Table 5. *Effects of ion deletion on the growth yields and rates of Bacteroides species*

Ion deleted	Organism							
	GA33[a]		2044		J1		7CM	
	Yield[b]	Rate[b]	Yield	Rate	Yield	Rate	Yield	Rate
None[c]	2.2 (0.06)	5.3 (0.84)	4.5 (0.03)	2.5 (0.22)	1.3 (0.01)	5.5 (0.28)	1.8 (0.04)	3.3 (0.04)
Na^+	0		1.7 (0.27)	7.0 (2.5)	0		1.7 (0.04)	3.9 (0.74)
K^+	0		0.9 (0.02)	18.7 (6.5)	0		0.6 (0.03)	21.1 (2.1)
PO_4^{3-}	0		0.6 (0.01)	5.1 (1.8)	0		0.04 (0.05)	8.8 (3.1)
SO_4^{2-}	2.2 (0.03)	6.3 (0.88)	4.3 (0.06)	3.5 (0.10)	1.3 (0.01)	6.3 (0.03)	2.0 (0.02)	11.6 (0.11)
Ca^{2+}	2.0 (0.15)	4.9 (0.62)	2.2 (0.26)	4.4 (0.34)	1.3 (0.05)	8.9 (0.55)	1.0 (0.10)	3.1 (0.11)
Mg^{2+}	0.5 (0.04)	21.3 (1.3)	2.4 (0.10)	3.8 (0.51)	0.5 (0.02)	180.4 (39.7)	0.5 (0.01)	5.9 (1.6)
Co^{2+}	2.4 (0.03)	5.7 (1.46)	4.1 (0.17)	5.4 (0.97)	1.2 (0.08)	4.2 (0.26)	1.8 (0.04)	5.6 (0.06)
Mn^{2+}	2.3 (0.02)	6.6 (1.7)	4.7	4.1 (0.04)	1.4 (0.07)	5.4 (0.33)	1.8 (0.02)	5.6 (0.25)

[a] The numbers denote *B. ruminicola* subsp. *brevis* GA33, *B. fragilis* subsp. *fragilis* 2044, and *B. oralis* strains J1 and 7CM. Results qualitatively similar to those shown for strain GA33 were also obtained for strains 23, $B_1$18, 118B, $B_1$4, and 8503, except that growth of strain 8503 was not completely eliminated when K^+ was deleted as a major medium ingredient. Results qualitatively similar to those shown for strain 2044 were also obtained for strains H, 9344, 8560, 2393, 8483, and 8482, except that the growth yield reductions accompanying Ca^{2+} were less severe for strains 8482 and 8483 than was the case with the other strains. Results similar to those shown for strain 7CM were also obtained with strains 2366 and 25560, except that a Ca^{2+} effect on growth could not be detected for strains *B. hypermegas*. Variability was observed among strains within species and also between species in the ability to detect growth rate effects as a function of divalent ion deletion.

[b] See Table 4, footnote *c*.

[c] The medium denoted by "None" was the medium described in Table 1 devoid of mineral-containing vitamins and contained all required cations at growth-supporting concentrations. The remaining media are identical to the cation-sufficient medium, except for the deletion of the ions indicated. The concentrations of Na^+, K^+, Ca^{2+}, Mg^{2+}, Co^{2+}, and Mn^{2+} in inoculated media from which they were deleted as major ingredients were 43, 1.8, 28, 10, 1.8, and 0.5 μM respectively.

Table 4 footnote 'c':

[c] Figures in columns denoted "Yield" are the growth yields in billions of cells per milliliter. Figures denoted "Rate" are the growth rates as measured by generation times in hours. Each value is the average of duplicate cultures from two or more experiments. Values of 0 indicate no growth detected by turbidity within 200 h of incubation at 37 C.

TABLE 1. *Defined medium used to study the inorganic and metal-organic growth requirements of Bacteroides species*

Component	Quantity[a]
Maltose	5.0
Resazurin	0.001
Methionine	0.45
$(NH_4)_2SO_4$	0.90
Menadione	0.001
Hemin[b]	0.001
Cysteine hydrochloride·water	0.5
Volatile fatty acid solution[c]	10.0
Vitamin solution[d]	10.0
Mineral solution[e]	50.0
Buffer[f]	
Distilled-demineralized water	
100% carbon dioxide gaseous phase	

[a] The quantities of maltose, resazurin, methionine, $(NH_4)_2SO_4$, menadione, hemin, and cysteine hydrochloride monohydrate are expressed in grams per liter. The quantities of volatile fatty acids, vitamins, and minerals are expressed as milliliters of aqueous stock solution per liter of medium.

[b] Hemin was incorporated into media in a 47.5% (vol/vol) ethyl alcohol-0.1 M KOH solution when factors other than K^+ were studied. When K^+ was studied, it was isomolarly replaced in the stock solution with NaOH.

[c] The volatile fatty acids used and their final medium concentrations were the following: acetic, 2.8×10^{-2} M; propionic, 9.9×10^{-3} M; *n*-butyric, 4.5×10^{-3} M; isobutyric, *n*-valeric, isovaleric, and DL-2-methylbutyric, 9.0×10^{-4} M each.

[d] The vitamins used and their final medium concentrations were the following: thiamine hydrochloride, 5.9×10^{-6} M; nicotinamide, 1.6×10^{-5} M; riboflavine, 5.6×10^{-6} M; *p*-aminobenzoic acid, 7.3×10^{-7} M; biotin, 2.0×10^{-7} M; folic acid, 1.1×10^{-7} M; lipoic acid, 2.4×10^{-7} M; cyanocobalamin, 3.7×10^{-9} M.

[e] The minerals used and their final medium concentrations were the following: KH_2PO_4, 6.5×10^{-3} M; NaCl, 1.5×10^{-2} M; $CaCl_2$, 1.8×10^{-4} M; $MgCl_2 \cdot 6H_2O$, 9.0×10^{-5} M; $MnCl_2 \cdot 4H_2O$, 5.0×10^{-5} M; $CoCl_2 \cdot 6H_2O$, 4.2×10^{-6} M; $FeSO_4 \cdot 7H_2O$, 3.6×10^{-5} M. When the effects of ion concentration were studied, ion concentrations were isoosmotically altered as described by Caldwell et al. (5).

[f] For all of the studies except those involving Na^+, CO_2-equilibrated 7.4×10^{-2} M $NaHCO_3$ buffer (pH 6.7 to 6.9) was used, and media were neutralized with 2.5 M NaOH. When Na^+ was studied, CO_2-equilibrated 7.4×10^{-2} M $KHCO_3$ replaced $NaHCO_3$, and media were neutralized with 2.5 M KOH. Neither of these procedures affected growth of any of the organisms in media containing adequate Na^+ and K^+.