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EDITORIAL NOTE:

Recent PERIOGRAMs seem to have stimulated more curiosity than understanding about ClO₂. Now I am asked for more details about my research on the ClO₂ toothpaste. Apparently I did make it clear that I have no association with Oxyfresh.

RESEARCH COMPLETED

The first research was with 0.1% ClO₂ solution in de-ionized water at pH 5.6. The lower the pH, the more active the ClO₂. The study showed this ClO₂ solution to have a bacterial kill equal to povidone iodine (Betadine). In this investigation, the only purpose was to determine the efficacy of ClO₂ as compared to povidone iodine.

The following table shows percent kill of a 2% povidone iodine solution on dental pathogens in ten seconds. In past issues of the PERIOGRAM we gave recommended the use of povidone iodine as a sulcular irrigant after scaling and root planing. This table will show why. This study was presented to the International Association for Dental Research, 1987.

ORGANISM Percent of Kill	Povidone - Iodine (ppm)				
	0	200	500	1000	2000
<i>P. gingivalis</i> Percent of Kill	1.2 X 10 ⁵⁺ NA	0 100%	0 100%	0 100%	0 100%
<i>P. intermedius</i> Percent of Kill	4.1 X 10 ³ NA	0 100%	0 100%	0 100%	0 100%
<i>C. ochrae</i> Percent of Kill	1.4 X 10 ⁶ NA	0 100%	0 100%	0 100%	0 100%
<i>S. mutans</i> Percent of Kill	1.8 X 10 ⁴ NA	2.4 X 10 ⁴ 0%	0 100%	0 100%	0 100%
<i>A. actino.</i> Percent of Kill	3.8 X 10 ⁴ NA	4.0 X 10 ⁴ 0%	0 100%	0 100%	0 100%

*plate count: organisms/ml surviving ten second challenge
 NA = Not applicable

RESULTS SHOWING THE BACTERICIDAL EFFECT OF CHLORINE DIOXIDE SOLUTIONS AGAINST PORPHYROMONAS GINGIVALIS, PREVOTELLA INTERMEDIUS, CAPNOCYTOHAGA OCHRAE, STREPTOCOCCUS MUTANS, AND ACTINOBACILLUS ACTINOMYCETEMCOMITANS

ORGANISM Percent of Kill	Chlorine Dioxide (ppm)				
	0	200	500 (.05%)	1000 (0.1%)	2000 (0.2%)
<i>P. gingivalis</i> Percent of Kill	1.2 X 10 ⁸ ** NA	0 100%	0 100%	0 100%	0 100%
<i>P. intermedius</i> Percent of Kill	3.9 X 10 ⁷ NA	43 99.9%	69 99.9%	0 100%	0 100%
<i>C. ochrae</i> Percent of Kill	1.2 X 10 ⁶ NA	1.1 X 10 ⁶ 7%	1.1 X 10 ⁶ 7%	8.6 X 10 ⁴ 93%	0 100%
<i>S. mutans</i> Percent of Kill	2.5 X 10 ⁶ NA	2.7 X 10 ⁶ 0%	3.0 X 10 ⁶ 0%	0 100%	0 100%
<i>A. actino.</i> Percent of Kill	2.3 X 10 ⁶ NA	0 100%	0 100%	0 100%	0 100%

*plate count: organisms/ml surviving ten second challenge

NA = Not Applicable

This looks great, but is meaningless regarding patient care. It only documents the efficacy of one compound relative to another. It is important, however, that povidone iodine is the gold standard against which efficacy comparisons are made. Betadine should not be used as a mouthwash due to risks attendant with daily increased absorption of iodine.

Because the mouth contains saliva with glycoproteins, it is essential to determine the effect of these proteins interacting with an oral rinse. Our studies showed a significant variation of protein content in saliva between individuals, the time of evaluation, before and after eating, etc.

Most people studied with stimulated saliva have enough glycoprotein in saliva to neutralize 600 to 700ppm (.06% - .07%) of ClO₂ solution. This was determined by mixing various concentrations of ClO₂ into a pooled saliva sample, then titrating the amount of ClO₂ solution required to leave some residual ClO₂ after stirring.

From this study, it was obvious that more than a .07% solution would be required if there were to be a therapeutic effect. Since a commercial product is in the marketplace at 500ppm, or .05%, it is important for the clinician to see the limitations of this formulation. Research followed using the FDA protocol wherein sheep serum is added to the culture medium to provide protein to simulate the oral environment. This has been presented in previous issues of the PERIOGRAM.

It took considerable time to develop another formulation that would be effective under these conditions. Further, toxicology questions had to be resolved to FDA standards regarding carcinogenesis, mutagenesis, iodine metabolism factors and glucose-6-phosphate dehydrogenase deficiency patients. We believe that the per day ClO₂ use by the patient, even if the rinse were swallowed, should not exceed the per day intake of that population which drinks water containing ClO₂ for purification purposes.

In vitro studies on the toothpaste have been completed. The research data is impressive. This was done with a non-foaming formulation. Most people will use the amount of generated suds as a criteria of when to stop brushing, but, of course, this is not a criterion of when the mouth is clean.

The protocol for toothpaste studies was to develop a broth inoculated with the test organism. To this is added sheep serum to simulate the oral environment. Samples are taken to determine the concentration of test organisms mixed with two parts distilled water to simulate salivary dilution. This is mixed with a magnetic stirring rod for ten seconds, at which time sodium thiosulfate is added to neutralize the ClO₂ present. Then the baseline count is compared to the count of organisms not killed during the ten second exposure.

This toothpaste experiment showed:

	Baseline (ML)	After ten seconds (ML)	Percent of Kill
S. Mutans	40,000,000	12,000	99%
Actinobacillus Actinomycetemcomitans	150,000,000	10	99+%
P. Gingivalis	15,000,000	10	99+%
Candida Albicans	1,700,000	20	99+%

One must exercise some caution. The percent kill in a laboratory experiment, even though it attempts to simulate a real life situation, may or may not be replicated in clinical trials. The *in vivo* clinical trials will test seven anaerobic organisms, three aerobic organisms, *Candida albicans*, plus evaluate if any aerobic to anaerobic shift occurs. This investigator has reason to believe that the two university based studies will be similar to our laboratory work - but, of course, only time will tell. Your author wrote the protocol and was there until the end of the study. Personally, I intend to use the toothpaste as soon as it is commercially available.

It is interesting to speculate what a good anti-microbial toothpaste could do. If it kills *S. mutans* at the 99% level *in vitro*, there might be less decay in areas of furcal exposure, exposed roots, at the margins of crowns, etc. Perhaps lesser-developed countries could use this in geographic locations lacking dental care. This could be equally true for periodontal disease.

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