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Research Article

Antibiogram of Bacteria and Fungi Isolated From Sex Toys in a Tertiary Institution

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ABSTRACT

Sexual health products including sex toys, have gained popularity in recent years, contributing to enhanced intimacy and pleasure for individuals and couples. However, the hygienic implications and potential risks of microbial contamination of these products are often overlooked. This study aimed to isolate bacteria and fungi from active sex toys and assess the antibiogram of the bacterial isolates so as to shed light on the potential health hazards associated with their use without adequate care. A total of five sex toys (*Dildo*) were sampled three (3) times for a period of one month within the campus. The samples were analyzed by aseptically using swabs on the surfaces of the toys and were cultured. Identification of microbial species was done using standard microbiological techniques; antimicrobial susceptibility testing was performed using Kirby-Bauer disc diffusion method. Results showed total heterotrophic bacterial count ranged from 1.8×10^7 to 2.9×10^7CFU/ml, the total coliform counts ranged from 5.0×10^4 to 2.4×10^5cfu/ml, while the fungal count ranged from 5.0×10^3 to 9.2×10^3sfu/ml. Twenty (20) bacterial isolates identified and the frequency included; *E. coli* 3(15%), and species belonging to the genera; *Bacillus* 5(25%), *Enterobacter* 3(15%), *Klebsiella* 4(20%), *Staphylococcus* 2(10%), *Proteus* 2(10%), and *Serratia* 1(5%), while the most prevalent fungal species included *Candida* sp (72.7%) and *Aspergillus niger* (27.3%). Antibiogram analysis demonstrated varying levels of susceptibility among the isolated microorganisms. While some strains were sensitive to standard antibiotics, others exhibited resistance to multiple drug classes, including commonly used broad-spectrum agents, highlighting the potential risk of cross-contamination and transmission of resistant pathogens. These findings underscore the importance of proper handling, hygiene and disinfection practices for sex toy users, as to minimize the risk of potential infection. Therefore, health education initiatives for vendors and users are highly recommended.

Keywords: Sex toys, Dildo, antibiogram, multiple drug resistant bacteria, fungi, *Staphylococcus*, *Candida*.

Introduction

The Oxford English Dictionary defines sex as physical interaction between two people that involves touching each other's genital organs and may or may not involve sexual activity. The capacity to engage in satisfying, safe, and pleasurable sex has been recognized by the World Health Organization and the Declaration of Sexual Rights by the World Association for Sexual Health as a fundamental human right. Thus, sexual pleasure does not only reflect an innate component of human sexuality (WHO, 2020).

Sex toys are devices for sexual enhancement that aim to increase the nature and quality of sexual experiences (Rosenberger *et al.,* 2012). Sex toys are tangible objects, as opposed to pornography.

Some sex toys resemble human body parts, such as the dildo in the shape of human male genitalia, while others take non-human forms such as the vibrator in the shape of a dolphin or a banana. During sexual activity, sex objects are utilized directly on the body (Döring and Pöschl, 2018). The idea that sex is only used for reproduction has long since been disproved. In our contemporary society, having sex for pleasure is widely acceptable and has taken on significant importance (Dewitte and Reisman, 2021).

Clinical and sex therapist suggestions to enhance the sexual experience and promote climax have further boosted the use of sex toys. They have also been used as part of a comprehensive therapeutic strategy for some types of vulvar discomfort (Herbenick *et al.*, 2015).

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Nonetheless, the majority of people who use sex toys do so against medical advice. In a previous study, it was reported that the availability and reported usage of sexual enhancement products (i.e., sex toys, vibrators), which were once taboo, are now more popular in North America (Wood *et al.*, 2017).

In Nigeria, the use of sex toys (dildos, vibrators, etc) is not widely accepted and still perceived to be a taboo. This is part of the reasons why users are very secretive and do not disclose their readiness to use it. Other reasons could be the stigmatization users could face from other persons and religious groups. There are various socio-demographic factors that are linked to female sex toy use (Herbenick *et al*., 2009). Despite the growing popularity of sexual devices, these products have remained largely under- researched (Dewitte and Reisman, 2021). The use of sex toys could alter the microflora by introducing microorganisms into the genitals, especially if the hygiene of these toys are questionable. More so, there is paucity of information on the bacteria and fungi associated with sex toys as well as their antibiogram hence the need for this study.

Materials and Methods

Study Area

The study was conducted in a tertiary institution in Rivers State, Nigeria.

Informed Consent, Inclusion and Exclusion Criteria

Informed oral or written consent from the owners/users of the sex toys were obtained before sample collection for the study. Individuals who use sex toys and were willing to volunteer the participation of their Dildos for this study were included in the study. Individuals who do not own or use a toy and/or were not willing to volunteer the participation of their Dildos were excluded from the study.

Questionnaire

Questions contained in the administered questionnaire were; Type of sex toy in use, number of toys in use, frequency of use, storage method, method of cleaning/sterilization do you use, cleaning agents mostly used, frequency of cleaning/sterilization, and complains of infection after use.

Sample Collection

A total of five (5) sex toy samples (*Dildos*) designated A, B, C, D, and E were collected from female students within the tertiary institution. The samples were investigated 3 times for a period of one month. Samples were collected by aseptically rotating a moist swab over the utilizable surface of the toys using sterile physiological saline (Ogbonna *et al.*, 2022). The samples were appropriately labeled and placed in an ice-packed container and immediately transported to the Microbiology Laboratory of the Rivers State University for analyses.

Microbiological Analyses

Enumeration of Bacteria and Fungi

Sampled swab sticks were incubated in test tubes containing 9mL sterile peptone broth. The broth which served as the stock was incubated for 24 hours. After 24 hours of incubation, the stock was diluted using the ten-fold serial dilution method (Ogbonna *et al.*, 2022). This was done by transferring 1mL of the stock with a sterile 1 mL pipettes from the original stock into test tube containing sterile 9 mL physiological saline. Another 1mL was withdrawn from the diluted tube and transferred to another tube containing sterile 9mL normal saline. This was done serially until the dilution of 10^{-7} was obtained.

For the enumeration and isolation of total heterotrophic bacteria, aliquot from the 10^{-5} dilution was inoculated on freshly prepared Nutrient agar plates while aliquot from the 10^{-2} dilution was inoculated on Eosin methylene blue (EMB) agar and Sabouraud Dextrose agar (SDA) plates respectively for the enumeration of total coliform and fungi in the samples. Nutrient and EMB agar plates were incubated at 37ºC for 24 to 48 hours while SDA plates were incubated at 25 ºC for 3-7 days. After incubation, the colonies that developed were enumerated and recorded as colony forming units per milliliter for bacteria (CFU/mL) and as spore forming units per milliliter for fungi (SFU/mL).

Isolation and Identification of Isolates

The colonies were first sub-cultured on freshly prepared sterile nutrient agar plates. This was repeated until the isolates were pure (void of contaminant). The bacterial isolates were identified based on their morphology and biochemical characteristics.

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The fungal isolates were identified based on colonial morphology and microscopy and the resulting characteristics were compared with those recorded in the book of medical fungi (Sarah *et al.,* 2016).

Antibiotics Susceptibility Test

The Kirby-Bauer disc diffusion method was used. In this method, the bacterial isolates which have been standardized using the 0.5 McFarland standard were seeded on the surface of dried Mueller-Hinton agar plates and allowed to dry for 3 minutes. Immediately after the specified time, wafers/ discs containing the impregnated antibiotics was transferred onto the surface of the plates using sterile forceps. The plates were incubated at 37ºC for 24 hours. At the end of incubation, plates were read by measuring the zone diameter formed. The zone diameter was used to interpret the susceptibility or resistance pattern with reference from the clinical laboratory standard institute (CLSI, 2019).

Statistical Analysis

The obtained data were analysed using the Statistical Package for Social Science (SPSS v27). The mean and standard deviations of the counts were calculated, the percentage occurrence and percentage resistance were also determined. The analysis of variance (ANOVA) was conducted and means were separated using Duncan multiple range test in areas where there was significant difference.

Results

A result of the total heterotrophic bacteria count, total coliform counts and fungal counts is presented in Table 1. Results showed that the total heterotrophic bacterial count ranged from 1.8×10^7 to 2.9×10^7CFU/ml, the total coliform counts ranged from 5.0×10^4 to 2.4×10^5CFU/ml, while the fungal count ranged from 5.0×10^3 to 9.2×10^3SFU/ml. Results also showed that the microbial loads (both bacterial and fungal counts) of the samples despite varying from one toy to another showed no statistical significant differences (*P>0.05*).

Results of the percentage occurrence of bacterial and fungal isolates are presented in Figure 1 and Figure 2 respectively. Twenty (20) bacterial isolates and their percentage occurrence, including *E. coli* (15%), and species belonging to the genera *Bacillus* (25%), *Enterobacter* (15%), *Klebsiella* (20%), *Staphylococcus* (10%), *Proteus* (10%), and *Serratia* (5%) were isolated.

Thus, *Bacillus* spp were the most dominant bacterial isolates followed by *Klebsiella* spp, *Enterobacter* spp and *E. coli* while *Serratia* sp was the least isolate. On the other hand, results of the fungal isolates showed that only two genera of fungi belonging to *Candida* spp (72.7%) and *A. niger* (27.3%). were isolated. Thus, *Candida* spp were the most dominant isolates while *Aspergillus niger* was the least isolate.

Table 1: Microbial counts of sex toy sampled in a tertiary institution

	Microbial counts of sex toy (Dildo)		
Dildo Code	**THB ($\times10^7$)**	**TCC ($\times10^5$)**	**FC ($\times10^3$)**
A	2.6±0.2[a]	1.1±0.0[a]	7.0±0.0[a]
B	2.9±0.0[a]	2.4±0.0[a]	9.2±0.0[a]
C	2.8±0.1[a]	0.5±0.0[a]	5.0±0.0[a]
D	1.8±0.2[a]	1.5±0.0[a]	4.2±0.0[a]
E	1.8±0.1[a]	0.8±0.1[a]	8.3±0.0[a]

*Means with similar superscript showed no significant difference (P>0.05)
Key: THB = total heterotrophic bacteria; TCC = total coliform counts; FC = fungal counts

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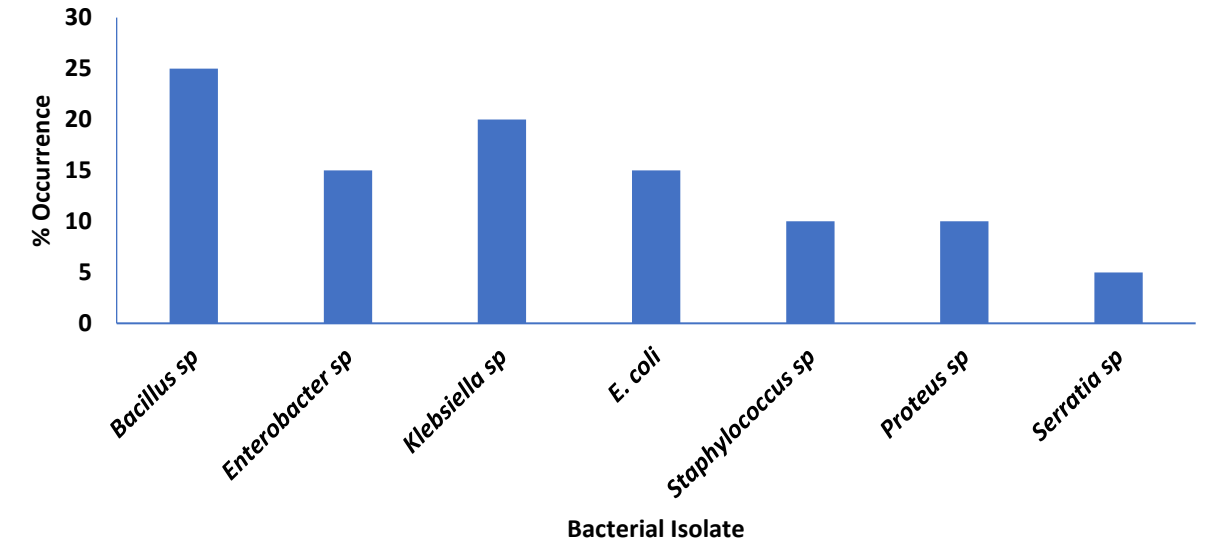

Fig. 1: Percentage Occurrence of Bacterial isolates

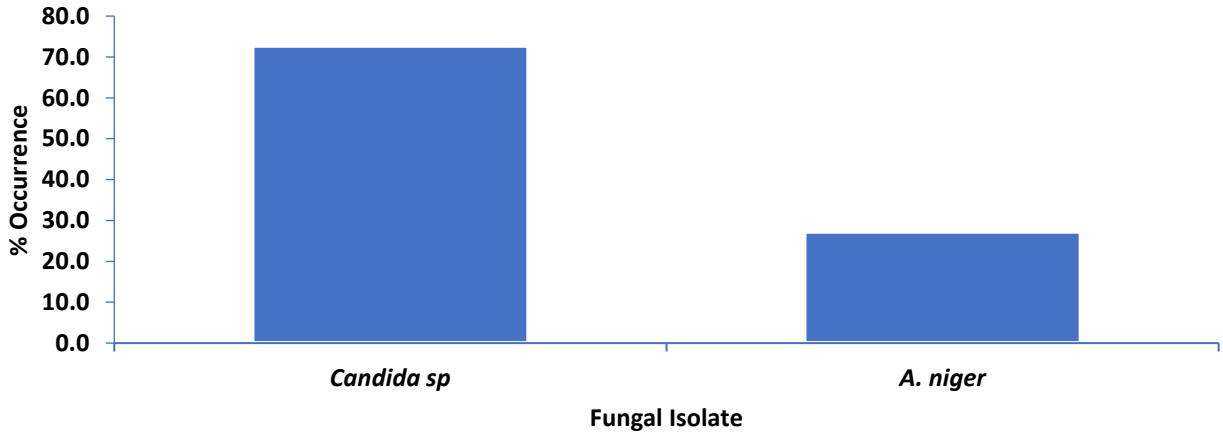

Fig. 2: Percentage Occurrence of Fungal Isolates

Table 2: Distribution of bacteria across the sex toy (*Dildo*) samples

Bacterial Isolate	Sex toy (*Dildo*) sample				
	A	**B**	**C**	**D**	**E**
Bacillus sp	+	+	+	+	+
E. coli	+	-	-	+	+
Enterobacter sp	+	-	-	-	+
Klebsiella sp	+	-	+	+	+
Proteus sp	-	-	-	+	+
Serratia sp	-	-	+	+	-
Staphylococcus sp	-	+	-	-	-

Key: +: isolated; -: not isolated

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Table 3: Distribution of fungi across the sex toy samples

Fungi isolate	Sex toy (*Dildo*) sample				
	A	**B**	**C**	**D**	**E**
Candida sp	+	+	-	+	-
Aspergillus sp	-	+	-	+	-

Keys: +: isolated; -: not isolated

The result of the antibiogram of the gram-negative isolates is presented in Table 4. Results showed that all the isolates of *Enterobacter* spp, *Klebsiella* spp, *E. coli*, *Proteus* spp, and *Serratia* sp were susceptible to gentamycin, ciprofloxacin and amikacin. Results also showed that susceptibility to chloramphenicol for *Klebsiella* spp and *E. coli* was 70% and 66.7%, respectively. *Serratia* and *Klebsiella* spp were susceptible to tetracycline antibiotics. *Enterobacter* spp, *Klebsiella* spp, *E. coli*,*Proteus* spp, and *Serratia* sp were resistant to cotrimoxazole, meropenem and Ceftriaxone (Table 4). In Table 5, all the *Staphylococcus* spp and *Bacillus* spp were susceptible to ciprofloxacin, cotrimoxazole, gentamycin and vancomycin but were resistant to ampicillin, Cefuroxime, ceftazidime and augmentin.

Table 4: Antibiogram of Gram-negative isolates from the sex toy samples

Isolates	GEN	CRX	CHL	CTR	CTX	TET	COT	MEM	CIP
Enterobacter sp (3)	S	R	R	S	R	I	R	R	S
Klebsiella sp (4)	S	R	S (70)	R	R	S	R	R	S
Proteus sp (2)	S	R	R	S	R	R	R	R	S
E. coli (3)	S	I	S (66.7)	S	S	R	R	R	S
Serratia (1)	S	R	R	S	I	S	R	R	S

Keys: GEN = gentamycin; CRX = Ceftriaxone, CHL = chloramphenicol, CTR = cefotaxime, TET = tetracycline, COT = cotrimoxazole, CIP = ciprofloxacin, MEM = meropenem

Table 5: Antibiogram of Gram-positive isolates from the sex toy samples

Isolates	CIP	AMP	ERY	TET	COT	CRX	GEN	CPZ	AUG	VAN
Staphylococcus sp (2)	S	R	R	S	S	R	S	R	R	S
Bacillus sp (5)	S	R	S	S	S	R	S	R	R	S

Keys: R = resistant; S = Susceptible, I = Intermediate, CIP = ciprofloxacin, VAN = vancomycin, ERY = erythromycin, COT = cotrimoxazole, GEN = gentamycin, CPZ = ceftazidime, CRX = Cefuroxime, AMP = ampicillin, TET = tetracycline, AUG = Augmentin.

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Discussion

The microbial load (both fungi and bacteria) associated from the various sex toys despite the variation from one sex toy to another is calls for concern due to their high occurrence. Although there is dearth of information concerning the acceptable limits of microbial load in sex toys, the fact that these toys are used on the genitals could signify potential infection irrespective of the observation of clinical signs or symptoms. Furthermore, the presence of a significant level of bacteria (10^5) in the urine has been regarded as a sign of urinary tract infection (Tadesse *et al.*, 2018).The high microbial load might not only be associated or signify the level of bacteria or fungi contracted from the vagina during the use of the toys but could be contamination from other sources.

During the study, some of the volunteers reported that they use special towels for cleaning after each use while others reported the use of water to wash the surface of the toys. Thus, the use of towels or water to clean the sex toys after each use could add to the microbial load. Educators and sex toy retailers recommended that sex toys be boiled (for silicon toys), cleaned with soap and water or cleaned with an antibacterial sex toy cleaner (Wood *et al.*, 2017).

The high microbial load is reflected on the type of microorganisms isolated from the sex toys. For instance, the presence of *E. coli, Staphylococcus*, *Klebsiella, Proteus* and *Serratia* spp which are known causes of UTI as well as sexually transmitted infections. Derbie *et al*. (2017) in their study reported that *E.coli, K. pneumonia, P. aeruginosa* and *S. aureus* accounted for 77.6% of the isolates associated with urinary tract infections. Behailu *et al.* (2016) in their study also reported that *E. coli, Klebsiella* and *Staphylococcus* spp. were the cause of UTIs.

Thus, the presence of these bacterial isolates on the surfaces of these used sex toys in the present study could raise concerns of vulvovaginal infection. The use of sex toys and whether they were cleaned may be related to the occurrence of certain vulvovaginal infections, according to some limited study (Anderson *et al.*, 2014). Aside UTI or vulvovaginal infections, some of these bacteria have been implicated in a number of infections. for instance, *Staphylococcus aureus* has been referred to as one of the most frequent bacteria that causes both community and nosocomial infections such as wound infections, otitis media, osteomyelitis, recurrent urinary tract infections, endocarditis and implant related infections(Gaire *et al.*, 2021).*Candida* sp are also known to be associated with UTIs and other vagina infections. In a previous study, one of the most notable opportunistic pathogenic fungus causing nosocomial UTIs were members of the *Candida* genus, and in particular *Candida albicans* (Behzadi *et al.*, 2015).

The antibiogram of the bacterial isolates showed high level of antibiotics resistance and all the isolates exhibited multi drug resistance even to the most commonly used antibiotics. The high resistance to ceftriaxone by the gram-negative bacteria isolates contradicts the findings of Tadesse *et al.* (2018) who reported 86.8% sensitivity of gram-negative isolates to ceftriaxone in their study.

Although, they reported high susceptibility by the gram-negative isolates to gentamycin and ciprofloxacin which agreed with the present study except for the fact that the isolates in the present study, they were completely susceptible to gentamycin and ciprofloxacin. Derbie *et al.* (2017)reported that susceptibility of *E. coli* to gentamycin was 72.4-75% while susceptibility of *Klebsiella* sp to ciprofloxacin was recorded as 79%. The differences observed could be attributed to the number of isolates considered in the respective studies.

Our findings agreed with Beyene and Tsegaye (2011) who reported complete susceptibility of *E. coli* and *K. pneumonia* to ciprofloxacin. Susceptibility of the gram-positive bacteria including *Staphylococcus* spp to gentamycin, ciprofloxacin and vancomycin is well documented. Fair and Tor (2014) had previously reported that the effectiveness of Gentamycin and Ciprofloxacin depends on their non-frequent usage since they may be considered costly or as a result of their nephrotoxic effects.

Thus, the high resistance or multi drug resistance observed in this study by both gram-positive and negative bacterial isolates could either be attributed to their over-use or environmental factors such as the acquisition of resistant genes (Obire *et al.*, 2009).

In conclusion, this study has revealed and shed light on the microbial landscape of sex toys (*Dildo*) in a tertiary institution in Nigeria and emphasizes the need for increased awareness of potential health risks associated with their use.

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By promoting hygienic practices, proper/adequate care and handling, individuals can enjoy the benefits of sexual health products while mitigating the potential health hazards posed by microbial contamination.

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