Supporting Information

Physicochemical properties predict retention of antibiotics in water in oil droplets.

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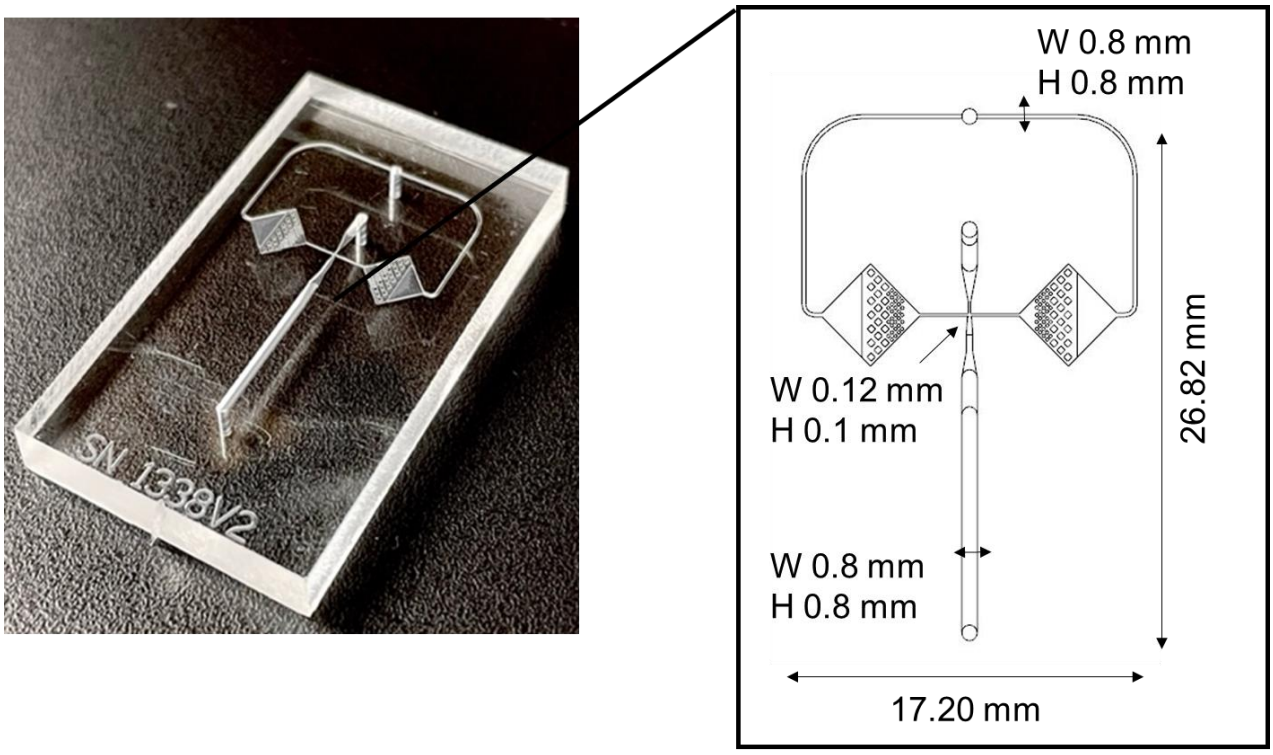


Figure S1. Scheme of droplet generation chip

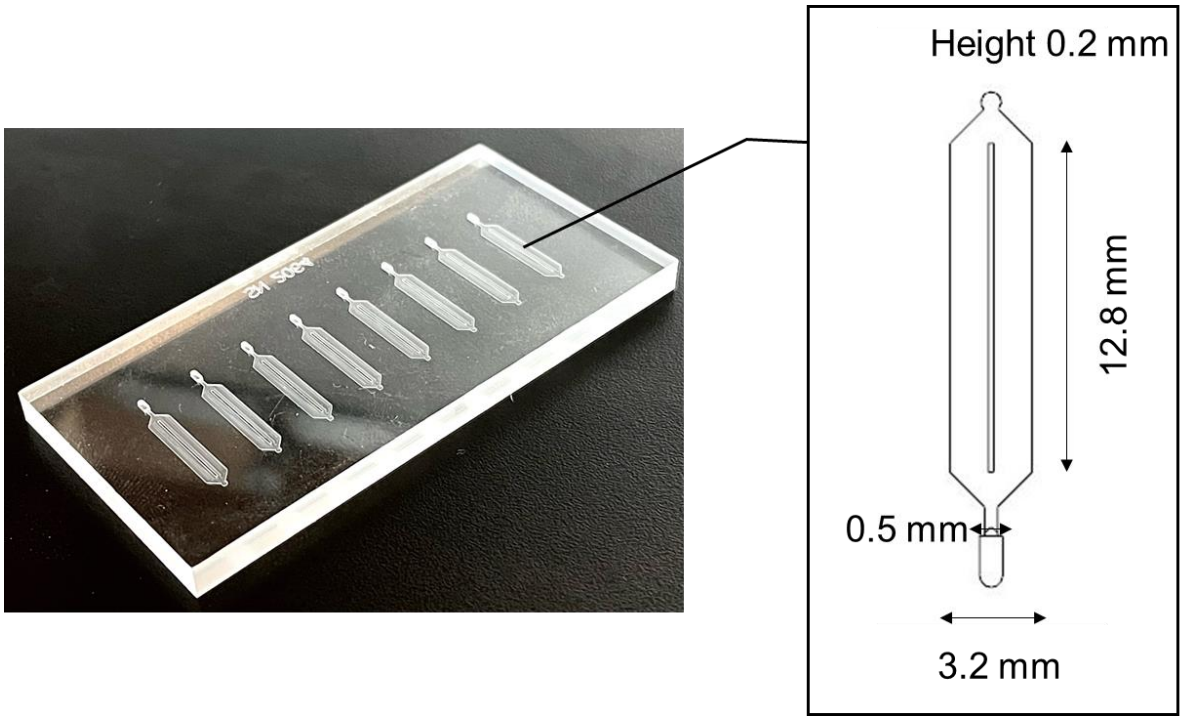
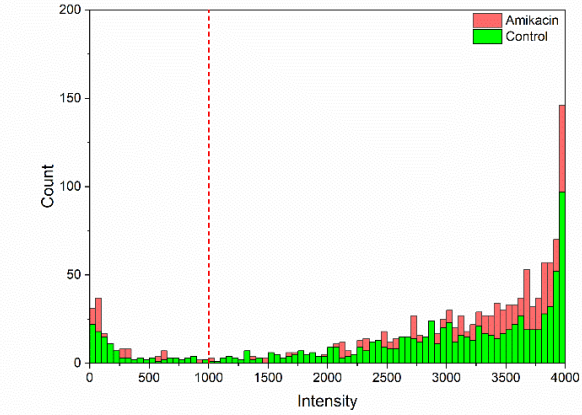


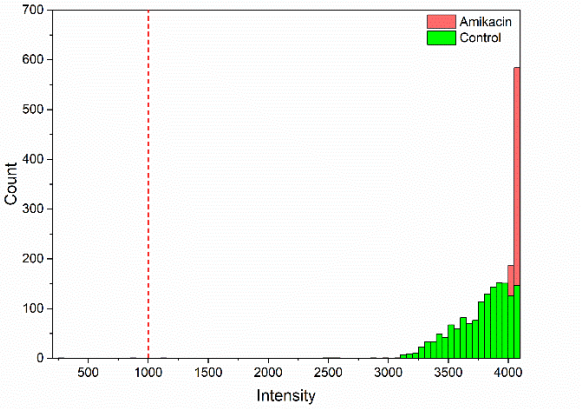
Figure S2. Scheme of the detection chamber

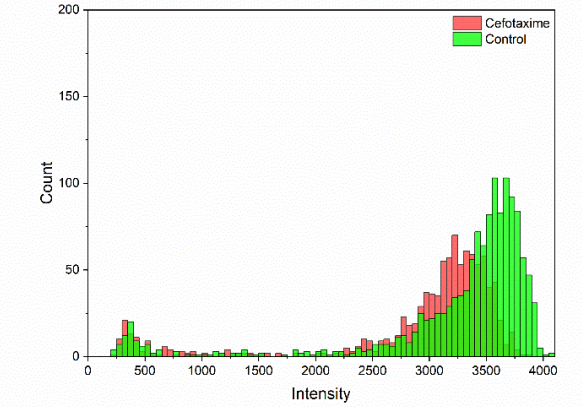
Table S1. Viability of bacteria co-incubated with 100 fold MIC in emulsions stabilized by two different types of surfactants

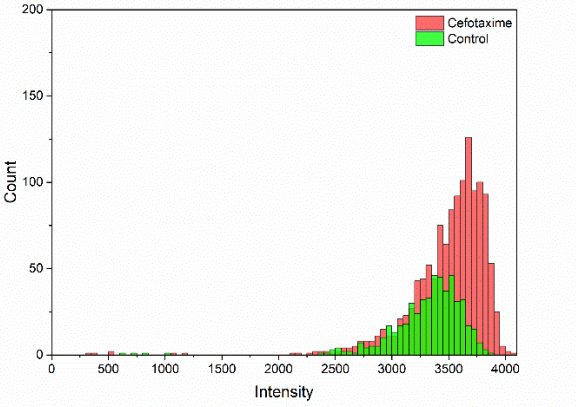
	PEG(PFPE)$_2$		Emulseo	
	Number of droplets (Cascade blue labelled)	Positive droplets [%]	Number of droplets (Cascade blue labelled)	Positive droplets [%]
Cefotaxime (CTX)	988	**90.99**	1273	**99.7**
Chloramphenicol (CHL)	1272	**0**	582	**0**
Ciprofloxacin (CIP)	1808	**0.83**	1656	**0.3**
Gentamycin (GEN)	773	**90.03**	1658	**98.19**
Spectinomycin (SPT)	1189	**75.2**	11663	**97.11**
Levofloxacin (LVX)	741	**0.13**	868	**0**
Doxycycline (DOX)	1336	**0.22**	1097	**0.46**
Kanamycin (KAN)	1956	**95.55**	1125	**99.73**
Norfloxacin (NOR)	1414	**1.06**	1109	**0.27**
Tetracycline (TET)	1924	**39.76**	1105	**54**
Amikacin (AMK)	1990	**92.96**	1134	**99.82**
Ceftazidime (CAZ)	1012	**95.36**	1113	**99.82**
Fosfomycin (FOF)	1549	**97.74**	1013	**99.8**
Tobramycin (TOB)	1741	**95.46**	1013	**99.3**
Trovafloxacin (TVA)	1652	**0.6**	1041	**0.96**
Imipenem (IPM)	1252	**99.92**	1264	**92.64**
Meropenem (MEM)	1181	**99.58**	1553	**98.65**
Nitrofurantoin (NIT)	890	**0.45**	1463	**0**

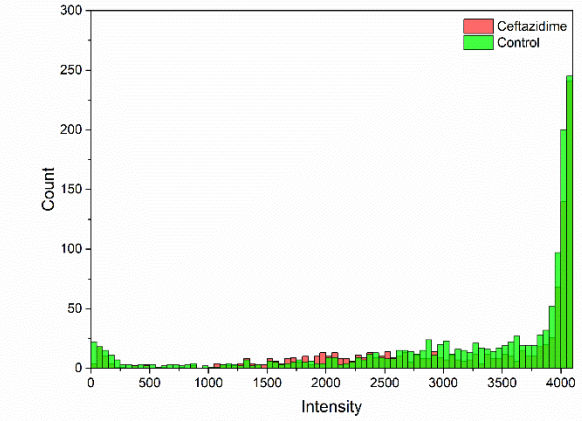
PEG(PFPE)$_2$	EMULSEO

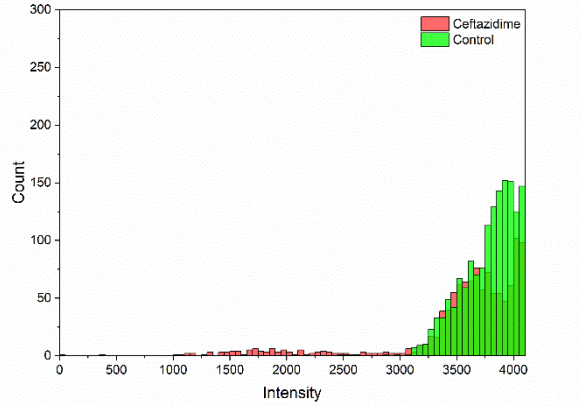


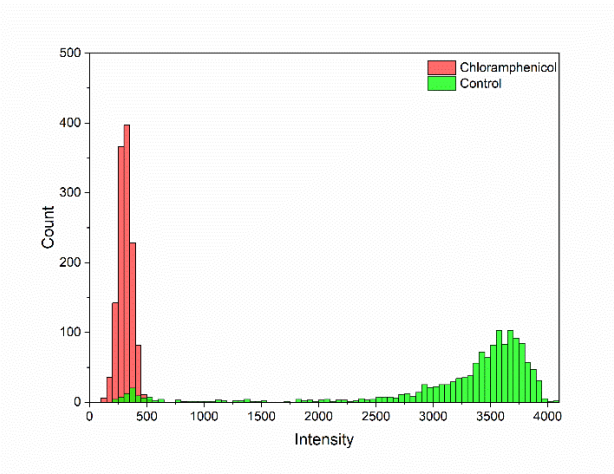








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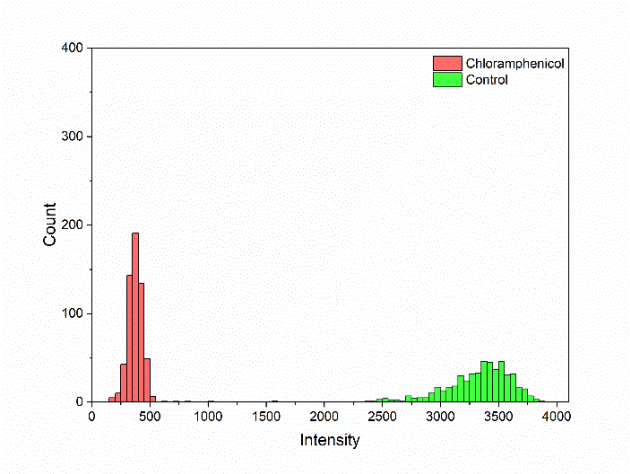
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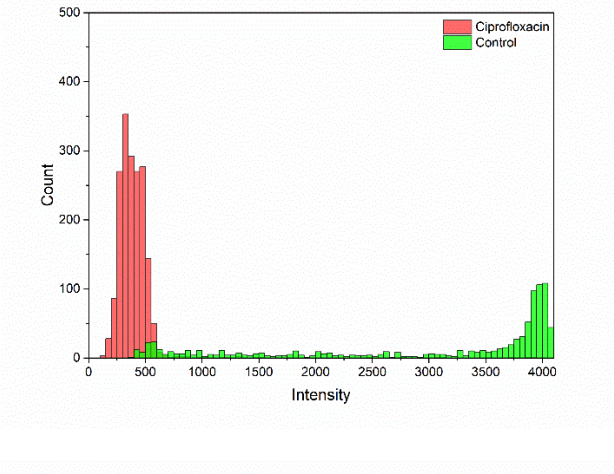
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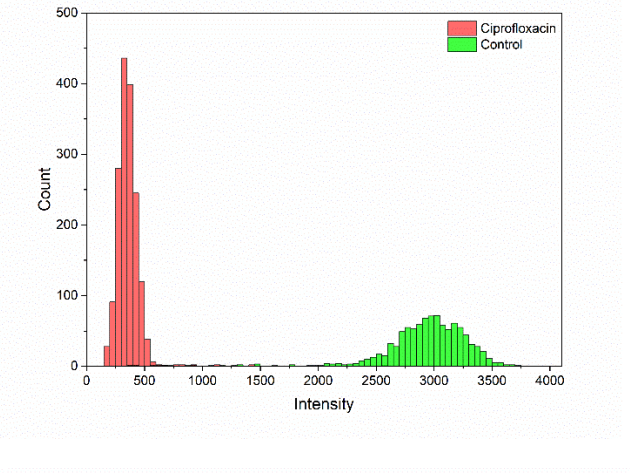
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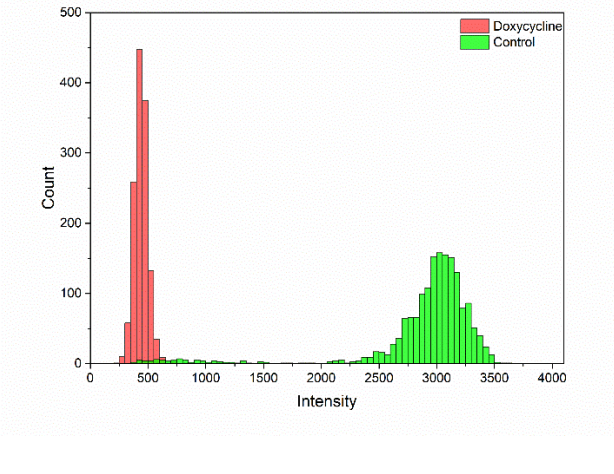
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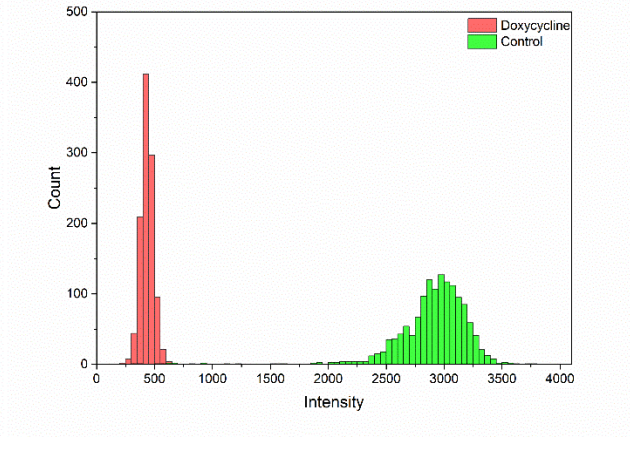
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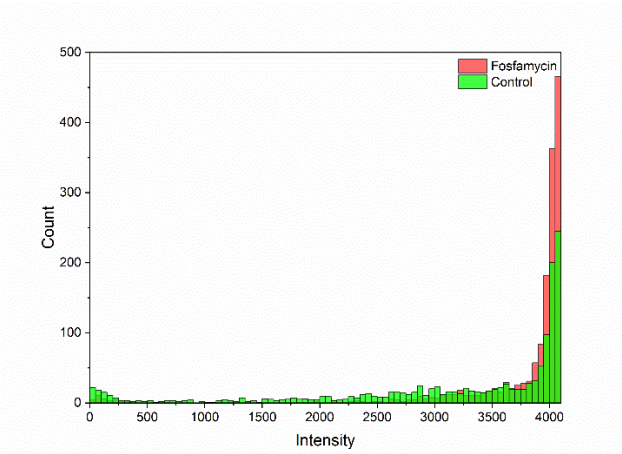
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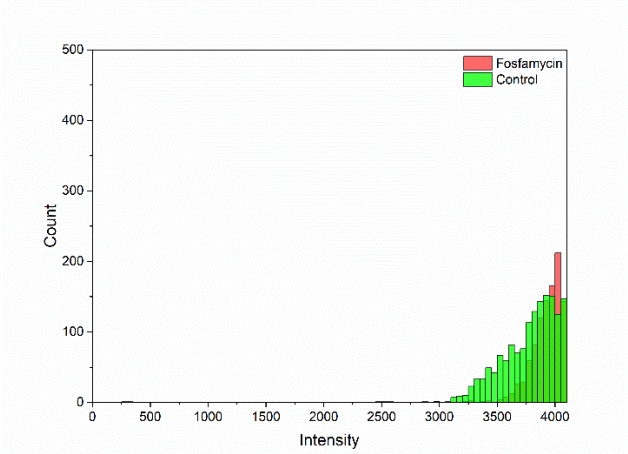
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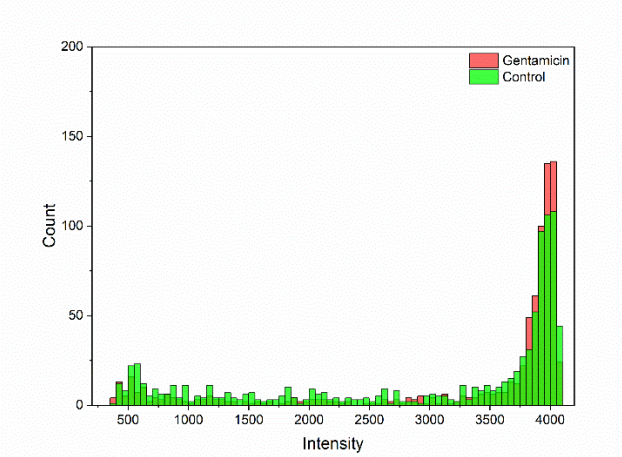
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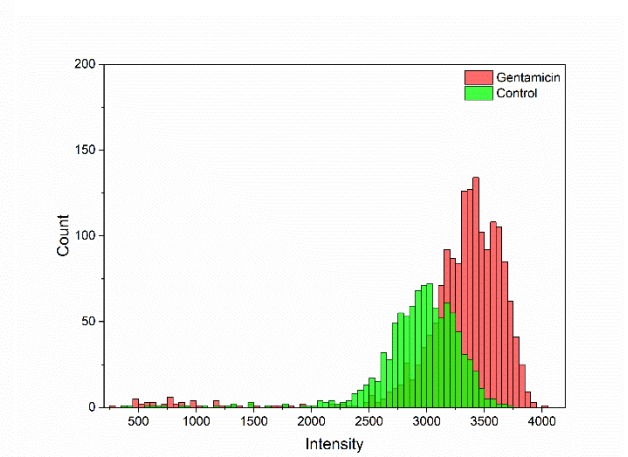
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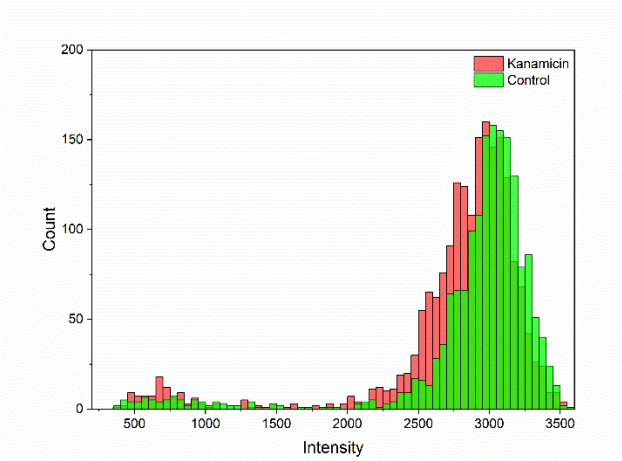
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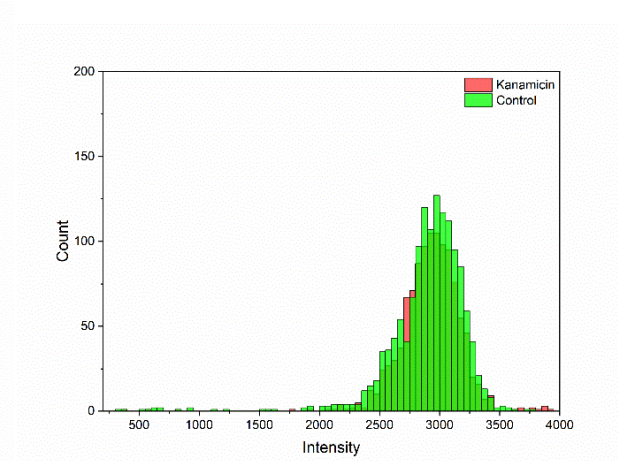
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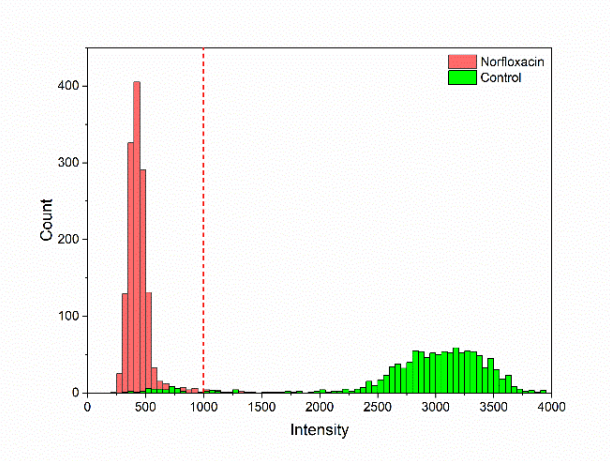
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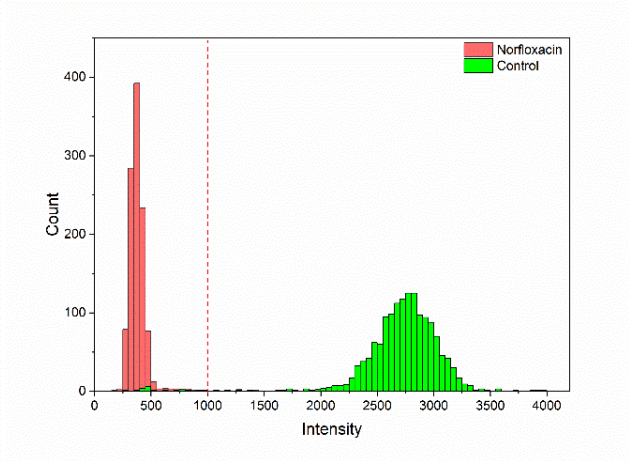
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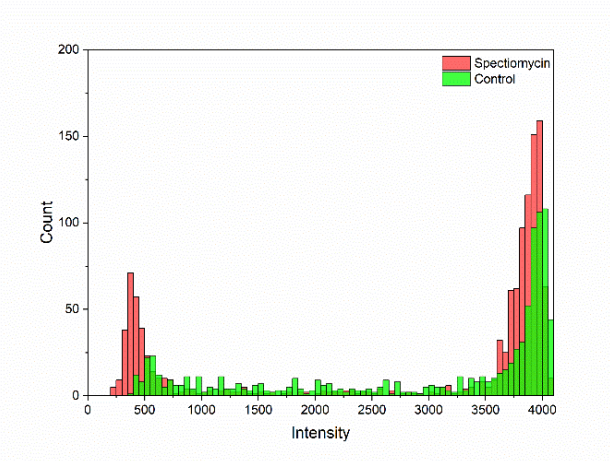
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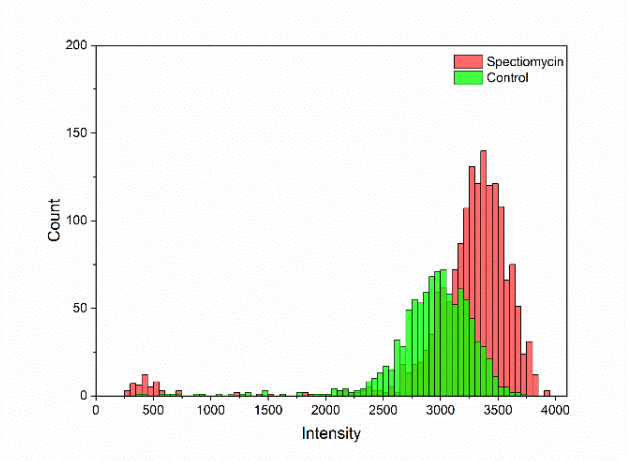
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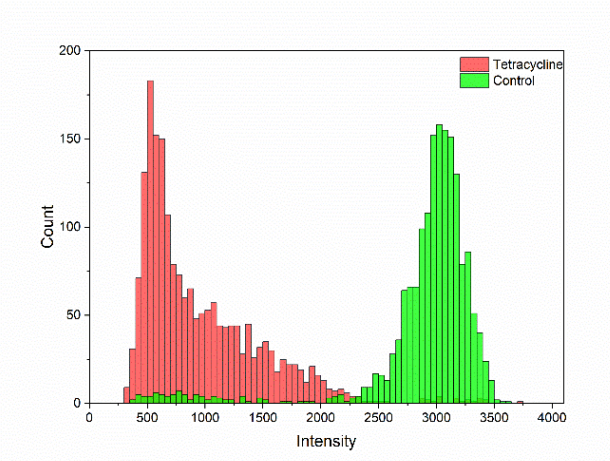
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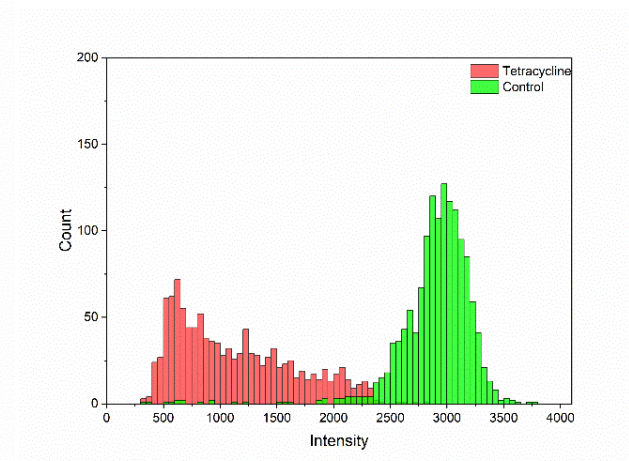
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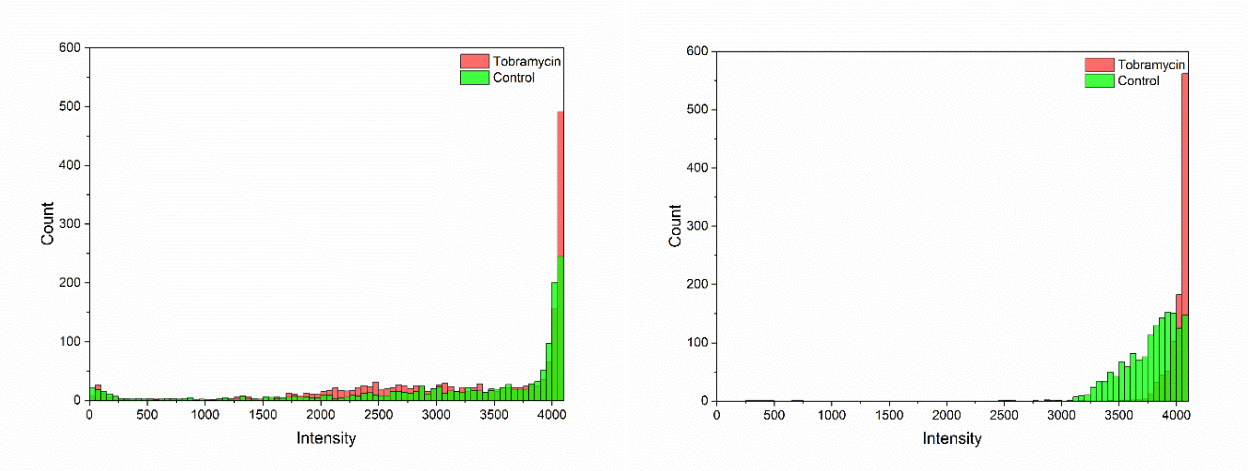
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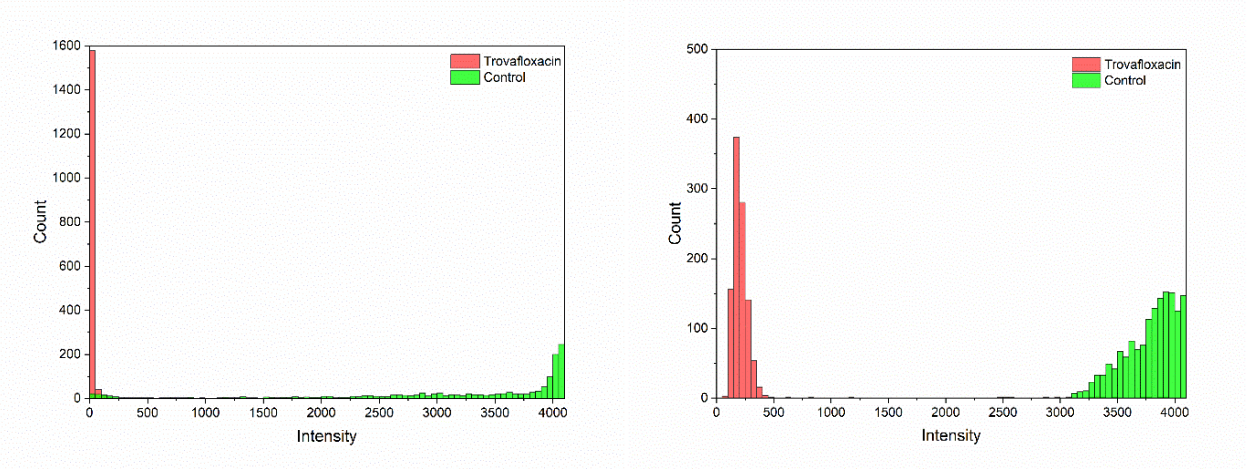
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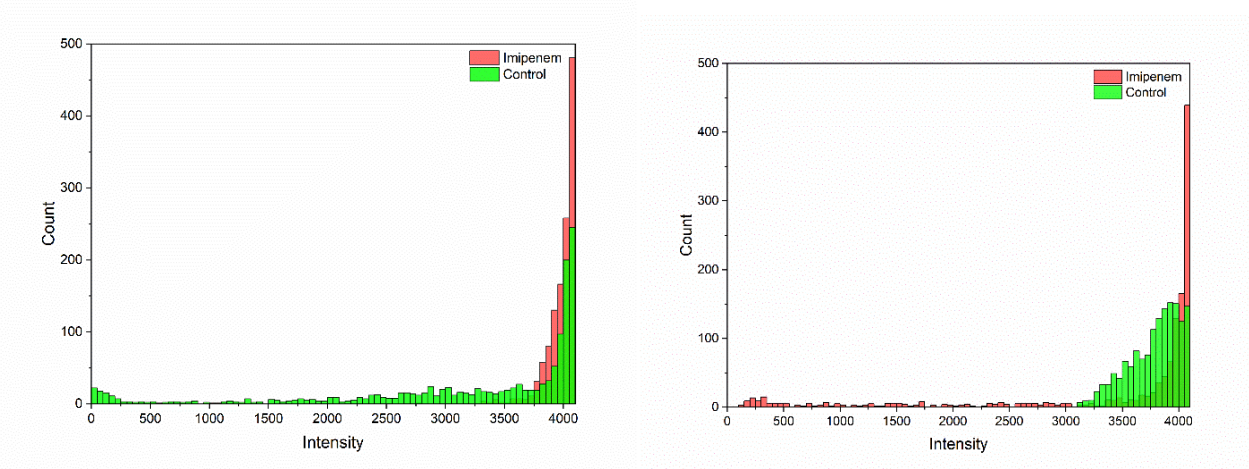
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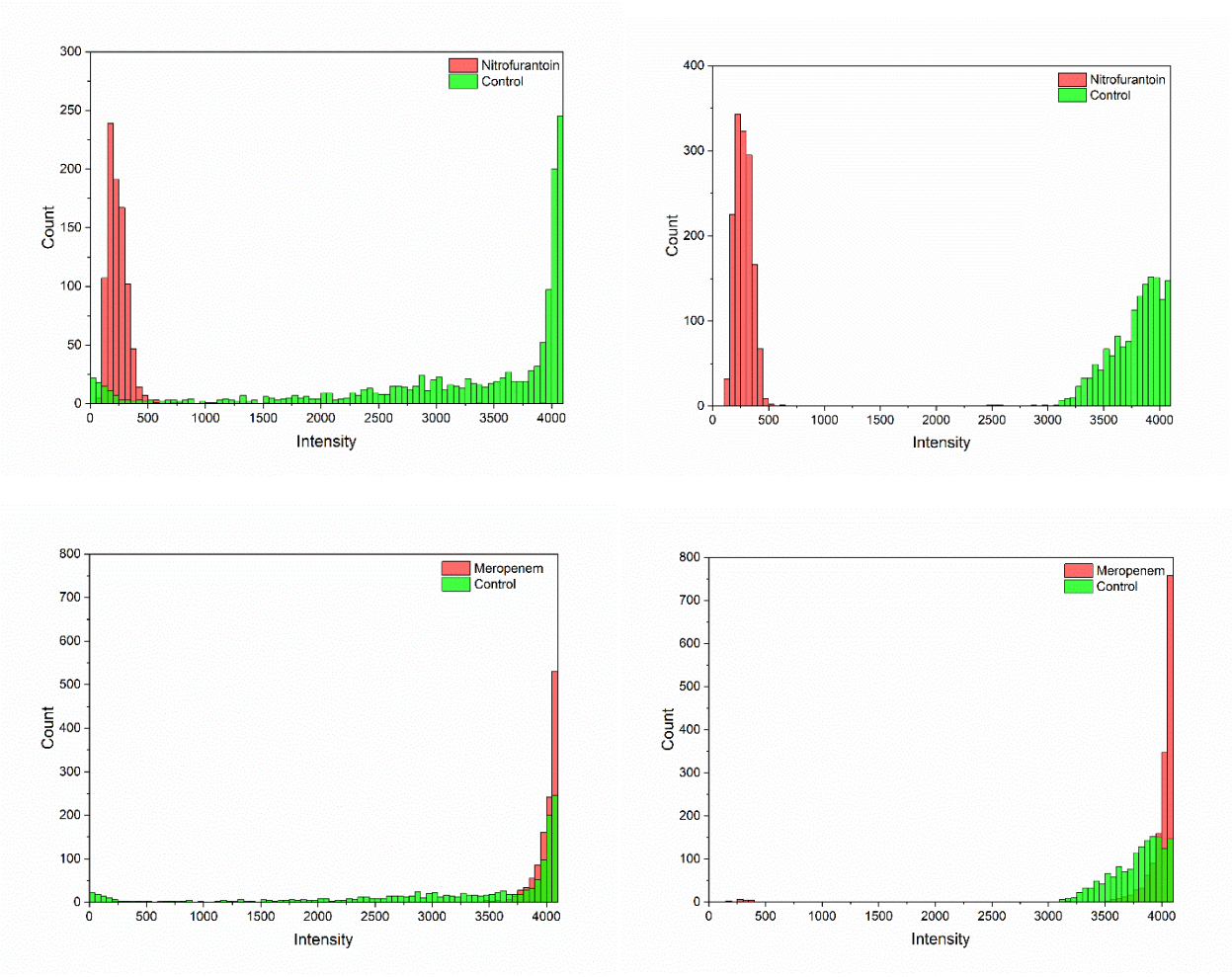
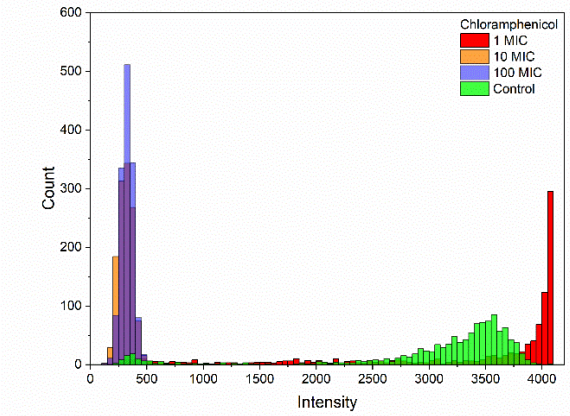
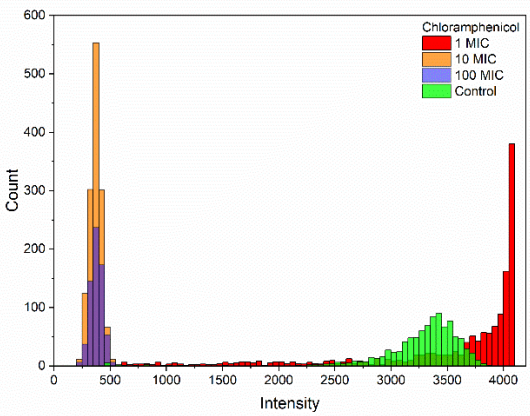


Figure S3. Histograms of the fluorescence intensity of droplets from the emulsion of droplets (100 MIC antibiotics and bacteria) suspended in fluorinate oil with two different surfactants

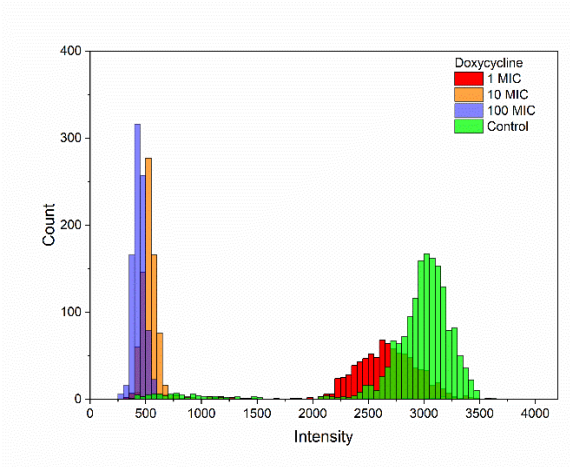
PEG(PFPE)2	EMULSEO

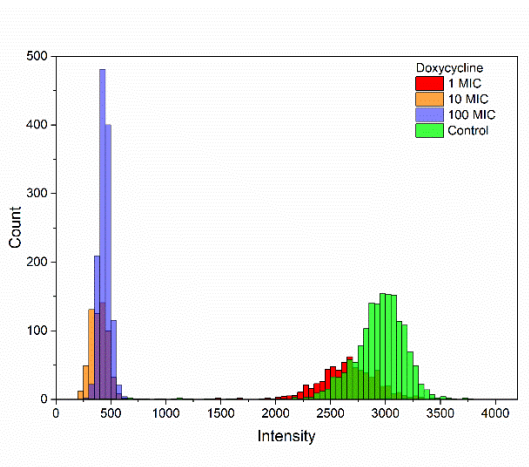




Chloramphenicol	Number of droplets	Positive droplets [%]	Number of droplets	Positive droplets [%]
control	1113	92.72	931	98.82
1x MIC	983	92.07	1394	97.85
10x MIC	1228	0	1368	0
100x MIC	1385	0	658	0

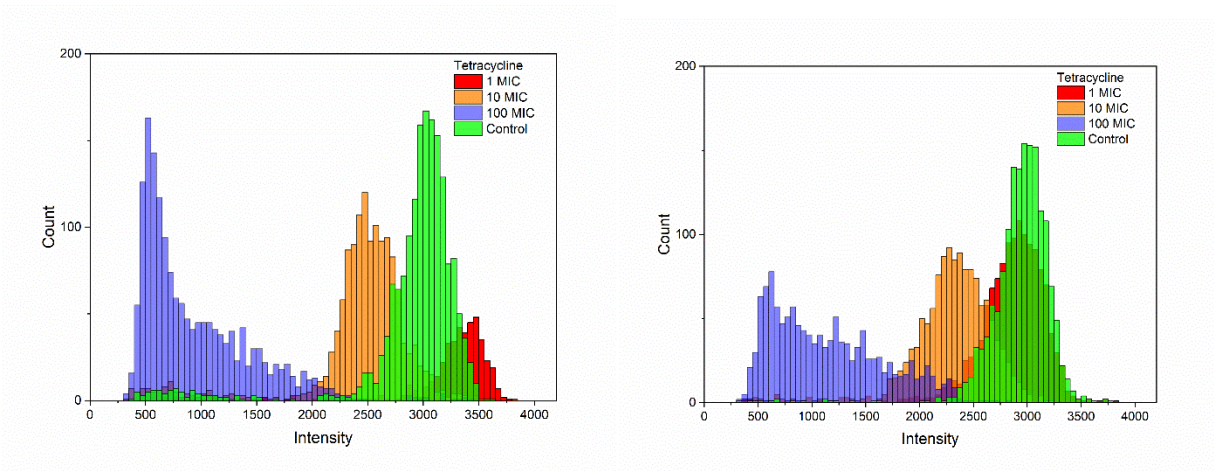
PEG(PFPE)2	EMULSEO





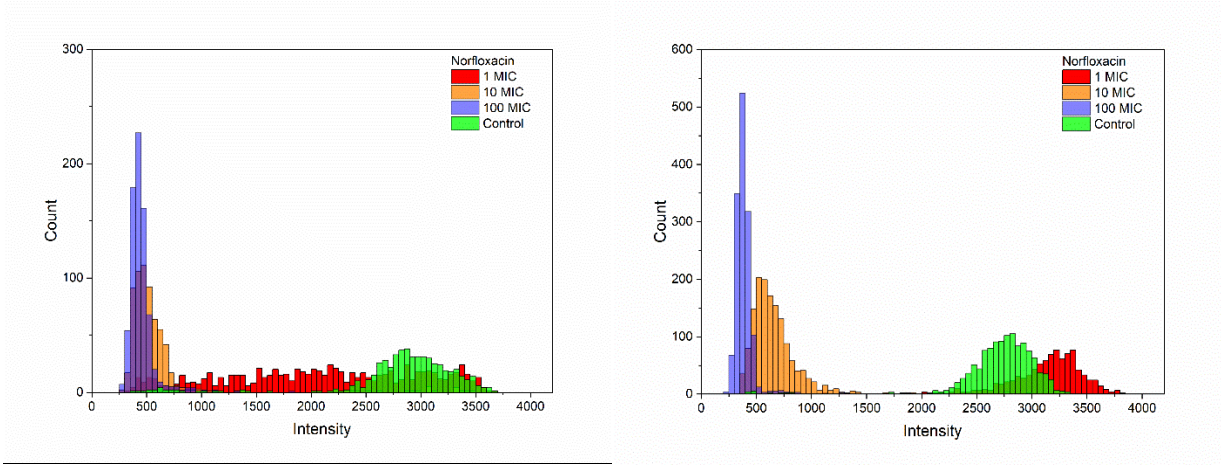
Doxycycline	Number of droplets	Positive droplets [%]	Number of droplets	Positive droplets [%]
control	1683	96.67	1594	99.44
1x MIC	897	94.54	602	99.85
10x MIC	788	3.43	602	0.17
100x MIC	874	0.23	1261	0.56

PEG(PFPE)2	EMULSEO



Tetracycline	Number of droplets	Positive droplets [%]	Number of droplets	Positive droplets [%]
control	1683	96.67	1594	99.44
1x MIC	441	98.41	1330	99.55
10x MIC	1382	94	1311	98.4
100x MIC	2133	40.18	1292	55.96

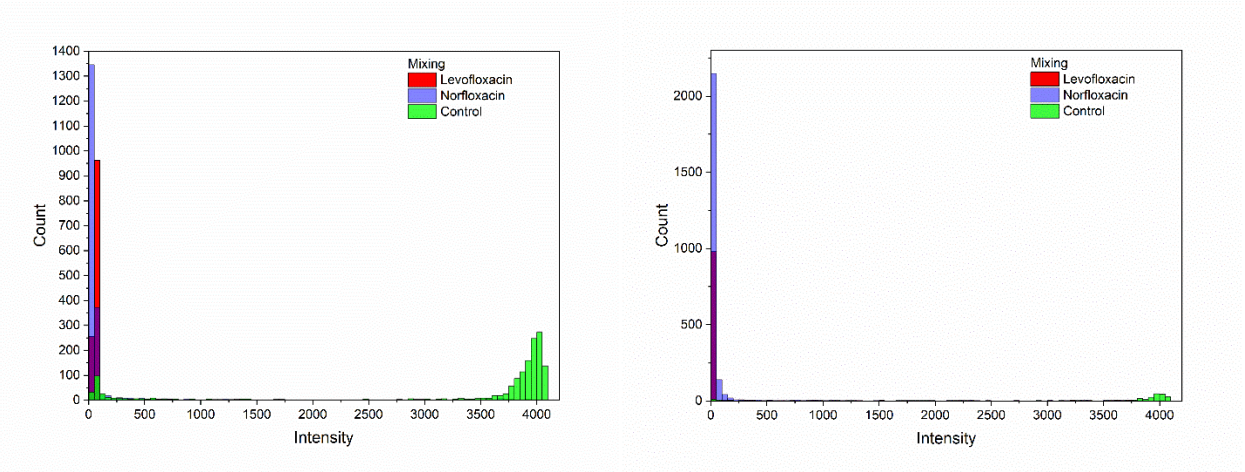
PEG(PFPE)2	EMULSEO



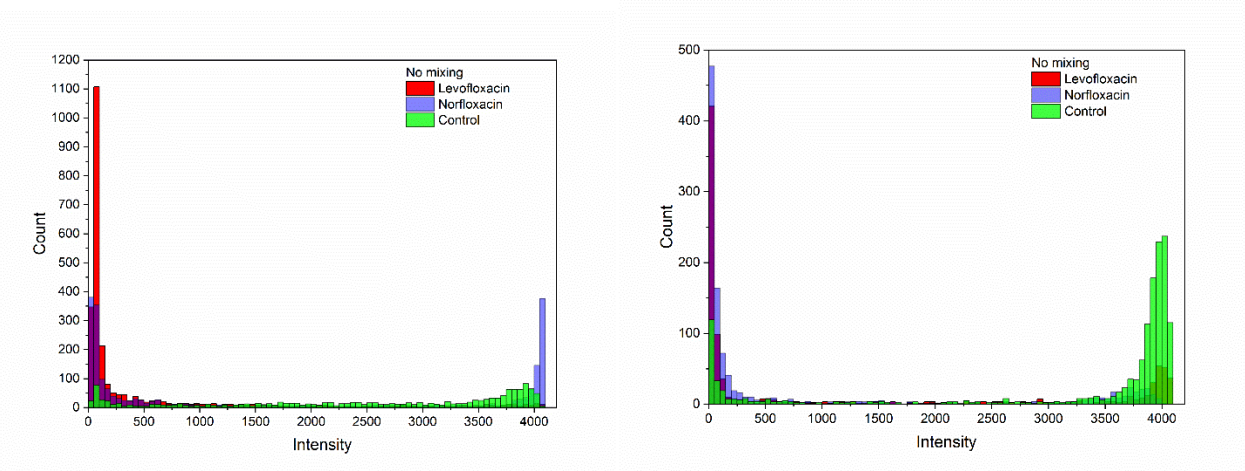
Norfloxacin	Number of droplets	Positive droplets [%]	Number of droplets	Positive droplets [%]
control	548	96.72	1211	98.27
1x MIC	918	98.91	889	87.06
10x MIC	638	4.23	1467	7.98

100x MIC	757	0.79	1413	0.35

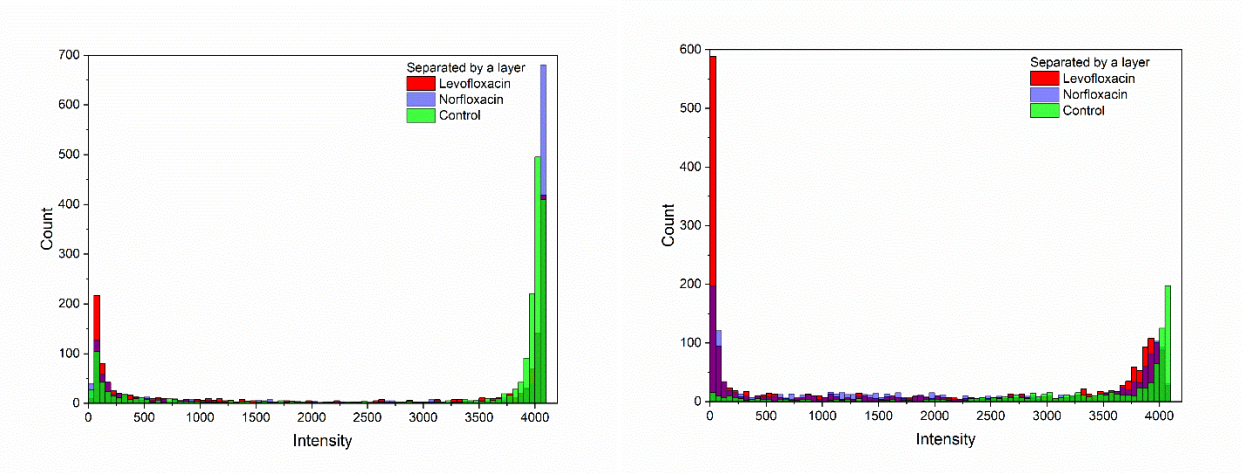
Figure S4. Viability of bacteria co-incubated with 100, 10 and 1 fold MIC of leaky antibiotics



	PEG(PFPE)2		EMU	
	Number of droplets	Positive droplets [%]	Number of droplets	Positive droplets [%]
Control mixed	1507	83.88	243	88.48
LVX mixed	1226	0.16	986	0.3
NOR mixed	1908	3.93	2433	1.23



	PEG(PFPE)2		EMU	
	Number of droplets	Positive droplets [%]	Number of droplets	Positive droplets [%]
Control no mixed	1422	81.08	1439	83.46
LVX no mixed	2511	15.45	942	33.44
NOR no mixed	2177	45.57	1117	23.01



	PEG(PFPE)2		EMU	
	Number of droplets	Positive droplets [%]	Number of droplets	Positive droplets [%]
Control separated by layers	1422	81.08	1439	83.46
LVX separated by layers	2511	15.45	942	33.44
NOR separated by layers	2177	45.57	1117	23.01

Figure S5. Viability of bacteria co-incubated with different methods (mixed, non-mixed and separated)

Software

We prepared our software for the determination of physicochemical descriptors in Microsoft Visual studio Community 2022. The software was created basing on .NET Chemistry Development Kit libraries (NCDK). The search for antibiotics can be done using either their CAS numbers or Smiles.

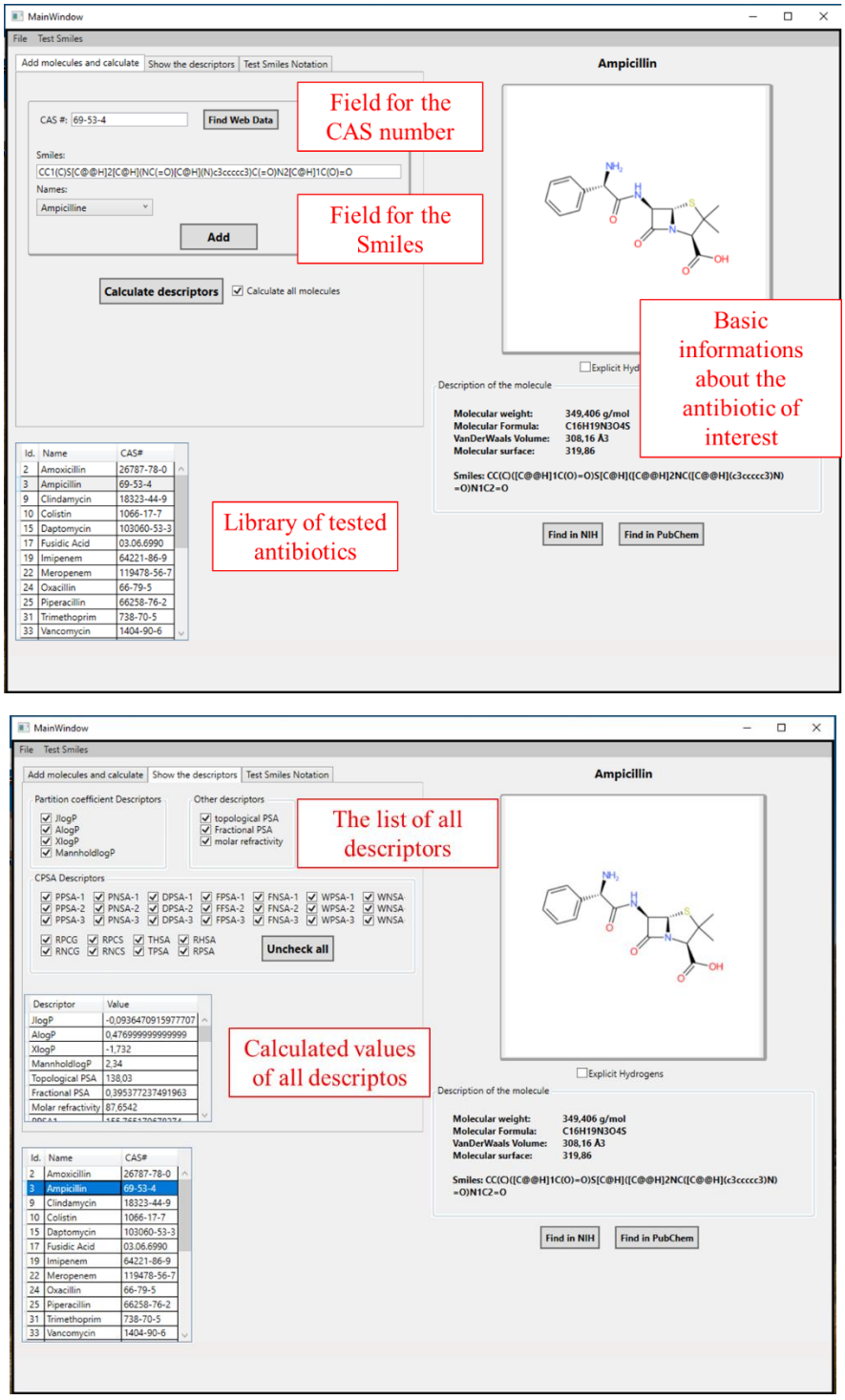


Figure S6. Design of the software for the determination of descriptors

Table S2. Pearson correlation coefficient and list of tested descriptors

	Leakage	Description
Fractional PSA	-0.86553	Surface area descriptor. Calculates the topological polar surface area and expresses it as a ratio to molecule size
Topological PSA	-0.71818	Surface area descriptor. Calculation of topological polar surface area based on fragment contributions
PPSA3	-0.6396	Charged Partial Surface Area (CPSA) descriptor. Charge weighted partial positive surface area
WPSA3	-0.61497	Charged Partial Surface Area (CPSA) descriptor. PPSA.3 * total molecular surface area / 1000
RPSA	-0.61399	Charged Partial Surface Area (CPSA) descriptor. TPSA / total molecular surface area
DPSA2	-0.57702	Charged Partial Surface Area (CPSA) descriptor. Difference of FPSA.2 and PNSA.2
DPSA3	-0.57619	Charged Partial Surface Area (CPSA) descriptor. Difference of PPSA.3 and PNSA.3
TPSA	-0.56239	Charged Partial Surface Area (CPSA) descriptor. Sum of solvent accessible surface areas of atoms with absolute value of partial charges greater than or equal 0.2
FPSA3	-0.55965	Charged Partial Surface Area (CPSA) descriptor. PPSA.3 / total molecular surface area
WPSA2	-0.49904	Charged Partial Surface Area (CPSA) descriptor. PPSA.2 * total molecular surface area /1000
PPSA2	-0.4418	Charged Partial Surface Area (CPSA) descriptor. Partial positive surface area * total positive charge on the molecule
WNSA1	-0.42602	Charged Partial Surface Area (CPSA) descriptor. PNSA.1 * total molecular surface area /1000
PNSA1	-0.35331	Charged Partial Surface Area (CPSA) descriptor. Partial negative surface area - sum of surface area on negative parts of molecule.
FPSA2	-0.34582	Charged Partial Surface Area (CPSA) descriptor. PPSA.2 / total molecular surface area
FNSA1	-0.27	Charged Partial Surface Area (CPSA) descriptor. PNSA.1 / total molecular surface area
WPSA1	-0.1784	Charged Partial Surface Area (CPSA) descriptor. PPSA.1 * total molecular surface area / 1000
Molar refractivity	-0.13412	a measure of the total polarizability of a mole of a substance and is dependent on the temperature, the index of refraction, and the pressure.
RPCS	-0.10921	Charged Partial Surface Area (CPSA) descriptor. Relative positive charge surface area - most positive surface area * RPCG
PPSA1	0.03127	Charged Partial Surface Area (CPSA) descriptor. Partial positive surface area - sum of surface area on positive parts of molecule
RNCG	0.11564	Charged Partial Surface Area (CPSA) descriptor. Relative negative charge - most negative charge / total negative charge
RPCG	0.11672	Charged Partial Surface Area (CPSA) descriptor. Relative positive charge -most positive charge / total positive charge

THSA	0.17183	Charged Partial Surface Area (CPSA) descriptor. Sum of solvent accessible surface areas of atoms with absolute value of partial charges less than 0.2
RNCS	0.17797	Charged Partial Surface Area (CPSA) descriptor. Relative negative charge surface area - most negative surface area * RNCG
DPSA1	0.26974	Charged Partial Surface Area (CPSA) descriptor. Difference of PPSA.1 and PNSA.1
FPSA1	0.27	Charged Partial Surface Area (CPSA) descriptor. PPSA.1 / total molecular surface area
PNSA3	0.45836	Charged Partial Surface Area (CPSA) descriptor. Charge weighted partial negative surface area
WNSA3	0.47352	Charged Partial Surface Area (CPSA) descriptor. PNSA.3 * total molecular surface area / 1000
FNSA3	0.47549	Charged Partial Surface Area (CPSA) descriptor. PNSA.3 / total molecular surface are
FNSA2	0.53166	Charged Partial Surface Area (CPSA) descriptor. PNSA.2 / total molecular surface area
PNSA2	0.53805	Charged Partial Surface Area (CPSA) descriptor. Partial negative surface area * total negative charge on the molecule
WNSA2	0.54751	Charged Partial Surface Area (CPSA) descriptor. PNSA.2 * total molecular surface area / 1000
MannholdlogP	0.61309	Partition coefficient descriptor . Prediction of logP based on the number of carbon and hetero atoms
RHSA	0.61399	Charged Partial Surface Area (CPSA) descriptor. THSA / total molecular surface area
AlogP	0.68878	Partition coefficient descriptor . This class calculates ALOGP (Ghose-Crippen LogKow)
JlogP	0.70904	Partition coefficient descriptor. Model donated by Lhasa Limited. It is based on an atom contribution model.
XlogP	0.90559	Partition coefficient descriptor. Prediction of logP based on the atom-type method.
Leakage	1	

Table S3. XlogP and fractionaPSA values

	Name	CAS number	Abbreviation	XlogP	Fractional PSA
1	Tobramycin	32986-56-4	TOB	-5.381	0.573921372
2	Amikacin	37517-28-5	AMK	-6.562	0.567141789
3	Ceftazidime	72558-82-8	CAZ	-1.186	0.448197008
4	Kanamycin	59-01-8	KAN	-5.486	0.583617903
5	Fosfomycin	23155-02-4	FOF	-1.578	0.578733747
6	Cefotaxime	63527-52-6	CTX	-2.712	0.498948549
7	Gentamycin	1403-66-3	GEN	-2.88	0.418443748
8	Spectinomycin	1695-77-8	SPT	-1.913	0.389904392
9	Tetracycline	60-54-8	TET	0.259	0.4089129
10	Ciprofloxacin	85721-33-1	CIP	1.809	0.220092687
11	Trovafloxacin	147059-72-1	TVX	3.942	0.239744514
12	Norfloxacin	70458-96-7	NOR	1.689	0.228368579
13	Doxycycline	564-25-0	DOX	0.387	0.4089129
14	Levofloxacin	100986-85-4	LVX	1.995	0.203021631
15	Chloramphenicol	56-75-7	CHL	0.685	0.358309264
16	Enoxacin	54132-24-0	ENX	1.573	0.242011558
17	Azlocillin		AZL	0.032	0.376135586
18	Trimethoprim	738-70-5	TMP	-0.813	0.360001239
19	Amoxicillin	26787-78-0	AMX	-3.064	0.43346489
20	Ampicillin	69-53-4	AMP	-2.35	0.395377237
21	Apramycin	37321-09-8	APR	-4.994	0.525960289
22	Bekanamycin	4696-76-8	BKA	-5.553	0.596787558
23	Cefaclor	53994-73-3	CEC	-2.414	0.376063216
24	Cefadroxil	50370-12-2	CFR	-3.524	0.435871225
25	Cefamandole	34444-01-4	FAM	-1.612	0.428196096
26	Cefdinir	91832-40-5	CDR	-2.081	0.527243339
27	Cefditoren	104145-95-1	CDN	-1.674	0.464262351
28	Cefepime	88040-23-7	FEP	-3.056	0.41678733
29	Cefetamet	65052-63-3	FET	-2.415	0.496862547
30	Cefiderocol	1225208-94-5	FDC	-2.533	0.408666869
31	Cefixime	79350-37-1	CFM	-2.533	0.517789449
32	Quinupristin	120138-50-3	QUI	1.993	0.250589061
33	Cefotetan	69712-56-7	CTT	-2.671	0.552780547
34	Cefprozil	92676-86-3	CPR	-2.5	0.40672874
35	Cefsulodin	62587-73-9	CES	-1.621	0.420412825
36	Oritavancin	171099-57-3	ORI	-0.434	0.313297914
37	Ceftriaxone	74578-69-1	CRO	-2.896	0.51322448
38	Cefuroxime	55268-75-2	CXM	-0.803	0.460184671
39	Cephalexin	15686-71-2	LEX	-2.81	0.397673279
40	Cephalothin	153-61-7	CEF	-0.203	0.413109644

41	Cephradine	38821-53-3	RAD	9.061	0.12365815
42	Methicillin	61-32-5	MET	0.872	0.343247976
43	Cinoxacin	28657-80-9	CIN	1.128	0.337443132
44	Loracarbef	76470-66-1	LOR	-2.311	0.322931857
45	Clarithromycin	81103-11-9	CLR	1.66	0.244703217
46	Clindamycin	18323-44-9	CLI	2.056	0.308949125
47	Colistin	1066-17-7	CST	0.634	0.42490585
48	Dalbavancin	171500-79-1	DAL	3.086	0.315500551
49	Dalfopristin	112362-50-2	DAF	1.323	0.261266407
50	Rifampicin	13292-46-1	RIF	3.238	0.267690453
51	Daptomycin	103060-53-3	DAP	0.415	0.431101766
52	Delafloxacin	189279-58-1	DLX	1.283	0.271469202
53	Dirithromycin	62013-04-1	DTM	1.555	0.235253855
54	Eravacycline	1207283-85-9	ERV	0.06	0.347054156
55	Oxacillin	66-79-5	OXA	1.759	0.333080247
56	Erythromycin	114-07-8	ERY	1.141	0.264376615
57	Fleroxacin	79660-72-3	FLE	2.249	0.173624456
58	Vancomycin	1404-90-6	VAN	-3.391	0.36650472
59	Fusidic Acid	6990-06-3	FA	5.904	0.201531886
60	Gatifloxacin	112811-59-3	GAT	2.509	0.218866947
61	Vaborbactam	1360457-46-0	VAB	0.33	0.407830474
62	Grepafloxacin	119914-60-2	GRX	2.45	0.202915366
63	Iclaprim	192314-93-5	ICL	0.236	0.294915545
64	Imipenem	64221-86-9	IPM	-3.02	0.47316232
65	Plazomicin	1154757-24-0	PLZ	-5.023	0.454618207
66	Piperacillin	66258-76-2	PIP	0.328	0.351397834
67	Linezolid	165800-03-3	LZD	0.405	0.210918911
68	Omadacycline	389139-89-3	OMC	1.808	0.317568346
69	Meropenem	96036-03-2	MEM	-0.779	0.353593821
70	Tigecycline	220620-09-7	TGC	1.033	0.351558311
71	Nalidixic acid	389-08-2	NAL	0.997	0.30148464
72	Netilmicin base		NET	-2.815	0.42021828
73	Nitrofurantoin	67-20-9	NIT	-0.093	0.495937932
74	Telithromycin	191114-48-4	TEL	2.137	0.208386441
75	Ofloxacin	82419-36-1	OFX	1.995	0.203021631
76	Streptomycin	57-92-1	STR	-5.988	0.578788697
77	Tedizolid	856866-72-3	TZD	-0.232	0.276802891
78	Telavancin	372151-71-8	TLV	1.983	0.346650904
79	Rifapentine	61379-65-5	RFP	4.497	0.251183158
80	Rifabutin	72559-06-9	RFB	3.967	0.246963314
81	Teicoplanin aglycone	89139-42-4	TEC	-2.538	0.340138039
82	Relebactam	1174018-99-5	REL	-2.529	0.392576658
83	Sulfamethoxazole	723-46-6	SMZ	0.255	0.403711311

84	Sulbactam (sodium salt)	69388-84-7	SUL	-1.132	0.429676482
85	Sparfloxacin	110871-86-8	SPX	2.353	0.252189126
86	Tazobactam	89786-04-9	TZB	-2.177	0.426891476
87	Azithromycin	83905-01-5	AZM	1.888	0.240585102
88	Lincomycin	154-21-2	LCM	0.69	0.363823226
89	Mupirocin	12650-69-0	MUP	2.451	0.291925701
90	Benzopenicillin	61-33-6	PEN	1.296	0.335260181
91	Ticarcillin	34787-01-4	TIC	1.232	0.454660287
92	Aztreonam	78110-38-0	ATM	-1.261	0.539544878
93	Ertapenem	153832-46-3	ETP	-0.703	0.382138938
94	Doripenem	148016-81-3	DOR	-4.179	0.465921458
95	Gramicidine	1405-97-6	GRA	5.273	0.283854321