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APPENDICES

Appendix A Media for Microorganisms

1. Carboxymethyl cellulose (CMC) broth medium

Carboxymethyl cellulose (CMC)	1.0	g
Peptone	5.0	g
Yeast extract	1.0	g
K ₂ HPO ₄	4.0	g
MgSO ₄ .7H ₂ O	1.0	g
KCl	0.2	g
FeSO ₄ .7H ₂ O	0.02	g
Distilled water	1000	ml

Dissolve and adjust pH to 7.0

Autoclave at 121°C and pressure at 15 pounds/square inch for 15 minutes

2. Carboxymethyl cellulose (CMC) agar medium

Carboxymethyl cellulose (CMC)	1.0	g
Peptone	5.0	g
Yeast extract	1.0	g
K ₂ HPO ₄	4.0	g
MgSO ₄ .7H ₂ O	1.0	g
KCl	0.2	g
FeSO ₄ .7H ₂ O	0.02	g
Agar	15.0	g
Distilled water	1000	ml

Dissolve and adjust pH to 7.0

Autoclave at 121°C and pressure at 15 pounds/square inch for 15 minutes

3. 65 modified DSMZ broth medium 1

Yeast extract	40.0	mg
Malt extract	100.0	mg

CaCO ₃	2.0	g
Distilled water	1000	ml

Dissolve and adjust pH to 7.2

Autoclave at 121°C and pressure at 15 pounds/square inch for 15 minutes

4. NIH Thioglycollate broth

Approximate formula per liter

Casein	15.0	g
Yeast extract	5.0	g
Dextrose	0.5	g
L-cystine	0.5	g
Sodium chloride	2.5	g
Sodium thioglycollate	0.5	g

Autoclave at 121°C and pressure at 15 pounds/square inch for 15 minutes

5. 65 modified DSMZ broth medium 3

Approximate formula per liter

Carboxymethyl Cellulose (CMC)	5.0	g
Yeast extract	4.0	g
Malt extract	10.0	g

Dissolve and adjust pH to 7.2

Autoclave at 121°C and pressure at 15 pounds/square inch for 15 minutes

6. 65 modified DSMZ agar medium 3

Approximate formula per liter

Carboxymethyl cellulose (CMC)	5.0	g
Yeast extract	4.0	g
Malt extract	10.0	g
Agar	12.0	g

Dissolve and adjust pH to 7.2

Autoclave at 121°C and pressure at 15 pounds/square inch for 15 minutes

7. Tryptic soy broth (TSB)

Approximate formula per liter

Pancreatic digest of casein	17.0	g
Enzymatic digest of soybean meal	3.0	g
Sodium chloride	5.0	g
Dipotassium phosphate	2.5	g
Dextrose	2.5	g

Autoclave at 121°C and pressure at 15 pounds/square inch for 15 minutes

8. Nutrient Broth (NB)

Approximate formula per liter

Beef Extract	3.0	g
Peptone	5.0	g

Autoclave at 121°C and pressure at 15 pounds/square inch for 15 minutes

9. Nutrient Agar (NA)

Approximate formula per liter

Beef Extract	3.0	g
Peptone	5.0	g
Agar	15.0	g

Autoclave at 121°C and pressure at 15 pounds/square inch for 15 minutes

Appendix B Reagent Preparations

1. 0.85 wt/vol % NaCl in 1000 ml

Sodium chloride (NaCl)	8.5	g
Distilled water	1000	ml

2. Hydrochloric acid 1 N in 100 ml

Hydrochloric acid (HCl conc.)	8.29	ml
Distilled water	91.71	ml

3. Sodium hydroxide 1 N in 100 ml

Sodium hydroxide (NaOH)	4.0	g
Distilled water	100	ml

4. Sodium hydroxide 0.1 N in 1000 ml

Sodium hydroxide (NaOH)	4.0	g
Distilled water	1000	ml

5. 0.1 wt/vol % Congo red solution in 1000 ml

Congo red dye	1.0	g
Distilled water	1000	ml

6. Gram's iodine staining solution in 300 ml

Iodine crystal	1.0	g
Potassium iodide (KI)	2.0	g
Distilled water	300.0	ml

Keep in a dark bottle

7. Ammonium oxalate crystal violet solution

Solution A

Crystal violet dye	3.0	g
95 vol % Ethyl alcohol	20.0	ml

Solution B

Ammonium oxalate	0.8	g
Distilled water	50.0	ml

Procedure

Mix solution A and solution B and filtrate before using

8. Safranin solution in 100 ml

Safranin powder	0.25	g
95 vol % Ethyl alcohol	10.0	ml
Distilled water	100.0	ml

Procedure

Dissolve safranin powder in 95 vol % Ethyl alcohol. Add distilled water, mix together and filtrate before using

9. Malachite green solution

Malachite green powder	5.0	g
Distilled water	95.0	ml

10. 3 vol % Hydrogen peroxide (H₂O₂)

Hydrogen peroxide (H ₂ O ₂)	3.0	ml
Distilled water	97.0	ml

11. DNSA reagent in 100 ml

Dinitrosalicylic acid	1.0	g
Potassium tartrate (C ₄ H ₄ K ₂ O ₆ · 4H ₂ O)	30.0	g
2 M Sodium hydroxide (NaOH)	20.0	ml
Distilled water	80.0	ml

Keep in dark bottle

12. 0.5 M Citrate Buffer (pH 4.3)

Citric acid monohydrate (C ₆ H ₈ O ₇ · H ₂ O)	210.0	g
Distilled water	750.0	ml

Sodium hydroxide (NaOH) 50.0 g

Procedure

Add NaOH until pH equals 4.3 (50–60 g)

Keep in cold and dilute 10x before using

13. Lowry A solution in 1000 ml

Disodium carbonate (Na_2CO_3) 20.0 g

Sodium hydroxide (NaOH) 4.0 g

Potassium sodium tartrate tetrahydrate
($\text{C}_4\text{H}_4\text{KNaO}_6 \cdot 4\text{H}_2\text{O}$) 0.268 g

Distilled water 1000.0 ml

Keep in a dark bottle

14. Lowry B solution in 500 ml

Copper sulphate pentahydrate
($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$) 2.5 g

Distilled water 500.0 ml

15. Lowry C solution

Lowry A 50 parts

Lowry B 1 part

Procedure

Mix lowry A and lowry B before using

16. Folin-Ciocalteu's phenol solution

Procedure

Folin-Ciocalteu's phenol reagent 1 part

Distilled water 1 part

17. 2 wt/vol % Carboxymethyl cellulose (CMC) solution in 100 ml

Carboxymethyl cellulose (CMC) powder 2.0 g

50 mM Citrate buffer 100.0 ml

18. 15 mM Cellulobiose solution in 100 ml

Cellulobiose powder	0.513	g
50 mM Citrate buffer	100.0	ml

19. 1 N Trizma-HCl, pH 8.0

Trizma base	121	g
Distilled water	800	ml

Procedure

Dissolve Tris base thoroughly and adjust pH with HCl to pH 8.0. After that the distilled water was added to reach 1000 ml. Autoclave at 121°C and pressure at 15 pounds/square inch for 15 minutes. Keep at room temperature.

20. 0.5 N Ethylenediamine tetraacetic acid (EDTA), pH 8.0

Ethylenediamine tetraacetic acid (EDTA)	86.10	g
Distilled water	800	ml

Procedure

Dissolve EDTA thoroughly and adjust pH with NaOH to pH 8.0. After that the distilled water was added to reach 1000 ml. Autoclave at 121°C and pressure at 15 pounds/square inch for 15 minutes. Keep at 4°C.

21. Trizma-EDTA buffer (TE buffer)

1 N Trizma-HCl, pH 8.0	10	ml
0.5 N EDTA, pH 8.0	2	ml

Procedure

Mix Tris-HCl (pH 8.0) and EDTA (pH 8.0). After that the distilled water was added to reach 1000 ml. Autoclave at 121°C and pressure at 15 pounds/square inch for 15 minutes. Keep at room temperature.

22. Lysozyme

Lysozyme	100	mg
Distilled water	1	ml

Procedure

Dissolve lysozyme in 1 ml distilled water and then mix thoroughly. Sterile by nylon filter membrane. Keep at -20°C.

23. 20 wt/vol % Sodium dodecyl sulfate (SDS)

Sodium dodecyl sulfate (SDS)	0.2	g
Distilled water	1	ml

Procedure

Dissolve SDS in 1 ml distilled water and then mix thoroughly. Autoclave at 121°C and pressure at 15 pounds/square inch for 15 minutes. Keep at room temperature.

24. STEP solution 100 ml

20 wt/vol % SDS	0.25	ml
1 M Tris-HCl pH 8.0	15	ml
0.5 M EDTA pH 8.0	80	ml
20 mg/ml Proteinase K	1.25	ml
Distilled water		

Procedure

Mix all reagents, after that the distilled water was added to reach 100 ml. Then, mix thoroughly and sterile by nylon filter membrane. Keep at -20°C

25. Solution for PCR (Polymerase Chain Reaction) 10 µl

10x Buffer	1	µl
2 mM dNTP mix	1	µl
25 mM MgCl ₂	0.6	µl
Forward primer (20 µM)	0.5	µl
Reverse primer (20 µM)	0.5	µl
Taq DNA polymerase (5U)	0.1	µl
Deionized water	5.3	µl
DNA template	1	µl

Appendix C Standard Calibration Curves

1. Glucose calibration curve

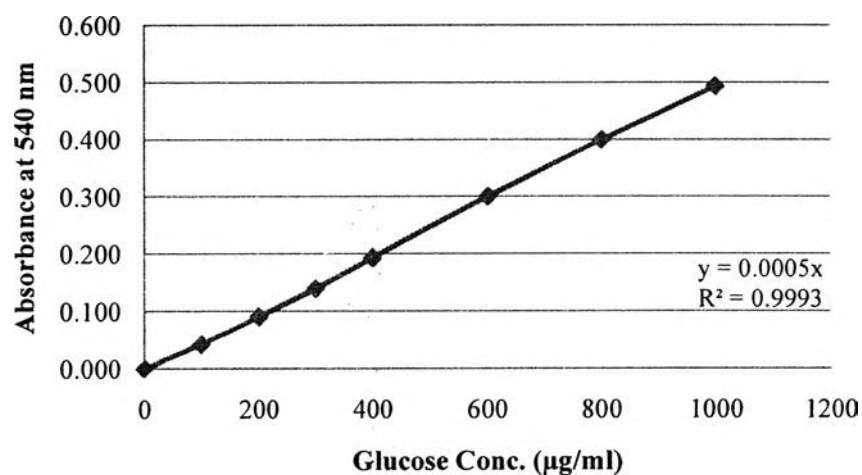


Figure C1 The relationship between glucose concentration ($\mu\text{g/ml}$) and absorbance at 540 nm.

Table C1 Glucose calibration curve

Glucose concentration ($\mu\text{g/ml}$)	Average optical density (nm)
0	0.000
100	0.043
200	0.090
300	0.139
400	0.193
600	0.300
800	0.399
1000	0.493

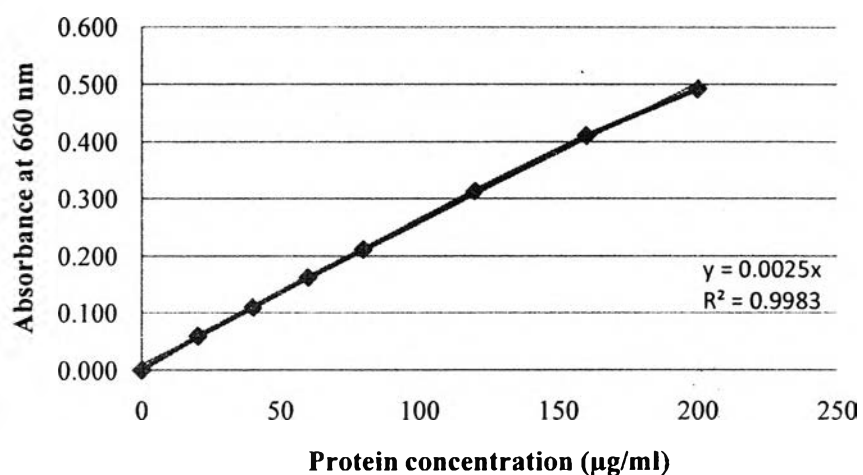


Figure C2 The relationship between protein concentration ($\mu\text{g/ml}$) and absorbance at 660 nm.

Table C2 Protein calibration curve

Protein concentration ($\mu\text{g/ml}$)	Average optical density (nm)
0	0.000
100	0.059
200	0.109
300	0.162
400	0.211
600	0.313
800	0.410
1000	0.492

Appendix D Calculations

1. Hydrolysis capacity (HC) value calculation

$$\text{Hydrolysis capacity (HC) value} = \frac{\text{Average diameter of clear-zone (cm)}}{\text{Average diameter of bacterial colony (cm)}}$$

2. Cellulase enzyme activity calculation

$$\text{Enzymatic activity (U/ml)} = \frac{\text{Absorbance at 540 nm} \times \text{Df} \times \text{Reaction mixture (ml)}}{30 \text{ min} \times \text{Slope of standard glucose calibration curve (ml/}\mu\text{g)} \times \text{Molecular weight of glucose (g/mol)} \times \text{Volume of enzyme (ml)}}$$

where:

Df = dilution factor

Slope of standard glucose calibration curve = 0.0005 ml/ μ g

Molecular weight of glucose = 180.16 g/mol

3. Protein concentration calculation

$$\text{Protein concentration (mg/ml)} = \frac{\text{Absorbance at 660 nm} \times \text{Df}}{\text{Slope of standard protein} \times 1000 \text{ calibration curve (ml/}\mu\text{g)}}$$

where:

Df = dilution factor

Slope of standard protein calibration curve = 0.0025 ml/ μ g

4. Specific enzyme activity calculation

$$\text{Specific enzyme activity (U/ mg protein)} = \frac{\text{Enzymatic activity (U/ml)}}{\text{Protein concentration (mg/ml)}}$$

5. Specific growth rate calculation

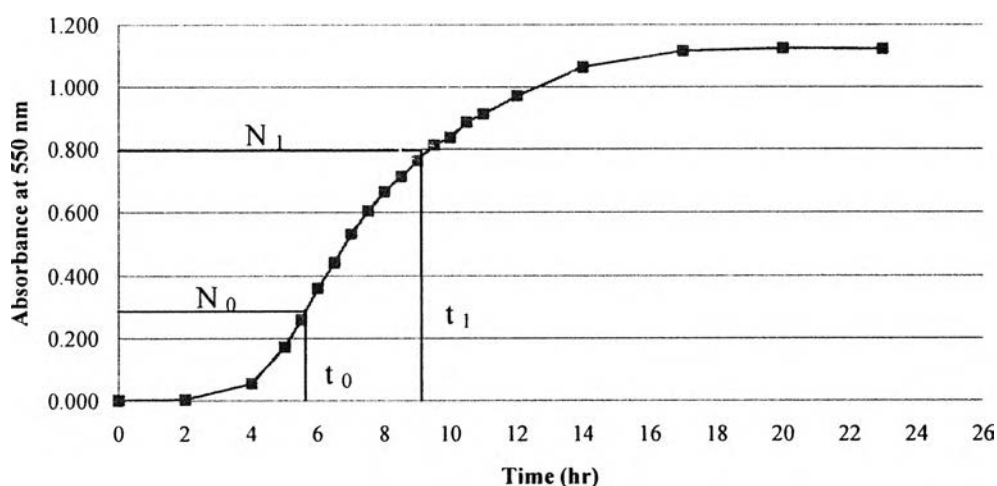


Figure D1 Growth curve of strain F 018 in the presence of 0.1 %(v/v) [BMIM]Cl.

$$\text{Specific growth rate } (\mu, \text{ hr}^{-1}) = \frac{\text{Ln } (N_1/N_0)}{t_1 - t_0}$$

Appendix E Experiment Data of Cellulose-Degrading Bacteria

Table E1 Average diameter of bacterial colony and clear-zone of isolates from aerobic condition

No. of isolate	Average diameter of colony (cm)	Average diameter of colony (cm)
A 001	0.48	No clear-zone
A 002	0.58	1.58
A 003	0.50	No clear-zone
A 004	0.53	No clear-zone
A 005	0.70	1.2
A 006	0.50	No clear-zone
A 007	1.60	1.98
A 008	0.63	No clear-zone
A 009	0.53	1.25
A 010	0.68	No clear-zone
A 011	2.45	3.13
A 012	0.58	1.45
A 013	0.98	1.55

* The values in the table are average from 4 replications.

Table E2 Average diameter of bacterial colony and clear-zone of isolates from 2 steps anaerobic condition

No. of isolate	Average diameter of colony (cm)	Average diameter of colony (cm)
M 001	0.65	1.60
M 002	0.73	1.73
M 003	1.40	2.45
M 004	1.40	2.50
M 005	2.38	3.03
M 006	0.73	1.50
M 007	0.63	1.45
M 008	0.73	1.68
M 009	0.48	No clearzone
M 010	0.55	1.60
M 011	1.35	2.40
M 012	1.00	1.60
M 013	1.35	2.40
M 014	1.23	2.23
M 015	0.60	2.20
M 016	0.70	1.50
M 017	0.63	2.20
M 018	0.71	1.80
M 019	0.85	2.10
M 020	1.33	2.20

* The values in the table are average from 4 replications.

Table E3 Average diameter of bacterial colony and clear-zone of isolates from aerobic with anaerobic pretreatment step condition

No. of isolate	Average diameter of colony (cm)	Average diameter of colony (cm)
F 001	0.85	2.00
F 002	1.55	2.40
F 003	0.95	1.95
F 004	0.86	1.60
F 005	0.90	1.60
F 006	0.78	1.70
F 007	1.45	2.08
F 008	0.85	1.80
F 009	0.83	2.00
F 010	0.79	No clear-zone
F 011	0.80	No clear-zone
F 012	0.90	1.70
F 013	0.70	1.40
F 014	0.68	No clear-zone
F 015	0.81	1.93
F 016	0.63	1.50
F 017	0.68	1.70
F 018	0.75	1.90
F 019	1.30	1.95
F 020	0.81	1.70
F 021	1.20	2.18
F 022	0.80	1.80
F 023	0.80	2.00
F 024	1.60	1.60

* The values in the table are average from 4 replications.

Table E4 Specific cellulase enzyme activities and protein concentrations at 37°C of isolate strain A 002

Specific activity (U/mg protein)	37°C						
	4 hr	8 hr	10 hr	12 hr	16 hr	20 hr	24 hr
Endoglucanase	0.594	0.666	0.814	0.806	0.755	0.656	0.566
Exoglucanase	0.522	0.537	0.626	0.607	0.544	0.500	0.415
β-glucosidase	0.504	0.484	0.620	0.610	0.553	0.481	0.422

Table E5 Specific cellulase enzyme activities and protein concentrations at 40°C of isolate strain A 002

Specific activity (U/mg protein)	40°C						
	4 hr	8 hr	10 hr	12 hr	16 hr	20 hr	24 hr
Endoglucanase	0.432	0.539	0.598	0.595	0.573	0.488	0.394
Exoglucanase	0.419	0.510	0.517	0.529	0.463	0.431	0.350
β-glucosidase	0.492	0.555	0.541	0.528	0.475	0.435	0.385

Table E6 Specific cellulase enzyme activities and protein concentrations at 45°C of isolate strain A 002

Specific activity (U/mg protein)	45°C						
	4 hr	8 hr	10 hr	12 hr	16 hr	20 hr	24 hr
Endoglucanase	0.555	0.625	0.609	0.597	0.571	0.491	0.439
Exoglucanase	0.380	0.481	0.497	0.481	0.413	0.361	0.313
β -glucosidase	0.455	0.514	0.523	0.485	0.445	0.389	0.330

Table E7 Specific cellulase enzyme activities and protein concentrations at 50°C of isolate strain A 002

Specific activity (U/mg protein)	50°C						
	4 hr	8 hr	10 hr	12 hr	16 hr	20 hr	24 hr
Endoglucanase	0.477	0.598	0.571	0.521	0.501	0.487	0.475
Exoglucanase	0.421	0.426	0.445	0.422	0.384	0.353	0.354
β -glucosidase	0.385	0.405	0.421	0.415	0.362	0.347	0.339

Table E8 Specific cellulase enzyme activities and protein concentrations at 37°C of isolate strain M 015

Specific activity (U/mg protein)	37°C						
	4 hr	8 hr	10 hr	12 hr	16 hr	20 hr	24 hr
Endoglucanase	0.580	0.571	0.811	0.984	1.098	1.067	0.912
Exoglucanase	0.504	0.453	0.532	0.528	0.483	0.420	0.319
β-glucosidase	0.516	0.438	0.504	0.487	0.459	0.386	0.312

Table E9 Specific cellulase enzyme activities and protein concentrations at 40°C of isolate strain M 015

Specific activity (U/mg protein)	40°C						
	4 hr	8 hr	10 hr	12 hr	16 hr	20 hr	24 hr
Endoglucanase	0.447	0.511	0.545	0.570	0.581	0.573	0.518
Exoglucanase	0.414	0.458	0.457	0.448	0.428	0.366	0.286
β-glucosidase	0.449	0.478	0.479	0.471	0.458	0.351	0.276

Table E10 Specific cellulase enzyme activities and protein concentrations at 45°C of isolate strain M 015

Specific activity (U/mg protein)	45°C						
	4 hr	8 hr	10 hr	12 hr	16 hr	20 hr	24 hr
Endoglucanase	0.502	0.551	0.566	0.577	0.547	0.455	0.396
Exoglucanase	0.417	0.434	0.454	0.398	0.351	0.286	0.241
β -glucosidase	0.422	0.454	0.475	0.466	0.384	0.284	0.239

Table E11 Specific cellulase enzyme activities and protein concentrations at 50°C of isolate strain M 015

Specific activity (U/mg protein)	50°C						
	4 hr	8 hr	10 hr	12 hr	16 hr	20 hr	24 hr
Endoglucanase	0.642	0.608	0.536	0.485	0.434	0.370	0.332
Exoglucanase	0.457	0.405	0.356	0.297	0.272	0.210	0.184
β -glucosidase	0.423	0.412	0.353	0.310	0.279	0.242	0.199

Table E12 Specific cellulase enzyme activities and protein concentrations at 37°C of isolate strain F 018

Specific activity (U/mg protein)	37°C						
	4 hr	8 hr	10 hr	12 hr	16 hr	20 hr	24 hr
Endoglucanase	0.615	0.603	0.805	0.819	0.897	0.900	0.776
Exoglucanase	0.552	0.523	0.684	0.669	0.609	0.602	0.502
β-glucosidase	0.514	0.497	0.655	0.673	0.638	0.616	0.515

Table E13 Specific cellulase enzyme activities and protein concentrations at 40°C of isolate strain F 018

Specific activity (U/mg protein)	40°C						
	4 hr	8 hr	10 hr	12 hr	16 hr	20 hr	24 hr
Endoglucanase	0.463	0.522	0.572	0.579	0.582	0.522	0.454
Exoglucanase	0.476	0.546	0.557	0.533	0.505	0.395	0.345
β-glucosidase	0.471	0.576	0.606	0.520	0.488	0.423	0.355

Table E14 Specific cellulase enzyme activities and protein concentrations at 45°C of isolate strain F 018

Specific activity (U/mg protein)	45°C						
	4 hr	8 hr	10 hr	12 hr	16 hr	20 hr	24 hr
Endoglucanase	0.508	0.529	0.525	0.551	0.538	0.498	0.396
Exoglucanase	0.452	0.464	0.485	0.501	0.463	0.430	0.372
β-glucosidase	0.479	0.525	0.540	0.533	0.474	0.450	0.402

Table E15 Specific cellulase enzyme activities and protein concentrations at 50°C of isolate strain F 018

Specific activity (U/mg protein)	50°C						
	4 hr	8 hr	10 hr	12 hr	16 hr	20 hr	24 hr
Endoglucanase	0.538	0.561	0.583	0.639	0.658	0.620	0.580
Exoglucanase	0.413	0.437	0.486	0.493	0.494	0.483	0.461
β-glucosidase	0.423	0.440	0.452	0.460	0.473	0.449	0.405

Table E16 Average growth curve of isolate strain A 002 in various concentrations of [BMIM]Cl

Time (hr)	Average growth curve of strain A 002 in the presence of [BMIM]Cl					
	0 %(v/v)	0.1 %(v/v)	0.5 %(v/v)	1.0 %(v/v)	5.0 %(v/v)	10.0 %(v/v)
0	0.002	0.002	0.002	0.003	0.004	0.005
2	0.006	0.005	0.003	0.004	0.005	0.008
3	0.037	0.027	0.005	0.005	0.006	0.008
4	0.265	0.170	0.003	0.003	0.005	0.007
4.5	0.448	0.327	0.001	0.001	0.001	0.002
5	0.575	0.493	0.004	0.003	0.004	0.006
5.5	0.627	0.581	0.008	0.003	0.005	0.007
6	0.675	0.638	0.013	0.007	0.003	0.003
6.5	0.705	0.676	0.037	0.004	0.010	0.007
7	0.737	0.712	0.093	0.002	0.002	0.004
7.5	0.782	0.757	0.224	0.003	0.005	0.003
8	0.825	0.801	0.405	0.001	0.001	0.002
8.5	0.865	0.844	0.539	0.002	0.002	0.003
9	0.908	0.887	0.590	0.002	0.004	0.005
9.5	0.973	0.951	0.673	0.008	0.004	0.004
10	1.005	0.988	0.711	0.004	0.006	0.006
11	1.059	1.040	0.793	0.008	0.005	0.004
13	1.128	1.084	0.949	0.043	0.005	0.009
15	1.127	1.010	1.010	0.361	0.004	0.006
17	1.133	0.996	1.114	0.466	0.004	0.006
19	1.155	1.028	1.019	0.707	0.003	0.003
21	1.199	1.102	0.997	0.902	0.004	0.005
23	1.259	1.154	1.103	1.041	0.005	0.005
24	1.276	1.173	1.138	1.125	0.006	0.008

* The values in the table are average from 3 replications.

Table E17 Average growth curve of isolate strain M 015 in various concentrations of [BMIM]Cl

Time (hr)	Average growth curve of strain M 015 in the presence of [BMIM]Cl					
	0 %(v/v)	0.1 %(v/v)	0.5 %(v/v)	1.0 %(v/v)	5.0 %(v/v)	10.0 %(v/v)
0	0.004	0.004	0.001	0.000	0.004	0.006
2	0.048	0.043	0.012	0.008	0.000	0.000
4	0.452	0.462	0.278	0.165	0.000	0.000
4.5	0.511	0.532	0.394	0.243	0.000	0.000
5	0.574	0.597	0.478	0.382	0.007	0.009
5.5	0.615	0.659	0.560	0.461	0.008	0.011
6	0.677	0.722	0.625	0.535	0.003	0.006
6.5	0.726	0.778	0.671	0.602	0.002	0.002
7	0.781	0.837	0.754	0.670	0.007	0.006
8	0.860	0.925	0.834	0.768	0.001	0.000
8.5	0.913	0.993	0.899	0.844	0.005	0.006
9	0.952	1.029	0.932	0.891	0.002	0.001
10	0.997	1.075	0.978	0.941	0.003	0.001
11.5	1.119	1.201	1.105	1.070	0.003	0.003
12.5	1.188	1.267	1.176	1.138	0.002	0.003
14	1.260	1.339	1.246	1.212	0.002	0.001
17	1.422	1.493	1.407	1.362	0.001	0.002
20	1.536	1.589	1.520	1.465	0.002	0.000
24	1.602	1.627	1.591	1.534	0.001	0.002

* The values in the table are average from 3 replications.

Table E18 Average growth curve of isolate strain F 018 in various concentrations of [BMIM]Cl

Time (hr)	Average growth curve of strain F 018 in the presence of [BMIM]Cl					
	0 %(v/v)	0.1 %(v/v)	0.5 %(v/v)	1.0 %(v/v)	5.0 %(v/v)	10.0 %(v/v)
0	0.000	0.001	0.000	0.000	0.001	0.000
2	0.002	0.004	0.001	0.003	0.021	0.010
4	0.081	0.055	0.055	0.033	0.002	0.002
5	0.238	0.173	0.179	0.107	0.005	0.005
5.5	0.341	0.260	0.273	0.165	0.002	0.002
6	0.428	0.361	0.384	0.241	0.003	0.001
6.5	0.482	0.441	0.449	0.304	0.003	0.002
7	0.572	0.531	0.548	0.391	0.002	0.001
7.5	0.658	0.605	0.628	0.482	0.002	0.000
8	0.714	0.665	0.696	0.545	0.002	0.001
8.5	0.755	0.713	0.748	0.597	0.001	0.001
9	0.805	0.764	0.799	0.654	0.001	0.000
9.5	0.846	0.814	0.848	0.709	0.001	0.001
10	0.872	0.837	0.873	0.738	0.000	0.002
10.5	0.921	0.887	0.919	0.791	0.001	0.000
11	0.946	0.913	0.950	0.817	0.004	0.002
12	1.002	0.971	1.010	0.880	0.001	0.001
14	1.090	1.064	1.073	0.980	0.004	0.002
17	1.153	1.116	1.099	1.049	0.002	0.002
20	1.191	1.125	1.151	1.100	0.002	0.003
23	1.204	1.123	1.194	1.100	0.002	0.001
24	1.223	1.140	1.209	1.108	0.002	0.004

* The values in the table are average from 3 replications.

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Proceeding:

1. Taechoempol, K.; Rangsunvigit, P.; Chavadej, S., Sreethawong, T., and Rengpipat., S. (2009, April 22) Isolation of Cellulose-Degrading Bacteria from Termites *Microcerotermes* sp. Proceeding of The 15th PPC Symposium on Petroleum, Petrochemicals, and Polymers, Bangkok, Thailand.

