

An Approach to Effective Disinfection of Salon Items [clippers, combs and scissors]

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Antibacterial susceptibility patterns of some bacteria isolated from selected barbing salons in parts of Northern Nigeria was studied for the purpose of developing a disinfectant system suitable for use in salons. The K-values for selected cells ranged from 0.0072 to 0.0399 (benzalkonium chloride), and from 0.0062 to 0.1338 (propylene glycol) as against a range of 0.0147 to 0.1343 when the two chemicals were combined. The observed D-value range of 64.5 to 99 (benzalkonium chloride), 31.5 to 105 (Propylene glycol) and 21 to 24 (admixture of the two chemicals) were exploited in the development of "SALONSAFE" – a salon disinfectant that was able to eliminate 10⁵ cfu/ ml (of the most resistant bacterial isolated in these studies) completely in 60 seconds.

Key words: Salonsafe, antibacterial, disinfectant, salon, K-value, D-value.

INTRODUCTION

In the recent past, several reports have identified resistances among pathogenic bacteria and fungi [1-6]. This may be due to the fact that antimicrobial resistant and stress-modified strains of microorganisms frequently emerge in nature [7].

Bacteria display an amazing capacity to survive in extremely hostile environment. Entire group of microorganisms have adapted their lifestyles to prefer these extreme environments (examples are thermophiles, halophytes, acidophiles). For most, the tolerance can be pushed to maximum limits if the cell is provided sufficient opportunity to sense and adapt to a deteriorating condition [8]. Inducible tolerances to temperature, salt, DNA-damaging agents and oxidative stress are widely known and well studied.

The desire to release some genetically modified microorganisms (useful as biological control agents or for degradation of pollutants in land reclamation) into the environment has caused concerns over potential environmental damages [9, 10]. This calls for measures to ensure minimum damages from such releases [11].

Very few known pathogenic microorganisms have become extinct despite worldwide efforts to eradicate them [12]. This is due mainly to their ability to perpetuate themselves and

survive in nature depending on such factors as their readiness to escape from the infected animal in life or at death, ability to survive in the environment outside the animal, their transmission to susceptible hosts and their ability to colonize and cause infection in the new hosts.

Barbing salons have been reported to harbour pathogenic microorganisms [13, 14] many of which were resistant to both antibiotics and chemical (none-antibiotic) anti microbial agents. Such observations have led to world-wide concern about the emergence of antimicrobial resistances in common pathogens of community [15].

Available evidence show that significant proportion of the populace patronize barbing salons where the barbers do not employ hygienic practices. The soaps, mixtures or even the barbers' water may be reservoirs of pathogenic microorganisms from other clients thus subjecting susceptible clients to great risks. It is therefore very essential to develop potent antimicrobial products with increased value over those currently available. Such products may be better achieved by exploiting the phenomenon of synergism between two or more antimicrobial agents [16].

In this paper, we present the report of studies leading to the formulation and compounding of a new disinfectant product based on the

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Increasing the concentration of Benzalkonium chloride, gradually, from 1×10^{-4} ug/ml to 20×10^{-4} ug/ml did not lead to significant increase in cell deaths (Figure 1), but when a sub-lethal concentration (0.0003 % w/v) Benzalkonium chloride was combined with increasing concentrations (Figure 2) or with a constant low concentration (20 % v/v) of propylene glycol (Figure 3), a significant increase in the rates of cell deaths were recorded.

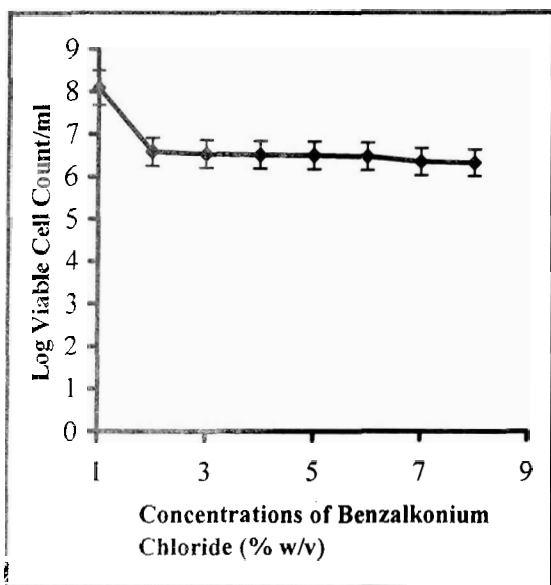


Figure 1: Effect of increasing the concentrations of bc on cell survival [*Staphylococcus aureus*]

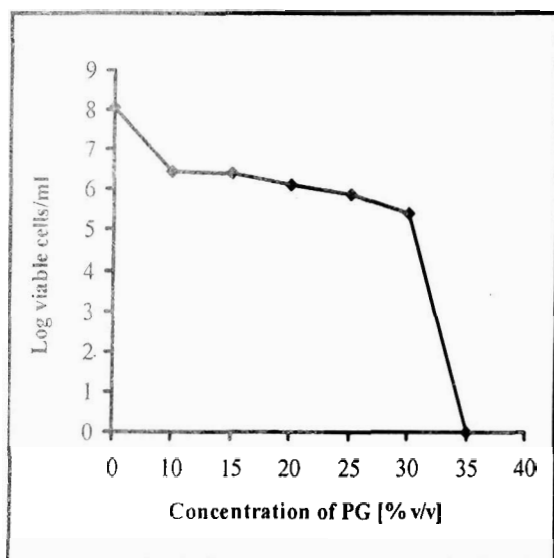


Figure 2: Effect of 0.0003 % [w/v] bc + varied Concentrations of pg on cell survival (*Staphylococcus aureus*)

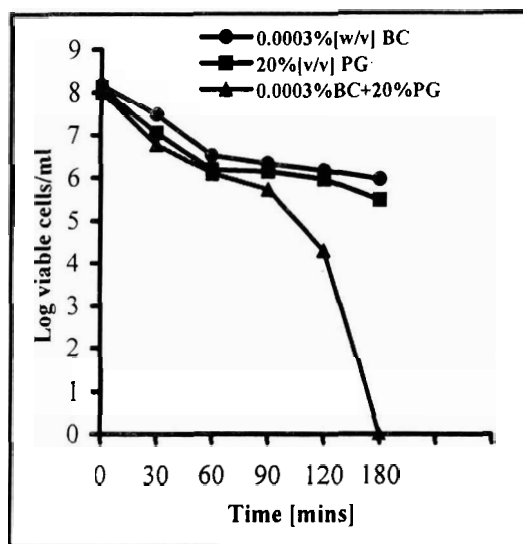


Figure 3: Effects of 0.0003 % [w/v] bc and 20 % [v/v] pg (alone and in combination) on cells survival with time (*Staphylococcus aureus*)

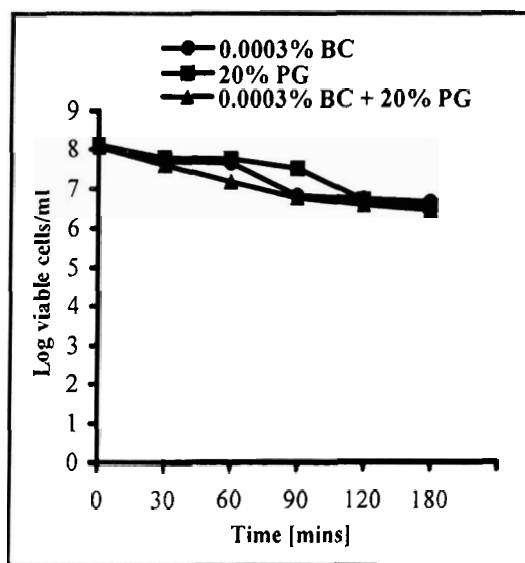


Figure 4: Effects of 0.0003 % [w/v] bc and 20 % pg (alone and in combination) on cells survival with time (*Escherichia coli*)

For example, there was a one-log cycle reduction in the population of *Staphylococcus aureus* from 81 when Benzalkonium chloride was used alone to 22.5 when combined with propylene glycol (Table 2).

The observed disparity in the responses of *E. coli* (the most resistant isolate in this investigation) may be due to the fact that the isolate could have acquired some peculiar

resistant characteristics; depending on the environment from which it originated [17] or possibly because of constant contact with sublethal doses of the antimicrobial agents in nature [18] as it is a common knowledge that these chemicals are widely used as preservatives in cosmetics and cells are liable to making contacts with them in sub-lethal doses.

Benzalkonium chloride has found extensive use as an anti-microbial agent because of its rapid bactericidal effects [19] but the ease with which microorganisms developed resistance to otherwise potent antimicrobial agents has led to a suggestion that formulations be designed to contain two or more antimicrobial agents [16].

Indeed, resistance to disinfectants based on quaternary ammonium compounds has been reported to be widespread among clinical strains of staphylococci in studies from many countries [20]. This observation justifies the need to use two or more antimicrobial agents in new formulations because of stated advantages of such practice- particularly with use of agents that are synergistic in action.

The phenomenon of synergism often enables a reduction of effective doses of chemotherapeutic agents [5], and this is believed to be brought about via three mechanisms namely increase by one agent of the permeability of cell wall and membranes to the second, inhibition of enzymes able to degrade the second agent and double blocking by the two, of components of successive steps in the metabolic sequences [21, 22].

The recovery of various bacterial species in these studies (Table 1) confirms an earlier report on the incidence of various bacterial species [13] in barbing salons. Many of these salon isolates have been found to be resistant to most chemical preservatives used in cosmetics.

These observations were built into the formulation of a disinfectant with reference name "Salonsafe" which contained benzalkonium chloride and propylene glycol as active anti-microbial constituent, citronella oil (fragrance) and iodine (colorant) in methanol vehicle-which also acted as drier. This product was challenged with 10^5 cfu/ml of the most resistant cells, which were completely killed at a short time of 60 seconds (Figure 5). This time is

by far less than the time that would be needed to prepare another client for barbing, thus limiting the risks of transferring infections among clients.

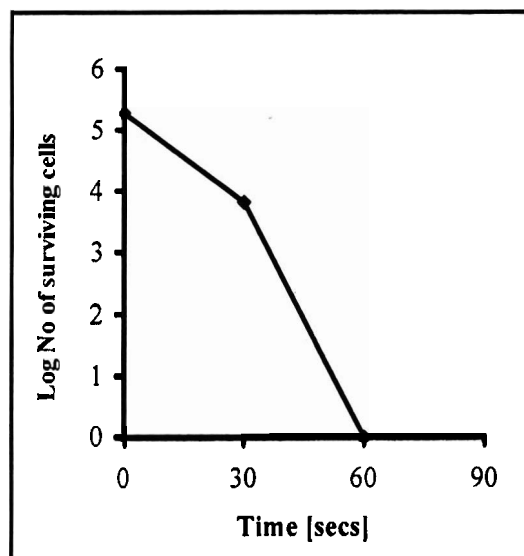


Figure 5: Log survival of *Escherichia coli* in "salonsafe"- a laboratory formulated disinfectant

It must be noted that currently, barbers "sterilize" their clippers, combs and scissors by cleaning them with methylated spirit. Studies in our laboratories have shown that this approach is ineffective. It is therefore essential to develop effective products for use as salon disinfectants.

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