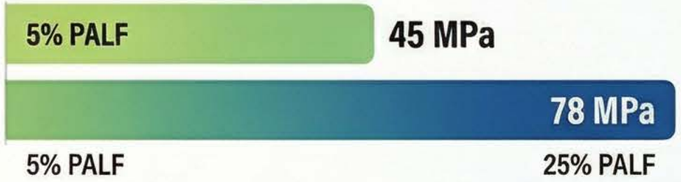
Pineapple Leaf Fibre: The Sustainable Future of Biomedical Engineering

The mechanical and tribological superiority of PALF reinforced polymer composites as a sustainable alternative for medical applications.

Mechanical Performance and Strength

Increasing PALF content boosts durability.

73% Increase in Tensile Strength

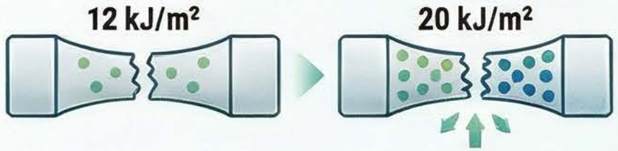


Increasing PALF content from 5% to 25% boosted tensile strength from 45 to 78 MPa.

Matching Human Bone Properties

PALF composite tensile strength (up to 78 MPa) aligns with cortical bone (80–150 MPa).

Enhanced Impact Toughness

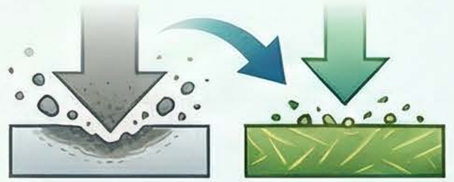


Impact energy absorption rose from 12 to **20 kJ/m²**, significantly improving material durability.

Durability and Biomedical Suitability

PALF offers exceptional wear resistance and biocompatibility.

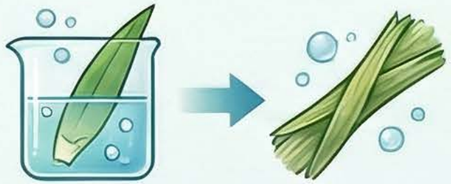
Superior Wear Resistance



36%
Decrease in Wear Rate

Wear rate decreased by 35%, falling to **3.7×10^{-8} mm³/Nm** at maximum loading.

Critical Alkali Pre-treatment



5% NaOH treatment removes impurities, enhancing the vital bond between fibres and matrix.

Fibre Loading & Performance Correlation

5% (C1)	Young's Modulus (GPa): **2.1**	Coefficient of Friction: **0.62**
15% (C3)	Young's Modulus (GPa): **2.8**	Coefficient of Friction: **0.56**
25% (C5)	Young's Modulus (GPa): **3.5**	Coefficient of Friction: **0.51**

Proven Biocompatibility

90%+

PALF is non-toxic and biodegradable, showing cell viability rates exceeding 90%.