

SUPPORTING INFORMATION

Optimization of Protein Kinase CK2 Inhibitors Derived from 4,5,6,7-Tetrabromobenzimidazole

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Table 1. TLC and UV data of tetrabromobenzimidazole derivatives

Compound	TLC: Rf (solvent)	UV: λ_{max} (ϵ_{max})
2a	0.50 (A)	(0.1 N HCl/ MeOH, 1:1): 231 (41 700), 245 (14 500), 304 (7 900); (water/MeOH, 1:1): 235 (42 600), 262 (11 700), 308 (7 700); (0.1 N NaOH/ MeOH, 1:1): 239 (41 100), 302 (8 000).
2b	0.48 (A)	(0.1 N HCl/MeOH, 1:1): 231 (42 400), 235 (37 800), 307 (8 400); (water/MeOH, 1:1): 238 (40 600), 268 (10 700), 311 (8 900); (0.1 N NaOH/ MeOH, 1:1): 242 (37 800), 269 (4 900), 311 (8 800)
2c	0.61 (A)	(0.1 N HCl/ MeOH, 1:1): 237 (39 300), 309 (10 500); (water/MeOH, 1:1): 242 (37 600), 272 (11 800), 316 (10 900); (0.1 N NaOH/ MeOH, 1:1): 248 (36 000), 269 (5 300), 319 (11 100)
2e	0.74 (A)	(0.1 N HCl/ MeOH, 1:1): 242 (38 300), 311 (9 300); (water/MeOH, 1:1): 238 (40 500), 269 (10 900), 312 (9 300); (0.1 N NaOH/ MeOH, 1:1): 236 (37 300), 307 (9 200)
2d	0.48 (B)	(0.1 N HCl/ MeOH, 1:1): 232 (45 700), 306 (8200); (water/MeOH, 1:1): 236 (45 100), 266 (9 700), 311 (8 300); (0.1 N NaOH/ MeOH, 1:1): 239 (40 100), 267 (4 600), 310 (9 800)
2f	0.45 (A)	(0.1 N HCl/ MeOH, 1:1): 235 (40 600), 307 (9 700); (water/MeOH, 1:1): 238 (40 300), 276 (12 800), 312 (9 400); (0.1 N NaOH/ MeOH, 1:1): 242 (39 700), 269 (7 600), 310 (11 400)
2g	0.15 (C)	(0.1 N HCl/ MeOH, 1:1): 233 (44 600), 306 (9 900); (water/MeOH, 1:1): 238 (40 600), 268 (10 700), 311 (8 900); (0.1 N NaOH/ MeOH, 1:1): 241 (37 800), 269 (4 900), 311 (8 900)
3a	0.46 (D)	(water/MeOH, 1:1): 235 (37 100), 274 (11 100), 305 (5 600)
3b	0.59 (D)	(water/MeOH, 1:1): 234 (49 000), 274 (11 900), 305 (5 900)
3c	0.39 (A)	(water/MeOH, 1:1): 227 (50 100), 268 (10 500), 302 (6 900)
4a	0.69 (D)	(water/MeOH, 1:1): 233 (36 400), 263 (9 300), 304 (3 900)
4b	0.69 (D)	(water/MeOH, 1:1): 232 (37 500), 264 (9 600), 304 (4 100)
5	0.77 (A)	(water/MeOH, 1:1): 234 (40 800), 252 (10 600), 310 (5 100); (0.1 N NaOH/ MeOH, 1:1): 239 (40 100), 267 (6 600), 305 (5 700)

Table 1. continued

6a	0.33 (D)	(0.1 N HCl/ MeOH, 1:1): 240 (40 400), 311 (10 200); (water/MeOH, 1:1): 243 (39 800), 274 (12 300), 313 (8 100).
6b	0.78 (B)	(0.1 N HCl/ MeOH, 1:1): 236 (45 400), 310 (8 300); (water/MeOH, 1:1): 241 (45 700), 273 (10 700), 315 (7 900).
8	0.74 (A)	(water/MeOH, 1:1): 237 (38 500), 271 (12 100), 313 (14 400); (0.1 N NaOH/MeOH, 1:1): 244 (35 000), 316 (10 400).
9	0.69 (D)	(water/MeOH, 1:1): 243 (42 400), 276 (12 800), 314 (12 100).
10a	0.73 (B)	(water/MeOH, 1:1): 240 (36 800), 271 (21 400), 313 (16 300); (0.1 N NaOH/MeOH, 1:1): 242 (33 900).
10b	0.25 (C)	(water/MeOH, 1:1): 236 (35 900), 272 (11 400), 312 (13 300); (0.1 N NaOH/MeOH, 1:1): 245 931 700), 317 (10 300)
10c	0.39 (A)	(water/MeOH, 1:1): 237 (32 600), 313 (12 900); (0.1 N NaOH/MeOH): 243 (34 400), 316 (9 200)
11	0.78 (A)	(water/MeOH, 1:1): 236 (40 400), 276 (11 100), 312 (13 200); (0.1 N NaOH/MeOH): 240 (36 700), 315 (10 200).
12	0.40 (A)	(water/MeOH, 1:1): 230 (46 700), 249 (12 500), 307 (6 000); (0.1 N NaOH/MeOH): 234 (44 900), 269 (7 600), 304 (6 900)

(A): CHCl₃/MeOH, 90:10; (B): CHCl₃/MeOH, 95:5; (C): CHCl₃/MeOH, 70:30; (D): CHCl₃**Table 2.** Mass spectrometry and elemental analysis data of tetrabromobenzimidazole derivatives

Compound	Mass spectrometry data	Elemental analysis data
2a	454 (2), 453 (17), 452 (6), 451 (66), 450 (10), 449 (100), 448 (7), 445 (17)	Anal. calcd for C ₇ H ₃ Br ₄ N ₃ (448.74): C, 18.74; H, 0.67; N, 9.36. Found: C, 18.82; H, 0.80; N, 9.21.
2b	467 (15), 466 (10), 465 (64), 464 (27), 463 (100), 462 (34), 461 (67), 460 (20).	Anal. calcd for C ₈ H ₅ Br ₄ N ₃ (462.77): C, 20.76; H, 1.09; N, 9.08. Found: C, 20.70; H, 1.25; N, 8.93.

Table 2. continued

2c	481 (17), 480 (8), 479 (64), 478 (13), 477 (100), 476 (11), 475 (69), 474 (5), 473 (17).	Anal. Calcd for C ₉ H ₇ Br ₄ N ₃ (476.79): C, 22.67; H, 1.48; N, 8.81. Found: C, 22.71; H, 1.65; N, 8.68
2d	497 (6), 496 (3), 495 (23), 494 (5), 493 (38), 492 (5), 491 (24).	Anal. Calcd for C ₉ H ₇ Br ₄ N ₃ O (492.79): C, 21.94; H, 1.43; N, 8.53. Found: C, 21.90; H, 1.61; N, 8.40.
2e	494 (5), 494 (3), 493 (22), 492 (6), 491 (33), 490 (5), 489 (22), 449 (100)	Anal. Calcd for C ₁₀ H ₉ Br ₄ N ₃ (490.82): C, 24.47; H, 1.85; N, 8.56. Found: C, 24.36; H, 1.98; N, 8.40
2f	511 (4), 510 (3), 509 (17), 508 (3), 507 (24), 506 (3), 505 (17), 449 (100)	Anal. Calcd for C ₁₀ H ₉ Br ₄ N ₃ O (506.82): C, 23.70; H, 1.79; N, 8.29. Found: C, 23.66; H, 1.88; N, 8.16
2g	MS (EI) (M+H ⁺): 521	Anal. Calcd for C ₁₁ H ₁₂ Br ₄ N ₄ (519.86): C, 25.41; H, 2.33; N, 10.78. Found: C, 25.56; H, 2.48; N, 10.64
3a	532 (9), 531 (5), 530 (47), 529 (10), 528 (98), 527 (10), 526 (100), 525 (6), 524 (50)	Anal. Calcd for C ₈ H ₃ Br ₅ N ₂ (526.65): C, 18.25; H, 0.57; N, 5.22. Found: C, 18.33; H, 0.70; N, 5.04.
3b	558 (7), 557 (6), 556 (48), 555 (12), 554 (98), 553 (12), 552 (100), 551 (6), 550 (49)	Anal. Calcd for C ₁₀ H ₅ Br ₅ N ₂ (552.68): C, 21.73; H, 0.91; N, 5.07. Found: C, 21.75; H, 0.79; N, 5.04.
3c	573 (8), 572 (2), 571 (19), 570 (2), 569 (19), 567 (10), 565 (3), 491 (100)	Anal. Calcd for C ₉ H ₄ Br ₅ N ₃ O (569.67): C, 18.98; H, 0.71; N, 7.38. Found: C, 19.10; H, 0.77; N, 7.55.
4a	496 (6), 495 (3), 494 (24), 493 (50), 492 (37), 491 (3), 490 (24), 488 (7), 464 (100)	Anal. Calcd for C ₁₀ H ₈ Br ₄ N ₂ O (491.80): C, 24.42; H, 1.64; N, 5.70. Found: C, 24.58; H, 1.77; N, 5.55.
4b	510 (2), 509 (1), 508 (8), 507 (1), 506 (12), 505 (1), 504 (8), 464 (100)	Anal. Calcd for C ₁₁ H ₁₀ Br ₄ N ₂ O (506.02): C, 26.11; H, 1.99; N, 5.54. Found: C, 25.98; H, 1.97; N, 5.41

Table 2. continued

5	469 (2), 468 (16), 467 (8), 466 (68), 465 (18), 464 (100), 463 (19), 462 (70), 461 918), 460 (18)	Anal. calcd for C ₈ H ₄ Br ₄ N ₂ O (463.75): C, 20.72; H, 0.87; N, 6.04. Found: C, 20.75; H, 1.01; N, 5.91
6a	495 (15), 494 (8), 493 (61), 492 (15), 491 (91), 490 (14), 489 (63), 462 (100)	Anal. calcd for C ₁₀ H ₉ Br ₄ N ₃ (490.82): C, 24.47; H, 1.85; N, 8.56. Found: C, 24.55; H, 1.94; N, 8.60
6b	509 (6), 508 (4), 507 (23), 506 (7), 505 (36), 504 (7), 503 (25), 463 (100)	Anal. calcd for C ₁₁ H ₁₁ Br ₄ N ₃ (504.848): C, 26.17; H, 2.20; N, 8.32. Found: C, 26.36; H, 2.40; N, 8.19
8	485 (2), 484 (18), 483 (11), 482 (69), 481 (24), 480 (100), 479 (29), 478 (68), 477 (16), 476 (18)	Anal. calcd for C ₈ H ₄ Br ₄ N ₂ S (479.81): C, 20.03; H, 0.84; N, 5.84. Found: C, 20.18; H, 0.91; N, 5.71
9	499 (20), 498 (20), 497 (9), 496 (68), 495 (18), 494 (100), 493 (16), 492 (68)	Anal. calcd for C ₉ H ₆ Br ₄ N ₂ S (493.84): C, 21.89; H, 1.22; N, 5.67. Found: C, 21.80; H, 1.30; N, 5.55
10a	606 (3), 605 (19), 604 (12), 603 (68), 602 (19), 601 (100), 600 (14), 599 (66)	Anal. calc for C ₁₄ H ₇ Br ₄ N ₃ O ₂ S (600.91): C, 27.98; H, 1.17; N, 6.99. Found: C, 28.13; H, 1.22; N, 6.81
10b	MS (EI) (M+H ⁺): 524	Anal. calc for C ₉ H ₄ Br ₄ N ₂ O ₂ S (523.819): C, 20.64; H, 0.77; N, 5.35. Found: C, 20.54; H, 0.90; N, 5.22
10c	538 (1.5), 540 (2.2), 542 (1.5), 450 (100)	Anal. calc for C ₁₀ H ₈ Br ₄ N ₂ O ₂ S (539.862): C, 22.25; H, 1.49; N, 5.19. Found: C, 22.33; H, 1.62; N, 5.01
11	556 (9), 555 (4), 554 (32), 553 (7), 552 (46), 551 (4), 550 (31)	Anal. calc for C ₁₁ H ₈ Br ₄ N ₂ O ₂ S (551.87): C, 23.94; H, 1.46; N, 5.08. Found: C, 24.08; H, 1.45; N, 4.95
12	454 (16), 453 (5), 452 (64), 451 (9), 450 (100), 449 (6), 448 (67)	Anal. calc for C ₇ H ₂ Br ₄ N ₂ O (449.72): C, 18.70; H, 0.46; N, 6.23. Found: C, 18.72; H, 0.60; N, 6.10