RESEARCH ARTICLE

# Prevalence of *Staphylococcus aureus* from dogs, pigs and their handlers in Zaria and Kaduna, Metropolis, Kaduna State

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## ABSTRACT

**Background:** *Staphylococcus aureus* is a critically important human pathogen that is also an emerging concern in veterinary medicine and animal agriculture. The present study aimed to identify the prevalence of Staphylococcus aureus from dogs, pigs, and their handlers in Zaria and Kaduna, Metropolis, Kaduna State**. Methods:** A total of three (300) samples were obtained from the Skin, anus, and anterior nare of pigs, dogs, and hand swabs of their handlers in three (3) Communities; Buwaya, Gonin-Gora, Maraban Rido, all in Kaduna and Samaru, Zaria in Kaduna state. *S. aureus* was isolated and characterized using standard microbiological protocols. **Results:** The results revealed that one Hundred and Sixty-five (165) of the samples isolated were *Staphylococcus* after the samples were cultured on Mannitol Salt Agar (MSA). Ninety-five (95) were confirmed to be *Staphylococcus* species after the Coagulase test was carried out. Further identification of the Ninety-five (95) isolates using the Microgen Staph-ID kit results revealed that 46(48.4%) of the isolates were *S. aureus*, 49 (51.5%) other species of *Staphylococcus* that were coagulase-positive but not *S. aureus,* like *S. Intermedius* 6(6.3 %,) *S. hyicus* 4(4.2%). The coagulase-negative isolates consists of *S.xylosus* 27 (28.4%), *S.chromogenes* 8 (8.4 %), *S. hominis* 4(4.2%). **Conclusion:** the results of the present study calls for public health concern because of the health risk associated with colonization of individuals with *Staphylococcus aureus*.

**Keywords:** Staphylococcus aureus; prevalence; dogs; pigs; handlers; Zaria and Kaduna

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## 1.0 Introduction

*Staphylococcus aureus* is a Gram-positive, facultative, anaerobic, non-motile, and non-spore forming bacterium, that causes a wide spectrum of diseases that include bacteremia, endocarditis, osteomyelitis, nosocomial infection [1]. This pathogenic bacterium could also cause mild conditions such as skin and soft tissue infections, to life-threatening debilitations like toxic shock syndrome [2]. Staphylococci are important pathogens that cause healthcare-associated infections and were mostly responsible for healthcare-associated infections in a United State [3].

Endogenous spread of staphylococci is a potential source of infection in surgical patients; surgical prophylaxis is administered to reduce the risk of postoperative surgical-site infection [4] *Staphylococcus aureus* has persisted and is now

resurging as an important hospital and community-acquired pathogen and live-stock acquired pathogen [5]. *Staphylococcus aureus* causes an array of infections in economically important livestock animals, particularly pigs [6]. The success of *Staphylococcus aureus* as a pathogen is partly due to its ability to express a variety of virulence factors that mediate host colonization, tissue invasion, and dissemination [7,8]

Interactions between *S. aureus* and other bacteria of the nasal flora appear to aid or retard the growth of *S. aureus* in the anterior nares [9]. Humans are not the only reservoir for this organism because the organism can be isolated from companion animals, livestock, and wild animals [10]. About 4% of dogs and some cats carry *S. aureus* at one or more body sites (e.g., abdomen), including MRSA strains [11]. Additionally, livestock, especially pigs but also chickens and cattle, carry strains of ST398 that have been the cause of human infections [12].

Animals in wild populations (e.g, chimpanzees) harbor and shed *S.aureus [11]*. The presence of livestock-associated *S. aureus* in farmers constitutes a major threat to the public health care system[11]. *Staphylococcus aureus* prevalence in humans is strongly associated with prevalence in animals and intensity of contact with animals positive for *Staphylococcus aureus* [13]

In Nigeria, several studies conducted have shown that methicillin-resistant *Staphylococcus aureus* is a common cause of hospital and community-acquired infections [14-16]. A nasal carriage of *Staph aureus* has also been reported[17,18]. However, only a few studies have been carried out on the prevalence of *Staphylococcus aureus* infection from dogs, pigs, and pig farms and dog handlers to commonly used antibiotics, especially in the northern part of the country particularly in Zaria and Kaduna. Therefore, it is the aim of this study to isolate and identify the prevalence of *S.aureus* from pigs dogs and owners/handlers in Zaria and Kaduna Metropolis.

## 2.0 Material and Methods

### 2.1 Study Areas

The study areas where piggeries samples were collected included; Samaru, Zaria, and also from Buwaya Community in Gonin-Gora Kaduna state and the dogs, Maraban-rido area of Kaduna State. These areas were selected for the study based on the availability of the animals and the permission of the owners to allow for sample collection

### 2.2 Reagent and Media

Muller Hinton Agar (Oxoid Ltd., Basingstoke, Hampshire, England), Mannitol Salt Agar (Oxoid Ltd., Basingstoke, Hampshire, England), Nutrient Broth and Agar (Fluka, Bioche, Sigma-Aldrich). Crystal violet (May and Baker Ltd. Dagenham England), Ethanol, CarbolFuschin, Starch Soluble (BDH Chemicals Ltd., England), Phosphate Buffer PH 8 Bromothymol Blue, Lugol's iodine (May and Baker Ltd. Dagenham England), Hydrogen peroxide (SKG Pharma Ltd. Ikeja Lagos, Nigeria), Sterile deionized water, Hydrochloridic Acid, Ethanol-acetone, immersion oil (BDH), Serum Plasma, Sucrose, Normal Saline, 0.2M Monosodium Phosphate, Benzyl Penicillin potassium salt Deoxyribonuclease acid(Sigma Chemicals Company St Louis M.O. USA).

### 2.3 Collection of Samples

A total of 300 samples were collected and analyzed in this study. Samples were collected from nasal, rectal, and skin swabs of the pigs and dogs and nasal and hand swabs of workers and dog owners. Following the aseptic technique, samples were collected using a sterile cotton swab and were taken to the laboratory for bacteriological analysis in an ice pack. A total of 261 samples were collected from pigs, Dogs, farmworkers, and Dog Owners/Handlers.

### 2.4 Identification of *Staphylococcal* isolates from the sample

Samples were inoculated into sterile Nutrient agar (NA) and also Nutrient Broth (NB) and incubated at 37°C for 24 h. The overnight culture was then sub-cultured on the surface of sterile Mannitol Salt agar (MSA) by streaking and incubation at 37°C for 18-24 hours. Cultural characteristics of the resulting colonies were noted after which further confirmation of species was carried out on each isolate. The isolated samples were characterized using the simple staining, gram staining, and growth on selective media according to the methods of Cheesbrough, [19], and biochemical tests including the catalase test, coagulase test, and microgen staph ID test

### 2.5 Data Analysis

Data obtained from the study were analyzed statistically using Statistical Package for Social Sciences (SPSS) Version 13 software. Frequencies were obtained and percentages for study variables were calculated.

## 3.0 Results

### 3.1 Identification and Purification of Isolates obtained from the various Farms and Sample sites

Out of the 300 samples evaluated, only 198(66%) were cocci shape bacteria, and 95(57.5%) were identified as Staphylococcus spp. Out of the Staphylococcus spp. Identified, 46(48.4%) were Staphylococcus aureus while others were identified as Staphylococcus hyicus, Staphylococcus hominis, Staphylococcus intermedius, Staphylococcus chromogemes, and Staphylococcus xylosus,

### 3.2 Distribution of Coagulase Negative Staphylococcus (CoNS) according to the sample and location

From the distribution of the CONs in the studied areas, a total of 43 different species of CONs 6 COPs were obtained 22 from Buwaya Community (BGG), 14 from Maraban Rido (MR), and 13 from Samaru Zaria (SZ). Of the 43 CONs tested, 27 were *S. xylosus* (55.1%), *S. chromogens* 8(16.3%), and *S. hominis* 4 (8.2 %), other COPs that were not *S. aureus* were *S. hyicus* 4 (8.2 %) and *S. intermedius* 6(12.2%) (Table 2). According to the sample source, out of the 49 CoNS, 22 (44.89%), 14(28.57%), and 13(26.53%) were identified in pigs, dog, and human sample respectively (Table 3)

### 3.3 Occurrence of *Staphylococcus aureus* among the collected samples from the Swabs of the Animals in Zaria and Kaduna Metropolis.

The Occurrence and distribution of *Staphylococcus aureus* among the Swabs samples collected from animals in Zaria and Kaduna Metropolis are shown in table 4: Out of the total 46(100%) *Staph aureus* samples obtained, 20(43.5%) were obtained from Buwaya Gonin-Gora, 14(30.4%) from Maraban Rido while 12(26.1%) were obtained from Samaru Zaria (Table 4). The skin of the animals had the highest occurrence 20(43.5%), the nose and anus had an occurrence of 10(21.7%) and 9(19.6%) respectively while the handler's palm had the least occurrence of 7(15.2%).

**Table 1:** Identification and Purification of Staphylococcus isolates

| Total No. of tested samples | Test | Results | No of Isolates Positive (%) | Inference |
|---|---|---|---|---|
| 300 | Gram staining (Microscopy) | Cocci | 198(66%) | *Staphylococcus spp/ Micrococcus spp/ Streptococcus Spp* |
| 300 | Selective Media (Mannitol Salt Agar) | Golden Yellow | 165(55%) | *Staphylococcus spp* |
| 300 | Catalase | Bubbles | 165(55%) | *Staphylococcus spp* |
| 165 | Agglutination Test | Coagulase | 95(57.5%) | *Staphylococcus spp* |
| 95 | Microgen Test | | 46(48.4%) | *Staphyloccoccus aureus* |
| | | | 27(28.4%) | *Staphylococcus xylosus,* |
| | | | 8(8.4%) | *Staphylococcus chromogemes* |
| | | | 6(6.3%) | *Staphylococcus intermedius.* |
| | | | 4(4.2%) | *Staphylococcus hominis* |
| | | | 4(4.2%) | *Staphylococcus hyicus* |

**Table 2:** Prevalence of Coagulase Negative Staphylococcus (CoNS), among humans, Pigs and Dogs according to Location

| Staphylococcus Species | BGG (%) N= 22 | MR (%) N= 14 | SZ (%) N= 13 | Total N= 49 |
|---|---|---|---|---|
| *S. xylosus* | 10(45.45) | 8(57.14) | 9(69.2) | 27(55.1) |
| *S. chromogens* | 3(13.63) | 4(28.57) | 1(7.69) | 8(16.3) |
| *S.intermedius* | 2(9.09) | 2(14.28) | 2(15.38) | 6(12.2) |
| *S. hominis* | 4(18.18) | 0(0) | 0(0) | 4(8.2) |
| *S.hyicus* | 3(13.63) | 0(0) | 1(7.69) | 4(8.2) |
| Total | 22 (44.89%) | 14 (28.57%) | 13(25.58%) | 49(100) |

**KEY:** BGG= Buwaya Gonin-Gora, MR= Maraban Rido, SZ= Samaru Zaria, N= Total Number of Coagulase Negative *Staphylococcus* spp

**Table 3:** Distribution of Coagulase Negative Staphylococcus (CoNS), among humans, pigs and dogs

| CoNS Species | Humans (%) | Pigs (%) | Dogs (%) | Total |
|---|---|---|---|---|
| *S. xylosus* | 4(30.76) | 17(77.27) | 6(42.85) | 27(55.1) |
| *S. chromogenes* | 3(23.07) | 2(9.09) | 3(21.42) | 8(16.3) |
| *S.intermedius* | 6(46.15) | 0(0) | 0(0) | 6(12.2) |
| *S. hominis* | 0(0) | 0(0) | 4(28.57) | 4(8.2) |
| *S.hyicus* | 0(0) | 3(13.63) | 1(7.14) | 4(8.2) |
| Total | 13(26.53%) | 22 (44.89%) | 14(28.57%) | 49(100) |

**Table 4:** Occurrence and distribution of *Staphylococcus aureus* from samples obtained from Animals and their Handlers in Zaria and Kaduna Metropolis

| Location | Prevalence (%) | Source | | Prevalence (%) |
|---|---|---|---|---|
| Buwaya Gonin-Gora | 20(43.5%) | Skin | Pig | 5(20%) |
| | | | Dog | 4(25) |
| | | Nose | Pig | 2(10%) |
| | | | Dog | 2(10%) |
| | | Anus | Pig | 2(10%) |
| | | | Dog | 1(5%) |
| | | Handlers | | 4(20%) |
| Maraban Rido | 14(30.4%) | Skin | Pig | 3(21.43%) |
| | | | Dog | 3(21.43%) |
| | | Nose | Pig | 1(7.14%) |
| | | | Dog | 2(14.28%) |
| | | Anus | Pig | 1(7.14%) |
| | | | Dog | 2(14.28%) |
| | | Handlers | | 2(14.28%) |
| Samaru Zaria | 12(26.1%) | Skin | Pig | 4(33.33%) |
| | | | Dog | 1(8.33%) |
| | | Nose | Pig | 3(25%) |
| | | | Dog | - |
| | | Anus | Pig | 3(25%) |
| | | | Dog | - |
| | | Handlers | | 1(8.33%) |
| Prevalence | 46(100%) | | | |

## 4.0 Discussion

*Staphylococcus aureus,* a major cause of potentially life-threatening infections that is acquired from and in Healthcare and Community settings and are also found on the skin and nasal regions of animals such as pigs and domestic companion animal's dogs has developed resistance to most classes of antimicrobial agents [14,17,20]. In this study, *S. aureus* was identified in dogs, pigs, and members of the household that own them in Buwaya, Gonin-Gora, Maraban rido Area, and Samaru Zaria all in Kaduna state was studied. The skin, nose, anus, and palm swab samples were obtained from communities populated predominantly by farmers with little or no educational background and have the tendency of taking antibiotics without prescription.

In all the households and pig farms where the study was conducted, the heads of the households admitted to self-medication with antibiotics. This study reported species distribution of staphylococcus strains isolated from the farm attendants, dogs, and pigs in Kaduna, Nigeria. The epidemiology of staphylococcus infections continued to evolve, with different characteristic patterns and associated clinical complications[21,22]. In this study, the *S. aureus* colonization rate was 46(48.4%) were phenotypically detected in dog and pig and also the palms of the farm attendants.

Pig and dog constitute one of the important animals reared within the communities in the study area and an important source of animal proteins for the communities. Pigs were first reported as an animal reservoir of *S. aureus* in 2005 [23]. In the Netherlands, 45% of veterinarians attending pig farms were positive for MRSA [24], while in Belgium and Denmark, the prevalence of Staphylococcus isolates in veterinarians was 9.5% and 1.4%, respectively [25].

Apart from the fact that high staphylococcus isolates colonization rate was recorded among the pig and dog in this study, a total of 7(15.2%) *S. aureus* were isolated from the animal's handlers. This contamination occurs through the high level of contact with the animals through rearing and domestication. This is of public health concern because of the possible transmission and dissemination of the staphylococcus isolates within the community through nasal dropping during movement within the community and contamination of meat and milk products by colonized handlers [26]. Studies have reported that staphylococcus isolates colonization of animals posed a potential risk of up to 60% transmission to the contact persons [27,28]

The level of Staphylococcus isolates colonization rate among contact persons varied with geographic location, type of animals, and culture methods employed in the studies [29,30]. *Staphylococcus aureus* is a clinically relevant pathogen due to its antimicrobial resistance and evasion of the host immune system. The present study has demonstrated the existence of an alarming level of *S. aureus* in the study area. The results were in accordance with reports from earlier studies in other countries. In the present study, the staphylococcus isolates colonization rate among contact persons was 13(26.53%) this level is comparatively higher than the values reported in from other geographical studies [31-33].

All studies on Staphylococcus colonization or infection among pets have shown that both human-to-animal and animal-to-human transmission occur and that environmental sources in veterinary clinics, veterinary staff, and other hospitalized animals play a crucial role. Pets are able to exchange resistant pathogens with humans, as shown by epidemiological studies performed in different countries [34,35]. It is well known that Staphylococcus spp. are important nosocomial pathogens in both human and veterinary medicine.

The public health implication is that Staphylococcus spp. strains are resistant to multiple antimicrobial agents and as such, treatment options are limited. Staphylococcus spp. may cause severe problems such as bloodstream infections, pneumonia, and surgical site infections [36]. However, from this study, it is observed that the transmission is most likely animal-to-human as the isolates from the handlers are less compared to that of the pigs and dogs.

## 5.0 Conclusion

In conclusion, this study established a high prevalence of Staphylococcus aureus from dogs, pigs, and their handlers in Zaria and Kaduna,

Metropolis, Kaduna State. The results of the present study call for public health concern because of the health risk associated with the colonization of individuals with Staphylococcus aureus

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