RELEVANCE OF GREEN CHEMISTRY IN ORAL CARE PRODUCTS

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Abstract: A large number of individuals use personal care products (PCPs) and as a rule are unconscious that these products are causing mischief to the earth. It is of desperate significance to deal with the implications of these products having to the environment. Inferable from the way that that consumers drive the market, scientific information about the inferences of normally used ingredients, could help alleviate the related negative effects. An attempt has been made in this paper to review the destructive effects of ingredients used in oral care products. In consideration of sustainable development, the unconventional ingredients suggested by researchers and industry are evaluated with the green chemistry principles in mind. In addition, the query put forth is whether the alternatives are green. Through awareness, public sentiments could enable turn research efforts to safer and greener solutions.

IndexTerms – Oral Care Products, Triclosan, Green Chemistry, Chalcones

I. INTRODUCTION

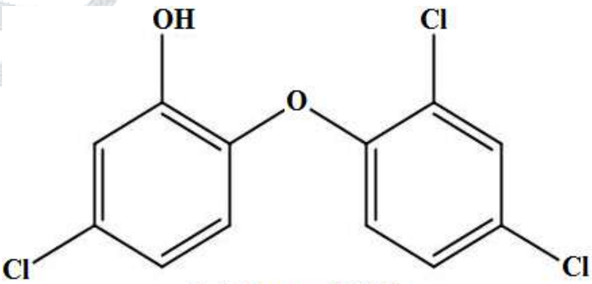
The personal care product industry is predominately determined by assorted variety and advancement since we demand it. The industry improves and manufactures cosmetics products which is defined as- "Any substance, or combination of substances, produced, sold or characterized for use in cleansing, improving or varying the complexion, skin or teeth and comprises deodorants and perfumes" (Naik, P. J. et al, 2013). Everyday considerable people use one of the personal care products (PCPs) and unconsciously expose the environment and ourselves unnecessarily to harm. Exclusion of these products completely is paradigm however terribly unrealistic. In the approaching years, consumers will probably attempt and try for products that guarantee manifold benefits (Cizmas, L. et al, 2015). It is essential to know, what the ingredients are. Moreover, are the ingredients harmful and is the manufacturer concerned with green chemistry practices.

With the pervasive use of these products, the risks caused by these to our environment require to better understand. Lots of personal care products have several synthetic chemicals substances used to attain different functions or provide a particular benefit. Studies have given confirmation that the synthetic chemicals at present used in personal care products have a threat and cause a risk to the environment. Presently, a globally overarching objective is to attain sustainable development. The most viable option for achieve sustainable development is by means of twelve principles of green chemistry (Anastas and Williamson, 1998). In conjunction with these green chemistry principles, Jessop et al (2015) recommended cost- competence and the cancer-causing nature of ingredients needs to also be considered.

An attempt has been made in this paper is to review some of the ingredients used presently in oral care products and the issues that emerge, slow down the sustainable development. Attempt has also been made to focus on ingredients used generally in oral care products and their ecological effects. Through the execution of some of the green chemistry principles, alternatives to toxic chemicals are also offered.

II. ORAL CARE PRODUCTS

The hunt for healthier teeth and gums has been never-ending and chemistry has an important role in the enhancement of overall oral health. Some of the ingredients of these oral products have confirmed to be a threat to the environment. Triclosan (TSC) is an antimicrobial disinfectant, which is commonly used as in personal care products. Also, triclosan [5-chloro-2(2, 4-dichlorophenocy) phenol; TSC] a halogenated phenol (Dann, A. B. et al, 2011), has been used in oral care products, particularly as an antibacterial in mouthwash and toothpaste (Ricart, M. et al, 2010) Furthermore, researches has demonstrated their viability in killing several types of bacteria, some fungi and are a primary player in the prevention of bacterial growth (Dann,2011 and Ricart, 2010) .

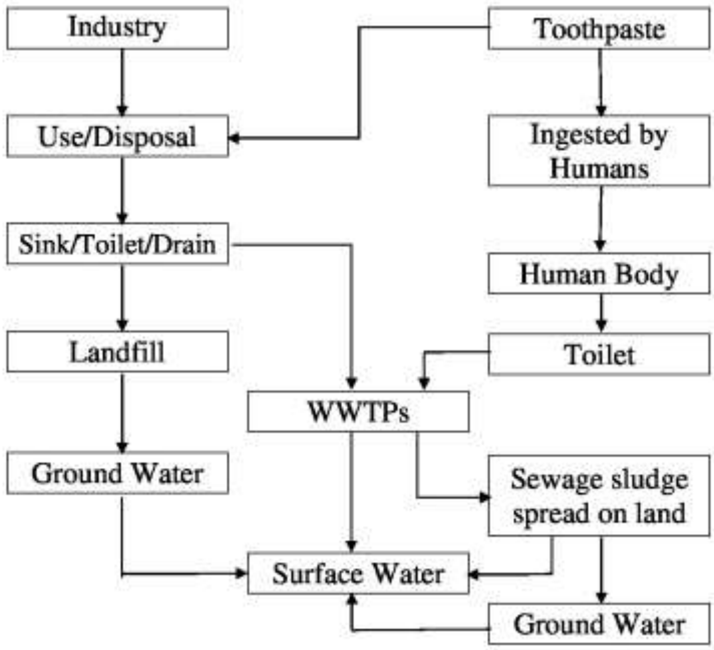


Triclosan (TSC)

Recently, studies have shown the health implications of TSC (Yueh, M. et al, 2015) including being a liver tumor promoter. Along with the health affects there is strong evidence to advocate that TSCs pretense a threat the environment. No known natural sources of TSC exist with this it can be presumed that its existence in the environment is due to human activity (Assessment, P., 2012).

III. ENVIRONMENTAL IMPACTS OF ORAL CARE PRODUCTS

Triclosan, present in toothpaste is released down the drain, discharged into sewers and carried to Waste Water Treatment Plants (WWTPs). Following figure depicts the possible pathways for release of TSC to the environment.

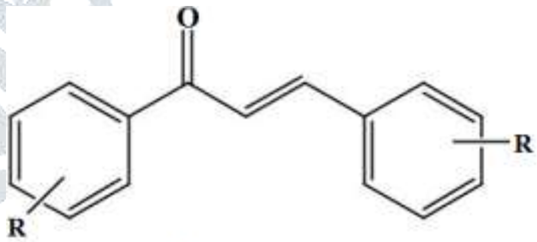


Possible pathways for releases of TSC to the environment

A variety of problems arise because of the use and existence of TCS in the environment. Furthermore, the effect of triclosan to the aquatic environment has been investigated to a great extent. The eco-toxicological analysis has revealed that triclosans are toxic to bacteria and can bio-accumulate (Ricart, M. et al, 2010). TCS is everywhere and found in diverse environmental settings (Bedoux, G. et al, 2012). With the release of TCS in WWTPs, in many cases free chlorine is also available as it is normally used all through wastewater treatments. Also, when free chlorine, which is utilized in wastewater treatment, reacts with phenol, are results in 2-chlorophenol and 4-chlorophenol as the initial products. These are further chlorinated to form 2,3-dichlorophenol and 2,6-dichlorophenol to produce 2,4,6 TCP (Fiss, E. M. et al, 2007). In addition, TCSs can react with free chlorines to give chloroform. Furthermore, it has been put forward that the complex matrix of wastewater could react with triclosan and the degree of the ecological ramifications, which are not completely comprehended.

IV. Green Alternatives

If possible, it is best to avoid the creation of waste rather than clean it up. While TCS has been revealed to be expelled from water by means of reverse osmosis, this process has its shortcomings, for example fouling (Vrouwenvelder, J. S. et al, 2008), finding out how to eradicate the requirement for water remediation is more advantageous. This should be possible by replacing TCS with an ingredient that does not persist in the environment and is naturally safer. Chalcones a flavonoid and a renewable resource has shown assurance to replace these TCS and offer antimicrobial resistance (Wallock-Richards, D. J. et al 2015). Specifically, it was appeared to slow down some strains of bacteria that TCS inhibits too, in particular, *Streptococus mutans*, and bacteria known to be a factor of human dental decay.



1,3-diphenyl-2-propen-1-one framework of flavonoid natural product, chalcone

The chalcone and TSC are alike as both of them contain aromatic rings, though, chalcone is found in nature. Chalcone synthesis can be proficient solvent-free and acquaintance to green chemistry principles. In particular, Saini et al (2005) showed that chalcones can be obtained in excessive yield and great purity by grinding piperanal and the acteophenone in the presence of solid NaOH. A general representation is as under-

$$RCOCH_3 + R'CHO \xrightarrow[\text{Grinding}]{\text{NaOH}} RCHOCH{=}CHR'$$

Synthesis of chalcones (Rateb, N. M. et al, 2009)

Furthermore, its potential to replace TSC is demonstrated, as it verified to have good activity against gram-positive and gram-negative bacteria *viz staphylococcus aureux*, *Escherichia coli*, *Steptococcus viridiaus* and *K.Salmonilla* (K. Saini, K. R. et al, 2005). In addition, Chalcones (Subramanyam, R. et al, 2012) were shown to enhance the adequacy of anti-microbrial agents to treat oral conditions such as gingivitis, and plague. In regards to the green chemistry, above reaction is a solvent free, proceeds at ambient temperature and pressure and is derived from a natural feedstock. The persistence of chalcone in the environment is not an issue anyway this perspective hasn't been completely examined.

V. Conclusion

It is evident that elimination of existing toxic substances in personal care products (PCPs) should be tended to. With the green chemistry principles viable alternatives can be found and achievement can be made. Endeavors should be focused on understanding the complete implications of the PCP ingredients as there is a lack of information regards to this. For improving the biodegradability of ingredients, the diminution of harmful synthetic substances must be done either by absolutely supplanting the toxic chemicals or by finding ways to deal with reduce the need of the risky chemicals through blending them with natural products. Last but not least, biodiversity should be considered when attempting to discover 'green' alternatives, it is important not to imperil the system.

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