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In Vitro Antibacterial Activities of DQ-113, a Potent Quinolone, against Clinical Isolates

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The antibacterial activity of DQ-113, formerly D61-1113, was compared with those of antibacterial agents currently available. MICs at which 90% of the isolates tested are inhibited (MIC_{90}s) of DQ-113 against clinical isolates of methicillin-susceptible and -resistant *Staphylococcus aureus* and methicillin-susceptible and -resistant coagulase-negative staphylococci were 0.03, 0.008, 0.03, and 0.06 μg/ml, respectively. Moreover, DQ-113 showed the most potent activity against ofloxacin-resistant and methicillin-resistant *S. aureus*, with a MIC_{90} of 0.25μg/ml. DQ-113 inhibited the growth of all strains of *Streptococcus pneumoniae*, including penicillin-resistant strains, and *Streptococcus pyogenes* at 0.06 μg/ml, and DQ-113 was more active than the other quinolones tested against *Enterococcus faecalis* and *Enterococcus faecium* with MIC_{90}s of 0.25 and 2 μg/ml, respectively. Against vancomycin-resistant enterococci, DQ-113 showed the highest activity among the reference compounds, with a MIC range from 0.25 to 2 μg/ml. DQ-113 also showed a potent activity against *Haemophilus influenzae*, including ampicillin-resistant strains (MIC_{90}, 0.015 μg/ml), and *Moraxella catarrhalis* (MIC_{90}, 0.03 μg/ml). The activity of DQ-113 was roughly comparable to that of levofloxacin against all species of *Enterobacteriaceae*. The MICs of DQ-113 against ofloxacin-susceptible *Pseudomonas aeruginosa* ranged from 0.25 to 2 μg/ml, which were four times higher than those of ciprofloxacin. From these results, DQ-113 showed the most potent activity against gram-positive pathogens among antibacterial agents tested.

Multidrug-resistant gram-positive pathogens, including methicillin-resistant *Staphylococcus aureus* (MRSA), penicillin-resistant *Streptococcus pneumoniae* (PRSP), and vancomycin-resistant enterococci (VRE), have become a serious problem in the medical community (1–5, 7, 9, 10). There are a few therapeutic agents, such as vancomycin, quinupristin/dalfopristin, and linezolid; however, these agents showed some problems, e.g., resistance mutations and/or side effects (1, 3, 4, 6, 8, 9). These problems have been the driving force for the development of new antibacterial agents that would be applicable to infections caused by multidrug-resistant gram-positive pathogens.

DQ-113 is a new fluoroquinolone whose chemical structure shown in Fig. 1. In this study, we compared the antimicrobial activity of DQ-113 with those of ciprofloxacin, gatifloxacin, gemifloxacin, levofloxacin, moxifloxacin, sitafloxacin, sparfloxacin, tosufloxacin, and T-3811ME (BMS284756) and other classes of antibacterial agents, such as β-lactam antibiotics, against freshly isolated bacteria.

DQ-113, ciprofloxacin, gatifloxacin, gemifloxacin, levofloxacin, moxifloxacin, sitafloxacin, sparfloxacin, tosufloxacin, T-3811ME (BMS284756), vancomycin, teicoplanin, oxacillin, benzylpenicillin, ampicillin, imipenem, cefaclor, cefotaxime, arbekacin, minocycline, and linezolid were used in this study. All quinolones and linezolid were synthesized at Daiichi Pharmaceutical Co. Ltd., Tokyo, Japan. The other antibiotics were purchased from their manufacturers or Sigma Aldrich Japan (Tokyo, Japan).

A total of 608 strains, which were collected by the Levofloxacin Surveillance Group in 1998 and 2000 from patients in Japan (11), were used (one isolate per patient). Twenty-six strains of VRE were collected in Europe in 1997 and 1998. The reference strains were included as internal controls throughout the study.

The MICs were determined by the standard agar dilution method with Mueller-Hinton agar (Difco Laboratories, Detroit, Mich.) (6). Mueller-Hinton agar supplemented with 2% NaCl was used for staphylococci, Mueller-Hinton agar supplemented with 5% sheep blood was used for streptococci and *Moraxella catarrhalis*, and Mueller-Hinton agar supplemented with 3% Fildes enrichment was used for *Haemophilus influenzae*. GC agar (Difco) was used for *Neisseria gonorrhoeae*. Drug-containing agar plates were incubated with one loopful (5 μl) of inoculum corresponding to about 10^4 CFU per spot and were incubated at 35°C for 18 h. *N. gonorrhoeae* was incubated under 5% CO_2. The MIC was defined as the lowest drug concentration which prevented visible growth of bacteria.

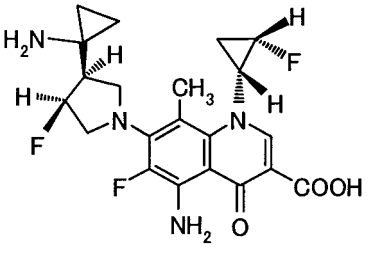

FIG. 1. Chemical structure of DQ-113.

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TABLE 1. Antibacterial activities of DQ-113 and reference compounds against gram-positive bacteria[a]

Organism (no. of strains) and compound	MIC (μg/ml)		
	Range	MIC_{50}	MIC_{90}
MSSA (25)			
DQ-113	≤0.004–0.06	0.008	0.03
Sitafloxacin	0.008–0.12	0.03	0.12
Levofloxacin	0.12–1	0.25	0.5
Ciprofloxacin	0.25–4	0.5	1
Sparfloxacin	0.06–0.25	0.12	0.25
Tosufloxacin	0.015–0.25	0.06	0.12
Gatifloxacin	0.06–0.5	0.12	0.25
Moxifloxacin	0.06–0.25	0.06	0.12
T-3811ME	≤0.004–0.12	0.03	0.06
Gemifloxacin	0.03–0.25	0.06	0.06
Imipenem	0.03–0.06	0.06	0.06
Arbekacin	0.5–4	4	4
Minocycline	0.06–0.25	0.12	0.12
Vancomycin	1	1	1
Teicoplanin	0.25–1	0.5	0.5
Linezolid	2	2	2
Oxacillin	0.25–1	0.5	1
MRSA			
Ofloxacin-susceptible (24)			
DQ-113	≤0.004–0.015	≤0.004	0.008
Sitafloxacin	0.008–0.06	0.03	0.06
Levofloxacin	0.12–1	0.25	0.5
Ciprofloxacin	0.25–2	0.5	1
Sparfloxacin	0.03–0.12	0.06	0.12
Tosufloxacin	0.015–0.12	0.06	0.06
Gatifloxacin	0.06–0.25	0.12	0.25
Moxifloxacin	0.03–0.25	0.12	0.12
T-3811ME	0.008–0.06	0.03	0.03
Gemifloxacin	0.015–0.06	0.06	0.06
Imipenem	0.5–32	4	32
Arbekacin	4–>128	16	64
Minocycline	0.12–8	0.12	8
Vancomycin	1–2	1	2
Teicoplanin	0.5–2	0.5	2
Linezolid	1–2	2	2
Oxacillin	16–>128	64	>128
Ofloxacin-resistant (25)			
DQ-113	0.03–2	0.06	0.25
Sitafloxacin	0.25–32	1	4
Levofloxacin	4–>128	16	64
Ciprofloxacin	16–>128	128	>128
Sparfloxacin	2–>128	8	32
Tosufloxacin	1–64	32	32
Gatifloxacin	2–>128	8	16
Moxifloxacin	1–64	4	8
T-3811ME	0.25–64	2	8
Imipenem	4–128	64	128
Arbekacin	4–64	8	32
Minocycline	0.12–32	8	32
Vancomycin	0.5–2	1	2
Teicoplanin	0.5–4	1	4
Linezolid	1–2	2	2
Oxacillin	64–>128	>128	>128
MSCNS (27)			
DQ-113	≤0.004–0.06	0.008	0.03
Sitafloxacin	0.008–0.25	0.03	0.25
Levofloxacin	0.12–8	0.25	4
Ciprofloxacin	0.06–64	0.25	8
Sparfloxacin	0.03–8	0.12	4
Tosufloxacin	0.015–16	0.06	4
Gatifloxacin	0.06–4	0.25	2
Moxifloxacin	0.03–4	0.12	1
T-3811ME	0.015–4	0.06	1
Gemifloxacin	0.008–2	0.06	0.25
Imipenem	0.015–0.03	0.03	0.03
Arbekacin	1–64	4	16
Minocycline	0.06–16	0.12	0.5
Vancomycin	0.5–4	2	2
Teicoplanin	0.25–16	1	2
Linezolid	1–2	1	2
Oxacillin	0.06–0.25	0.25	0.25
MRCNS (36)			
DQ-113	≤0.004–0.12	0.03	0.06
Sitafloxacin	0.008–0.5	0.12	0.5
Levofloxacin	0.12–32	4	16
Ciprofloxacin	0.12–128	8	64
Sparfloxacin	0.06–16	4	8
Tosufloxacin	0.03–16	4	16
Gatifloxacin	0.12–4	2	4
Moxifloxacin	0.06–8	1	4
T-3811ME	0.03–4	1	4
Gemifloxacin	0.015–4	0.5	2
Imipenem	0.12–>128	64	128
Arbekacin	0.25–128	8	32
Minocycline	0.12–16	0.5	4
Vancomycin	1–4	1	2
Teicoplanin	0.25–32	1	8
Linezolid	1–2	2	2
Oxacillin	1–>128	128	>128
PSSP (25)			
DQ-113	0.008–0.06	0.03	0.03
Sitafloxacin	0.03–0.12	0.12	0.12
Levofloxacin	1–4	2	2
Ciprofloxacin	1–8	2	4
Sparfloxacin	0.25–1	0.5	1
Tosufloxacin	0.25–0.5	0.25	0.5
Gatifloxacin	0.25–1	0.5	0.5
Moxifloxacin	0.12–0.5	0.25	0.5
T-3811ME	0.03–0.12	0.12	0.12
Gemifloxacin	0.03–0.12	0.12	0.12
Cefotaxime	0.008–0.25	0.12	0.25
Imipenem	0.008–0.03	0.015	0.015
Vancomycin	0.25–0.5	0.5	0.5
Teicoplanin	0.12–0.5	0.5	0.5
Linezolid	0.5–1	1	1
Ampicillin	0.015–0.12	0.06	0.12
Benzylpenicillin	0.015–0.06	0.06	0.06
PISP and PRSP (50)			
DQ-113	≤0.008–0.015	≤0.008	0.015
Sitafloxacin	0.015–0.06	0.03	0.06
Levofloxacin	0.25–1	1	1
Ciprofloxacin	0.25–4	1	2
Sparfloxacin	0.12–0.5	0.25	0.5
Tosufloxacin	0.06–0.25	0.12	0.25
Gatifloxacin	0.06–0.5	0.25	0.25
Moxifloxacin	0.06–0.25	0.12	0.25
T-3811ME	0.015–0.06	0.03	0.06
Gemifloxacin	0.015–0.06	0.03	0.06
Imipenem	0.12–0.5	0.25	0.5
Vancomycin	0.25–0.5	0.5	0.5
Teicoplanin	0.12–1	0.25	0.5
Linezolid	0.25–0.5	0.5	0.5
Benzylpenicillin	1–4	2	2
S. pyogenes (25)			
DQ-113	≤0.004–0.015	0.008	0.015
Sitafloxacin	0.015–0.06	0.03	0.06
Levofloxacin	0.06–1	0.25	0.5
Ciprofloxacin	0.12–1	0.25	1

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TABLE 1—*Continued*

Organism (no. of strains) and compound	MIC (μg/ml)			Organism (no. of strains) and compound	MIC (μg/ml)		
	Range	MIC_{50}	MIC_{90}		Range	MIC_{50}	MIC_{90}
Sparfloxacin	0.12–1	0.5	1	Sitafloxacin	0.12–8	1	8
Tosufloxacin	0.06–1	0.12	0.5	Levofloxacin	2–>128	32	128
Gatifloxacin	0.12–0.5	0.25	0.5	Ciprofloxacin	1–>128	32	64
Moxifloxacin	0.12–0.5	0.12	0.5	Sparfloxacin	0.5–64	16	32
T-3811ME	0.03–0.25	0.06	0.25	Tosufloxacin	0.5–16	8	16
Ceftazidime	0.12–0.5	0.12	0.25	Gatifloxacin	1–64	8	32
Cefotaxime	0.008–0.03	0.015	0.015	Moxifloxacin	0.5–64	4	16
Imipenem	≤0.004–0.015	≤0.004	≤0.004	T-3811ME	0.25–64	4	16
Vancomycin	0.06–0.5	0.25	0.25	Cefotaxime	>128	>128	>128
Teicoplanin	0.12–1	0.25	0.5	Imipenem	8–>128	>128	>128
Linezolid	1–2	1	2	Vancomycin	0.5–2	1	2
Ampicillin	0.015–0.12	0.015	0.03	Teicoplanin	0.25–1	0.5	1
E. faecalis (25)				Linezolid	1–2	2	2
DQ-113	0.015–0.25	0.03	0.25	Ampicillin	2–128	128	128
Sitafloxacin	0.06–2	0.12	2	VRE (26)			
Levofloxacin	0.5–64	1	32	DQ-113	0.25–2	0.5	2
Ciprofloxacin	0.25–64	1	32	Sitafloxacin	1–8	2	8
Sparfloxacin	0.25–32	0.5	16	Levofloxacin	16–64	32	64
Tosufloxacin	0.25–16	0.25	16	Ciprofloxacin	32–>128	64	>128
Gatifloxacin	0.25–16	0.5	16	Sparfloxacin	8–64	32	64
Moxifloxacin	0.25–16	0.25	8	Tosufloxacin	16–32	32	32
T-3811ME	0.12–4	0.25	2	Gatifloxacin	4–64	16	32
Cefotaxime	0.25–>128	>128	>128	Moxifloxacin	2–32	16	32
Imipenem	0.06–8	2	4	T-3811ME	1–32	4	8
Vancomycin	0.5–4	1	2	Gemifloxacin	1–32	4	32
Teicoplanin	0.12–0.5	0.25	0.5	Imipenem	2–>128	128	>128
Linezolid	2	2	2	Arbekacin	2–>128	8	64
Ampicillin	0.5–4	1	2	Minocycline	0.06–16	0.12	16
E. faecium (23)				Vancomycin	>128	>128	>128
DQ-113	0.06–4	0.5	2	Teicoplanin	0.5–>128	32	128
				Linezolid	2	2	2

[a] Abbreviations and resistance criteria are as follows: MSSA, oxacillin MIC ≤ 2 μg/ml; MRSA, oxacillin MIC ≥ 4 μg/ml; MSCNS, oxacillin MIC ≤ 0.25 μg/ml; MRCNS, oxacillin MIC ≥ 0.5 μg/ml; PSSP, penicillin-susceptible *S. pneumoniae* (penicillin MIC ≤ 0.06μg/ml); PISP and PRSP, penicillin-intermediate and -resistant *S. pneumoniae*, respectively (penicillin MIC ≥ 0.12 μg/ml) VRE, vancomycin MIC ≥ 32μg/ml; ofloxacin-susceptible, ofloxacin MIC ≤ 2 μg/ml; ofloxacin-resistant, ofloxacin MIC ≥ 8 μg/ml.

Tables 1 and 2 compare the activity of DQ-113 against gram-positive and -negative bacteria to those of the reference drugs. The MICs at which 90% of the isolates tested are inhibited (MIC_{90}s) of DQ-113 against methicillin-susceptible *S. aureus* (MSSA) and methicillin-susceptible coagulase-negative staphylococci (MSCNS) were both 0.03 μg/ml. MIC_{90}s against ofloxacin-susceptible MRSA, ofloxacin-resistant (MIC of ofloxacin, ≥8 μg/ml) MRSA, and methicillin-resistant coagulase-negative staphylococci (MRCNS) were 0.008, 0.25, and 0.06 μg/ml, respectively. The antibacterial activity against MSSA was twofold higher than those of T-3811ME, gemifloxacin, and imipenem; fourfold higher than those of sitafloxacin, tosufloxacin, moxifloxacin, and minocycline; and at least eightfold higher than those of the other reference compounds, including vancomycin, teicoplanin, and linezolid, at MIC_{90} levels. Against MSCNS, DQ-113 showed activity comparable to that of imipenem, and activity was at least eightfold higher than those of the other reference compounds. Against ofloxacin-susceptible MRSA, DQ-113 activity was fourfold higher than that of T-3811ME and at least eightfold higher than those of the other reference compounds at MIC_{90} levels. Furthermore, DQ-113 showed the highest activity against ofloxacin-resistant MRSA among the compounds tested. Against MRCNS, the MIC_{90} of DQ-113 was at least eightfold lower than those of the reference compounds.

MIC_{90}s for penicillin-susceptible and -resistant *S. pneumoniae* and *Streptococcus pyogenes* were 0.03, 0.015, and 0.015 μg/ml, respectively, which were at least fourfold lower than those of the quinolones tested. Against *Enterococcus faecalis* and *Enterococcus faecium*, DQ-113 showed the highest activity among the compounds tested, with MIC_{90}s of 0.25 and 2 μg/ml, respectively. Against VRE, DQ-113 also showed the highest activity among quinolones tested. The MIC ranged from 0.06 to 2 μg/ml.

H. influenzae, including ampicillin-resistant strains, and *M. catarrhalis* were susceptible to DQ-113, with MIC_{90}s for these strains being 0.015 and 0.03 μg/ml, respectively. Against these strains, DQ-113 activity was roughly comparable to those of the reference quinolones. Against various members of the *Enterobacteriaceae*, DQ-113 activity was up to four times that of levofloxacin at MIC_{90} levels. DQ-113 inhibited 90% of isolates of *Escherichia coli*, *Klebsiella pneumoniae*, *Serratia marcescens*, *Enterobacter* spp., *Proteus mirabilis*, and indole-positive *Proteus* spp. at 0.25, 0.25, 1, 1, 2, and 1 μg/ml, respectively. At MIC_{90} levels, DQ-113 showed activity comparable to those of levofloxacin, sparfloxacin, and gatifloxacin; was four to eight times

TABLE 2. Antibacterial activities of DQ-113 and reference drugs against gram-negative bacteria[a]

Organism (no. of strains) and compound	MIC (μg/ml)		
	Range	MIC_{50}	MIC_{90}
E. coli (22)			
DQ-113	≤0.004–2	0.03	0.25
Sitafloxacin	≤0.004–0.5	0.008	0.06
Levofloxacin	≤0.004–2	0.015	0.5
Ciprofloxacin	≤0.004–2	0.008	0.5
Sparfloxacin	≤0.004–16	0.015	0.5
Tosufloxacin	≤0.004–16	0.015	0.5
Gatifloxacin	≤0.004–2	0.03	0.5
Moxifloxacin	≤0.004–8	0.06	1
T-3811ME	≤0.004–16	0.06	1
K. pneumoniae (25)			
DQ-113	0.03–2	0.06	0.25
Sitafloxacin	0.015–1	0.03	0.25
Levofloxacin	0.06–8	0.06	1
Ciprofloxacin	0.015–4	0.03	0.5
Sparfloxacin	0.03–4	0.06	0.5
Tosufloxacin	0.03–2	0.03	0.5
Gatifloxacin	0.03–4	0.06	1
Moxifloxacin	0.12–4	0.25	1
T-3811ME	0.06–4	0.12	2
Gemifloxacin	0.03–4	0.06	1
S. marcescens (22)			
DQ-113	≤0.25–4	0.5	1
Sitafloxacin	0.06–1	0.12	0.25
Levofloxacin	0.12–8	0.25	2
Ciprofloxacin	0.06–8	0.12	1
Sparfloxacin	0.25–8	0.5	2
Tosufloxacin	0.12–8	0.25	1
Gatifloxacin	0.25–4	0.5	2
Moxifloxacin	0.25–8	1	2
T-3811ME	1–16	2	8
Gemifloxacin	0.12–8	0.5	2
Enterobacter spp. (23)			
DQ-113	0.03–4	0.06	1
Sitafloxacin	0.008–1	0.03	0.25
Levofloxacin	0.03–8	0.06	2
Ciprofloxacin	0.008–16	0.03	2
Sparfloxacin	0.015–4	0.06	2
Tosufloxacin	≤0.004–4	0.06	1
Gatifloxacin	0.03–8	0.12	1
Moxifloxacin	0.06–4	0.25	2
T-3811ME	0.06–16	0.25	2
Gemifloxacin	0.03–8	0.06	1
P. mirabilis (25)			
DQ-113	0.06–2	0.12	2
Sitafloxacin	0.015–0.5	0.03	0.25
Levofloxacin	0.03–4	0.06	1
Ciprofloxacin	0.015–16	0.03	0.5
Sparfloxacin	0.12–16	0.25	8
Tosufloxacin	0.06–16	0.12	4
Gatifloxacin	0.12–8	0.12	2
Moxifloxacin	0.12–16	0.25	2
T-3811ME	0.25–32	0.5	16
Gemifloxacin	0.06–16	0.12	4
Indole-positive *Proteus* (25)			
DQ-113	0.06–2	0.12	1
Sitafloxacin	0.008–0.5	0.03	0.25
Levofloxacin	0.03–2	0.06	1
Ciprofloxacin	0.008–4	0.03	1
Sparfloxacin	0.06–4	0.25	4
Tosufloxacin	0.03–4	0.12	2
Gatifloxacin	0.03–2	0.12	2
Moxifloxacin	0.12–4	0.25	4
T-3811ME	0.25–8	0.5	4
Gemifloxacin	0.03–8	0.12	4
P. aeruginosa, ofloxacin-susceptible (24)			
DQ-113	0.25–2	0.5	2
Sitafloxacin	0.03–0.5	0.12	0.25
Levofloxacin	0.25–2	1	2
Ciprofloxacin	0.03–0.5	0.12	0.25
Sparfloxacin	0.12–2	1	2
Tosufloxacin	0.06–0.5	0.25	0.5
Gatifloxacin	0.25–4	1	2
Moxifloxacin	0.5–8	2	4
T-3811ME	0.5–4	1	4
Acinetobacter spp. (24)			
DQ-113	0.015–0.5	0.03	0.25
Sitafloxacin	0.015–1	0.03	0.25
Levofloxacin	0.12–4	0.25	1
Ciprofloxacin	0.12–4	0.25	2
Sparfloxacin	0.008–1	0.03	0.5
Tosufloxacin	0.015–1	0.06	0.5
Gatifloxacin	0.03–2	0.12	0.5
Moxifloxacin	0.06–4	0.12	1
T-3811ME	0.015–4	0.06	1
Gemifloxacin	0.06–2	0.12	0.5
H. influenzae			
Ampicillin-susceptible (38)			
DQ-113	≤0.004–0.03	0.008	0.015
Sitafloxacin	≤0.004–0.008	≤0.004	≤0.004
Levofloxacin	≤0.004–0.03	0.015	0.015
Ciprofloxacin	≤0.004–0.06	0.008	0.015
Sparfloxacin	≤0.004–0.03	0.008	0.008
Tosufloxacin	≤0.004–0.015	≤0.004	0.008
Gatifloxacin	≤0.004–0.03	0.008	0.008
Moxifloxacin	0.008–0.06	0.03	0.03
T-3811MEE	≤0.004–0.015	≤0.004	0.008
Gemifloxacin	≤0.004–0.03	≤0.004	0.008
Cefaclor	1–64	2	32
Ampicillin	0.12–1	0.25	1
β-Lactamase-negative, ampicillin-resistant (14)			
DQ-113	≤0.004–0.015	0.015	0.015
Sitafloxacin	≤0.004	≤0.004	≤0.004
Levofloxacin	0.008–0.015	0.015	0.015
Ciprofloxacin	≤0.004–0.015	0.008	0.015
Sparfloxacin	≤0.004–0.015	0.008	0.015
Tosufloxacin	≤0.004–0.008	≤0.004	0.008
Gatifloxacin	≤0.004–0.008	0.008	0.008
Moxifloxacin	0.008–0.03	0.015	0.03
T-3811ME	≤0.004–0.015	0.008	0.008
Gemifloxacin	≤0.004–0.008	≤0.004	0.008
Cefaclor	32–128	64	128
Ampicillin	2–8	2	4
β-Lactamase-positive, ampicillin-resistant (21)			
DQ-113	≤0.004–0.03	0.008	0.015
Sitafloxacin	≤0.004	≤0.004	≤0.004
Levofloxacin	0.008–0.015	0.008	0.015
Ciprofloxacin	≤0.004–0.015	0.008	0.008
Sparfloxacin	≤0.004–0.015	0.008	0.008

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TABLE 2—*Continued*

Organism (no. of strains) and compound	MIC (μg/ml)			Organism (no of strains) and compound	MIC (μg/ml)		
	Range	MIC_{50}	MIC_{90}		Range	MIC_{50}	MIC_{90}
Tosufloxacin	≤0.004–0.008	≤0.004	0.008	Moxifloxacin	0.03–0.12	0.12	0.12
Gatifloxacin	≤0.004–0.015	0.008	0.008	T-3811ME	0.004–0.06	0.03	0.03
Moxifloxacin	0.015–0.06	0.015	0.03	Gemifloxacin	≤0.004–0.06	0.03	0.03
T-3811ME	≤0.004–0.03	≤0.004	0.008				
Gemifloxacin	≤0.004–0.015	≤0.004	0.008	*N. gonorrhoeae* (35)			
Cefaclor	1–64	8	32	DQ-113	≤0.004–2	0.25	1
Ampicillin	4–>128	16	128	Sitafloxacin	≤0.004–0.5	0.12	0.25
				Levofloxacin	0.015–16	4	16
M. catarrhalis (25)				Ciprofloxacin	0.008–32	4	16
DQ-113	≤0.004–0.03	0.015	0.03	Sparfloxacin	≤0.004–16	2	8
Sitafloxacin	≤0.004–0.03	0.015	0.015	Tosufloxacin	0.008–32	2	16
Levofloxacin	0.03–0.06	0.06	0.06	Gatifloxacin	0.008–4	1	4
Ciprofloxacin	0.015–0.06	0.06	0.06	Moxifloxacin	≤0.004–8	2	8
Sparfloxacin	≤0.004–0.03	0.015	0.03	T-3811ME	≤0.004–8	0.5	4
Tosufloxacin	≤0.004–0.03	0.015	0.03	Gemifloxacin	≤0.004–16	1	8
Gatifloxacin	0.015–0.06	0.03	0.06				

[a] Resistance criteria are as follows: ampicillin-susceptible, ampicillin MIC ≤ 1 μg/ml; ampicillin-resistant, ampicillin MIC ≥ 4 μg/ml.

less active than sitafloxacin, ciprofloxacin, and tosufloxacin; was two times more potent than moxifloxacin and T-3811ME; and was eight times more active than imipenem against ofloxacin-susceptible *P. aeruginosa*. Against *Acinetobacter* spp., DQ-113 activity was comparable to that of sitafloxacin and was at least twofold higher than those of the other reference quinolones, with a MIC_{90} of 0.25 μg/ml. Against *N. gonorrhoeae*, including ofloxacin-resistant strains, the MIC_{90} of DQ-113 was 1 μg/ml. The interpretive MICs of the compounds tested against the reference strains for quality control were reproducible throughout the study.

This study showed that DQ-113, a recently synthesized quinolone, possesses the most potent antibacterial activity against staphylococci, streptococci, and enterococci among the reference compounds, such as sitafloxacin, levofloxacin, ciprofloxacin, sparfloxacin, tosufloxacin, gatifloxacin, moxifloxacin, T-3811ME, gemifloxacin, vancomycin, teicoplanin, and linezolid. Moreover, DQ-113 showed good antibacterial activity against strains of *Enterobacteriaceae*, *Pseudomonas aeruginosa*, *H. influenzae*, *M. catarrhalis*, and *N. gonorrhoeae*, known clinically as significant pathogens.

DQ-113 showed a potent antibacterial activity against gram-positive bacteria as well as favorable safety and pharmacokinetic profiles (H. Takahashi, Abstr. 40th Intersci. Conf. Antimicrob. Agents Chemother., abstr. 1505, 2000). The relative potency of DQ-113 will be better understood when the human pharmacokinetics are available. Further studies of DQ-113 are warranted based upon the available data.

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