Effect of bacterial cellulose from cultivated banana on PLA properties

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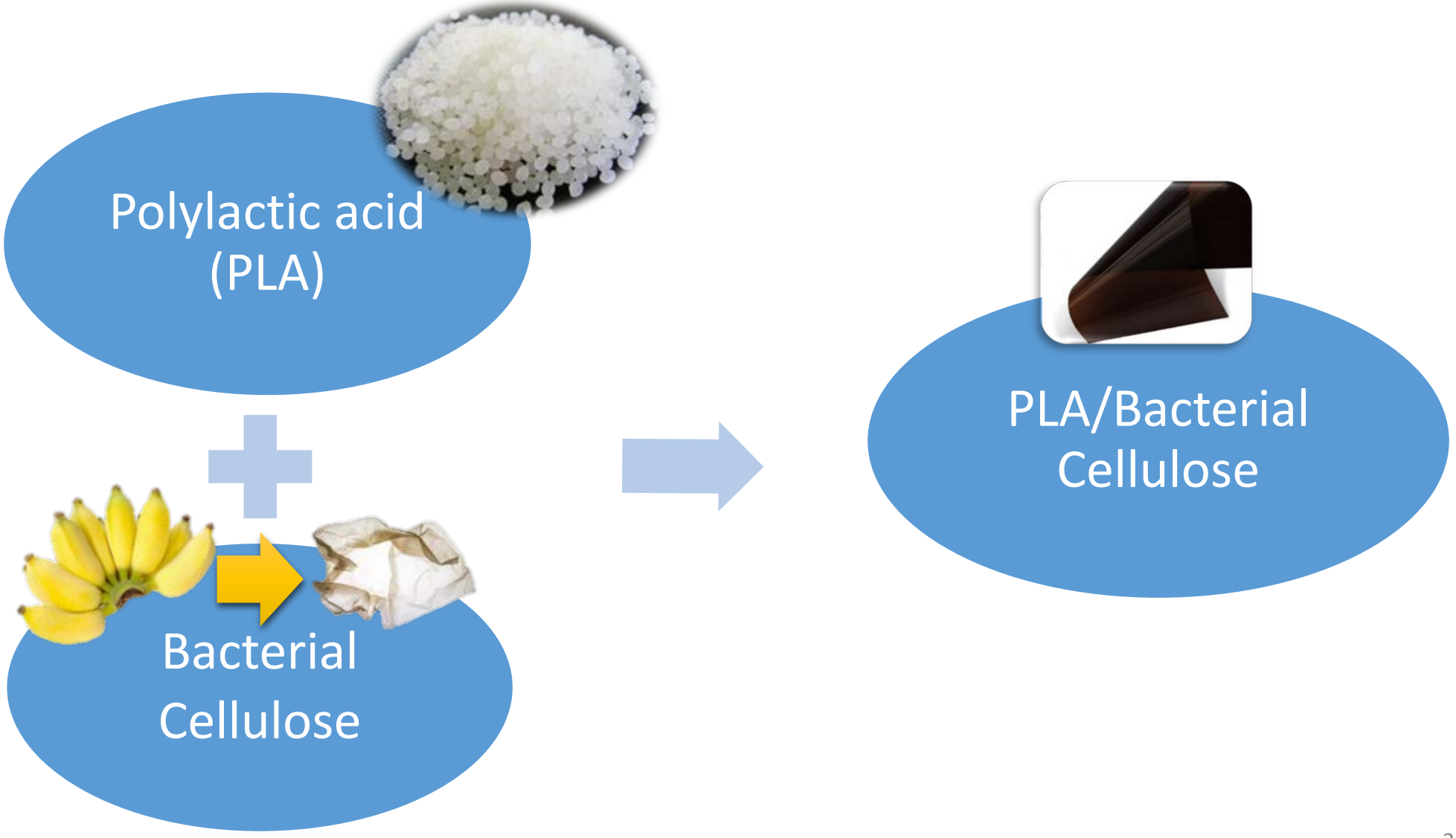
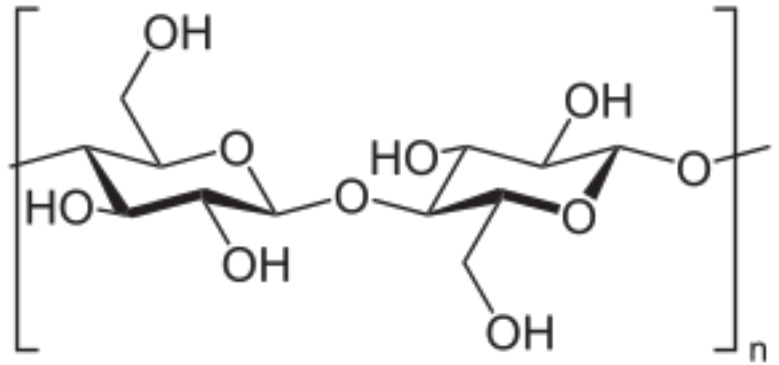
Introduction



What’s Bacterial cellulose?

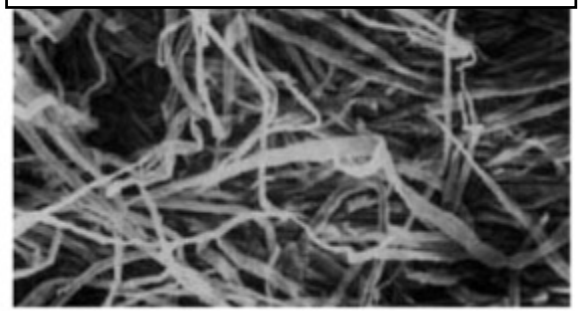
Bacterial cellulose is an organic compound with the formula $(C_6H_{10}O_5)_n$ produced by certain types of bacteria. While cellulose is a basic structural material of most plants, it is also produced by bacteria, principally of the genera *Acetobacter*, *Sarcina ventriculi* and *Agrobacterium*. Bacterial, or microbial, cellulose has different properties from plant cellulose and is characterized by high purity, strength, moldability and increased water holding ability.



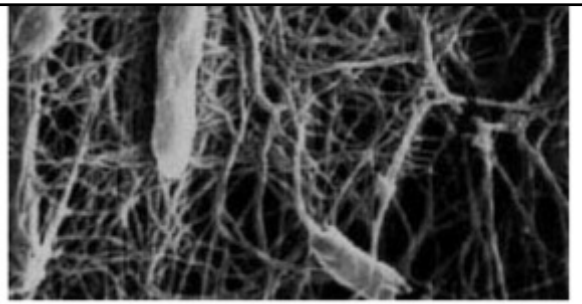
Properties of bacterial cellulose

- Cellulose is the main component of plant cell walls. Some bacteria produce cellulose (celled biocellulose or bacterial cellulose).
- Plant cellulose and bacterial cellulose (BC) have the same chemical structure, but different physical and chemical properties.
- BC is produced by culturing a strain of *Acetobacter xylinum*
- High water capacity, high crystallinity, ultrafine fibre networks with a diameter of 20–100 nm, high purity (which is distinguished from plant cellulose), and high tensile strength

Cellulose from plant

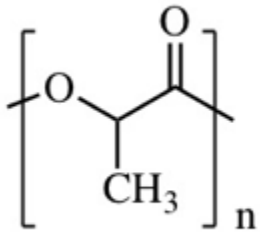


Cellulose from bacteria



Properties of Polylactic acid (PLA)

Typical Resin Properties	Value	Standard Method
Melting Temperature (℃)	145	-
Density (g/cm^3)	1.26	ASTM D1505
Tensile Strength at Yield (kgf/cm^2)	300.3	ASTM D638
Elongation Ratio at Yield (%)	11.2	ASTM D638
Yield Strength (kgf/cm^2)	396.5	ASTM D638
Izod Impact Strength (J/m)	40.2	ASTM D256
HDT (load 66 psi) (℃)	73.6	ASTM D648
MFR.190 C.2.16 kg. (g/10min)	8.51	ASTM D1238
Hardness, Shore D (D)	89	ASTM D2240
Color	White	-
Mold Shrinkage Ratio (%)	0.246	ASTM D955



from : Properties of Polylactic acid(GP 330-1) (Bio Green World Co.,Ltd.)

Cultivated banana

- Cultivates banana is widely popular in Thailand. It’s Cheap and Planted widely in all regions of the country.
- banana ripens the starch turns into several types of sugar (sucrose, fructose and glucose) and fructans appear to increase. Reactions to fully ripe banana has often been attributed to fructose. However, a fully ripe banana (yellow with some brown spots) is 14 % fructose, 20 percent glucose, and 66 percent sucrose

Objective

Characterization of bacterial cellulose reinforced by addition Polylactic acid (PLA)

Experimental method

Glucose 20 g, yeast extract 5 g, peptone 5 g and Dipotassium hydrogen phosphate (K_2HPO_4) 2.7 g in distilled water for 1 liter

Preparation of leavening agent

Adjustment pH to 4.2 by Acetic acid

Adding A. xylinum for 10%

Leave at room temperature for 3 days.

Preparation of bacterial cellulose

Preparation ripe banana 30 g in Distilled water for 200 ml

Blended thoroughly

Filter with a Straining cloth

Boil at 100°C.
For 10 minutes.

pour on a petri dish and adding A.xylinum 10%

Fermentation at room temperature for 10 - 14 days

drying at 60°C for 3 day

Praparation of PLA solution

25 g

PLA

225 g

1,4-dioxane

Stir at room temperature

Preparation of Bacterial cellulose

With different weight

BC1 1 g

BC2 2 g

BC3 3 g

BC4 4 g

The process of polymer composite

Preparation of PLA solution

BC

20 g

PLA solution

Covered with aluminum foil. Leave it at room temperature for 24 hours.

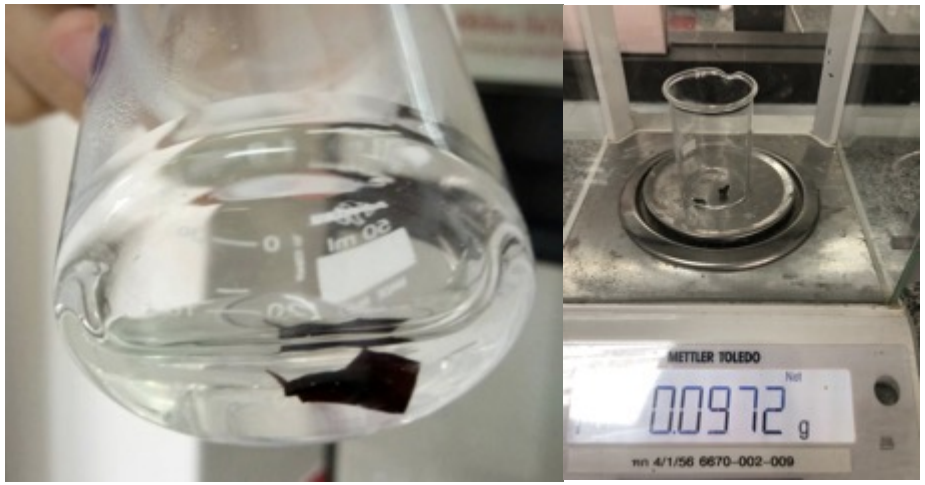
BC-PLA Solution

5 g

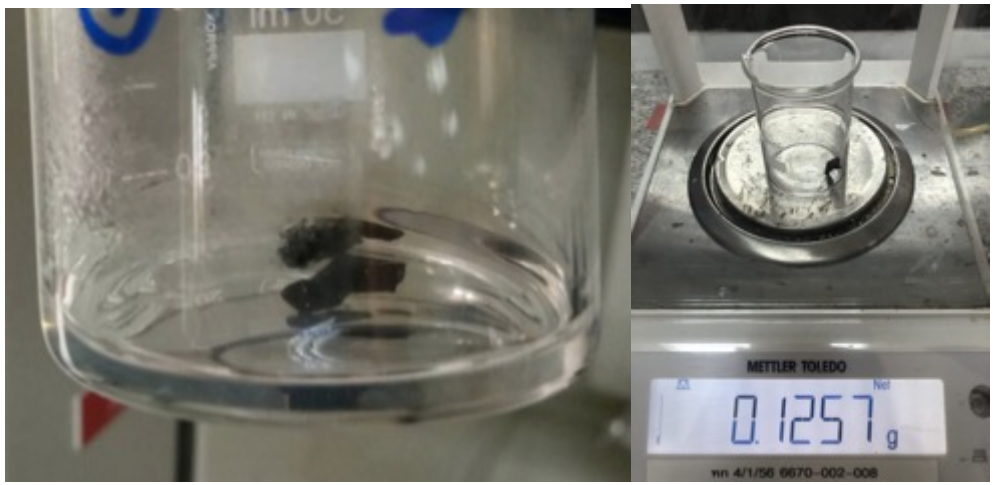
3-repeat each sample left at room temperature 24 hours.

drying at 50°C under vacuum (100 mbar) for 12 hrs

Result



BC-1,4-dioxane



BC-PLA-1,4-dioxane

Dissolution Testing			
BC	1,4 dioxane	PLA 10 %. In 1,4 dioxane	Weight of BC after soaking
0.1151	5 ml	-	0.0972g
0.1070	-	5 ml	0.1257g

Conclusion

The effect of BC incorporation on mechanical properties, wettability, and water absorption behavior of PLA was analyzed. It is found that the pore structure PLA is improved by adding BC into PLA that adding BC into PLA can significantly improve the mechanical properties, wettability, and water absorption behavior of PLA

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THANK YOU