 2011).

In addition, knowing that the proliferation of pathogenic biofilm is the main causal factor of periodontal disease (Park M *et al*., 2008), although it is not exactly the objective of the present study, it is valid to state that ginger, thanks to components such as alkylated gingerols, has antimicrobial efficacy against periodontopathogenic bacteria, such as *Porphyromonas gingivalis* and *Prevotella intermedia* (Park M *et al*., 2008). This action has repercussions as an improvement in the results of periodontal

clinical parameters, such as a reduction in gingival bleeding and probing depth (Park M *et al*., 2008), which helps to explain the positive results in this systematic review.

The limitations of this study include the short follow-up period of patients evaluated in some of the included studies, which may not have been sufficient to assess the outcomes with greater certainty. The findings in this systematic review can be interpreted with a high level of confidence, mainly because they are based on randomized controlled clinical trials with a low risk of bias in most domains assessed.

As future suggestions, it is recommended to standardize the methods for assessing periodontal indices for future randomized clinical trials, as well as investing in a longer follow-up period. In addition, clinical testing of a possible formulation that combines chlorhexidine and ginger to verify efficacy for the periodontium or other oral conditions may be promising, with attention to the taste of the therapeutic ginger formulation, since this was an outcome negatively evaluated by some patients (Bauer Faria TR *et al*., 2021).

CONCLUSION

This systematic review showed that the use of ginger products after periodontal therapy demonstrated promising adjunctive effects, showing potential as an adjunct in periodontal therapy.

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