

# Antimicrobial resistance trends of *Staphylococcus aureus* isolated from bovine intramammary infections from 1990 to the present time in Argentina

*Staphylococcus aureus* is one of the most prevalent major mastitis pathogens in dairy herds worldwide [1]. Antimicrobial therapy is one of the bases of *S. aureus* mastitis control programmes, both for subclinical cases at drying off and clinical cases during lactation [1]. However, cure rates following antibiotic therapy are variable since several factors associated with host, pathogen and treatment regimen affect the probability of cure of *S. aureus* intramammary infection (IMI) [2]. Among pathogen factors, antibiotic resistance is an obvious reason for treatment failure, although selection of antibiotics based on in vitro susceptibility testing does not assure therapeutic success [3]. Despite this drawback, most authors agree that antibiotic susceptibility testing should precede antibiotic treatment, mainly in case of subclinical mastitis [2]. In addition, antimicrobial susceptibility testing is important for monitoring the spread of resistant strains among bacterial populations. Both determination of minimum inhibitory concentration (MIC) and disk diffusion test (DD), which is the most widely applied method in routine veterinary laboratories due to its simplicity and low cost, have been used for performing antimicrobial susceptibility surveys worldwide [4, 5]

The aim of this study was to review published research in Argentina on antimicrobial susceptibility of *S. aureus* isolated from bovine IMI. Searching for the survey included the words “mastitis”, “bovine”, “*Staphylococcus aureus*”, “coagulase-positive *Staphylococcus*”, “antimicrobial” “susceptibility” and “resistance”. Since previous reports indicated that the majority of coagulase-positive *Staphylococci* isolated from bovine milk are *S. aureus* [1] studies which characterized the isolates either as *S. aureus* or coagulase-positive *Staphylococci* were considered. The inclusion criteria were: studies

performed in Argentina which evaluated antimicrobial susceptibility of *S. aureus* isolated from mammary secretion quarter and composite samples of cows with subclinical and clinical mastitis using MIC determination or DD test published in peer reviewed journals. Scopus, PubMed, and Academic Google databases were searched for scientific papers unrestricted by language and published from 1990 to 2018. A total of nine scientific publications which reported antimicrobial susceptibility of *S. aureus* isolated from bovine mastitis in Argentina is included (Table 1). Only those antibiotics included in at least three studies are shown in the table.

## DISCUSSION

There is a growing concern about overuse and misuse of antimicrobial products for treating and preventing infectious diseases in cattle due to its contribution to the emergence and spread of antimicrobial resistant organisms. These organisms represent a great threat to human and animal health, and to the world ecosystem [15]. Bovine mastitis is the most frequent reason for treating both lactating and non-lactating dairy cattle [16, 17] There are no studies in Argentina and limited studies worldwide which compare resistance patterns before and after antibiotic usage throughout years using consistent procedures to evaluate the emergence of resistance due to antibiotic usage [16]. However, several studies have described occurrence of *S. aureus* resistance to antibiotics over time [5]. The antibiotics that were more consistently evaluated in Argentina were the beta-lactams and those of the macrolide-lyncosamide class. Penicillin is considered a first choice antibiotic for treating bovine mastitis. Resistance to penicillin has varied among studies showing the highest percentages during the first two decades (1990–2000) and lower percentages in studies conducted in the current decade. Only in one study, published in 2001, oxacillin-

resistant coagulase-positive *Staphylococci* were detected, indicating that it could have been an isolated finding. However, since methicillin-resistant *S. aureus* have been detected in several countries [18], continuous surveillance is needed for early detection of emergence of this type of resistance.

Antibiotics from macrolide-lyncosamide class are frequently used in Argentina for treating bovine mastitis [17]. Erythromycin is the most commonly tested macrolide as representative of this group, using approved human interpretive criteria [19]. Resistance to erythromycin was low in most studies. Only in one study in the last decade did it exceed 20%, which is higher than percentages reported both in Argentina and other countries [5]. Pirlimycin was commercially available in Argentina during the 90s, and has recently been introduced again to the veterinary market. Susceptibility to this antibiotic was reported in studies published at the beginning of the 2000 decade using veterinary-specific interpretive criteria [19], showing variable resistance among studies and percentages comparable with previous reports in other countries [5].

In conclusion, although information is limited, there is no apparent emergence or progression of *S. aureus* resistance to the most commonly used antibiotics for treating bovine mastitis in Argentina. This finding is in accord with previous reports which included studies conducted in different countries [5, 16]. However, there is a need to extend these studies to other bovine mastitis pathogens, using a harmonized approach to allow measuring resistance trends over time [15]. This information, together with increasing knowledge about antibiotic usage in dairy farms in Argentina [17] will allow us to evaluate and propose actions for a more responsible and prudent use of antibiotics in our dairy farms.

| Antibiotic   | % Resistant |      |       |      |      |      |      |       |       |
|--------------|-------------|------|-------|------|------|------|------|-------|-------|
|              | 1           | 2    | 3     | 4    | 5    | 6    | 7    | 8     | 9     |
| Penicillin   | 14.81       | 77.5 | 55.89 | 40.3 | 47.6 | 48.4 | 14.3 | 28.12 | 33.85 |
| Oxacillin    | -           | -    | 2.94  | 0    | 0    | 0    | -    | 0     | 0     |
| Erythromycin | -           | -    | 5.6   | 11.6 | 2    | 2.1  | 22.2 | 3.12  | 7.69  |
| Pirlimycin   | -           | -    | 14.71 | 7.7  | 4    | -    | -    | -     | -     |
| N            | 33          | 79   | 34    | 206  | 101  | 95   | 63   | 96    | 65    |
| Reference    | 1           | 2    | 3     | 4    | 5    | 6    | 7    | 8     | 9     |

**Table 1** – Antimicrobial resistance of *Staphylococcus aureus* isolated from bovine mastitis in Argentina ([6, 7, 8, 9, 10, 11, 12, 13, 14].

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