International Research in Material and Environment
Volume 6, Issue 1, 2026 (pp. 47-58)
www.abjournals.org

CHARACTERIZATION OF FUNCTIONAL GROUPS IN *ADONIDIA MERRILLII* AND *DACRYODES EDULIS* SEED RESIDUES USING FTIR SPECTROSCOPY

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Cite this article:

E. S., Okon, O. M., Olatunji, I. E., Ekop (2026), Characterization of Functional Groups in Adonidia Merrillii and Dacryodes Edulis Seed Residues Using FTIR Spectroscopy. International Research in Material and Environment 6(1), 47-58. DOI: 10.52589/IRME-LBAQ2SWR

Manuscript History

Received: 2 May 2026

Accepted: 4 Jun 2026

Published: 1 Jul 2026

ABSTRACT: *The generation of agricultural residues from Adonidia merrillii and Dacryodes edulis continually and the need for sustainable resource utilization, have intensified research into biomass characterization for energy and material applications. However, limited information is available on the chemical structure and functional groups present in the seed residues of Adonidia merrillii, (Christmas palm) and Dacryodes edulis (African pear), despite their abundance as agro-waste. This study aimed to characterize the functional groups present in these seed residues using Fourier Transform Infrared (FTIR) spectroscopy to understand their chemical composition and potential utilization pathways. Seed residues of Adonidia merrillii, and Dacryodes edulis were collected, cleaned, air-dried, ground, and sieved to obtain uniform particle sizes. The prepared samples were analyzed using FTIR spectroscopy within the spectral range of 4000–500 cm^{-1}. The spectra obtained were interpreted to identify characteristic absorption bands corresponding to different functional groups and to compare the chemical composition of the two biomass residues. The FTIR spectra revealed the presence of several important functional groups in both samples, including hydroxyl (–OH), carbonyl (C=O), aliphatic C–H, aromatic C=C, ether (C–O), and amide (N–H) groups. These functional groups indicate the presence of lignocellulosic components such as cellulose, hemicellulose, and lignin within the biomass structure. For Christmas Palm, the 3334.3cm^{-1} wave number indicates hydroxyl groups, common in alcohols, phenols, or moisture presence, The peak at 2918.5 cm^{-1} and 2850.8 cm^{-1} both indicates an Aliphatic C-H stretching vibrations, typical for Alkanes or fatty acids, the peak at 1644.9 cm^{-1} is indicative of Alkenes, 1438.8 cm^{-1} and 1367.9 cm^{-1} shows a functional group belonging to the CH_2 and CH_3, 1260.9 cm^{-1} and 1177.8 cm^{-1} has a mood vibration of stretching. For African Pear, 3280 cm^{-1}: likely represents O-H stretching, 2922 cm^{-1} and 2856 cm^{-1}: typical for C-H stretching in alkanes, 1710 cm^{-1} indicates C=O stretching, 1148 cm^{-1}: likely indicative of C-O stretching, 1438 – 1334 cm^{-1}: suggest deformation, 700 – 995 cm^{-1}: out-of-plane bending vibrations, The 2079.9 cm^{-1} and 2009.0 cm^{-1} indicates the presence of unsaturated bonds such as alkynes or nitriles. The spectral patterns showed similarities between the two residues, although variations in peak intensities suggested differences in their chemical composition. The identified functional groups are known to influence the physicochemical behavior and thermal reactivity of biomass materials. The findings demonstrate that Adonidia merrillii and Dacryodes edulis seed residues contain functional groups typical of lignocellulosic biomass, indicating their potential suitability for bioenergy production, bio-based materials, and other value-added applications. The study highlights and supports the sustainable utilization of these biomass resources in energy and environmental engineering applications.*

KEYWORDS: *Adonidia merrillii,* Agricultural waste Valorization, Biomass Characterization, *Dacryodes edulis* Fourier transform infrared (FTIR*)* spectroscopy, Functional Group and Seed Residues.

Article DOI: 10.52589/IRME-LBAQ2SWR
DOI URL: https://doi.org/10.52589/IRME-LBAQ2SWR

INTRODUCTION

The utilization of biomass residues for energy production and environmental applications has garnered significant attention in recent years due to their renewable nature and potential to mitigate climate change (Demirbas, 2010; Pandey et al., 2017). *Adonidia merrillii* and *Dacryodes edulis* seeds, abundant agricultural residues, present promising energy conversion potential (Rathore & Madan, 2018; Sharma et al*.,* 2011). These seeds, often considered as waste, possess untapped value for sustainable resource utilization.

*Adonidia merrillii***,** commonly known as the "Christmas palm" or "Manila palm," is a species of palm tree native to the Philippines (Noltie, 1994). It belongs to the *Arecaceae* family and is characterized by its slender trunk, graceful arching fronds, and vibrant red fruits, which resemble miniature Christmas ornaments. *Adonidia merrillii* is cultivated for ornamental purposes in tropical and subtropical regions worldwide due to its attractive appearance and ability to thrive in a variety of environmental conditions (Noltie, 1994). Research on *Adonidia merrillii* seeds and their residues is limited, but there is growing interest in exploring their potential for sustainable resource utilization. Studies have shown that palm oil extracted from palm fruits, including those of *Adonidia merrilli*, can be used for biodiesel production (Rocha et al., 2007). Additionally, the fibrous husks of palm seeds have been investigated for their potential as a lignocellulosic biomass feedstock for bioenergy production (Sanusi et al., 2016).

Figure 1. ***Adonidia merrillii*** **tree and seed**

belonging to the family *Burseraceae*. It is native to West and Central Africa and is widely cultivated for its edible fruits, which are rich in nutrients and have a pleasant flavor (Adaramola et al*.,* 2019). The fruit of *Dacryodes edulis* is commonly consumed fresh or processed into various food products, including jams, jellies, and beverages (Adaramola et al*.,* 2019).

However, research has shown that *Dacryodes edulis* seed residues have potential value for various applications. For example, studies have investigated the use of *Dacryodes edulis* seed oil for biodiesel production due to its high oil content and favorable fatty acid composition (Olukunle et al*.,* 2018). Additionally, the protein-rich seed cake obtained after oil extraction has been explored as a potential animal feed ingredient (Ajala et al., 2020).

While research on *Dacryodes edulis* seed residues is still emerging, their utilization has the potential to contribute to sustainable resource management and economic development in regions where the tree is cultivated. Further studies are needed to explore additional applications and optimize extraction processes for maximizing the value of *Dacryodes edulis* seed residues.

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Figure 2. *Dacryodes edulis* fruit and a cross section showing its seed

There is a lack of comprehensive studies characterizing the chemical composition of *Adonidia merrillii* and *Dacryodes edulis* seed residues using FTIR spectroscopy. Understanding the molecular structure and functional groups present in these residues is crucial for exploring their potential applications in various fields. Effective valorization strategies for converting agricultural residues into value-added products or energy sources are increasingly important for sustainable development. However, the lack of detailed knowledge about the chemical composition of *Adonidia merrillii* and *Dacryodes edulis* seed residues using FTIR spectroscopy.

Agricultural residues, if not properly managed, can contribute to environmental pollution and greenhouse gas emissions. Understanding the chemical composition of *Adonidia merrilli* and *Dacryodes edulis* seed residues is critical for evaluating their environmental impact and implementing sustainable waste management practices.

Fourier Transform Infrared (FTIR) spectroscopy offers a powerful tool for characterizing the chemical composition of biomass residues (García & Pizarro, 2015). By analyzing the absorption of infrared radiation, FTIR spectroscopy can provide detailed insights into the molecular structure and functional groups present in the samples.

However, there is a notable gap in the literature regarding the FTIR spectra of *Adonidia merrilli* and *Dacryodes edulis* seed residues. This study aim to characterize the chemical composition and identify the functional groups present in Adonidia *merrillii* and *Dacryodes edulis* seed residues using Fourier Transform Infrared (FTIR) spectroscopy.

MATERIALS AND METHOD

Study Area

The study was conducted using seed residues of *Adonidia Merrilli and Dacryodes edulis* collected at Nwaniba, Uyo Local Government Area of Akwa Ibom State, Nigeria. Uyo is located in the South-South region of Nigeria and lies approximately between latitude 5°03'N and longitude 7°56'E. The area experiences a tropical rainforest climate characterized by high temperatures and significant annual rainfall, which support the growth of various fruit-bearing and ornamental plant species. The choice of the study area was influenced by the abundance and availability of both plant species within the locality, making it suitable for the collection of representative biomass residue for characterization.

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Sample Collection

Dacryodes edulis seed residue was collected from different disposed source of the seeds which have been considered not useful after the fruit has been eaten from it, while *Adonidia Merrilli* seeds were collected from mature fruits harvested from Christmas palm trees within the study area.

Sample Preparation

The sample materials were manually sorted and the unwanted materials were removed, leaving the required seed residue suitable for the analysis. The *Adonidia Merrilli* seed was collected from a uniform source at Nwaniba in Uyo. The seeds collected were air-dried under ambient laboratory conditions to reduce their moisture content before further processing, so the dried fruits were piled off leaving the seeds suitable for analysis.

Adonidia Merrilli and *Dacryodes edulis* seeds were air-died in the laboratory for about a month. After drying the two biomass samples were ground using a mechanical grinder and sieved to a particle size between 0.07–1.00 mm.

Plate 1: sorting of the samples.

Plate 2: Drying of the sample residues.

The seed residues were first sundried for about a week to allow the removal of the chaffs and the seed residue was separated from the fruit. The seeds were then allowed to dry in the laboratory for about a month for a uniform moisture content.

The dried seeds were ground using a mechanical grinder to obtain a fine powder suitable for the analysis.

After grinding to the required size, the sample were stored in airtight containers to prevent moisture absorption before analysis for about 3 weeks.

Plate 3: Stored grounded sample of *Adonidia Merrilli seed.*

Plate 4: Stored *Dacryodes edulis* seed.

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FTIR Instrumentation

Fourier Transform Infrared (FTIR) spectroscopy was employed to identify the functional groups present in the seed residues of *Adonidia Merrilli* and *Dacryodes edulis.* The analysis was carried out using FTIR spectrometer, Apodization-Happ-Genzel, with a wave length range from 650cm^{-1} to 400cm^{-1}, with precision of 8cm^{-1} and resolution software. Prior to analysis, the instrument was calibrated according to the manufacturer's specifications to ensure accuracy and reproducibility of the spectral measurements. The powdered biomass samples were prepared and analyzed under ambient laboratory conditions.

This instrument was used to identify the functional groups present in the seed residues by measuring their infrared absorption spectra. It provided insights into the chemical composition, including the presence of lignin, cellulose, hemicellulose, and other organic compounds. The spectra helped in understanding the structural characteristics that influence thermal stability.

A total of 16 background scans and 32 sample scans were carried out. The data interval provided by the instrument for a resolution of$8\ cm^1\ is\ 100\ cm^1$. A small quantity of the sample was deposited between two well-polished KBr disks, creating a thin film. Duplicate spectra were collected for the same sample. All spectra were recorded from $4000cm^1\ to\ 500\ cm^1$ and processed with the computer software program Spectrum for Windows (Perkin-Elmer).

FTIR Analysis Conditons

The prepared seed residue samples were subjected to FTIR analysis over the mid-infrared spectral region of$4000cm^1\ to\ 500\ cm^1$. Spectra were recorded with multiple scans averaged for each sample to improve the signal-to-noise ratio. Background spectra were collected before each measurement and automatically subtracted from the sample spectra to eliminate atmospheric interference. The resulting spectra were used to identify characteristic absorption bands associated with specific functional groups present in the biomass material. The spectra of both seed residues were compared to identify similarities and differences in their chemical composition.

Data Processing

The FTIR spectra obtained from the analyses were processed using the computer software program Spectrum for Windows (Perkin-Elmer). Baseline correction and spectral normalization were performed where necessary to enhance peak resolution and facilitate comparison between samples.

Functional groups were identified by assigning the observed absorption bands to their corresponding vibrational frequencies using standard FTIR reference data reported in the literature. The identified peaks were interpreted to determine the chemical constituents and structural characteristics of the seed residues, with particular emphasis on functional groups associated with cellulose, hemicellulose, lignin and other organic compound present in the biomass.

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RESULTS

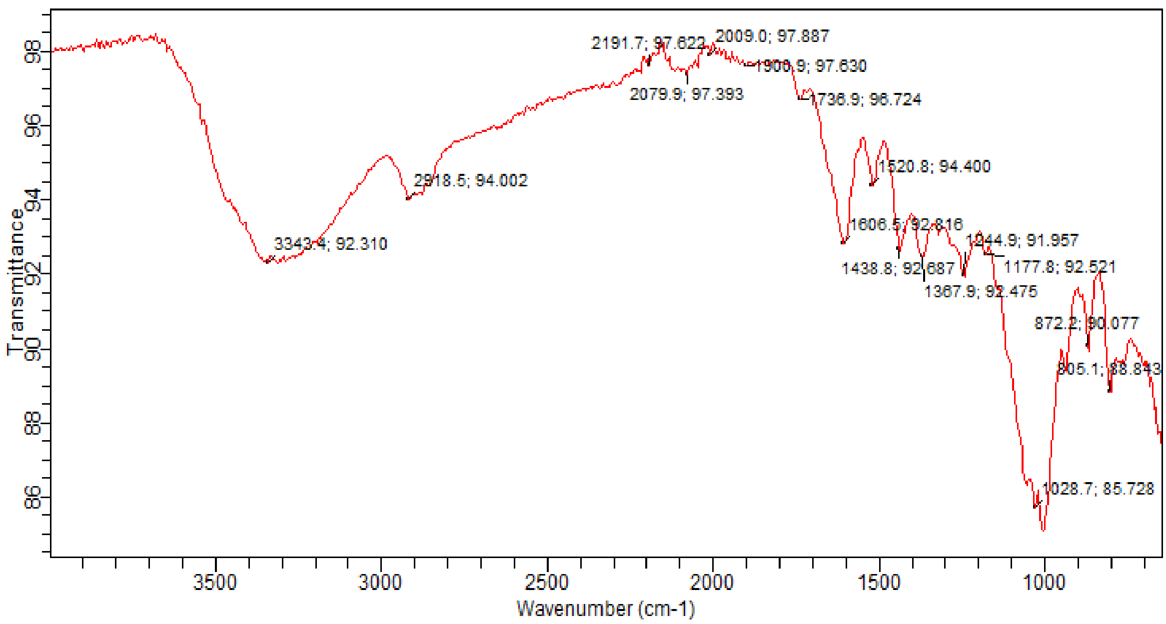
Fourier Transform Infrared (FTIR) spectroscopy analysis

The lignocellulosic cell wall consists of a complex network of cellulose, hemicellulose, and lignin, which are intricately bound together. The composition of these components varies depending on the biomass source. Fourier Transform Infrared (FTIR) spectroscopy is widely used to analyze the chemical composition of biomass and identify its functional groups (Sun et al., 2020). Figure 4.3 and 4.4 show the spectra for *Adonidia merrillii* and *Dacryodes edulis* seed residues, respectively, while Table 4.2 presents the spectral band assignment of *Adonidia merrillii* and *Dacryodes edulis*.

For *Adonidia merrillii*, the 3334.3cm^{-1} wave number is a broad peak that indicates hydroxyl groups, common in alcohols, phenols, or their presence. It shows a stretch H-bonded hydroxyl group. The peaks at 2918.5 cm^{-1} and 2850.8 cm^{-1} both indicate an Aliphatic C-H stretching vibration, typical for Alkanes or fatty acids. The 2079.9 cm^{-1} and 2009.0 cm^{-1} indicate the presence of unsaturated bonds such as alkynes or nitriles, they also show a carbon triple bond, C≡C, C=N. the peak at 1644.9 cm^{-1} is indicative of Alkenes or Amide functional group, likely a C=C stretch or amides (C=O), and confirms some degrees of unsaturation.1438.8 cm^{-1} and 1367.9 cm^{-1} show a functional group belonging to the CH_2 and CH_3 bending observed in compounds with methyl or methylene groups, common in alkanes or lipids. 1260.9 cm^{-1} and 1177.8 cm^{-1} have a mode vibration of stretching and suggest the presence of oxygenated groups, e.g., ethers, esters, or amines.1028.7 cm^{-1} is indicative of a single bond involving carbon and oxygen, typically seen in alcohols or esters.

For inference, *Adonidia merrillii* contains hydroxyl groups, pointing to possible alcohol or phenols. The saturated (C-H) and unsaturated (C=C, C=C) groups indicate a mixture of fatty acid derivatives. The potential carbonyl (C=O) and ether (C-O) or amine (C-N) stretches suggest that it contains esters, ketones, or proteins. This spectrum likely represents a biomaterial rich in lipids and other organic compounds, consistent with a plant-based source.

Figure 4.3: FTIR spectrum of *Adonidia merrilii*



Article DOI: 10.52589/IRME-LBAQ2SWR
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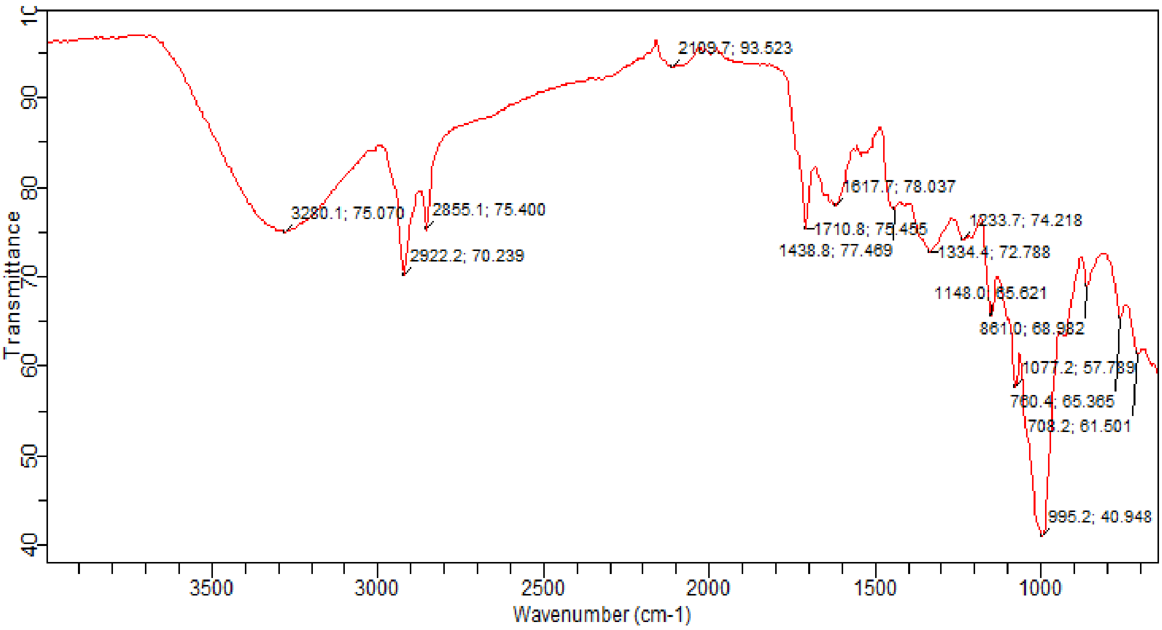
Table 4.2: FTIR spectra band assignment for *Adonidia Merilili* (Christmas palm)

Peak wavenumber (cm^{-1})	Functional Group	Type of Bond	Ref.
3334.3	Hydroxyl (O-H)	Alcohols (H-bonded O-H stretch)	(Schulz and Baranska, 2007)
2918.5	Alkane (C-H)	Asymmetric stretch	(Wu *et al.*, 2001)
2850.8	Alkane (C-H)	Asymmetric stretch	(Fung *et al.*, 1996)
2009.0 – 2079.9	Carbon triple bonds (C≡C, C≡N)	Unsaturated stretches	(Reusch, 2013)
1644.9 – 1608.0	Alkenes (C=C) or amides (C=O, N-H)	C=C stretch or C=O stretch	(Eckel *et al.*, 2001)
1438.8 – 1367.9	CH_2, CH_3 Bending	Alkane bending vibrations	(Fujioka *et al.*, 2004)
1260.9 – 1177.8	C-O, C-N	Ester, Ether, or Amine stretch	Department of Chemistry and Biochemistry,NIU (n.d.)
1028.7	C-O	Alcohols, ethers (C-O stretch)	Adebawo et al.,2022)

Figure 4.4: FTIR spectrum of *Dacryodes edulis*



For *Dacryodes edulis*, 3280 cm^{-1}: likely represents O-H stretching (hydroxyl groups, typically associated with alcohol or phenols) indicating strong hydroxyl functionality, possibly due to alcohols or water in the sample. 2922 cm^{-1} and 2856 cm^{-1}: typical for C-H stretching in alkanes, suggest aliphatic content in biomass, common in plant residue. 1710 cm^{-1} indicates C=O stretching (carbonyl groups, likely from esters or ketones), presence of carbonyl groups,

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possibly esters or ketones, indicates thermal or oxidative byproducts. 1148 cm^{-1}: likely indicative of C-O stretching in esters, ethers, or carbohydrates. 1438 – 1334 cm^{-1}: suggest deformation or bending modes, possibly from CH_2 or C-H bonds, 700 – 995 cm^{-1}: out-of-plane bending vibrations, possibly due to aromatic or alkene functional groups. <1000 cm^{-1}: likely deformation vibrations related to aromatic groups or unsaturated hydrocarbons.

Inference for *Dacryodes edulis*: this biomass contains O-H groups typical of alcohols or phenols, possibly from plant-based extracts. The prominent C=O stretches suggest esters, aldehydes, or fatty acids, supporting the lipid content. The presence of C-H stretches (alkanes) and C=C/aromatic groups indicates both saturation and unsaturation. It is likely to contain proteins, phenolics, or polyphenolic compounds (from –NH or aromatic peaks). The spectrum reflects the structure of a material rich in unsaturated fats, possibly with minor proteins or phenolic contributions.

Table 4.3: FTIR spectra band assignment for *Dacrayodes edulis* seed (African Pear)

Peak wavenumber (cm^{-1})	Functional Group	Type of Bond	Ref.
3280.1	Hydroxyl (O-H)	Alcohols, phenols (H-bonded O-H stretch)	(Dovbeshko et al., 2000)
2922.2	Alkane (C-H)	Asymmetric stretch	(Wu et al., 2001)
2855.1	Alkane (C-H)	Asymmetric stretch	(Fung et al., 1996)
2105.7	Carbon triple bonds (C≡C, C≡N)	Unsaturated stretches	(Reusch, 2013)
1710.8	carbonyl (C=O)	Ketones, esters, aldehydes	(Wu et al., 2001)
1617.6	Alkenes (C=O) or Aromatic rings	C≡C stretch in aromatics	(Dovbeshko et al., 2000)
1438.8	CH_2, CH_3 Bending	Alkane bending vibrations	(Yang et al., 2005)
1334.4	C-H, C-O, or N-H	Aromatics, phenols or amides	Department of Chemistry and Biochemistry,NIU (n.d.)
1148.0	C-O, C-N	Alcohols, ethers or amines	Department of Chemistry and Biochemistry,NIU (n.d.)
995.2	C=C Bending	Alkenes or aromatic out-of-plane bending	(Adebawo et al., 2022)

Comparative Analysis

Both spectra show broad O-H stretches around 3300cm^{-1}, confirming Alcohols or phenols in the plant-derived samples. Both spectra exhibit C-H stretches (saturation) and unsaturated peaks (C≡C) or C=C, but *Dacryodes edulis* has stronger unsaturation based on its aromatic or alkyne features.

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Dacryodes edulis exhibits a stronger and clearer C=O stretch at 1710.8 cm^{-1} than Christmas Palm, indicating more lipidic esters or ketones. *Dacryodes edulis* shows a broader range of functional groups (phenols, esters, amides alkenes), suggesting it may have a higher diversity of organic compounds.

APPLICATIONS

These analyses can serve to:

Confirm the presence of lipids, phenolics, or carbohydrates in both samples, and determine chemical components if the goal is to use these materials for energy production, nutritional profiling, or functional group modification for engineering applications. It could predict physical and chemical behaviors such as thermal stability, solubility, and reactivity.

Lipids (Fatty Acids)

Energy Application: The C-H stretching vibrations (2922.2 – 2855.1 cm^{-1}), characteristic of lipids or fatty acids, and the C=O carbonyl stretch (1710.8 cm^{-1}) which is common in esters (triglycerides) and free fatty acids are applicable in energy production. Lipids are a key component for biodiesel production. Through transesterification, triglycerides in the material can be converted into fatty acid methyl esters (FAME). Unsaturated C=C bonds suggest that these lipids may have high calorific value, making them suitable for bio-oil or biogas.

Engineering Application: The hydrocarbon chains make these biomaterials ideal for polymer modification or reinforcement of bio-composite. Functionalization of fatty acids enables the creation of bio-based adhesive coating or resins.

Phenolic Compounds

The broad O-H peak (3280.1 – 3334.3 cm^{-1}) indicates the presence of hydroxyl groups typical of phenolic and the aromatic features (1617.6 cm^{-1}) further confirm the existence of phenolic or lignin-driven substances.

Energy production: phenolic compounds enhance biochar production during pyrolysis, increasing the energy density and carbon content. High thermal decomposition efficiency due to aromaticity makes them suitable for thermochemical processes like gasification or pyrolysis.

Engineering application: polyphenols can be chemically modified for resin synthesis or anticorrosive coatings. The aromatic rings can be used in cross-linked polymer matrices for bio-based construction materials.

Carbohydrates (cellulose and Hemicellulose)

The C-O stretching peaks (1260.9 – 1028.7 cm^{-1}) are typical of polysaccharides like cellulose and hemicellulose. The sharp peaks around 1148.0 – 995.2 cm^{-1} are consistent with cyclic structure in carbohydrate backbones.

Energy production: carbohydrates are precursors for bioethanol production through enzymatic hydrolysis and fermentation. During pyrolysis, these components break down to produce synthesized gas (syngas) or bio-oil.

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Engineering Application: Cellulose can be used in fiber-reinforced composites, biogradable films, and structural biomaterials. Chemical modifications (via hydroxyl and ether groups) enable development of hydrogels or cross-linked polymers for water purification or biochemical applications.

Proteins and Amides

Amide peaks (possible C=O stretching around 1644.9 cm^{-1} and N-H stretches at 1438.8-1334.4 cm^{-1} indicate trace proteins. N-H bending suggests protein degradation or the presence of nitrogen-containing compounds.

Energy Production: protein provides a nitrogen source in the biogas digester, improving the nutritional value for microbial activity during anaerobic digestion. Amides in these compounds stabilize the formation of biochar with high nitrogen content for soil amendment.

Engineering Application: Nitrogen-containing functionalities can be used to develop functionalized adsorbents for heavy metal removal in wastewater treatment.

Unsaturated Compounds

The C=C (1617.6 cm^{-1}) and C=C (2105.7 – 2079.9 cm^{-1}) bonds indicate the presence of alkenes and alkynes. Unsaturation is critical for chemical reactivity and energy conversion processes.

Energy production: unsaturated compounds enhance thermal cracking efficiency. This can produce hydrogen or synthetic fuels during pyrolysis. Double and triple bonds serve as active sites for catalysts in biodiesel or bio-oil upgrading.

Engineering Application: unsaturation allows graft polymerization or functionalization to form advanced polymer composites with enhanced mechanical and thermal properties. Double bonds can be exploited for vulcanization reactions in rubber applications.

Aromatic and Cyclic Structures

Aromatic C=C peaks (1617.6 cm^{-1}) suggest lignin or other aromatic compounds. Out-of-plane bending peaks around 995.2 cm^{-1} confirm the aromacity.

Energy production: Aromatic compounds in lignin yield high-carbon biochar, which are excellent for long-term carbon sequestration and soil enrichment. Aromacity contributes to stable thermal decomposition products during pyrolysis or gasification.

Engineering Application: Lignin-based aromatic units are used in polyurethane synthesis, thermoplastics, and bio-based adhesives. Aromacity improves structural integrity in fire-resistant materials.

In summary, Christmas Palm and African Pear biomaterials possess diverse organic functional groups that make them highly versatile for energy and engineering applications. Their rich composition of lipids, phenolics, carbohydrates, and unsaturated compounds presents opportunities for biofuel production, functionalized composite materials, and sustainable chemical modifications.

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CONCLUSION

The *Adonidia merrillii* and *Daceyodes edulis* biomaterials possess diverse organic functional groups that make them highly versatile for energy and engineering applications.

The study successfully analyzed the chemical properties of *Adonidia merrillii* and *Daceyodes edulis* seed residue using FTIR spectroscopy and thermogravimetric analysis. The FTIR spectroscopy showed a clear distinction between *Adonidia merrillii* and *Dacryodes Edulis* seed residues and revealed the presence of key functional groups like the OH, C=O, CH, and C-O in both samples. The relationship between their chemical composition shows that these seed residues have potential applications in bioenergy and material science. The findings contribute to the ongoing exploration of agricultural waste valorization for environmental and industrial benefits.

REFERENCES

Adaramola, B., Ademoyegun, O., & Ajibade, V. A. (2019). Optimization of the drying and rehydration conditions of African pear (Dacryodes edulis) fruit. *Food Science & Nutrition,* 7(10), 3364-3371.

Adebawo, F. G., Akinyemi, B. T., & Adebayo, G. B. (2022). Characterization of acetylated mahogany (Daniella oliveri) and mango (Mangifera indica) wood tablets and their resistance to biodegradability. *International Journal of Nanomaterials and Molecular Nanotechnology.* Retrieved from https://www.pubtexto.com\

Ajala, O., Oyeyinka, S., & Akinlua, A. (2020). Optimization of oil extraction from African pear (Dacryodes edulis) seed and characterization of its protein concentrate. *Journal of Food Measurement and Characterization,* 14(3), 1646-1656.

Demirbas, A. (2010). Use of algae as biofuel sources. *Energy Conversion and Management*, 51(12), 2738-2749.

Department of Chemistry and Biochemistry, Northern Illinois University. (n.d.). IR absorption frequencies. Retrieved from https://www.niu.edu

Dovbeshko, G. I., Gridina, N. Y., Kruglova, E. B., & Pashchuk, O. P. (2000). FTIR spectroscopy studies of nucleic acid damage. *Talanta*, 53(1), 233-246.

Eckel, R., Huo, H., Guan, H. W., Hu, X., Che, X., & Huang, W. D. (2001). Characteristic infrared spectroscopic patterns in the protein bands of human breast cancer tissue. *Vibrational Spectroscopy*, 27(2), 165-173.

Fujioka, N., Morimoto, Y., Arai, T., & Kikuchi, M. (2004). Discrimination between normal and malignant human gastric tissues by Fourier transform infrared spectroscopy. *Cancer Detection and Prevention*, 28(1), 32-36.

Fung, M. F. K., Senterman, M. K., Mikhael, N. Z., Lacelle, S., & Wong, P. T. (1996). Pressure-tuning Fourier transform infrared spectroscopic study of carcinogenesis in human endometrium. *Biospectroscopy*, 2(3), 155-165.

García, R., & Pizarro, C. (2015). A review of recent advances in biomass characterization using spectroscopic and thermal techniques. *Analytica Chimica Acta*, 956, 1-16.

Noltie, H. J. (1994). The palms of the Malay Peninsula. Kuala Lumpur: *Forest Research Institute Malaysia*

Article DOI: 10.52589/IRME-LBAQ2SWR
DOI URL: https://doi.org/10.52589/IRME-LBAQ2SWR

Olukunle, O. J., Adepoju, T. F., & Onifade, K. R. (2018). Potential of African pear (Dacryodes edulis) seed oil as biodiesel feedstock. *Journal of King Saud University - Science,* 30(4), 564-569.

Pandey, V. C., Singh, K., Singh, J. S., Kumar, A., & Singh, B. (2017). Potential of biomass production from agro-wastes and their utilization for bioenergy purposes. *Energy Reports,* 3, 251-255.

Rathore, D., & Madan, S. (2018). Comprehensive review on biomass energy resources, potential, conversion and policies in India. *Renewable and Sustainable Energy Reviews*, 89, 92-109.

Reusch, W. (2013). Infrared spectroscopy. Retrieved from *https://www2.chemistry.msu.edu*

Rocha, J. D., Almeida, M. F., & Queiroz, M. R. (2007). Ethanolysis of palm oil: A kinetic study. *Journal of the Brazilian Chemical Society*, 18(2), 356-361.

Sanusi, S. A., Abd-Aziz, S., Mohamad, R., Hassan, M. A., Shirai, Y., & Nishida, H. (2016). Potential of palm kernel cake as substrate for cellulase and xylanase production by Aspergillus terreus SUK-1: Application of crude enzymes in hydrolysis of palm kernel cake and oil palm empty fruit bunches. *Waste Management*, 49, 111-120.

Schulz, H., & Baranska, M. (2007). Identification and quantification of valuable plant substances by IR and Raman spectroscopy. *Vibrational Spectroscopy*, 43(1), 13-25.

Sharma, Y. C., Singh, B. & Korstad, J. (2011). Valorization of agricultural biomass for bioenergy: Opportunities and challenges. *Renewable and Sustainable Energy Reviews*, 15(9), 504-515.

Sun, S.,Cao, X., & Sun, R. (2020). The role of lignin in the biochemical conversion of lignocellulose to biofuels and bioproducts. *Industrial Crops and Products, 140*, 111698.

Wu, J. G., Xu, Y. Z., Sun, C. W., Soloway, R. D., Xu, D. F., Wu, Q. G., & Xu, G. X. (2001). Distinguishing malignant from normal oral tissues using FTIR fiber-optic techniques. *Biopolymers: Original Research on Biomolecules*, 62(4), 185-192.

Yang, Y., Sulé-Suso, J., Sockalingum, G. D., Kegelaer, G., Manfait, M., & El Haj, A. J. (2005). Study of tumor cell invasion by Fourier transform infrared microspectroscopy. *Biopolymers: Original Research on Biomolecules*, 78(6), 311-317.

Article DOI: 10.52589/IRME-LBAQ2SWR
DOI URL: https://doi.org/10.52589/IRME-LBAQ2SWR