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Effects of Surfactants on Microorganisms Isolated from Human Gold Jewellery

Science

KEYWORDS : Jewellery, surfactants, bacterial isolates, sanitizing potential.

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ABSTRACT

Jewellery serve as formites and easily get colonized by pathogenic and non-pathogenic microorganisms through intimate contact with the skin or clothing of the wearer thus causing skin infections and diseases which may be of public health significance. The effects of different surfactants [Ariel, Omo, Klin, Linear alkylbenzene sulfonate neutralized with sodium carbonate (LAS washing soda) and Linear alkylbenzene sulfonate neutralized with ammonium salt (LAS ammonia)] on microorganisms isolated from human gold jewellery was investigated to ascertain the best surfactant that could be employed in sanitizing the human jewellery. In this study, sixteen (16) bacterial isolates Staphylococcus albus, Staphylococcus aureus, Bacillus subtilis, Micrococcus varians, Staphylococcus epidermidis, Streptococcus pyogenes, Proteus vulgaris, Serratia marcescens, Aeromonas sobria, Escherichia coli, Shigella sp., Corynebacterium sp., Bacillus firmus, Bacillus circulans, Rothia sp., Pseudomonas sp. recovered from a total of fifty (50) pieces of different human gold jewellery were examined using the agar well diffusion method. At the highest concentration (200mg / ml), all bacterial isolates showed clear zones of inhibition to all test solution used. S. albus was the most sensitive to LAS washing soda with a diameter of 40mm at 200mg / ml. All the isolates had minimal inhibitory concentration (MIC) value of 25 mg / ml for LAS washing soda which was also the most potent showing greater antimicrobial activity than the other surfactants at all concentrations used. This study therefore shows that LAS washing soda has the best sanitizing potential than the other surfactants and would be most expedient when used as a constituent in the preparation of most detergents / surfactants used as cleaning agents especially for jewellery.

INTRODUCTION

A form of body adornment, manifesting itself as brooches, rings, necklaces, earrings and bracelets is known as Jewellery. It may be made from any material, usually gemstones, precious metals, beads or shells (Isitua et al., 2012). Factors affecting the choice of materials include cultural differences and the availability of the materials. Jewellery may be appreciated because of its material properties, its patterns or for meaningful symbols (Greenbaum and Tom, 2004).

The first pieces of jewellery were made from natural materials such as bone, animal teeth, shell, wood and carved stone (Kunz and George, 1917). Some jewellery throughout the ages may have specifically been as an indication of a social group. More exotic jewellery is often for wealthier people, with its rarity increasing its value. Due to its personal nature and its indication of social class, some cultures established traditions of burying the dead with their jewellery (Ifesan et al., 2004).

Jewellery is sometimes regarded as a way of showing wealth and might also possess some minimal functionality, such as holding a garment together or keeping hair in place. It has been made to adorn nearly every body parts, from hair pins to toe rings and many more types of jewellery (Yildirim et al., 2008). While traditional jewellery is usually made with gemstones and precious metals such as silver or gold, there is also a growing demand for art jewellery where design and creativity is prized above material value. In addition, there is the less costly costume jewellery, made from lower value materials and often mass produced. Other variations include wire sculpture (wrap) jewellery, using anything from base metal work with rock tumbled stone to precious metals and precious gemstones (Greenbaum and Tom, 2004) .

Alloys of nearly every metal known have been encountered in jewellery. Bronze for example, was common in Roman times. Modern fine jewellery usually includes gold, white gold, platinum, titanium, or silver. Most American and European gold jewellery is made of an alloy of gold, the purity of which is stated in Karats, indicated by a number followed by the letter K. The silver used in jewellery is usually sterling silver, or 92.5 % fine silver. In costume jewellery, stainless steel findings are sometimes used (Ifesan et al., 2004; Kayode-Isola et al., 2010).

Surfactants are compounds that lower the surface tension of a liquid, the interfacial tension between two liquids, or that between a liquid and a solid (Smulders et al., 2002). Surfactants may act as detergents, wetting agents, emulsifiers, foaming agents and dispersants. A detergent is a surfactant or a mixture of surfactants having cleaning properties in dilute solutions. In common usage, "detergent" refers to alkylbenzene sulfonates, a family of compounds that are similar to soap but are less affected by hard water. In most house hold contexts, detergents refers specifically to laundry or dish detergents, as opposed to hand soap or other types of cleaning agents and are commonly available as powders or concentrated solutions (Jensen, 1997). Linear alkylbenzene sulfonates (LAS) is the largest volume synthetic surfactant because of its relatively low cost, good performance, the fact that it can be dried to a stable powder and the biodegradable environmental friendliness as it has straight chains (Rapaport and Eckhoff, 1999).

Jewellery make intimate contact with the skin or clothing of the person wearing it; as a result they easily get colonized by bacteria and fungi on the skin or clothes of the wearer thus serving as formites (Isitua et al., 2012). These colonizing organisms can get established on jewellery using glycocalyx and later develop into a biofilm or microbial mat on or around the jewellery (Yildirim et al., 2008) causing skin diseases and can penetrate the blood system creating life-threatening diseases particularly in immune-suppressed individuals (Cogen et al., 2008). Dirty pieces of jewellery are sometimes washed with surfactant / detergent solution which act as a cleaning agent that could dislodge the microbial mats that form on jewellery. Although not intended as antimicrobial substances, LAS and detergents have been found to be active against a variety of bacteria (WHO, 1996).

This study therefore aims at determining the effect of some surfactants commonly used as cleaning agents on micro-organisms isolated from human gold jewellery (necklaces, earrings and hand chains) with a view to ascertain the surfactant that could act as the best sanitizing agent for jewellery.

MATERIAL AND METHODS

Test Organisms

The isolated bacteria from gold necklaces, earrings and hand chains of selected individuals were used as test organisms. These isolates include: Staphylococcus albus, Staphylococcus aureus, Bacillus subtilis, Micrococcus varians, Staphylococcus epidermidis, Streptococcus pyogenes, Proteus vulgaris, Serratia marcescens, Aeromonas sobria, Escherichia coli, Shigella sp., Corynebacterium sp., Bacillus firmus, Bacillus circulans, Rothia sp., and Pseudomonas sp. Pure cultures of these test organisms were used to determine the minimum inhibitory concentration (MIC) of the surfactants used.

Determination of the Antimicrobial Activity of the Surfactants

The antimicrobial activity of LAS and some detergent formulations containing LAS were assessed using agar well diffusion method (Kayode-Isola et al., 2010). The test solutions were labelled;

- LAS ammonia (Liquid Alkylbenzene Sulfonate neutralized with ammonium salt)
- LAS washing soda (Liquid Alkylbenzene Sulfonate neutralized with sodium carbonate)
- OMO (Omo detergent)
- KLIN (Klin detergent)
- ARIEL (Ariel detergent)

Following dilution in sterile distilled water, varying concentrations of the test solutions were obtained as; 200 mg/ml, l00 mg/ml, 50 mg/ml, and 25 mg/ml with sterile distilled water used as control.

In-vitro Demonstration of Antimicrobial Activity (Sensitivity Tests)

After solidification of nutrient agar, 1ml of the different isolates already prepared according to MacFarland Standard was seeded evenly unto the surface of the nutrient agar plates and a sterile glass spreader was used for even distribution of the inocula. Holes or wells were drilled in the agar using a sterile cork borer of 6mm diameter and 0.5ml of the test solutions at different concentrations (200 mg/ml, l00 mg/ml, 50 mg/ml, and 25 mg/ml) was introduced into separate wells. The test solutions were allowed to diffuse into the medium and then incubated aerobically for 24hrs at 37oC. The plates were examined for zones of inhibition which indicated the degree of susceptibility of the isolates. The Minimum inhibitory concentration (MIC) which is defined as the lowest concentration that completely inhibited the growth showing a clear zone (Thongson et al., 2004) was also determined.

RESULTS AND DISCUSSION

From the investigation on the effects of some surfactants on microorganisms isolated from human gold jewelries, the following results were obtained:

The different test solutions (LAS neutralized with sodium carbonate or washing soda, LAS neutralized with ammonia or ammonium salt, Ariel, Klin, and Omo detergents) showed antimicrobial activity with respect to the different concentrations used (Figures 1, 2, 3 and 4). At the highest concentration (200 mg/ml), all bacterial isolates showed clear zones of inhibition to all test solutions used. Staphylococcus albus was most sensitive to LAS neutralized with washing soda with a diameter of 40mm. LAS neutralized with sodium carbonate (washing soda) was the most potent showing greater antimicrobial activity than the other test solutions at all concentrations (200 mg/ml, 100 mg/ml, 50 mg/ml, and 25 mg/ml).

Bacterial susceptibility of the other test solutions (LAS neutralized with ammonia, Klin, Omo, and Ariel detergents), reduced with decreasing concentration. Bacillus subtilis, Staphylococcus epidermidis, Serratia marcescens, Aeromonas sobria, Bacillus firmus, and Bacillus circulans showed no zone of inhibition to LAS neutralized with ammonia at the lowest concentration of 25mg/ml. Table 1 shows the minimum inhibitory concentration (MIC) of the various test solutions. LAS neutralized with sodium carbonate inhibited the growth of all the bacterial isolates showing clear zones of inhibition even at the lowest concentration of 25 mg/ml. Other test solutions (LAS neutralized with ammonia, Klin, Omo, Ariel) showed varying MICs ranging from 25mg/ml to 100mg/ml (or even 200 mg/ml for Klin and Ariel).

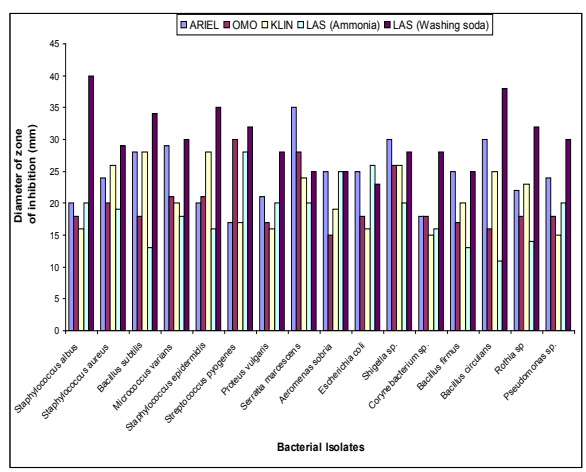

Figure 1: Inhibition of bacterial isolates by the test solutions at 200 mg/ml concentration

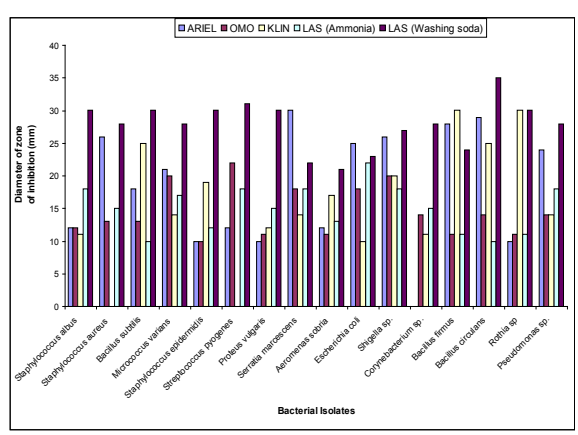

Figure 2: Inhibition of bacterial isolates by the test solutions at 100 mg/ml concentration

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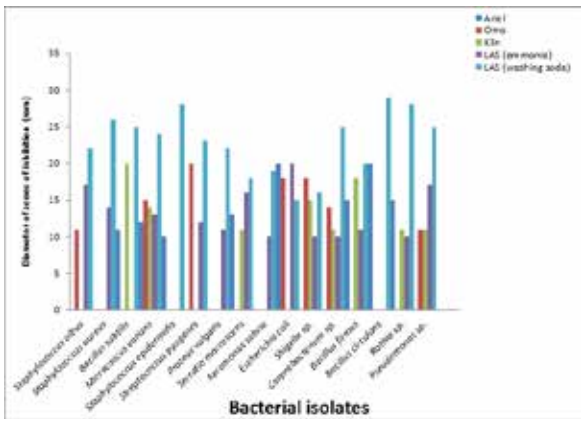

Figure 3: Inhibition of bacterial isolates by the test solutions at 50 mg/ml concentration

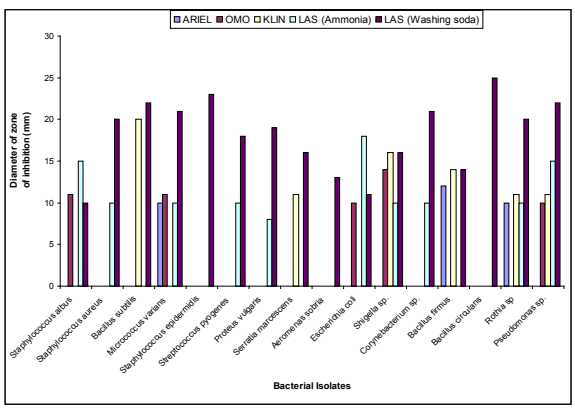

Figure 4: Inhibition of bacterial isolates by the test solutions at 25 mg/ml concentration

Table 1: Minimal inhibitory concentration (MIC) value (mg/ml) of the bacterial isolates to the various test solutions

Isolates	Ariel	Omo	Klin	LAS ammonia	LAS-washing soda
Staphylococcus albus	100	25	100	25	25
Staphylococcus aureus	100	100	200	25	25
Bacillus subtilis	50	100	25	100	25
Micrococcus varians	25	25	50	25	25
Staphylococcus epidermidis	50	100	100	100	25
Sreptococcus pyogenes	100	50	200	25	25
Proteus vulgaris	100	100	100	25	25
Serratia marcescens	50	100	25	50	25
Aeromonas sobria	100	100	100	50	25
Escherichia coli	50	25	100	25	25
Shigella sp.	100	25	25	25	25
Corynebacterium sp.	200	50	50	25	25
Bacillus firmus	25	100	25	50	25
Bacillus circulans	50	100	100	100	25
Rothia sp.	25	100	25	25	25
Pseudomonas sp.	100	25	25	25	25

All the bacterial isolates showed zones of inhibition to all the surfactants used in this study at different concentrations. This finding is similar to the results obtained by Eniola and Olayemi (2000) who found that Staphylococcus sp. and Streptococcus sp. were inhibited by varying concentrations of detergent formulation; and categorized them as detergent sensitive bacteria (DSB). Also, LAS have been shown to be inhibitory to several microorganisms (WHO, 1996). This result is also similar to results obtained by Kayode-Isola et al. (2010), who found that the growth of Bacillus circulans, Staphylococcus aureus, Staphylococcus haemolyticus, and Streptococcus pyogenes were inhibited with varying concentrations of the detergent formulations.

From the foregoing, LAS neutralized with washing soda (sodium carbonate) had the most potent antimicrobial effects on majority of the bacterial isolates (with wide zones of inhibition) compared with the other test solutions. This therefore depicts that LAS neutralized with washing soda has the best sanitizing potential and would be most expedient when used as a constituent in the preparation of most detergents. This added antimicrobial property could be due to the presence of the sodium carbonate (washing soda) in LAS which is more active than ammonia. This investigation also justifies the fact that LAS which is an active constituent of most detergent is majorly responsible for the antimicrobial properties of most detergents with the ability to properly dislodge mats or films of pathogenic and non-pathogenic microorganisms from surfaces, especially; human jewellery which can serve as a vehicle of transmission (either by chest contact with the skin or by unhygienic condition) of infectious diseases as earlier suggested by the 14th century Arabian Physician: Ibn al-Khatib that earrings can serve as vehicles of transmission of pathogens (Syed, 2002; Isitua et al., 2012). Some of these organisms produce very toxic substances that could be very fatal when ingested.

CONCLUSION AND RECOMMENDATION

In summary, this study demonstrates that surfactants / detergents have the ability to dislodge and or inhibit colonizing pathogenic or non-pathogenic bacteria from human gold jewellery. This inhibitory activity demonstrated by LAS and the detergents indicates that they can be employed as sanitizing agents for jewellery. The old practice of washing dirty jewellery with detergent is thus a kind of preventing intervention, which should be encouraged. Hence, it is very important to sanitize the jewellery regularly with the appropriate sanitizing agent. The use of LAS washing soda as a constituent in the preparation of most detergents or surfactants used as cleaning agents should also be encouraged because it is very potent.

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