

# A Safe, Effective Germicide-Deodorizer

## For Removable Appliances

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Germicidal agents marketed for dentures kill microorganisms and deodorize. However, the cytotoxicity of these preparations precludes their use for applications in which residual chemicals may come into contact with tissue. All of these preparations carry the warning to keep them away from children. Ethyl alcohol is an excellent germicide, but only at high concentrations. Thirty percent ethyl alcohol failed to kill *Staphylococcus aureus* (Harrington and Walker) and *Streptococcus pyogenes* (Morton) in one hour. A product containing more than 30 percent alcohol would be especially inappropriate for children or teenagers. An acceptable germicide-deodorizer for removable orthodontic appliances must be capable of destroying a wide variety of microorganisms, must be non-toxic to children, must be esthetically pleasant, and must be relatively inexpensive. The purpose of this article is to describe a germicide that satisfies these requirements.

### Methods and Materials

Microbial species included *Streptococcus salivarius* and *Escherichia coli*. Cultures were incubated at 37°C. Liquid suspensions were prepared in Brain Heart Infusion Broth (BBL Laboratories). Titering was carried out with Brain Heart Infusion Agar onto which 0.1ml samples or dilutions of samples were spread and incubated overnight. Colony-forming units were scored.

The germicide consists of sodium benzoate, citric acid, disodium phosphate, glycerin, water, FD and C blue No. 1, FD and C yellow No.

5, sodium saccharin, and flavoring. The pH is 3.4.

To determine the power of the germicide to inhibit concentrations of bacteria, 10ml of an 18-hour culture were mixed into 90ml of the agent, and held at ambient temperature. At specific times, samples were drawn, brought to pH 7.0 with sodium hydroxide, and titered.

In trials with appliances, retainers were provided by patients aged 9 through 12. Retainers were removed from the mouth and immersed in germicide, just covering the appliance. At 15 minutes, the appliance was transferred aseptically into 200ml of broth and agitated periodically over a period of 30 minutes. After removing the appliance, the broth was incubated for 24 hours at 37°C in a candle jar.

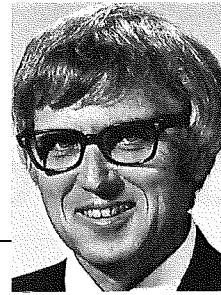
### Results

The inhibitory effect of the germicide on a gram-positive species, *Streptococcus salivarius*, and on a gram-negative species, *Escherichia coli*, was determined with three different lots of germicide. The pH of the germicide-bacterial mixture was 3.4. Inhibition by all three preparations was essentially identical. The inhibitory effect of the germicide is lethal rather than static: after 30 minutes of treatment, undiluted samples of both acidified and neutralized suspensions yielded no viable organisms. These trials also show that residual benzoic acid or benzoate ion carried over to the recovery plates does not inhibit growth. Long ago Entekin showed that benzoic acid is bactericidal and fungicidal.

The effectiveness of the germicide in clinical use was demonstrated with retainers from 10 subjects. All of the appliances had been in the mouth one hour or longer. Nine of the pa-

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tients had removed their appliances before consuming their most recent meal; during incubation of the broths that had come into contact with these germicide-treated retainers, no visible growth of microorganisms ensued. The pH of the broth was 7.2 both before and after an appliance was immersed, thus eliminating the need for additional neutralization. One patient had eaten a snack of cheese crackers just prior to the experiment. His appliance was heavily contaminated with food residue that protected microorganisms from the germicide. The broth in which this appliance had been immersed developed heavy microbial growth.

### Discussion

In the selection of a germicide for the disinfection of orthodontic appliances, two criteria were paramount: the agent must be effective against a wide variety of microorganisms, and the agent must not be toxic to humans. The Food and Drug Administration has certified that benzoic acid is an effective germicide, that it is non-toxic and non-carcinogenic. Ingested, benzoic acid combines with glycine to form hippuric acid, which is eliminated in the urine.

Benzoic acid has an optimum pH in the range of 2.5 to 4.0 (Cruess and Richert). Acidified benzoate is approximately 100 times more effective than a neutral solution, because the undissociated acid — not the benzoate ion — is the active form (Rahn and Conn).

In clinical use, the germicide will be required to destroy oral microbes in large numbers. In studies with soil, benzoic acid killed all vegetative forms present, including gram-positive spore-forming rods, gram-positive cocci, yeasts, and molds (Entrekin); this work also

demonstrated that heavy organic and inorganic contamination did not suppress germicidal activity. Our results with retainers contaminated with salivary-borne microorganisms (but not with food particles) give strong indication that exposure for 15 minutes to the germicide is an effective method to disinfect orthodontic appliances.

### Conclusions

A new germicide\* contains as its active ingredient benzoic acid, which is non-cytotoxic, non-carcinogenic, and relatively inexpensive. No alcohol or other ingredient harmful to children and teenagers is included. This preparation proved to be germicidal against both gram-positive and gram-negative bacteria. It is recommended that, for disinfection, orthodontic appliances should be immersed 15 minutes in the germicide.

\*Available from Great Lakes Orthodontics, 1550 Hertel Avenue, Buffalo, NY 14216.

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