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Assessment of antibacterial activity of medicated soap against bacteria associated with wound infections

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Abstract
This study was carried out to assess the antibacterial activity of selected medicated soaps against bacteria associated with wound infections. Wound swab samples were collected from patients with infected wounds and analyzed using standard microbiological techniques. Bacteria isolated and identified from the samples included Staphylococcus aureus, Pseudomonas spp., and Bacillus spp. Five brands of medicated soaps Carex, Tura, Dettol, Septol, and Tetmosol were evaluated for their antibacterial activity using the agar well diffusion method on Mueller-Hinton agar. The results revealed varying degrees of antibacterial effectiveness among the tested soaps. Septol and Dettol exhibited the highest zones of inhibition against all the identified bacteria, indicating strong antibacterial potency. Carex showed moderate activity, while Tura and Tetmosol demonstrated the least inhibitory effects. Staphylococcus aureus was found to be the most susceptible organism to the medicated soaps, whereas Pseudomonas spp. showed the highest resistance. The findings of this study suggest that Septol and Dettol are the most effective medicated soaps for inhibiting bacterial pathogens commonly associated with wound infections. It is therefore recommended that individuals should use medicated soaps with proven antimicrobial properties for personal hygiene, especially in preventing wound infections. Further research should be carried out to identify the specific active ingredients responsible for the antibacterial effects and to test their efficacy against a wider range of clinical isolates.

Keywords: Antibacterial, Carex, Tura, Dettol, Septol, and Tetmosol

Introduction

Wound infections represent one of the most frequent complications encountered in clinical practice, especially in developing countries where hygienic practices and access to effective antimicrobial agents may be limited. These infections are primarily caused by opportunistic bacterial pathogens such as *Pseudomonas* (a Gram-negative bacillus) and *Staphylococcus aureus* (a Gram-positive coccus), which are commonly isolated from infected wounds. These organisms can delay wound healing, increase treatment costs, and even result in life-threatening systemic infections when not managed promptly (Okeke *et al.,* 2023) [5]. Infections caused by *S. aureus* are particularly problematic due to the organism's ability to produce biofilms and its increasing resistance to conventional antibiotics. *Pseudomonas*, though typically associated with intestinal infections, also plays a key role in wound contamination and is noted for its virulence and multidrug resistance (Chigozie *et al.,* 2022). With the rising concern over antimicrobial resistance, there is an increasing interest in exploring the antimicrobial properties of readily available topical agents such as medicated soaps and alcohol-based antiseptics. Medicated soaps are hygiene products that incorporate antimicrobial agents like chloroxylenol, triclosan, and sulfur. Common brands in Nigeria such as Dettol, Tura, Septol, Carex and Tetmosol are widely marketed for their germicidal properties. Dettol contains chloroxylenol, known for its effectiveness against Gram-positive bacteria, while Tura and Septol contain similar phenolic or sulfur-based compounds which act by disrupting bacterial membranes (Afolabi *et al.,* 2021). Tetmosol on the other hand, is a well-known disinfectant that functions by denaturing proteins and dissolving bacterial cell membranes. It is effective against a broad spectrum of bacteria and viruses at concentrations between 60% and 90% (CDC, 2021) [3]. In 2021 study conducted at Southern Nigeria reported that Tura soap demonstrated strong antibacterial activity against *S. aureus* isolated from wounds, with inhibition zones reaching up to 20 mm, compared to 12 mm for Dettol (Abubakar *et al.,* 2021) [1]. Similarly, a 2022 *in vitro* analysis comparing Dettol, Tura, and Tetmosol soaps found that all three soaps showed considerable inhibition against *S. aureus, Pseudomonas* and *Bacillus*, with Dettol producing zones of inhibition between 12–14 mm depending on concentration (Chinedu & Bello, 2022) [4]. Furthermore, a 2024 study conducted at Rhema University Teaching Hospital confirmed the effectiveness of these soaps against clinical isolates of *S. aureus*, although the study did not include *Pseudomonas* or *Bacillus* in its evaluation (Okonkwo *et al.,* 2024).

Materials and Methods

Research Design

This study was an experimental laboratory-based investigation designed to assess the antibacterial activity of selected medicated soaps against bacteria isolate from wound infections. The research involved the collection of wound swab samples, isolation and identification of bacterial pathogens, and determination of the antibacterial effects of different medicated soaps using the agar well diffusion method.

Sample Collection

A wound swab samples were collected from patients attending health facilities within the study area. Sterile cotton swab sticks were used to collect samples from infected wounds by gently rotating the swab over the affected area. The swabs were immediately placed in sterile

test tubes and transported to the laboratory in a cold box for microbiological analysis.

Media Used/ Preparation
All culture media used in the study were prepared according to the manufacturer's instructions. The required amounts of powdered media were weighed and dissolved in the appropriate volume of distilled water. The media were sterilized by autoclaving at 121°C for 15 minutes. After cooling to about 45–50°C, the sterile media were poured into Petri dishes and allowed to solidify (Obi *et al*., 2020) [8].

Isolation of Bacteria
Each wound swab was streaked onto Nutrient agar, MacConkey agar, and Blood agar plates using a sterile inoculating loop. The plates were incubated at 37°C for 24 hours. After incubation, colonies showing distinct morphological characteristics were selected and sub cultured on fresh nutrient agar plates to obtain pure isolates (Obi *et al*., 2020) [8].

Identification of Bacteria
Bacterial isolates were identified based on their colony morphology, Gram staining, and biochemical characteristics.

Morphological Appearance
Parameter such as color, shape elevation, pigmentation and nature of edges of the colonies were observed for each isolate.

Gram Staining
A smear from the sample was made on a clean grease-free slide, air dried and heat fixed. The slide was flooded with crystal violet for 1 minute, and rinsed with water. Lugol iodine was applied for 60 seconds and rinsed. Acteon was used in decolorizing and washed immediately then counter stained with neutral red for 1 minute. It was then rinsed with water, blotted carefully and air dried. The slide was observed under the microscope using oil immersion objectives (×100) (Obi *et al*., 2020).

Biochemical Tests
Isolated organisms were identified by standard microbiology identification techniques including Catalyst test, Citrate utilization test, mythyl-Red test, Voges-Proskauer test, Urease test and Indole test.

Preparation of Soap Extracts
Each medicated soap, Carex, Tura, Dettol, Septol, and Tetmosol was prepared for testing as follows: A portion of 10 g of each soap was cut into small pieces and dissolved in 100 ml of sterile distilled water. The solutions were heated gently in a water bath at 50°C to ensure complete dissolution. The soap extracts were allowed to cool and then filtered using sterile filter paper to remove impurities. The filtrates were stored in sterile bottles at room temperature and labeled appropriately (Nwachukwu *et al*., 2020) [9].

Determination of Antibacterial Activity
The antibacterial activity of the medicated soaps was determined using the agar well diffusion method as described by Clinical and Laboratory Standards Institute (CLSI, 2018).

Preparation of Inoculum
Bacterial were cultured, grown on nutrient agar slants for 24 hours. The colonies were suspended in sterile normal saline and adjusted to match 0.5 McFarland standard turbidity, equivalent to approximately 1.0×10^8 CFU/ml (Nwachukwu *et al*., 2020) [9].

Inoculation of Plates and Soap Extracts
Cork borer were used to make well in the agar. Each well was filled with 0.1 ml of the respective soap extract (Carex, Tura, Dettol, Septol, and Tetmosol). The plates were allowed to stand for 30 minutes at room temperature to allow diffusion of the extracts into the medium (Nwachukwu *et al*., 2020) [9].

Measurement of Zones of Inhibition
After incubation, the plates were examined for zones of inhibition around each well. The diameters of the zones were measured in millimeters (mm) using a transparent ruler. Larger inhibition zones indicated higher antibacterial activity.

Results and Discussion
Table 1 presents the colonial morphology of the three bacterial isolates grown on selective and differential media, which serves as the primary step in their identification. The observation of golden yellow colonies on Mannitol Salt Agar (MSA) for *S. aureus* is a classic diagnostic feature. MSA is both selective for salt-tolerant *Staphylococci* and differential, as the fermentation of mannitol produces acid, turning the phenol red indicator yellow. This characteristic, combined with the golden pigment, strongly suggests a pathogenic strain. The description of *Bacillus spp.* as dry, circular, and white on Nutrient Agar is typical for this genus, indicating its non-fastidious nature and ability to form robust colonies, though this morphology offers limited differentiation from other non-pigmented, rod-shaped bacteria. Most notably, the green pigmentation observed for *Pseudomonas spp.* on Nutrient Agar is highly indicative of Pseudomonas aeruginosa, a common opportunistic pathogen. These distinct morphological features provide the initial evidence for the presence of these specific pathogens in the wound samples, guiding the subsequent biochemical confirmation.
Table 2 shows the biochemical test results that confirmed the identity of the bacterial isolates from the wound infection. The Gram reaction and shape establish the basic taxonomy: Gram-positive cocci (*S. aureus)*, Gram-positive rods (*Bacillus* spp.), and Gram-negative rods (*Pseudomonas* spp.). The positive catalase test for all three isolates shows positive the coagulase test is a critically positive result definitively identifying the *S. aureus* isolate with negative results for *Bacillus* and *Pseudomonas* spp. The mannitol fermentation result further confirms the identity of *S. aureus*, which is typically a fermenter, as initially seen on MSA. In contrast, the negative result for *Pseudomonas* spp. is consistent with its metabolic profile, as it is an oxidative organism rather than a fermentative one. *Bacillus* spp. negative mannitol fermentation helps distinguish it from mannitol-positive bacilli. This suite of tests conclusively differentiates the three isolates and confirmed their preliminary identification from Table 1.
Table 3 displays the efficacy of five medicated soaps against the wound isolates, measured by the zone of inhibition. The

results reveal significant and concerning variability in antibacterial activity. The *S. aureus* isolate from the X-lab source showed complete resistance to all tested soaps, with a 0 mm zone of inhibition, which is an alarming finding given its pathogenicity. *Bacillus* spp., isolated from a burn wound, was susceptible to four of the five soaps, with Tetimosol being the most effective (26 mm), and followed by Septol (20 mm). Dettol, however, showed no activity against this isolate. The most notable result was for *Pseudomonas* spp from a colostomy wound, which was only susceptible to Tura soap, which exhibited a large zone of inhibition (40 mm), but was completely resistant to all other formulations. This high level of resistance in *Pseudomonas* and the total resistance in the *S. aureus* isolate underscore the challenge of treating wound infections and suggest that these bacterial strains may have developed or possess resistance mechanisms to common antibacterial agents found in these soaps, highlighting a critical need for targeted antiseptic selection.

Table 1: Morphological Features of Bacteria Isolated from Wound Infection

Isolates	Morphological features on Selective and Differential Media
S. aureus	Golden yellow colonies on Mannitol salt agar
Bacillus spp	Dry, circular and white colonies on Nutrient Agar
Pseudomonas spp	Green Pigmentation colonies on Nutrient Agar

Table 2: Biochemical Characterization of Bacteria Isolated from Wound Infection

Biochemical Parameters	Bacterial Isolates		
	S. aureus	***Bacillus* spp**	***Pseudomonas spp***
Gram reaction	+	+	-
Shape	Cocci	Rod	Rod
Catalase	+	+	+
Coagulase	+	-	-
Mannitol fermentation	+	-	-

Key; +: Present, -: Absent

Table 3: Activity of Different Medicated Soap against *S. aureus, Bacillus spp* and *Pseudomonas spp* isolated from wound Infection

Isolates	Sample Source	Zone of Inhibition (mm/dm)				
		Carex	Tura	Dittol	Septol	Tetimosol
s. aureus	X-lab	0	0	0	0	0
Bacillus spp	Burn	18	15	0	20	26
Pseudomonas spp	Colostomy	0	40	0	0	0

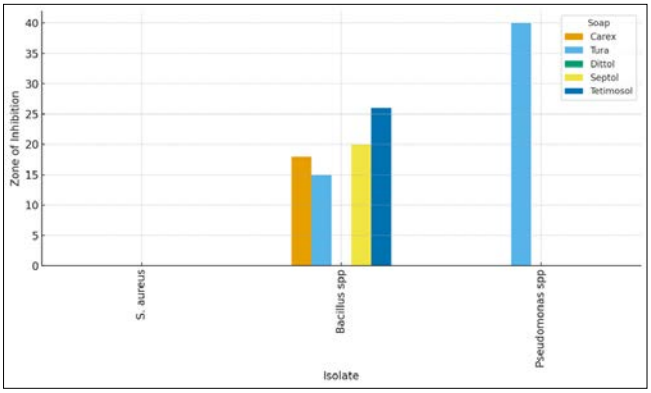

Fig 1

Conclusion

This study assessed the antibacterial activity of selected medicated soaps Carex, Tura, Dettol, Septol, and Tetmosol against bacteria isolated from wound infections. The bacterial species identified from the infected wound samples were *Staphylococcus aureus, Pseudomonas spp*., and *Bacillus spp.* These organisms are among the most common etiological agents associated with wound infections. The isolation of *Staphylococcus aureus* is consistent with its well-known role as a major pathogen in wound infections. It is part of the normal skin flora but becomes pathogenic when it gains access to underlying tissues through cuts or wounds. The identification of *Pseudomonas spp*. also agrees with several reports describing it as an opportunistic pathogen that thrives in moist environments and is often associated with chronic and hard-to-heal wounds. *Bacillus spp.* was also isolated, which may have originated from environmental contamination, as this organism is ubiquitous in soil and dust and can infect open wounds through contact.

The antibacterial activity of the medicated soaps varied across the bacterial isolates. Among the soaps tested, Septol and Dettol exhibited the highest zones of inhibition against all three bacterial isolates *S. aureus, Pseudomonas spp., and Bacillus spp.* indicating strong antibacterial potency. This may be due to the presence of active ingredients such as chloroxylenol in Dettol and triclosan or related compounds in Septol, which have broad-spectrum antibacterial effects.

Carex demonstrated a moderate inhibitory effect against the bacterial isolates. This suggests that although Carex contains antimicrobial agents, the concentration or composition of these agents may not be as potent as those in Dettol and Septol.

Tura and Tetmosol showed the least antibacterial activity against the wound isolates. Their relatively lower inhibition zones could be attributed to differences in their active ingredients, which might be more effective against skin parasites or fungi than against bacteria. For example, Tetmosol contains monosulfiram, which is primarily used for treating scabies rather than for antibacterial purposes.

Among the bacterial isolates, *Staphylococcus aureus* was the most susceptible to the medicated soaps, while *Pseudomonas spp*. was the least susceptible. This pattern aligns with earlier studies (Olayemi & Oyeyiola, 2021; [7] Abubakar *et al*., 2020) [2] showing that Gram-positive bacteria such as *S. aureus* are generally more sensitive to disinfectants and soaps than Gram-negative bacteria like *Pseudomonas* spp. The results therefore indicate that the medicated soaps tested possess varying degrees of antibacterial activity, with Septol and Dettol being the most effective overall. Their use can play an important role in reducing microbial load on the skin and in preventing wound infections when used properly and consistently.

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