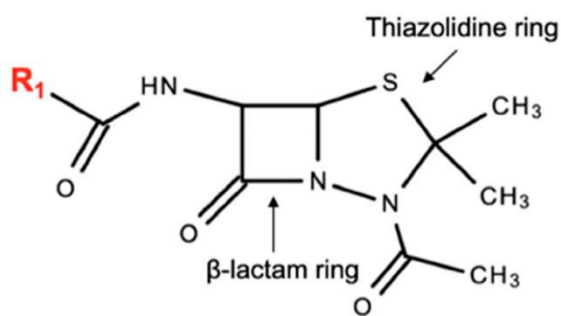


SUPPLEMENTARY MATERIAL

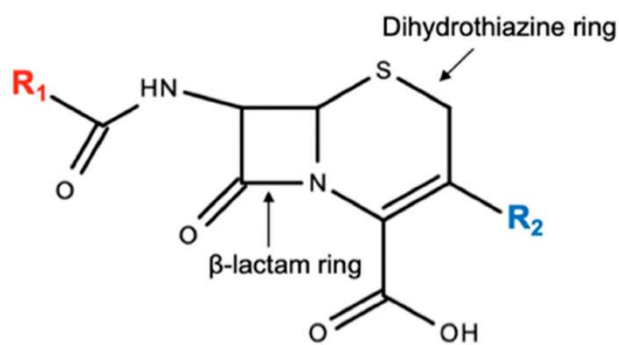
Transformation products of antibacterial drugs in environmental water: identification approaches based on liquid chromatography-high resolution mass spectrometry

Carmela Maria Montone, Benedetta Giannelli Moneta, Aldo Laganà, Susy Piovesana, Enrico Taglioni, Chiara Cavaliere*

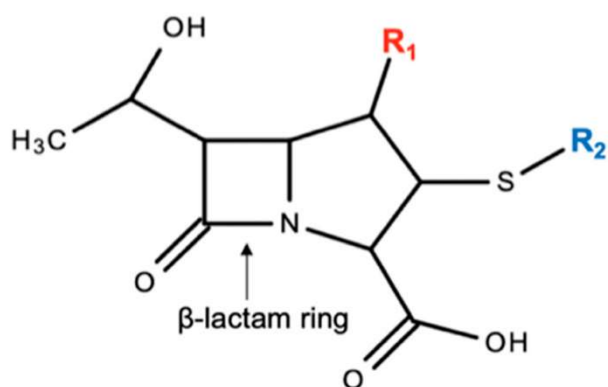
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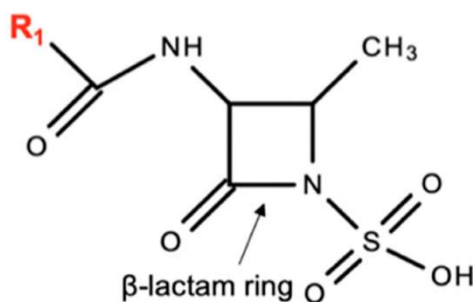
Penicillin Core Structure



Cephalosporin Core Structure



Carbapenem Core Structure



Monobactam Core Structure

Fig. S1. General chemical structures of the β -lactam antibiotics: penicillins, cephalosporins, carbapenems, and monobactams. Reprinted from [1].

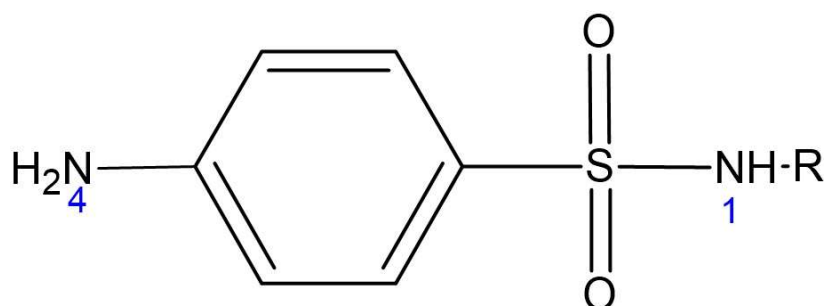


Fig. S2. General chemical structure of sulfonamides

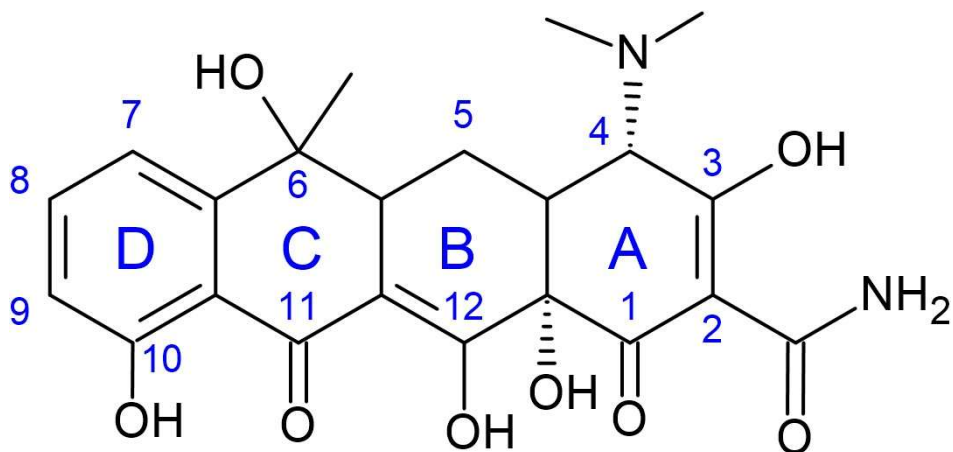


Fig. S3. General chemical structure of tetracyclines

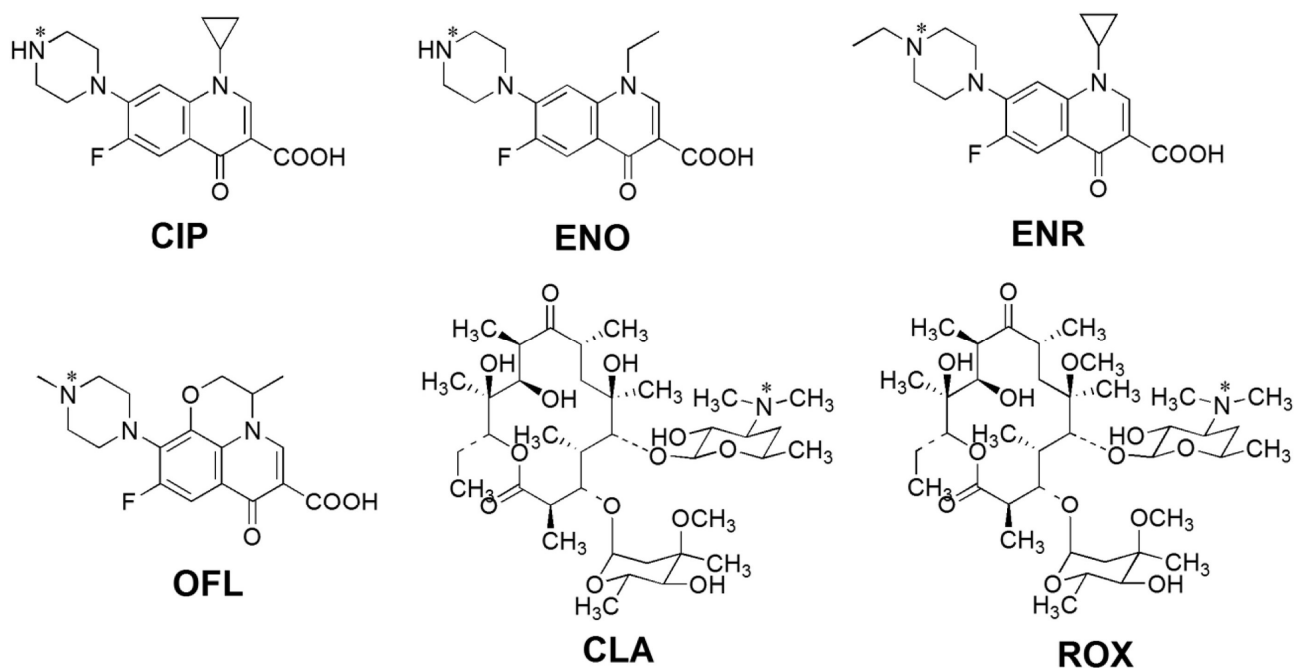


Fig. S4. Chemical structures of the main fluoroquinolone and macrolide antibiotics. Reprinted from [2]. Copyright (2016), with permission from Elsevier.

Table S1. Main available standards of transformation products (TPs) of sulfonamides. The TPs belong to sulfamethoxazole (SMX, C₁₀H₁₁N₃O₃S), sulfapyridine (SPD, C₁₁H₁₁N₃O₂S), sulfadiazine (SDZ, C₁₀H₁₀N₄O₂S), sulfamerazine (SMR, C₁₁H₁₂N₄O₂S), and sulfamethazine (SMT, C₁₂H₁₄N₄O₂S).

Transformation product	CAS number	Molecular formula	Parent compound	Δ formula
N-acetylsulfadiazine	127-74-2	C ₁₂ H ₁₂ N ₄ O ₃ S	SDZ	+ C ₂ H ₂ O
N-acetylsulfamerazine	127-73-1	C ₁₃ H ₁₄ N ₄ O ₃ S	SMZ	+ C ₂ H ₂ O
N-acetylsulfamethazine	100-90-3	C ₁₄ H ₁₆ N ₄ O ₃ S	SMT	+ C ₂ H ₂ O
N-acetylsulfamethoxazole	21312-10-7	C ₁₂ H ₁₃ N ₃ O ₄ S	SMX	+ C ₂ H ₂ O
N-acetylsulfapyridine	19077-98-6	C ₁₃ H ₁₃ N ₃ O ₃ S	SPD	+ C ₂ H ₂ O
4-nitroso sulfamethoxazole	131549-85-4	C ₁₀ H ₉ N ₃ O ₄ S	SMX	- H ₂ , + O
sulfamethoxazole β-D-glucuronide	14365-52-7	C ₁₆ H ₁₉ N ₃ O ₉ S	SMX	+ C ₆ H ₈ O ₆
5-Hydroxysulfapyridine	50930-57-9	C ₁₁ H ₁₁ N ₃ O ₃ S	SPD	+ O
5-[4-(Acetylamino)benzenesulf-onyloxy]sulfapyridine acetate	-	C ₂₁ H ₂₀ N ₄ O ₇ S ₂	SPD	+ C ₁₀ H ₉ NO ₅ S

Table S2. Main available standards of transformation products (TPs) of tetracyclines. The TPs belong to tetracycline (TC, C₂₂H₂₄N₂O₈), chlortetracycline (CTC, C₂₂H₂₃ClN₂O₈), doxycycline (DOX, C₂₂H₂₄N₂O₈), and oxytetracycline (OTC, C₂₂H₂₄N₂O₉).

Transformation product	CAS number	Molecular formula	Parent compound	Δ formula
4-epi-tetracycline	79-85-6	C ₂₂ H ₂₄ N ₂ O ₈	TC	-
anhydrotetracycline	1665-56-1	C ₂₂ H ₂₂ N ₂ O ₇	TC	- H ₂ O
4-epi-anhydrotetracycline	7518-17-4	C ₂₂ H ₂₂ N ₂ O ₇	TC	- H ₂ O
4-epi-chlortetracycline	14297-93-9	C ₂₂ H ₂₃ ClN ₂ O ₈	CTC	-
isochlortetracycline	514-53-4	C ₂₂ H ₂₃ ClN ₂ O ₈	CTC	-
6-demethyl-chlortetracycline	-	C ₂₁ H ₂₀ ClN ₂ O ₈ ⁻	CTC	- CH ₃
N-Desmethyl doxycycline	86271-83-2	C ₂₁ H ₂₂ N ₂ O ₈	DOX	- CH ₂
4-epi-oxytetracycline	14206-58-7	C ₂₂ H ₂₄ N ₂ O ₈	OTC	-

Table S3. Main available standards of transformation products (TPs) of macrolides. The TPs belong to erythromycin (ERY, C₃₇H₆₇NO₁₃), clarithromycin (CLA, C₃₈H₆₉NO₁₃), azithromycin (AZI, C₃₈H₇₂N₂O₁₂)

Transformation product	CAS number	Molecular formula	Parent compound	Δ formula
Anhydroerythromycin	23893-13-2	C ₃₇ H ₆₅ NO ₁₂	ERY	- H ₂ O
Erythromycin oxime	13127-18-9	C ₃₇ H ₆₈ N ₂ O ₁₃	ERY	+ NH
Erythromycin enol ether	33396-29-1	C ₃₇ H ₆₅ NO ₁₂	ERY	- H ₂ O
<i>N</i> -Demethylethromycin	992-62-1	C ₃₆ H ₆₅ NO ₁₃	ERY	- CH ₂
<i>N</i> -Desmethyl clarithromycin	101666-68-6	C ₃₇ H ₆₇ NO ₁₃	CLA	- CH ₂
Descladinosyl clarithromycin	118058-74-5	C ₃₀ H ₅₅ NO ₁₀	CLA	- C ₈ H ₁₄ O ₃
14-hydroxy clarithromycin	116836-41-0	C ₃₈ H ₆₉ NO ₁₄	CLA	+ O
<i>N</i> -Desmethyl azithromycin	76801-85-9	C ₃₇ H ₇₀ N ₂ O ₁₂	AZI	- CH ₂
<i>N</i> '-Desmethyl azithromycin	172617-84-4	C ₃₇ H ₇₀ N ₂ O ₁₂	AZI	- CH ₂
Descladinose azithromycin	117693-41-1	C ₃₀ H ₅₈ N ₂ O ₉	AZI	- C ₈ H ₁₄ O ₃
Azithromycin <i>N</i> -oxide	90503-06-3	C ₃₈ H ₇₂ N ₂ O ₁₃	AZI	+ O

References

- [1] S.B. Chaudhry, M.P. Veve, J.L. Wagner, Cephalosporins: A Focus on Side Chains and β -Lactam Cross-Reactivity, *Pharmacy*. 7 (2019) 103. <https://doi.org/10.3390/pharmacy7030103>.
- [2] J. Deng, T. Yu, Y. Yao, Q. Peng, L. Luo, B. Chen, X. Wang, Y. Yang, T. Luan, Surface-coated wooden-tip electrospray ionization mass spectrometry for determination of trace fluoroquinolone and macrolide antibiotics in water, *Anal Chim Acta*. 954 (2017) 52–59. <https://doi.org/10.1016/j.aca.2016.12.008>.