



RESEARCH ARTICLE

DEVELOPMENT AND PHYSICOCHEMICAL CHARACTERIZATION OF ACTIVATED CARBONS PRODUCED FROM CORN COBS AND WOOD SAWDUST TO ENHANCE THEIR EFFICIENCY IN ADSORBING POLLUTANTS

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ARTICLE INFO

Article History:

Received 14th February, 2026
Received in revised form
26th March, 2026
Accepted 15th April, 2026
Published online 29th May, 2026

Key Words:

Activated Carbon, Corn Cobs, Wood Sawdust, Pollutant Adsorption.

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ABSTRACT

The utilization of agricultural and forestry residues represents a sustainable approach to the production of low-cost adsorbent materials. This study focuses on the preparation and characterization of activated carbons derived from corn cobs and wood sawdust. The carbonization and activation processes yielded porous materials with a high specific surface area and a good distribution of micropores and mesopores. The corn cob-based activated carbon exhibits a high iodine index (810.19 mg/g), indicative of high microporosity. With an ash content of 3.94% and a yield of 35%, this material stands out for its stability and effectiveness. The wood sawdust-based activated carbon has a high iodine index (600.34 mg/g), indicating good microporosity. It is characterized by an ash content of 3.11% and a yield of 28%. The physicochemical analyses conducted showed that the observed differences are related to the nature of the biomass. The results obtained open up prospects for improved pollutant adsorption and the reduction of the environmental impact of biomass waste.

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Citation: EHOUMAN Ahissan Donatien, Beda Reginald Henriette Blanche, KONAN Gbangbo Rémis, KONAN Amenan Sylvie. 2026. "Development and physicochemical characterization of activated carbons produced from corn cobs and wood sawdust to enhance their efficiency in adsorbing pollutants.". *International Journal of Current Research*, 16, (05), 37070-37073.

INTRODUCTION

The production of activated carbon (AC) from lignocellulosic residues, such as corn cobs and sawdust, represents a sustainable solution for valorizing agricultural and forestry waste while meeting the growing demand for adsorbent materials used in the treatment of polluted water (1). These biomass materials, which are abundant and low-cost, can be transformed into high-performance ACs through carbonization and activation, thereby offering environmentally friendly and cost-effective solutions for pollution control. Corn cobs, after chemical activation, have shown an iodine index of up to 856.42 mg/g, indicating high microporosity and significant adsorption capacity (1;2). Similarly, wood sawdust, depending on activation conditions, can exhibit iodine indices ranging from 470.41 mg/g to 1,628.95 mg/g, highlighting its potential

as an effective adsorbent material (3;4). However, the final properties of ACs, such as yield, specific surface area, pore distribution, and surface chemistry, depend heavily on preparation parameters, including temperature, activation time, precursor-to-activator ratio, and the nature of the activating agent (2). These factors directly influence the effectiveness of activated carbon in adsorbing pollutants. The objective of this study is to develop and characterize activated carbon derived from corn cobs and wood sawdust, in order to compare their performance and determine the optimal preparation conditions for effective use in the treatment of certain pollutants.

MATERIAL AND METHODS

Study Materials: Corn plays a major role in the economy of Côte d'Ivoire, particularly in rural areas. Its production, estimated at 2.9 million tons in 2020, places Côte d'Ivoire

among the leading corn-producing countries in West Africa. Since the cob accounts for 20 to 30% of the fruit's weight, it would be a shame not to recycle this plant material (5). It is therefore a vast resource for a circular economy and for the processing and recovery of this waste. As for sawdust production, it amounts to approximately 1.9 to 2 million m³/year (6). The choice of corn cobs and sawdust is based on their availability, low cost, energy and environmental potential, and their role in the transition to a circular bioeconomy.



Figure 1. Characteristics of corn cobs



Figure 2. Characteristics of wood sawdust

Production of biochar and activated carbon

Biochar production: The corn cob samples were ground to a diameter generally ranging from 8 mm to 4 mm; biochar production is carried out at low temperatures between 100 and 600 °C. Pyrolysis time varies considerably, ranging from a few minutes to several hours depending on the selected temperature. In this study, once dried, the material was carbonized for 4 hours at a temperature of 450°C in an oven under an oxygen-limited atmosphere (7-9).

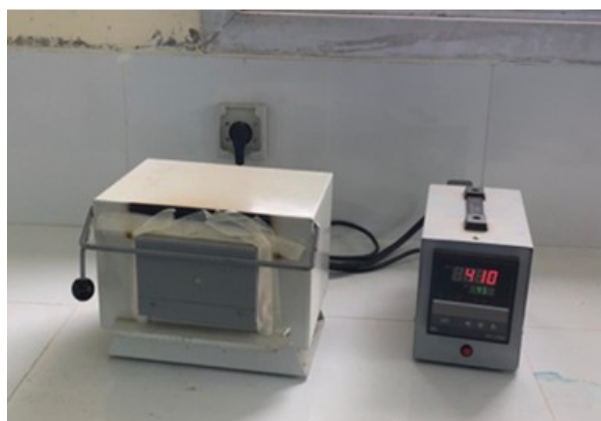


Figure 3. Electric oven for carbonization

Production of activated carbons (Chemical impregnation of the precursor): The chemical activation of the ground material was performed using a 500 ppm potassium hydroxide (KOH) solution prepared with distilled water. The shredded material was impregnated with the potassium hydroxide (KOH) solution at an impregnation concentration of 0.3 g/mL. The impregnation, which lasted 6 hours, was carried out at room temperature in hermetically sealed jars that were agitated to ensure thorough homogenization.

Technical Equipment

Electronic Scales: Using electronic scales, we measured the required masses of our material and aluminum samples during various procedures.

Mortar and Sieve: For sieving the precursor (palm kernel shells) that had been crushed using a mortar.

Oven: The samples were dried in an oven for 24 hours at 105°C after impregnation [10].

Magnetic stirrer: A stirrer was used to agitate the mixture of charcoal and iodine during the determination of the iodine value.

Study Methods

Characterization

Yield: The yield is the ratio of the mass of the precursor to the mass of the prepared activated carbon. A quantity of precursor is measured and carbonized (m_0); upon exiting the furnace, the mass of the resulting carbon is measured (m_1). The yield (%) is given by the following formula:

$$R (\%) = ((m_1 / m_0)) \times 100 \quad (1)$$

Iodine index: The purpose of the iodine index test is to determine the ability of carbon to adsorb small molecules. It characterizes the micropores accessible to small particles. The iodine number is an important parameter in evaluating the micropores of activated carbon. It was determined as follows. A 15 mL volume of a 0.1 N iodine solution was brought into contact with 0.05 g of activated carbon for 4 minutes. The treated solution was filtered, and then 10 mL of the filtrate was titrated with a 0.1 N sodium thiosulfate solution in the presence of a few drops of a 0.1 N starch paste solution used as a color indicator. The sodium thiosulfate solution is added dropwise to the Erlenmeyer flask containing the filtrate until the solution is completely decolorized. A blank test was performed under the same conditions in the absence of activated carbon, and we obtained a volume $V_b = 5.4$ mL (11-12). Finally, the iodine value (I_d), expressed in mg/g, was calculated using the following formula $V_b = 5.4$ mL (11-12). Finally, the iodine value (I_d), expressed in mg/g, was calculated using the following formula (4) :

$$\text{iodine index } (I_d) \text{ (mg/g)} : I_d = \frac{(V_b - V_s) \times N \times 126.9 \times (\frac{15}{10})}{m} \quad (2)$$

With:

V_b : Volume in mL of 0.1 N sodium thiosulfate added to the blank test..

Vs: Volume in mL of 0.1 N sodium thiosulfate added to the test with adsorbent.

N: Normality of the sodium thiosulfate solution in (eq.g/L).

126.9: the atomic mass of iodine.

m: the mass of the adsorbent in (g)

Ash Content Tc: Ash content indicates the material’s richness in minerals such as silica, aluminum, iron, magnesium, and calcium. The result is expressed as a percentage of ash content relative to dry weight (ash mass / dry mass of the fuel). To determine this, we used the following method:

First, 0.5 g of activated carbon was placed in a crucible and placed in an oven at 80°C for 24 hours. Then, after drying, the crucible and its contents were placed in an oven set to 450°C for 4 hours. After cooling to room temperature, the crucible and its contents were weighed again (13). The ash content (Tc) is determined as follows:

$$Tc (\%) = ((m_3 - m_2) / m_1) \times 100 \quad (3)$$

- m₁: mass of the coal;
- m₂: mass of the crucible and coal after removal from the furnace;
- m₃: mass of the crucible and coal after drying.

RESULTS AND DISCUSSION

Characterization of Activated Carbons Made from Corn Cobs and Sawdust: The table below presents some of the characteristics of the activated carbons prepared from corn cobs and sawdust.

Table 1. Characteristics of Activated Carbons (Corn Cobs and Sawdust)

Material	Iodine index (mg/g)	Ash content (%)	Yield %
Corn cobs	810.19	3.94	35
Sciure de bois	600.34	3.11	28

Iodine index : La Figure 4 below shows the iodine indices of the activated carbons studied.

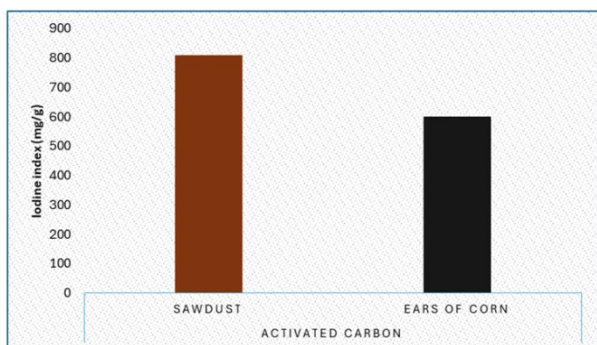


Figure 4. Iodine indices of corn cobs and wood sawdust

Activated carbons made from corn cobs and wood sawdust, activated with potassium hydroxide (KOH), show better results 810.19 mg/g and 600.34 mg/g, respectively which are higher than 500 mg/g and can therefore adsorb very small pollutants (0–2 nm) (14-18).

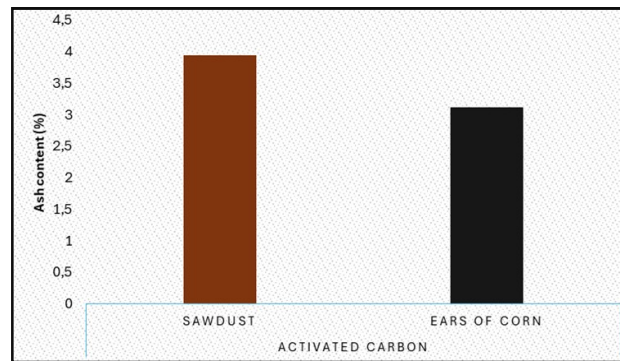


Figure 5. Ash content of corn cobs and wood shavings

Ash Content: La figure 5 below shows the ash contents of the activated carbons studied. Ash content is one of the parameters that influence the adsorption properties of coal. This parameter has a significant effect on the quality of activated carbon. It appears that a high ash content reduces the specific surface area. Furthermore, the ash content of a good adsorbent should not be too high; that is, it should be less than or equal to 20% (19). An excessively high ash content (>20%) reduces the activated carbon’s activity and reactivation potential and can lead to the leaching of impurities (mineral salts) (19). In our study, the ash content of activated carbon prepared from corn cobs is 3.94%, while that of sawdust is 3.11%. The ash content obtained in this study is characteristic of a plant suitable for activated carbon production and also indicates good adsorption capacity for the synthesized activated carbons (19;20).

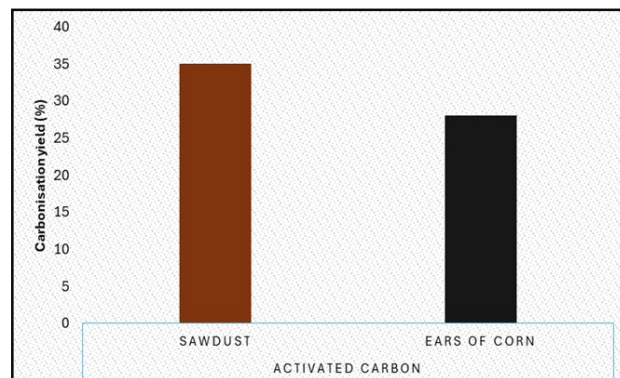


Figure 6. Ash content of corn cobs and sawdust

Yield: Figure 6 below shows the yields of the activated carbons. In our study, the yield of activated carbon prepared from corn cobs was 35%. The yield of activated carbon prepared from wood sawdust was 28%. This indicates a loss of volatile matter during carbonization. The yield is considered good since it exceeds 20% (21).

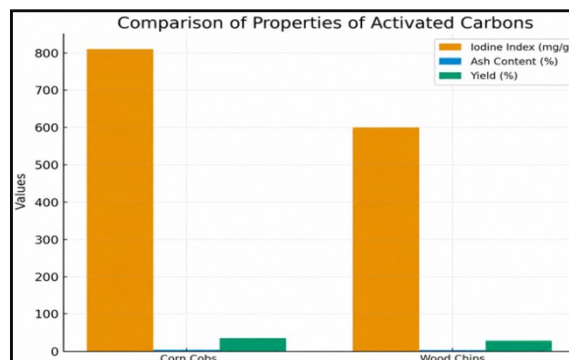


Figure 7. Comparison chart of the properties of corn cobs and wood shavings

Comparison of Activated Carbon Properties: Figure 7 below shows a comparison of activated carbon properties. An analysis of the comparison of the iodine indices observed for corn cobs and wood sawdust (810.19 mg/g; 600.34 mg/g) indicates that activated carbon derived from corn cobs has a larger specific surface area and superior adsorption capacity, particularly for organic micropollutants. This difference is explained by the fibrous structure of the corn cob, which promotes the development of fine pores after activation. A comparison of the ash content of corn cobs (3.94%) and wood shavings (3.11%) indicates the presence of minerals and inorganic substances (silica, potassium, calcium, etc.). If this level is too high, it can reduce adsorption efficiency by clogging the pores, but here the values remain relatively low and are therefore acceptable for good-quality activated carbon. In terms of yield, corn cobs have a higher yield (35%) compared to wood sawdust (28%). The lower yield of sawdust can be explained by its higher proportion of volatile matter, which decomposes more during carbonization, leading to a greater loss of mass. In contrast, corn cobs, with their more robust lignocellulosic structure, retain a greater residual mass after activation.

CONCLUSION

The overall objective of our study is to develop and characterize activated carbons derived from corn cobs and wood sawdust. Overall, corn cobs appear to be a better precursor than wood sawdust for the production of activated carbons intended for pollutant adsorption, thanks to their high iodine index and superior yield, despite a slightly higher ash content.

ACKNOWLEDGMENTS

We would like to thank all the laboratories that contributed to this study and express our gratitude to NANGUI Abrogoua University in Abidjan, the University of Kara in Togo, and Félix Houphouët-Boigny University in Cocody, Abidjan, Côte d'Ivoire.

REFERENCES

He, X., et al. (2023). *Optimization of activated carbon production from corn cob using response surface methodology*. *Frontiers in Environmental Science*, 11, 1105408. <https://doi.org/10.3389/fenvs.2023.1105408>

Spencer, W., Ibana, D., & Singh, P. (2024). Effect of surface area, particle size and acid washing on the quality of activated carbon derived from lower rank coal by KOH activation. *Sustainability*, 16(1), 1–15. <https://doi.org/10.3390/su16010001>

Oladimeji, T. E., et al. (2021). Production of activated carbon from sawdust and its efficiency in the treatment of sewage water. *Science Progress*, 104(2), 0036850421100657. <https://doi.org/10.1177/0036850421100657>

Mianowski, A., Owczarek, M., & Marecka, A. (2007). *Surface area of activated carbon determined by the iodine adsorption number*. *Energy Sources, Part A: Recovery, Utilization, and Environmental Effects*, 29(11), 1021–1032. <https://doi.org/10.1080/00908310600974675>

FAOSTAT. (2020). Production de maïs en Côte d'Ivoire. Organisation des Nations Unies pour l'alimentation et l'agriculture. Consulté le 30 septembre 2025 sur <https://www.fao.org/faostat/fr/>

Boursenews. (2023). Côte d'Ivoire: environ deux millions de m³ de sciage par an de bois pour la consommation (ministère). Consulté sur <https://boursenews.ma/article/afrique/cote-d-ivoire-environ-deux-millions-de-m3-de-sciage-par-an-de-bois-pour-la-consommation-ministere>

BOUKHERIS, Tarek, MILTI, Anis, et SFAKSI, Zoubida Encadreur. Comparaison entre charbon actif et biocharbon (Étude théorique). Thèse de doctorat. Université de Jijel. 2020.

Gbamgbo Remis, K., Kouakou Rodrigue, A., Donatien, Ehouman., YAO, Benjamin.,GVG, L., BBH, G., & MNA, K Characterization of Musa Paradisiac Activated Carbon Supporting Iron Nanoparticles, after Adsorption of Hydrogen Sulphide (H₂S) from Biogas on a Fixed Bed Column; 2023.

Boumessaidia, S., Mohammedi, O., Cheknane, B., Bouchenafsaib, N., & Bachari, K. kinetic and isotherm adsorption studies of cobalt (ii) on mesoporous aluminosilicate materials and mesoporous carbon of mcm-41 type; *Journal of Fundamental and Applied Sciences*, 2018 vol. 68, no 6, p.405-418.

Slasli, Mohammed Abdelbassat. Modélisation de l'adsorption par les charbons microporeux: Approches théorique et expérimentale. 2002. Thèse de doctorat. Université de Neuchâtel.

Le Cloirec, Pierre. Adsorption en Traitement de l'air. Ed. Techniques Ingénieur, 2003.

Meunier, F. et Sun, Liang-Ming. Adsorption aspects théoriques. *Techniques de l'ingénieur Procédés de traitement des eaux potables, industrielles et urbaines base documentaire: TIB318DUO (ref. article: j2730)*, 2003.

Bansal, R. C., Donnet, J. B., et Stoeckli, F. *Active Carbon*; Marcel Decker. Inc., New York, 1988, vol. 482.

CHEKEM, Cedric Telegang. Matériaux carbonés multifonctionnels à porosité contrôlée à partir des ressources végétales tropicales: application au traitement de l'eau par photocatalyse. 2017. Thèse de doctorat. Université de Perpignan.

KONÉ, Horo, ASSÉMIAN, Alain Stéphane, TIHO, Tagouèlè, et al. Borassus aethiopicum activated carbon prepared for nitrate ions removal. *Journal of Applied Water Engineering and Research*, 2022, vol. 10, no 1, p. 64-77.

Chaima, Sakher. Préparation d'une nouvelle phase adsorbante et étude comparative. 2016. Thèse de doctorat.

Ayral, Catherine. Elimination de polluants aromatiques par oxydation catalytique sur charbon actif. Thèse de doctorat, Université de Toulouse; France; 2009; 227 pages.

Portères, Roland. Le Palmier Ronier (Borassus aethiopicum Mart.) dans la Province du Baoulé (Côte d'Ivoire); *Journal d'agriculture traditionnelle et de botanique appliquée*, 1965, vol. 12, no 1, p. 80-107.

MAAZOU, Siragi DB, HIMA, Halidou I., ALMA, Maman Mousbahou Malam, et al. Elimination du chrome par du charbon actif élaboré et caractérisé à partir de la coque du noyau de Balanites aegyptiaca. *International Journal of Biological and Chemical Sciences*, 2017, vol. 11, no 6, p. 3050-3065.

KIARI, Mahamane Nassirou AMADOU, FANOU, Guy Didier, SYLVIE, Affoué Tindo, et al. Process conditions optimization of plant waste-derived microporous activated carbon using a full factorial design and genetic algorithm. *J. Mater. Environ. Sci*, 2022, vol. 13, no 8, p. 884-899.

Habibi, Mohammad Hossein, Tangestaninejad, Shahram, et Yadollahi, Bahram. Photocatalytic mineralisation of mercaptans as environmental pollutants in aquatic system using TiO₂ suspension; *Applied Catalysis B: Environmental*, 2001, vol. 33, no 1, p. 57-63.
