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REVIEW ARTICLE

# EXPLORING AND EVALUATING THE ORAL HEALTH BENEFITS OF OXALIS CORNICULATA

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**Abstract**

**Background:** Plaque management is critical for preventing gingival and periodontal diseases. The health benefits of Oxalis corniculata (OC) have recently gained prominence in medical research. This systematic study set out to investigate the many therapeutic effects of Oxalis corniculata on oral health, with a particular focus on its impact on gingivitis and plaque.

**Methods:** The Preferred Reporting Items for Systematic Review recommendations will be followed while conducting a systematic review. The therapeutic benefits of Oxalis corniculata in oral health will be assessed. The research studies from 2013 to 2023 will be included after retrieving from search engines utilized to identify appropriate information about Oxalis corniculata from databases like PubMed, Scopus, and Web of Science.

**Results:** The eligible randomized controlled trials (RCTs) and systematic reviews will be used for quantitative synthesis. The risk of bias assessment will be done by the Cochrane risk assessment tool and the quality of the research studies will be assessed by the critical appraisal check assessment scale (CASP).

**Conclusion:** This study will evaluate the effectiveness of Oxalis corniculata in reducing plaque and gingivitis. As a result, the new ethnomedicinal plant, Oxalis corniculata, with several therapeutic effects on oral health may be investigated.

**Trial registration:** The protocol was registered on December 30, 2023, with registration ID CRD42023495473 with the International Prospective Register of Systematic Reviews (PROSPERO). https://www.crd.york.ac.uk/prospero/#loginpage.

***Key-words:*** *Gingivitis; oral health; oxalis corniculata; plaque*

## Introduction

Oxalis corniculata is a tiny blooming plant that is frequently mistaken for a weed, commonly referred to as creeping woodsorrel or yellow wood sorrel. Although it has been used for various purposes in traditional medicine, there isn't much scientific data that directly supports its benefits for oral health. It's crucial to remember that there might not be much information available on this subject, so you should seek individual counsel from a healthcare provider.[1]

Nevertheless, some plants, including Oxalis corniculata, might contain substances that have some benefits for dental health. It has anti-inflammatory, and antimicrobial characteristics along with rich antioxidants.[2]

The anti-inflammatory properties of Oxalis corniculata aid in lowering oral cavity irritation. Bacterial growth inhibition may be aided by Oxalis corniculata's antibacterial qualities. Because there is a decreased chance of bacterial infections and plaque development, this may improve oral health. Some of Oxalis corniculata's antioxidants may be beneficial for dental health in addition to helping the body combat free radicals. If Oxalis corniculata contains a lot of antioxidants, this could help with dental health in general.[3-6]

Since traditional applications of plants aren't often backed by solid scientific research, it's critical to approach information about them with caution. Speak with a skilled herbalist or healthcare provider if you're interested in using Oxalis corniculata for potential oral health advantages. They may also be aware of any possible drug interactions or negative effects and can offer advice based on your particular health situation. Furthermore, keeping consistent dental checkups, brushing, and flossing are essential for preserving general oral health.[7-12]

Regarding the precise effects of Oxalis corniculata on the health of the gingiva and periodontal tissues, there is little scientific data. It's critical to follow accepted oral hygiene procedures and seek the counsel of medical specialists for specific recommendations. Herbal medicines should be used carefully, and their effectiveness and safety for dental health should be extensively assessed.[13-14]

The purpose of this comprehensive study was to explore the several medicinal benefits of Oxalis corniculata for oral health, including its specific effects on plaque and gingivitis.

## Methods

### *Study design and setting*

This systematic review aimed to explore the many therapeutic effects of Oxalis corniculata on oral health, with a particular focus on gingivitis and plaque. It followed the PRISMA (Preferred Reporting Items for Systematic Research and Meta-Analysis) standards. The Kappa value of 0.75 suggested a high degree of inter-observer agreement. In PubMed, the Boolean operator AND/OR/NOT was used to limit or broaden the search to include all possible articles. ("oxalidaceae"[MeSH Terms] OR "oxalidaceae"[All Fields] OR ("oxalis"[All Fields] AND "corniculata"[All Fields]) OR "oxalis corniculata"[All Fields]) AND ("oral health"[MeSH Terms] OR ("oral"[All Fields] AND "health"[All Fields]) OR "oral health"[All Fields])

The research question in this study was "How do the therapeutic effects of Oxalis corniculata benefit oral health?" The PICO framework, comprising Population, Intervention, Comparison, and Outcome,

is utilized to translate this research issue.

PICO Search: Research on adults was included; I-Studies with and without intervention; C-Studies on the possible medicinal advantages of Oxalis corniculata were also included. O: Specific impacts on plaque and gingivitis were highlighted.

***Literature Search Protocol***

Two reviewers individually and independently searched for the publications. We searched pertinent publications that are included in electronic databases such as PubMed, Web of Science, and Scopus to do a focused systematic review.

***Eligibility Criteria for Study***

The controlled clinical trials assessing the various therapeutic effects of Oxalis corniculata in oral health, as well as any original research studies, case studies, and systematic reviews on the association between Oxalis corniculata and its specific effects on plaque and gingivitis, were included in this systematic review of English-language research publications. Study articles written in non-English languages, studies deviating from the review's study aims, technical notes, brief communications, editorial letters, and mini-reviews were all included.

This protocol for the study was registered with PROSPERO (the International Prospective Register of Systematic Reviews) on December 30, 2023, with registration number CRD42023495473. We generated a list of keywords based on our knowledge of the topic and previously published research. Researchers looked at the meanings of "oral health," "Oxalis corniculata," and how the plant especially affects plaque and gingivitis. The above-specified keywords were used to search the databases Scopus, Web of Science, and PubMed.

Using the Rayyan website was part of the study selection process. It won't show duplicate search results from different databases. Nominations and abstracts that are inappropriate will also not be accepted. The gathered research will be closely examined to make sure it meets the predetermined inclusion and exclusion criteria. Any bias found will be included in the qualitative synthesis (Systematic Review) when it has been detected.

## Results

***Research Identification and Selection***

Using a search method, research articles from 2013 to 2023 that are pertinent to resolving the research challenges connected to the review's aims were located for this systematic review. January 2024 was the date of the most current search. Finding the search field for Oxalis corniculata benefits in dental health was one of the plan's objectives.

The research was conducted by PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) criteria, as seen in Figure 1.

The first step in finding research was searching through PubMed, Web of Science, and Scopus, three online databases.

Two examiners finished the data extraction, and their methodology was based on publically available sources, such as journal articles and clinical trials, that provide helpful details on the procedures and findings of the included publications. The data-collecting forms were made simpler to complete by using the information to create the outlines of the tables and figures that would be included in the evaluation.

A brief search using all journals' keywords turned up 258 articles. After the first screening, only 93 publications were left for examination by the goals of the systematic review. 32 of the 93 documents that were sought to be obtained were considered relevant to the goals or standards of the review and were taken into consideration for determining eligibility. Only ten publications out of all the qualified studies provided thorough and contrasting evaluations of Oxalis corniculata's advantages for oral health (Figure 1).

In the final remarks, the research articles and reviews that are included are compiled according to their significance and the study's objectives. Table 1 enumerates the qualitative characteristics of the research publications that were considered for this systematic evaluation.

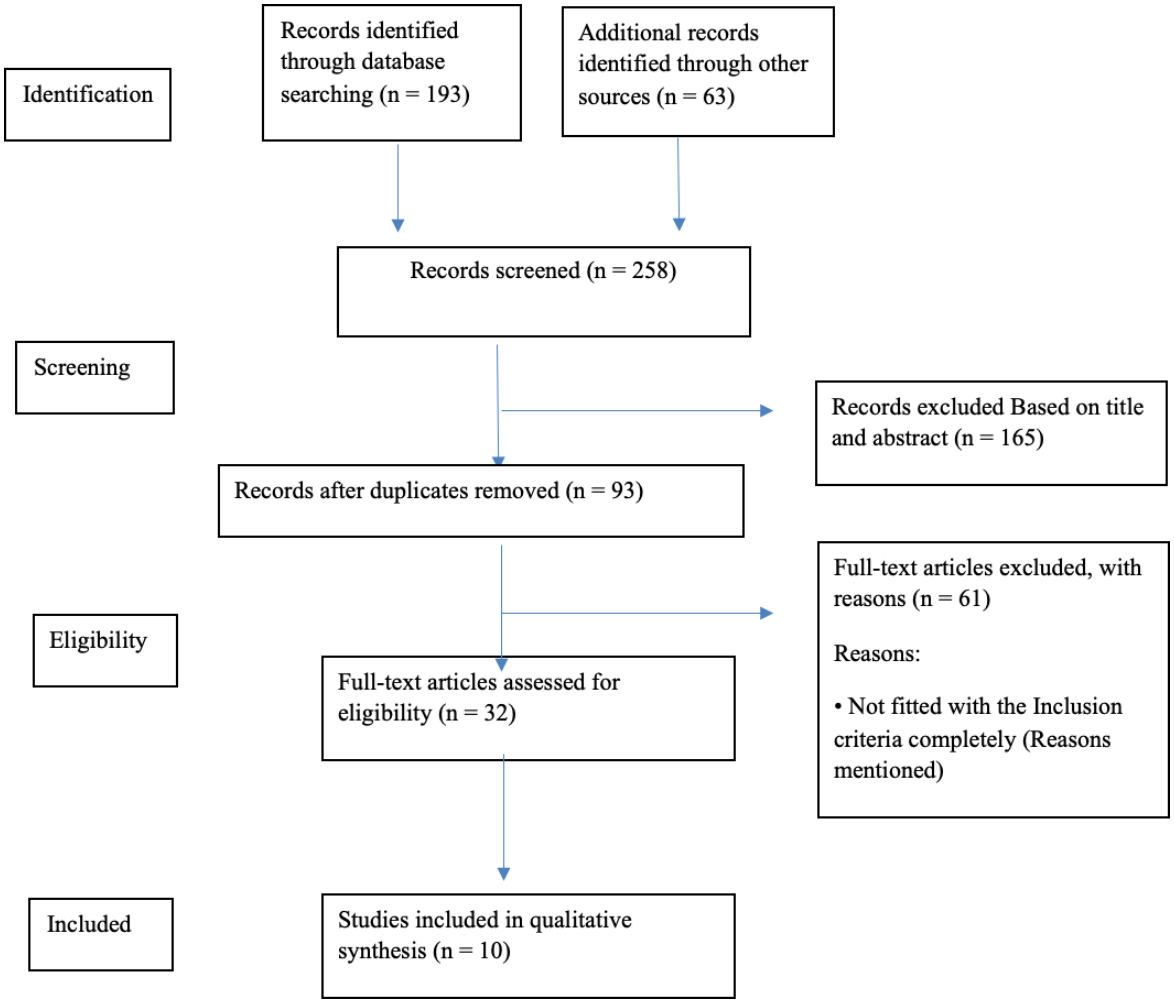


***Figure 1.*** *Demonstrates the flow diagram of the study selection process as indicated by the PRISMA (Preferred Reporting Items for Systematic Review and Meta-analysis)*

***Risk of Bias Assessment***

This systematic review used the Cochrane Risk of Bias Tool and the ROB-ME tool (Risk of Bias due to Missing Evidence in a Synthesis) to assess potential risks in the included systematic reviews and the included publications that contained randomized clinical trials, respectively. By using this risk assessment method, we were able to produce excellent papers with strong conclusions. To assess the subjective risk of bias in pertinent publications, the following standards were applied. Following participant blinding, sequence creation, allocation concealment, blinding outcome, incomplete data outcome, and selective outcome reporting, the risk was further divided into three categories. The Cochrane Risk of Bias assessment tool indicated that there were around 73.33% low-risk judgments, 16.67% equivocal judgments, and 10% high-risk judgments (Figure 2 and Figure 3).

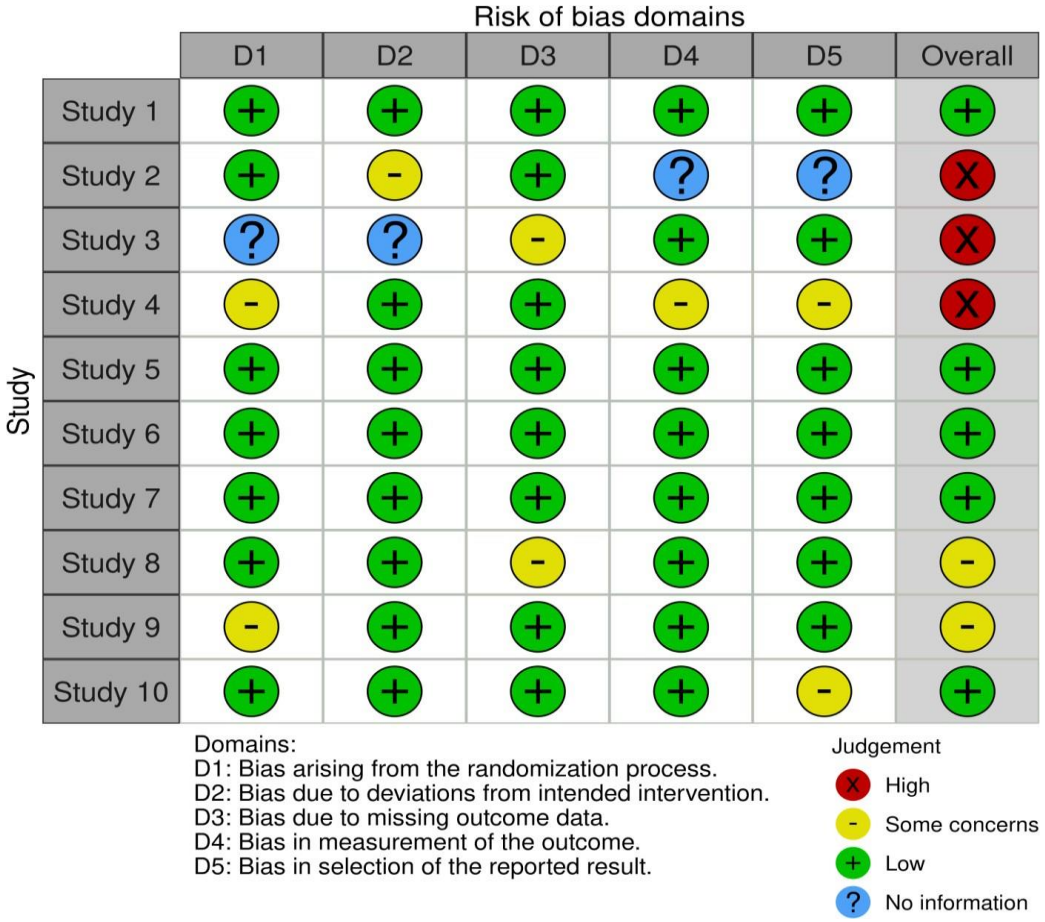


***Figure 2.*** *"Traffic light" plots of the domain-level judgments for each result*

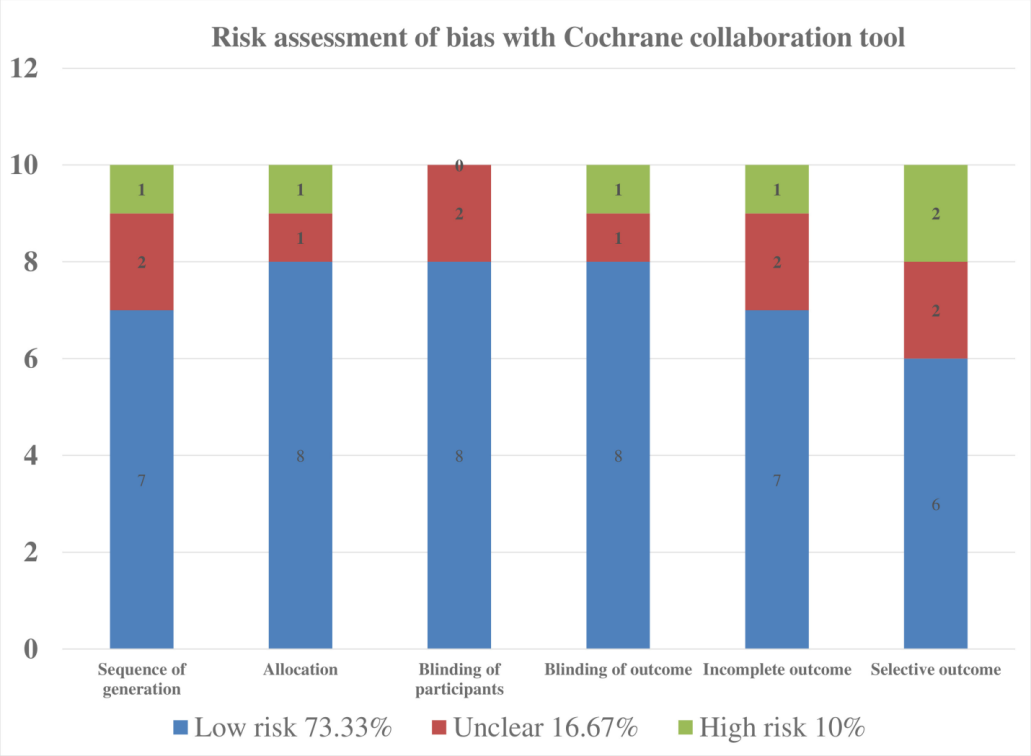


***Figure 3.*** *Weighted bar plots of the distribution of risk-of-bias judgments within each bias domain*

A collection of specialized quality evaluation tools was established by the National Heart, Lung, and Blood Institute (NHLBI) to help reviewers concentrate on ideas that are critical to a study's internal validity. An NHLBI/NIH quality assurance tool is used to evaluate the methods used to determine the benefits and drawbacks of the chosen study as well as the quality of assessments. Every included study had a "fair" quality rating (scoring from 7 to 10). Because all publications were subjected to a full-text evaluation during the selection process, which also excluded articles with lower quality ratings, papers that fell within the purview of this review but lacked a clearly defined research subject and study population were deleted (Table 1).

***Qualitative synthesis***

A qualitative synthesis was conducted on the principal findings from each of the ten research projects. Data on the study design, type of clinical trial, and number of participants, intervention, and treatment outcomes are compiled in Table 1.

***Table 1.*** *Characteristics of included studies*

| Ref. No. | Authors, Title, Journal & Year | Research Design | Sample Characteristics | Intervention | Quality assessment score | Research Significance |
|---|---|---|---|---|---|---|
| [10] | Diwan PD, Gadhikar YA, Jain SB. Traditional Ethnomedicinal plants used for oral health care by tribals of Melghat region, dist. Amravati (MS), India. Int. J. Pharm. Sci. Rev. Res. 2013 | Ethnobotanical survey | 24 plants 314 villages | Oral Health Care | 10 | The goal of the study is to raise public awareness of the possibility of using natural remedies to avoid oral health issues. |
| [11] | Srikanth M, Swetha T, Veeresh B. Phytochemistry and pharmacology of Oxalis corniculata Linn.: A review. International journal of pharmaceutical sciences and research. 2012 | A review | - | - | 7 | The necessary phytochemical and pharmacological information about the plant was provided by the review. |
| [12] | Silalahi M. Utilization of Oxalis corniculata Linn as a traditional medicine and its bioactivity. Magna Scientia Advanced Research and Reviews. 2022 | A systematic review. | - | - | 7 | O. corniculata may be used as an antimicrobial and natural preservative. |
| [13] | Mohan SM, Pandey B, Deshpande B, Chandrakar V. Antibacterial activity of plant extract of Oxalis corniculata. Indian Journal of Life Sciences. 2015 | A review | - | - | 7 | In underdeveloped nations, the utilization of medicinal plants is essential for meeting basic healthcare needs, and these plants may provide a novel supply of antiviral, antifungal, and antibacterial compounds with potent action against infectious microbes. |
| [14] | Tibuhwa DD. Oxalis corniculata L. in Tanzania: traditional use, cytotoxicity, and antimicrobial activities. Journal of Applied Biosciences. 2016 | Questionnaire survey | 125 members - | Antimicrobial activities | 10 | The study's conclusions encourage the use of traditional medicine and call for a deliberate, in-depth investigation to isolate the bioactive ingredients and scale up potential medication and nutraceutical development. |
| [15] | Swami DR, Malpathak NP. Exploring in-vivo and in-vitro Oxalis Corniculata L. for phytochemicals using a non-targeted LC-MS approach and its antioxidant capacity. International Journal of Pharmaceutical Sciences and Research. 2018 | Phytochemical investigation | 26 compounds | Non-targeted LC-MS approach | 10 | O. corniculata preparations both in vitro and in vivo demonstrated strong antioxidant capacity and free radical scavenging activities, most likely as a result of the synergistic effect of bioactive ingredients. |

| | | | | | | |
|---|---|---|---|---|---|---|
| [16] | Lubna, Asaf S, Jan R, Khan AL, Lee IJ. Complete chloroplast genome characterization of oxalis Corniculata and its comparison with related species from the family Oxalidaceae. Plants. 2020 | Genome sequence analysis | 131 genes were compared | Chloroplast Genome Characterization | 10 | The entire genome of O. corniculata, which was sequenced for this study, is a useful tool for analyzing population dynamics and evolutionary genetics in the Oxalidaceae family and can be used to distinguish closely related species. |
| [17] | Tibuhwa DD. Antioxidant potentialities and Antiradical Activities of Oxalis corniculata Linn from Tanzania. Journal of Applied Biosciences. 2017 | Phytochemical screening | - | Antioxidant potentialities | 9 | The findings suggested that Oxalis corniculata may be a valuable dietary source of biomolecules, which are precursors to the majority of physiologically active compounds of medical significance, and antioxidants with strong scavenging capabilities. |
| [18] | Golbarg H, Mehdipour Moghaddam MJ. Antibacterial potency of medicinal plants including Artemisia annua and Oxalis corniculata against multi-drug resistance E. coil. BioMed Research International. 2021 Jun 1;2021. | Invitro study | - | Antibacterial activity | 8 | The investigated products' antibacterial properties, which are more potent than certain antibiotics and suitable for ingestion, allow these products to be recommended as alternatives to certain antibiotics. |
| [19] | Mukherjee S, Pal S, Chakraborty R, Koley H, Dhar P. Biochemical assessment of extract from Oxalis corniculata L.: Its role in food preservation, antimicrobial and antioxidative paradigms using in situ and in vitro models. Indian Journal of Experimental Biology. 2018 | Biochemical analysis | - | Antimicrobial and antioxidative activity | 10 | The results of the investigation showed that the extract from Oxalis corniculata reduces power, stops liposome peroxidation, scavenges hydroxyl radicals, and quenches free radicals of the DPPH type. |

## Discussion

There is already a variety of indigenous natural therapeutic medicines that deserve to be recognized for their contribution to bettering oral health. Oxalis corniculata, a member of the oxidaceae family, grows as a creeper in hedges. It is high in carbohydrates, fat, and protein, as well as minerals including sodium, potassium, calcium, nitrogen, and magnesium. It contains tannins, palmitic acid, linoleic and linolenic acids, glycosides, phytosterols, phenolic compounds, amino acids, proteins, flavonoids, and volatile oil in methanolic and ethanolic extracts.[15,16]

The plant has a variety of medicinal applications, including anti-diabetic, anti-microbial, anti-fungal, antiamoebic, anti-ulcer, and anti-inflammatory properties. It also possesses anti-cancer, hepatoprotective, anti-implantation, and abortifacient properties. Given these advantages, Oxalis Corniculata mouth rinse might be advocated as a method of preventing oral diseases.[17]

Oxalis corniculata and its therapeutic effects on oral health in dentistry have been proven to be strongly correlated, following a thorough systematic review and qualitative study. Significant advantages have been shown by research, particularly when studying Oxalis corniculata's effects on gingivitis and plaque. Gingival and periodontal examinations, a brief follow-up time, heterogeneous exposure, the Oral Hygiene Index Simplified (OHI-s), the Plaque Index (PI), the Gingival Index (GI), and probing pocket depths (PPD) were the main components of these research.[18,19]

To present the traditional use, cytotoxicity, and antibacterial activity of Oxalis corniculata, an indigenous plant from Tanzania, Tibuhwa DD, et al. (2016) undertook a study. With the largest inhibition zone in Gram-negative bacteria, the antibacterial activities were found to be effective against medically significant strains of both Gram-positive and Gram-negative bacteria as well as standard fungal strains. For the first time, records of Oxalis corniculata's traditional applications in treating tonsillitis, toothaches, flu, diarrhea, and antirust were made.[20]

Using LC-MS, Swami DR, et al. performed a

phytochemical analysis to determine potential constituents from in-vitro and in-vivo whole plant extract. It has identified 26 chemicals with established biological action, the primary one being embelin. O. corniculata preparations both in vitro and in vivo demonstrated strong antioxidant capacity and free radical scavenging activities, most likely as a result of the synergistic effect of bioactive ingredients.[21]

To compare O. corniculata's chloroplast genome sequence with those of other members of the Oxalidaceae family, Lubna et al. conducted a study to identify the genome's entire sequence for the first time. Comparisons of chloroplast genomes showed that O. corniculata and O. drummondii had a high degree of sequence similarity overall, although the intergenic spacers of adjacent Oxalidaceae species showed some divergence.[22]

To give the necessary antioxidant potentialities of the native Tanzanian plant Oxalis corniculata Linn (creeping wood sorrel) and the related precursors of biochemical components accountable for its folklore pharmacological justifications, Tibuhwa DD (2017) undertook a study. The findings suggested that Oxalis corniculata may be a valuable dietary source of biomolecules, which are precursors to the majority of physiologically active compounds of medical significance, and antioxidants with strong scavenging capabilities.[23]

In Golbarg H, et al.'s work from 2021, the antibacterial activity of two medicinal plants—Oxalis corniculata (EtOc, AqOc) and Artemisia annua (EtAa, AqAa)—as well as the essential oil (EoAa) of A. annua was examined about multi-drug resistant (MDR) E. coli. The study's findings showed that the investigated products' antibacterial properties made them suitable substitutes for certain antibiotics and food preservatives in the fight against MDR E. Coli.[24]

In a 2018 study, Mukherjee S. et al. examined the biochemical evaluations and bioactivity of a flavonoid-rich methanolic extract from the creeping woodsorrel leaf, Oxalis corniculata L., against a few common pathogenic bacteria. The study's findings demonstrated that Oxalis corniculata extract lowers power, inhibits liposome peroxidation, scavenges hydroxyl radicals, and quenches DPPH free radicals.[25]

This study's limitation stemmed from the inability to do a meta-analysis of the effect of Oxalis corniculata on oral health since there weren't enough papers published in reputable publications. The study's findings emphasize the vital requirement of raising awareness on Oxalis corniculata and its therapeutic benefits in oral health; with a focus on the effect on plaque and gingivitis is required to ensure the effectiveness of Oxalis corniculata on overall oral health.

***Future implications***

In light of the drawbacks associated with chemical mouth rinses, herbal-based anti-plaque remedies have emerged in recent years. Asians have come to trust herbs because they were first used as a key source of healing during the times of Charaka and Sushruta. For a very long time, people have used turmeric, Triphala, neem, honey, ajwain, and other naturally occurring herbs as effective and safe antibacterial agents, either by themselves or in combination. There are several medicinal applications for the Oxalis corniculata plant. Because of these advantages, Oxalis corniculata may be used to stop oral conditions including gingivitis and dental caries.

## Conclusion

Based on an updated qualitative systematic review, the therapeutic benefits of Oxalis corniculata on oral health were determined. More reliable longitudinal studies need to explore the benefits of its use in dentistry.

## Declarations

***Conflicts of interest and financial disclosures***

The author declares that he has no conflict percent and there was no external source of funding for the research in question.

***Ethical approval***

The study was approved by the University ethics committee and was conducted in accordance with the Declaration of the World Medical Association.

***Informed consent***

Informed consent was obtained from all individual participants included in the study.

***Source of funding***

The work was not funded.

***Author contribution***

Conceptualization MKP; PG; methodology, AB; SS; MKP; software, PG; and MKP; formal analysis, AB and SS; investigation, MKP; and AB; data curation, AB; and SS; writing—original draft preparation, SH, DR; M.C.; G.M.; writing—review and editing, DR; MC.; G.M.; supervision, GM; funding acquisition, SH; administration: SH. All authors have read and agreed to the published version of the manuscript.

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