

Placid Hills Farm Seeks to Make Bioplastic from Horse Manure



Challenge

Placid Hills wanted to understand the feasibility of producing PHB, a bio-derived polymer, from horse biowaste products.

Solution

- NYSP2I partnered with CALS to conduct a two-phase evaluation of the horse biowastes
- Biowaste samples were characterized to evaluate suitability as inducers for bacterial growth
- Ecoli cells were modified to produce PHB by inserting bioengineered genetic instructions
- The optimized biowaste broths were used to induce growth of E-coli, producing PHB

Results

Producing PHB using horse biowaste as an inducer was shown to be feasible

Placid Hills Farm

Placid Hills is a commercial horse farm located in Brunswick, NY. The farm has 45 stalls containing a mixture of horse manure, pine shavings, and urine (i.e. horse manure mixture). The farm contains a 30 ton, in-vessel composting system, which produces a compost/mulch product from the manure mixture (i.e. composted horse manure mixture). This product is spread on Placid Hill's 100+ acres of hay fields, eliminating the need to use chemical fertilizers.

Challenge

Placid Hills wanted to understand the feasibility of producing PHB from horse biowaste products. Polyhydroxy Butyrate (PHB) is a bio-derived polymer that can be used to produce biodegradable water bottles, bottle caps, or other plastic products through blow molding and/or injection molding. The process requires that cultured cells be induced by a carbon source substrate. In most lab scale systems, sugars cells such as glucose, arabinose, and Isopropyl β -d-1-thiogalactopyranoside

"It was exciting to see the value and opportunities of organic properties integrated with technology to advance environmental solutions. The collaboration with the teams at NYSP2I, RIT, and Cornell was a great experience and one of true ingenuity, passion, and professionalism."

Joseph Sessa, Owner, Placid Hills Farm

(IPTG) are used. However, other alternatives, such as whey, molasses, waste lipids, and agricultural residues, have also been used successfully. This project sought to understand if a horse manure mixture or a composted horse manure mixture can be used as another alternative.

Solution

The New York State Pollution Prevention Institute (NYSP2I) partnered with Cornell University's College of Agriculture and Life Sciences (CALs) to conduct a two-phase evaluation of the horse bio-waste mixtures. In Phase 1 of the project, samples of the horse biowastes were first taken by Placid Hills, delivered to CALs for evaluation, and prepared for analysis by chemical and thermal treatment to increase homogeneity. The horse manure mixture was analyzed first. The manure sample was first characterized using near-infrared (NIR) spectroscopy and other characterization techniques to assess its suitability as an inducer for bacterial (E-coli) growth. This initial investigation



showed acceptable suitability, so the manure was next tested as an inducer for E-coli growth. To do this, detoxified horse manure hydrolysate (D-HMH) was first prepared and then used to create LB broths with varied concentrations of D-HMH. Bacterial growth in the broths was monitored to determine the optimal concentration of D-HMH for maximum bacterial growth. In Phase 2 of the project, CALs tested the feasibility of modifying E-coli DNA to allow it to produce PHB. Snapgene® software was used to design the plasmid harboring PHB codon, which was ordered and delivered to CALs and transferred into an E-coli cell using the heat-shock method. The remainder of Phase 2 focused on optimizing the process, with specific goals of increasing the yield of bacterial growth, increasing the molecular weight of the polymer, and increasing the speed of the bacterial growth.

Results

The results showed that it is feasible to produce PHB from horse manure using horse manure hydrolysates (HMH) as the sole carbon source for the bacterial production of PHB. The next steps may include further work to determine the scalability of the process. In general, two other steps must be taken for large-scale production of bioplastics using horse manure hydrolysate including pilot plant production and scaled-up production.



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Partners



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