COMPARATIVE STUDY OF CINNAMON OIL & CLOVE OIL ON SOME ORAL MICROBIOTA

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Summary

A comparative study was carried out between cinnamon oil & clove oil on the oral micro-biota causing dental caries. Cinnamon oil was found to be more effective than clove oil exhibiting broad spectrum of antibacterial activity inhibiting all the ten test bacterial species involved in dental caries. Cinnamon oil produced maximum inhibition zone of diameter (IZD) 24.0mm against the major causative bacteria of dental plaque i.e. *Streptococcus mutans* & *Pseudomonas sp.* The second highest inhibition zone was produced against *Halobacterium sp.* with an IZD of 21.0mm whereas clove oil produced an IZD of 13.0mm & 16.0mm only against *Streptococcus mutans* & *Pseudomonas sp.* respectively. This is contrary to the popular belief that clove oil is effective in tooth decay & dental plaque. Chlorhexidine (present in mouthwashes to prevent infection of dental caries) was used as a positive control. This study shows the potential of cinnamon oil over clove oil in the treatment of dental caries.

Keywords: Cinnamon oil, clove oil, antibacterial, oral microbiota.

Introduction

Recently there has been increased dialogue related to natural antimicrobials as topical actives & preservatives in the personal care industry. Synthetic compounds long accepted as effective in controlling microbial growth have come under scientific & regulatory scrutiny. These efforts are mainly driven by safety & environmental concerns, & the increased incidence of antibiotic resistant microbial strains. Natural alternatives derived from botanicals are therefore being explored by researchers around the world. Multi-functionality is an additional advantage of natural extracts. Several of them offer anti-inflammatory, immunological and wound healing support as well.

Microorganisms also affect dental health. Gum disease involves bacterial growth & production of metabolic substances that gradually destroy the tissue surrounding & supporting the teeth. Oral cavity pathogens include *Streptococcus mutans*, *Streptococcus salivarius, Halobacterium sp., Veilonella sp.* etc. These bacteria grow & attack the tissues causing gingivitis, characterized by inflamed gums that bleed easily. If left untreated the condition progresses to periodontal disease with severe inflammation, bone damage & tooth loss. The causative bacteria reside in plaque, the deposit that forms on the base of the teeth & hardens to form tartar.

Poor oral hygiene is the major cause of gum disease. Lifestyle, nutrition & ageing affect the immune response & increase the risk of gum disease. Antimicrobials target oral pathogens such as *Streptococcus mutans,* while anti-inflammatory & wound healing extracts offer support to healthy gums & teeth.

In the present study, we have compared the antimicrobial activity of cinnamon oil & clove oil on oral microbiota for the first time.

Materials and Methods

Materials: All chemicals used were of analytical-reagent grade and obtained from E. Merck (Mumbai, India). Readymade cinnamon & clove oil was purchased from local market of Meerut (Uttar Pradesh, India).

Bacterial Strains: Ten bacterial strains (6 Gram positive and 4 Gram negative), involved in dental caries were selected for the study. Gram positives were *Streptococcus mutans, Streptococcus salivarius*, *Lactobacillus* sp., *Bacillus* sp., *Micrococcus* sp., *Staphylococcus aureus, Halobacterium* sp., *Veilonella* sp., *Pseudomonas aeruginosa*, *Pseudomonas* sp. The bacterial stock cultures were obtained from the culture collection unit of Department of Microbiology, C.C.S University, Meerut, India. The viability tests for each isolate were carried out by resuscitating the organism in nutrient agar medium. The stock on nutrient agar medium (Hi Media, Mumbai, India) was incubated for 24h at 37°C following refrigeration storage at 4°C until required for sensitivity testing.

Determination of antimicrobial activity: Antimicrobial activity of the essential oils was evaluated by the paper disc diffusion method [1]. For determination of antibacterial activity, bacterial cultures were adjusted to 0.5 McFarland turbidity standard and inoculated onto Mueller Hinton Agar plates (diameter: 15cm). Sterile filter paper discs (diameter 6mm) impregnated with 50µL of essential oil were applied over each of the culture plates previously seeded with the 100µL of 0.5 McFarland and 10^6 CFU/mL cultures of bacteria. Bacterial cultures were then incubated at 37°C for 24h. Paper discs impregnated with 50µL of a solution of 10mg/mL of chlorhexidine (positive control) as standard antimicrobials for dental caries were used for comparison. Sterile dimethyl sulfoxide (DMSO) served as negative control. Antimicrobial activity was determined by measurement of zone of inhibition around each paper disc. For each extract three replicate trials were conducted against each organism.

Results

The antimicrobial activity as determined by paper disc diffusion method demonstrated that cinnamon oil is more effective than clove oil against the microbes causing dental caries. Table 1 shows the antimicrobial activity of cinnamon oil & clove oil on the indigenous oral microbiota that cause dental caries. The oil was effective against both Gram positive and Gram negative bacteria. However the cinnamon oil was more effective as compared to clove oil against all the test bacterial species. The highest inhibition zone was produced against *Streptococcus mutans* (main causative organism of dental caries) with an IZD of 24.0mm. Clove oil produced an IZD of only 13.0mm against *Streptococcus mutans*. Chlorhexidine, on the other hand was less effective producing an inhibition zone of diameter 14mm. Amongst the Gram negative bacteria, the cinnamon oil showed highest activity against *Pseudomonas* sp. with diameter of zone of inhibition 24.0mm while clove oil produced an IZD of 16.0mm against *Pseudomonas sp.*

Discussion

From this investigation, it was observed that cinnamon oil was more effective than clove oil & chlorhexidine against both groups of bacteria. It may possibly be due to the presence of cinnamaldehyde, an aromatic aldehyde that inhibits amino acid decarboxylase activity [2], and has been proven to be active against many pathogenic bacteria [3]. Cinnamon bark is rich in cinnamaldehyde (50.5%), which is highly electronegative. Such electro-negative compounds interfere in biological processes involving electron transfer and react with nitrogen-containing components, e.g. proteins and nucleic acids, and therefore inhibit the growth of the microorganisms.

Table 1: Zone of inhibition (mm) by test essential oils on indigenous oral

microbiota on Mueller-Hinton Agar medium

S. No.	Bacteria	Cinnamon oil	Clove oil	Positive control	Negative Control
1.	*Bacillus sp.*	**18.0**	**13.0**	**15.0**	0.0
2.	*Halobacterium sp.*	**21.0**	**15.0**	9.0	0.0
3.	*Lactobacillus sp.*	**17.0**	**19.0**	11.0	0.0
4.	*Micrococcus sp.*	**18.0**	**17.0**	10.0	0.0
5.	*Pseudomonas aeruginosa*	**18.0**	10.0	10.0	0.0
6.	*Pseudomonas sp.*	**24.0**	**16.0**	12.0	0.0
7.	*Staphylococcus aureus*	**14.0**	**16.0**	11.0	0.0
8.	*Streptococcus mutans*	**24.0**	**13.0**	14.0	0.0
9.	*Streptococcus salivarius*	**18.0**	9.0	14.0	0.0
10.	*Veilonella sp.*	**14.0**	**13.0**	15.0	0.0

Incubation temperature: 37ºC; Incubation period: 24h
Negative control- Dimethyl sulfoxide
Positive control- Chlorhexidine
Volume of oil in each well = 50µL

Cinnamon oil contains benzoic acid, benzaldehyde and cinnamic acid, of which the lipophylic moiety of these compounds has been recognized as being responsible for its antimicrobial property [4].
Also, cinnamon oil from bark contains 4.7% eugenol [5]. Members of this class are known to be either bactericidal or bacteriostatic agents, depending upon the concentration used [6]. These compounds were strongly active despite their relatively low capacity to dissolve in water, which is in agreement with published data [7-10]. Essential oil from cinnamon bark also contains cinnamyl acetate (8.7%), which increases the activity of the parent compound.

Conclusion

In conclusion, cinnamon oil was found to be a much better antagonistic agent, exhibiting broad range of antimicrobial activity against the microbes causing dental caries than clove oil and chlorhexidine. Hence, it represents an alternative source of natural antimicrobial substances for use in chemotherapeutic agents.

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