

# TRICLOSAN : A CONTROVERSIAL ANTIBACTERIAL

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## Abstract

**T**riclosan (5 chloro 2 (2, 4 dichlorophenoxy) phenol also known as Irgasan or Microban is a chlorinated compound which has functional groups representative of both ether and phenols. It is a potent wide spectrum antibacterial and antifungal agent. It was recently shown to target a specific bacterial fatty acid biosynthetic enzyme, enoyl[acyl carrier protein] reductase, in Gram negative and Gram positive bacteria, as well as in the Mycobacteria. Triclosan is used in many common household products including Clearsil Daily face wash, Dentyl face wash, Dentyl mouth wash, Colgate total range, Sensodyne total care etc. Reports have suggested that Triclosan reacts with the free chlorine in tap water to produce lesser compounds like 2,4 dichlorophenol which converts into Dioxins upon exposure to UV radiation and these dioxins are extremely toxic and are very potent endocrine disruptor in the North American bullfrog. However at this stage, further research may be needed before we arrive at a final conclusion.

**Key words:** Antiplaque agents, Triclosan, ENR enzyme, Dioxins.

## Introduction

Today it is generally recognized that periodontitis and caries can be prevented by the daily removal of dental plaque. However, mechanical plaque eradication requires above average motivation and skill and is more difficult for handicapped persons<sup>14</sup>. Antiplaque agents therefore, are valuable adjuncts in preventive dentistry. To date, Chlorhexidine (CHX), a bisbiguanide mouth wash is the most effective antiplaque agent; when used twice daily<sup>5</sup>. But its efficacy as a mouth wash is limited by an apparent failure to penetrate periodontal pockets<sup>4</sup> and the gel form seems even less promising<sup>2</sup>.

Recently, Triclosan, a low toxic non-ionic phenolic derivative with a wide spectrum of antimicrobial activity has been successfully incorporated into toothpastes, resulting in moderate but distinctive positive effects on both the dental biofilm and gingivitis<sup>8</sup>.

## Properties & Uses

At in-use concentrations, it acts as a biocide, however at lower concentration it appears bacteriostatic and is seen to target bacteria mainly by inhibiting fatty acid synthesis. Triclosan binds to bacterial enoyl-acyl carrier protein reductase enzyme (ENR) which is encoded by the gene *FabI*. This binding increases the enzyme's affinity for nicotinamide adenine dinucleotide (NAD<sup>+</sup>). This results in the formation of a stable ternary complex of ENR-NAD<sup>+</sup>-triclosan which is unable to participate in fatty acid synthesis. Fatty acid is necessary for reproducing and building cell membranes. Humans do not have an ENR enzyme, and thus are not affected.

Triclosan is found in soaps (0.15 -0.30%), deodorants, toothpastes, shaving creams, mouth washes, and cleaning agents and is infused in an increasing number of consumer products, such as kitchen utensils, toys, bedding, sometimes as the proprietary Microban treatment. More recently, showering or bathing with 2 % Triclosan has become a recommended regimen for the decolonization of patients whose skin is carrying methicillin resistant *Staphylococcus aureus* (MRSA)<sup>3</sup>.

## Discussion

There is evidence indicating that the ingredients in the formula of triclosan containing mouth washes, including vehicle and other active substances, may influence its antimicrobial activity, and consequently its clinical efficiency<sup>6</sup>. The use of co-polymers to improve active agent delivery is well established<sup>7</sup>. Methoxyethylene and maleic acid (Gantrez) are copolymers that have been proven to increase triclosan retention in the oral cavity, but the precise mechanism of this enhancement is still unknown<sup>11</sup>.

Some authors have reported that, when used in combination with triclosan, Gantrez clearly enhances the uptake of this antibacterial agent by teeth and soft tissues<sup>12</sup>. Rodrigues et al (1999)<sup>9</sup>

reported that the addition of Zinc citrate or Gantrez copolymer increased the bio film inhibitory activity of triclosan. This observation is supported by Singh et al (1991)<sup>13</sup> reporting that the addition of the copolymer Gantrez may potentiate the activity of triclosan in vitro. An in vitro study on biofilm formation in an experimental biofilm model observed that mouth wash containing triclosan/Gantrez provided a 31% reduction in biofilm formation when compared to a placebo solution<sup>16</sup>.

In addition to being beneficial it may also be harmful. Reports have suggested that triclosan can combine with chlorine in tap water to form Chloroform gas, which the United States Environmental Protection Agency classifies as a probable human carcinogen. Triclosan reacts with the free chlorine in tap water to also produce lesser amounts of other compounds like 2, 4-dichlorophenol<sup>10</sup>. Most of these intermediates convert into dioxins upon exposure to UV radiation (from the sun or other sources). Although small amounts of dioxins are produced, there is a great deal of concern over this effect because some dioxins are extremely toxic and are very potent endocrine disruptors.

Study by Veldhoen et al (2006)<sup>15</sup> concluded that low doses of triclosan act as an endocrine disruptor in the North American bullfrog. The hypothesis proposed that triclosan blocks the metabolism of thyroid hormone, because it chemically mimics thyroid hormone and binds to the hormone receptor sites, so that the normal hormones cannot be utilized.

Triclosan has also been found in both the bile of fish living downstream from waste processing plants and in human breast milk<sup>1</sup>.

## Conclusion

In the light of present knowledge, the control of sub gingival dental plaque would seem to have an important bearing on the successful treatment of chronic inflammatory periodontal disease. Among the chemotherapeutic agents used in mouthwashes, Chlorhexidine is usually the "gold standard" or positive control for comparison to other substances due to its proven efficiency. Triclosan, though has a number of health concern, at this stage further research may be needed before we arrive at a final conclusion.

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