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Natural-derived sorbents: Application of biochar materials as green extractive approach in food analysis

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INTRODUCTION & AIM

The growing demand for **sustainable practices** in **analytical chemistry** has positioned biochar as a promising bio-based sorbent derived from agro-industrial residues.

Eco-friendly alternative to conventional materials

Biochar ← **High porosity**, **Tunable surface chemistry**, **Low-cost synthesis**

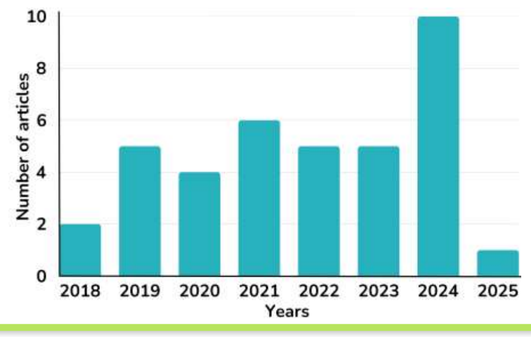
Its application in food analysis is strongly aligned with the principles of Green Analytical Chemistry.

→ Reduced solvent consumption
→ Minimal waste generation
→ Improved overall efficiency.

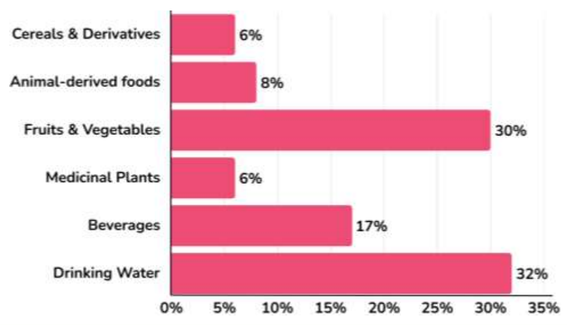
This work aims to present a structured view of the applications of biochar as a natural sorbent in the preparation of samples for food analysis.

METHOD

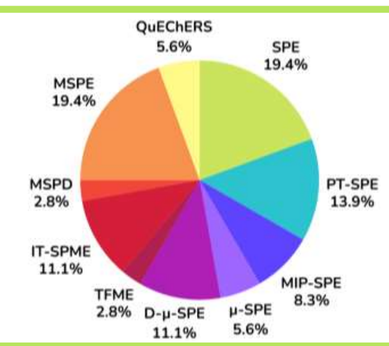
A comprehensive literature review (2018–2025) was carried out to evaluate **the role of biochar in food analysis**. Publication activity has grown steadily, with a peak in **2024.**



Most studies focused on **drinking water** and **fruits/vegetables**, while beverages and other matrices were less explored.



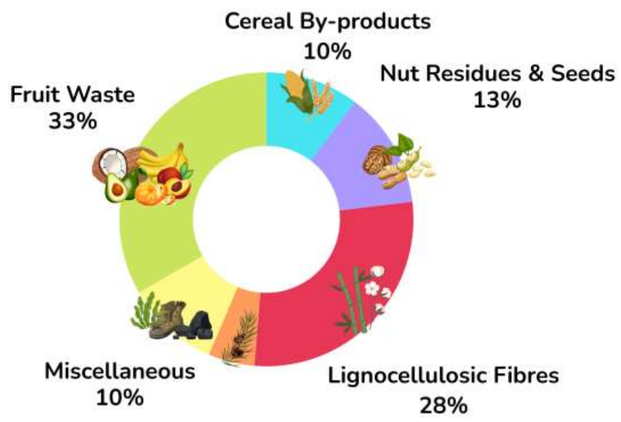
SPE and **MSPE** were the dominant extraction techniques, with additional use of PT-SPE, MIP-SPE, IT-SPME, and others.



RESULTS & DISCUSSION

The **efficiency** and **sustainability** of biochar sorbents depend mainly on the biomass precursor, synthesis method, and extraction conditions.

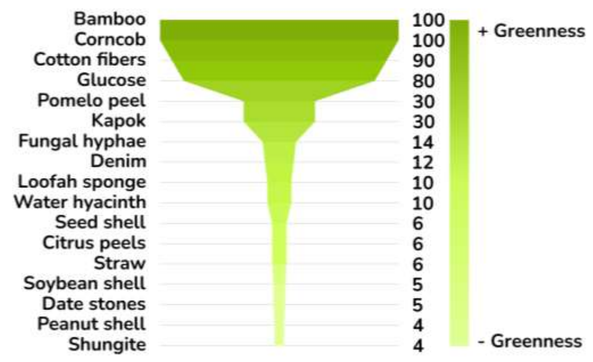
Among the raw materials used to prepare biochar agricultural residues such as **fruit peels**, and **lignocellulosic fibres** dominate. Other precursors remain less explored.



Frequency of raw materials used in preparation of biochar.

- **Biochar as green materials**

The potential for **reusability** is a critical parameter for assessing the economic and environmental value of biochar. Reusability varies with precursor type. **Bamboo**, **corncob**, and **cotton fibers** show high stability, while others are less durable.

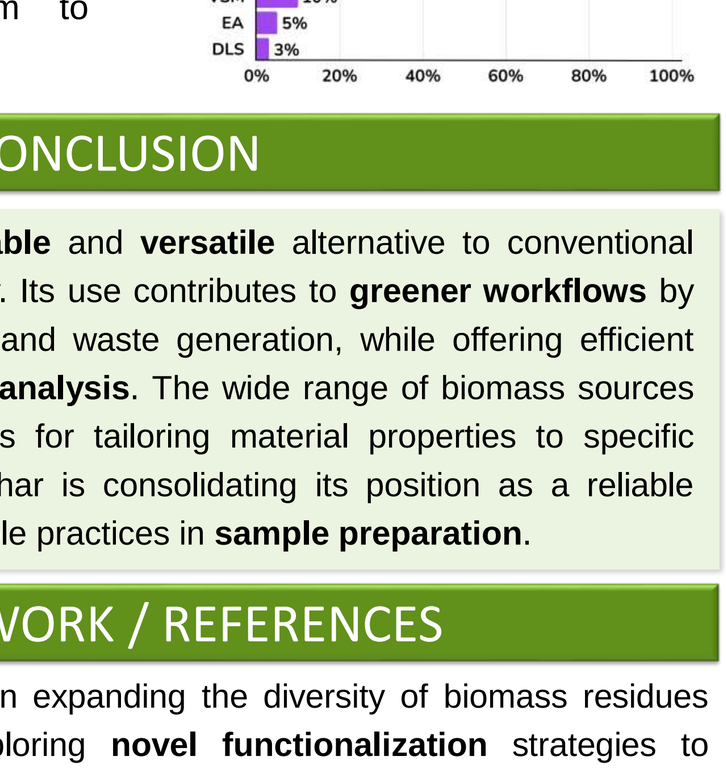


- **Biochar preparation**

Biochar is obtained through **biomass pre-treatment, thermal conversion under anoxic conditions, and post-processing**.

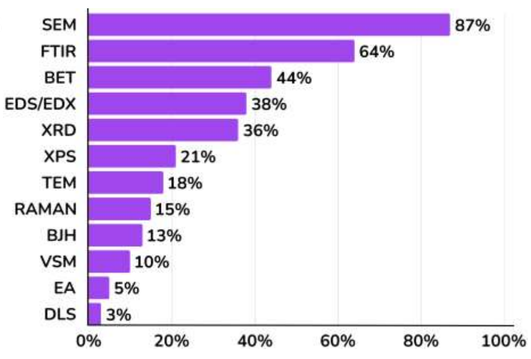
- **Solvents for desorption**

Problematic solvents are still common, but **greener alternatives** are increasingly recommended to improve sustainability.



- **Biochar characterization techniques**

SEM, FTIR, BET, and XRD are most frequently used to determine the **physicochemical characteristics** of the obtained materials and relate them to extraction performance.



CONCLUSION

Biochar represents a **sustainable** and **versatile** alternative to conventional sorbents in analytical chemistry. Its use contributes to **greener workflows** by reducing solvent consumption and waste generation, while offering efficient extraction capabilities for **food analysis**. The wide range of biomass sources available provides opportunities for tailoring material properties to specific analytical needs. Overall, biochar is consolidating its position as a reliable sorbent for advancing sustainable practices in **sample preparation**.

FUTURE WORK / REFERENCES

Future research should focus on expanding the diversity of biomass residues employed as **precursors**, exploring **novel functionalization** strategies to further improve selectivity, and integrating biochar into **miniaturized** and **automated** sample preparation techniques. Such innovations will enhance its applicability and long-term impact in food analysis.

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