



# CONSTRUCTION OF SIMPLIFIED MICROBIAL CONSORTIUM FROM GOLD ORNAMENTS AND THEIR SENSITIVITY AGAINST DISINFECTANTS

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**Abstract:** Jewelry is the common accessories worn by healthcare workers in hospitals. High level of microorganisms is seen on the jewels and other accessories. A total of 60 pieces of gold jewellery like 20 chains, 20 rings, 10 bangles and 10 anklets were collected from health care workers at KMCH, Coimbatore and some volunteers from non healthcare workers (other professional workers living in Tirupur) and used for study. The samples were examined microscopically, morphologically, culturally and biochemically using standard procedures. The identified microorganisms were *Staphylococcus aureus*, *Streptococcus sp*, Methicillin-resistant *Staphylococcus aureus*, *Bacillus sp*, *Escherichia coli*, *Shigella sp*, *Serratia sp*, *Pseudomonas sp*, *Citrobacter sp*, *Klebsiella sp*. The fungal isolates include *Aspergillus niger*, *Aspergillus flavus*, *Penicillium sp*. The mean population counts of bacteria and fungi isolated from the pieces of human jewellery ranged from  $1.09 \times 10^5$  to  $1.41 \times 10^5$  Cfu/ml and  $1.32 \times 10^5$  to  $4.32 \times 10^5$  Cfu/ml respectively. *Staphylococcus aureus* was the most common encountered bacterial isolates in all the four types of jewellery. Different kinds of microbes identified from jewels of health care workers when compared with other professional workers. The sensitivity of this identified microbes against disinfectant was identified using Alum, sodium bicarbonate, vinegar, hydrogen peroxide, and Dettol. Dettol shows high amount of sensitivity against microbes when compare with others. *Staphylococcus aureus*, *Streptococcus sp*, *E.coli*, *Klebsiella sp*, *Bacillus sp*, *Pseudomonas sp* are sensitive to all type of disinfectant. This study revealed that it is very important to sanitize the jewellery with disinfectant at every interval of time regularly.

**Index terms:** Jewels, Healthcare workers, Bacteria, Fungi, Alum, Hydrogen peroxide, Vinegar, Sodium bicarbonate, Dettol, Antimicrobial sensitivity test.

I. **INTRODUCTION:** India is one of the world's largest diamonds and gem polishing and jewellery manufacturing centre, it is also first largest consumers of gold. The exports and imports of gold, precious metals, precious stones, gems and jewellery accounts for the largest portion of India's global trade.

Jewellery consists of small decorative items worn for personal adornment, such as brooches, rings, necklaces, bracelets and earrings. It may be attached to the body or cloths. It is an important emerging sector in the economy. Ranked among the fastest growing sectors, it is also a leading for foreign exchange generation. Jewellery is made of an alloy of gold, white gold, platinum, palladium, titanium, silver etc. Jewellery makes 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 C.C., Igbinidu O.F. and Imariabe O.J. 2012*). Microbes are present in and around the body. Jewellery is assumed to have an impact on the bacterial load on human skin. They can increases the rate of carriage of potentially pathogenic bacteria and fungi, 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 (*Kelechi Mary,2016*).

Bangles, wrist watch, rings and chains are the common accessories worn or carried by Healthcare workers in hospital settings. Higher bacterial colonization is seen on the skin of Health care workers with jewels and other accessories. Elaborate jewels are known to interfere with active patient's intervention. The Health care workers who took off their rings and jewellery just before a surgical procedure had higher bacterial counts than those who did not wear any accessories. The occurrence and undesirable complications from Healthcare associated infections (HAIs) have been well recognised in the literature for last several decades. The occurrence of nosocomial infection continues to increase at an alarming rate. Transmission of infection through contaminated Health care workers hands are the most common pattern observed in most settings. Randomized controlled trials have already highlighted increased deposit of microorganisms under jewels with the risk of cross-transmission pathogens during hospital (*U Maharjan, 2014*).

The relationship between wearing jewels and the transmission of microorganisms is still unclear. The centres for disease control and prevention guidelines has categorized this as an "unresolved issue" in need of additional research; the draft WHO guidelines also do not have a stated recommendation against the wearing of jewels but note that " the consensus recommendation is to discourage the wearing of rings or other jewellery during Health care". The published research appears to show that jewellery is a significant vehicle for the transmission of pathogens.

Furthermore, most of the fungal isolates are the major culprits of dermatophytoses. The fungus settles on the skin, germinates, and forms a mass of branching hyphae, which grows out radially to produce circular lesions. Pieces of jewelries harboring these organisms could serve as a vehicle transmission to immunocompromised patients. *Aspergillus* spp. has been associated with human infection. Immunocompromised patients exposed to sources contaminated with *Aspergillus*. sp. may become

colonized and subsequently infected. (Isitua C.C., Igbiduru O.F. and Imariabe O.J. 2012). Some of the organisms produce very toxic substances that may lead to many diseases. Skin infections may be either primary or secondary. Primary infections have characteristic morphologies and courses, are initiated by single organisms, and usually occur in normal skin. They are most frequently caused by *Staphylococcus aureus*, *Streptococcus pyogenes*, and coryneform bacteria. Impetigo, folliculitis, boils, and erythrasma are common examples. Systemic infections may also have skin manifestations. Secondary infections originate in diseased skin as a superimposed condition. Intertrigo and toe web infections are examples of secondary infections. Clinical manifestations vary from disease to disease. Most skin diseases involve erythema, edema, and other signs of inflammation. Fungal skin infections or superficial mycoses are common cause of skin disease in most age groups.

Normally, health workers exposed too many areas and handle many patients that create chance to spread pathogenic diseases from one person to another. Some of the organisms produce very toxic substances that may lead to many diseases (AL-ALLAK, 2008).

Much number of antiseptics and disinfectants are extensively used in hospitals and other health care settings for variety of applications. These antiseptics are also used as the cleaner for jewels. A wide variety of active chemical agents have been used for hundreds of years, including ethanol, methanol, sodium hypochlorite and vinegar. Most of these active agents demonstrate broad-spectrum antimicrobial activity; however little is known about the mode of action of these agents in comparison to antibiotics (Gerald McDonnell, 2012). The aim of this study is to isolate and identify microorganisms from gold jewellery (necklace, rings, hand chains and anklets) worn by health workers (KMCH, Coimbatore) and Non- health workers (Tirupur). To Study the sensitivity of frequently used disinfectant (vinegar, Dettol, sodium bicarbonate, hydrogen peroxide and alum) against pathogens isolated from the jewels.

## II. MATERIALS AND METHODS:

**2.1 COLLECTION OF SAMPLES:** A total of 60 pieces of gold jewellery (20 chains, 20 rings, 10 bangles and 10 anklets) were collected from health workers (KMCH, Coimbatore) and some volunteers from non health workers (other professional workers living in Tirupur) and used for study. Presence of skin rashes (if any) was noted. All samples were not been washed for over 3 months and they were collected in the piece of sterile papers, carefully fold and then placed in the air tight container to await microscopy and cultural analysis.

**2.2 ISOLATION OF MICROORGANISMS:** The jewellery samples were aseptically picked with sterile forceps and soaked in 10.0ml of sterile distilled water, shaken vigorously (30 minutes) in shaker for uniform distribution to make a stock solution. After which they were removed aseptically using sterile forceps. 1.0ml of stock solution were serially diluted for up to  $10^{-8}$  in test tubes and 0.1 ml of the dilution samples was inoculated separately in the plates of nutrient agar and Rose Bengal agar using pour plate method and spread plate method.

**2.3 IDENTIFICATION OF MICROORGANISMS:** Gram staining and capsule staining was performed to demonstrate the morphology of capsule possession of the organisms. The culture was subjected to lacto phenol blue staining method. Cultural characteristics and biochemical test were used to identified the organisms.

**2.4 ANTIMICROBIAL SENSITIVITY TEST:** Mueller- Hinton agar is majorly used for antimicrobial sensitivity test. Prepare the medium and sterile it by autoclave for 15mins. Allow it to cool to about 50°C and pour the medium in Petri plate. Swab the sample culture on the petri dish, taken from the 24 hrs incubated broth culture. Then, a hole with a diameter of 6 to 8 mm is punched aseptically with a sterile cork borer or a tip, and a volume (100 micro litres) of he detergent is introduced into the well. Then agar plates are incubated for 24 hours at 37°C. observe the result and measure the zones formed in the petriplates. (Mounyr Balouiri, 2016).

**III. RESULT AND DISCUSSION:** From the investigation of the microorganisms associated with the jewellery worn by health workers of KMCH hospital, Coimbatore and non-health workers at Tirupur, the following results were obtained: of the 11 bacterial isolates, four were positive and seven were negative. The gram positive isolates were *Staphylococcus aureus*, *Streptococcus sp*, Methicillin-resistant *Staphylococcus aureus* and *Bacillus sp* while the gram negative isolates were *Escherichia coli*, *Shigella sp*, *Serratia sp*, *Pseudomonas sp*, *Citrobacter sp*, *Klebsiella sp*. The fungal isolates include *Aspergillus niger*, *Aspergillus flavus*, *Penicillium sp* (table 1). This findings is in accordance with the result of Isitua C.C. (2012).

**TABLE 1: MICROORGANISMS ISOLATED FROM THE PIECES OF HUMAN JEWELS**

<b>BACTERIA</b>	<b>FUNGI</b>
<i>Staphylococcus aureus</i>	<i>Aspergillus niger</i>
<i>Streptococcus sp</i>	<i>Aspergillus flavus</i>
<i>Shigella sp</i>	<i>Penicillium sp</i>
<i>Serratia sp</i>	-
<i>Pseudomonas sp</i>	-
<i>Proteus sp</i>	-
Methicillin-resistant <i>staphylococcus aureus</i>	-
<i>Bacillus sp</i>	-
<i>Citrobacter sp</i>	-
<i>Klebsiella sp</i>	-
<i>E.coli</i>	

The mean population counts of bacteria and fungi isolated from the pieces of human jewellery ranged from  $1.09 \times 10^5$  to  $1.41 \times 10^5$  Cfu/ml and  $1.32 \times 10^5$  to  $4.32 \times 10^5$  Cfu/ml respectively. (Table 2).

**TABLE 2: MEAN POPULATION COUNTS OF BACTERIA AND FUNGI ISOLATED FROM THE HUMAN JEWELLERIES**

<b>JEWEL SAMPLE</b>	<b>BACTERIA COUNT (cfu/ml)</b>	<b>Fungal count (Cfu/ml)</b>
Chains	$1.09 \times 10^5$	$4.32 \times 10^5$
Rings	$1.54 \times 10^5$	$1.44 \times 10^5$
Anklets	$1.45 \times 10^5$	$1.43 \times 10^5$
Bangles	$1.07 \times 10^5$	$1.08 \times 10^5$

*Staphylococcus aureus* was the most common encountered bacterial isolates in all the four types of jewellery, while MRSA were only encountered in health care worker chain. The occurrence of the 11 isolates varied slightly with a total of 43 isolates gotten from chains, 23 isolates gotten from anklets, 40 isolates gotten from rings and 10 isolates gotten from bangles. *Aspergillus niger* was the most encountered fungal isolate in all the jewellery examined, while *Penicillium sp* was only encountered in ring of healthcare worker.

This study revealed that, jewels of health care workers have high number of isolates when compare with jewels of non health workers. Chains, rings, bangles and anklets worn by health care workers harbour varieties of bacteria.

The occurrence of the bacteria on the jewellery suggests 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 jewellery by skin flora. This findings may be due to the fact that chains and bangles are have tiny openings which can hold some moisture and they make intimate contact with the skin thus harbouring more organisms than other jewellery.

While, *Bacillus sp*, *Proteus sp* and *Escherichia coli* are likely to be contaminants from the environmental sources. They are associated with gastrointestinal tract infections making their presence significant (Grice et al, 2009).

This results is not at variance with the results obtained in previous studies by Kayode-Isola et al(2010), who reported that necklace and hand chains were more heavily loaded with microorganisms that the other jewellery they analysed.

*Staphylococcus aureus* may cause scalded skin syndrome, which could be fatal. This mode of transmission to other pathogenic strains of all these organisms isolated resulting to a sequel of diseases. Some of the microbes isolated from the rings may lead to cause ringworm lesions on human. Pieces of jewellery harbouring these organisms could serve as a vehicle for transmission to immunocompromised patients.

They can be shed into food during handling; their presence is significant because they are associated with gastrointestinal tract infections. *S.pyogens* is capable of causing lesions on skin where prior injuries have occurred.

The activities of the different disinfectants on the microbial isolates from jewellery were also shown. The results shows that all the test disinfectants (alum, sodium bicarbonate, hydrogen peroxide, Dettol and vinegar), exhibited microbial activity against all the isolates. Dettol shows high amount of sensitivity against microbes when compare with others (table 3).

**TABLE 3: ANTIMICROBIAL ACTIVITY OF DISINFECTANTS**

S.NO	BACTERIAL ISOLATES	Zone of inhibition (mm) alum	Zone of inhibition (mm) Sodium bicarbonate	Zone of Inhibition (mm) Hydrogen peroxide	Zone of inhibition (mm) vinegar	Zone of Inhibition (mm) dettol
1	<i>Staphylococcus aureus</i>	13mm	14mm	13mm	13mm	17mm
2	<i>Streptococcus sp</i>	12mm	13mm	12mm	12mm	16mm
3	<i>Shigella sp</i>	13mm	-	-	11mm	14mm
4	<i>Serratia sp</i>	12mm	-	-	-	15mm
5	<i>Pseudomonas sp</i>	13mm	13mm	12mm	11mm	17mm
6	<i>Proteus sp</i>	13mm	12mm	-	-	15mm
7	Methicillin-resistant <i>staphylococcus aureus</i>	12mm	-	-	-	16mm
8	<i>Bacillus sp</i>	14mm	13mm	14mm	13mm	17mm
9	<i>Citrobacter sp</i>	-	-	12mm	-	15mm
10	<i>Klebsiella</i>	12mm	12mm	13mm	12mm	18mm
11	<i>E.coli</i>	14mm	12mm	13mm	12mm	19mm

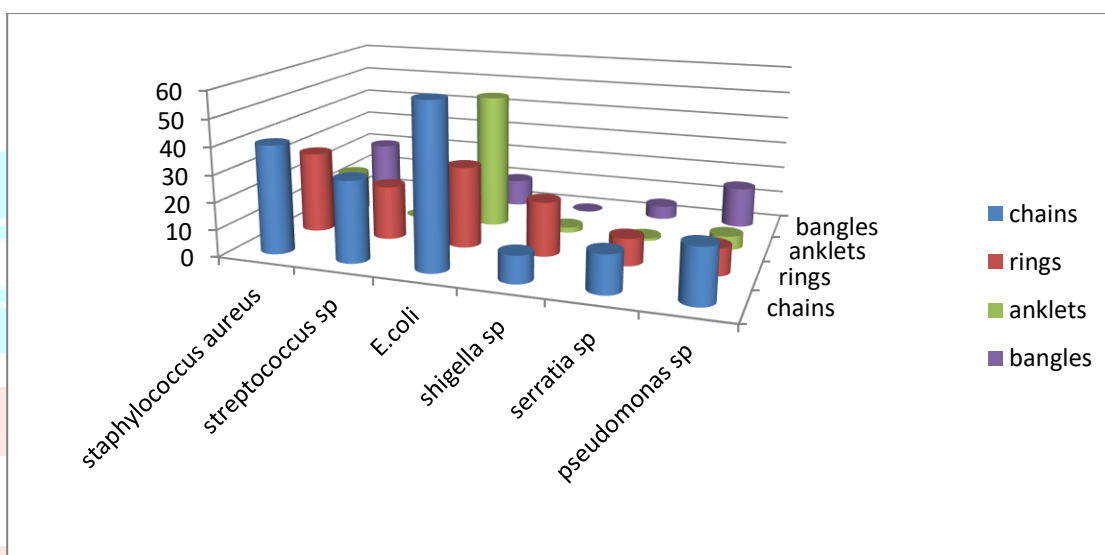
*Staphylococcus aureus*, *Streptococcus sp*, *E.coli*, *Klebsiella sp*, *Bacillus sp*, *Pseudomonas sp* are sensitive to all type of disinfectant.

Methicillin resistant *Staphylococcus aureus* shows resistant to sodium bicarbonate, vinegar, hydrogen peroxide and *Citrobacter* shows resistant to alum and sodium bicarbonate.

*Shigella sp* shows resistant to sodium bicarbonate and vinegar and *Proteus sp* shows resistant to vinegar and hydrogen peroxide.

**FIGURE- 1**

**OCCURENCE OF BACTERIAL ISOLATES IN DIFFERENT TYPES OF JEWELLERIES**



**FIGURE 2**

**OCCURENCE OF BACTERIAL ISOLATES IN DIFFERENT TYPES OF JEWELLERIES**

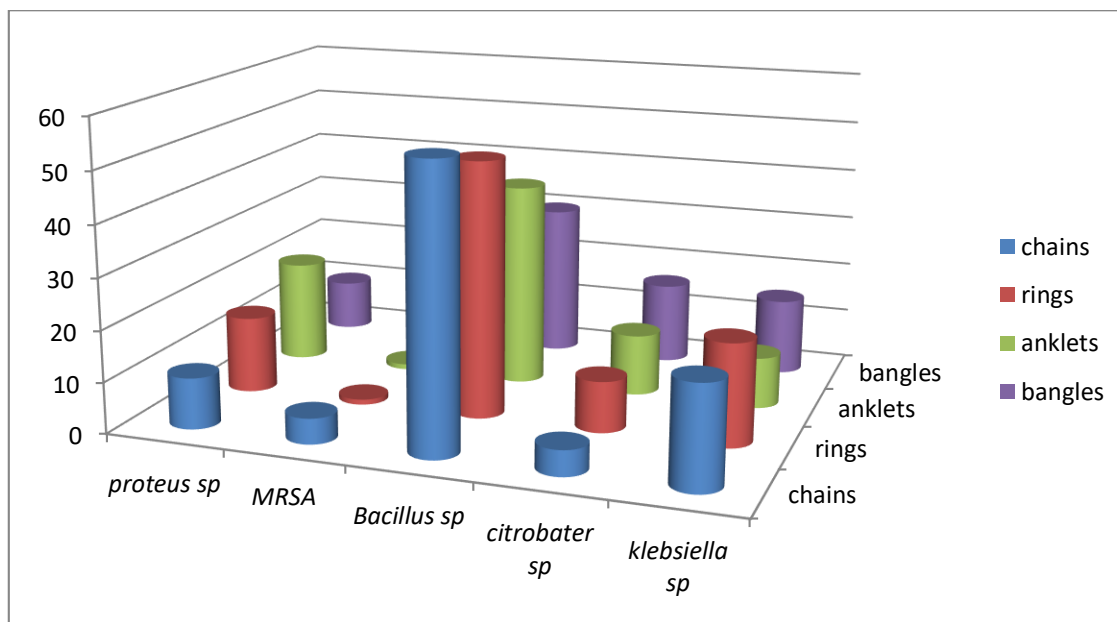
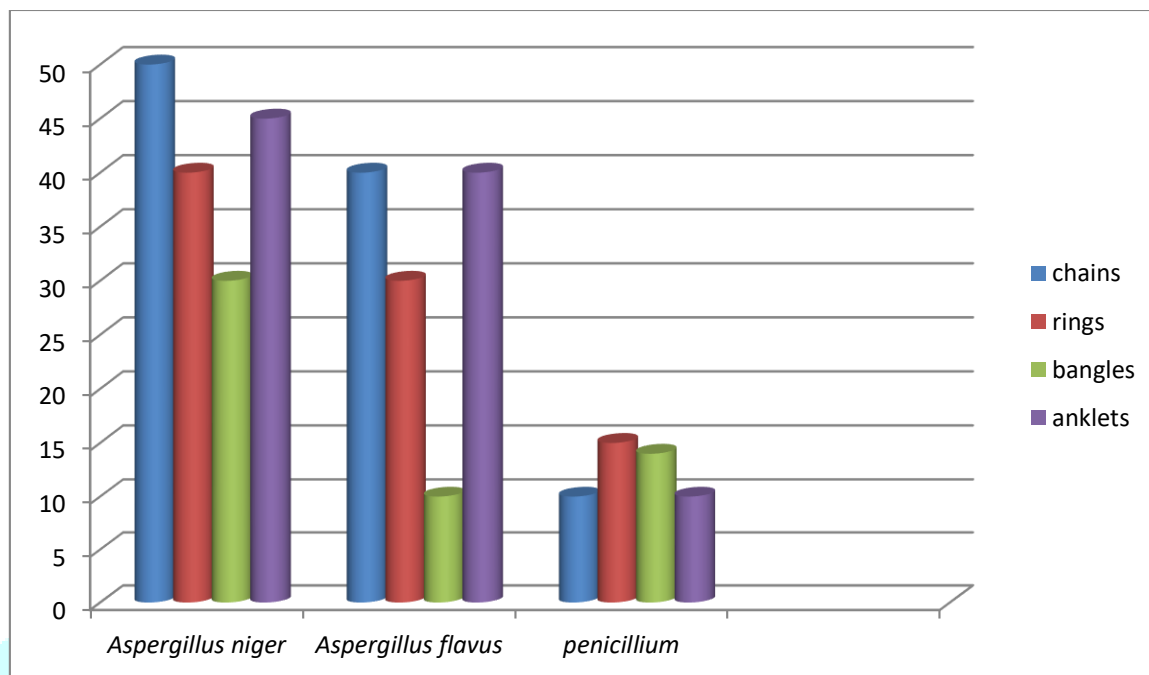


FIGURE 3

## OCCURENCE OF FUNGI ISOLATES IN DIFFERENT TYPES OF JEWELLERIES



**IV. SUMMARY AND CONCLUSION:** Personal accessories can harbour and act as vehicle for transfer of pathogenic micro organisms and can serve as transmission of infectious diseases as earlier suggested by the 14<sup>th</sup> century Arabian physician: *Ibn al-Khatib*. The microorganisms isolates from the jewelleryes can be inactivating by some of the disinfectant that is alum, sodium bicarbonate, hydrogen peroxide and vinegar.

This disinfectant shows sensitive to some of the micro organisms. Alum and sodium bicarbonate are high range of sensitivity against microbes. They inactivate the microbial growth and prevent the jewels from pathogenic contamination. The ability of disinfectants to inhibit colonizing pathogenic organisms from jewelleryes should be adopted by using these disinfectants to keep jewels free from disease causing organisms.

The health care workers must exhibit good personal hygiene and not wear or carry personal accessories during direct patient care. Some of these organisms are produce very toxic substances that could be very dangerous when ingested. Hence it is very important to sanitize the jewellery with disinfectant at every interval of time regularly.

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