ANTIMICROBIAL AGENTS AND CHEMOTHERAPY, Sept. 1998, p. 2459–2462 Vol. 42, No. 9
0066-4804/98/$04.00+0
Copyright © 1998, American Society for Microbiology. All Rights Reserved.

Activities of Gatifloxacin Compared to Those of Seven Other Agents against Anaerobic Organisms

LOIS M. EDNIE,[1] MICHAEL R. JACOBS,[2] AND PETER C. APPELBAUM[1]*

Department of Pathology (Clinical Microbiology), Hershey Medical Center, Hershey, Pennsylvania 17033,[1] and Department of Pathology, Case Western Reserve University, Cleveland, Ohio 44106[2]

Received 13 March 1998/Returned for modification 2 June 1998/Accepted 15 June 1998

The agar dilution MIC was used to compare activities of gatifloxacin with those of ciprofloxacin, sparfloxacin, trovafloxacin, ampicillin, ampicillin-sulbactam, clindamycin, and metronidazole against 351 anaerobes. Overall MICs at which 50% of the isolates are inhibited and MICs at which 90% of the isolates are inhibited (in micrograms per milliliter) were as follows: gatifloxacin, 0.5 and 4; ciprofloxacin, 2 and 32; sparfloxacin, 2 and 8; trovafloxacin, 1 and 4; ampicillin, 1 and 64; ampicillin-sulbactam, 0.5 and 4; clindamycin, 0.125 and 8; and metronidazole, 1 and >16, respectively. Gatifloxacin MICs were similar to those of trovafloxacin in all organism groups.

Anaerobes are becoming increasingly resistant to β-lactams due to β-lactamase production and other mechanisms. Although β-lactamase production, as well as concomitant resistance to β-lactams, is the norm among the *Bacteroides fragilis* group, other anaerobic gram-negative bacilli in the genera *Prevotella*, *Porphyromonas*, and *Fusobacterium* have increasingly become β-lactamase positive. β-Lactamase production also has been described for clostridia. Metronidazole resistance in organisms other than non-spore-forming gram-positive bacilli has been described elsewhere, as has clindamycin resistance in anaerobic gram-negative bacilli (1–5).

Quinolones such as ciprofloxacin, ofloxacin, fleroxacin, pefloxacin, enoxacin, and lomefloxacin are inactive or only marginally active against anaerobes (6–10, 16, 17). Newer quinolones with increased antianaerobic activities include (i) those with slightly increased activities (sparfloxacin, grepafloxacin, and levofloxacin) and (ii) those with significantly improved antianaerobic activities (trovafloxacin, clinafloxacin, moxifloxacin, and DU-6859a) (6–10, 16, 17).

Gatifloxacin (AM-1155, CG 5501) is a broad-spectrum quinolone which shares with sparfloxacin and grepafloxacin a methyl piperazinyl side chain at position 7 and a cyclopropyl substituent at position 1 (9, 11–13, 19, 21). The current study used standardized agar dilution methodology to examine the activities of gatifloxacin compared with those of ciprofloxacin, sparfloxacin, trovafloxacin, ampicillin, ampicillin-sulbactam, clindamycin, and metronidazole against 351 anaerobes.

All anaerobes were clinical strains isolated during the past 4 years identified by standard procedures (18) and kept frozen in 200 g of skim milk (dehydrated skim milk; Difco Laboratories, Detroit, Mich.) per liter at −70°C until use. Prior to testing, strains were subcultured three times onto enriched sheep blood agar plates. Gatifloxacin Susceptibility powder was obtained from Bristol-Myers Squibb Laboratories, Wallingford, Conn., and other drugs were obtained from their respective manufacturers. β-Lactamase testing was performed by the nitrocefin disk method (Cefinase; BBL Microbiology Systems, Cockeysville, Md.) (1, 2). Agar dilution susceptibility testing was performed according to the latest method (approved but not yet published) recommended by the National Committee for Clinical Laboratory Standards (15), with brucella agar with 5% sterile defibrinated laked sheep blood for non-*B. fragilis* group strains; sulbactam was added to ampicillin at a fixed ratio of 1:2. All quality control gram-negative and -positive strains (15) recommended by the National Committee for Clinical Laboratory Standards were included with each run; in every case, results (where available) were in control.

Among anaerobic gram-negative bacilli, 86.3% of *B. fragilis* group isolates, 61.2% of *Prevotella-Porphyromonas* isolates, and 5.0% of fusobacteria produced β-lactamase. Results of MIC testing are presented in Table 1. Overall, MICs at which 50% of the isolates are inhibited (MIC_{50}s) and MIC_{90}s (in micrograms per milliliter) were as follows: gatifloxacin, 0.5 and 4; ciprofloxacin, 2 and 32; sparfloxacin, 2 and 8; trovafloxacin, 1 and 4; ampicillin, 1 and 64; ampicillin-sulbactam, 0.5 and 4; clindamycin, 0.125 and 8; and metronidazole, 1 and >16, respectively.

Gatifloxacin and trovafloxacin had the lowest MICs of all quinolones tested, followed by sparfloxacin and ciprofloxacin. MICs of the former two compounds were similar, with trovafloxacin MICs tending to be 1 or 2 dilutions lower than those of gatifloxacin. Gatifloxacin and trovafloxacin MICs were lower for non-*B. fragilis* group anaerobic gram-negative bacilli other than *Prevotella bivia* and *Fusobacterium varium* and for gram-positive anaerobes. One each of three strains (*Bacteroides thetaiotaomicron*, *F. varium*, and *Lactobacillus* spp.) yielded gatifloxacin and trovafloxacin MICs of >8 μg/ml.

Addition of sulbactam enhanced the activities of ampicillin against β-lactamase-producing anaerobic gram-negative bacilli. Although most strains tested were susceptible (MICs of ≤2 μg/ml) to clindamycin, resistance was seen in some members of most groups tested. With the exception of one strain of *Prevotella denticola* with a metronidazole MIC of 16 μg/ml, the only anaerobes resistant to metronidazole were the anaerobic gram-positive bacilli.

All strains with unexpectedly high gatifloxacin, trovafloxacin, and metronidazole MICs were tested three times; in each case, results were identical.

Kato and coworkers (13) reported in vitro activity of gatifloxacin against a wide range of anaerobes. MIC_{90}s of 3.13 to 6.25 μg/ml were found for all members of the *B. fragilis* group. MIC_{90}s for *P. bivia* were 6.25 μg/ml. By comparison, gatifloxa-

* Corresponding author. Mailing address: Department of Pathology, Hershey Medical Center, 500 University Dr., Hershey, PA 17033. Phone: (717) 531-5113. Fax: (717) 531-7953. E-mail: pappelbaum@psghs.edu.

TABLE 1. MICs (micrograms per milliliter) of agents

Organism	MIC range	MIC_{50}	MIC_{90}
Bacteroides fragilis (10/10)[a]			
Gatifloxacin	0.5–1	1	1
Ciprofloxacin	4–8	8	8
Sparfloxacin	1–2	1	2
Trovafloxacin	0.125–0.5	0.5	0.5
Ampicillin	8–128	64	128
Ampicillin-sulbactam	2–8	2	4
Clindamycin	0.25–4	1	2
Metronidazole	1–2	1	1
Bacteroides thetaiotaomicron (11/11)			
Gatifloxacin	1–>32	2	2
Ciprofloxacin	8–>32	32	32
Sparfloxacin	1–>32	2	4
Trovafloxacin	0.5–32	1	1
Ampicillin	32–>128	64	64
Ampicillin-sulbactam	2–8	2	4
Clindamycin	1–>32	4	8
Metronidazole	1–2	1	1
Bacteroides distasonis (3/10)			
Gatifloxacin	1–4	1	4
Ciprofloxacin	8–>32	8	>32
Sparfloxacin	2–8	4	4
Trovafloxacin	0.5–4	1	1
Ampicillin	4–>128	8	>128
Ampicillin-sulbactam	4–16	8	16
Clindamycin	1–>32	8	16
Metronidazole	1–2	1	2
Bacteroides vulgatus (10/10)			
Gatifloxacin	0.5–4	1	2
Ciprofloxacin	8–>32	32	32
Sparfloxacin	1–2	1	2
Trovafloxacin	0.25–0.5	0.25	0.5
Ampicillin	4–>128	16	>128
Ampicillin-sulbactam	1–16	2	8
Clindamycin	≤0.016–>32	0.5	>32
Metronidazole	1–2	1	2
Bacteroides ovatus/*uniformis*[b] (10/10)			
Gatifloxacin	1–2	2	2
Ciprofloxacin	8–32	16	32
Sparfloxacin	2–8	2	4
Trovafloxacin	0.5–2	1	2
Ampicillin	32–>128	64	>128
Ampicillin-sulbactam	1–16	2	8
Clindamycin	0.03–>32	2	>32
Metronidazole	0.25–2	1	2
Bacteroides fragilis group (44/51)			
Gatifloxacin	0.5–>32	1	2
Ciprofloxacin	4–>32	16	32
Sparfloxacin	1–>32	2	4
Trovafloxacin	0.125–32	0.5	1
Ampicillin	4–>128	32	>128
Ampicillin-sulbactam	1–16	2	8
Clindamycin	≤0.016–>32	2	>32
Metronidazole	0.25–2	1	2
Prevotella bivia (28/40)			
Gatifloxacin	2–8	4	8
Ciprofloxacin	8–>32	32	32
Sparfloxacin	4–16	8	8
Trovafloxacin	2–4	2	4
Ampicillin	≤0.125–>128	4	64
Ampicillin-sulbactam	≤0.125–8	1	4
Clindamycin	≤0.016–0.125	0.03	0.06
Metronidazole	1–8	4	4
Prevotella buccae (6/10)			
Gatifloxacin	0.25–0.5	0.5	0.5
Ciprofloxacin	2–4	2	2
Sparfloxacin	1–4	2	4
Trovafloxacin	1–2	1	2
Ampicillin	0.25–>128	32	>128
Ampicillin-sulbactam	0.25–4	2	4
Clindamycin	≤0.016–0.03	0.03	0.03
Metronidazole	1–4	1	2
Prevotella intermedia (7/13)			
Gatifloxacin	0.25–1	0.5	0.5
Ciprofloxacin	1–2	1	2
Sparfloxacin	2–8	2	4
Trovafloxacin	0.5–1	1	1
Ampicillin	≤0.125–16	2	8
Ampicillin-sulbactam	≤0.125–1	0.5	1
Clindamycin	≤0.016–0.03	≤0.016	0.03
Metronidazole	≤0.125–2	1	2
Prevotella melaninogenica (8/11)			
Gatifloxacin	0.5–2	2	2
Ciprofloxacin	2–8	2	8
Sparfloxacin	2–8	4	4
Trovafloxacin	1–4	2	2
Ampicillin	≤0.125–>128	2	64
Ampicillin-sulbactam	≤0.125–4	0.5	2
Clindamycin	≤0.016–0.03	0.03	0.03
Metronidazole	0.5–1	1	1
Prevotella corporis (3/11)			
Gatifloxacin	0.25–1	0.5	0.5
Ciprofloxacin	0.5–2	2	2
Sparfloxacin	1–8	4	8
Trovafloxacin	0.5–2	1	1
Ampicillin	≤0.125–64	≤0.125	8
Ampicillin-sulbactam	≤0.125–2	≤0.125	1
Clindamycin	≤0.016–0.03	≤0.016	0.03
Metronidazole	≤0.125–0.5	≤0.125	0.25
Miscellaneous *Prevotella*/*Porphyromonas*[c] (11/18)			
Gatifloxacin	0.125–4	0.5	4
Ciprofloxacin	1–16	2	8
Sparfloxacin	0.5–8	4	4
Trovafloxacin	0.125–2	1	2
Ampicillin	≤0.125–>128	2	64
Ampicillin-sulbactam	≤0.125–8	0.5	2
Clindamycin	≤0.016–4	≤0.016	0.03
Metronidazole	≤0.125–16	1	4
Prevotella/*Porphyromonas* (63/103)			
Gatifloxacin	0.125–8	1	4
Ciprofloxacin	0.5–>32	4	32
Sparfloxacin	0.5–16	4	8
Trovafloxacin	0.125–4	2	4
Ampicillin	≤0.125–>128	4	64
Ampicillin-sulbactam	≤0.125–8	0.5	4
Clindamycin	≤0.016–4	0.03	0.03
Metronidazole	≤0.125–16	2	4
Fusobacterium nucleatum (2/10)			
Gatifloxacin	0.25–0.5	0.5	0.5
Ciprofloxacin	2–4	4	4
Sparfloxacin	0.5–2	1	2
Trovafloxacin	0.25–1	0.5	1
Ampicillin	≤0.125–>128	0.5	>128
Ampicillin-sulbactam	≤0.125–>128	0.5	32
Clindamycin	0.06–0.125	0.06	0.125
Metronidazole	≤0.125–0.5	≤0.125	0.25
Fusobacterium necrophorum (0/10)			
Gatifloxacin	0.5–1	0.5	1
Ciprofloxacin	2–4	2	2
Sparfloxacin	1–4	2	4
Trovafloxacin	0.25–1	0.5	0.5
Ampicillin	≤0.125	≤0.125	≤0.125
Ampicillin-sulbactam	≤0.125	≤0.125	≤0.125
Clindamycin	≤0.016–0.06	0.06	0.06
Metronidazole	≤0.125–0.5	≤0.125	0.25
Fusobacterium mortiferum (0/10)			
Gatifloxacin	0.25–0.5	0.5	0.5
Ciprofloxacin	2	2	2
Sparfloxacin	1–2	1	2
Trovafloxacin	1–2	1	2
Ampicillin	1–>128	2	>128
Ampicillin-sulbactam	1–>128	2	128
Clindamycin	0.06–0.125	0.125	0.125
Metronidazole	≤0.125–0.5	0.25	0.25

Continued on following page

TABLE 1—*Continued*

Organism	MIC range	MIC_{50}	MIC_{90}
Fusobacterium varium (0/10)			
Gatifloxacin	2–>32	4	4
Ciprofloxacin	4–32	8	8
Sparfloxacin	8–>32	8	16
Trovafloxacin	4–16	4	8
Ampicillin	2–4	2	4
Ampicillin-sulbactam	1–4	2	2
Clindamycin	2–32	8	32
Metronidazole	≤0.125–0.5	0.25	0.5
Fusobacteria (2/40)			
Gatifloxacin	0.25–>32	0.5	4
Ciprofloxacin	2–32	2	8
Sparfloxacin	0.5–>32	2	8
Trovafloxacin	0.25–16	1	4
Ampicillin	≤0.125–>128	2	128
Ampicillin-sulbactam	≤0.125–>128	2	16
Clindamycin	≤0.016–32	0.125	16
Metronidazole	≤0.125–0.5	0.25	0.25
Peptostreptococci (0/55)[d]			
Gatifloxacin	0.06–1	0.5	1
Ciprofloxacin	0.25–4	1	4
Sparfloxacin	0.06–2	0.5	1
Trovafloxacin	0.06–1	0.25	0.5
Ampicillin	≤0.125–32	0.25	16
Ampicillin-sulbactam	≤0.125–32	0.25	16
Clindamycin	≤0.016–>32	0.5	4
Metronidazole	≤0.125–2	1	2
Propionibacteria (0/19)[e]			
Gatifloxacin	0.25–0.5	0.5	0.5
Ciprofloxacin	0.5–1	1	1
Sparfloxacin	0.25–0.5	0.5	0.5
Trovafloxacin	1–2	1	1
Ampicillin	≤0.125–1	≤0.125	0.5
Ampicillin-sulbactam	≤0.125–1	≤0.125	0.5
Clindamycin	0.06–0.5	0.06	0.25
Metronidazole	>16	>16	>16
Other gram-positive non-spore-forming bacilli (0/28)[f]			
Gatifloxacin	0.25–16	1	2
Ciprofloxacin	1–>32	4	32
Sparfloxacin	0.25–32	2	8
Trovafloxacin	0.125–8	1	2
Ampicillin	≤0.125–4	0.5	2
Ampicillin-sulbactam	≤0.125–2	0.5	2
Clindamycin	≤0.016–8	0.25	4
Metronidazole	0.25–>16	>16	>16
Clostridium perfringens (0/20)			
Gatifloxacin	0.25–1	0.5	1
Ciprofloxacin	0.25–2	1	1
Sparfloxacin	0.125–1	0.5	1
Trovafloxacin	0.125–0.25	0.25	0.25
Ampicillin	≤0.125–0.5	≤0.125	0.25
Ampicillin-sulbactam	≤0.125–0.25	≤0.125	0.25
Clindamycin	0.03–4	1	4
Metronidazole	≤0.125–2	0.5	1
Clostridium difficile (0/10)			
Gatifloxacin	1–2	2	2
Ciprofloxacin	8–32	16	16
Sparfloxacin	4–8	8	8
Trovafloxacin	1–2	1	2
Ampicillin	1–8	2	2
Ampicillin-sulbactam	1–4	1	2
Clindamycin	4–>32	16	>32
Metronidazole	≤0.125–0.25	0.25	0.25
Miscellaneous clostridia (0/25)[g]			
Gatifloxacin	0.125–2	0.5	2
Ciprofloxacin	0.5–8	2	8
Sparfloxacin	0.25–16	1	16
Trovafloxacin	0.125–2	0.5	2
Ampicillin	≤0.125–2	0.5	1
Ampicillin-sulbactam	≤0.125–2	0.5	1
Clindamycin	0.03–32	1	16
Metronidazole	≤0.125–1	0.25	1
All strains (109/351)			
Gatifloxacin	0.06–>32	0.5	4
Ciprofloxacin	0.25–>32	2	32
Sparfloxacin	0.06–>32	2	8
Trovafloxacin	0.06–32	1	4
Ampicillin	≤0.125–>128	1	64
Ampicillin-sulbactam	≤0.125–>128	0.5	4
Clindamycin	≤0.016–>32	0.125	8
Metronidazole	≤0.125–>16	1	>16

[a] Number of strains β-lactamase positive/number of strains tested.
[b] *Bacteroides ovatus*, 5; *Bacteroides uniformis*, 5.
[c] *Prevotella oralis*, 1; *Prevotella oris*, 2; *Prevotella denticola*, 1; *Prevotella disiens*, 8; *Prevotella* spp., 2; *Porphyromonas asaccharolytica*, 3; *Porphyromonas gingivalis*, 1.
[d] *Peptostreptococcus asaccharolyticus*, 14; *Peptostreptococcus magnus*, 13; *Peptostreptococcus anaerobius*, 14; *Peptostreptococcus tetradius*, 14.
[e] *Propionibacterium acnes*, 18; *Propionibacterium* spp., 1.
[f] *Actinomyces* spp., 6; *Eubacterium* spp., 6; *Bifidobacterium* spp., 4; *Lactobacillus* spp., 12.
[g] *Clostridium tertium*, 5; *Clostridium bifermentans*, 4; *Clostridium cadaveris*, 2; *Clostridium sordelli*, 5; *Clostridium histolyticum*, 1; *Clostridium* spp., 8.

cin was more active against *Prevotella intermedia*, *Porphyromonas gingivalis*, *Fusobacterium* species, peptostreptococci, and *Clostridium perfringens*, with MIC_{90}s of ≤0.39 μg/ml for all species except *Peptostreptococcus asaccharolyticus*. Gatifloxacin was not active against *Clostridium difficile* (MIC_{90} of 25 μg/ml) (13). Gatifloxacin MICs were several dilutions lower than those of ciprofloxacin, ofloxacin, tosufloxacin, temafloxacin, and sparfloxacin (13). By contrast, Bauernfeind (9), in a preliminary study, has reported a MIC_{90} of 2 μg/ml for *C. difficile*.

In general, our results with gatifloxacin are similar to those reported by Kato et al. (13) and Bauernfeind (9). However, in contrast to findings by Kato et al. (13), we found lower gatifloxacin MICs, similar to those reported by Bauernfeind (9) against *C. difficile*. Although Kato et al. (13) found MIC_{90}s of 0.39 μg/ml against 13 fusobacteria, the species of these strains was not reported. Wexler and coworkers (20) have reported elevated trovafloxacin MICs against *F. varium* compared to those of the same drug against other fusobacteria, and it is probable that the same applies for gatifloxacin. This needs to be confirmed by others.

Antianaerobic activities of ciprofloxacin, sparfloxacin, and trovafloxacin are similar to those reported previously (7–10, 16, 17, 20). Slightly higher trovafloxacin MICs obtained in this study may be dependent on the composition of strains tested compared to those in other reports by us and others (16, 20). Activities of ampicillin-sulbactam, clindamycin, and metronidazole reflect well-known patterns obtained with these drugs, with ampicillin-sulbactam being very active against β-lactamase-producing strains, clindamycin being active against all strains except some clostridia (especially *C. difficile*), and metronidazole being active against all strains except anaerobic gram-positive bacilli. High β-lactam MICs for β-lactamase-negative fusobacteria have been described before (1–5). We do not have an explanation for the metronidazole resistance encountered in one strain of *P. denticola*; this phenomenon is currently under investigation.

Nakashima and coworkers (14) have reported maximum concentrations of drug in serum in healthy human volunteers of 0.873, 1.71, 3.35, and 5.41 μg/ml after single oral doses of 100, 200, 400, and 600 mg, respectively. Values for area under the concentration-time curve after the four doses were 7.0, 14.5, 32.4, and 53.5 μg · h/ml, respectively. Serum concentrations reached a peak between 1 and 2 h (14). With the above

pharmacokinetic data considered with the MIC data presented above as well as its known activity against members of the family *Enterobacteriaceae* (9, 11, 12, 21), gatifloxacin shows promise in treatment of mixed anaerobic infections, especially of those of the respiratory tract, ear, nose and throat, skin and soft tissue, and bite wounds. Clinical studies will be necessary to validate these hypotheses.

This study was supported by a grant from Bristol-Myers Squibb Laboratories.

REFERENCES

1. **Appelbaum, P. C., A. Philippon, M. R. Jacobs, S. K. Spangler, and L. Gutmann.** 1990. Characterization of β-lactamases from non-*Bacteroides fragilis* group *Bacteroides* spp. belonging to seven species and their role in β-lactam resistance. Antimicrob. Agents Chemother. **34:**2169–2176.
2. **Appelbaum, P. C., S. K. Spangler, and M. R. Jacobs.** 1990. Evaluation of two methods for rapid testing for beta-lactamase production in *Bacteroides* and *Fusobacterium*. Eur. J. Clin. Microbiol. Infect. Dis. **9:**47–50.
3. **Appelbaum, P. C., S. K. Spangler, and M. R. Jacobs.** 1990. β-Lactamase production and susceptibilities to amoxicillin, amoxicillin-clavulanate, ticarcillin, ticarcillin-clavulanate, cefoxitin, imipenem, and metronidazole of 320 non-*Bacteroides fragilis Bacteroides* isolates and 129 fusobacteria from 28 U.S. centers. Antimicrob. Agents Chemother. **34:**1546–1550.
4. **Appelbaum, P. C., S. K. Spangler, and M. R. Jacobs.** 1993. Susceptibility of 539 gram-positive and -negative anaerobes to new agents, including RP 59500, biapenem, trospectomycin and piperacillin/tazobactam. J. Antimicrob. Chemother. **32:**223–231.
5. **Appelbaum, P. C., S. K. Spangler, G. A. Pankuch, A. Philippon, M. R. Jacobs, R. Shiman, E. J. C. Goldstein, and D. Citron.** 1994. Characterization of a β-lactamase from *Clostridium clostridioforme*. J. Antimicrob. Chemother. **33:**33–40.
6. **Barry, A. L., and P. C. Fuchs.** 1991. In vitro activities of sparfloxacin, tosufloxacin, ciprofloxacin, and fleroxacin. Antimicrob. Agents Chemother. **35:** 955–960.
7. **Barry, A. L., P. C. Fuchs, D. M. Citron, S. D. Allen, and H. M. Wexler.** 1993. Methods for testing the susceptibility of anaerobic bacteria to two fluoroquinolone compounds, PD 131628 and clinafloxacin. J. Antimicrob. Chemother. **31:**893–900.
8. **Bauernfeind, A.** 1993. Comparative in vitro activities of the new quinolone, Bay y 3118, and ciprofloxacin, sparfloxacin, tosufloxacin, CI-960 and CI-990. J. Antimicrob. Chemother. **31:**505–522.
9. **Bauernfeind, A.** 1997. Comparison of the antibacterial activities of the quinolones Bay 12-8039, gatifloxacin (AM 1155), trovafloxacin, clinafloxacin, levofloxacin and ciprofloxacin. J. Antimicrob. Chemother. **40:**639–651.
10. **Goldstein, E. J. C., and D. M. Citron.** 1992. Comparative activity of ciprofloxacin, ofloxacin, sparfloxacin, temafloxacin, CI-960, CI-990, and Win 57273 against anaerobic bacteria. Antimicrob. Agents Chemother. **36:**1158–1162.
11. **Hosaka, M., S. Kinoshita, A. Toyama, M. Otsuki, and T. Nishino.** 1995. Antibacterial properties of AM-1155, a new 8-methoxy quinolone. J. Antimicrob. Chemother. **36:**293–301.
12. **Hosaka, M., T. Yasue, H. Fukuda, H. Tomizawa, H. Aoyama, and K. Hirai.** 1992. In vitro and in vivo antibacterial activities of AM-1155, a new 6-fluoro-8-methoxy quinolone. Antimicrob. Agents Chemother. **36:**2108–2117.
13. **Kato, N., H. Kato, K. Tanaka-Bandoh, K. Watanabe, and K. Ueno.** 1997. Comparative in-vitro and in-vivo activity of AM-1155 against anaerobic bacteria. J. Antimicrob. Chemother. **40:**631–637.
14. **Nakashima, M., T. Uematsu, K. Kosuge, H. Kusajima, T. Ooie, Y. Masuda, R. Ishida, and H. Uchida.** 1995. Single- and multiple-dose pharmacokinetics of AM-1155, a new 6-fluoro-8-methoxy quinolone, in humans. Antimicrob. Agents Chemother. **39:**2635–2640.
15. **National Committee for Clinical Laboratory Standards.** 1993. Methods for antimicrobial susceptibility testing of anaerobic bacteria, 3rd ed. Approved standard. NCCLS publication no. M11-A3. National Committee for Clinical Laboratory Standards, Villanova, Pa.
16. **Spangler, S. K., M. R. Jacobs, and P. C. Appelbaum.** 1994. Activity of CP 99,219 compared with those of ciprofloxacin, grepafloxacin, metronidazole, cefoxitin, piperacillin, and piperacillin-tazobactam against 489 anaerobes. Antimicrob. Agents Chemother. **38:**2471–2476.
17. **Spangler, S. K., M. R. Jacobs, and P. C. Appelbaum.** 1997. Bactericidal activity of DU-6859a compared to activities of three quinolones, three β-lactams, clindamycin, and metronidazole against anaerobes as determined by time-kill methodology. Antimicrob. Agents Chemother. **41:**847–849.
18. **Summanen, P., E. J. Baron, D. M. Citron, C. A. Strong, H. M. Wexler, and S. M. Finegold.** 1993. Wadsworth anaerobic bacteriology manual, 5th ed. Star Publishing Co., Belmont, Calif.
19. **Wakabayashi, E., and S. Mitsuhashi.** 1994. In vitro antibacterial activity of AM-1155, a novel 6-fluoro-8-methoxy quinolone. Antimicrob. Agents Chemother. **38:**594–601.
20. **Wexler, H. M., E. Molitoris, D. Molitoris, and S. M. Finegold.** 1996. In vitro activities of trovafloxacin against 557 strains of anaerobic bacteria. Antimicrob. Agents Chemother. **40:**2232–2235.
21. **Wise, R., N. P. Brenwald, J. M. Andrews, and F. Boswell.** 1997. The activity of the methylpiperazinyl fluoroquinolone CG 5501: a comparison with other fluoroquinolones. J. Antimicrob. Chemother. **39:**447–452.