

Methicillin Resistant *Staphylococcus aureus* (MRSA) Strains and the Staphylococcal Cassette Chromosome *mec* Types in Iran

Abdolmajid Ghasemian¹, Mohsen Mirzaee*²

1. Department of Bacteriology, Faculty of Medical Sciences, Tarbiat Modares University, Tehran, IR Iran

2. Department of Laboratory Sciences, Boroujerd Branch, Islamic Azad University, Boroujerd, IR Iran

*Corresponding author: Mohsen Mirzaee, Dept. of Laboratory Sciences, Boroujerd Branch, Islamic Azad University, Boroujerd, Iran, Email: Mohsen1439@yahoo.com

Submitted: November 20, 2014; Revised: April 11, 2015; Accepted: April 17, 2015

Background: *Staphylococcus aureus* can cause infections with a wide spectrum of illnesses ranging from benign skin infections to bloodstream infection leading to mortality. Antimicrobial resistance especially methicillin resistance in *S. aureus* (MRSA strains) is currently problematic. The emergence of MRSA infections has developed in both the healthcare and the community settings. The aim of this study was to determine the prevalence of MRSA and SCC*mec* types in Iran according to the previously published studies.

Methods: For this review, the terms of MRSA, Iran, methicillin, *mecA* and SCC*mec* types were searched in searching engines including Google scholar, PubMed, SciVerse, and Scopus. Data from veterinary sources were excluded. Data were analyzed with Graph Pad Prism 6 considering meta-analysis section.

Results: Among several studies and approximately of 1810 results, the prevalence of MRSA was determined as approximately 56.5%. In the year of 2015 and 2016, results exhibited a higher prevalence of MRSA (62.2%) compared to 2013 and 2014, although not exceeded from 46% in healthy individuals. Moreover, among the SCC*mec* types, the SCC*mec* Type III has been reported as the predominant type (60.48%) followed by Type IV (21.2%), Type I (17.72%), Type II (17.12%), and Type V (0.56%).

Conclusion: According to previous data, the prevalence of MRSA is increasing in Iran. However, it may be different for each year depending on several reasons. Moreover, the SCC*mec* Type III is the predominant type in the country. The SCC*mec* Type IV has also emerged in CA-MRSA isolates.

Key words: Iran, *Staphylococcus aureus*, Methicillin resistance, Staphylococcal Cassette Chromosome *mec* types

1. Introduction

Staphylococcal infections are the most common cause of nosocomial ailments and even deaths and constitute 60% of the infections in the intensive care units (ICU). Moreover, surgical wounds, pneumonia and intravenous catheters are the most common nosocomial infections from which *S. aureus* has been mostly collected (1). In the post-antibiotic era, bloodstream infections of *S. aureus* were usually fatal, and more than 95% of the patients with the age of 50 or more, were dead in the early 1940s. Shortly, after the use of beta lactam agents, the strains gained resistance (2). To date, strains with resistance to methicillin (MRSA) have been reported worldwide. The prevalence of MRSA is increasing (3-5). MRSA has emerged as one of the predominant hospital-associated and drug-resistant microorganisms, and up to 53 million people carry MRSA (6). The range of MRSA worldwide varies between 1% in Scandinavian countries to 60% in the United States and Brazil. The three major clones of HA-MRSA since 1960, CA-MRSA since 1990s, and Livestock-associated MRSA (LA-MRSA) since 2000s are now pandemic (7, 8). MRSA is often referred to in the press as a "superbug". The drug-resistant infections due to MRSA have developed in hospital settings (9, 10).

Several studies have determined high prevalence of MRSA in ICUs in addition to other wards of hospitals (9,11,12). Within a year, after the consumption of semisynthetic penicillins such as methicillin, there were reports of resistant isolates in 1961 (13). MRSA was initially associated with hospitals, with reports of outbreaks increasing all over the

world, the epidemic was controlled with the search-and-destroy-strategy. Risk factors for community-acquired infections include intravenous drugs, prior antimicrobial usage, and underlying illnesses such as pulmonary disease, diabetes, and chronic skin diseases (14-16). All MRSA isolates express an additional penicillin-binding protein named PBP2a or PBP2 which confers resistance to all the available β -lactam agents in current, including penicillinase-resistant penicillins (such as oxacillin and methicillin) and cephalosporins (such as cefoxitin) (17). PBP2a is encoded by the *mecA* gene that causes resistance to beta lactams because of low affinity of these agents (Figure 2). The defining feature of MRSA strains is the staphylococcal cassette chromosome *mec* (SCC*mec*) element (18). A detailed explanation for the term "SCC*mec*" is available at the website (<http://www.staphylococcus.net>). This is a mobile genetic element that contains the central determinant of resistance to beta lactams, encoded by the *mecA* gene. The acquisition and insertion of the SCC*mec* element into the chromosome of methicillin susceptible strains have culminated in the emergence of methicillin-resistant staphylococcal lineages. The SCC*mec* Types I, II, and III are located in the genome of MRSA from hospital, whereas SCC*mec* Types IV and V have integrated in the genome of community acquired strains (19, 20). Pantone-Valentine leucocidin (PVL) suggested being a marker for CA-MRSA together with SCC*mec* Type IV is predominantly associated with severe skin and skin related infections and necrotizing pneumonia. Recent studies have reported that CA-MRSA strains are spreading in hospital settings and are replacing traditional HA-MRSA strains (21-24).

2. Objectives

Staphylococcus aureus (*S. aureus*) is one of the most important pathogen which causes several infections. Methicillin resistant *S. aureus* (MRSA), which is usually multi-resistant in hospitals, has been a daunting challenge for clinicians for more than half a century.

The aim of this study was to determine the prevalence of MRSA and SCCmec types in Iran according to the previously published studies in different regions of Iran.

3. Methods

3.1. Literature search

For this review, the terms of MRSA, Iran, methicillin, *mecA* and SCCmec Types were searched in searching engines including Google scholar, PubMed, SciVerse, and Scopus. Moreover, the Persian published results and the 3 recent congresses (First International and 12th Iranian Congress of Microbiology, The First Iranian International Congress of Medical Bacteriology, The Congress of Infections and Antibiotic Resistance, 13th, 14th and 15th Iranian Congress of Microbiology and The Congress of Rational Usage of Antibiotics) and also a systematic and met analysis of relative prevalence of MRSA in Iran by Askari were included (28).

3.2. Inclusion and exclusion criteria

All the following results were considered as suitable:

- 1) *Staphylococcus aureus* isolates collected from Iranian hospitals.
- 2) Clinical specimens from patients and also healthy individuals for instance hospital carriers.
- 3) The molecular results for the *mecA* detection were preferred to the phenotypic tests. Because the phenotypic tests have several conditions including: media pH, incubation period, the quality of disks and media, different susceptibility test media, and personal skills. Moreover, breakpoints of phenotypic tests may vary over time.
- 4) In the studies that the method of MRSA detection were not mentioned were excluded.

3.3. Data collection and statistical analysis

All the collected results were designed in an Excel format and Graph Pad Prism and next were analyzed. The authors accompanied in the adoption of correct results and the interpretation of data. We also used the previous review article published by Askari (28).

4. Results

In south of Iran, Ekrami showed that 27.8% of the wound and blood specimens were infected by *Staphylococci*, among which, 60% were identified as methicillin resistant (25). In a study conducted for detection of MRSA, Najar Peerayeh detected 48.2% in 2009 and 47.5% in 2012 (10, 26). Moreover, in Loghman hospital the prevalence of MRSA was lower than 30% in 2014 (4, 5, 27). A systematic review and meta-analysis by Askari determined that relative frequency (RF) of MRSA is high in Iran (48.5%) (28). According to the previous published studies, the average of MRSA in each year is exhibited in the Figure 1. The prevalence of MRSA up to 2012 has been reported by Askari and colleagues (28). According to which in Khuzestan it was higher than 60%. Moreover, in Tehran, Mashhad, Tabriz, Hamadan, Isfahan, and Shahrekord it was 50-60%. Shiraz and Kurdistan cities had the prevalence of 45-50% and lower than 40% respectively. The prevalence of MRSA up to 2012 is shown in Figure 2. Moreover, the results of the MRSA prevalence studies in Iran in the year of 2013 are depicted in Table 1. On the other hand, the SCCmec types detected to date in Iran are

displayed in Table 2. However, among the SCCmec types, the SCCmec Type III has been reported as the predominant type (60.48%) followed by Type IV (21.2%), Type I (17.72%), Type II (17.12%), and Type V (0.56%).

Table 1. The results of the MRSA prevalence studies in Iran in the year of 2013.

Author	source	MRSA (%)	City	Reference
Havaei	Milk	7.69	Isfahan	*
Sedigh	Inpatients	44	Shiraz	*
Teyhoo	Inpatients	71.6	Lahijan	*
Ahanjan	Carriers	9.5	Sari	*
Amini	Inpatients	51.6	Golestan	*
Aslanimehr	Inpatients	59	Qazvin	*
Sahlebnasagh	Inpatients	75.9	Zanjan	*
Mohajeri	Carriers	36.8	Kermanshah	(29)
Bahmani	Neonates	55	Kurdistan	(30)
Dibah	Inpatients	46.3	Ardabil	(31)

*The study was published in the 13th Iranian and 2nd international congress of Bacteriology.

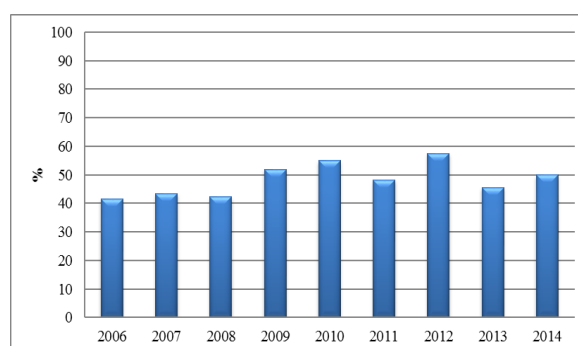


Figure 1. The average of MRSA prevalence alterations in the country between the years of 2006 and 2014.



Figure 2. The prevalence of MRSA in the year of 2012 (28).

4.1. The SCCmec typing results

As most of the previous studies have determined, the SCCmec Type III is the predominant SCCmec type in Iran (32). For instance, Fatollahzadeh detected the Type III in 98% of the MRSA in Tehran, and also Japoni's survey in southern Iran, resulted in the presence of SCCmec Type III in 78% of the MRSA (23). The SCCmec Type III is usually detected in the nosocomial MRSA isolates. The different SCCmec types prevalence in Iran has been summarized in Table 2.

Table 2. The SCCmec types detected in Iran.

Author	SCCmec types (%)					No	Year	reference
	I	II	III	IV	V			
Ghasemian	0	0	94.2	0	5.8	78	2014	(36)
Moghadami	56.9	22	0	0	0	109	2010	(33)
Fatollahzadeh	0	0	98	2	0	199	2008	(23)
Japoni	0	0.6	78	10	2.6	156*	2011	(34)
Havaei	0	0	45	24	0	100*	2012	(35)
Veerarghavan	3.4	13.8	39	13.8	3.4	87*	2011	(36)
Momtaz	0	0	28.52	21	52.83	132	2014	(37)

*These isolates were MRSA

5. Discussion

The MRSA isolates have been detected in both community and healthcare settings. However, the hospital associated isolates have an extended spectrum of antibiotic resistance to antibiotics (38, 39). Numerous previous studies have detected the MRSA with the *mecA* gene amplification. To determine whether MRSA isolates have been originated from healthcare or community settings, the detection of SCCmec types have been raised in the country alongside with the other areas of the world (40). As included in the results section, the prevalence of MRSA is approximate to 47% and follows to some extent alterations in every year, although it has determined that the origin/source of isolates plays an important role in the prevalence of MRSA strains. However, two previous worldwide reports did not give an exact percentage of MRSA in Iran. The previous systemic and meta-analysis by Askari in 2012 exhibited that it was 52% (28). In Ohadian Moghaddam's study performed in 2015, the prevalence of MRSA was 61.53% in Tehran (24). The prevalence in different cities is not the same. This is an alarming point because MRSA isolates are multidrug-resistant and may not response to nearly all the antibiotics, except for glycopeptides such as vancomycin and teicoplanin (25). In recent years, vancomycin intermediate resistant isolates (VISA) or even vancomycin-resistant *S.aureus* have emerged and developed in several areas of the world (41). Among the Middle East countries, Iran is the second country for the prevalence of MRSA, after Iraq as the first one. On the other hand, a study among the Asian countries showed that the HA-MRSA prevalence is lower than that of several other countries. Argentina and Mexico are similar to our country in this regard (42), Australia and United States have lower and higher prevalence than Iran, and also the European countries have heterogeneous prevalence (43). The studies have attained different results of the predominant SCCmec type and the pattern of types detected in Iran. However, most of the healthcare associated isolates contained SCCmec Type III (26-29). From Table 2, it may be revealed that the SCCmec Type III predominated among other types but in the year of 2014 the SCCmec Type V has increased sharply (28). There is now a suggestion that the community associated MRSA isolates may spread in the hospital as several previous studies have exhibited this phenomenon. In a study in Iraq, 95% of the MRSA isolates harbored the SCCmec Type IV (44). The SCCmec Types I and II detected in the two studies (Table 2) are also found in healthcare associated isolates. One of the important factors interfering in the prevalence results is the area of the study. Following and surveillance of SCCmec types is helpful in the determination of MRSA sources and origins.

6. Conclusion

MRSA as a miscellaneous pathogen is a significant cause of both healthcare and community-associated infections. Its widespread have developed multiple - drug resistant strains, and antibiotic resistant clones are worrying issues. The

SCCmec Type III is the predominant type detected in hospital settings. However, the community-acquired MRSA containing SCCmec Types IV has increasingly developed in healthcare settings. The SCCmec typing can contribute to uncovering the possible origin of MRSA.

Conflict of Interests

The authors declare they have no conflict of interest.

Acknowledgements

This study was supported by Tarbiat Modares University.

Authors Contribution

All authors contribute in writing different parts of this manuscript.

Funding/Support

None to declare.

References:

- Inweregbu K, Dave J, Pittard A. Nosocomial infections. Continuing Education in Anaesthesia, Critical Care & Pain. 2005;5(1):14-7.
- Mediavilla JR, Chen L, Mathema B, Kreiswirth BN. Global epidemiology of community-associated methicillin resistant *Staphylococcus aureus* (CA-MRSA). Current opinion in microbiology. 2012;15(5):588-95.
- Peerayeh SN, Azimian A, Nejad QB, Kashi M. Prevalence of agr specificity groups among *Staphylococcus aureus* isolates from university hospitals in Tehran. Laboratory Medicine. 2009;40(1):27-9.
- Ghasemian A, Najar PS, Bakhshi B, Mirzaee M. Comparison of Biofilm Formation between Methicillin-Resistant and Methicillin-Susceptible Isolates of *Staphylococcus aureus*. Iranian biomedical journal. 2016.
- Ghasemian A, Peerayeh SN, Bakhshi B, Mirzaee M. Inducible clindamycin resistance in clinical isolates of *Staphylococcus aureus*. Archives of Clinical Infectious Diseases. 2014;9(2).
- Woodford N, Livermore DM. Infections caused by Gram-positive bacteria: a review of the global challenge. Journal of Infection. 2009;59:S4-S16.
- Enright MC, Robinson DA, Randle G, Feil EJ, Grundmann H, Spratt BG. The evolutionary history of methicillin-resistant *Staphylococcus aureus* (MRSA). Proceedings of the National Academy of Sciences. 2002;99(11):7687-92.
- Stefani S, Chung DR, Lindsay JA, Friedrich AW, Kearns AM, Westh H, et al. Methicillin-resistant *Staphylococcus aureus* (MRSA): global epidemiology and harmonisation of typing methods. International journal of antimicrobial agents. 2012;39(4):273-82.
- Saderi H, Habibi M, Owlia P, Asadi Karam M. Detection of methicillin resistance in *Staphylococcus aureus* by disk diffusion and PCR methods. Iranian Journal of Pathology. 2008;3(1):11-4.
- Azimian A, Najar-Pirayeh S, Mirab-Samiee S, Naderi M. Occurrence of methicillin resistant *Staphylococcus aureus* (MRSA) among clinical samples in tehran-iran and its correlation with polymorphism of specific accessory gene regulator (AGR) groups. Brazilian Journal of Microbiology. 2012;43(2):779-85.
- Croft AC, D'Antoni AV, Terzulli SL. Update on the antibacterial resistance crisis. Medical Science Monitor Basic Research. 2007;13(6):RA103-RA118.
- Vincent J-L, Bihari DJ, Suter PM, Bruining HA, White J, Nicolas-Chanoin M-H, et al. The prevalence of nosocomial infection in intensive care units in Europe: results of the European Prevalence of Infection in Intensive Care (EPIC) Study. Jama. 1995;274(8):639-44.
- Pantosti A, Sanchini A, Monaco M. Mechanisms of antibiotic resistance in *Staphylococcus aureus*. 2007.

14. Moreno F, Crisp C, Jorgensen JH, Patterson JE. Methicillin-resistant *Staphylococcus aureus* as a community organism. *Clinical Infectious Diseases*. 1995;21(5):1308-12.
15. Hersh AL, Chambers HF, Maselli JH, Gonzales R. National trends in ambulatory visits and antibiotic prescribing for skin and soft-tissue infections. *Archives of Internal Medicine*. 2008;168(14):1585-91.
16. Baba T, Takeuchi F, Kuroda M, Yuzawa H, Aoki K-i, Oguchi A, et al. Genome and virulence determinants of high virulence community-acquired MRSA. *The Lancet*. 2002;359(9320):1819-27.
17. Fishovitz J, Hermoso JA, Chang M, Mobashery S. Penicillin-binding protein 2a of methicillin-resistant *Staphylococcus aureus*. *IUBMB life*. 2014;66(8):572-7.
18. Mohammadi S, Sekawi Z, Monjezi A, Maleki M-H, Soroush S, Sadeghifard N, et al. Emergence of SCCmec type III with variable antimicrobial resistance profiles and spa types among methicillin-resistant *Staphylococcus aureus* isolated from healthcare-and community-acquired infections in the west of Iran. *International Journal of Infectious Diseases*. 2014;25:152-8.
19. Borbón-Esquer EM, Villaseñor-Sierra A, Martínez-López E, Jáuregui-Lomeli JJ, Villaseñor-Martínez R, Ruiz-Briseño MdR. SCC mec types and pvl gene in methicillin-resistant *Staphylococcus aureus* strains from children hospitalized in a tertiary care hospital in Mexico. *Scandinavian journal of infectious diseases*. 2014;46(7):523-7.
20. Dhawan B, Rao C, Udo E, Gadepalli R, Vishnubhatla S, Kapil A. Dissemination of methicillin-resistant *Staphylococcus aureus* SCCmec type IV and SCCmec type V epidemic clones in a tertiary hospital: challenge to infection control. *Epidemiology and Infection*. 2015;143(02):343-53.
21. Qi W, Ender M, O'Brien F, Imhof A, Ruef C, McCallum N, et al. Molecular epidemiology of methicillin-resistant *Staphylococcus aureus* in Zürich, Switzerland (2003): prevalence of type IV SCCmec and a new SCCmec element associated with isolates from intravenous drug users. *Journal of clinical microbiology*. 2005;43(10):5164-70.
22. Strandén A, Frei R, Adler H, Flückiger U, Widmer A. Emergence of SCCmec type IV as the most common type of methicillin-resistant *Staphylococcus aureus* in a university hospital. *Infection*. 2009;37(1):44-8.
23. Fatholahzadeh B, Emaneini M, Gilbert G, Udo E, Aligholi M, Modarressi MH, et al. *Staphylococcal cassette chromosome mec (SCCmec)* analysis and antimicrobial susceptibility patterns of methicillin-resistant *S. aureus* (MRSA) isolates in Tehran, Iran. *Microb Drug Resist*. 2008;14(3):217-20.
24. Ohadian-Moghadam S, Havaei S, Pourmand M. Prevalence of methicillin-resistant *Staphylococcus aureus* carrying panton-valentine leukocidin gene in cutaneous infections in the city of Isfahan. *Journal of Medical Bacteriology*. 2015;1(1-2):9-16.
25. Ekrami A, Samarbafzadeh A, Alavi M, Kalantar E, Hamzeloi F. Prevalence of methicillin resistant *Staphylococcus* species isolated from burn patients in a burn center, Ahvaz, Iran. *Jundishapur J Microbiol*. 2010;3(2):84-91.
26. Najar Peerayeh S, Azimian A, Mostafaei M, Siadat SD. Identification of methicillin-resistant *Staphylococcus aureus* by disk diffusion method, determination of MIC and PCR for mecA gene. *Modares Journal of Medical Sciences: Pathobiology*. 2009;12(3):61-9.
27. Ghasemian A, Peerayeh SN, Bakhshi B, Mirzaee M. Accessory gene regulator specificity groups among *Staphylococcus aureus* isolated from hospitalized children. *Archives of Pediatric Infectious Diseases*. 2014;2(4).
28. Askari E, Soleymani F, Arianpoor A, Tabatabai SM, Amini A, Naderi Nasab M. Epidemiology of mecA-methicillin resistant *Staphylococcus aureus* in Iran: A systematic review and meta-analysis. *Iranian journal of basic medical sciences*. 2012;15(5):1010-9.
29. Mohajeri P, Izadi B, Rezaei M, Farahani A. Frequency distribution of hospital-acquired mrsa nasal carriage among hospitalized patients in West of Iran. *Jundishapur Journal of Microbiology*. 2013;6(6).
30. Bahmani N, Kalantar E, Torabi V. Survey of methicillin-resistant Strains of *Staphylococci* from Neonatal Septicemia for mecA gene. *Life Science Journal*. 2013;10(10s).
31. Dibah S, Arzanlou M, Jannati E, Shapouri R. Prevalence and antimicrobial resistance pattern of methicillin resistant *Staphylococcus aureus* (MRSA) strains isolated from clinical specimens in Ardabil, Iran. *Iranian journal of microbiology*. 2014;6(3):163.
32. Peng Q, Hou B, Zhou S, Huang Y, Hua D, Yao F, et al. *Staphylococcal cassette chromosome mec (SCCmec)* analysis and antimicrobial susceptibility profiles of methicillin-resistant *Staphylococcus aureus* (MRSA) isolates in a teaching hospital, Shantou, China. *African Journal of Microbiology Research*. 2010;4(9):844-8.
33. Moghadami M, Japoni A, Karimi A, Mardani M. Comparison of community and healthcare-associated MRSA in Iran. *Archives of Clinical Infectious Diseases*. 2010;5(4):206-12.
34. Japoni A, Jamalidoust M, Farshad S, Ziyaeyan M, Alborzi A, Japoni S, et al. Characterization of SCCmec types and antibacterial susceptibility patterns of methicillin-resistant *Staphylococcus aureus* in Southern Iran. *Japanese journal of infectious diseases*. 2011;64(1):28-33.
35. Azimian A, Havaei SA, Fazeli H, Naderi M, Ghazvini K, Samiee SM, et al. Genetic characterization of a vancomycin-resistant *Staphylococcus aureus* isolate from the respiratory tract of a patient in a university hospital in northeastern Iran. *Journal of clinical microbiology*. 2012;50(11):3581-5.
36. Veeraghavan B, Kurien T. Antibiotic resistance and molecular subtypes of clinical methicillin-resistant *Staphylococcus aureus* in a teaching hospital. *Indian journal of medical microbiology*. 2011;29(3).
37. Fatholahzadeh B, Emaneini M, Aligholi M, Gilbert G, Taherikalani M, Jonaidi N, et al. Molecular characterization of methicillin-resistant *Staphylococcus aureus* clones from a teaching hospital in Tehran. *Jpn J Infect Dis*. 2009;62(4):309-11.
38. Ghasemian A, Peerayeh SN, Bakhshi B, Mirzaee M. Detection of accessory gene regulator groups genes and cassette chromosome mec types among *Staphylococcus aureus* isolated from intensive care unit patients. *Asian Pacific Journal of Tropical Disease*. 2015;5(2):153-7.
39. Ghasemian A, Peerayeh SN, Bakhshi B, Mirzaee M. The Microbial Surface Components Recognizing Adhesive Matrix Molecules (MSCRAMMs) Genes among Clinical Isolates of *Staphylococcus aureus* from Hospitalized Children. *Iranian journal of pathology*. 2015;10(4):258.
40. Bareja R, Goel K, Pottathil S, Narang VK, Singh VA, Grover PS. Evaluation of Methicillin Resistant *Staphylococcus aureus* Colonization in Patients and Nursing Staff of Intensive Care Units of A Tertiary Care Hospital in A Rural Area. 2013.
41. Mirzaee M, Najar-Peerayeh S, Behmanesh M, Moghadam MF. Relationship Between Adhesin Genes and Biofilm Formation in Vancomycin-Intermediate *Staphylococcus aureus* Clinical Isolates. *Curr microbiol*. 2015;70(5):665-70.
42. Guzmán-Blanco M, Mejía C, Isturiz R, Alvarez C, Bavestrello L, Gotuzzo E, et al. Epidemiology of methicillin-resistant *Staphylococcus aureus* (MRSA) in Latin America. *International journal of antimicrobial agents*. 2009;34(4):304-8.
43. Nimmo GR, Pearson JC, Collignon PJ, Christiansen KJ, Coombs GW, Bell JM, et al. Antimicrobial susceptibility of *Staphylococcus aureus* isolated from hospital inpatients, 2009: Report from the Australian Group on Antimicrobial Resistance. 2011.
44. Al-Charrakh AH, Al-Hassnawi HH, Al-Khafaji JK. Molecular Characteristics of Community-Associated Methicillin-resistant *Staphylococcus aureus* (CA-MRSA) Isolates from Clinical Specimens in Iraq. *British Microbiology Research Journal*. 2015;5(3):227.

How to cite this article: Ghiamati Yazdi F, Yavarmanesh M, Khomeiri M, Mahdavi M. Microbial Safety of Masske: A Traditional Butter From South of Khorasan, Genetic Similarity of Pathogenic Bacteria Indicators. *Infection, Epidemiology and Medicine*. 2016; 2(3): 31-34.