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# Prevalence of Multidrug-Resistant *Staphylococcus aureus* in Meals Served at Hospitals

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**Abstract**

*Staphylococcus aureus* (*S. aureus*) is one of the major causes of foodborne intoxication worldwide. Meals introduced to patients at hospitals are mandatory to be free from pathogens. Therefore, this study was conducted to investigate the prevalence of *S. aureus* in four basic meals hosted to hospitals in Menoufia government, Egypt including fried chicken, fried meat, grilled chicken, and grilled meat. The antimicrobial resistance of the recovered *S. aureus* isolates was screened. The public health significance of *S. aureus* was further discussed. The obtained results revealed that 31 out of 120 samples (25.6%) were found to be contaminated with *S. aureus*. The highest prevalence of *S. aureus* was found in grilled chicken (36.7%), followed by fried chicken (26.7%), grilled meat (23.3%), and fried meat (16.7%). The mean values (CFU/g) of *S. aureus* counts in grilled chicken, fried chicken, grilled meat and fried meat were $1.59\times10^4\pm0.26\times10^4$, $8.12\times10^3\pm 2.04\times10^3$, $6.63\times10^3\pm 1.51\times10^3$, and $2.97\times10^3\pm 0.39\times10^3$ respectively. Most of the *S. aureus* isolates showed high resistance to Kanamycin (100%), Neomycin (93.5%), and Streptomycin (90.3%), respectively. The moderate resistance of *S. aureus* isolates was detected for erythromycin (58%), followed by gentamicin (32.3%), Oxacillin (19.4%), Enrofloxacin (6.5%), and Vancomycin (3.2%) respectively. Using polymerase chain reaction, the coding genes for the drug resistance against Methicillin, Vancomycin, Erythromycin, and Gentamicin were detected in several isolates. In conclusion, strict hygienic measure should be followed during preparation of the meals served at the hospitals to avoid their contamination with food poisoning organisms, particularly *S. aureus*.

**Keywords:** Meals, Staphylococcus aureus, Drug resistance.

## Introduction

Meat are regarded as significant providers of essential amino acids, B complex vitamins, minerals, and protein. Conversely, it serves as a great growing medium for a wide range of harmful microorganisms. It has been underlined how crucial it is for hospitalized patients to eat healthfully and how eating tainted food could hinder their recuperation [1]. Outbreaks of foodborne infection at hospitals can be avoided, but they are made more likely by a number of variables, such as unsanitary kitchens, untrained food handlers, and staff carriers. Given to patients who are ill, tainted food poses a risk to their health [2].

Food poisoning diseases are caused by the Gram-positive pathogenic bacterium *Staphylococcus aureus* (*S. aureus*) [3]. Global reports of epidemics of enterotoxins and *S. aureus* food poisoning (SFP) have been made [4, 5]. A total of 241,188 instances of SFP were reported in the United States between 2006 and 2008, according to the Centres for Disease Control and Prevention's assessment of foodborne illness [6]. These cases led to 1064 hospitalizations and 6 fatalities. According to Wu et al. [7], *S. aureus* is one of the most dangerous bacteria for humans. In

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China, microorganisms were responsible for 53.7% of instances of food poisoning in 2015. The sudden start of SFP, which causes vomiting, nausea, and cramping in the abdomen in patients [8]. Numerous additional illnesses, such as bacteremia, pneumonia, soft tissue infections, and toxic shock syndrome, are also caused by *S. aureus* [9].

Abuse of antibiotic used may caused *S. aureus* to become more resistant to drugs over time, and different regions are seeing distinct pandemic trends. Previous reports [10] have indicated that antibiotic-resistant *S. aureus* has been linked to outbreaks of foodborne disease, particularly methicillin-resistant *S. aureus* (MRSA) and multidrug-resistant *S. aureus* (MDR), which present a threat to public health security [11].

Multidrug resistant forms of bacteria are becoming more frequently as a result of the widespread use of antibiotics in recent decades, posing serious risks to public health. *S. aureus* is able to quickly develop resistance to almost all antibiotics due to its ability to adapt to its surroundings [12]. Food poisoning outbreaks have been linked to MDR *S. aureus*, which has been isolated from several food products [13, 14]. Furthermore, MRSA has received a lot of attention lately. It shown numerous antibiotic resistances, and the World Health Organization ranked it among the top 12 families of bacteria in 2017 for threat to human health [15]. Drug abuse without a prescription, excessive dosages, and pointless drug application have all contributed to the progressive rise in *S. aureus* drug resistance in recent decades and caused bacterial evolution [16, 17]. Multidrug-resistant *S. aureus* strains, particularly those that are MRSA, represent a significant health risk to humans, resulting in significant morbidity and mortality. This is particularly true in hospitals and among healthy individuals [18]. Livestock-associated MRSA is spread via foods obtained from animals [19, 20]. At abattoirs, meat processing facilities, , carcasses, meat products, or ready-to-eat (RTE) foods may act as possible sources of MRSA and pose a risk to consumers [21, 22].

According to Holmes et al. [23], vancomycin has historically been used as a last-resort treatment for MRSA infections. Nevertheless, overuse of it results in diverse vancomycin-intermediate *S. aureus* strains, and vancomycin-resistant S. *aureus* [24].

One class of antibiotics called macrolides, which also contains erythromycin, is used to treat *S. aureus*-related infections. Erythromycin resistance is a result of overuse and uncontrolled usage among many infections. *S. aureus* resistance to erythromycin has been linked to a number of mechanisms. One of these mechanisms is the alteration of the ribosomal binding site, which lessens the capacity of erythromycin to bind to ribosomes. This change is mediated by the production of ribosomal methylase, which is encoded by *erm* genes [25].

One class of antibiotics that is crucial in the management of staphylococcal infections is aminoglycosides Aminoglycoside-modifying enzymes (AMEs), which are encoded by genetic elements, inactivate antibiotics and are the primary mechanism of resistance to aminoglycosides [26]. Thus, the most significant genes in this regard are those that encode aminoglycoside-6'-N-acetyltransferase/2"-O-phosphoryltransferase, aminoglycoside-4'-O-nucleotidyltransferase I, aminoglycoside-3'-O-phosphoryltransferase III, and streptomycin modifying enzyme, respectively. These genes are aac (6')-Ie + aph (2''), ant (4')-Ia, aph (3')-IIIa, and ant (6)-Ia. A bifunctional enzyme with AAC (6') and APH (2") activity mediates staphylococci's resistance to gentamicin, kanamycin, and tobramycin. While the APH (3')-III enzyme inactivates neomycin, the ANT (4')-IA enzyme inactivates kanamycin, amikacin, neomycin, and tobramycin [27].

Thus, the current study set out to assess the *S. aureus* prevalence in the fried and grilled chicken and red meat at the hospital restaurants. The disk diffusion method was used to screen the obtained isolates' antibiograms. Furthermore, PCR was used to screen for the presence of vancomycin, gentamycin, methicillin, and erythromycin resistance genes in *S. aureus*.

## Material and Methods

This study was done according to the guidelines of Benha University, and no living animals were used in the present study.

*Collection of samples*

A governmental hospital restaurant in Menoufia government, Egypt provided 120 randomized samples of grilled chicken, fried chicken, grilled meat, and fried meat (30 of each type). Samples (100 g/ each) were provided during serving (about 30 minutes after cooking). Every sample that was taken was separately stored in a sterile plastic bag, kept cold in an ice-box, and then brought straight into the laboratory at Food Hygiene and Control Department, Faculty of Veterinary Medicine, Benha University, where it was kept in perfect aseptic conditions. The collected samples underwent a bacteriological analysis as soon as it arrived to identify *S. aureus* and characterize its genes related to resistance to antibiotics.

*Bacteriological examination:*

*Preparation of samples* [28]

Ten-fold serial dilutions were made from the sample after 225 ml of 0.1 % sterile peptone water was precisely added to 25g of the sample and carefully blended for 1.5 minutes using a sterile blender.

*Determination of total S. aureus count* [29].

Using a sterile bent glass spreader, one millilitre from each of the created serial dilutions was spread over the Baired Parker agar plate. After being turned over, the control and inoculation plates were incubated for 48 hours at 37°C. The colonies were counted; they were lustrous black colonies. The black, shiny, round, smooth, convex, and narrowly white margined suspicious colonies of *S. aureus* were counted, and the number of colonies per milligram of *S. aureus* was determined.

*Identification of Staphylococcus aureus:*

The process involved morphological examination [30], followed by biochemical identification [31] and testing for the presence of hemolysis, coagulase, thermostable nuclease test "D-Nase activity," mannitol, growth at 10% NaCl, bile esculent test, catalase activity, oxidase, and fermentation of sugars [32].

*Antibiotic susceptibility testing of S. aureus.*

Using the Kirby Bauer disk diffusion test [33], the antibiotic susceptibility of all *S. aureus* isolates was assessed against 14 antibiotics on Mueller-Hinton agar plates (Oxoid, England). Trypticase Soy Broth (Oxoid, Basingstoke, UK) was used to cultivate *S. aureus*, and it was cultured for 18 hours at 37°C. After obtaining an optical density with sterile physiological saline, it was corrected to 0.5 McFarland standards and then plated on Müller Hinton Agar (Oxoid, Basingstoke, UK). To prevent inhibition zone overlap, the antibiotic discs were positioned far on the Müller Hinton Agar (Oxoid, Basingstoke, UK) surface. Incubation plates for 24 hours at 37°C. Following incubation, the inhibition zones were measured, and the Clinical Laboratory Standard Institute guidelines [34] were followed for the interpretation of the results. The following equation was used to compute the multiple antibiotic resistance index of the *S. aureus* isolate, in accordance with the formula provided by Singh et al. [35]:

MAR index= Number of resistance profile antibiotics / the number of used antibiotics

*Polymerase Chain Reaction Detection of Methicillin, Erythromycin, Gentamicin and Vancomycin-Resistance Genes:*

*DNA Extraction by QIA amp kit* [36]:

Utilizing the DNA extraction kit (Qiagen, GmbH, Germany) per the manufacturer's instructions, genomic DNA was extracted from 24-hour cultures of phenotypic MRSA" (*mecA*) and antibiotic resistance genes represented by Erythromycin (*ermA*), Gentamicin (*aac 6-aph 2*), and Vancomycin (*vanA*) of *S. aureus* isolates in BHI broth [36]. Thermo Fisher Scientific, Waltham, Massachusetts, USA, provided the NanoDropTM 1000 spectrophotometer, which was used to measure the quantity and purity of DNA. As previously reported [37-39], the methicillin resistance gene (*mecA*), the erythromycin resistance gene (*ermA*), the gentamicin resistance gene (*aac 6-aph 2*), and the vancomycin resistance gene (*vanA*) were identified by PCR using primers (Pharmacia Biotech) described before.

*Multiplex polymerase chain reaction:*

In accordance with Perez-Roth et al. [40], a 25 µL total volume was used for the multiplex PCR, which included 1 µL of bacterial suspension extracted using the rapid DNA extraction method, 80 mM MgCl2, PCR buffer, 3.5 mM DNTP mix (Fermentas), 10 picomoles µL-1 of each primer, and 1 unit of Taq polymerase (BioSyntech Technologies). The following thermal cycling profile was used for the amplifications: a first denaturation step at 94°C for 5 minutes was followed by 10 cycles of amplification (denaturation at 94°C for 30 seconds, annealing at 64°C for 30 seconds, and extension at 72°C for 45 seconds); 25 cycles of amplification (denaturation at 94°C for 45 seconds, annealing at 50°C for 45 seconds, and extension at 72°C for 1 minute) and a final extension step at 72°C for 10 minutes. Following amplification, a 2% agarose gel containing 10 µL of the reaction mixture was electrophoresed to determine the sizes of the amplified products using a 100-bp molecular size standard ladder (MBI Fermentas). After staining the gel with ethedium bromide, the gel was photographed under a UV lamp.

*Statistical analysis*

The Analysis of Variance (ANOVA) test was used to statistically evaluate the obtained results [41].

## Results

Out of the 120 examined samples, *S. aureus* was isolated from 31 samples (25.6%). *S. aureus* was isolated from grilled chicken at 11 out of 30 (36.7%), fried chicken at 8 out of 30 (26.7%), grilled meat at 7 out of 30 (23.3%), and fried meat at 5 out of 30 (16.7%), respectively.

It was revealed that the count of *S. aureus* in grilled chicken ranged from 4.0 $x10^2$ to $3.7\times10^4$ with a mean value of $1.59\times10^4\pm0.26\times10^4$ CFU/g, the range of *S. aureus* in fried chicken ranged from 2.0 $x10^2$ to $1.9\times10^4$ with a mean value of $8.12\times10^3\pm 2.04\times10^3$ CFU/g, the range of *S. aureus* in grilled meat ranged from 1.0 $x10^2$ to $1.1\times10^4$ with a mean value of $6.63\times10^3\pm 1.51\times10^3$ CFU/g, and the range of *S. aureus* in fried meat ranged from 1.0 $x10^2$ to $8.0\times10^3$ with a mean value of $2.97\times10^3\pm 0.39\times10^3$ CFU/g (Table 2).

Table 3 shows the resistance of 31 isolates of *S. aureus* from grilled chick (11 isolates), fried chicken (8 isolates), grilled meat (7 isolates) and fried meat (5 isolates) against 14 antimicrobials using the disc

diffusion method. In our study, isolates of *S. aureus* demonstrated the peak resistance to Kanamycin, Neomycin and Streptomycin (100%, 93.5%, and 90.3% respectively), followed by Nalidixic acid, Penicillin, and Oxytetracycline (77.4%, 67.4% and 64.5%) respectively. The moderate resistance of *S. aureus* isolates was detected for erythromycin (58%), followed by sulfamethoxazole, Cephalothin, and Ciprofloxacin (48.4%, 41.9% and 41.9%), respectively. While the lower resistance of *S. aureus* isolates was found for Gentamicin, Oxacillin, Enrofloxacin and Vancomycin (32.3%, 19.4%, 6.5%, and 3.2%), respectively.

Table 4 shows detailed antimicrobial resistance profiles. MDR index among the 31 *S. aureus* isolates ranged from 0.071 to 1. As 21 isolates (67.7%) were resistant to three classes of antimicrobials. While 10 isolates (32.3%) were resistant to eight classes of antimicrobials, and one strain (3.2%) was resistant to more than eight classes of antimicrobials. The average MAR index value was 0.54.

Out of the 31 *S. aureus* isolates, 16 isolates (51.6 %,) were screened by PCR for harboring MRSA-coding gene *(mecA)* and antibiotic resistance-coding genes, Erythromycin *(ermA)*, Gentamicin *(aac 6-aph 2)* and Vancomycin (*vanA*) as presented in Fig. 1. The obtained results revealed that 9 out of 16 (56.25%) were +ve *ermA* gene, 7 out of 16 (43.75%) were +ve *aac (6)-aph* (Table 5), 4 out of 16 (25%) were +ve *mecA* gene, and 2 out of 16 (12. 5%) were +ve *vanA* (Table 6).

## Discussion

According to Wegndlandt et al. [42] and Sergelidis and Angelidis [43], *S. aureus* is thought to be the primary source of food poisoning in hospitals and one of the most frequent causes of nosocomial infections. Hospital meals are an essential component of medical care. Encouraging patients to eat properly and providing them with the nutrition they need to recover from sickness can be achieved with safe and comprehensive meals. *S. aureus* contamination of food can result from contaminated food produced by animals, from unsanitary manufacturing conditions, from food storage problems at retail, or from human sources.

The results of this study (Tables 2-6) showed that the prevalence of *S. aureus* in various hospital food samples, which included fried chicken, grilled chicken, and fried meat, was (25.6%). The present study's prevalence rate of *S. aureus* in hospital food samples was more than that of Portugal (11.10%) [44], and Iran (6.42%) [45]. However, research's prevalence rate of *S. aureus* in hospital food samples was lower than the 50% reported in Brazil [46] and the 50.8% reported in Egypt (Benha city) for ready-to-eat meat products sampled from restaurants and street vendors [47]. Additionally, findings are consistent with the 33.26% reported prevalence in ready-to-eat meat products collected in all of South Africa's provinces [48]. The prevalence rates of *S. aureus* in hospital meals that our research examined were (36.7%, 26.7%, 23.3%, and 16.7%) for grilled chicken, fried chicken, grilled meat, and fried meat, respectively. These results are consistent with earlier reports [49, 50] that found *S. aureus* in samples of luncheon food, burgers, shawerma, and kofta that were examined.

Arab [51] looked at the bacteriological quality of cooked beef, they found $1.86 \times 10^3 \pm 0.64 \times 10^3$ CFU/g, which is almost identical to the counts of *S. aureus* found in the current experiment. The bacteriological quality of fried beef burgers was probably investigated by Ali [52], who discovered that the mean count of staphylococci was $1.85 \times 10^3 \pm 0.42 \times 10^3$ / (CFU/g). Mohamed et al. [53] also measured the mean counts of staphylococci at $2.10 \times 10^3 \pm 0.32 \times 10^3$ and $9.58 \times 10^3 \pm 2.08 \times 10^3$ CFU/g in fried beef and chicken flesh, respectively. The isolation of *S. aureus* from the examined samples, particularly heat-treated could be attributed to post-processing contamination and reflects poor personal hygiene during serving of the meals at the hospital [2].

Thirty-one *S. aureus* isolates' resistance profiles against several antibiotic classes partially matched findings from other investigations [54, 55]. Because of their ability to produce an exopolysaccharide barrier [56] and a wide variety of multidrug resistant genes on plasmids, which can be exchanged and spread between different species of Staphylococci [57], *S. aureus* strains are known to be frequently resistant to antibiotic therapy. Antimicrobial resistance monitoring is therefore crucial to determining the efficacy of novel antibiotic generations.

As a result of temperature fluctuations during storage, MRSA can multiply and spread to cooked goods. According to previous reports, the usage of antibiotics during livestock and poultry production may be connected to the greater MRSA contamination of the different RTE sandwiches under examination [58].

## Conclusions

The study's findings revealed isolation of multidrug resistant S. aureus from meals served at hospitals. The recovered isolates harbored coding genes responsible for the observed MDR phenomenon. This could be because of improper handling practices and insufficient staff cleanliness. Hygiene precautions to prevent and minimize *S. aureus* food contamination are the cornerstone of the prevention of staphylococcal food-borne illness.

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*Conflicts of interest*

The authors declared no competing interests.

*Funding statement*

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**TABLE 1. Primer sequences of *S. aureus* used for PCR system.**

| Target gene | Oligonucleotide sequence (5′ → 3′) | Product size (bp) | References |
|---|---|---|---|
| *mecA* (F) | **5′** AAAATCGATGGTAAAGGTTGGC**′3** | 533 | **[38]** |
| *mecA* (R) | **5′** AGTTCTGGAGTACCGGATTTGC**′3** | | |
| *ermA* (F) | **5′** TATCTTATCGTTGAGAAGGGATT **′3** | 139 | |
| *ermA* (R) | **5′** CTACACTTGGCTTAGGATGAAA **′3** | | |
| *aac 6-aph 2* (F) | **5′** TTGGGAAGATGAAGTTTTTAGA **′3** | 174 | **[39]** |
| *aac 6-aph 2* (R) | **5′** CCTTTACTCCAATAATTTGGCT **′3** | | |
| *vanA* (F) | **5′**CATGAATAGAATAAAAGTTGCAATA**′3** | 1030 | |
| *vanA* (R) | **5′** CCCCTTTAACGCTAATACGATCAA **′3** | | |

**TABLE 2. Statistical analytical results of *S. aureus* count/g in the examined meals served at governmental hospitals (n=30/ each).**

| Meals | +Ve samples No. | % | Min. | Max. | Mean ± S.E* |
|---|---|---|---|---|---|
| **Grilled chicken** | 11 | 36.7 | $4.0\times10^2$ | $3.7\times10^4$ | $1.59\times10^4 \pm 0.26\times10^4$ **A** |
| **Fried chicken** | 8 | 26.7 | $2.0\times10^2$ | $1.9\times10^4$ | $8.12\times10^3 \pm 2.04\times10^3$ **B** |
| **Grilled meat** | 7 | 23.3 | $1.0\times10^2$ | $1.1\times10^4$ | $6.63\times10^3 \pm 1.51\times10^3$ **C** |
| **Fried meat** | 5 | 16.7 | $1.0\times10^2$ | $8.0\times10^3$ | $2.97\times10^3 \pm 0.39\times10^3$ **D** |

*Mean values with different superscript letters in the same column are significantly

**TABLE 3. Percentages of Antimicrobial susceptibility of *S. aureus* strains isolated from the examined samples of governmental hospital meals (n=31).**

| Antimicrobial agent | S | | I | | R | |
|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % |
| Kanamycin (K) | - | - | - | - | 31 | 100 |
| Neomycin (N) | - | - | 2 | 6.5 | 29 | 93.5 |
| Streptomycin (S) | 1 | 3.2 | 2 | 6.5 | 28 | 90.3 |
| Nalidixic acid (NA) | 3 | 9.7 | 4 | 12.9 | 24 | 77.4 |
| Penicillin (P) | 2 | 6.5 | 9 | 29.0 | 21 | 67.7 |
| Oxytetracycline (T) | 5 | 16.1 | 6 | 19.4 | 20 | 64.5 |
| Erythromycin (E) | 6 | 19.4 | 7 | 22.6 | 18 | 58 |
| Sulphamethoxazol (SXT) | 8 | 25.8 | 8 | 25.8 | 15 | 48.4 |
| Cephalothin (CN) | 14 | 45.2 | 4 | 12.9 | 13 | 41.9 |
| Ciprofloxacin (CP) | 15 | 48.4 | 3 | 9.7 | 13 | 41.9 |
| Gentamicin (G) | 17 | 54.8 | 4 | 12.9 | 10 | 32.3 |
| Oxacillin (OX) | 23 | 74.2 | 2 | 6.5 | 6 | 19.4 |
| Enrofloxacin (EN) | 24 | 77.4 | 5 | 16.1 | 2 | 6.5 |
| Vancomycin (V) | 27 | 87.1 | 3 | 9.7 | 1 | 3.2 |

**TABLE 4. Antimicrobial resistance profile of *S. aureus* strains isolated from the examined samples of meat products (n=31).**

| No. | *S.aureus* serovar | Antimicrobial resistance profile | MAR index |
|---|---|---|---|
| **1** | *S. aureus* | **K, N, S, NA, P, T, E, SXT, CN, CP, G, OX, EN, V** | 1 |
| **2** | *S. aureus* | **K, N, S, NA, P, T, E, SXT, CN, CP, G, OX, EN** | 0.928 |
| **3** | *S. aureus* | **K, N, S, NA, P, T, E, SXT, CN, CP, G, OX** | 0.857 |
| **4** | *S. aureus* | **K, N, S, NA, P, T, E, SXT, CN, CP, G, OX** | 0.857 |
| **5** | *S. aureus* | **K, N, S, NA, P, T, E, SXT, CN, CP, G, OX** | 0.857 |
| **6** | *S. aureus* | **K, N, S, NA, P, T, E, SXT, CN, CP, G, OX** | 0.857 |
| **7** | *S. aureus* | **K, N, S, NA, P, T, E, SXT, CN, CP, G** | 0.786 |
| **8** | *S. aureus* | **K, N, S, NA, P, T, E, SXT, CN, CP, G** | 0.786 |
| **9** | *S. aureus* | **K, N, S, NA, P, T, E, SXT, CN, CP, G** | 0.786 |
| **10** | *S. aureus* | **K, N, S, NA, P, T, E, SXT, CN, CP, G** | 0.786 |
| **11** | *S. aureus* | **K, N, S, NA, P, T, E, SXT, CN, CP** | 0.714 |
| **12** | *S. aureus* | **K, N, S, NA, P, T, E, SXT, CN, CP** | 0.714 |
| **13** | *S. aureus* | **K, N, S, NA, P, T, E, SXT, CN, CP** | 0.714 |
| **14** | *S. aureus* | **K, N, S, NA, P, T, E, SXT** | 0.571 |
| **15** | *S. aureus* | **K, N, S, NA, P, T, E, SXT** | 0.571 |
| **16** | *S. aureus* | **K, N, S, NA, P, T, E** | 0.500 |
| **17** | *S. aureus* | **K, N, S, NA, P, T, E** | 0.500 |
| **18** | *S. aureus* | **K, N, S, NA, P, T, E** | 0.500 |
| **19** | *S. aureus* | **K, N, S, NA, P, T** | 0.428 |
| **20** | *S. aureus* | **K, N, S, NA, P, T** | 0.428 |
| **21** | *S. aureus* | **K, N, S, NA, P** | 0.357 |
| **22** | *S. aureus* | **K, N, S, NA** | 0.286 |
| **23** | *S. aureus* | **K, N, S, NA** | 0.286 |
| **24** | *S. aureus* | **K, N, S, NA** | 0.286 |
| **25** | *S. aureus* | **K, N, S** | 0.214 |
| **26** | *S. aureus* | **K, N, S** | 0.214 |
| **27** | *S. aureus* | **K, N, S** | 0.214 |
| **28** | *S. aureus* | **K, N, S** | 0.214 |
| **29** | *S. aureus* | **K, N, S** | 0.214 |
| **30** | *S. aureus* | **K, N** | 0.143 |
| **31** | *S. aureus* | **K** | 0.071 |
| **Average** | **0.54** | | |

K: Kanamycin N: Neomycin S: Streptomycin NA: Nalidixic acid
P: Penicillin T: Oxytetracycline CN : Cephalotin E: Erythromycin
CP: Ciprofloxacin G: Gentamicin OX: Oxacillin EN: Enrofloxacin
V: Vancomycin SXT: Sulphamethoxazol

**TABLE 5. Incidence of erythromycin and gentamicin Resistant *Staphylococcus aureus* by PCR using specific *ermA* gene *and aac (6)-aph (2)* gene.**

| Hospital meals | No of examined strains | +ve *ermA* gene | | -ve *ermA* gene | | +ve *aac (6)-aph (2)*gene | | -ve *aac (6)-aph (2)* gene | |
|---|---|---|---|---|---|---|---|---|---|
| | | No. | % | No. | % | No. | % | No. | % |
| **Grilled chicken** | 4 | 3 | 75 | 1 | 25 | 3 | 75 | 1 | 25 |
| **Fried chicken** | 4 | 3 | 75 | 1 | 25 | 2 | 50 | 2 | 50 |
| **Grilled meat** | 4 | 2 | 50 | 2 | 50 | 1 | 25 | 3 | 75 |
| **Fried meat** | 4 | 1 | 25 | 3 | 75 | 1 | 25 | 3 | 75 |
| **Total** | 16 | 9 | 56.25 | 7 | 43.75 | 7 | 43.75 | 9 | 56.25 |

**TABLE 6. Incidence of Methicillin and vancomycin Resistant *Staphylococcus aureus* (MRSA) by PCR using specific mecA gene and specific *vanA* gene.**

| Hospital meals | No of examined strains | +ve *mecA* gene | | -ve *mecA* gene | | +ve *vanA* gene | | -ve *vanA* gene | |
|---|---|---|---|---|---|---|---|---|---|
| | | No. | % | No. | % | No. | % | No. | % |
| Grilled chicken | 4 | 2 | 75 | 1 | 25 | 1 | 25 | 3 | 75 |
| Fried chicken | 4 | 1 | 75 | 1 | 25 | 1 | 25 | 3 | 75 |
| Grilled meat | 4 | 1 | 50 | 0 | 0 | 0 | 0 | 4 | 100 |
| Fried meat | 4 | 0 | 25 | 0 | 0 | 0 | 0 | 4 | 100 |
| Total | 16 | 4 | 25 | 2 | 12.50 | 2 | 12.50 | 14 | 87.50 |

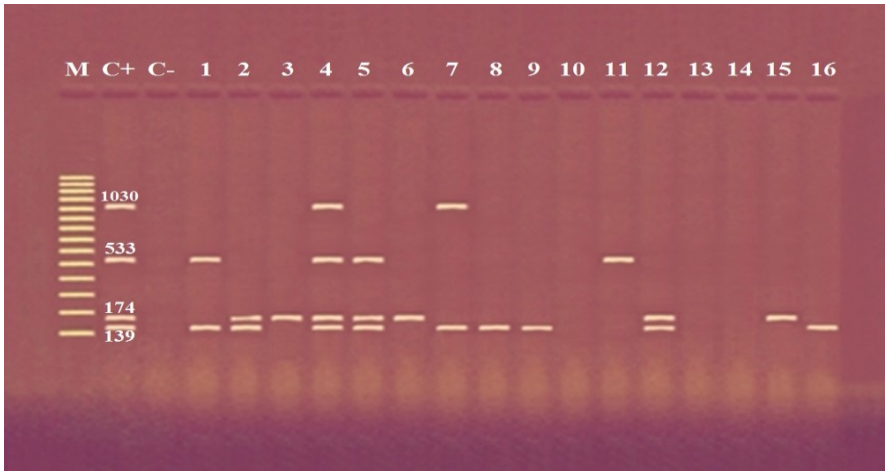


**Fig. 1. Agarose gel electrophoresis of multiplex PCR of *ermA* (139 bp), *aac (6)-aph (2)* (174 bp), *mecA* (533 bp) and *vanA* (1030 bp) antibiotic resistance genes of *S. aureus.***

**Lane M:** 100 bp ladder as molecular size DNA marker.
**Lane C+:** Control positive for *ermA, aac (6)-aph (2), mecA* and *vanA* genes.
**Lane C-:** Control negative.
**Lanes 1, 2, 4, 5, 7, 8, 9, 12 & 16:** Positive *S. aureus* strains for *ermA* gene.
**Lanes 2, 3, 4, 5, 6, 12 & 15:** Positive *S. aureus* strains for *aac (6)-aph (2)* gene.
**Lanes 1, 4, 5 & 11:** Positive *S. aureus* strains for *mecA* gene.
**Lanes 4 & 7:** Positive *S. aureus* strains for *vanA* gene.
**Lanes 10, 13 & 14:** Negative strains for *ermA, aac (6)-aph (2), mecA* and *vanA* genes.

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## تواجد المكور العنقودي الذهبي متعدد المقاومة للمضادات الحيوية في الوجبات المقدمة في احدي المستشفيات

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**المستخلص**

جديرا بالذكر أن المكورات العنقودية الذهبية أحد الأسباب الرئيسية للتسمم الغذائي في جميع أنحاء العالم. لذلك فمن الضروري ان تكون الوجبات المقدمة للمرضى في المستشفيات خالية من مسببات الأمراض. أجريت هذه الدراسة لبحث مدى انتشار جراثيم المكورات العنقودية الذهبية في عدد من الوجبات التي يتم تقديمها بأحدي المستشفيات بمحافظة المنوفية، مصر، وشملت الوجبات الدجاج واللحوم المحمرة والدجاج واللحوم المشوية. بالإضافة إلى ذلك، تم فحص مقاومة المضادات الحيوية لعزلات المكورات العنقودية الذهبية. هذا وقد تمت مناقشة الأهمية الصحة لتلك الميكروبات. وكشفت النتائج المتحصل عليها أن عدد 31 من أصل 120 عينة (25.6%) وجدت ملوثة ببكتريا المكورات العنقودية الذهبية. تم الوقوف على أعلى معدل لانتشار البكتيريا العنقودية الذهبية في الدجاج المشوي (36.7%)، يليه الدجاج المحمر (26.7%)، واللحوم المشوية (23.3%)، واللحوم المحمرة(16.7%). كان متوسط العدد الكلي للبكتريا في الدجاج المشوي والدجاج المحمر واللحوم المشوية واللحوم المحمرة هو عدد $1.59 \times 10^4 \pm 0.26 \times 10^4$ ، $8.12 \times 10^3 \pm 2.04 \times 10^3$ ، $6.63 \times 10^3 \pm 1.51 \times 10^3$ ، و $2.97 \times 10^3 \pm 0.39 \times 10^3$ على التوالي. وأكدت النتائج أن معظم عزلات المكورات العنقودية الذهبية مقاومة عالية لمركبات الكانامايسين والنيومايسين والستربتوميسين بنسب 100%، 93.5%، 90.3% على التوالي. بينما تم الكشف عن المقاومة المعتدلة لعزلات المكورات العنقودية الذهبية للإريثرومايسين (58%)، تليها الجنتاميسين، أوكساسيلين، الإنروفلوكساسين، والفانكومايسين (32.3%، 19.4%، 6.5%، و 3.2%) على التوالي. وتم استخدام تقنية تفاعل البلمرة المتسلسل للكشف عن جينات الضراوة لمقاومة الأدوية ضد الميثيسيلين، الفانكومايسين، الاريثروميسين، والجنتاميسين في عدة عزلات. و وخلصت الدراسة الي ضرورة اتباع إجراءات صحية صارمة أثناء إعداد الوجبات المقدمة في المستشفيات من أجل تلافي تلوث الوجبات المقدمة للمرضي بميكروبات التسمم الغذائي وبصفة خاصة المكور العنقودي الذهبي.

**الكلمات الدالة:** المكور العنقودي الذهبي ، وجبات المستشفيات ، مقاومة للمضادات الحيوية.