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Bacteriological Evaluation of Poultry Carcasses with A Special Focus on *Staphylococcus aureus* Prevalence, Enterotoxin Production and Antimicrobial Sensitivity

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Abstract

A TOTAL of 200 random samples, including 50 samples from each of broiler, baladi chicken, pigeon, and duck. The samples from each species consisted of 25 from each breast and thigh were collected to assess their microbiological quality. The recorded results showed that the highest total bacterial counts (TBC) in the broiler sample were found in the breast and thigh (5.19±0.30, and 5.62±0.29 log 10 cfu/g, respectively), while the lowest TBC was recorded in the pigeon's breast (4.19±0.30 log 10 cfu/g). The highest mold count was found in the baladi samples (3.01±0.37 log 19 cfu/g), and the lowest count was recorded in the pigeon thigh samples (2.28±0.12 log 10 cfu/g). The highest *Staphylococcus aureus* (*S. aureus*) counts were recorded in the broiler samples (thigh, and breast) at 4.56±0.20, and 4.42±0.22 log 10 cfu/g. The highest prevalence rates of *S. aureus* were recorded in broiler thigh (64%), and breast samples (48%), with production of enterotoxin A from 2 isolates. *S. aureus* isolates recovered from duck samples could produce enterotoxins A, C, and D types. In contrast, *S. aureus* isolates recovered from baladi and pigeon samples do not show any ability to produce enterotoxins. A significant number of *S. aureus* isolates demonstrated resistance to Neomycin (100%), Nalidixic acid (38.8%), Colistin (80.8%), Tetracycline (68.1%), Sulphamethoxazole (61.7%), and Penicillin (44.6%). Conversely, the isolates exhibited the highest sensitivity to Daptomycin (97.9%), Vancomycin (93.6%), Oxacillin (91.4%), Levofloxacin (83.0%), Meropenem (78.7%), Gentamicin (72.3%), and Cefepime (68.1%). In conclusion, strict hygienic measures should be followed during the preparation of poultry carcasses to reduce the microbial load and enhance the keeping quality.

Keywords: Poultry carcasses, Microbial contamination, *S. aureus*, antimicrobial susceptibility.

Introduction

The global poultry meat industry has reached a high level of development to meet the need for protein obtained from animals, particularly in areas where red meat is in insufficient supply. Various vital minerals, vitamins, and polyunsaturated fatty acids can be found in chicken meat and meat products [1]. At any stage of the processing chain, including slaughter, scalding, Defeathering, evisceration, cutting, distribution, and storage, these products are susceptible to microbial contamination. This includes the possibility of contamination at any point in the chain. Consuming contaminated food, which may contain bacterial pathogens and toxins, can lead to microbiological food poisoning. This type of food poisoning can be prevented. The incidence of illnesses transmitted through food is a direct indicator of the level of hygiene [2].

In 2015, the World Health Organization revealed that out of 600,000 cases of infection, roughly 420,000 people died as a result of foodborne pathogens. The majority of these deaths were attributable to *Salmonella sp., Listeria sp., Campylobacter sp., Vibrio cholera, and S. aureus* [3, 4]. There are a significant number of these pathogens that have been found in chicken samples [5]. This is especially true because chicken meat has a high moisture content, nitrogen-rich compounds (including proteins and essential amino acids), and a favorable mineral and vitamin profile, which makes it an ideal environment for the proliferation of bacteria [6].

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Due to the fact that they can attach to and resist chlorine in the final rinse water, *Staphylococci, and Staphylococcus aureus (S. aureus)* in particular, are frequently isolated from chicken meat [7]. Furthermore, *S. aureus* is recognized as the third biggest cause of food poisoning cases worldwide, and it is a contributor to significant outbreaks of foodborne illnesses [8]. The ability of *S. aureus* to produce a variety of staphylococcal enterotoxins (SEs) is the primary cause for concern. These SEs include A, B, C, D, E, G, H, I, J, K, L, M, N, O, P, Q, R, and U. However, only SEA, SEB, SEC, and SED are of major concern, as they are responsible for 95% of all cases of food poisoning related to enterotoxins [9,10,11,12]. Additionally, SEs are heat-stable, which means that they can withstand high temperatures and are not eliminated by the various techniques of cooking that are commonly used. In addition, it is difficult to identify these toxins in food because they do not cause any alterations to the product's aroma, flavor, and color [13, 14]. In light of the previous facts, it is of the utmost importance to investigate the microbial quality of the retailed poultry meat, including chicken, ducks, and pigeons. This study investigated the microbial status of chickens, ducks, and pigeons with a special focus on *Staphylococcus aureus* prevalence, enterotoxin production, and antimicrobial sensitivity.

Material and Methods

Samples collection

A total of two hundred random samples, including 50 from each of broilers, baladi, ducks, and pigeons. Such fifty samples in each species included 25 from each of the thigh and breast. Samples were collected from the retail stores in Zagazig city, Egypt. After being placed in an insulated ice container, each sample was instantly taken to the laboratory of the Meat Hygiene and Technology, Department of Food Hygiene, Safety and Technology, Faculty of Veterinary Medicine, Zagazig University, Egypt for bacteriological investigation.

Samples preparation

A meat homogenate was produced for each sample by first cutting 25 grams of the sample with sterile scissors and then inserting it in a sterile stomacher bag while the conditions were aseptic. After that, 225 milliliters of sterile buffer peptone water at a concentration of 0.1% was added. Following the homogenization of the mixture with a stomacher (Lab blender 400, Sweard Lab, Model No. AB 6021) for two minutes, the mixture was at room temperature for five minutes before being transferred to a sterile glass flask, where it was shaken firmly to ensure that it was fully mixed. In the end, one milliliter of this combination was transferred into separate tubes, each one contained nine milliliters of sterile diluent consisting of peptone water at a concentration of 0.1% [15].

Determination of total bacterial count (TBC)

Using the pouring plate technique, according to the method reported by APHA [16], TBC was estimated using plate count agar medium.

Determination of the total mold count

Following the cultivation of duplicate plates on malt extract agar media (MEA) (Oxoid) and the subsequent incubation of these plates at a temperature of 25 ℃ for five to seven days, the overall mold count was determined. Throughout the incubation period, the plates were examined regularly to see whether or not they contained any star-shaped mold growth. Mold colonies were carefully picked under aseptic circumstances, and then sub-cultured onto MEA slopes for further examination [16, 17].

S. aureus Isolation and Identification

From each chicken meat sample's serial dilution, 0.1 mL was surface spread onto Baird-Parker agar (Difco Laboratories, Detroit) supplemented with potassium tellurite and egg yolk (Difco Laboratories). Incubation of the inoculated plates was place for forty-eight hours at 37 ℃in an inverted orientation. The putative *S. aureus* was identified by counting and recording all of the characteristic colonies, which were distinguished by their black glossy convex shape, measuring between one and one and a half millimeters, having a small white boundary, and being enclosed by a clear zone that extended into an opaque medium. After that, these colonies were chosen and grown on nutrient agar slopes for further identification [15].

Identification of Staphylococcus aureu:

S. aureus was subjected to morphological study and Gram's staining, which revealed Gram-positive cocci that, when viewed through a light microscope, resembled bunches of grapes [18]. *S. aureus* was confirmed using coagulase activity, catalase testing, anaerobic glucose and mannitol utilization, sensitivity to lysostaphin, and the synthesis of thermostable nuclease [15]. The biochemical identification was carried out per the approach described before [15].

Serology confirmation of Staphylococcus aureus

A reputable latex slide agglutination test kit, known as the Dry Spot Staphytect plus Kit Oxoid DR0100M, was utilized in order to validate the presence of *S. aureus* through the use of serology. Within twenty seconds, agglutination of the latex particles occurs, which indicates the presence of *S. aureus*. This approach separates *S. aureus* by recognizing clumping factor, Protein A, and specific polysaccharides.

Detection and typing of Staphylococcus aureus enterotoxins

A determination was made regarding the ability of S. *aureus* isolates that were confirmed to be positive through serological testing to create enterotoxins. At first, the Sac culture method was carried out by the instructions before [19]. After that, the detection and typing of enterotoxins were carried out using the RPLA technique, which was carried out with the SET-RPLA KIT TOXIN DETECTION KIT (Oxoid TD0900, Japan LTD). This kit was designed for the identification of staphylococcal enterotoxins A, B, C, and D [20, 21].

Antimicrobial susceptibility of S. aureus in the examined samples

To determine the antimicrobial susceptibility of *S. aureus*, a total of sixteen different antimicrobials were examined. These antimicrobials included Oxacillin (OX) and Erythromycin (E), Vancomycin (V), Penicillin (P), Nalidixic acid (NA), Sulfamethoxazol (SXT), Cefepime (FEP) and Meropenem (M), Colistin (CO), Azithromycin (AZ) and Gentamicin (G), Neomycin (N), Ciprofloxacin (CP), and Tetracycline (T). The minimum inhibitory concentration (MIC) for each antibiotic was determined under the standards and guidelines [22]. Multidrug resistance, often known as MDR, is a condition that is characterized by acquired resistance to at least one antimicrobial agent across three or more specific categories.

Statistical analysis

All microbial counts were transformed to log 10 colony forming units (cfu)/ g. Means of microbial counts were calculated, and statistical analysis was conducted using ANOVA followed by Tukey's Kramer HSD test using SPSS software.

Results

The result of total bacterial count is shown in Table 1 and indicates that the highest total bacterial count was in broiler breast and thigh samples (5.19±0.30, and 5.62±0.29 log 10 cfu/g, respectively) and the lowest count was recorded in the breast of pigeon (4.19±0.30 log 10 cfu/g). The results illustrated in Table 2 showed that the highest mold count was recorded in baladi thigh samples (3.01±0.37 log 10 cfu/g), while the lowest count was recorded in the pigeon's breast samples (2.28±0.12 log 10 cfu/g). Results in Table 3 revealed that the maximum counts of *S. aureus* were recorded in broiler thigh, and breast samples at 4.56±0.20, and 4.42±0.22 log 10 cfu/g, respectively.

The prevalence of *S. aureus* in the examined poultry meat samples is shown in Table 4. Among 100 chicken meats, 94 were observed to be positive for S. aureus. Among chicken meats that had originated from broiler chicken operations that had A enterotoxin had the highest prevalence of S. aureus (16% of thigh, 12% of the breast), and from duck showed A and D enterotoxin from thigh and C and D from breast as percentage 5% of samples while baladi and pigeon not showed any enterotoxin of S. aureus.

The results of the antimicrobial susceptibility of *S. aureus* isolates are shown in Table 5. A high proportion of *S. aureus* isolates was resistant to Neomycin (47 isolates, 100%), Nalidixic acid (45 isolates, 95.7%), Colistin (38 isolates, 80.8%), Tetracycline (32 isolates, 68.1%), Sulphamethoxazol (25 isolates, 61.7%), and Penicillin (21 isolates, 44.6%), respectively. However, the isolates showed the highest sensitivity to Daptomycin (97.9%), Vancomycin (93.6%), Oxacillin (91.4%), Levofloxacin (83.0%), Meropenem (78.7%), Gentamicin (72.3%), and Cefepime (68.1%). The results of the antimicrobial resistance analysis of the S. aureus isolates are shown in Table 6.

Discussion

In particular, poultry meat and the products derived from it are susceptible to contamination by a wide variety of bacteria, which can pose a substantial threat to the public's health. Microbial contamination might take place during preparation of poultry carcasses including defeathering, evisceration, and following processing phases [23, 24]. It is widely acknowledged that *S. aureus* is a main contributor to foodborne diseases. Staphylococcal foodborne disease (SFD) is one of the most common foodborne diseases in the world. It is frequently caused by the presence of pre-formed enterotoxins [25, 26]. The initial microbial load of poultry meat plays a significant role in determining its shelf life; consequently, a higher level of initial contamination is associated with a shorter shelf life of chicken meat [27]. It is vital to continuously and severely implement measures that ensure the personal hygiene of staff members and the cleanliness of their work apparel to reduce the risk of meat contamination during the manufacturing and processing stages [28]. According to the findings, there are potential hygienic hazards connected to the retail sale of fresh chicken meat that is not wrapped by the manufacturer. Through the adoption of the HACCP system, which includes preparatory programs such as Good Hygiene Practices (GHP) and Good Manufacturing Practices (GMP), these hazards should be reduced to the greatest extent possible [29].

According to the findings of the total bacterial count, it was observed that the broiler samples had the highest total bacterial count, on the other hand, the breast of the pigeon had the lowest count. This could be attributed to the cross contamination from the surrounding environment [30, 31]. In agreement with the recorded results in the present study, it was

recorded high TBC in the retailed chicken meat reaching 7.9 log10 cfu/g. It has been established in a great number of studies that the use of HACCP systems in the food industry leads to a more efficient prevention of pathogens that are transmitted through food [32, 33, 34].

Samples collected from baladi chicken showed the highest total mold counts, while pigeon samples had the lowest. Relatively similar counts were reported by Mahmoud et al. (2020), who recorded total mold count in breast samples ranged from 2×10 to 1.4×10^3 cfu/g, with an average of 3.6×10^2 cfu/g [35]. In a study conducted by Habib (2017), it was discovered that the mould count obtained from frozen carcasses varied from 7×10 to 4.7×10^3 cfu/g, with a mean of 6.6×10^2 cfu/g [36]. Mold count acted as an indicator of the microbial quality of the product and the level of sanitation. As well as contributing to the processes of decomposition, molds have the potential to give a disagreeable odor and flavor to food products. Molds can be found on almost all food products at almost any temperature at which they are stored since they can thrive throughout a wide temperature range. This makes it possible to find mold on almost all food products. In addition, molds are known to facilitate the process of decomposition and have the ability to produce hazardous substances known as mycotoxins, which are known to be harmful to both people and animals.

S. aureus is a known foodborne pathogen that is responsible for many cases of foodborne intoxication due to the ability to produce enterotoxins. In the present study *S. aureus* was isolated from the collected samples at variable rates, particularly from thigh and breast samples of broilers. Isolates recovered from broilers and ducks could produce enterotoxins. On the other hand, baladi and pigeon samples did not demonstrate any enterotoxins of *S. aureus*. Likely, Mahmoud et al. (2020) revealed that the count of staphylococci in breast samples ranged from 1.7×10^2 to 4.6×10^3 cfu/g, with an average count of 6.3×10^2 cfu/g [35]. According to Habib (2017), who reported similar findings, the staphylococci count in frozen carcasses varied from 1.2×10^2 to 4.1×10^3 cfu/g, with a mean of 8.9×10^2 cfu/g. Staphylococci are frequently found on the skin and in the upper respiratory tracts of both humans and animals. This makes it likely that carcasses could be contaminated, particularly as a result of contaminated equipment and the hands of workers who may have abrasions or wounds [36].

According to several studies, the prevalence of Staphylococcus in market samples of chicken meat can range anywhere from 82 % to 100% [37]. When Staphylococcus is found in food, it indicates that humans have been in touch with it, which is typically the result of inadequate personal hygiene and poor production practices [38]. When ingested, the enterotoxins that are produced by Staphylococcus are resistant to high temperatures and can cause symptoms such as nausea, vomiting, and diarrhoea [39]. Furthermore, these bacteria can survive in concentrations of sodium chloride that are extremely high [40]. Although food poisoning caused by *S. aureus* very rarely results in death, it can be extremely dangerous for young children and those whose immune systems are already impaired [41]. The presence of Staphylococci in meat is indicative of unclean circumstances, the possibility of cross-contamination during processing, environmental factors, temperatures during processing, and personal touch. In addition to being a commensal organism that can be found on human skin, *S. aureus* is also a frequently occurring pathogen that is responsible for a wide variety of diseases, ranging from mild to severe, including food poisoning [42]. In a study that was conducted at the Central Health Laboratory in Mauritius by Hoteun et al. [43], it was discovered that *S. aureus* was the second most prevalent pathogen found in the food samples that were examined [43]. According to the findings of this investigation, the prevalence of *S. aureus* in market meat was 17.1%, which is consistent with the findings of Kozacinski et al. [27], who determined that the prevalence was 17.9%.

Antimicrobial susceptibility testing of the recovered *S. aureus* isolates showed marked multidrug resistance profiling. In particular, the recovered isolates showed marked resistance to Neomycin (100%), Nalidixic acid (38.8%), Colistin (80.8%), Tetracycline (68.1%), Sulphamethoxazole (61.7%), and Penicillin (44.6%). Conversely, the isolates exhibited the highest sensitivity to Daptomycin (97.9%), Vancomycin (93.6%), Oxacillin (91.4%), Levofloxacin (83.0%), Meropenem (78.7%), Gentamicin (72.3%), and Cefepime (68.1%). Likely, according to Li et al. [44], the highest level of resistance was identified against trimethoprim-sulfamethoxazole and erythromycin among the 289 *S. aureus* isolates that were investigated in their study. Both amoxicillin–clavulanic acid and ampicillin had resistance rates of 45.0% (130 out of 289) and 42.6% (123 out of 289), respectively, with 99.7% of *S. aureus* isolates displaying resistance to at least one antimicrobial agent. It is possible that intensive breeding techniques could result in a higher and more considerable utilization of antimicrobial drugs, which would then lead to an increase in the resistance rates among chicken isolates [45].

Conclusion

A considerable number of potentially harmful bacteria are found to be present in chicken carcasses, according to the findings of this study. These bacteria can be traced back to unclean activities, cross-contamination, and inadequate personal hygiene during the processes of handling, packaging, storing, distributing, and selling chickens. Therefore, to

guarantee the excellent quality of chicken carcasses and to safeguard the health of consumers, it is very necessary to adopt severe hygienic measures as soon as possible during the loading of imported frozen chicken.

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Declaration of Conflict of Interest

The authors declare that there is no conflict of interest.

Ethical of approval

This study was conducted according to the ethical guidelines of Zagazig University, Egypt.

TABLE 1. Statistical analytical results of aerobic bacteria count (log $_{10}$ CFU/g) in the examined poultry samples

Samples		Minimum	Maximum	Mean ± S.E.
Broiler	**Thigh**	4.48	6.40	5.62±0.29^{a}
	Breast	4	6.30	5.19±0.30^{ab}
Baladi	**Thigh**	4.15	6.34	4.67±0.34^{ab}
	Breast	3.08	5.40	4.20±0.43^{b}
Duck	**Thigh**	4.15	4.87	4.46±0.17^{b}
	Breast	4	4.99	4.42±0.24^{b}
Pigeon	**Thigh**	3.78	5.36	4.58±0.43^{ab}
	Breast	3.30	5.18	4.19±0.30^{b}

(N=25 of each). Means with different superscript letters are statistically different at P< 0.0.

TABLE 2. Statistical analytical results of total Mold count (log $_{10}$ CFU/g) in the examined poultry samples

Samples		Minimum	Maximum	Mean± S.E.
Broiler	**Thigh**	2	3	2.39±0.13
	Breast	2	3.30	2.31±0.19
Baladi	**Thigh**	2	4.30	3.01±0.37
	Breast	2	3	2.38±0.19
Duck	**Thigh**	2	3	2.59±0.19
	Breast	2	3.60	2.51±0.33
Pigeon	**Thigh**	2	2.78	2.43±0.12
	Breast	2	2.60	2.28±0.12

TABLE 3. Statistical analytical results of total staphylococcus count (log $_{10}$ CFU/g) in the examined poultry samples

Samples		Minimum	Maximum	Mean±S.E.
Broiler	**Thigh**	4.15	5	4.56±0.20
	Breast	4	4.96	4.42±0.22
Baladi	**Thigh**	3	4.15	3.75±0.75
	Breast	3	4.26	3.63±0.62
Duck	**Thigh**	3.78	4.53	4.15±0.38
	Breast	3.70	4.15	3.92±0.22
Pigeon	**Thigh**	3.78	4.53	4.15±0.38
	Breast	3.70	4.15	3.92±0.22

TABLE 4. Prevalence of *S. aureus* in the examined poultry samples

Samples		Number	Percentage	Enterotoxin
Broiler	**Thigh**	16	64%	A (2)
	Breast	12	48%	A
Baladi	**Thigh**	2	8%	-
	Breast	2	8%	-
Duck	**Thigh**	5	20%	A&D
	Breast	5	20%	C&D
Pigeon	**Thigh**	3	12%	-
	Breast	2	8%	-
Total		47	23.5%	

TABLE 5. Antimicrobial susceptibility of *S. aureus* in the examined samples

Antimicrobial agent	S		I		R	
	NO	%	NO	%	NO	%
Neomycin (N)	-	-	-	-	47	100
Nalidixic acid (NA)	-	-	2	4.3	45	95.7
Colistin (CO)	6	12.8	3	6.4	38	80.8
Tetracycline (T)	11	23.4	4	8.5	32	68.1
Sulphamethoxazol (SXT)	17	36.2	1	2.1	29	61.7
Penicillin (P)	24	51.1	2	4.3	21	44.6
Azithromycin (AZ)	29	61.7	-	-	18	38.3
Erythromycin (E)	29	61.7	1	2.1	17	36.2
Ciprofloxacin (CP)	30	63.8	3	6.4	14	29.8
Cefepime (FEP)	32	68.1	2	4.3	13	27.7
Gentamicin (G)	34	72.3	-	-	13	27.7
Meropenem (M)	37	78.7	2	4.3	8	17.0
Levofloxacin (L)	39	83.0	3	6.4	5	10.6
Oxacillin (OX)	43	91.4	2	4.3	2	4.3
Vancomycin (V)	44	93.6	1	2.1	2	4.3
Daptomycin (DA)	46	97.9	-	-	1	2.1

TABLE 6. Antimicrobial resistance profile of *S. aureus* strains (n=47).

Pattern	Antimicrobial resistance profile	No of isolate	MAR index
I	N, NA, CO, T, SXT, P, AZ, E, CP, FEP, G, M, L, OX, V, DA	1	1
II	N, NA, CO, T, SXT, P, AZ, E, CP, FEP, G, M, L, OX, V	1	0.938
III	N, NA, CO, T, SXT, P, AZ, E, CP, FEP, G, M, L	3	0.813
IV	N, NA, CO, T, SXT, P, AZ, E, CP, FEP, G, M	3	0.750
V	N, NA, CO, T, SXT, P, AZ, E, CP, FEP, G	5	0.688
VI	N, NA, CO, T, SXT, P, AZ, E, CP	1	0.563
VII	N, NA, CO, T, SXT, P, AZ, E	3	0.500
VIII	N, NA, CO, T, SXT, P, AZ	1	0.438
IX	N, NA, CO, T, SXT, P	3	0.375
X	N, NA, CO, T, SXT	8	0.313
XI	N, NA, CO, T	3	0.250
XII	N, NA, CO	6	0.187
XIII	N, NA	7	0.125
XIV	N	2	0.063
	Average 0.406		

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التقييم البكتريولوجي لذبائح الدواجن مع التركيز الخاص على انتشار المكورات العنقودية الذهبية، وإنتاج السموم المعوية، والحساسية للمضادات الحيوية

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الملخص

تم جمع 200 عينة عشوائية تشمل 50 عينة من كل من لحوم بداري التسمين، الدجاج البلدي، الحمام، والبط. تكونت العينات من كل نوع من 25 عينة من كل من الصدر والفخذ وتم جمعها لتقييم جودتها الميكروبيولوجية. أظهرت النتائج المسجلة أن أعلى عدد للبكتيريا في لحوم بداري التسمين بينما كان أدنى عدد للبكتيريا في صدر الحمام. وكانت أعلى عدد للفطريات وُجد في عينات البلدي، وأقل عدد وُجد في عينات أفخاذ الحمام. سُجلت أعلى معدلات لعد البكتيريا العنقودية الذهبية في عينات بداري التسمين (الفخذ والصدر) عند 4.56±0.20 و4.42±0.22 لوغاريتم 10 وحدة تشكيل المستعمرات لكل جرام.أعلى معدلات انتشار المكورات العنقودية الذهبية سُجلت في أفخاذ الدجاج اللاحم (64%)، وعينات الصدر (48%)، مع إنتاج السم المعوي A من عزلتين.عزلات المكور العنقودي الذهبي المستعادة من عينات البط كانت لديها القدرة على إنتاج الأنواع A و Cو Dمن السموم المعوية. على العكس من ذلك، لم تُظهر عزلات المكور العنقودي الذهبي المستعادة من عينات الدجاج البلدي والحمام أي قدرة على إنتاج السموم المعوية.أظهرت عدد كبير من عزلا .المكور العنقودي الذهبي مقاومة للنيومايسين (100%)، وحمض الناليديكسيك (38.8%)، والكولستين (80.8%)، والتتراسيكلين (68.1%)، والسلفاميثوكسازول (61.7%)، والبنسلين (44.6%).على العكس من ذلك، أظهرت العزلات أعلى حساسية لدابتوميسين (97.9%)، فانوكومايسين (93.6%)، أوكساسيلين (91.4%)، ليفوفلوكساسين (83.0%)، ميروبيم (78.7%)، جنتاميسين (72.3%)، وسيفيبيم (68.1%). لذلك يجب اتباع تدابير صحية صارمة أثناء تحضيرذبائح الدواجن لتقليل الحمل الميكروبي وتعزيز جودة الحفظ.

الكلمات الدالة: ذبائح الدواجن، التلوث الميكروبي، المكورات العنقودية الذهبية، الحساسية للمضادات الميكروبية.