

Characterization and degradation potential of diesel-degrading bacterial strains for application in bioremediation

Supplementary material

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**Table 1.** Collection of bacterial strains isolated from a contaminated site and selected for this study.

Phylum	Species	Strain	GenBank*
Actinobacteria	<i>Arthrobacter</i> sp.	PG21	KU350608
	<i>Brevibacterium</i> sp.	PG27	KU350614
	<i>Microbacterium</i> sp.	PG28	KU350615
	<i>Microbacterium hydrocarbonoxydans</i>	PG29	KU350616
	<i>Arthrobacter</i> sp.	SPG23	KU350590
Proteobacteria	<i>Acinetobacter calcoaceticus</i> .	GK1	KU350617
	<i>Acinetobacter calcoaceticus</i>	GK2	LQMV01000001
	<i>Acinetobacter oleivorans</i>	PF1	KU350618
	<i>Acinetobacter calcoaceticus</i>	PG7	KU350598
	<i>Acinetobacter calcoaceticus</i>	PG8	KU350599
	<i>Pseudomonas reinekei</i>	PG10	KU350591
	<i>Pseudomonas putida</i>	PG11	KU350601
	<i>Pseudomonas</i> sp.	PG12	KU350602
	<i>Pseudomonas koreensis</i>	PG13	KU350603
	<i>Pseudomonas brassicacearum</i>	PG16	KU350593
	<i>Pseudomonas brassicacearum</i>	PG17	KU350605
	<i>Acinetobacter calcoaceticus</i>	PG19	KU350619
	<i>Pseudomonas</i> sp.	PG24	KU350611
<i>Acinetobacter</i> sp.	PG26	KU350613	

\*NCBI GenBank accession number: 16S ribosomal RNA gene partial sequence

**Table 2.** Results of the biosurfactant production screening assays using supernatant (SN) and pellet suspensions (PEL) for each strain.

Strain	Drop collapse <sup>1</sup>		Oil displacement (halo diameter, cm)		Emulsification assay (emulsification activity, %) <sup>2</sup>				Lipase production	
					Hexadecane		Diesel			
	SN	PEL	SN	PEL	SN	PEL	SN	PEL	SN	PEL
PG21	-	-	0.5	0.5	50	SL	SL	30	+	-
PG27	-	-	0.3	0.3	30	40	-	50	+	-
PG28	-	-	1.4	-	-	10	-	40	-	-
PG29	-	-	0.4	-	-	60	15	40	-	-
SPG23	++	-	1.1	0.4	40	60	SL	SL	+	-
GK1	-	-	0.6	-	-	50	-	25	-	-
GK2	++	-	1.3	-	-	60	SL	SL	-	-
PF1	-	+	1.2	-	-	60	SL	SL	-	-
PG7	-	-	0.5	-	-	25	SL	30	-	-
PG8	-	-	0.9	-	-	50	-	20	+	-
PG10	-	-	0.8	0.3	30	60	SL	55	+	-
PG11	-	++	-	-	-	40	SL	35	+	-
PG12	-	-	1	0.5	50	60	-	50	+	-
PG13	-	-	0.6	0.4	40	60	5	45	-	-
PG16	++	-	1.1	0.5	50	65	10	40	-	-
PG17	-	+	1.2	0.6	60	-	-	50	-	-
PG19	-	-	1.3	-	-	50	-	25	-	-
PG24	+	-	0.4	0.4	40	60	SL	35	-	-
PG26	++	-	0.5	0.4	40	40	-	15	-	-

Negative results in all protocols are indicated with “-”.

<sup>1</sup> Positive results were comparatively characterized as + and ++ according to the degree of drop flattening.

<sup>2</sup> Strains presenting only a slight emulsification layer are detailed as “SL” (slight layer).

**Table 3.** Adherence indices (obtained from Eq. 1) of the bacterial strains in polypropylene (PP) and polystyrene (PS) plates in the presence of hexadecane or diesel. The results are expressed as the mean  $\pm$  the standard error ( $n=3$ ). Significant differences with the respective control are indicated with an asterisk ( $p<0.05$ ).

Strain	Hexadecane		Diesel	
	PP	PS	PP	PS
<b>Control</b>	3.5 $\pm$ 0.4	1.9 $\pm$ 0.6	3.4 $\pm$ 0.4	2.3 $\pm$ 0.2
<b>PG21</b>	10.1 $\pm$ 0.5	10.6 $\pm$ 4.7	6.0 $\pm$ 2.7	8.5 $\pm$ 1.2
<b>PG27</b>	81.0 $\pm$ 5.1*	38.4 $\pm$ 3.3*	2.2 $\pm$ 0.7	53.4 $\pm$ 10.5*
<b>PG28</b>	61.7 $\pm$ 8.2*	68.4 $\pm$ 2.7*	3.2 $\pm$ 1.3	68.0 $\pm$ 2.3*
<b>PG29</b>	35.5 $\pm$ 9.5	12.6 $\pm$ 2.1	4.1 $\pm$ 0.8	6.6 $\pm$ 0.3
<b>SPG23</b>	62.6 $\pm$ 2.2*	55.5 $\pm$ 2.9*	5.8 $\pm$ 1.4	43.1 $\pm$ 2.3*
<b>GK1</b>	80.6 $\pm$ 12.5*	39.1 $\pm$ 9.8*	3.1 $\pm$ 0.1	42.2 $\pm$ 2.1*
<b>GK2</b>	128.1 $\pm$ 2.6*	114.0 $\pm$ 6.0*	6.1 $\pm$ 2.0	46.0 $\pm$ 6.2*
<b>PF1</b>	16.7 $\pm$ 2.1	15.0 $\pm$ 1.8	3.1 $\pm$ 0.8	13.3 $\pm$ 2.3
<b>PG7</b>	10.0 $\pm$ 2.0	8.6 $\pm$ 0.5	3.2 $\pm$ 1.1	10.3 $\pm$ 0.4
<b>PG8</b>	75.1 $\pm$ 8.7*	47.9 $\pm$ 3.1*	1.4 $\pm$ 0.4	26.6 $\pm$ 2.6
<b>PG10</b>	20.6 $\pm$ 0.6	16.0 $\pm$ 3.6	6.1 $\pm$ 1.2	16.3 $\pm$ 1.7
<b>PG11</b>	4.2 $\pm$ 0.8	7.3 $\pm$ 0.2	4.3 $\pm$ 2.2	7.3 $\pm$ 0.8
<b>PG12</b>	30.8 $\pm$ 7.5	22.7 $\pm$ 3.2	2.2 $\pm$ 0.8	12.1 $\pm$ 1.3
<b>PG13</b>	35.5 $\pm$ 5.3	22.6 $\pm$ 1.8	3.7 $\pm$ 0.1	19.2 $\pm$ 3.4
<b>PG16</b>	14.1 $\pm$ 2.4	10.6 $\pm$ 1.9	5.2 $\pm$ 1.6	11.8 $\pm$ 1.8
<b>PG17</b>	9.1 $\pm$ 1.7	19.4 $\pm$ 3.1	3.2 $\pm$ 0.5	12.1 $\pm$ 4.4
<b>PG19</b>	71.7 $\pm$ 12.9*	51.0 $\pm$ 5.1*	4.1 $\pm$ 1.4	12.6 $\pm$ 0.2
<b>PG24</b>	23.9 $\pm$ 3.9	14.6 $\pm$ 0.9	2.0 $\pm$ 0.8	22.2 $\pm$ 11.6
<b>PG26</b>	74.8 $\pm$ 7.0*	51.1 $\pm$ 1.1*	2.7 $\pm$ 0.1	62.4 $\pm$ 5.3*