

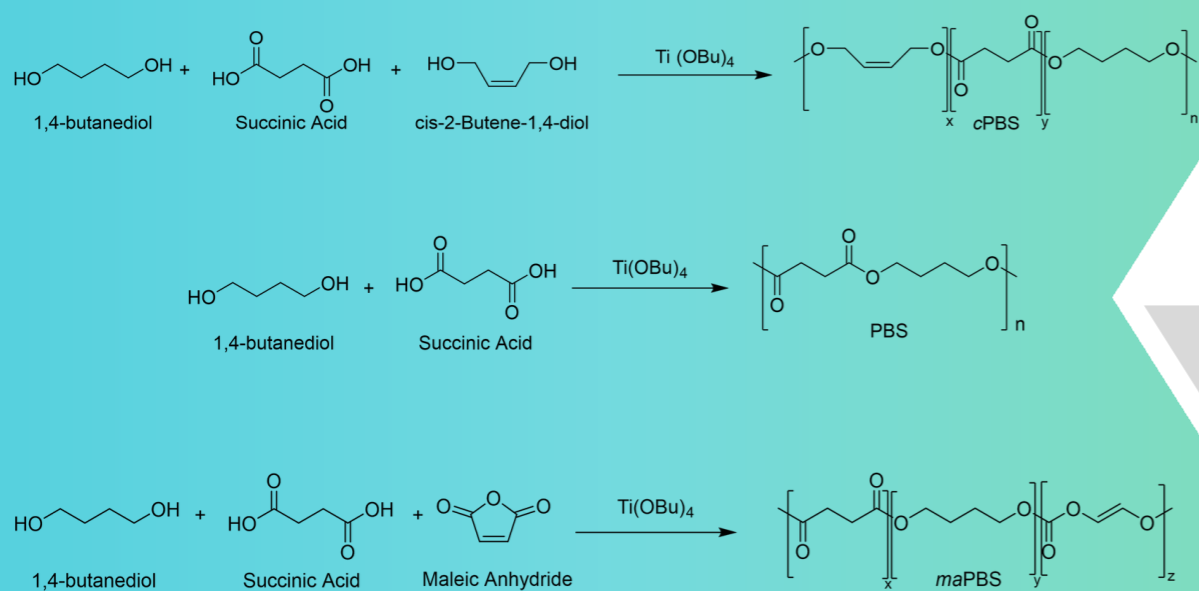
Interest in biodegradable polymers like polybutylene succinate (PBS) has risen due to their eco-friendly properties. However, PBS needs greater strength, elasticity, and toughness for various applications^[1]. Significant improvements in the mechanical properties of PBS have been achieved by adding small amounts of citric and tartaric acid during the polycondensation process^[2]. Based on this work, our study aims to improve the performance of PBS by introducing double bonds into the polymer chain using maleic anhydride (*ma*) and cis-2-butene-1,4-diol (*c*), resulting in novel *ma*-PBS and *c*-PBS variants, which will be used to chemically bind keratin to the polymer chain. Previously, our research has shown that keratin-polycaprolactone blends improved the cell viability of keratinocytes^[3].

STRUCTURAL MODIFICATIONS AND KERATIN INTEGRATION IN POLYBUTYLENE SUCCINATE FOR SUSTAINABLE ADVANCED MATERIALS

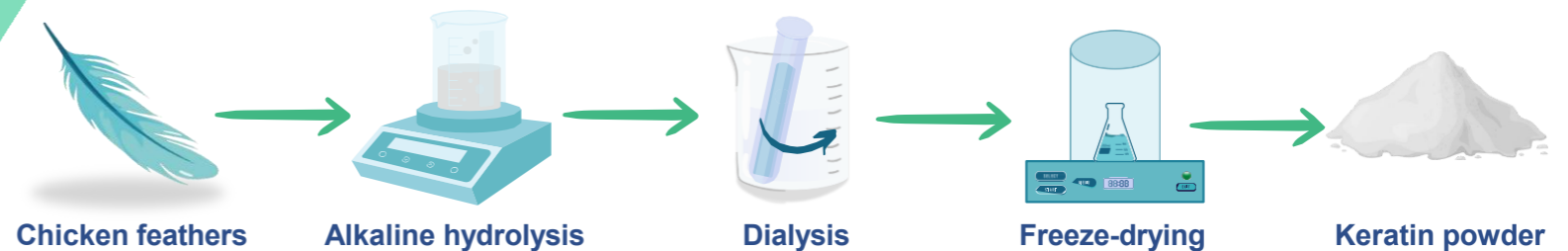
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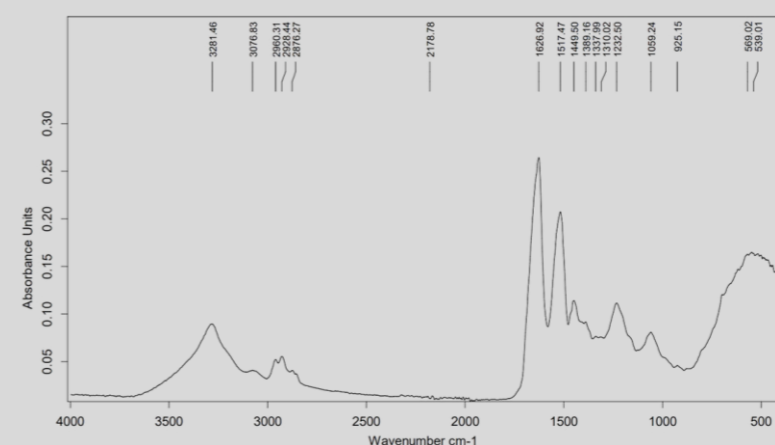
PBS SYNTHESIS



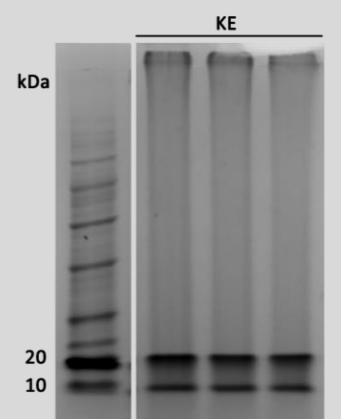
KERATIN EXTRACTION



KERATIN CHARACTERIZATION

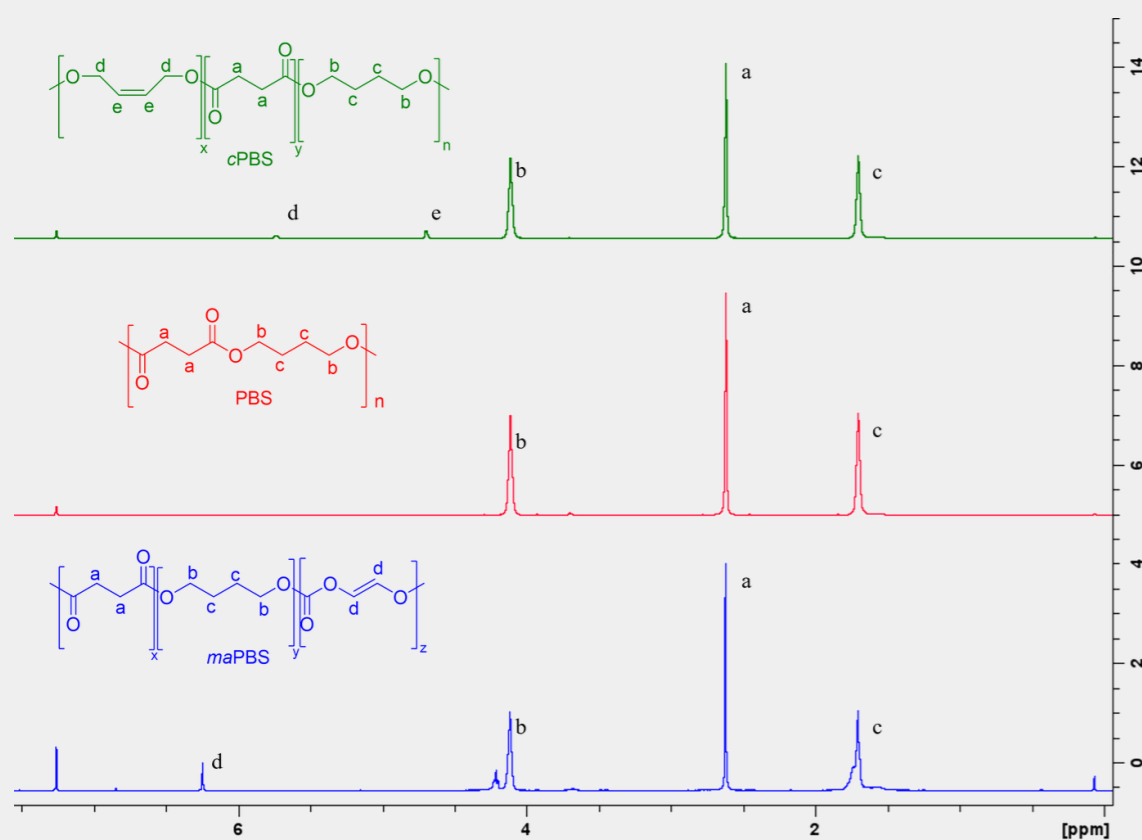


FTIR spectrum of Keratin extract

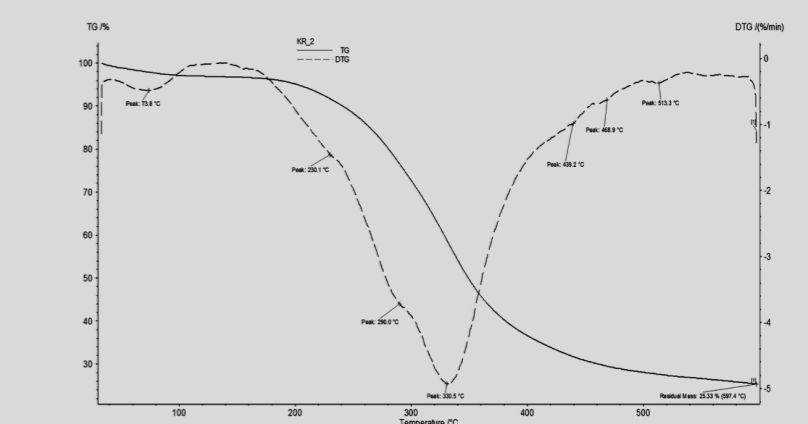


SDS-PAGE of Keratin

POLYMER CHARACTERIZATION



¹H NMR of *c*-PBS (green); PBS (red) and *ma*-PBS (blue) (300 MHz, CDCl₃, 298K)



Thermogravimetric curve (TG) and first derivative of TG curve (DTG) of keratin extract

Run	Polymer composition (mol ratio)	T (°C)	Time (h)	Mn (Daltons)	Mw (Daltons)	D
1	SA:BD mol ratio 1:1,2	170-230	7	68484	127247	1.858
2	SA:BD:cBD mol ratio 1:1,08:0,12	170-230	7	29337	54376	1.853
3	SA:BD:MA mol ratio 0,8:1,2:0,2	170-230	7	27200	13486	2.324

SA = Succinic Acid; BD = 1,4-butanediol; cBD = cis-2-Butene-1,4-diol; MA = Maleic Anhydride

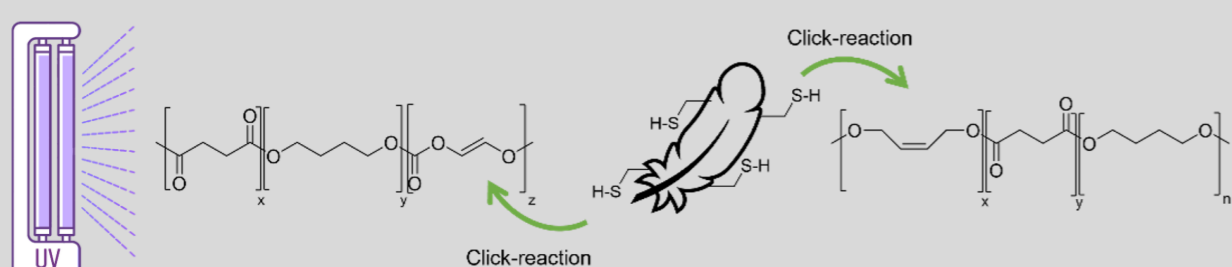
Gel Permeation Chromatography (GPC) molecular weight averages of 1) PBS; 2) *c*-PBS and 3) *ma*-PBS

REFERENCES

- [1] Pinazo, J. M.; Domine, M. E.; Parvulescu, V.; Petru, F. Catal. Today 2015, 239, 17–24.
- [2] Kim, H.; Shin, G.; Jang, M.; Nilsson, F.; Hakkarainen, M.; Kim, H. J.; Hwang, S. Y.; Lee, J.; Park, S. B.; Park, J.; Oh, D. X.; Jeon, H.; Koo, J. M. Toward Sustaining Bioplastics: Add a Pinch of Seasoning. ACS Sustain. Chem. Eng. 2023, 11 (5), 1846–1856.
- [3] Rinaldi, G.; Coccia, E.; Ferrentino, N.; Germinario, C.; Grifa, C.; Paolucci, M.; Pappalardo, D. Adv. Polym. Technol. 2024, 12.

FUTURE PERSPECTIVES

Future directions of this study include optimizing the reaction conditions to improve the mechanical and thermal properties of the modified PBS. Keratin from poultry feather waste will be used to conduct thiol-ene reactions that target the protein to the unsaturations introduced in the modified PBS. This approach adds new functionalities such as biocompatibility and microbial resistance and promotes sustainability and circular economy. Subsequently, thermal and mechanical characterizations will be conducted, including differential scanning calorimetry (DSC), thermogravimetric analysis (TGA), tensile tests to measure Young's modulus, and contact angle measurements to evaluate the surface properties.



Acknowledgement

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