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ANTIMICROBIAL ACTIVITY OF LOCALLY PRODUCED BLACK SOAPS SOLD IN AGBOR, DELTA STATE, NIGERIA

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ABSTRACT

Antimicrobial resistance is a key global health challenge, particularly in developing regions where access to medicated hygiene products is limited. Locally produced black soap in Agbor, Delta State, Nigeria, holds cultural significance and is widely used for skin care. However, scientific evaluation of its antimicrobial efficacy and quality remains insufficient. Black soap samples were collected from three major markets in Agbor and tested for antimicrobial activity against *Staphylococcus aureus*, *Candida albicans*, and *Escherichia coli* using agar well diffusion, minimum inhi bitory concentration, and minimum bactericidal concentration assays. Physicochemical properties including pH, total alkali, free fatty matter, and moisture content were also analyzed. Data were statistically evaluated to assess correlations between properties and antimicrobial effectiveness. All black soap samples showed antimicrobial activity, with greater inhibition observed against *S. aureus* and *C. albicans* compared to *E. coli*. The soaps exhibited alkaline pH and varied physicochemical parameters depending on source and formulation. Soaps with higher free fatty matter and moderate alkali content generally showed stronger antimicrobial effects, whereas excessive alkali could pose skin irritation risks. The study provides evidences, supporting the antimicrobial efficacy of locally produced black soap in Agbor. Variation in quality highlights the need for standardization to ensure consistent antimicrobial performance and consumer safety. These findings support the integration of indigenous hygiene products in public health strategies.

Keywords: Antimicrobial, Black Soap, *Staphylococcus aureus*, Traditional, Hygiene

INTRODUCTION

Antimicrobial resistance has emerged as a critical global health challenge, particularly in developing regions where access to medicated hygiene products is often limited. In Nigeria, many households rely on locally produced alternatives, among which African black soap is highly popular due to its affordability, cultural value, and traditional reputation for skin care. Known by various local names in Nigeria such as ọsẹ dúdú (Yoruba), sabulun salo (Hausa), or ncha nkota (Igbo), black soap is typically made from plant-based materials including cocoa pods, plantain peels, palm leaves, and shea tree bark. These are burned into ash to provide alkali for saponification, then combined with oils such as palm kernel oil, coconut oil, or shea butter. The final product, featured as a distinctively dark-colored soap, contains bioactive compounds reported to have antimicrobial, antifungal, and skin-healing properties (Ogunbiyi & Enechukwu, 2021, Akinmoladun & Olaleye, 2013).

Despite its widespread local and international use, the antimicrobial properties of black soap remain insufficiently validated by scientific research. Traditional production methods vary significantly, with differences in raw materials, additives (e.g. honey, lime, and herbs), and preparation techniques leading to inconsistencies in both antimicrobial activity and physicochemical quality (Aliyu *et al.*, 2012). These inconsistencies are important to address because skin infections are prevalent in communities such as Agbor, Delta State, where pathogens like *Staphylococcus aureus*, *Candida albicans*, and *Escherichia coli* are commonly associated with boils, abscesses, candidiasis, and wound infections (Taylor & Unakal, 2021, Stevens & Bryant 2017). In such contexts, black soap is often relied upon as an affordable substitute for commercial medicated soaps, but without proper standardization and validation, its effectiveness and safety remain uncertain (Prescott *et al.*, 2008).

This study therefore evaluates the antimicrobial efficacy of locally produced black soaps sold in three major markets in Agbor, consisting of the Baleke market, Edikeh market, and Garage market, against *S. aureus*, *C. albicans*, and *E. coli*. Antimicrobial assays including agar well diffusion, minimum inhibitory concentration (MIC), and minimum bactericidal concentration (MBC) were used to determine efficacy, while physicochemical parameters such as pH, total alkali, free fatty matter, and moisture content were analyzed to assess quality differences. This research seeks to provide insight into the effectiveness of Agbor's black soaps, with implications for consumer safety, public health, and the standardization of indigenous hygiene products for infection control.

MATERIALS AND METHODS

Study Location

Soap samples were collected in Agbor, the headquarters of Ika South Local Government Area in Delta State, Nigeria. The town lies at Latitude 6.264092° N and Longitude 6.201883° E, with an elevation of about 60 meters above sea level. Agbor is a major commercial center in the region, noted for the local production and distribution of traditional black soaps.

Sample Collection

For this study, three (3) soap samples were purchased from Baleke Market, Edikeh Market, and Garage Market been major markets in Agbor, to ensure authenticity and representation of commonly available products. Each sample was labeled according to its market source to enable comparative analysis.

All laboratory analyses, including antimicrobial assays and physicochemical evaluations were conducted under

controlled conditions at MYCO FARMS, microbiology laboratory, Benin City, Edo State.

Sample Analysis

Microbial Strains and Culture Conditions

The antimicrobial activity of the soap samples was tested against three common skin pathogens: *Staphylococcus aureus*, Candida albicans, and *Escherichia coli*. These strains were obtained from recognized microbial culture collections and maintained under standard laboratory conditions. Nutrient agar and Sabouraud dextrose agar were used for bacterial and fungal culture, respectively.

Preparation of Soap Solutions

Soap samples were aseptically grated and dissolved in sterile distilled water to prepare 10% (w/v) stock solutions. The mixtures were stirred at 60°C for 30 minutes to ensure complete dissolution and then filtered through sterile filter papers to remove particulate matter.

Antimicrobial Assays

The agar well diffusion method was employed to evaluate the antimicrobial activity of the soap solutions. Standardized microbial suspensions adjusted to 0.5 McFarland turbidity were spread on Muller Hinton Agar (for bacteria) and Sabouraud Dextrose Agar (for fungi) plates. Wells of 5 mm diameter were cut in the agar and filled with different concentrations of the soap solutions. Plates were incubated at 37°C for 24 hours for bacterial cultures and appropriate temperatures for fungal.

Minimum Inhibitory Concentration (MIC) and Minimum Bactericidal Concentration (MBC)

Serial dilutions of the soap solutions were prepared to determine the MIC, defined as the lowest concentration inhibiting visible microbial growth after incubation. For MBC determination, aliquots from MIC tubes showing no growth were subcultured onto fresh agar plates and incubated to detect bacterial or fungal survival. Complete absence of growth indicated bactericidal or fungicidal activity (CLSI, 2023; Usman *et al*., 2020).

Physicochemical Analysis

The soaps were analyzed for physicochemical parameters including pH, moisture content, total alkali content, matter insoluble in alcohol, and free fatty matter. Standard analytical methods were employed, with all measurements conducted in triplicates for accuracy and reproducibility.

Data Analysis

Data obtained from antimicrobial assays, including agar well diffusion, minimum inhibitory concentration (MIC), and minimum bactericidal concentration (MBC) tests, were subjected to descriptive statistical analysis. Measurements of zones of inhibition (in millimeters) from triplicate experiments were compiled and expressed as mean ± standard deviation (SD) to ensure consistency and accuracy of results (Aneja, 2018, CLSI, 2023). MIC and MBC values were determined by identifying the lowest concentration of soap extract that either inhibited visible microbial growth (MIC) or completely eradicated viable organisms (MBC), following standard microbiological protocols as outlined by the Clinical and Laboratory Standards Institute (CLSI, 2023; Jaboro *et al*., 2025).

Zone of inhibition measurements were used to evaluate the antimicrobial efficacy of each soap sample against *Staphylococcus aureus*, *Escherichia coli*, and Candida albicans. These measurements were obtained using the agar well diffusion method, where clear zones around wells indicated microbial inhibition. Larger zones of inhibition corresponded to stronger antimicrobial activity. Data from multiple concentrations (2000 mg/ml down to 15.6 mg/ml) were assessed to determine dose-dependent effects. The zones were measured with a metric ruler, and the results were analyzed in triplicate to reduce experimental error and improve reliability (Hudzicki, 2009, Okoro *et al.,* 2020). Comparative evaluation between samples from Edikeh, Baleke, and Garage markets enabled identification of the most effective formulations.

Physicochemical parameters of the soap samples, including pH, moisture content, free fatty matter (FFM), matter insoluble in water (MIW), and total alkali content, were also analyzed using established protocols from AOAC (2019). These parameters influence not only soap quality and shelf-life but also antimicrobial performance. For example, an alkaline pH may enhance microbial membrane disruption, while excess free fatty matter may improve skin moisturizing but reduce soap hardness. Each parameter was measured in triplicate, and results were expressed as mean ± SD. The values were compared across the three different market sources to assess variation in manufacturing consistency and potential correlations with antimicrobial activity (Abdel-Rahman *et al.,* 2022, Mahesar *et al.,* 2019).

A correlation analysis between antimicrobial activity (measured by zones of inhibition at 2000 mg/ml concentration) against *Candida albicans*, *Staphylococcus aureus*, and *Escherichia coli* and the physicochemical parameters of the black soap samples (pH, Matter Insoluble in Water, Free Fatty Matter, Moisture, and Total Alkali) was conducted using Pearson correlation coefficient.

The formula for the Pearson correlation coefficient r between two variables X and Y is:

$$r = \frac{\sum(X_i - X)(Y_i - Y)}{\sqrt{\sum(X_i - \bar{X})^2}\sqrt{\sum(Y_i - \bar{Y})^2}}$$

Where:

X_i and Y_i are the individual data points of variables X and Y,

$\bar{X}$ and $\bar{Y}$ are the mean values of variables X and Y,

The numerator calculates the covariance between X and Y,

The denominator standardizes by the standard deviations of X and Y.

This coefficient ranges between -1 and +1, where:

+1 means perfect positive linear correlation,

-1 means perfect negative linear correlation,

0 means no linear relationship.

The antimicrobial activity values (zones of inhibition) for each soap market against each microbe were used as one variable. The physicochemical parameter values for each soap market were used as the other variable. The Pearson correlation was calculated pairwise between all antimicrobial activities and physicochemical parameters to find the strength and direction of their linear association.

All results were statistically processed using Microsoft Excel and Python's pandas library, where relevant, and visualized through bar charts for clearer interpretation of inter-sample differences. The results were systematically tabulated for comparative analysis across different microbial species and soap sources.

Ethical Considerations

As the research involved only in vitro testing of soap samples and microbial cultures without human or animal subjects, ethical approval was obtained in accordance with institutional

guidelines. Laboratory safety protocols were strictly observed throughout the research process.

RESULTS AND DISCUSSION

Antimicrobial Activity

Black soap samples obtained from the three major markets in Agbor; Baleke, Edikeh, and Garage, demonstrated varying degrees of antimicrobial activity against *Staphylococcus aureus*, Candida albicans, and *Escherichia coli* (Table 1). Black soap gotten from Baleke Market showed a high effectiveness at a conc. of 2000 mg/ml against *Candida* sp. (71.3± 3.5; Baleke Market) while at concentration of 31.25 mg/ml, it showed no effectiveness against *Candida* sp (Edikeh Market). Black soap at concentrations of 15.6 mg/ml had no effect on *Staphylococcus aureus* (Baleke Market). The same trend was observed with Escherichia coli at concentrations of 31.25 and 15.6 for Edikeh and Garage Markets, respectively (Table 1). Garage soap showed the highest zones of inhibition across all the tested organisms, indicating superior antimicrobial potency, particularly against *Staphylococcus aureus* (18 mm). In comparison, Baleke soap exhibited moderate activity with inhibition zones of 17 mm, 14 mm, and 11 mm against *S. aureus*, *E. coli*, and *C. albicans*, respectively, while Edikeh soap demonstrated the lowest antimicrobial effect, with inhibition zones of 16 mm, 13 mm, and 10 mm (Figure 1)

Table 1: Mean ± SD Zone of INHIBITION (mm) for Soap Samples from Different Markets

Microorganism	Conc. (mg/ml)	Edikeh Market (EM)	Garage Market (GM)	Baleke Market (BM)
Candida sp.	2000	70.7 ± 5.0	70.0 ± 10.0	71.3 ± 3.5
	1000	64.7 ± 5.0	62.0 ± 14.1	48.0 ± 13.1
	500	50.0 ± 7.2	58.0 ± 7.2	40.7 ± 3.1
	250	24.7 ± 5.1	26.3 ± 8.5	19.7 ± 4.7
	125	15.3 ± 5.1	23.3 ± 5.8	25.0 ± 5.8
	62.5	3.3 ± 2.3	14.0 ± 13.9	8.3 ± 4.9
	31.25	0.0 ± 0.0	5.3 ± 5.7	2.7 ± 3.8
Staphylococcus aureus	2000	73.0 ± 4.2	64.7 ± 5.0	56.7 ± 8.5
	1000	69.0 ± 5.6	55.7 ± 7.2	50.0 ± 9.0
	500	57.3 ± 6.1	46.0 ± 4.0	51.0 ± 3.6
	250	43.3 ± 9.5	28.0 ± 8.2	46.0 ± 11.0
	125	26.0 ± 10.0	28.0 ± 5.3	28.0 ± 9.8
	62.5	21.0 ± 7.8	12.7 ± 6.1	19.3 ± 1.2
	31.25	4.7 ± 4.6	2.0 ± 1.4	4.0 ± 3.5
	15.6	0.7 ± 1.2	0.7 ± 1.2	0.0 ± 0.0
Escherichia coli	2000	74.0 ± 5.3	68.0 ± 7.2	74.7 ± 5.0
	1000	67.3 ± 6.1	61.0 ± 3.6	65.0 ± 6.6
	500	60.7 ± 7.2	44.7 ± 3.2	56.7 ± 6.4
	250	24.7 ± 5.1	42.7 ± 11.4	44.0 ± 4.0
	125	14.7 ± 8.5	10.0 ± 0.0	34.7 ± 11.1
	62.5	10.7 ± 5.0	4.7 ± 4.6	13.3 ± 7.6
	31.25	0.0 ± 0.0	3.3 ± 1.2	4.7 ± 4.2
	15.6	0.7 ± 1.2	0.0 ± 0.0	1.3 ± 1.2

Figure 1: Mean Zones of Inhibition (mm) at 2000 mg/ml Soap Concentration

Minimum Inhibitory Concentration (MIC) and Minimum Bactericidal Concentration (MBC)

Minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) values further supported these findings (Table 2). The soaps obtained from Garage Market demonstrated consistent bactericidal activity against all tested organisms (30 mg/ml) (Table2). The MIC of black soaps from Edikeh Market ranged between 40 – 60 mg/ml and those from Baleke Market ranged from 20 – 60 mg/ml.

Table 2: Minimum Inhibitory Concentrations (mg/ml)

Isolate	Edikeh Market	Garage Market	Baleke Market
Candida sp.	60	30	60
Staphylococcus aureus	40	30	20
Escherichia coli	50	30	30

Table 3 shows the minimum bactericidal concentration and bactericidal effects. Black soaps, such as those from Baleke and Edikeh Markets, exhibited only bacteriostatic effects against *Candida* sp. and *Escherichia coli* at the highest concentration of 2000 mg/ml (Table 3). Bactericidal activities were observed across the three isolates for soap bought from Garage Market (candida sp. and Staphylococcus aureus). Also, black soap sourced from Edikeh,and Garage Markets showed bactericidal effects against *Staphylococcus aureus* and *Escherichia coli.*

Table 3: Minimum Bactericidal Concentration and Bactericidal Effects

Isolate	Market	Conc. (mg/ml)	Growth	Inference
Candida sp.	Baleke	2000	+	Bacteriostatic
	Edikeh	2000	+	Bacteriostatic
	Garage	2000	-	Bactericidal
Staphylococcus aureus	Baleke	2000	-	Bactericidal
	Edikeh	2000	-	Bactericidal
	Garage	2000	-	Bactericidal
Escherichia coli	Baleke	2000	+	Bacteriostatic
	Edikeh	2000	-	Bactericidal
	Garage	2000	-	Bactericidal

The antibiotic sensitivity of the bacteria isolates (*Staphylococcus aureus* and *Escherichia coli*) is shown in Table 4. *Staphylococcus aureus* was sensitive to pefloxacin, levofloxacin, azithromycin, ciprofloxacin and rocephine. The resistance index of *S. aureus* was 40% while *Escherichia coli* had a resistance index of 60% (Table 4).

Table 4: Antibiogram Profile of the Bacteria Isolates

	POSITIVE DISC										
	PEF	**LEV**	**CN**	**AZ**	**APX**	**E**	**Z**	**CPX**	**AM**	**R**	**MDRI**
Concentration	10µg	30µg	10µg	30µg	30µg	10µg	20µg	10µg	30µg	25µg	
Organism											
Staphylococcus aureus	20 (S)	20 (S)	16 (I)	18 (S)	10 (R)	10 (R)	6 (R)	22 (S)	0 (R)	18 (S)	0.4
	NEGATIVE DISC										
	SXT	CH	CF	CPX	AM	AU	CN	PEF	OFX	S	
	30µg	30µg	10µg	10µg	30µg	10µg	10µg	10µg	10µg	30µg	
Escherichia coli	0 (R)	0 (I)	18 (S)	22 (R)	0 (R)	0 (R)	8 (R)	28 (S)	22 (S)	8 (R)	0.6

Key: Pefloxacin (10 µg; PEF), Gentamicin (10 µg; CN), Ampliclox (30 µg; APX), Zinnacef (20 µg; Z), Amoxicillin (30 µg; AM), Rocephin (25 µg; R), Ciprofloxacin (10 µg; CPX), Septrin (30 µg; SXT), Chloramphenicol (30 µg; CH), Sparfloxacin (10 µg; SP), Augmentin (10 µg; AU), Tarivid (10 µg; OFX), and Streptomycin (30 µg; S)**.** MDR.I = Multi-Drug Resistance Index. Resistant (R) = 0-10mm, Intermediate (I) = 11-16mm, Sensitive (S) =17mm and above.

Physicochemical Properties

The physicochemical analysis of the soap samples showed pH values within the alkaline range (9.09 ± 0.02 - 9.44 ± 0.13), consistent with traditional soap compositions (Table 5). Black soap gotten from Baleke Market had the highest percentage free fatty matter (92.23 ± 0.12) as compared to those from Edikeh (87.78 ± 0.35) and Garage (89.09 ± 0.22) Markets, respectively. Moisture content varied slightly across samples but remained within acceptable limits, 15.22 ± 0.42, 13.78 ± 0.13 and 13.83 ± 0.08 for Edikeh, Garage and Baleke Markets, respectively.

Table 5: Mean ± SD Physicochemical Properties of Soap Samples

Parameter	Edikeh Market	Garage Market	Baleke Market
pH	9.27 ± 0.01	9.09 ± 0.02	9.44 ± 0.13
Matter Insoluble in Water (%)	1.97 ± 0.06	2.00 ± 0.10	5.43 ± 0.11
Free Fatty Matter (%)	87.78 ± 0.35	89.09 ± 0.22	92.23 ± 0.12
Moisture (%)	15.22 ± 0.42	13.78 ± 0.13	13.83 ± 0.08
Total Alkali (%)	1.26 ± 0.06	0.27 ± 0.12	1.18 ± 0.09

Figure 2 is a bar-chart that shows the percentage alkaline, moisture pH, matter insoluble in water and free fatty matter of the black soaps from the various Markets. The mean alkaline ranged from (0.27 ± 0.12 - 1.26 ± 0.06). Soap from Edikeh market had the highest total alkaline (1.26 ± 0.06).

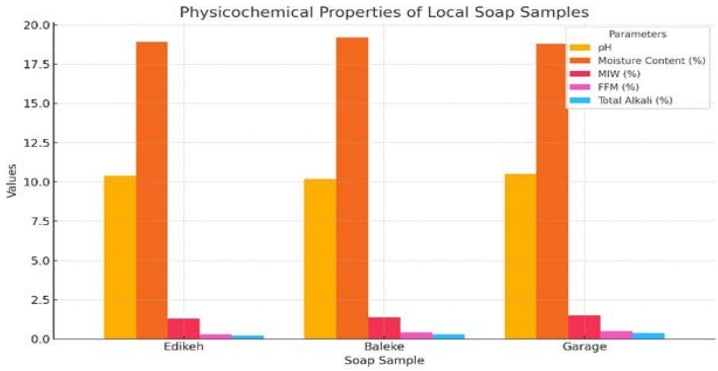

Figure 2: Physicochemical Parameters across Soap Samples

Correlation between Antimicrobial Activity and Physicochemical Parameters

The antimicrobial activity against *Candida albicans* showed strong positive correlations with pH, Matter Insoluble in Water, and Total Alkali content. For *Staphylococcus aureus*, the activity showed strong negative correlations with Matter Insoluble in Water and Free Fatty Matter, a moderate negative correlation with pH, and a strong positive correlation with Moisture content. In the case of *Escherichia coli*, the antimicrobial activity showed strong positive correlations with both pH and Total Alkali. Moisture content showed a weak to moderate positive correlation with *Staphylococcus aureus* and *Escherichia coli*, but showed negligible correlation with *Candida albicans*. This correlation suggests that the antimicrobial efficacy of black soap varies with physicochemical properties, and different microbes respond differently to these parameters in the soap formulation.

The correlation between antimicrobial activity and physicochemical parameters is shown in table 6. *Candida albicans* (0.9996) and *Escherichia coli* (0.9164) showed a positive correlation in their pH. The high alkalinity infers that the black soap is effective against both isolates, but effectiveness decreases with respect to *Staphylococcus aureus* which showed a negative correlation (-0.4763). This trend was observed with the matter insoluble in water and free fatty matter. Unlike other parameters, moisture and total alkali showed a positive correlation amongst the three isolates, Candida albicans, Staphylococcus aureus and Escherichia coli.

Table 6: Correlation between Antimicrobial Activity and Physicochemical Parameters

Physicochemical Parameter	*Candida albicans*	*Staphylococcus aureus*	*Escherichia coli*
Ph	0.9996	-0.4763	0.9164
Matter Insoluble in Water	0.8389	-0.8645	0.5739
Free Fatty Matter	0.6536	-0.9704	0.3224
Moisture	0.0749	0.8559	0.4431
Total Alkali	0.8515	0.0833	0.9859

Discussion

The antimicrobial screening revealed that all soap samples exhibited varying levels of inhibition against *Candida sp*. *Staphylococcus aureus*, and *Escherichia coli*, with inhibition zones increasing proportionally to soap concentration. The most pronounced effects were observed at 2000 mg/ml across all isolates and markets, demonstrating that the antimicrobial potential of these soaps is concentration-dependent. Among the tested organisms, *Candida sp*. and *E. coli* were generally more susceptible than *S. aureus*, particularly in soap samples obtained from Edikeh and Garage markets.

The marked activity against *E. coli* is of particular interest, given that Gram-negative bacteria typically exhibit higher resistance to antimicrobial agents due to their protective outer membrane. Yet, all soap samples produced inhibition zones ≥70 mm at 2000 mg/ml. This suggests the presence of potent antimicrobial compounds such as essential oils, fatty acids, or unreacted alkalis, which are often reported in natural and handmade soaps (Okoro *et al.*, 2020; Hassan *et al.*, 2022). *S. aureus*, a Gram-positive bacterium, also showed substantial susceptibility, with inhibition zones above 60 mm in most high-concentration tests. This observation aligns with earlier findings that Gram-positive bacteria are generally more sensitive to natural surfactants and antimicrobial agents found in soaps (Eziuzo *et al.*, 2021).

At lower concentrations (≤125 mg/ml), the soaps exhibited diminished activity, with minimal or no inhibition observed, particularly at 31.25 and 15.6 mg/ml. This indicates the existence of a concentration threshold below which the antimicrobial components are insufficient to breach microbial defenses. The Minimum Inhibitory Concentration (MIC) and Minimum Bactericidal Concentration (MBC) tests further revealed that some soap samples exerted bacteriostatic rather than bactericidal effects. For instance, *Candida sp*. growth persisted in samples from Baleke and Edikeh markets at 2000 mg/ml, suggesting that these formulations inhibited fungal growth without killing the cells. This partially supports Aneja (2018), who emphasized that high concentrations of active compounds are necessary for bactericidal effects.

These results are broadly consistent with previous studies. Idoko *et al.*, (2018) reported that Nigerian-made soaps contain antimicrobial ingredients capable of inhibiting both Gram-positive and Gram-negative organisms. Similarly, Mahesar *et al.*, (2019) demonstrated comparable inhibition patterns in branded Pakistani soaps, attributing antimicrobial effects to fatty acids, fragrances, and residual alkali. However, while branded soaps in earlier studies showed more uniform activity across concentrations, the present findings revealed greater variability, particularly in locally produced soaps at lower concentrations. Such differences may be attributed to inconsistencies in formulation and the absence of strict quality control measures in local production.

Several notable patterns and unexpected findings emerged. Soap samples from Garage Market displayed superior

antimicrobial activity across most test organisms, especially *Candida sp*. which was completely inhibited at higher concentrations. This may suggest that soaps from this market are either better formulated, fresher, or contain higher levels of antimicrobial constituents such as unreacted lye or essential oils. Unexpectedly, all soap samples showed strong activity against *E. coli*, a Gram-negative bacterium typically resistant to many antimicrobials. This indicates the possible presence of amphiphilic agents with the ability to disrupt bacterial membranes. Additionally, the inhibition of *Candida sp*. by all soaps suggests that these formulations may contain antifungal components, a rarely explored property of locally made soaps.
The physicochemical analysis provided further insights into these antimicrobial properties. All soap samples had alkaline pH values ranging from 9.09 to 9.51, which fall within acceptable cleansing standards but may pose risks of skin irritation with prolonged use (Oyeleke *et al.*, 2023). The highest pH value (9.51) was recorded in Baleke Market soap, which could partly explain its strong activity against *S. aureus*, as alkalinity is known to disrupt microbial membranes. Free Fatty Matter (FFM) content was also highest in Baleke soap (92.23%), suggesting incomplete saponification or intentional addition of fats to enhance moisturizing properties. Although high FFM can improve soap quality, it may also harbor contaminants if poorly processed. Furthermore, Matter Insoluble in Water (MIW) was notably high in Baleke soap, reflecting the presence of unreacted additives or fillers that could compromise product consistency and shelf life. Variations in moisture and total alkali content across samples further highlighted the lack of standardization in local soap production.
These findings underscore both the antimicrobial potential and the limitations of locally produced soaps. While the presence of active compounds confers strong antibacterial and antifungal effects, inconsistencies in formulation and physicochemical properties point to the need for improved quality control and standardization in production practices.

CONCLUSION

This study evaluated the antimicrobial activity and physicochemical properties of local bathing soaps sold in Agbor, Delta State. The findings reveal that the soaps possess varying degrees of antimicrobial activity against *Candida sp*. *Staphylococcus aureus*, and *Escherichia coli*. The antimicrobial effects were concentration-dependent, with the highest activity observed at 2000 mg/ml. Among the soap samples, the one obtained from Garage Market demonstrated superior antimicrobial activity, especially against *Candida sp*. which exhibited bactericidal outcomes. All soap samples showed bactericidal activity against *S. aureus* at high concentrations. Physicochemical analysis confirmed that the soaps met acceptable standards, with slightly alkaline pH and varied levels of total alkali, moisture, free fatty matter, and matter insoluble in water. Overall, the findings suggest that certain local soaps can serve as effective antimicrobial agents and could be considered as alternatives or supplements to standard antibiotics, particularly where resistance to conventional drugs is a concern.

REFERENCES

Akinmoladun, F. O., & Olaleye, T. M. (2013). Antimicrobial activity of local black soap on clinical isolates of bacteria. *Journal of Microbiology and Antimicrobials, 5*(2), 2–26.

Aliyu, G., Abdulrahman, M. B., & Suleiman, M. (2012). Analysis of the antibacterial activity of African black soap on some selected pathogens. *ARPN Journal of Science and Technology, 2*(2), 358–364.

Aliyu, M. S., Tijjani, M. B., Doko, M. H. I., Garba, I., Ibrahim, M. M., Abdulkadir, S. M., Abba, D., & Zango, U. U. (2012). Antimicrobial activity of Sabulun Salo, a local traditional medicated soap. *Nigerian Journal of Basic and Applied Sciences, 20*(1), 35–38.

Aneja, K. R. (2018). *A textbook of basic and applied microbiology* (7th ed.). New Age International Publishers.

AOAC International. (2019). *Official methods of analysis of AOAC International* (21st ed.).

Clinical and Laboratory Standards Institute. (2023). *Performance standards for antifungal susceptibility testing of filamentous fungi (CLSI M38)*.

Clinical and Laboratory Standards Institute. (2023). *Reference method for broth dilution antifungal susceptibility testing of filamentous fungi (CLSI Standard M38)*.

Eziuzo, K., Obinna, A., & Ogunlana, T. (2021). Analysis of antibacterial activity of different soaps on skin flora. *Journal of Applied Life Sciences, 14*(1), 25–30.

Hassan, F. U., Tukur, H. A., & Umar, M. A. (2022). Comparative analysis of local and commercial soaps sold in Nigerian markets. *Nigerian Journal of Health and Environment, 8*(2), 72–80.

Hudzicki, J. (2009). *Kirby-Bauer disk diffusion susceptibility test protocol*. American Society for Microbiology.

Idoko, O., Emmanuel, S. A., Salau, A. A., & Obigwa, P. A. (2018). Quality assessment on some soaps sold in Nigeria. *Nigerian Journal of Technology (NIJOTECH), 37*(4), 1137–1140. Doi: https://doi.org/10.4314/njt.v37i4.37

Jaboro, A. G., Oyem, I. M., Obayagbona, O. N., Igborgbor, J. C., Konyeme, T. E., Oghene, U. J. and C. Ikechukwu (2025). Antibiogram profiles of heterotrophic bacteria and coliforms isolated from Orogodo River in Agbor-Southern Nigeria. *Journal of Basics and Applied Sciences Research*. 3(5): 78-87.

Mahesar, S. A., Chohan, R., & Sherazi, S. T. H. (2019). Evaluation of physico-chemical properties in selected branded soaps. *Pakistan Journal of Analytical and Environmental Chemistry, 20*(2), 177–183. Doi: https://doi.org/10.21743/pjaec/2019.12.22

Ogunbiyi, A., & Enechukwu, N. A. (2021). African black soap: Physiochemical, phytochemical properties, and uses. *Dermatologic Therapy, 34*(3), e14870.

Okoro, C. K., Okafor, M. I., & Iheanacho, C. C. (2020). Evaluation of the antimicrobial potential of natural herbal soaps. *Journal of Microbiological Research, 10*(3), 45–52. Doi: https://doi.org/10.12691/jmr-10-3-1

Oyeleke, M. A., Sanni, A. I., & Oladele, J. O. (2023). Characterization and health assessment of pH and moisture content in local cosmetic products. *African Journal of Public Health Research, 6*(1), 12–18.

Prescott, L. M., Harley, J. P., & Klein, D. A. (2008). *Microbiology* (7th ed.). McGraw-Hill.

Stevens, D. L., & Bryant, A. E. (2017). Severe skin and soft-tissue infections. *New England Journal of Medicine, 376*(23), 2253–2265. Doi: https://doi.org/10.1056/NEJMra1607771

Taylor, T. A., & Unakal, C. G. (2021). Staphylococcus aureus. In *StatPearls*. StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK441868/

Usman, A. H., Ali, T. And Danjuma, A. G. (2020). Phytochemical and antimicrobial studies of stem bark extract of *Anogeissusleiocarpus* found in Dutsin-Ma, Katsina-Nigeria. FUDMA Journal of Science. 4(2):156-167.

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