



Methicillin Resistance Coagulase Positive *Staphylococci* and *Staphylococcus aureus* Isolated from Raw Milk and Cheese, Samsun Province-TURKEY

Samsun İlinde Çiğ Süt ve Peynirlerden İzole Edilen Metisilin Dirençli Koagulaz Pozitif *Staphylococcus* ve *Staphylococcus aureus*

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Abstract

Today, MRSA is among the most important causes of antimicrobial-resistant health care-associated infections worldwide. The aim of the present study, 100 coagulase positive staphylococci (CPS) isolates recovered from raw cow milk and different kind of cheese samples, collected from different part of Samsun province, Turkey, using classic culture technique were determined for *Staphylococcus aureus* (*S. aureus*) and methicillin-resistant (MR) properties. For *S. aureus* determination of the isolates, nuc gene (*S. aureus* specific gene) was detected, and to determination of methicillin resistance properties of the isolates, *mecA* gene was determined in the isolates using PCR assay technique. As a result; nuc gene was detected in 72 (72%) (44 of which milk and 28 of which cheese origin) out of 100 CPS. In the 100 CPS isolates, *mecA* gene was detected 15 (15%, n=15; 4 milk and 11 cheese origin) CPS isolates, and the isolates were evaluated as MRCPS. The number of both nuc and *mecA* present isolates were 5 (4 milk and 1 cheese origin). These 5 isolates were evaluated as MRSA (5%). The remaining 10 (%10) containing *mecA* isolates were evaluated as MRCPS. In conclusion, raw cow milk and cheese samples have a potential health risk for mainly *S. aureus* and then coagulase positive staphylococci. In addition to this, analyzed samples also contaminated with MRSA or MRCPS isolates, become a big challenge for human health.

Keywords: Milk, Cheese, Coagulase Positive Staphylococci, *S. aureus*, Methicillin Resistance

Özet

Günümüzde MRSA, dünya genelinde antimikrobiyel dirençlilik ile ilgili sağlık problemlerinin en önemli nedenleri arasında yer almaktadır. Bu çalışmada, çiğ inek sütü (n=50) ve çeşitli tip peynirlerden (n=50) klasik kültür tekniği ile izole edilen toplam 100 koagulaz pozitif staphylococcus (KPS) izolatlarında *S. aureus*'un belirlenmesi ve metisiline dirençlilik (MR) özelliklerinin moleküler yöntemle saptanması amacıyla analiz edildi. *S.aureus*'un saptanması için nuc, metisiline dirençlilik özelliklerini saptanması ise *mecA* gen varlıkları PZR tekniği kullanılarak saptandı. Sonuç olarak, nuc geni toplam 100 KPS izolatının 72 (%72)'sinde saptandı ve bu izolatlar *S.aureus* (%72, n=72; 44'ü süt orjinli, 28'i ise peynir orjinli) olarak değerlendirildi. 100 KPS izolatında *mecA* geni ise 15 izolat (%15, n=15; 4 süt ve 11 peynir orjinli) saptandı. *mecA* geni saptanan bu 15 izolat MRKPS olarak belirlendi. Çalışmada nuc ve *mecA* genlerinin her ikisinin de bulunduğu izolat sayısı ise 5 (4 süt, 1 peynir orjinli) olup, bu izolatlar MRSA (%5) olarak değerlendirilirken, geriye kalan 10 izolat ise MRKPS (%10) olarak değerlendirildi. Bu çalışma bulguları çerçevesinde, Samsun ilinde tüketime sunulan peynirlerin ve çiğ inek sütlerinin başta *S. aureus* olmak üzere koagulaz pozitif stafilokoklarla kontamine olduğu, ayrıca analiz edilen örneklerin halk sağlığı yönünden çok önemli bir tehdit olan MRSA ve MRCPS ile de kontamine olduğu saptandı.

Anahtar kelimeler: Süt, Peynir, Koagulaz Pozitif Stafilokok, *S.Aureus*, Metisiline Dirençlilik

1. Introduction

Staphylococci are important microorganisms in terms of public health because they cause infections and food intoxication in humans and animals. Causing mastitis in animals, *S. aureus* is placed on the top. Therefore, one of the important means of transmission is contaminated milks obtained from particularly subclinical mastitis (Jay et al. 2005; Erol 2007). Dairy products especially cheese, are produced under unsuitable condition, are also placed among the risky foods. Approximately 10% of cheese production in Europe is made from raw milk and as well as Turkey (Beuvier and Buchin 2004). For this reason, cheese made from raw milk takes place among risky foods related to *S. aureus* and CPS (André et al. 2008). Likewise, the reports collected from 16 Europe countries have argued that the role of milk and dairy products accounts for some 1-9% in a total staphylococcal food poisoning (SFP) (EC 2003). It is estimated that annually staphylococcal intoxication case number is about 241 000 in the USA, and dairy products in among responsible foods for this term is about 2,1% (Doyle et al. 2012). In different countries, staphylococcal food poisoning (SFP) is a foodborne diseases, and its prevalence is highly common (Atanassova et al. 2001; Anonymous 2017; Denayer et al. 2017; Ercoli et al. 2017). A different kind of foods can support the growth of *Staphylococcus* species.

Antimicrobial resistance is a prominent role public health fear across the world based upon the persistent circulation of resistant bacterial strains in the environment and thereafter contamination of water and foods. Foods, especially animal origin, are an important way to create a vehicle for introducing pathogenic microorganisms to the general population. Generally, in animals, for 1 kg meat production, roughly 100 mg antimicrobial drugs is used in Europe (Anonymous 2002). The major factor contributing to the raising of AR in animal origin foods may be because of administration of antibiotics to livestock for therapeutic or as growth supports' aims. As a consequence, the resistant bacteria enter into the human intestinal system after the consumption of these foods (Sorum and L' Abee-Lund 2000).

An increase in AR bacteria isolated from animals of various origin has also been observed. Mainly, *S. aureus* and other *Staphylococcus* species have been commonly reported to show multi- antimicrobial resistance patterns (Enright 2003). Data gathered around the world show that the highest MRSA rate occurs mainly in European countries. Besides European countries, many South American and Middle Eastern countries also have significant problems with MRSA (Grundmann et al. 2006).

S. aureus is a highly significant pathogenic bacteria leading to considerable human mortality and morbidity around the world. It is also a major causative agent for infective endocarditis bacteremia, pleuropulmonary, skin and soft tissue, osteoarticular and device-related infective disease (Tong et al. 2015). At the beginning, most staphylococcal infections were susceptible against penicillin. Generally, staphylococcal infections can be treatment with penicillin or penicillin-related antibiotics. That time, it is called methicillin-sensitive *S. aureus* (MSSA). Nevertheless, many diseases became resistant to penicillin (due to β -lactamase production) and methicillin in the 1950s and, MRSA (phenotypic resistance to methicillin and related β -lactam antibiotics) identified in 1962 are nowadays as a widespread global problem (Jevons et al. 1963; David and Daum 2010; Rossolini et al. 2014).

Methicillin resistance in *S. aureus* is primarily mediated by over production of the penicillin-binding protein (PBP) 2a, an altered PBP with extremely low affinities for β -lactam antibiotics. The *mecA* gene encodes a form of PBP2a that is not present in susceptible isolates (Ma et al. 2002). Today, MRSA is among the most important causes of antimicrobial-resistant health care-associated infections worldwide (Moellering 2012).

The first outbreak of foodborne MRSA was reported in 1995 by Kluytmans et al. (1995). This outbreak resulted in five deaths out of 21 reported cases. Since 1994, consumption of animal origin foods containing MRSA has been recognized as a health hazard, and a lot of studies have highlighted the public health threat associated with the MRSA presence in foods (Chambers 1997; Antunes et al. 2006; Haran et al. 2012; Argudín et al. 2011; Aras et al. 2012; Can and Celik 2012; Bardiau et al. 2013, Bardiau et al. 2013; Kamal et al. 2013, Cho et al. 2014; Aghazadeh et al. 2015; Abdou et al. 2016; Rodríguez-Lázaro et al. 2017).

MRSA is a pathogen emerging in hospitals community, livestock and animal origin foods. MRSA is a significant and costly public health concern because it may enter the human food chain and contaminate milk and dairy products causing foodborne illness. Many studies have indicated that MRSA can be present in milk and dairy products (Normanno et al. 2007; Haran et al. 2012; Aras et al. 2012; Can and Celik 2012; Bardiau et al. 2013; Kamal et al. 2013; Abdou et al. 2016; Rodríguez-Lázaro et al. 2017). Therefore the aim of the study was to determined *S. aureus*, MRSA and MRCPS in the 100 coagulase staphylococci isolates (CPS) isolated from raw milk origin (n=50 isolates) and different kind of cheese origin (n=50 isolates), in Samsun province of Turkey.

2. Materials and Methods

In the present study, 100 CPS isolates (n=50 raw milk origin and n=50 cheese origin isolates) were used as a materials. The isolates were obtained from white brined and other kind of cheese samples purchased randomly from local small or large scale retail market in Samsun province. The cow origin raw milk samples collected from around the Samsun province. All the samples were transferred to our laboratory under the refrigerated conditions. Then, the samples analyzed immediately. For this aim, each samples (10 ml or g) was added to a sterile polyethylene bag containing 90 ml peptone water (PW, 10%), and homogenized. Then, the samples were subjected to 10-fold serial dilutions using sterile PW. Each dilutions was then spread onto Baird-Parker agar (Oxoid) using drop plating technique. After that the plates were incubated at 37°C for 24-48 h. Presumptive colonies for Stapylococci/ *S. aureus* were selected. Follow up, the colonies were streaked onto Trypticase Soy agar (TSA, Oxoid), and then identified based on Gram staining, colony morphology, catalase tests, anaerobic utilization of glucose, mannitol test (Bennett et al. 2001), and coagulase test (Thatcher and Clark, 1978).

2.1. DNA extraction of Coagulase Positive Staphylococci:

For DNA extractions of the isolates, boiling method was applied. For this, each colony obtained was inoculated on TSA containing plates. Then, the plates were incubated at 37°C for 24 h. Two or three colonies from each plates were choised and suspended separately in 500 µL of sterile distilled water in microcentrifuge tubes. Thereafter, the tubes were incubated at 95°C for 10 min in a water bath. Following boiling procedure, the tubes were centrifuged (Hettich) at $9,503 \times g$ for 10 min, and then the supernatant containing the DNA to be used as the template DNA was transferred into Dnase/Rnase-free microcentrifuge tubes. Until use, the extracted DNA samples were stored at -20oC.

2.2. Detection of *nuc* and *mecA* genes

For the detection of *S. aureus* in CPS isolates, *nuc* gene (*S. aureus* species-specific gene) was detected in the isolates. For methicillin-resistance *S. aureus* (MRSA) or CPS (MR-CPS) detection, *mecA* gene was detected in the isolates.

The oligonucleotide primers used for the detection of *nuc* and *mecA* genes are listed in Table 1. The reagents were purchased from Sigma Chemical Co. (St. Louis, MO, USA) and Fermentas (Lithuania). Oligonucleotide primers were obtained from ThermoHybaid (Germany). A methicillin-sensitive *S. aureus* (MSSA; ATCC 29213) and ATCC 43300 strains were used as reference control for MRSA strains. The PCR amplification was performed using a Thermo thermal cycler (Thermo-PXE 0.2 Thermal Cycler). For gel electrophoresis, it was used Power Pac-Basic (Owi-OSP 30-2Q). The PCR products were visualized under gel documentation and analysis system (BioRAD-Imaging Systems MiniBIS Pro).

Table 1. Primers Used in This Study

Amplified	Oligonucleotid sequence (5'-3')	Products (bp)	Reference
<i>mecA</i>	F GTA GAA ATG ACT GAA CGTCCG ATA A R CCA ATT CCA CAT TGT TTC GGT CTA A	310	Zhang ve ark.(2004)
<i>nuc</i>	F GCG ATT GAT GGT GAT ACG GTT R AGC CAA GCC TTG ACG AAC TAA AGC	279	Zhang ve ark.(2004)

For the detection of the *nuc* gene of CPS, PCR was carried out according to Louie et al. (2002). PCR was performed in a final volume of 25 µL reaction mixture containing 1X PCR buffer (750 mM Tris-HCl, 200 mM (NH₄)₂SO₄), 3 mM of MgCl₂, 200 µM of each dNTP, 1 U of Taq DNA polymerase, 0,2 µM each of *nuc* primers, and with 5 µL (5 ng) of template DNA. The amplification was performed as follows: 94 °C for 2 min, followed by 25 cycles at 94 °C for 15 s, 55 °C for 30 s, and 72°C for 30 s, with a final extension at 72 °C for 10 min. PCR products were loaded onto 2% agarose gel containing 5 µg/mL ethidium bromide. The strains which gave the band of 279 bp were evaluated as positive for the *nuc* gene and identified as *S. aureus*.

For the detection of the *mecA*, PCR assay was carried out according to McClure et al. (2006). For this, five microliters (5 ng) of the extracted DNA were used as template in a final volume of 25 µL reaction mixture containing 1X PCR buffer (750 mM Tris-HCl, 200 mM (NH₄)₂ SO₄), 3 mM of MgCl₂, 0,2 mM of each deoxynucleoside triphosphate (dNTP), 0,24 µM *mecA* primers, and 1U of Taq DNA polymerase.

The amplification of DNA was carried out as follows: 94 °C for 10 min of initial denaturation; 10 cycles at 94 °C for 45 s, 55 °C for 45 s, and 72 °C for 75 s; 25 cycles at 94 °C for 45 s, 50°C for 45 s, and 72 °C for 75 s; and a final extension at 72 °C for 10 min. The PCR products were loaded onto 2% agarose gel with 5 µg/mL ethidium bromide. The bands of 310 bp was evaluated as positive for *mecA* (Figure 1).

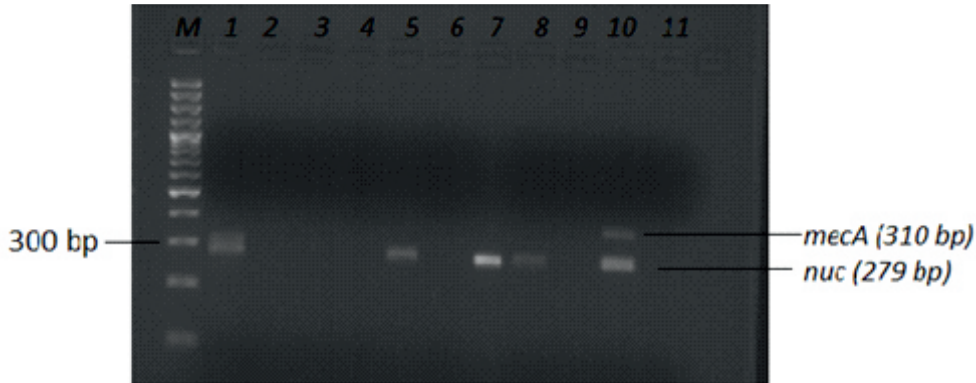


Figure 1. *nuc* ve *mecA* genes. Lanes 1,5,7 and 8: *nuc* gene positive alone isolates; lane 10: *nuc* and *mecA* genes positive isolate; Lanes 2,3,4,6,9 and 11: both *nuc* and *mecA* genes negative isolates. M: 100 bp marker

3. Results and Discussion

The present study, the *nuc* gene was detected in 72 CPS isolates (44 milk and 28 cheese origin samples) and the isolates were evaluated as *S. aureus* (72/100, 72,0%). The *mecA* gene was detected in 15 (15%) CPS isolates; 4 of which was milk origin (4/50, 8,0%), and 11 of which was cheese origin [11/50 CPS, 22%]. So, these 15 (15%) isolates were evaluated as MRCPS. Both *nuc* and *mecA* genes were detected in 5 CPS isolates. Therefore, the 5 CPS isolates were evaluated as MRSA (10%) (Table 2).

According to analyzed milk samples origin isolates; *mecA* gene was detected in 4 (8%) milk origin isolates. The *nuc* gene was also detected in the same four isolates. Therefore, the 4 isolates were evaluated as MRSA (8%) (Table 2).

As for cheese samples origin isolates, *mecA* gene was detected in 11 (22%) out of 50 CPS isolates. However, *nuc* gene was detected in only one cheese origin isolate. Therefore, 1(2%) out of 50 isolates was evaluated MRSA, and the remaining 10 (20%) isolates were evaluated as MRCPS.

Table 2. Number and Distribution of Methicillin-Resistant Coagulase Positive Staphylococci (MRCPS) and Methicillin-Resistant *S.aureus* (MRSA) Isolates

Identification method	Raw milk origin isolate (n= 50) (%)	Cheese origin isolates (n=50) (%)	All isolates (n=100) (%)	Results
<i>nuc</i> positive	44 (88%)	28 (56%)	72 (72%)	<i>S. aureus</i>
<i>mecA</i> positive	4 (8%)	11 (22%)	15 (15%)	MRCPS or MRSA
<i>nuc</i> and <i>mecA</i> positive (MRSA)	4 (8%)	1 (2%)	5 (5%)	MRSA
<i>nuc</i> negative but <i>mecA</i> positive	-	10 (20%)	10 (10%)	MRCPS

Cheese is popular in many countries (Anonymous 2017a) because of the unique flavor and aroma, health benefits including natural probiotic and anti-tumors properties (Gorbach and Goldin 1992) as well as reduce the incidence of type II diabetes due to rich source of dietary calcium, phosphorus and proteins (Choi et al. 2016). Although cheese is generally considered a safe food because of the physicochemical and antagonistic properties like bacteriocin of lactic acid bacteria, it contains some kind of foodborne bacteria, including *S. aureus* (Rabello et al. 2007). Similarly, in the present study, *S. aureus* was detected in 28 out 50 cheese samples origin isolates. In addition, 1 isolate was MRSA. Therefore, cheese sample was susceptible or potential a kind of dairy products for customers.

There have been some studies according to contamination ratio of milk, cheese and other dairy product with *S. aureus* and present of their toxins. One of them reported from one of the EU countries, Italy. In the survey, the contamination rate of *S. aureus* in milk samples was 7% (451 of 6,482 samples). *Staphylococcus* species were detected in 628 (9,7%) milk samples. In another survey carried out Bulgaria, *S. aureus* was detected in only one soft cheese samples made from pasteurized cow's milk. From Spain, *Staphylococcus* spp. were detected in 201 out of 940 samples (milk, cheeses, meat, bakery products, vegetable products etc.). In the present study, for *S. aureus* determination, we could not use samples levels detection. However, we searched isolate levels, and *S. aureus* was detected in 88% of milk origin isolates. The ratio was very high compared to above study results. The reason is mainly raw milk, in other words it did not applied any heated process. It is known that, the bacterium is not resistance against heated process such as pasteurization or UHT. As for cheese origin isolate, *S. aureus* contamination ratio (56%) in the samples origin isolates was relatively low compared the milk origin isolates. However, the rate was also high compared other area. The reason may be depend on lower quality or raw milk used for making cheese or not enough heated process of curd. The other factor could be seconder contamination of curd with *S. aureus* or CPS via equipment, food handlers or environment conditions etc.

In another survey carried out 9 EU countries (Croatia, the Czech Republic, Hungary, Italy, Portugal, Romania, Slovakia, Slovenia and Spain), 940 milk and dairy products samples were searched for staphylococcal enterotoxins, and 7 (soft-semi soft and hard cheese samples) of them were contaminated with staphylococcal enterotoxins (Anonymous 2017). According to Ercoli et al. (2017) from Italy, they are reported a SFP outbreak occurred in 2015, and affecting 24 (57,14%) customers who had dinner at a local restaurant. In the outbreak, high levels of CPS (108 CFU/g) as well as staphylococcal enterotoxins (SEA) were detected in both the cream dessert. CPS were also detected on the kitchen table's surface. In addition the findings, 5 food handlers were positive for *S. aureus*. In total, 5 enterotoxigenic *S. aureus* isolates were obtained from 3 food handlers, a kitchen surface, and the Chantilly cream dessert. In the outbreak, MR genes (*mecA*, *mecC*, and *mupA*) were detected in the isolates. Another three SFP outbreaks because of enterotoxigenic *S. aureus* besides other CPS species were reported from Belgium by Denayer et al. (2017). A total 52 cases were involved in these outbreaks. According to molecular typing of human and food isolates and enterotoxin gene typing, it was confirmed the link between patients and the suspected foodstuffs. A SFP outbreak according to soft cheese (produced from raw cow milk origin) consumption outbreak in Swiss reported by Johler et al. (2015). In the outbreak, 14 children were affected. An SEA and SED enterotoxin type-strain was responsible of the outbreak. The Centers for Disease Control guessed that 240,000 SFP cases (Scallan et al. 2011). In the EU, in 2013, 386 SFP outbreaks reported (Anonymous 2015). According to Asao et al. (2003), in 2000, a large-scale and widespread outbreak of SFP occurred in Kansai district in Japan, and 13420 people were affected. They frequently ingested some dairy products, including low-fat milk and drink-type yogurt manufactured by a factory in Osaka City. The main ingredient of these dairy products was powdered skim milk manufactured. In Austrian, there were observed an outbreak 2007, it was seen a SFP related to consumption of milk, cacao milk or vanilla milk was associated with a 37,8 times higher risk of becoming a case (Schmidt et al. 2009). In the present study, we did not searched for SE type of toxins.

MRSA has increasingly been recognized in farm animal populations (Anonymous 2009). There have been some studies have investigated MRSA prevalence in milk and cheese. One of them, Zinke et al. (2012) reported that a total of 72 cheese samples had been analyzed for *S. aureus* and MRSA. From these, two cheese samples, manufactured from pasteurized milk and two samples, produced from raw milk, were *S. aureus* positive with CFU/g between $1,0 \times 10^1$ and $7,0 \times 10^1$. However, MRSA was not detected. Another study, Hummerjohan et al. (2014) reported that *S. aureus* was detected in 77 out of the 78 raw milk cheese samples. A total 609 out of 623 CPS isolates were *S. aureus*.

Abdou et al. (2016) reported that MRSA was detected in 53% (106/200) among all milk and dairy products with prevalence rates of 75%, 65%, 40%, 50%, and 35% in raw milk, Damietta cheese, Kareish cheese, ice cream, and yogurt samples, respectively. The mean *S. aureus* counts were 3,49; 3,71; 2,93; 3,40 and 3,23 log₁₀ CFU/g among tested raw milk, Damietta cheese, Kareish cheese, ice cream and yogurt, respectively, with an overall count of 3,41 log₁₀ CFU/g. Interestingly, all recovered *S. aureus* isolates were genetically verified as MRSA strains by molecular detection of the *mecA* gene.

In the present study, *mecA* gene was detected in 4 (8%) milk origin isolates. The nuc gene was also detected in the same four isolates. Therefore, the 4 isolates were evaluated as MRSA (8%). Many studies have evaluated the prevalence of MRSA in milk. One of them, Basanisi et al. (2017) reported that 12,9% of samples were contaminated by *S. aureus* and the 8,3% were MRSA. Riva et al. (2015) found that the prevalence of *S. aureus* was 9,1% in raw milk and the 20% were MRSA. Another study reported from Germany that 4,4% of bulk tank milk were contaminated with MRSA. Study also reported from Germany that the occurrence of MRSA in three dairy herds had experienced individual cases of clinical and subclinical mastitis associated with MRSA. Bulk tank milk samples were also tested. Furthermore, nasal swabs were collected from people working on the

farms and from cattle. Environmental samples were collected from associated pig holdings. They found that milk samples of 5,1-16,7% of dairy cows were found positive for MRSA. The respective proportions in the second herd level investigation were 1,4-10,0%. MRSA were also detected in nasal swabs of staff (7/9), cows (7/15) and calves (4/7), bulk tank milk samples (3/3) and environmental samples from pig premises (4/5) on the farm (Spohr et al. 2011). Normanno et al. (2007) reported that of the 160 analyzed *S. aureus* strains, six (3,75%) were *mecA* positive and derived from six different samples; four isolates were from bovine milk and two from dairy products (pecorino cheese and mozzarella cheese). Two strains isolated from milk belonged to the non-host-specific biovar while the others to the ovine biovar. The strain isolated from mozzarella cheese belonged to the non-host-specific biovar and the strain isolated from pecorino cheese to the ovine biovar. Haran et al. (2012) reported from Minnesota farms that a total of 150 pooled BTM samples from 50 farms, collected over 3 seasons (spring, summer, and fall of 2009), were assessed, and a total of 93 MSSA isolates and 2 MRSA isolates were recovered from 150 BTM samples. In the recent study, Rodríguez-Lázaro et al. (2017) also found that the highest prevalence of *S. aureus* was found at 64,6% ratio. The MRSA strains were isolated from 21 milk and dairy products in Europe Union. Basanisi et al. (2017) reported that occurrence and the characteristics of MRSA isolated from 3760 samples of milk and dairy products analyzed. Overall out of 484 *S. aureus* strains isolated, 40 (8,3%) were MRSA. The 50% of isolated strains harbored PVL-encoding genes.

In the present and other studies' results mentioned above, the contamination rate of milk and cheese samples with *S. aureus*, MRSA and MRCPS is changing in the world even in the same country. According results, generally, raw milk samples potential high risk for consumer than cheese samples for containing *S. aureus* and other kind of *Staphylococcus* species. The risk may be reduced some extent providing applying heat treatment. In other words, raw milk should not consumed or not used for cheese production. In the farm levels, cow should examine for clinic or sub clinic mastitis, and if it is necessary, antibiotic can used but according to antibiogram test result. Antibiotic can used only treatment. Hygienic condition of the farm must be improve for healthy cow breeding and their products such as milk. Cheese is more safety a kind of dairy product than raw milk. However, during the manufacturing, we have to avoid using raw milk. We can HACCP program or like that program for prevent seconder contamination. The producer can test before purchase milk for determination of antibiotic residue as well as MRSA or MRCPS and *S. aureus*. We know that animal origin food like milk and dairy products a vehicle for consumer due to *S. aureus* and their toxins, *S. aureus*, MRSA and MRCPS.

4. Conclusion

MRSA is a pathogen emerging in hospitals as well as community and livestock. MRSA is a significant and costly public health concern because it may enter the human food chain and contaminate milk and dairy products causing foodborne illness. In addition, HA-MRSA and LA-MRSA are a common cause of bovine mastitis and thus contaminate milk and dairy products which can be considered vehicles of transmission of MRSA to humans. As a result, MRSA and MRCPS were present in milk and cheese samples, and these kinds of samples have potential risk for human and food industries. In addition, these kinds of foods can difficulty for treatment of MRSA infection.

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