Electronic Supplementary Information

Metal removal and reduction potential of an exopolysaccharide produced by Arctic psychrotrophic bacterium *Pseudomonas* sp. PAMC 28620

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Table S1 Morphological and phenotypical characterization of arctic glacier soil bacterium *Pseudomonas* sp. PAMC 28620

Characteristics*	PAMC 28620
Morphology	Rods
Gram staining	–
Endospores	–
Motility	+
Fluorescence	+
Growth in pH:	
3.0	–
5.0	–
7.0	+
9.0	+
11.0	+
13.0	–
Growth at Temperature:	
4˚C	+
20˚C	+
25˚C	+
30˚C	+
37˚C	–
Growth in NaCl:	
1%	+
2%	+
5%	–
10%	–
15%	–
Growth in carbohydrates: Acid from	
D (+) - Glucose	+
D (+) - Galactose	+
D (+) - Maltose	+
D (+) - Cellibiose	–
D (+) - Trehalose	+
D (+) - Rhamnose	+
D - Xylose	+
D - Mannitol	+
D - Ribose	+
D (–) - Fructose	+
L (+) - Arabinose	+

L (–) Sorbose	–
Sucrose	–
Lactose	–
Dextrin	+
Gas from glucose:	–
Hydrolysis of:	
Cellulose	–
Starch	+
Casein	+
Gelatin	–
Biochemical and Enzyme tests:	
Catalase	+
Oxidase	+
Urease	–
VP test	–
NO_3 reduction	+
Indole	–
Citrate	+
Alkaline phosphatase	+
Esterase (C4)	+
Esterase lipase (C8)	+
Lipase (C14)	+
Leucine arylamidase	+
Valine arylamidase	+
Cystine arylamidase	+
Trypsin	–
α - chymotrypsin	–
Acid phospatase	+
Napthol-AS-BI-phosphohydrolase	+
α - galactosidase	+
α - glucuronidase	+
β - glucosidase	–
α - glucosidase	+
β - glucosidase	+
N-acetyl-b-glucosaminidase	+
α - mannosidase	+
α - fucosidase	–
Antibiotic sensitivity	
Kenamycin	s
Gentamycin	s
Chloramphenicol	s
Strain identified based on 16S rRNA and phenotypical characterization as:	*Pseudomonas* sp.

+ (positive); – (negative); s (sensitive)
*Bergey's manual of systematic bacteriology

Table S2 Minimal inhibitory concentration (MIC) of metals against to Arctic glacier soil bacterium *Pseudomonas* sp. PAMC 28620

Strain	MIC (m mol L^{-1})					
	Fe^{2+}	Cu^{2+}	Zn^{2+}	Ca^{2+}	Mn^{2+}	Mg^{2+}
Pseudomonas sp. PAMC 28620	2.0	1.5	0.5	1.5	0.75	1.5

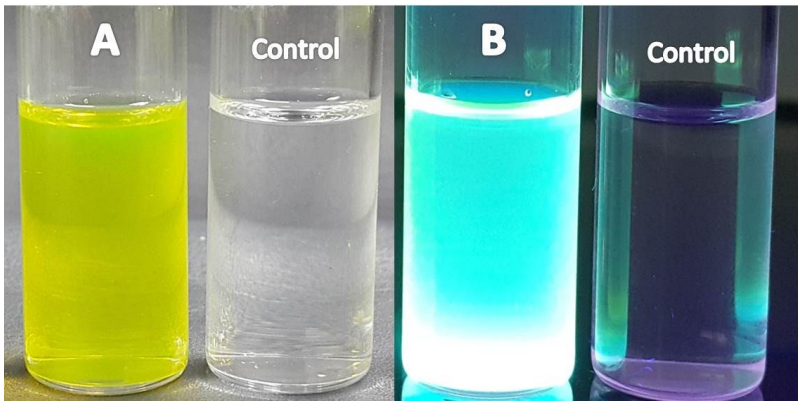

Fig. S1 Synthesis of fluorescent pyoverdine (PVD) siderophore from Arctic strain *Pseudomonas* sp. PAMC 28620. PVD synthesis was induced by depletion of trace metal ions in the growth medium. PVD was extracted from the cell free supernatant (CFS) by using ethanol and visualized under normal light (A) and UV (B) light with water as control.

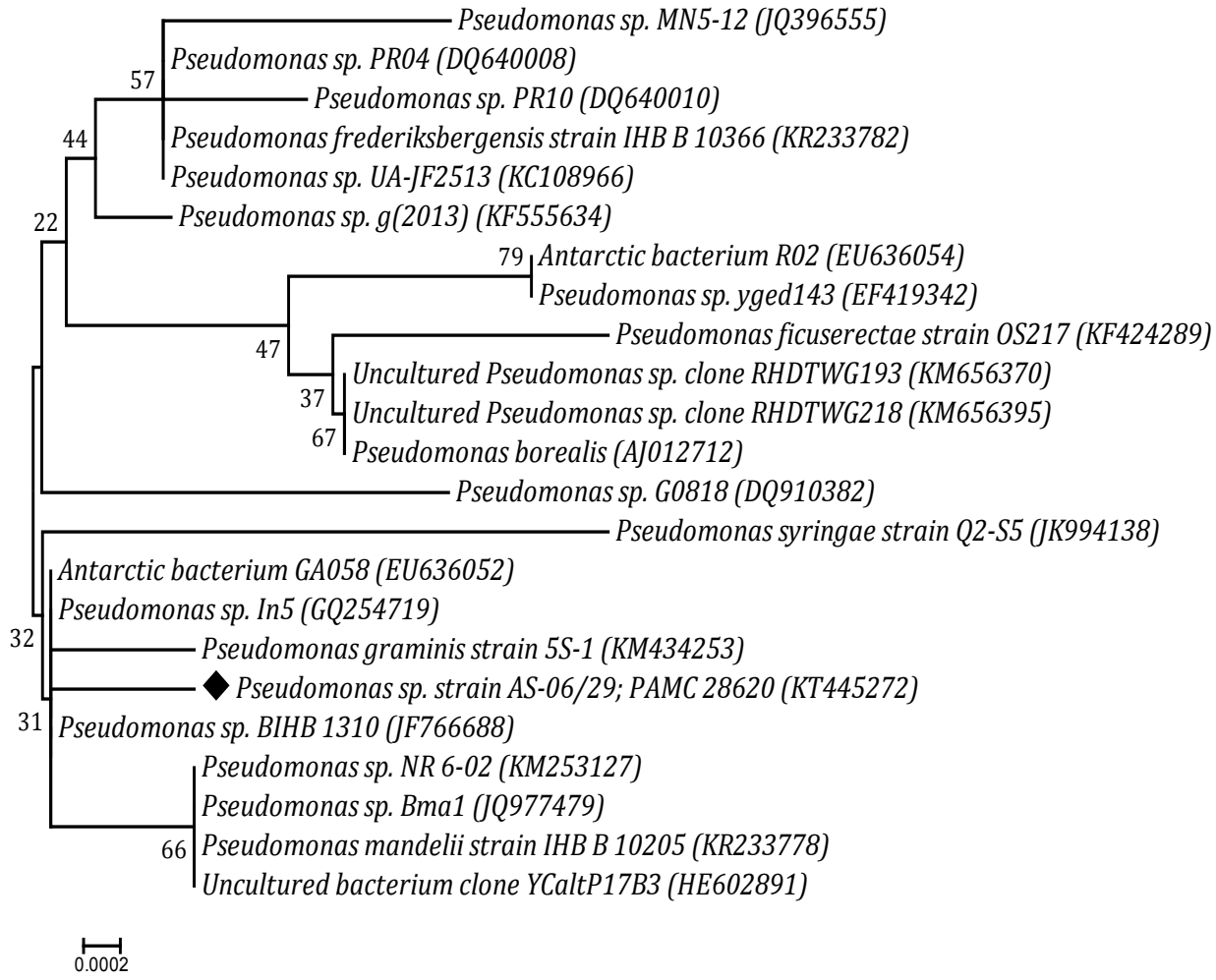

Fig. S2 Neighbor-Joining (NJ) bootstrapping (100) phylogenetic tree of arctic glacier soil bacterium *Pseudomonas* sp. PAMC 28620 and their closest NCBI (BLASTn) strains based on the 16S rRNA gene sequences. Phylogenetic tree was developed based on maximum composite likelihood method using a phylogenetic software MEGA 6.06 version.

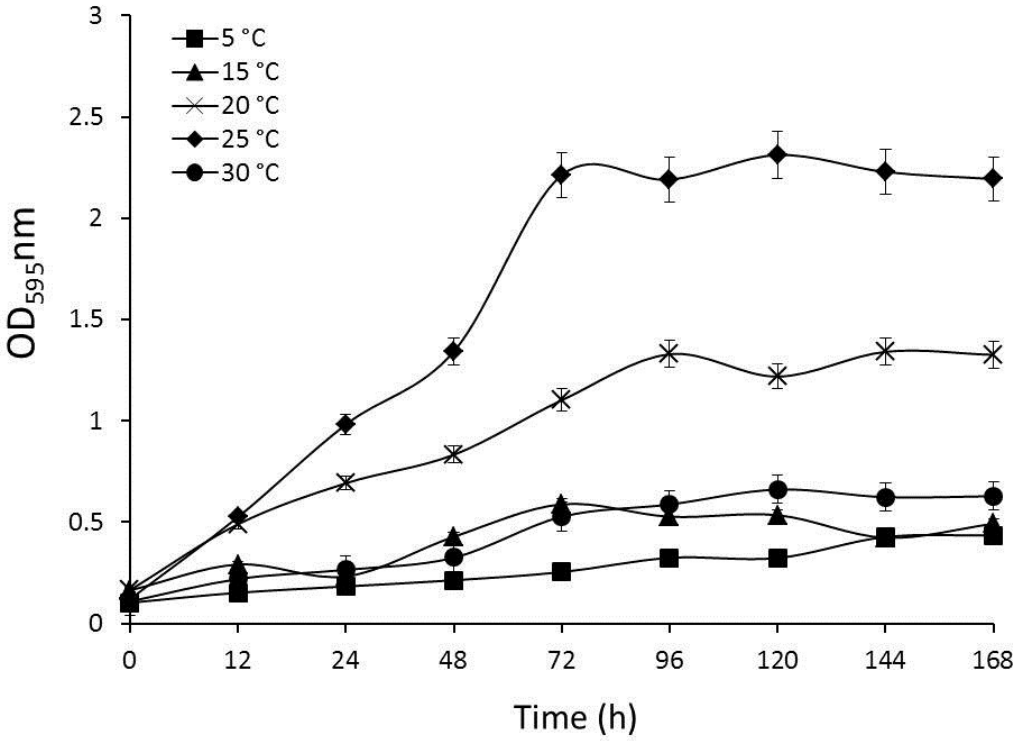

Fig. S3 Effect of temperature on the growth of *Pseudomonas* sp. PAMC 28620. PAMC 28620 was cultivated in a liquid medium (LB) included peptone 10 g L^{-1}, yeast extract 5 g L^{-1} and NaCl 10 g L^{-1} with pH 7.0 ± 0.2. The values shown are mean ± SD from three experimental replicates.

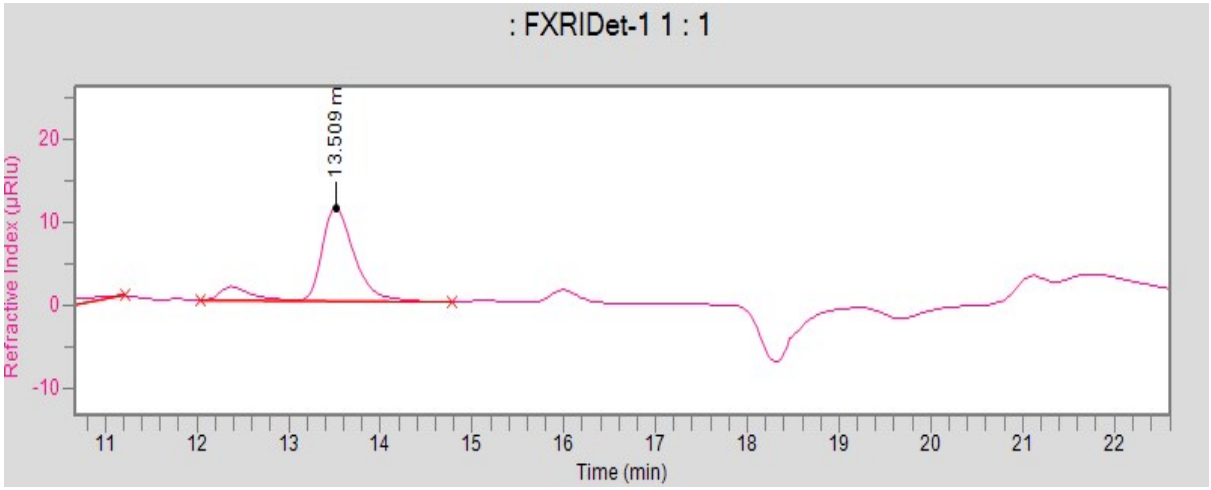

Fig. S4 HPLC chromatogram of EPS from strain *Pseudomonas* sp. PAMC 28620

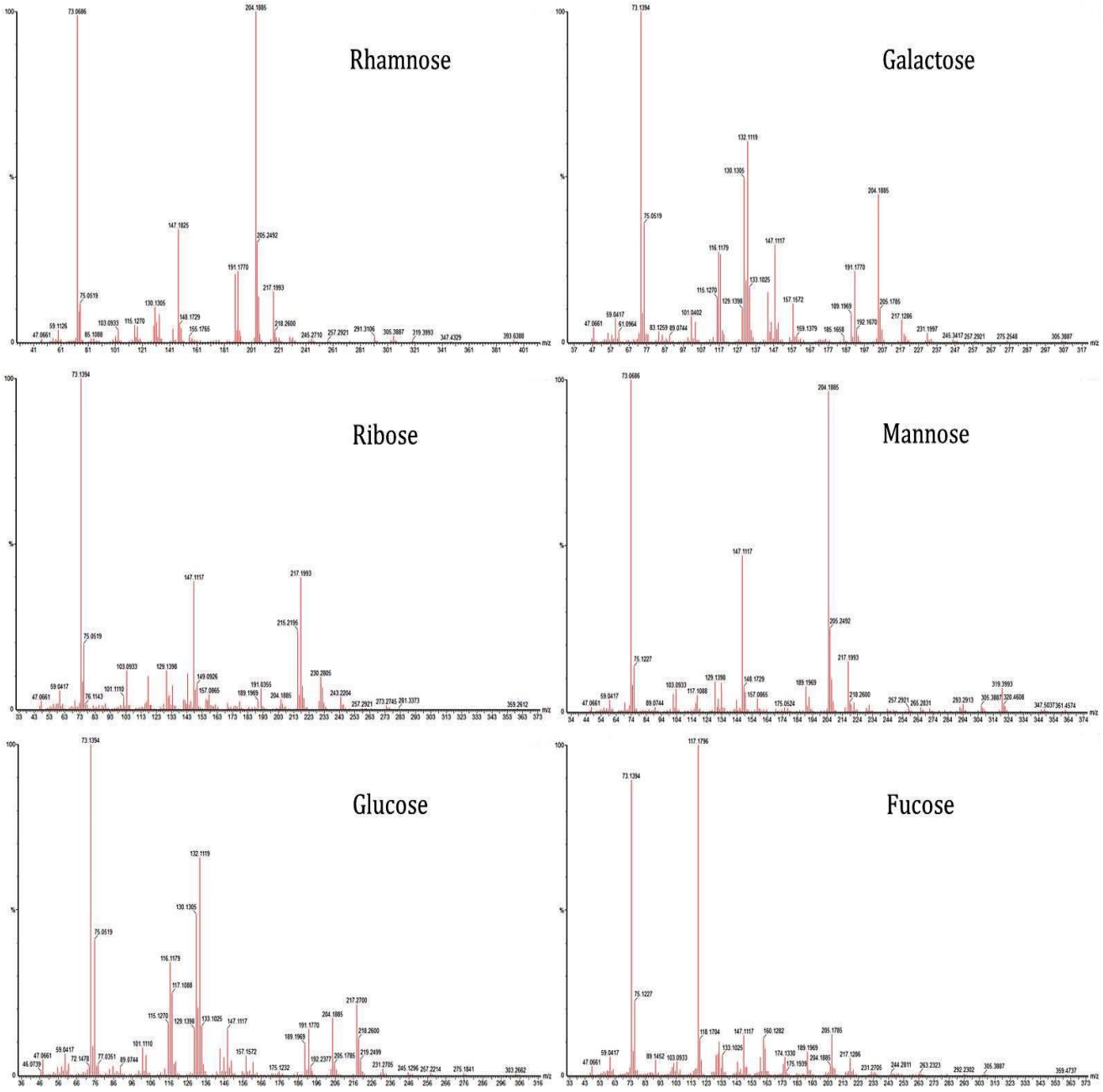

Fig. S5 Mass spectra (MS) of the each monosaccharide unit which present in the EPS obtained from Arctic *Pseudomonas* sp. PAMC 28620.

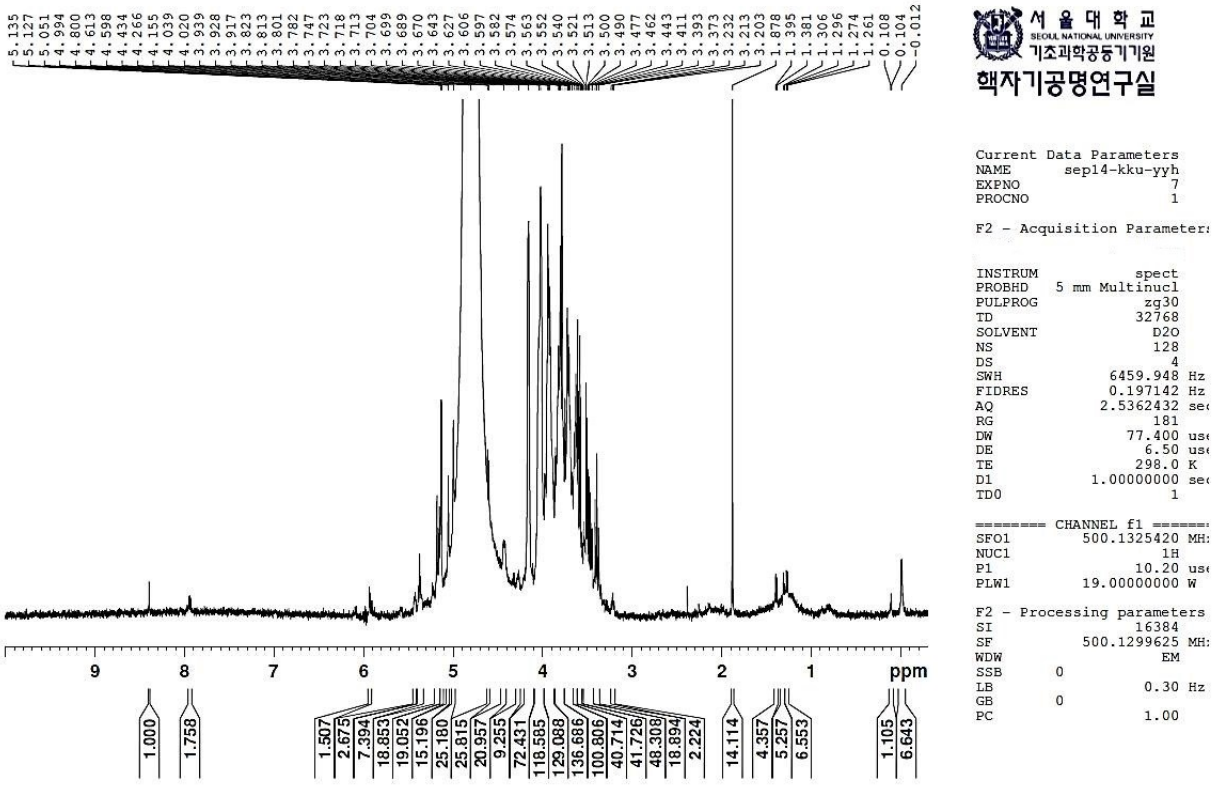

Fig. S6. Proton (^{1}H) NMR (500 MHz) spectrum of EPS obtained from Arctic *Pseudomonas* sp. PAMC 28620..

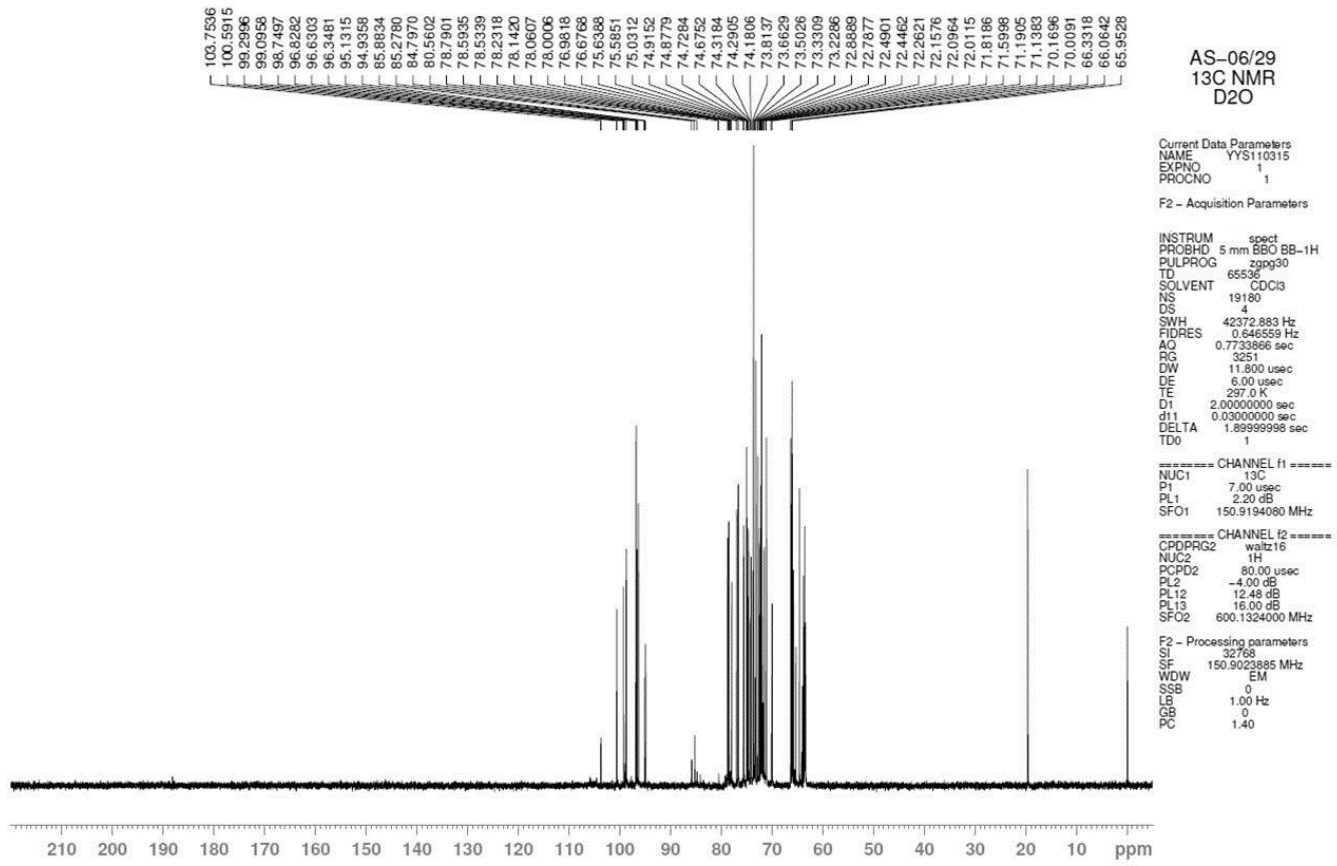

Fig. S7. Full carbon (^{13}C) NMR (150 MHz) spectrum of EPS obtained from Arctic *Pseudomonas* sp. PAMC 28620..

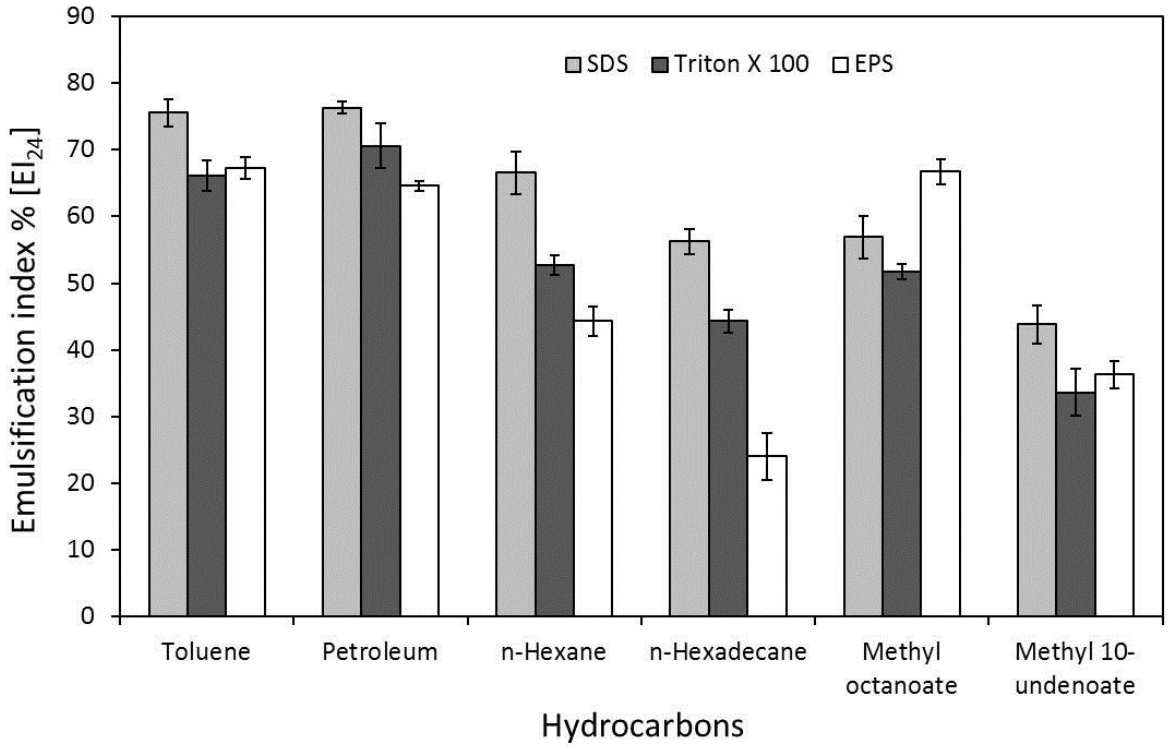

Fig. S8 Emulsification activity of the EPS purified from Arctic *Pseudomonas* sp. PAMC 28620. Emulsification index [EI_{24}] (mean ± SD) after 24 h was calculated with different hydrocarbons.

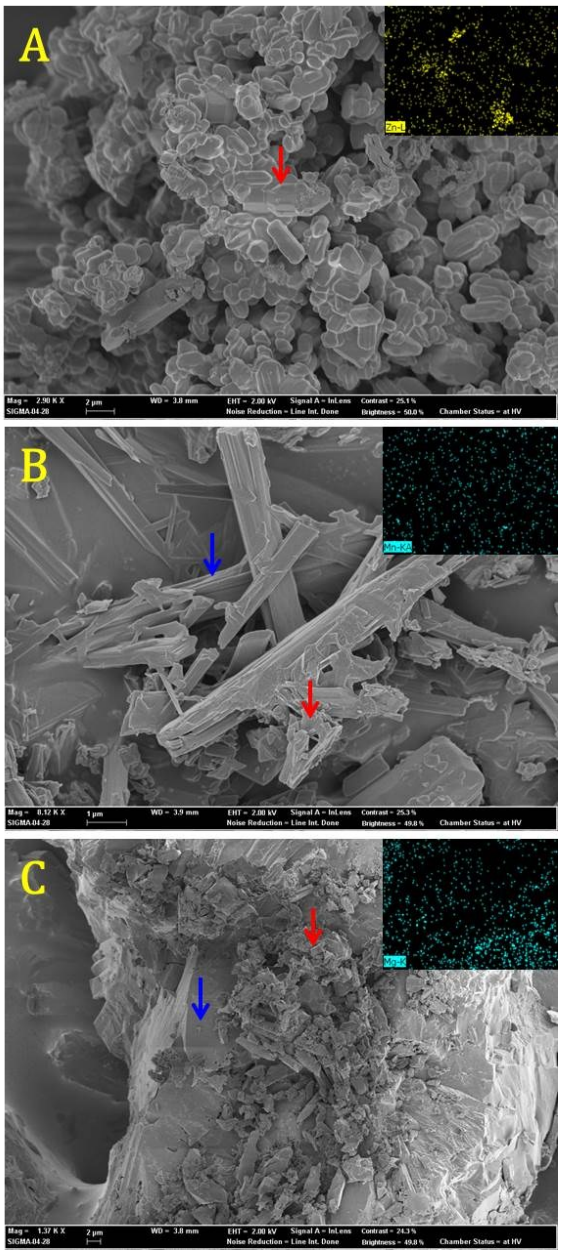

Fig. S9 FE-SEM micrograph of metal complexation and precipitation due to bacterial EPS obtained from Arctic *Pseudomonas* sp. PAMC 28620. (A) EPS with Zn^{2+}, (B) EPS with Mn^{2+}, and (C) EPS with Mg^{2+} ions. Red color arrows indicate the metal complex or aggregates produced by bacterial EPS and the blue color arrows shows the EPS matrix. The EPS and metal ion interacts together and forms metal clumps and precipitated along with EPS. Corresponding EDX chemical maps confirms the presence of metal ion in the EPS-metal complex.