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SENSITIVITY OF MICROORGANISMS ASSOCIATED WITH JEWELRIES AND WRISTWATCHES TO SOME DETERGENTS

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ABSTRACT
Sensitivity of microorganisms isolated from jewelries and wristwatches worn by students of Michael Okpara University of Agriculture, Umudike to some detergents: Omo, Aerial and Klin were investigated using agar well diffusion method. A total number of 40 jewelries were examined for the presence of bacteria and fungi using standard microbiological methods. The microorganisms isolated were Staphylococus aureus, Proteus, Pseudomonas sp.*, Streptococcus* sp.*, Escherichia coli and Bacillus* sp.*, for bacteria and Aspergillus* sp.*, Trichophyton* sp.*, Pencillium* sp.*, Microsporum* sp. *and Yeast for fungi. Staphylococcus aureus had the highest percentage occurrence in wristwatches, bracelets and jewelries. This was attributed to it being a normal flora of the human skin, while Proteus had the least occurrence. The percentage occurrences of the fungal isolates were generally low, with Yeast having the highest percentage occurrence and Penicillium sp. having the least percentage occurrence. Amongst the three test detergents, Omo showed highest antibacterial activity while Klin gave the least antibacterial activity on the test bacterial isolates. Staphylococcus aureus showed the highest sensitivity to Omo while Bacillus sp. showed the least sensitivity to Omo. Escherichia coli showed the highest sensitivity to Aerial while Streptococcus sp. gave the least sensitivity. Proteus showed the highest sensitivity to Klin while Staphylococcus aureus gave the least sensitivity. Minimum Inhibitory Concentrations ranged from 25mg/ml to 50mg/ml and 100mg/ml. Yeast showed the highest sensitivity to Omo. Microsporum sp. gave the highest sensitivity to Aerial. Yeast showed the highest sensitivity to Klin. Penicillium sp. gave the least sensitivity to the three detergents. Inhibitory activity demonstrated by these detergents indicates that they can be employed as sanitizing agents for jewelries.*
KEY WORDS: *Sensitivity, Jewelries, Wristwatches, Microorganisms, Detergents*

INTRODUCTION

Jewelry is a form of body adornment which includes rings, necklaces and bracelets. 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, fashion trend and the availability of the materials. Jewelry may be appreciated because of its material properties, its patterns or for meaningful symbols (Greenbaum & Tom, 2004). The first pieces of jewelries were made from natural materials such as bone, animal teeth, shell, wood and carved stone (Kunz & George, 1917). Owing to its indication of social class, some cultures established traditions of burying the dead with their jewelry (Ifesan *et al*., 2004). Jewelry 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 all parts of the body, from hair pins to toe rings (Yildirim *et al*., 2008).

The bacterial flora of skin under rings and watches are not predictable because changes encouraged by occlusion could be offset by the release of toxic metal ions, such as silver, copper and gold alloys. Microbes are present in and around the finger rings. In spite of hand washing, microbes persist. Rings and watches are assumed to have an impact on the bacterial load on the hands. They can increase the rate of carriage of potentially pathogenic bacteria, such as Coagulase positive Staphylococci, Gram-negative bacteria and coliforms that could pose a threat to the immune-compromised persons. In some circumstances, a higher degree of safety is required, and antiseptic preparations are needed for the reliable killing of transient organisms.

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 and good performance; the fact that it can be dried to a stable powder and the biodegradable environmental friendliness makes it widely used (Rapaport & Eckhoff, 1999).

This research therefore, is to isolate and identify microorganisms from jewelries and wrist watches worn by students of Michael Okpara University of Agriculture, Umudike, Abia State (MOUAU) to test the sensitivity of the microorganisms isolated from these jewelries and wrist watches to commonly used detergents (Omo, Aerial and Klin) sold in Umuahia, Abia State.

MATERIALS AND METHODS

A total number of 40 samples (10 necklaces, 10 wrist watches, 10 bracelets and 10 rings) that have not been washed for more than 2 months were collected from volunteers (students living within and outside of Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria) were used for this study. Presence of skin rash (if any) was noted. All samples were collected in sterile plastic bags, labeled and sent to the laboratory for microbiological analyses. The detergents used were Omo, Klin and Aerial. They were purchased from Amaba market in Abia State. These detergents are known to be commonly found and used in the locality.

The jewelry samples were aseptically removed. A swab stick moistened with normal saline was used to swab round the jewelries, on the surfaces and especially beneath the areas that touched the skin of the wearers. This was used to streak on Nutrient Agar and Sabouraud Dextrose Agar. The inoculated plates were incubated at 37^{o}C for 24 hours for Nutrient Agar and at room temperature (28 ± 2^{o}C) for 5-7 days for Sabouraud Dextrose Agar.

The bacterial isolates were examined for colonial morphology, cell micro-morphology and biochemical characteristics as described by Ukaegbu-Obi & Omeh (2014). Confirmatory identities of the bacteria were made using the Bergey's Manual of Determinative Bacteriology (Holt *et al.*, 1994).

Characterization of fungi was done by the macroscopic examination for growth, presence of visible mycelia, colony colour, nature of surface and underneath as well as visible spores. Further characterization involved examination of the fungal isolates microscopically on a slide mount with and without stain (lactophenol cotton blue) for structural features such as direction of growth of conidiophores, presence of sporangiophores, branching and septation (Ianovici *et al,* 2009).

The detergents used were Omo, Klin and Aerial. They were purchased from Amaba market in Umudike, Abia State. These detergents are known to be commonly used in Umudike and its environs. After dilution in sterile distilled water, varying concentrations of the test solutions were obtained as; 300mg/ml, 200mg/ml, 100mg/ml, 50mg/ml, 25mg/ml. The antimicrobial activities of detergents were assessed using agar well diffusion method as described by Kayode-Isola *et al.,* (2010). After solidification of Muller Hinton agar, the test organism was streaked on the surface of the agar plate. Wells were drilled using a sterile cork borer of 6mm and 0.5ml of the test solutions were introduced into separate well. The detergents were allowed to diffuse into the medium and incubated aerobically for 24hours at 37°C. The plates were examined for inhibition of microbial growth which indicated the susceptibility of the isolates to detergents.

The Minimum Inhibitory Concentration (MIC) which is defined as the lowest concentration that completely inhibited the growth showing a clear zone was also determined. The Minimum Inhibitory Concentrations of the detergents were determined by dilution to various concentrations according to the macro broth technique (Ukaegbu-Obi *et al*., 2015). Standard inoculum of each organism to be tested was added to series of sterile tubes of nutrient broth containing two fold dilutions of the detergents and incubated at 37°C for 24hours. The MIC was read as the least concentration that inhibited the growth of the isolates.

RESULTS AND DISCUSSIONS

Of the 6 (six) bacterial isolates, 3 were Gram positive and 3 Gram negative bacteria. The Gram positive isolates were *Staphylococcus aureus, Streptococcus* sp. *and Bacillus* sp., while the Gram negative isolates were *Escherichia coli, Pseudomonas* sp*., and Proteus.* The fungal isolates included *Aspergillus* sp., *Penicillium* sp., Yeast, *Trichophyton* sp. and *Microsporum* sp.

TABLE 1: Antimicrobial activity of Omo on bacterial isolates

Bacterial Isolates	Diameter of zone of inhibition (mm) at different extract concentrations (mg/ml)					
	300	200	100	50	25	MIC
Staph. aureus	25.38±0.35	21.30±0.14	16.60±0.28	14.64±0.16	11.62±0.36	25
Pseudomonas sp	22.61±0.17	16.67±0.10	14.32±0.43	12.00±0.05	10.33±0.48	25
Streptococcus sp.	18.64±0.46	14.30±0.23	12.30±0.08	9.38±0.92	0.00	50
Bacillus sp.	17.50±0.22	15.00±0.03	13.36±0.16	0.00	0.00	100
Proteus	20.35±0.32	17.80±0.18	14.00±0.05	11.65±0.20	0.00	50
E. coli	21.63±0.20	18.34±0.31	15.38±0.27	13.67±0.64	11.60±0.25	25

Values are expressed as Mean ± SEM

TABLE 2: Antimicrobial activity of Aerial on bacterial isolates

Bacterial Isolates	Diameter of zone of inhibition (mm) at different extract concentrations (mg/ml)					
	300	200	100	50	25	MIC
Staph. aureus	17.30±0.22	14.64±0.47	11.55±0.11	10.30±0.20	0.00	50
Pseudomonas sp	15.36±0.17	13.30±0.23	10.26±0.45	0.00	0.00	100
Streptococcus sp	15.31±0.84	12.35±0.54	10.65±0.39	0.00	0.00	100
Bacillus sp	22.00±0.08	17.35±0.32	13.47±0.15	11.65±0.17	0.00	50
Proteus	18.67±0.43	16.00±0.12	11.00±0.35	8.33±0.30	0.00	50
Escherichia coli	25.60±0.36	21.33±0.33	16.00±0.14	13.00±0.10	8.35±0.24	25

Values are expressed as Mean ± SEM

TABLE 3: Antimicrobial activity of Klin on bacterial isolates

Bacterial Isolates	Diameter of zone of inhibition (mm) at different extract concentrations (mg/ml)					
	300	200	100	50	25	MIC
Staph. aureus	12.56±0.37	11.35±0.15	8.65±0.22	0.00	0.00	100
Pseudomonas sp	19.63±0.23	17.27±0.19	14.57±0.38	9.38±0.18	0.00	50
Streptococcus sp	13.00±0.08	12.46±0.33	8.36±0.19	0.00	0.00	100
Bacillus sp	17.34±0.43	12.30±0.26	0.00	0.00	0.00	200
Proteus	22.60±0.30	18.69±0.36	15.33±0.35	0.00	0.00	100
E. coli	17.37±0.26	14.36±0.17	12.00±0.15	8.65±0.35	0.00	50

Values are expressed as Mean ± SEM

TABLE 4: Antimicrobial activity of Omo on fungal isolates

Bacterial Isolates	Diameter of zone of inhibition (mm) at different extract concentrations (mg/ml)					
	300	200	100	50	25	MIC
Yeast	16.65±0.15	14.38±0.33	13.00±0.26	11.6±0.26	9.31±0.26	25
Aspergillus sp	15.33±0.36	13.66±0.96	11.3±0.26	0.00	0.00	100
Penicillium sp	13.37±0.08	11.32±0.25	8.3±0.26	0.00	0.00	100
Microsporum sp	14.68±0.82	12.3±0.26	10.6±0.26	8.3±0.26	0.00	50
Trichophyton sp	13.71±0.29	11.6±0.26	10.6±0.26	0.00	0.00	100

Values are expressed as Mean ± SEM

TABLE 5: Antimicrobial activity of Aerial on fungal isolates

Bacterial Isolates	Diameter of zone of inhibition (mm) at different extract concentrations (mg/ml)					
	300	200	100	50	25	MIC
Yeast	13.60±0.11	13.3±0.21	11.3±0.17	10.3±0.24	6.6±0.12	25
Aspergillus sp	13.0±0.23	12.3±0.27	9.3±0.23	0.00	0.00	100
Penicillium sp	13.0±0.15	11.6±0.18	0.00	0.00	0.00	200
Microsporum sp	14.3±0.09	13.3±0.26	12.0±0.18	0.00	0.00	100
Trichophyton sp	13.6±0.26	12.6±0.18	9.6±0.21	0.00	0.00	100

Values are expressed as Mean ± SEM

TABLE 6: Antimicrobial activity of Klin on fungal isolates

Bacterial Isolates	Diameter of zone of inhibition (mm) at different extract concentrations (mg/ml)					
	300	200	100	50	25	MIC
Yeast	15.6±0.09	14.3±0.27	10.6±0.15	8.6±0.35	0.00	50
Aspergillus sp	12.3±0.17	10.6±0.31	8.3±0.36	0.00	0.00	100
Penicillium sp	10.6±0.22	9.3±0.18	0.00	0.00	0.00	200
Microsporum sp	11.6±0.39	9.6±0.50	6.6±0.26	0.00	0.00	100
Trichophyton sp	11.6±0.65	9.3±0.42	0.00	0.00	0.00	200

Values are expressed as Mean ± SEM

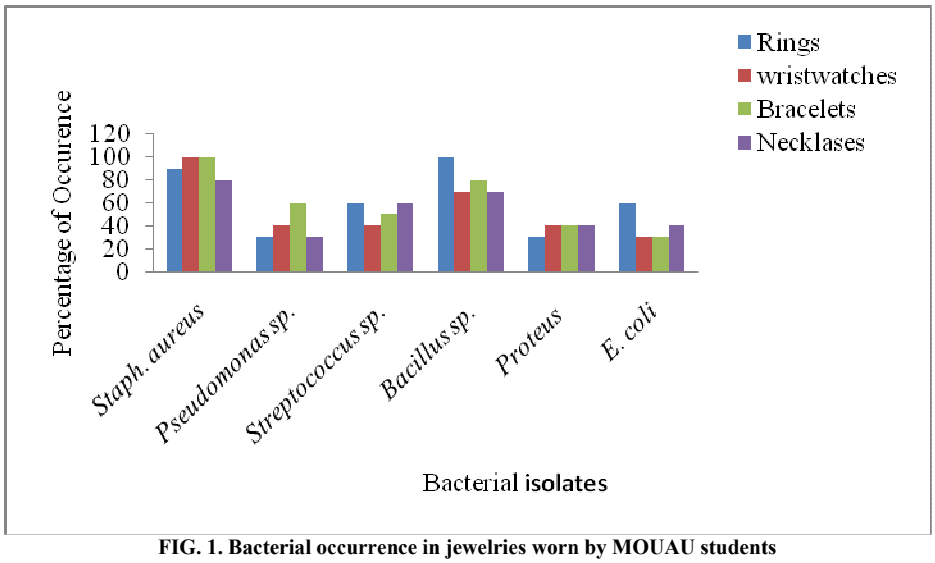

FIG. 1. Bacterial occurrence in jewelries worn by MOUAU students

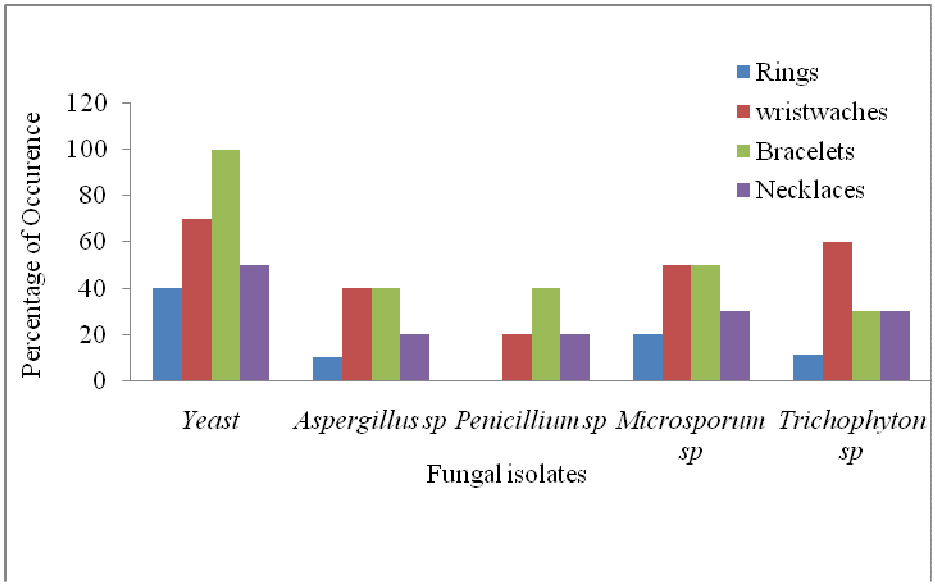

FIG. 2. Fungal occurrence in jewelries worn by MOUAU students

The result shows six (6) bacteria isolated from the jewelries worn by students of Michael Okpara University of Agriculture. These bacterial isolates were of the genera *Staphylococcus aureus, Pseudomonas* sp, *Streptococcus* sp, *Bacillus* sp, *Proteus and*

Escherichia coli. Staphylococcus aureus, Streptococcus sp. and *Bacillus* sp. are Gram positive, while *Pseudomonas* sp*, Proteus* sp and *Escherichia coli* are Gram negative. This is similar to the findings of Isitua *et al.* (2012**)** who isolated *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. Five species of fungi were isolated from the various jewelries. They include Yeast, *Aspergillus* sp, *Penicillum* sp, *Microsporum* sp, and *Trichophyton* sp. It conforms to the findings of Isitua *et al* (2012), who isolated *Microsporum* sp and *Trichophyton* sp among other isolates from gold jewelries.

The occurrences of the bacteria on the jewelries suggest a relationship with the amount of moisture at the body sites where they are worn. The presence of the *Staphylococcus aureus*, *Pseudomonas* sp., is attributable to colonization of the jewelry by skin flora, while *Bacillus* sp, *Proteus and Escherichia coli* are likely to be contaminants from environmental sources. They are associated with gastrointestinal tract infections making their presence significant (Grice *et al.,* 2009).

The activity of the different detergents on the microbial isolates from jewelries and wristwatches were also shown. The result shows that all the test detergents (Omo, Aerial and Klin), exhibited microbial activity against all the isolates.

For bacteria, *Staphylococcus aureus* was most sensitive at all the concentrations. This conforms to the result obtained by Kayode-Isola *et al*. (2010), who found that the growth of *Staphylococcus aureus* among other bacteria was inhibited with varying concentrations of detergent formulations. This was followed by *Pseudomonas* sp*, Escherichia coli* and *Proteus. Bacillus* sp was the least affected and was resistant at 50mg/ml and 25mg/ml concentrations.

Escherichia coli was the most sensitive to Aerial at all concentrations; followed by *Bacillus* sp and *Proteus*. At 25mg/ml concentration, all the isolates were resistant to Aerial. *Proteus* was the most sensitive to Klin at 300mg/ml, 200mg/ml and 100mg/ml concentrations. At the lowest concentration (25mg/ml), all the bacterial isolates were resistant to Klin.

Amongst the 3 test detergents, Omo showed highest antibacterial activity while Klin gave the least antibacterial activity on the test bacterial isolates.

For fungi, Yeast was the most sensitive to Omo at all concentrations; followed by *Aspergillus* sp and *Microsporum* sp. At 50mg/ml and 25mg/ml, all the fungal isolates except Yeast and *Microsporum* sp were resistant to Omo.

Microsporum sp was the most sensitive to Aerial followed by Yeast and *Trichophyton* sp. *Penicillium* sp. was resistant at 100mg/ml, at 50mg/ml and 25mg/ml with other fungal isolates except Yeast.

Yeast was the most sensitive to Klin followed by *Aspergillus* sp. *Penicillium* sp and *Trichophyton* sp showed resistance at 100mg/ml. All the fungal isolates were resistant at 50mg/ml (except for Yeast) and 25mg/ml.

The detergents showed varying Minimum Inhibitory Concentration ranging from 25mg/ml to 50mg/ml and 100mg/ml.

From the result of the percentage occurrence of bacterial isolates, *Staphylococcus aureus* had the highest level of occurrence ranging from 80% (in necklaces) to 100% in wristwatches and bracelets while *Proteus* had the least occurrence of 30-40% generally. *Bacillus* species had a relatively high occurrence of 70-100%, while *Streptococcus* and

Pseudomonas had moderate occurrences of 40-60% and 30-60% respectively. *Escherichia coli* was found more on rings with percentage occurrence of 60%. Comparatively however, much of the bacterial isolates were found more on the wristwatches and bracelets than the rings and necklace. The higher prevalence of *Staphylococcus aureus* in all the jewelry (80-100%) was attributed to it being a normal flora of the human skin while the relatively lower occurrence in rings due to its small size coupled with the fact that the hand is always being cleaned via washing could be the reason of reduction of its occurrence. Also most perfumes, creams and body sprays lead to reduced microbial proliferation around the neck. This could be a reason for low bacterial occurrence on some necklaces.

Although the percentage occurrences of the fungi were found to be generally low relative to that of bacteria, the significance of their presence was noted. In comparison, there were more of the fungi on wristwatches and bracelets than in rings and necklaces. Again, it was noted that dermatophytes were among the isolates and some possess potentials of causing skin infections with example being the presence of *Trichophyton* species which causes ring worms. It was observed that a wide range of microbial species were present in the different jewelries worn by students.

CONCLUSIONS

Jewelries and wristwatches can be colonized by microorganisms both pathogenic and non pathogenic and can serve as a vehicle of transmission for infectious diseases. Also the ability of detergents to dislodge and/or inhibit colonizing pathogenic organisms from jewelries and wristwatches should be adopted by using them to keep these jewelries free from pathogenic organisms.

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