Systematic Review on Effectiveness of Zinc Chloride in the Treatment of Halitosis

Vaishnavi Padmanabhan[1], Lubna Fathima[2], Bharathwaj[3], Raj Mohan[4], Sunayana Manipal[4], Prabu D.[5]

[1]Under Graduate Student (Bachelor of Dental Surgery), [2]Post Graduate Student (Master of Dental Surgery), [3]Master of Dental Surgery, Senior Lecturer, [4]Master of Dental Surgery, Reader, [5]Master of Dental Surgery, Professor and Head, Department of Public Health Dentistry, SRM Dental College and Hospital, Ramapuram, Chennai, India

Abstract

Background: Halitosis refers to a chronic offensive mal odour produced from body cavities, especially oral cavity. It can cause detrimental psychological effects on the patient as well as aggravate infections in the oral cavity due to increase in bacterial load. Zinc chloride provides a solution for both by providing an antibacterial property and neutralises the VSCs that cause halitosis.

Aim: To study the effectiveness of Zinc chloride in the treatment of Halitosis

Study Design: A systematic review of research articles was performed. Electronic and hand search retrieved 515 records, 436 were screened. The intervention and outcomes were assessed in the study included for systematic review.

Results: Four studies were included in this systematic review. These studies showed the antimicrobial efficacy and ability of zinc chloride to inhibit the Volatile sulphur compound (VSC) production by oral bacteria. It also showed the synergistic property of Zinc chloride when combined with other compounds.

Conclusion: Despite the effective antimicrobial property and neutralisation of Volatile sulphur compound by zinc chloride, it still is unable to directly act on the gaseous VSCs. Therefore further studies must be done to improve the efficacy of zinc chloride and to develop new formulations that will help in managing the condition in a more effective way.

Keywords: *Zinc Chloride, Halitosis, Volatile sulphur compounds, antimicrobial, Systematic review.*

Introduction

Halitosis is a chronic offensive bad odour, which originates from cavities such as mouth, nose or sinuses[1]. It often causes anxiety and embarrassment during social interactions to the person. It is caused due to the production volatile sulphur compounds which produces the malodour[2].

Halitosis is of two types: genuine and delusional. Genuine halitosis can be further classified into physiological and pathological, while delusional can be classified into pseudo halitosis and halitophobia[2].

Causes of halitosis can be broadly classified into intra oral and extra oral causes.Intra oral causes include poor oral hygiene, infections of periodontal structures and diseases of the oral mucosa. Extra oral causes include respiratory infections, malignancies of lung and nasal cavity, gastrointestinal diseases such as GERD- gastro

Corresponding Author:
Dr. Lubna Fathima
Designation: Post Graduate Student (Master of Dental Surgery), Department of Public Health Dentistry
Address: SRM Dental College and Hospital, Bharathi Salai, Ramapuram, Chennai, Tamilnadu-600089
e-mail: dr.lubnafathima@gmail.com

oesophageal reflux disorder (most common), peptic ulcer and oesophageal diverticulum. Other systemic conditions such as diabetes mellitus, kidney failure and liver cirrhosis also predispose halitosis. Drugs such as Amphetamines, Disulfuram, Nitrates and nitrites are also known to cause halitosis[3].

Management of halitosis is necessary both from a medical as well as a psychological stand-point. Thus, management can be primarily achieved by treating the cause of the condition. In case of extra oral causes, appropriate treatment is to be given for the underlying condition, wherein intra oral cause can be treated by either direct action on the bacteria or by action on the volatile sulphur compounds which lead to halitosis[4]. Treatment for halitosis can be achieved mechanically and chemically. Mechanical interventions include tongue scraping, tooth brushing, interproximal brushing and flossing. Chemical interventions include usage of mouth rinses, toothpastes and chewing gums containing Chlorhexidine, Zinc chloride and cetylpyridinium chloride[2].

Zinc salts have a wide range of dental uses. Theyare useful in controlling halitosis, preventing calculus formation and also have been proved to be anticariogenicity. They are also biocompatible in nature[4]. Studies suggest zinc chloride neutralize the VSCs and thus prevent halitosis along with its bacteriostatic nature[5]. It also shows synergistic effects when it is used along with chlorhexidine and cetylpyridinium chloride and does not stain teeth unlike chlorhexidine[6]. Thus the main objective of this systematic review is to assess the effectiveness of zinc chloride in the treatment of halitosis.

Objectives: To assess the effectiveness of Zinc chloride in the treatment of halitosis.

Material and Method

Eligibility Criteria:

Inclusion Criteria:

1. Articles based on zinc chloride as an intervention for treatment of halitosis were included.
2. Full text articles were included.
3. Studies published in English were included.
4. Publications from all years.

Exclusion Criteria:

1. Articles published in other languages.
2. Only abstracts available.
3. Unrelated articles.

Search Strategy: Literature on effectiveness of Zinc chloride in the treatment of Halitosis in databases such as PubMed, Elsevier science Direct, Cochrane, Wiley online library and Ovid Medline were taken into study for review. Literature search was conducted using the keywords Zinc chloride AND Halitosis.

Search Engines:

1. Pubmed
2. Elsevier Science Direct
3. Ovid Medline
4. Wiley Online Library
5. Cochrane

Results

The search yielded 515 articles and 436 were screened and were assessed independently. Among these articles four articles were included and studied for this systematic analysis. Figure 1 shows the flow diagram of the records that were identified, screened, assessed for eligibility, excluded and included in the review

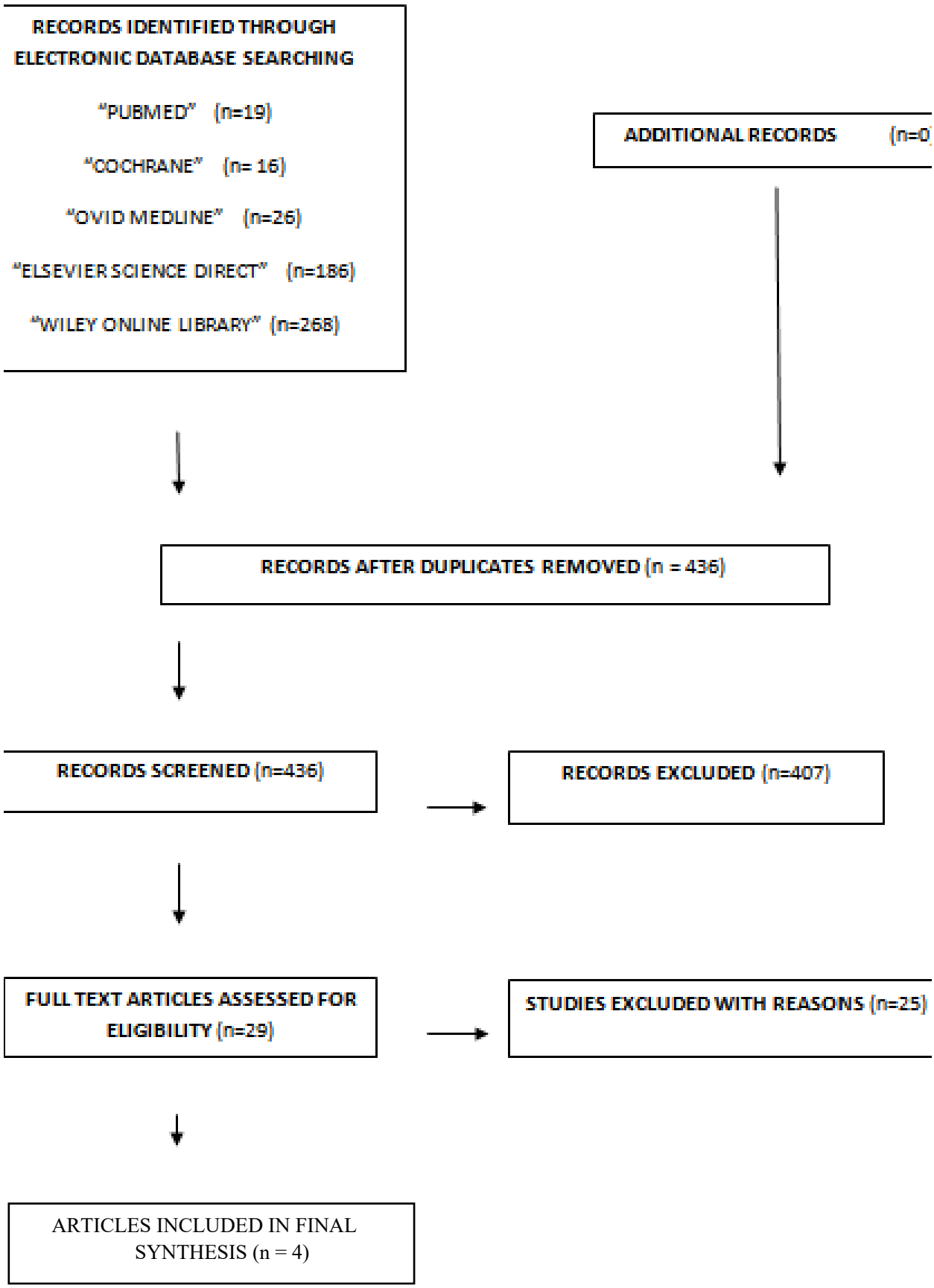

Figure 1: Flow diagram showing the number of studies identified, screened, assessed for eligibility, excluded and included in the systematic review

Table 1: Characteristics of the interventions in the included studies

S. No	Author Year	Aim of Review	Chemical Intervention Used	Substrate Used	Growth Medium and Temperature (If Bacterial Strains Used)
1.	JU-SIK KIM 2014	Ability of anti-vsc solutions to eliminate gaseous vscs by direct contact	20ml of 0.16% sodium chlorite, 0.25% zinc chloride, 0.1% chlorhexidine and distilled water	Mixed vscs, hydrogen sulphide, methyl mercaptan and Dimethyl sulphide	-
2.	ROBERT L. PIZZEY 2011	Evaluate antimicrobial effectiveness of an o-cymen-5-ol/zinc system	Zinc chloride, o-cymen-5-ol, zinc gluconate	• S.mutansnctc 10499 • S.mutans ua159 • A.viscosusnctc 10951 • F.nucleatumnctc 10562 • P.gingivali-s atcc 53978 • C.albicansncpf 3179	Blood agar;37°c; aerobically Blood agar;37°c; anaerobically Sabouraud's dextrose agar; 25°c; aerobically
3.	JEONG HYUN KANG 2015	Antimicrobial efficacy of zinc chloride and cetylpyridinium chloride on growth of bacteria which is involved in pathophysiology of halitosis and peri implant diesease	0.25% cpc, 2.5% zncl□ and 0.25% cpc and 2.5% zncl□ in combination	• F.nucleatumatcc 25586 • P.gingivalisatcc 33277 • P.intermedia atcc25611 • T.denticolaatcc 33521 • T.forsythiaatcc 43037 • S.aureusatcc 29213 • S.mutansatcc 25175	Brain heart infusion broth 37°c Modified new oral spirochete medium Tryptic soy broth
4.	JEONG HYUN KANG 2017	Investigate the antimicrobial efficacy of zncl□ and cetylpyridiniumchlorideand their inhibitrory capacity on vsc production by oral bacteria	Cpc, zncl□,cpc and zncl□ in combination	• A. actinomycetemcomitansatcc 437718 • F.nucleatumatcc 25586 • P.gingivalisatcc 33277 • P.intermediaatcc25611 • S.aureusatcc 29213 • S.mutansatcc 25175 • T.denticolaatcc 33521 • T.forsythiaatcc 43037	Brain heart infusion broth; 37°c; anaerobically Tryptic soy broth Modified new oral spirochete medium

Table 2: Outcome Data as Reported in Included Studies

S.No.	Author	Year	Outcome	Result
1.	Ju-Sik Kim	2014	Sodium Chlorite Solution Reduced The Vsc Concentration Remarkably, While Zinc Chloride And Chlorhexidine Decreased The Concentration By Approx.30%.	Results Suggest That Sodium Chlorite Solution Has Direct Action On The Vscs While The Anti-Vsc Zinc Chloride And Chlorhexidine Are More Likely Due To Their Antimicrobial Activity And Inhibition Of Vsc Production.
2.	Robert L. Pizzey	2011	Zinc Inhibited Glycolysis And Protease To A Greater Extent Than O-Cymen-5-Ol. Glycolysis Inhibition By The 2 Agents Was Additive. O-Cymen-5-Ol/Zinc Chloride Showed Greater Effects Than Placebo	The Combination System Has Direct Antimicrobial Effects And Shows Synergistic Effect Against Anaerobes, Thus Is Desirable For Toothpaste Preparations.
3.	Jeong Hyun Kang	2015	Both Zncl□ And Cpc Effectively Inhibited Bacterial Growth. Zncl□ Was Generally More Effective Than Cpc. Both Agents In Combination Showed Synergistic Effects.	Zinc And Cpc Inhibited Bacterial Growth That Causes Halitosis Effectively. The Effect Is Even More Powerful When Used In Combination.
4.	Jeong Hyun Kang	2017	Zncl□ And Cpc Effectively Inhibited Growth Of All 8 Strains. Zncl□ Was Generally More Effective.	Both Zncl□ And Cpc Provide Antibacterial Action And Directly Decreases The Bacterial Vscsproduction.

Discussion

Halitosis is a chronic offensive bad odour, which originates from cavities such as mouth, nose or sinuses[1]. Management of halitosis is crucial from both psychological and medical stand point. Management of halitosis can be achieved by 2 means: Chemical and Mechanical interventions include tongue scraping, tooth brushing, interproximal brushing and flossing. Chemical interventions include usage of mouth rinses, toothpastes and chewing gums containing Chlorhexidine, Zinc chloride and cetylpyridinium chloride[2].

In the 4 articles mentioned above, the action of zinc against oral microflora was studied so as to prove its effectiveness in the treatment of halitosis. Kang et al[6] has discussed antimicrobial efficacy of Zinc chloride and cetylpyridinium chloride on the growth of 7 different bacteria which include S.aureus, S.mutans, P.gingivalis, F.nucleatum, T.denticola and T.forsythia. This study showed that the combination of the 2 compounds were more effective than the individual compounds themselves. i.e.ZnCl□ + CPC >ZnCl□ > CPC, on all the bacteria except for P gingivalis and T denticola. Thus these two compounds together can reduce and supress he VSCs production by the bacteria when used together than we used individually.

J.-S. Kim et al[8] has studied the ability of Chlorine dioxide, Zinc chloride and Chlorhexidine solution to eliminate the gaseous VSCs by direct contact. This study showed that inspite of zinc chloride having two different mechanisms to control halitosis; by antimicrobial property and second by oxidising thiol group of amino acids on the VSCs, it still is only effective if the VSCs are dissolved into the solution or is present in a liquid medium. It has no direct on the gaseous form unlike Chlorine dioxide which has proved to be the most effective.

Pizzey et al[9] has studied the antimicrobial activity of zinc chloride, zinc gluconate and o-cymen-5-ol against S mutans, A.viscosus, P gingivalis, F.nucleatum and C albicans. This study showed that a combination system of these compounds showed a synergistic direct antimicrobial effect. Also zinc chloride inhibited glycolysis and protease to a greater degree than o-cymen-5-ol, thus indicating a potential for anticariogenicity.

J.H.Kang et al[10] has studied the antimicrobial efficacy and inhibition capacity of Zinc chloride and CPC on 8 different bacteria. This study showed that except for S.aureus and S mutans all the other bacteria produced VSCs. Also the VSCs produced by each of these bacteria were unique in nature. Zinc chloride and CPC both showed good antimicrobial activity and also showed synergistic properties when combined. But repeated ingestion of minimal quantities of zinc may lead to distress conditions such as nausea, abdominal pain and diarrhoea. This study concluded by saying that the treatment of halitosis in each patient must be individualised according to the concerned bacteria and an effective intervention must be chosen according to the bacteria which causes it.

Conclusion

Zinc chloride neutralises the VSCs in the oral cavity by both its antimicrobial action as well as by oxidising the thiol group in the VSCs. Thus it helps in both in prevention in formation of the VSCs and neutralisation of the VSCs. Even though it shows synergism when combined with compounds like Chlorhexidine, Cetylpyridinium chloride and o-cymen-5-ol, it is proved to have no direct action on gaseous VSCs unlike Chlorine dioxide. Therefore further studies must be done to improve the efficacy of zinc chloride and to develop new formulations that will help in managing the condition in a more effective way.

Conflict of Interest: No conflict of interest of any nature or kind of product, service or company presented in this article.

Source of Funding: Self

Ethical Approval: The study was approved by the institutional committee

References

1. Akaji EA, Folaranmi N, Ashiwaju O. Halitosis: a review of the literature on its prevalence, impact and control. Oral Health Prev Dent. 2014 Jan 1;12(4):297-304.
2. Kapoor U, Sharma G, Juneja M, Nagpal A. Halitosis: Current concepts on etiology, diagnosis and management. European journal of dentistry. 2016 Apr;10(2):292.
3. Scully C, Greenman J. Halitology (breath odour: aetiopathogenesis and management). Oral diseases. 2012 May;18(4):333-45.
4. Slot DE, De Geest S, van der Weijden FA, Quirynen M. Treatment of oral malodour. Medium-

term efficacy of mechanical and/or chemical agents: a systematic review. Journal of clinical periodontology. 2015 Apr;42:S303-16.

5. Almoudi MM, Hussein AS, Hassan MI, Zain NM. A systematic review on antibacterial activity of zinc against Streptococcus mutans. The Saudi dental journal. 2018 Oct 1;30(4):283-91.
6. Kang JH, Jang YJ, Kim DJ, Park JW. Antimicrobial Effectiveness of Cetylpyridinium Chloride and Zinc Chloride--Containing Mouthrinses on Bacteria of Halitosis and Peri-implant Disease. International Journal of Oral & Maxillofacial Implants. 2015 Nov 1;30(6).
7. Lourith N, Kanlayavattanakul M. Oral malodour and active ingredients for treatment. International journal of cosmetic science. 2010 Oct;32(5):321-9.
8. Kim JS, Park JW, Kim DJ, Kim YK, Lee JY. Direct effect of chlorine dioxide, zinc chloride and chlorhexidine solution on the gaseous volatile sulfur compounds. Acta OdontologicaScandinavica. 2014 Nov 1;72(8):645-50.
9. Pizzey RL, Marquis RE, Bradshaw DJ. Antimicrobial effects of o□cymen□5□ol and zinc, alone & in combination in simple solutions and toothpaste formulations. International dental journal. 2011 Aug;61:33-40.
10. Kang JH, Kim DJ, Choi BK, Park JW. Inhibition of malodorous gas formation by oral bacteria with cetylpyridinium and zinc chloride. Archives of oral biology. 2017 Dec 1;84:133-8.