A comparison of the antibacterial effects of Camphor-Mono-Chloro-Phenol and Carbamide Peroxide.

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Abstract:

Purpose: Camphor-Mono-Chloro-Phenol (CMCP) is routinely used in root canals of infected teeth as an antibacterial agent, while Carbamide Peroxide (CP) is usually used as a bleach. In this study, their antibacterial effects have been compared in vitro.

Methods: Six bacterial species (2 facultative anaerobes, 1 microaerophile, 3 strict anaerobes) were isolated from infected root canals and saliva. They were inoculated into Peptone Yeast Extract Glucose Broth which contained 10^2, $8.4x10^2$, $5.4x10^3$, $1.2x10^4$, 10^5, $2x10^5$ µg/ml of CMCP or CP. After 4 days of incubation, the optic densities of the broths were determined.

Results: In particular, CMCP aided anaerobic bacterial growth when at a critical concentration (≈840 µg/ml) while CP fully inhibited the same bacteria when it exceeded $12x10^3$ µg/ml.

Conclusion: CP irrigation of canals should be done during routine root canal treatment of teeth.

Keywords: Camphor-Mono-Chloro-Phenol, Carbamide Peroxide, endodontics, root canal treatment.

Introduction:

Camphor-Mono-Chloro-Phenol (CMCP) is a phenol derivative and is widely used in root canal treatments as an antiseptic agent. It is made up of a combination of 60% chloro-phenol, 40% camphor, and 6% menthol. Even a minimal amount of CMCP is capable of killing many bacteria but only after several days of vaporization. The antibacterial effect is mostly due to the protein binding of phenol and from the release of chlor gas which is highly penetrable into dentinal tubes.[1] Today, 1-5% solutions are preferred as an antiseptic in endodontics because higher concentrations of this group of disinfectants irritate periapical tissues.[2]

On the other hand, carbamide is a synonym for urea.[3] Derivates of carbamic acid ($NH_2.CO.OH$) include urea ($NH_2.CO.NH_2$). They are used as antimicrobial and antifungal agents in thiocarbamic acid ($R_2N.CS.OH$) (e.g. tolnaftate) and dithiocarbamate derivates ($R_2N.CS.SH$) (e.g. benomyl). Oxygenized carbamides are capable of emitting oxygen over a long period of time. They are currently used in dentistry as a bleaching agent at a concentration of 16%. Besides this, gly-oxide which contains carbamide-peroxide and unhydrated glycerol is also used in root canals but infrequently. It has a minimal toxic effect on periapical and gingival tissues.

The oxygen releasing property of carbamide peroxide led us to consider whether or not it may have a greater antimicrobic effect on specific anaerobes than it does on facultative anaerobes. Anaerobes are very sensitive to oxygen and are the most dominant flora in infected root canals.

This article reports a comparation between antimicrobic actions of CMCP and carbamide peroxide (CP) on root canal pathogens.

Materials and methods:

Two bacterial specimens (*Staphylococcus epidermidis* and *Lactobacillus casei*) were isolated from saliva samples. Four bacterial specimens (*Prevotella intermedia*, *Actinomyces israelii*, *Capnocytophaga ochracea* and *Eikenella corrodens*) were isolated from infected root canals using the paper-point method. They were identified according to the Gram stain, indole reaction, fluorescence, pigmentation, hemolysis and carbohydrate fermentation profile.[4,5,6,7,8]

Two out of six (*S. epidermidis, E. corrodens*) were facultative anaerobic; one (*L. casei*), microaerophilic; and three (*P. intermedia, A. israelii, C. ochracea*), anaerobic. Freshly prepared PYG (Peptone-Yeast-extract-Glucose) broth was used in this study. PYG broth contains trypticase 5 g, peptone 5 g, yeast extract 10 g, glucose 5 g, hemin 5 mg, Vit K_1 1 ml (%1 ethanol solution), and *L*-cystine 400 mg.

Each of the six bacterial specimens were adjusted to a turbidity of Mc Farland 0.5 and inoculated into 3 series of PYG broths (each of 8 ml). The first inoculums contained 10^2, $8.4x10^2$, $5.4x10^3$, $1.2x10^4$, 10^5, $2x10^5$ µg/ml of CMCP (Asit Fenik, Güler Kimya, Türkiye). The second inoculums contained CP (Carbamide-Peroxide, Vella, Istanbul) at the same concentration of CMCP, while their controls contained neither CMCP nor CP. They were incubated at 37 °C for 4 days. The spectrophotometer (Spectronic 20D, Bausch&Lombs, USA) was calibrated according to the optic density (OD) of the inoculated and uninoculated broths which was 0 and 100, respectively. Then, OD values of all tubes were read at approximately 512 nm.

Results:

The OD values of the broths correlated well with the bacterial growth. If any OD value was negative, we considered that the concentration of the CMCP or CP enhanced the bacterial growth. The OD values are shown Fig 1. for each of 6 bacterial specimens.

Each concentration of CMCP affected all facultative bacteria, but not all of anaerobes. *L. casei* and *A. israelii* were less affected by CMCP , and *E. corrodens* was more sensitive to CMCP than the other bacterial specimens were. Bacterial growth of anaerobic specimens was enhanced by CMCP, but only at a concentration close to 840 µg/ml.

CP fully inhibited all specimens when its concentration exceeded $1.2x10^4$ µg/ml. There was no significant difference between the antibacterial effects of CMCP and CP on facultative anaerobic bacterial specimens. CP less inhibited *A. israelii* somewhat at 840 µg/ml, but did not contribute to the growth. Mostly, CP was found to be more potent for specific anaerobic specimens.

Discussion:

Anaerobic conditions are easy established in necrotic pulp tissue or a closed pulp chamber because of low oxygen tension, low reduction potential, lack of blood circulation and presence of putrifiable proteins i.e.. Thus, anaerobic bacteria are usually dominant (90%) in infected root canals.[9] For this reason, this group of bacteria must be the major target of root canal treatment rather than facultative anaerobic bacteria.

In the literature, there are many excellent investigations which demonstrated the antibacterial effect of CMCP but these were done on bacteria little related to root canal infection. They mostly used *Staphylococci*, *Streptococci*, *Neisseria*, *Enterobacteria* or other facultative anaerobic bacteria in their studies.[1,10] However, in recent years, it has been found that these bacteria may not be true root canal pathogens even though they are present in oral cavity.[9] For this reason, anaerobic bacteria were included in this study. Each of the bacterial species, except for *S. epidermidis*, is a true root canal pathogen. *S. epidermidis* was included in this study in order to make a definite comparison.

Proteins bound by phenol derivates can be reused as an energy source by some anaerobic-proteolytic bacteria (e.g., *Peptostreptococci* and *Wolinella spp.*).[7,8,9] This suggests that the protein binding specifity of phenols is reversible. Although, it has been shown that CMCP can inhibit a significant percentage of oral bacteria[1,10], well-known root canal pathogens were not tested.

As shown in Fig.1, CMCP contributed to growth of anaerobes but only in a critical concentration. Already, phenols are currently used in selective media for anaerobes. It is well known that, PEA (Phenyl-Ethyl-alcohol-Agar) contains 1 g of phenol derivative per liter (10^3 µg/ml).[7] This medium inhibits many bacteria except Gram-negative anaerobic rods.[7,8] Both *P. intermedia* and *C. ochracea* are Gram-negative anaerobic rods. The growth of both were enhanced by CMCP at a concentration of 840 µg/ml. Even though, CMCP kills some bacteria, it seems to be

favorable for anaerobic ecology. This result supports that the phenol concentration present in PEA medium was suitable.

When CMCP is introduced into the main canals of teeth, the critical concentration supporting anaerobic bacterial growth is established in any area of the dentinal tubes. However, CP in root canals may not have only an antibacterial effect, but also may be an antiecological intervention unfavorable to root canal pathogens, because, oxygen released from CP penetrates into dentinal tubes. CP can inactivate bacterial endotoxins[11], and also, CP can aid in the cleaning of smear layers while CMCP can not.[12]

A shift in root canal ecology by CP has more permanent results than that of temporary killing by CMCP, because fluid transport and bacterial penetration along root canals are usually possible even after they have been obstructed under laboratory conditions.[13]

These findings suggest that CP irrigation of canal walls are useful in routine root canal treatments.

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Fig 1

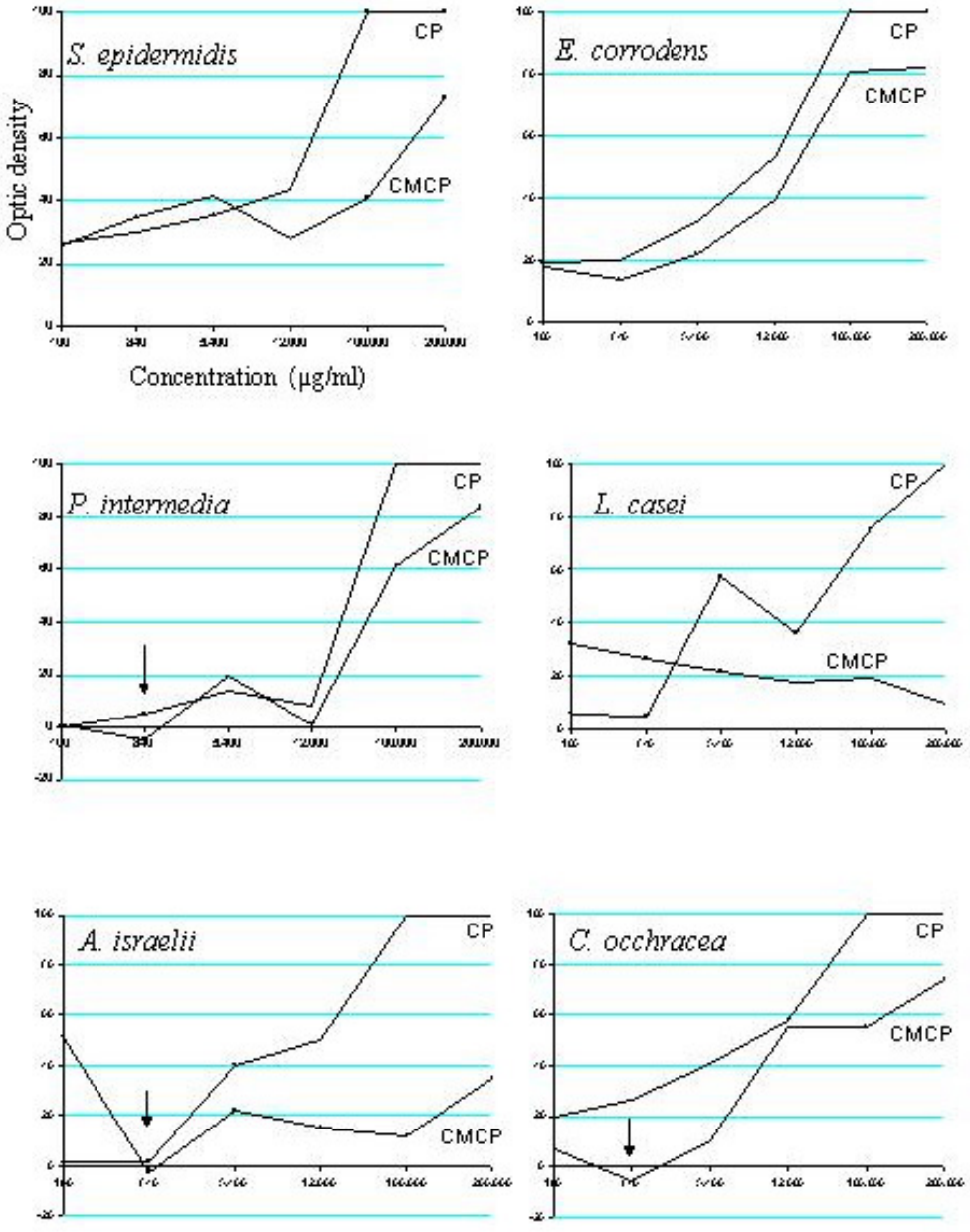
S. epidermidis
CP
CMCP
Optic density
Concentration (µg/ml)
E. corrodens
CP
CMCP
P. intermedia
CP
CMCP
L. casei
CP
CMCP
A. israelii
CP
CMCP
C. occhracea
CP
CMCP

Fig.1 The inhibitory effects of various concentration of Camphor-Mono-Chloro-Phenol (CMCP) and Carbamide Peroxide (CP) on six bacterial specimens. CMCP contributed anaerobic bacterial growth at 840 µg/ml (arrows). (*P. intermedia, A. israelii* and *C. ochracea* are anaerobic)

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