Novel Approach toward Food Safety in Milk: Detection of Antimicrobials and Non-Targeted Metabolite Residues as pivotal approach to prevent antibiotic resistance diffusion

Maria Nobile, Sara Panseri, Luca Maria Chiesa, Federica Di Cesare, Roberto Villa, Radmila Pavlovic, Francesco Arioli

Introduction

Antimicrobials have been widely used in animal husbandry for over 60 years for the prevention and therapy of common pathologies. Their misuse to increase growth performance can lead to the presence of residues in milk, with several impacts as:

- potential threat of direct toxicity to consumers
- antimicrobial resistance
- Implications in the cheese-making process

Fig.1: Food safety of milk and derivatives

Methodology

141 raw bovine milk samples were collected from local farms of Piedmont Region, North Italy, involved in Grana Padano PDO cheese production. The samples were from dairy cows previously treated with different antimicrobial drugs due to medical conditions, in accordance with the withdrawal period, collected after the seventh milking. Confirmatory analyses were performed by an HPLC system coupled with a Thermo Q-Exactive Orbitrap (Thermo Fisher Scientific, San Jose, CA, USA).

Results

The main findings after confirmatory analyses were:

- 41 samples (29%) showed the presence of antimicrobial residual in relation to the treatment presence of a treatment;
- 9% of the total samples revealed antimicrobials not indicated in the treatment protocol of the animal, often also during screening tests
- MRLs were exceeded in 8 samples (20% of the positives, 6% of the total);
- metabolites were also found in all samples with the presence of enrofloxacin and lincomycin;
- two new enrofloxacin metabolites not described until now in literature were tentatively identified and presented.

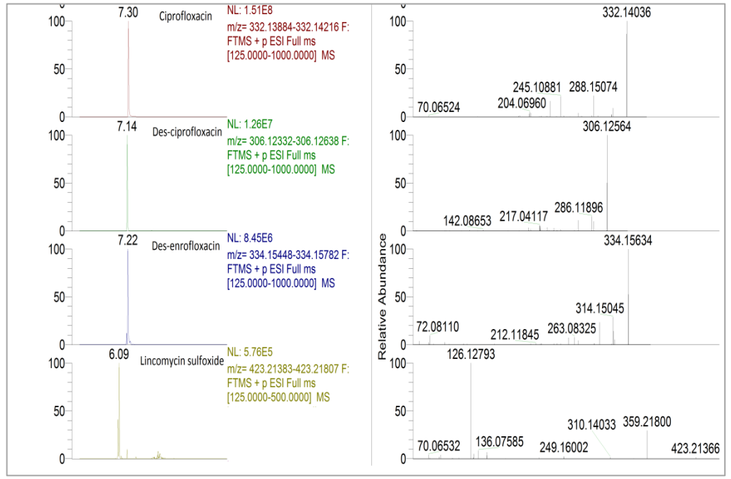

Fig. 2: Chromatograms and mass spectra of the detected enrofloxacin and lincomycin metabolites

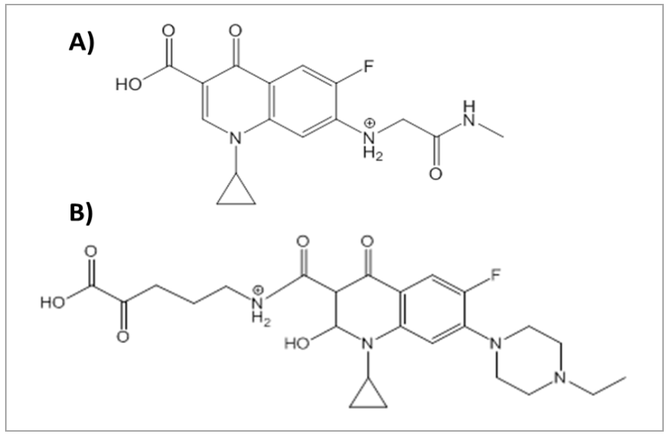

Fig. 3: Proposed structure formula of the 2 new identified enrofloxacin metabolites: A) ENRO-N-methylacetamide and B) ENRO-ornithine.

Conclusions

Antimicrobial residues in milk represent a serious health and technological problem for dairy chain also in the light of the “Farm to Fork” EU strategies process. Multi-class analysis after different therapeutical treatments, respecting the withdrawal periods, highlighted:

- the presence of parent drugs
- revealed undeclared treatments confirmed also through the presence of their metabolites, some of which are pharmacologically active

Literature cited and aknowledgments

Chiesa et al., 2020. Analysis of antibiotic residues in raw bovine milk and their impact toward food safety and on milk starter cultures in cheese-making process. LWT, 131, 109783

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Further information

Maria Nobile. Department of Veterinary Medicine and Animal Science, University of Milan, Via dell’ Università 6, 26900, Lodi, Italy. Mail: maria.nobile1@unimi.it