

## Effects of a mouthwash with chlorine dioxide on oral malodor and salivary bacteria: a randomized placebo-controlled 7-day trial.

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### Abstract

**BACKGROUND:** Previous research has shown the oxidizing properties and microbiological efficacies of chlorine dioxide (ClO<sub>2</sub>). Its clinical efficacies on oral malodor have been evaluated and reported only in short duration trials, moreover, no clinical studies have investigated its microbiological efficacies on periodontal and malodorous bacteria. Thus, the aim of this study was to assess the inhibitory effects of a mouthwash containing ClO<sub>2</sub> used for 7 days on morning oral malodor and on salivary periodontal and malodorous bacteria.

**METHODS/DESIGN:** A randomized, double blind, crossover, placebo-controlled trial was conducted among 15 healthy male volunteers, who were divided into 2 groups. Subjects were instructed to rinse with the experimental mouthwash containing ClO<sub>2</sub> or the placebo mouthwash, without ClO<sub>2</sub>, twice per day for 7 days. After a one week washout period, each group then used the opposite mouthwash for 7 days. At baseline and after 7 days, oral malodor was evaluated with Organoleptic measurement (OM), and analyzed the concentrations of hydrogen sulfide (H<sub>2</sub>S), methyl mercaptan (CH<sub>3</sub>SH) and dimethyl sulfide «CH<sub>3</sub>»<sub>2</sub>S, the main VSCs of human oral malodor, were assessed by gas chromatography (GC). Clinical outcome variables included plaque and gingival indices, and tongue coating index. The samples of saliva were microbiologically investigated. Quantitative and qualitative analyses were performed using the polymerase chain reaction-Invader method.

**RESULTS AND DISCUSSION:** The baseline oral condition in healthy subjects in the 2 groups did not differ significantly. After rinsing with the mouthwash containing ClO<sub>2</sub> for 7 days, morning bad breath decreased as measured by the OM and reduced the concentrations of H<sub>2</sub>S, CH<sub>3</sub>SH and «CH<sub>3</sub>»<sub>2</sub>S measured by GC, were found. Moreover ClO<sub>2</sub> mouthwash used over a 7-day period appeared effective in reducing plaque, tongue coating accumulation and the counts of *Fusobacterium nucleatum* in saliva. Future research is needed to examine long-term effects, as well as effects on periodontal diseases and plaque accumulation in a well-defined sample of halitosis patients and broader population samples.

**TRIAL REGISTRATION:** ClinicalTrials.gov NCT00748943.

## **Controlled clinical evaluations of chlorine dioxide, chlorite and chlorate in man.**

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### **Abstract**

To assess the relative safety of chronically administered chlorine water disinfectants in man, a controlled study was undertaken. The clinical evaluation was conducted in the three phases common to investigational drug studies. Phase I, a rising dose tolerance investigation, examined the acute effects of progressively increasing single doses of chlorine disinfectants to normal healthy adult male volunteers. Phase II considered the impact on normal subjects of daily ingestion of the disinfectants at a concentration of 5 *mg/l.* for twelve consecutive weeks. Persons with a low level of glucose-6-phosphate dehydrogenase may be expected to be especially susceptible to oxidative stress; therefore, in Phase III, chlorite at a concentration of 5 *mg/L* was administered daily for twelve consecutive weeks to a small group of potentially at-risk glucose-6-phosphate dehydrogenase-deficient subjects. Physiological impact was assessed by evaluation of a battery of qualitative and quantitative tests. The three phases of this controlled double-blind clinical evaluation of chlorine dioxide and its potential metabolites in human male volunteer subjects were completed uneventfully. There were no obvious undesirable clinical sequelae noted by any of the participating subjects or by the observing medical team. In several cases, statistically significant trends in certain biochemical or physiological parameters were associated with treatment; however, none of these trends was judged to have physiological consequence. One cannot rule out the possibility that, over a longer treatment period, these trends might indeed achieve proportions of clinical importance. However, by the absence of detrimental physiological responses within the limits of the study, the relative safety of oral ingestion of chlorine dioxide and its metabolites, chlorite and chlorate, was demonstrated.