Veterinary World, EISSN: 2231-0916
Available at www.veterinaryworld.org/Vol.6/Oct-2013/3.pdf

RESEARCH ARTICLE
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Prevalence of methicillin-resistant *Staphylococcus aureus* in poultry meat in Qena, Egypt

Mohamed Karmi

Department of Food Hygiene,
Faculty of Veterinary Medicine, Aswan University, 81528 Aswan, Egypt
Corresponding author: Mohamed Karmi, email: karmy99@ yahoo.com
Received: 15-04-2013, Revised: 15-06-2013, Accepted: 17-06-2013, Published online: 31-07-2013

doi: 10.14202/vetworld.2013.711-715
How to cite this article: Karmi M (2013) Prevalence of methicillin-resistant *Staphylococcus aureus* in poultry meat in Qena, Egypt, *Veterinary World* 6(10): 711-715.

Abstract

Aim: To study the prevalence of pathogenic coagulase positive, methicillin-resistant *Staphylococcus aureus* (MRSA) in poultry meat and its products.

Materials and Methods: A total of 125 poultry samples were collected during 2012 in Qena governorate for presence of pathogenic coagulase positive, methicillin-resistant *staphylococcus aureus* (MRSA). Samples were taken from freshly slaughtered whole chicken carcasses (25/125), chicken portions (25/125), chicken luncheon (25/125), chicken sausages (25/125) and chicken burgers (25/125).

Results: It was observed that 44% (11/25), 52% (13/25), 40% (10/25), 24% (6/25) and 44% (11/25) of bacterial isolates were positive for methicillin-resistance tests for freshly slaughtered whole chicken carcasses, chicken portions, chicken luncheon, chicken sausages and chicken burgers respectively. Higher contamination rate of MRSA was found in raw poultry meat and the lower rate in poultry meat products subjected to heat treatment and preservatives.

Conclusion: Poultry meat and its products were considered as an important source of spreading of MRSA in humans. Hence, strict hygienic measures should be taken in poultry slaughter houses and in food preparing establishments.

Keywords: coagulase, MRSA, poultry meat, *Staphylococcus aureus*

Introduction

Staphylococcus aureus is a gram positive, coagulase positive coccoid belonging to family Staphylococcaceae [1]. It is present on the skin and mucous membranes of humans and animals [2] and is highly vulnerable to destruction by heat treatment and nearly all sanitizing agents.Presence of this bacteria or its enterotoxins in processed foods or on food processing equipments is generally an indicator of poor sanitation. Methicillin-resistant *Staphylococcus aureus* (MRSA) is known to be one of the most prevalent nosocomial pathogens throughout the world and is capable of causing a wide range of food poisoning, pneumonia, post operative wound infections and nosocomial infections [3, 4]. MRSA strains are especially one of the great public concerns since the treatment of infections is more difficult when encountering resistance [5, 6] and considered one of the important agents of food poisoning around the world [7].

The presence of *S. aureus* in meat is often attributed to inadequate hygiene during handling by the individuals involved in the production of meat [8]. Poultry meat handled in the cutting section must be stored at temperature below 7 ºC and if this temperature is exceeded, the meat must be discarded to avoid possible public health problems [9]. Contaminated poultry meat can transfer expressive amounts of *S. aureus* to stainless steel and polyethylene surfaces [10, 11]. Since MRSA infections have become a public health concern in both communities and hospitals, testing for the presence of MRSA in poultry meat during slaughtering operations is warranted [12]. Treating *S. aureus* infection has been complicated by the emergence of drug resistant strains. MRSA infection is now a serious public health problem [13] and the poultry meat has been implicated as a main source of MRSA in humans [14].

It is well known that the organism produces various extracellular active substances, such as coagulase, hemolysins, nuclease, acid phosphatase, lipase, protease, fibrinolysin, enterotoxins and toxic shock syndrome toxin. These active substances are thought to contribute to the pathogenicity of the organism [15]. It is reported that strains of *S. aureus* which had strong proteolytic activity were isolated from chickens suffering from edematous and necrotic dermatitis [16], where in dermatolysis was observed in young chickens when inoculated subcutaneously with more than 107 cells of protease positive strains. Also, staphylococcal lipases are involved in the pathogenic processes through its support to the persistence of these strains in the fatty secretions in mammalian skin, and thus have an indirect influence on their pathogenic potential [17,18]. *S. aureus* isolates from chicken carcasses showed proteolytic and lipolytic activity at

Table-1. Prevalence of MRSA in poultry meat and poultry products.

Meat type	No. of samples	Growth on baird parker				Coagulase test				Methicillin resistance			
		positive		negative		positive		negative		positive		negative	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Carcasses	25	23	92	2	8	11	44	14	56	11	44	14	56
Portions	25	18	72	7	28	13	52	12	48	13	52	12	48
Luncheon	25	18	72	7	28	10	40	15	60	10	40	15	60
Sausages	25	20	80	5	20	6	24	19	76	6	24	19	76
Burgers	25	18	72	7	28	11	44	14	56	11	44	14	56
Total	125	97	77.6	28	22.4	51	40	74	60	51	40	74	60

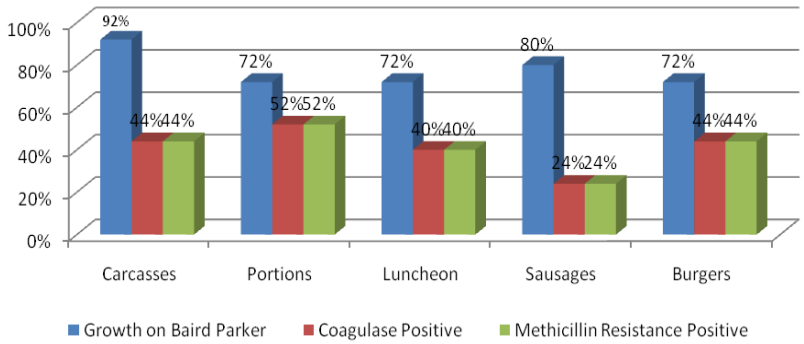

Figure-1. Prevalence Rate of MRSA in poultry meat and poultry products.

+20 ºC, causing meat spoilage [19]. Contamination with *S.aureus* is important in the evaluation of the safety and hygienic quality of chicken meat, and also in determining the origin of food poisoning [20].

Materials and Methods

Collection of samples: 125 chicken meat and its product samples were collected from retailers, supermarkets and poultry shops in Qena governorate. 25 samples were collected from each product such as freshly slaughtered chicken carcasses, frozen chicken portions (breasts & thighs), chicken luncheon, chicken sausages and chicken burgers. Sampling box containing ice pads was used for carrying the samples from market to laboratory maintaining low temperature. Samples were preserved in sterile polyethylene bags in the refrigerator.

Preparation of samples: Samples from whole chicken carcasses and chicken portions were trimmed from bones before sampling. 25 g meat samples were collected from all chicken meat and products, homogenized by using Stomacher® 400 Circulator (Seward Ltd., UK) and mixed in 225 ml Buffered Peptone Water (BPW).

Isolation and identification: The mixture samples were incubated at 37 °C for 18-24 hours [21, 22]. Pre-incubated samples (0.1 ml) in BPW were spread on the surface of Baird-Parker agar (BPA) medium supplemented with Egg-Yolk Tellurite Emulsion and Mannitol salt Agar (MSA) (Oxoid Limited, Hampshire, England), a selective media for *S. aureus* and incubated at 37 °C for 24-48 hours. Black colonies surrounded by whitish halo zone formation on BPA and yellow colonies on MSA were considered presumptive *S. aureus*, confirmed with the help of Gram's staining, coagulase, catalase and other biochemical tests.

Methicillin susceptibility and resistance: Isolates were identified with the help of the Staphytect Plus Kits (Oxoid Limited, Hampshire, England) which is a latex slide agglutination test for the differentiation of *S. aureus*, positive or negative for coagulase and methicillin-resistance.

Results

Poultry samples were examined for the presence of pathogenic *S. aureus*. Results revealed that about 77.6% of all poultry samples give typical colonies on Baird Parker Agar medium, distributed as follows: 92 % (23/25) from the whole chicken carcasses, 72 % (18/25) from chicken portions, 72 % (18/25) from chicken luncheon, 80 % (20/25) from chicken sausages and 72 % (18/25) from chicken burgers. Also, results of this study showed that 40 % (51/125) of *S. aureus* isolates from poultry samples were positive for coagulase and methicillin-resistance tests distributed as follows: 44 % (11/25) from whole chicken carcasses, 52 % (13/25) from chicken portions, 40 % (10/25) from chicken luncheon, 24 % (6/25) from chicken sausages and 44 % (11/25) from chicken burgers [Table: 1; Figures 1 and 2].

Discussion

In this study, the prevalence of methicillin-resistant *S. aureus* in poultry meat and poultry meat products were investigated, this prevalence ranged from 24-52 %, with mean of 40 %. The findings revealed that the prevalence of MRSA in whole chicken carcasses, chicken portions, chicken luncheon, chicken sausages and chicken burgers were 44 %, 52 %, 40 %, 24 % and 44 % respectively. These results in our study were agreed with some other studies such as Suk-kyung et al., 43.3 % [23], Shareef et al., 52.04 % [24], Kozacinski et al., 46.15 % [25], Citak and Duman,

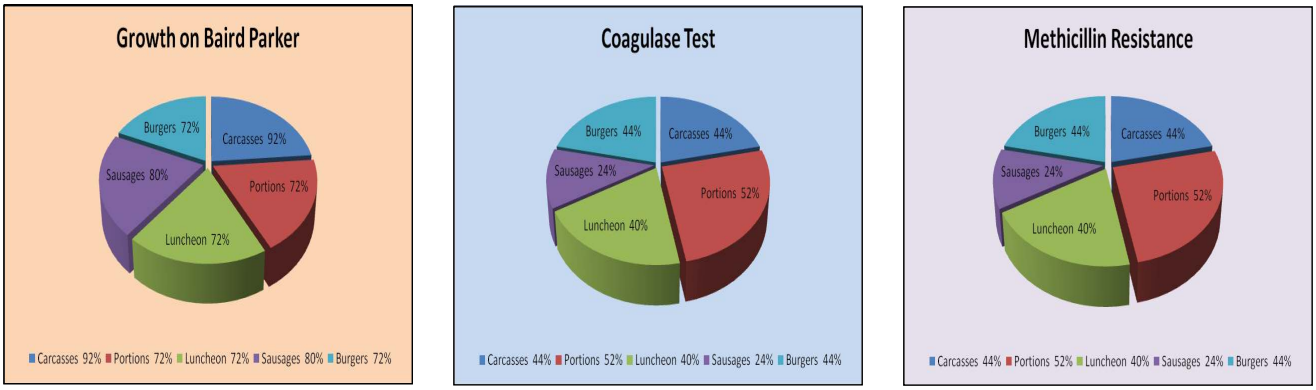

Figure-2. Rate Percentage of positive isolates for coagulase test and methicillin resistance in poultry meat and poultry products.

47.2 % [26] and Lee et al., 50 % [27] MRSA in chicken meat and chicken products, while our findings were higher than other studies such as Akbar and Anal, 18.18 % [28], EL-Shareek and Ali, 29.6 % [29], Heo et al., 10-16.6 % [30], Lin et al., 19.4 % [31], Boer et al., 16 % [32] and Weese et al 1.2 % [33].

It is observed in our study that all methicillin-resistant isolates were positive for coagulase test, but not all typical colonies on Baird Parker agar with halo zone were positive either for coagulase test or for latex agglutination test for methicillin resistance. Also, it is observed that the highest contamination rate was in raw chicken portions (52 %) followed by whole chicken carcasses (44 %) and chicken burgers (44 %) and this is can be attributed to the raw nature of these types of meat and partially due to frequent handling of these meats by hands of workers in poultry slaughter houses and during packaging. The lowest contamination rate was in chicken sausages (24 %) followed by chicken luncheon (40 %). It can be reasoned that these two products were subjected to heat treatment during manufacture and considered half-processed meat products, also these products may contain chemical preservatives such as sodium nitrate and sodium nitrite which has antimicrobial effects [34, 35].

Different stages of slaughter such as scalding, defeathering and chilling may affect the prevalence and bacterial load of *S.aureus* on the carcass [36, 37]. High contamination of *S.aureus* is the principal reason for the inadequate microbiological quality of chicken meat sold in common markets [38]. It is reported that the presence of *S.aureus* in foods commonly indicates contamination that may be directly introduced into the food by workers when have skin lesions containing *S.aureus* or sneezing or coughing [39] or indirectly through working surfaces and knives [40]. Contamination of the meat products by MRSA could be traced back to poor hygienic and sanitary conditions in Egypt [41].

The rates of resistance to other antimicrobial agents were higher in MRSA than in methicillin susceptible strains. A strong correlation between methicillin resistance and co-resistance to non-ß-lactam antibiotics has been reported [42, 43, 44]. The *mec*A gene is carried within the staphylococcal chromosomes cassette mec and has been implicated as a primary mechanism of methicillin resistance [45].

Conclusion

Staphylococcal food poisoning is one of the most important causes of food borne diseases especially MRSA which is now a serious health problem in both hospitals and community. MRSA contamination of meat increases the emergence of antimicrobial resistance to the human. Poultry meat and its products are considered as one of the main sources of spreading of MRSA in humans. Therefore, proper handling of raw meat, adequate cleaning of hands, surfaces, equipments, disinfection of poultry slaughter houses, vehicles and good personal hygiene can reduce spreading of MRSA.

Acknowledgements

The author is thankful to Faculty of Veterinary Medicine, Aswan University for Financial support. Author is also thankful to The Veterinarian, I. Hassanen, for his technical support and help in isolation of bacteria.

Competing interests

The authors declare that they have no competing interests.

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