Original article

Comparative study of cinnamon oil and clove oil on some oral microbiota

Charu Gupta[1], Archana Kumari[2], Amar Prakash Garg[3], R. Catanzaro[4], F. Marotta[5]

[1] Amity Institute for Herbal Research and Studies, Amity University, Noida, India; [2] Department of Biology, Faculty of Science, Ankara University, Ankara, Turkey; [3] Department of Microbiology, C.C.S university, India; [4] Gastroenterology Unit, Dept. of Internal Medicine, University of Catania, Italy; [5] ReGenera Research Group for Aging Intervention, Milan, Italy

Abstract. A comparative study was carried out between cinnamon oil and 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) of 24.0 mm against *Streptococcus mutans* (major causative bacteria of dental plaque) as compared to clove oil (IZD = 13.0mm). This is contrary to the popular belief that clove oil is effective in tooth decay and dental plaque. This study shows the potential of cinnamon oil over clove oil in the treatment of dental caries. (www.actabiomedica.it)

Key words: cinnamon oil, clove oil, antibacterial, oral microbiota

Introduction

Recently there has been increased dialogue related to natural antimicrobials as topical actives and preservatives in the personal care industry. Synthetic compounds long accepted as effective in controlling microbial growth have come under scientific and regulatory scrutiny. These efforts are mainly driven by safety and environmental concerns, and 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 and production of metabolic substances that gradually destroy the tissue surrounding and supporting the teeth. Oral cavity pathogens include *Streptococcus mutans*, *Streptococcus salivarius, Halobacterium sp., Veilonella sp.* etc. These bacteria grow and attack the tissues causing gingivitis, characterized by inflamed gums that bleed easily. The causative bacteria reside in plaque, the deposit that forms on the base of the teeth and hardens to form tartar. Poor oral hygiene is the major cause of gum disease. Lifestyle, nutrition and ageing affect the immune response and increase the risk of gum disease.

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

Materials and Methods

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

Bacterial Strains

Ten bacterial strains (6 Gram positive *Streptococcus mutans, Streptococcus salivarius*, *Lactobacillus* sp., *Bacillus* sp., *Micrococcus* sp., *Staphylococcus aureus*) and 4

Gram negative (*Halobacterium* sp., *Veilonella* sp., *Pseudomonas aeruginosa*, *Pseudomonas* sp), involved in dental caries were selected for the study. The bacterial stock cultures were obtained from the culture collection unit of Department of Microbiology, C.C.S University, Meerut, India. The stock on nutrient agar medium (Hi Media, Mumbai, India) was incubated for 24 h 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 (Aida *et al.,* 2001). Paper discs impregnated with 50 μL of a solution of 10 mg/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

Table 1 shows the antimicrobial activity of cinnamon oil and 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 24.0 mm. The second highest inhibition zone was produced against *Halobacterium sp.* with an IZD of 21.0 mm. Clove oil produced an IZD of only 13.0 mm against *Streptococcus mutans*. Chlorhexidine, on the other hand was less effective producing an inhibition zone of diameter 14 mm. Amongst the Gram negative bacteria, the cinnamon oil showed highest activity against *Pseudomonas* sp. with an IZD of 24.0 mm 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 and chlorhexidine against both groups of bacteria. It is due to the presence of cinnamaldehyde (highly electronegative), an aromatic aldehyde that inhibits amino acid decarboxylase activity (Wendakoon and Sakaguchi, 1995). 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. Cinnamon oil also contains benzoic acid, benzaldehyde and cinnamic acid, these has been recognized for their antimicrobial property (Ramos-Nino et al., 1996). Also, cinnamon oil from bark contains 4.7% eugenol (Ranasinghe et al., 2002). Members of this class are known to be either bactericidal or bacteriostatic agents, depending

Table 1. Zone of inhibition (mm) by test essential oils on indigenous oral microbiota on Mueller-Hinton Agar medium (Incubation temp.: 37°C; period: 24 h; Volume of oil in each well = 50 μL)

S. No.	Bacteria	Cinnamon oil	Clove oil	Chlorhexidine (+ve C)	DMSO (-ve C)
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

upon the concentration used (Pelczar et al., 1988). 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.

References

1. Aida P, Rosa V, Blamea F, Tomas A, Salvador C. Paraguyan plants used in traditional medicine. Short communicaton. *J Ethnopharm* 2001; 16: 93-8.
2. Pelczar ML, Chan ECS, Krieg NR. Control of microorganisms, the control of microorganisms by physical agents. In: Microbiology, New York: Mc Graw-Hill International, 1988, 469-509.
3. Ramos-Nino ME Cliford MN, Adams MR. Quantitative structure activity relationship for the effect of benzoic acid, cinnamic acids and benzaldehydes on *Listeria monocytogenes.* J Appl Microbiol 1996; 80: 303-10.
4. Ranasinghe L, Jayawardena B, Abeywickrama K . Fungicidal activity of essential oils of *Cinnamomum zeylanicum* (L.) and *Syzygium aromaticum* (L.) Merr et L.M. Perry against crown rot and anthracnose pathogens isolated from banana. *Letters in Appl Microbiol* 2002; 35: 208-11.
5. Wendakoon CN, Sakaguchi M. Inhibition of amino acid decarboxylase activity of *Enterobacter aerogenes* by active components of spices. *J Food Prot* 1995; 58: 280-283.

Accepted: October 4th 2011
Correspondence: Dr. Archana Kumari,
INRS Eau, Terre et Environnement,
490, rue de la Couronne, Sainte-Foy,
PQ, Canada G1K 9A9
E-mail: archanamicro@gmail.com