Supplementary material for

Adding available nitrogen and carbon can improve the efficiency of oil displacement with indigenous bacterial flooding

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Table S1

Number of bacteria in displaced fluid after displacement by different nutrient solutions (10^4 CFU/mL).

Treatment	Displacement time			
	1st	2nd	3rd	4th
Ctrl	1.37±0.39bB	0.99±0.26bB	5.93±0.31bA	0.44±0.11bC
N	91.33±9.02aB	184.00±70.34aB	953.33±236.92aA	310.00±43.59aB
G	0.37±0.02bAB	0.28±0.09bBC	0.53±0.17bA	0.11±0.01bC
N+G	3.20±0.20bB	7.93±2.40bA	9.20±0.53bA	10.00±2.00bA

Note: Ctrl, control salt solution; N, NH_4NO_3 solution; G, glucose solution; N+G, NH_4NO_3 + glucose solution. The same abbreviations apply to all tables. Data are mean ± standard deviation. Different lowercase letters in the same column indicate significant differences between different treatments in the same displacement time (p <0.05); different uppercase letters in the same row indicate significant differences between different displacement times in the same treatment (p <0.05).

Table S2

Amount and efficiency of oil displacement by different nutrient solutions.

Displacement time	Displacement amount (g/tube)				Displacement efficiency (%)			
	Ctrl	N	G	N+G	Ctrl	N	G	N+G
1st	0.68±0.02abA	1.04±0.14aA	0.51±0.15bB	1.01±0.40aA	2.24±0.17bcA	3.64±0.20abB	1.89±0.56cB	3.76±1.42aA
2nd	0.38±0.22bB	1.25±0.22aA	0.69±0.37bA	0.59±0.13bB	1.21±0.63bB	4.50±0.28aA	2.61±1.42bA	2.26±0.43bA
3rd	0.38±0.14aB	0.45±0.09aB	0.39±0.07aB	0.57±0.10aB	1.27±0.38bB	1.72±0.15abC	1.52±0.29bB	2.26±0.39aB
4th	0.28±0.13bB	0.51±0.06aB	0.25±0.04bB	0.30±0.06bB	0.96±0.40bB	1.95±0.06aC	0.98±0.13bB	1.21±0.22bB
∑	1.72±0.49b	3.25±0.50a	1.84±0.46b	2.46±0.47ab	5.57±1.10c	11.30±0.46a	6.80±1.74bc	9.17±1.51ab

Note: Data are mean ± standard deviation. Different lowercase letters in the same row indicate significant differences between different treatments in the same displacement time (p <0.05); different uppercase letters in the same column indicate significant differences between different displacement times in the same treatment (p <0.05).

Table S3

Parameters of injected and displaced fluids for the four displacements by different nutrient solutions.

Treatment		Liquid phase	pH	Oil-spreading diameter	Surface tension	Treatment		Liquid phase	pH	Oil-spreading diameter	Surface tension
				mm	mN/m					mm	mN/m
1st	Ctrl	Injected	6.05±0.06a	0	62.17±4.10a	3rd	Ctrl	Injected	6.56±0.10a	0	59.43±1.10a
		Displaced	5.38±0.03b	0	56.64±1.69a			Displaced	5.75±0.10b	0	56.20±4.76a
		⊿IN%	-11.1	-	-8.7			⊿IN%	-12.4	-	-5.5
	N	Injected	6.53±0.05a	2.7±2.1	50.38±2.24a		N	Injected	6.28±0.06a	12.0±1.0	48.05±2.21a
		Displaced	5.48±0.02b	0	47.01±3.07a			Displaced	6.08±0.09b	0	45.59±4.12a
		⊿IN%	-16.1	-100	-6.4			⊿IN%	-3.2	-100	-4.9
	G	Injected	6.44±0.05a	21.7±1.5	53.18±3.05a		G	Injected	6.33±0.06a	24.7±1.5	49.72±1.52a
		Displaced	4.07±0.05b	0	40.63±5.01b			Displaced	4.35±0.08b	0	49.22±2.16a
		⊿IN%	-36.8	-100	-23.7			⊿IN%	-31.4	-100	-1.0
	N+G	Injected	6.53±0.06a	45.0±4.4	51.29±3.41a		N+G	Injected	6.11±0.10a	50.7±2.1	49.35±1.53a
		Displaced	4.79±0.01b	0	43.42±2.92b			Displaced	6.24±0.08a	0	50.69±0.03a
		⊿IN%	-26.6	-100	-14.9			⊿IN%	2.2	-100	2.8
2nd	Ctrl	Injected	6.38±0.07a	0	60.00±1.09a	4th	Ctrl	Injected	6.29±0.08a	0	58.57±1.41a
		Displaced	5.42±0.04b	0	59.45±1.83a			Displaced	5.42±0.18b	0	56.45±2.68a
		⊿IN%	-15.0	-	-0.8			⊿IN%	-13.9	-	-3.6
	N	Injected	6.32±0.04b	9.3±1.5	51.30±0.95a		N	Injected	6.55±0.12a	11.3±1.5	52.00±4.01a
		Displaced	6.42±0.05a	0	44.74±1.60b			Displaced	6.03±0.22b	0	42.82±1.86b
		⊿IN%	1.6	-100	-12.8			⊿IN%	-7.9	-100	-17.3
	G	Injected	6.34±0.06a	21.0±1.0	49.41±1.08a		G	Injected	6.43±0.10a	21.0±1.0	47.18±2.09a
		Displaced	4.59±0.17b	0	44.45±2.29b			Displaced	4.34±0.10b	0	45.92±1.76a
		⊿IN%	-27.5	-100	-10.1			⊿IN%	-32.5	-100	-2.6
	N+G	Injected	6.18±0.04a	60.0±5.6	49.24±3.80a		N+G	Injected	6.39±0.09a	31.3±3.1	46.89±1.11a
		Displaced	5.41±0.03b	0	42.45±2.90a			Displaced	6.23±0.13a	0	41.74±3.23b
		⊿IN%	-12.5	-100	-13.7			⊿IN%	-2.5	-100	-10.9

Note: For the same displacement time, different lowercase letters in the same column indicate significant differences between the injected and displaced fluids in different treatments (p <0.05).

Table S4

Correlations between the properties of the displacing fluid in different displacements (n = 12).

Displacement time	Fluid parameter		pH	Oil-spreading diameter		Surface tension		
			*Δ*IN%	Injected fluid	*Δ*IN%	Injected fluid	Displaced fluid	*Δ*IN%
1st	Viable bacterial count	Displaced	0.382	-0.454	-0.336	-0.409	0.006	0.410
	Oil-spreading diameter	Injected	-0.647*	1.000	-0.552	-0.442	-0.594*	-0.351
		*Δ*IN%	0.672*		1.000	0.848**	0.843**	0.280
	Surface tension	Injected	0.426			1.000	0.652*	-0.104
		Displaced	0.825**				1.000	0.685*
		*Δ*IN%	0.674*					1.000
2nd	Viable bacterial count	Displaced	0.790**	-0.289	-0.327	-0.177	-0.251	-0.306
	Oil-spreading diameter	Injected	-0.115	1.000	-0.568	-0.589*	-0.631*	-0.594*
		*Δ*IN%	-0.091		1.000	0.916**	0.958**	0.852**
	Surface tension	Injected	0.059			1.000	0.949**	0.729**
		Displaced	-0.006				1.000	0.907**
		*Δ*IN%	-0.225					1.000
3rd	Viable bacterial count	Displaced	0.343	-0.286	-0.327	-0.436	-0.645*	-0.312
	Oil-spreading diameter	Injected	0.288	1.000	-0.670*	-0.578*	-0.209	0.487
		*Δ*IN%	-0.055		1.000	0.950**	0.712**	-0.287
	Surface tension	Injected	-0.120			1.000	0.721**	-0.349
		Displaced	-0.038				1.000	0.396
		*Δ*IN%	0.114					1.000
4th	Viable bacterial count	Displaced	0.330	-0.196	-0.344	0.039	-0.381	-0.590*
	Oil-spreading diameter	Injected	0.100	1.000	-0.786**	-0.888**	-0.740**	-0.065
		*Δ*IN%	0.014		1.000	0.833**	0.912**	0.359
	Surface tension	Injected	0.146			1.000	0.733**	-0.080
		Displaced	-0.217				1.000	0.616*
		*Δ*IN%	-0.514					1.000

Note: * $p < 0.05$ and ** $p < 0.01$.