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Development of fibre-reinforced biocomposite for flexible wearable electronic application

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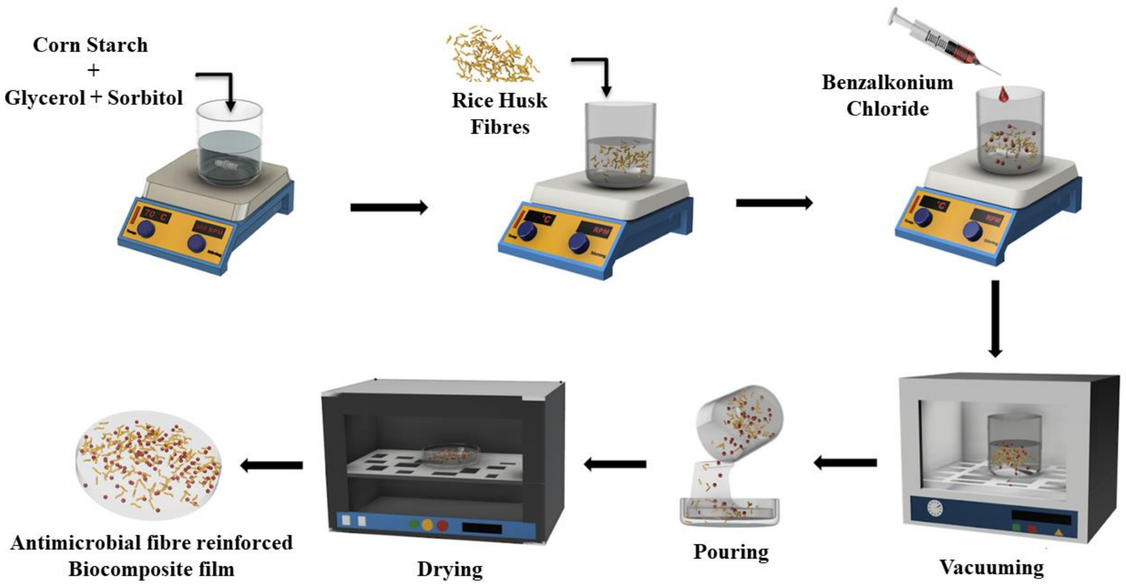
Abstract

The primary challenge in e-textile is the nondegradable and toxic electronic material waste generation. Herein we developed an antimicrobial biocomposite using rice husk agricultural waste as the reinforcement in corn starch matrix. This can be utilized as the matrix to embed electronic components as well as could be reinforced with conductive fillers such as graphene, CNT, etc., for flexible electronic applications. The results show a significant improvement in mechanical properties . The developed film is also utilized in designing a fabric-based capacitor using nickel chrome-plated polyester fabric as a conductive electrode and biodegradable film as a dielectric material. In the biodegradability test, it was found that all the developed samples were degradable under composting conditions.

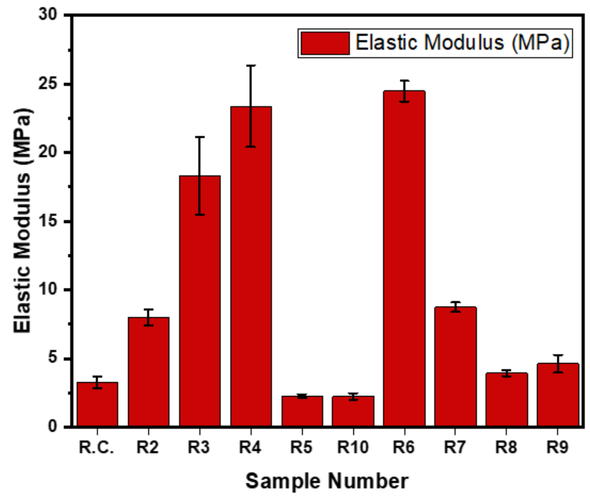
Materials and methods

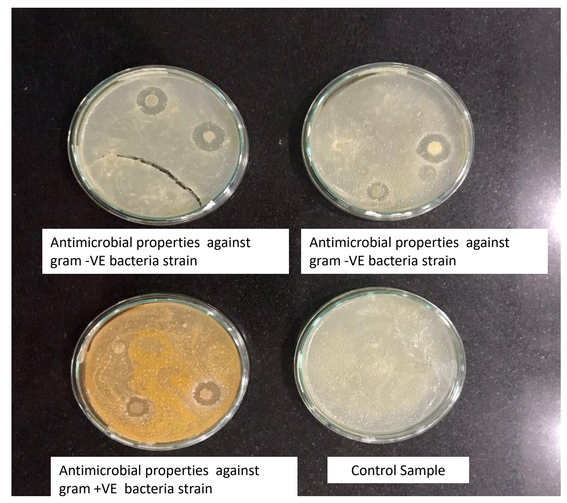


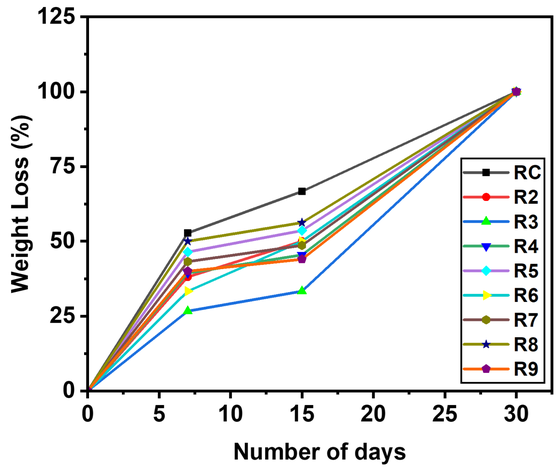
Process flow diagram

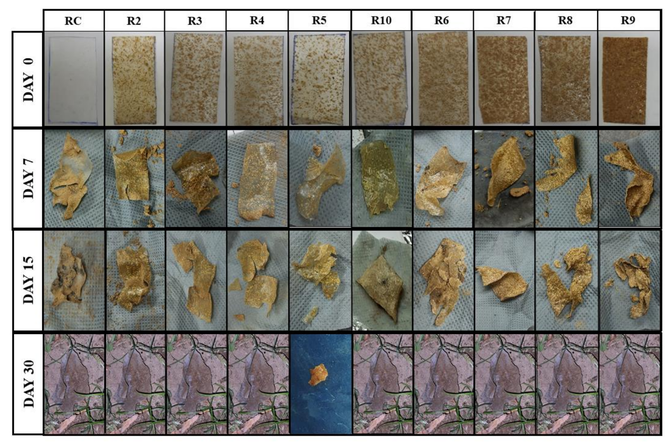
Sample Number	Fibre content (%)	BKC (%)	Thickness (mm)
RC	0	0	0.40±0.21
R2	10	1	0.52±0.26
R3	10	2	0.49±0.02
R4	10	3	0.47±0.01
R5	10	4	0.41±0.01
R6	20	1	0.52±0.03
R7	30	1	0.56±0.02
R8	40	1	0.54±0.01
R9	50	1	0.64±0.02

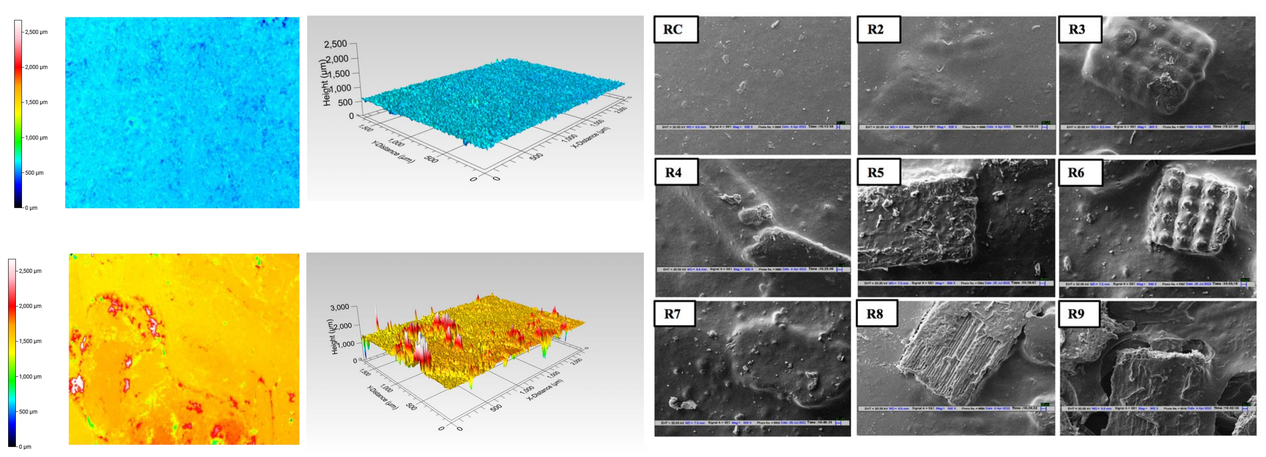
Results and Discussion



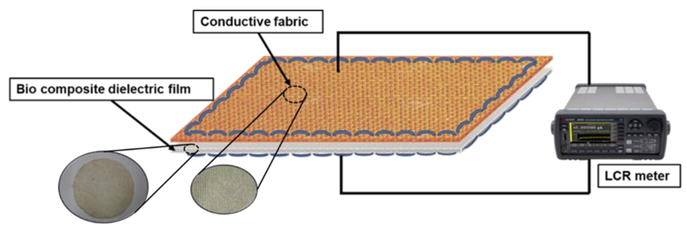


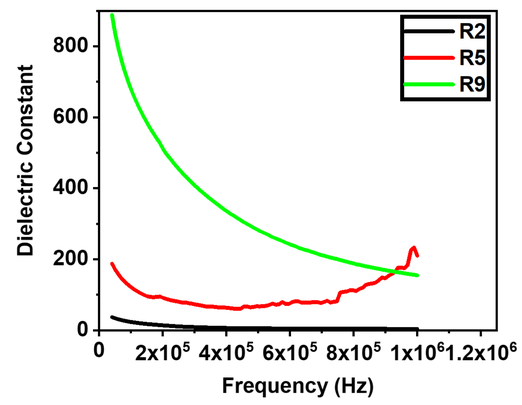






Applications





Conclusions

The developed biocomposite material is eco-friendly, biodegradable, and made from renewable resources. Biocomposite is made from rice husk, which is a byproduct of agricultural produce. It has the potential to replace existing petroleum-based flexible electronic material.

Its antimicrobial property makes it compatible with skin and wearable properties. The developed film has shown a good dielectric constant when tested in a frequency range of 10 Hz to 1 MHz. The film has shown high mechanical strength, inherent flexibility, and antimicrobial properties. All samples show biodegradation in garden composting conditions.

Publications

1. **Srivastava, V.**, Singh, S., Das, D. (2022). Biodegradable Fibre-Based Composites as Alternative Materials for Sustainable Packaging Design. In: Scholz, S.G., Howlett, R.J., Setchi, R. (eds) Sustainable Design and Manufacturing. KES-SDM 2021. Smart Innovation, Systems and Technologies, vol 262. Springer, Singapore. https://doi.org/10.1007/978-981-16-6128-0_9
2. **Srivastava, V.**, Singh, S., & Das, D. Novel rice husk fibre reinforced starch based biocomposite packaging film with antimicrobial properties for the extended shelf life of packed food. (IN patent app. No 202211056564)

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