Foods 2024 Conference
The 5th International Electronic Conference on Foods
28–30 October 2024 | Online
MDPI

Determination through ATR-FTIR Spectroscopy of the Structural Changes in Dietary Fiber from Pacaya (*Chamaedorea tepejilote* Liebm) Modified by Thermal, Acid, and Alkali Treatments

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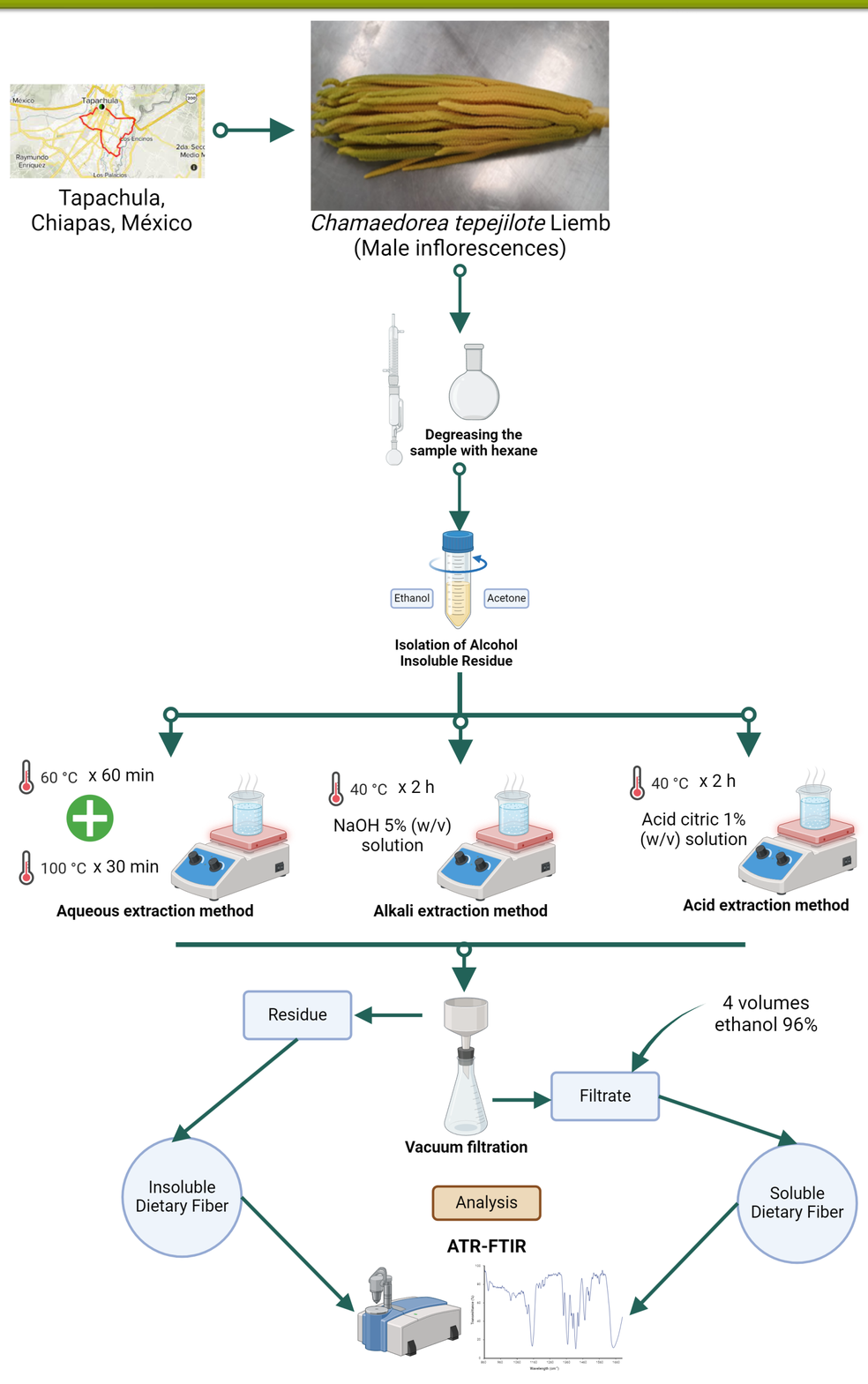
INTRODUCTION & AIM

Fourier Transform Infrared (FTIR) Spectroscopy has established itself as a valuable technique for the analysis of dietary fiber in foods. This methodology allows for the identification of the chemical components present in the fiber, providing information about its structural and functional composition. By taking advantage of FTIR's ability to detect molecular vibrations, spectra can be obtained that reflect the diversity of polysaccharides and other non-carbohydrate compounds in food matrices. Additionally, FTIR is a rapid, non-destructive, and low-cost technique, making it ideal for application in the food industry and nutritional research. Its integration with other analytical techniques can further enrich the understanding of dietary fiber and its implications for human health.

***Chamaedorea tepejilote* Liebm (pacaya or tepejilote)** is a native palm from the American continent. In Mexico, it grows in Veracruz, Oaxaca, and Chiapas states—the male inflorescences are consumed as a traditional dish after applying some thermal treatment due to their bitter after taste. Like many other fibers from natural plant sources, tepejilote fiber is primarily composed of cellulose, hemicellulose, and lignin. These compounds make it strong and durable, which allows it to serve a structural role in the plant, giving rigidity to the stems and leaves.

The objective of this study is to characterize the soluble and insoluble fiber of tepejilote using ATR-FTIR spectroscopy.

METHOD



RESULTS

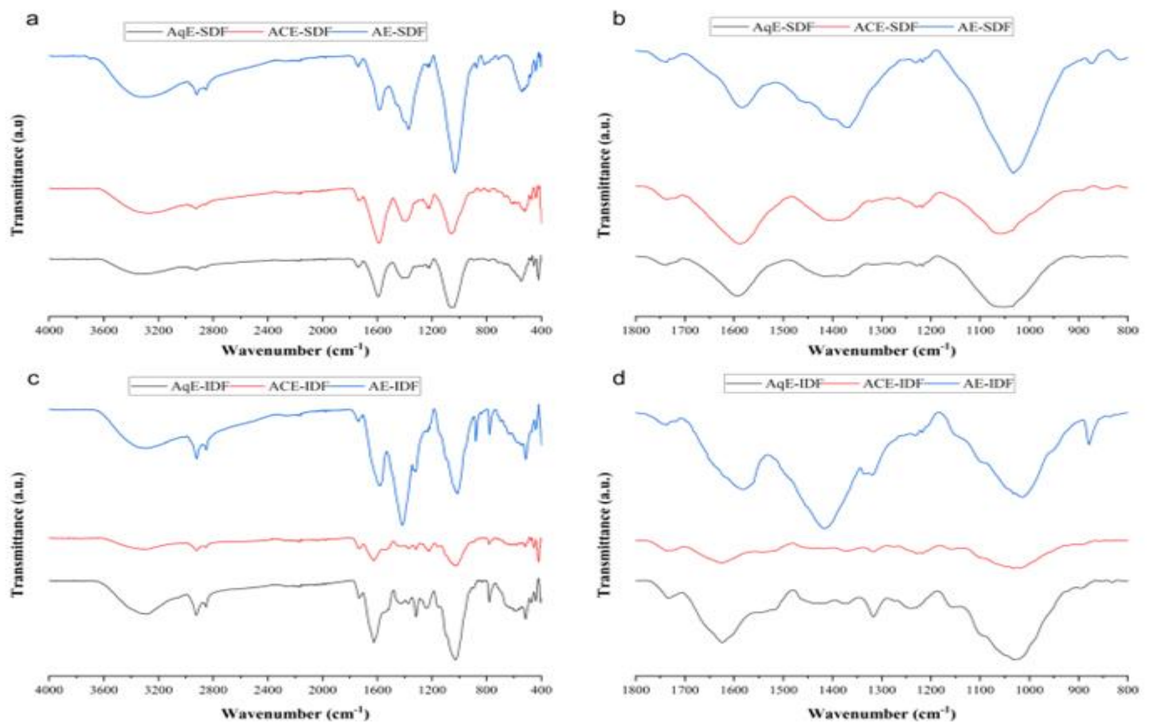


Figure 2. ATR-FTIR spectra from soluble and insoluble DF extracting with different extraction methods. Soluble DF at **a)** 4000 to 400 cm^{-1} and **b)** 1800 to 800 cm^{-1}(fingerprint region); insoluble DF at **c)** 4000 to 400 cm^{-1} and **d)** 1800 to 800 cm^{-1} (fingerprint region). *Abbreviations:* soluble DF from aqueous extraction (AqE-SDF), insoluble DF from aqueous extraction (AqE-IDF), soluble DF from citric acid extraction (ACE-SDF), insoluble DF from citric acid extraction (ACE-IDF), soluble DF from alkali extraction (AE-SDF), insoluble DF from alkali extraction (AE-IDF).

Table 1. Main FTIR signals indicating molecular vibrations associated with pectins, hemicelluloses and cellulose, found in the present work.

Wavenumber (cm^{-1})	Component	Functional Group	Description	Soluble/Insoluble Fiber
3300 - 3500	Cellulose	–OH (hydroxyl groups)	Stretching of intramolecular and intermolecular –OH bonds	Insoluble
2900 - 2940	Cellulose, Hemicellulose	C–H (alkyls)	Stretching of C–H bonds	Insoluble/Soluble
1730 - 1750	Hemicellulose, Pectins	C=O (carbonyl of esters, acetyl, uronic groups)	Stretching of C=O in hemicelluloses (xylans, acetylated) and pectins	Soluble
1640 - 1660	Cellulose, Pectins	H-O-H (absorbed water)	Bending vibration of absorbed water	Insoluble/Soluble
1420 - 1440	Cellulose, Hemicellulose	CH_2 (methylene groups)	CH_2 bending vibration, characteristic of crystalline cellulose	Insoluble/Soluble
1360 - 1375	Cellulose, Hemicellulose	C–H (deformation)	In-plane deformation of C–H bond	Insoluble/Soluble
1230 - 1260	Lignin	C–O (aryl ester bonds)	Stretching of C–O bonds in lignin	Insoluble
1150 - 1160	Cellulose, Hemicellulose	C–O–C (glycosidic bonds)	Stretching of C–O–C bonds, typical of polysaccharides	Insoluble/Soluble
1030 - 1050	Cellulose, Hemicellulose, Pectins	C–O (alcohols and ethers)	Stretching of C–O in primary and secondary alcohols	Insoluble/Soluble
830 - 900	Cellulose	β-glucosidic (deformation vibration)	Indicative of β-1,4-glucan structure in cellulose	Insoluble

CONCLUSION

The results showed changes in the intensity of the absorption bands of some functional groups related to the structure of cellulose, some hemicelluloses, pectins, and lignin. In particular, the alkaline treatment caused the hydrolysis of some of these components of the FD, such as cellulose, hemicelluloses, and pectins.

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