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Development of Soymeal-Based Baling Twine with High Digestibility

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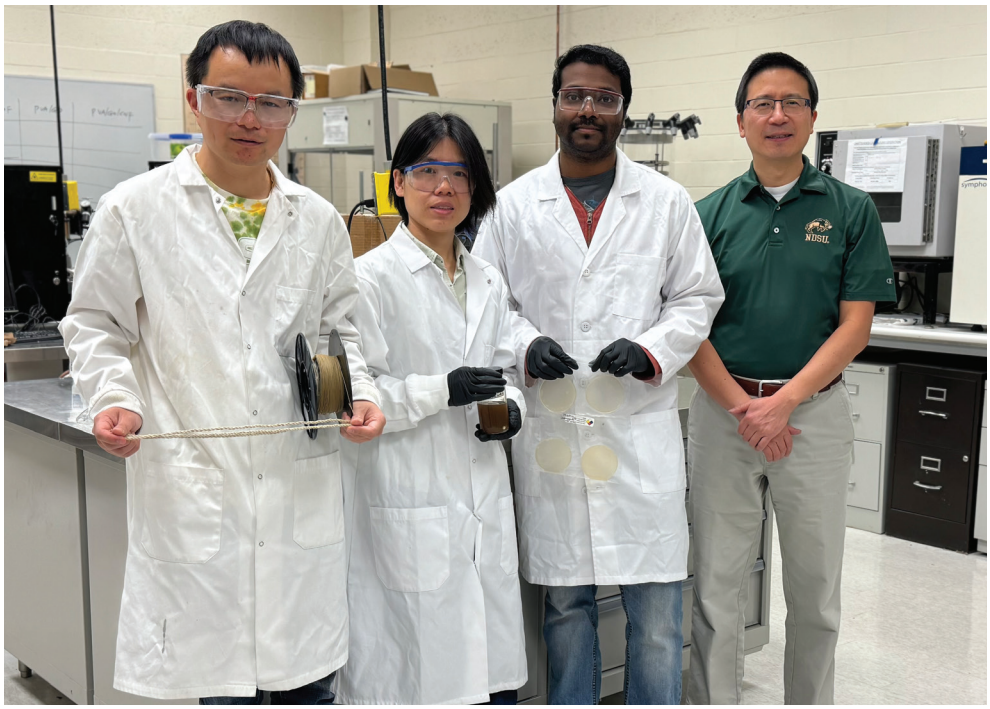
Why this Research is Important to North Dakota Soybean Farmers

Bailing twine and wraps are mostly made of polypropylene (PP), an indigestible plastic. Polypropylene can cause health issues or even death for the animals when ingested. In addition, PP is made from petroleum and lacks biodegradability, thus posing significant environmental concerns. Therefore, a biobased, biodegradable and more digestible bailing twine is highly desired. In this project, our goal is to develop a new twine material based on soymeal (SM) and polylactic acid (PLA), a biodegradable plastic made from corn starch.

Research Conducted

SM and PLA at different ratios were compounded and extruded into ribbon- and filament-shaped products. The products' mechanical testing, thermal stability, microstructure and digestibility were investigated. Soybean oil (SO) or epoxidized soybean oil (ESO) as well as a small amount of crosslinker and initiator were added to the SM/PLA base formulation at different contents in order to improve the products' flexibility, toughness and strength. The filaments made of the optimal formulation were twisted into twine, and the mechanical properties were evaluated. The properties were compared with the PP twine produced using the same method.

Figure 2. Long Jiang, Ph. D., far right, with his research team.



Findings of the Research

SM and PLA can be blended and extruded into nice ribbon and filament products at different SM to PLA ratios. The higher the ratio, the lower the surface quality and mechanical properties, but the higher the digestibility of the products. The 3:7 ratio was suitable for achieving a balanced property matrix. Incorporating the additives (i.e., plasticizer, crosslinker and initiator) can significantly improve the twine's desirable properties. SM/PLA filaments were successfully twisted into a twine product which had superior properties compared to the PP twine made using the same method. While pure PLA and PP showed zero digestibility, about 20% of the SM/PLA twine (the highest rate) were digested at the end of a digestion test with the cattle's rumen.

Figure 1. Digital photo of the bailing twine developed in this research.

Benefits to North Dakota Soybean Farmers

A new application for soymeal has been developed, presenting an exciting opportunity for soybean farmers and diverse industries.