# Environmentally Friendly Microwave Assisted Extraction of Cellulose from Waste Olive Wood by using Alkali

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**Abstract:** There has been an increasing focus on creating sustainable techniques for obtaining cellulose from natural sources in recent years. Waste olive wood (OW) is an abundant and sustainable resource that may be used for extracting cellulose using a microwave assisted extraction (MAE) method that is ecologically benign. The objective of this work is to create a MAE technique that is both eco-friendly and efficient for obtaining cellulose from olive wood waste, using alkali as a key component. The extraction procedure yielded 41.76% of at 100 $^0$C for 20 minutes and the resulting cellulose had a crystallinity index of 62.24%. Scanning electron microscopic (SEM) image, Fourier transform infrared (FT-IR) and thermogravimetric analysis (TGA) also revealed that the microwave with alkali successfully extracted the cellulose from waste OW. Microwave technology has considerably decreased the extraction time and energy use in comparison to conventional extraction techniques, hence enhancing the sustainability and efficiency of the process. The extracted cellulose may be used in biodegradable textiles including clothing, non-woven fabrics, and technical textiles, as well as packaging and biomedical applications. The results of this research demonstrate that it is possible to extract high-quality cellulose from discarded olive wood.

***Keywords:*** *microwave, extraction, cellulose, environmentally*

### Experimental

The olive wood powder was first subjected to treatment in NaOH solution (7% w/v) by using a microwave with open vessel configuration in a round bottom flask. The reaction was conducted for 20 minutes at temperature of 90$^0$C and 100$^0$C where the microwave power was 200 watt for both case. The extracted components were passed through a glass microfiber filter (MFV3; filter lab) to separate the solid component. The solid component underwent three rounds of washing with distilled water to get a neutral pH level. The material was dried in an oven. Then, the alkaline treated samples were subjected to bleaching using 1.5% (w/v) sodium chlorite and 0.5% (w/v) acetic acid in a microwave. The pH of the solution was adjusted to a range 4–5 by using acetic acid. The reaction mixture was exposed to microwave irradiation at 70°C for 15 minutes. At the end of the irradiation, the resultant solid material was filtered under vacuum and then washed three times with distilled water until it reached a neutral pH and dried in an oven.

### Results and Discussion

Table 1 shows the cellulose yield and crystallinity index of the extracted cellulose. The increase in crystallinity index (CI) values at elevated temperatures may be linked to the elimination of amorphous part of lignocellulosic biomass, resulting in an increase in crystallinity (Fig.1-a).

**Table 1** Microwave extraction parameters, cellulose yiled and crystlanity index.

| Microwave process parameters | *Alkali concentration* | *Cellulose yield (%)* | *Crystallinity index (%)* |
|---|---|---|---|
| Temp. 90 ºC | 7% (w/v) | 38.45 | 61.53 |
| Temp.100ºC | | 41.76 | 62.24 |

The SEM image (Fig. 1-b) illustrates that the cellulose loses its smooth surface, leading to an irregular surface. This behavior may indicate the removal of the exterior non-cellulosic material present in waste OW [1]. FT-IR analysis further indicates that several distinct peaks disappeared because of the extraction of lignin, hemicellulose, and non-cellulosic substances from the waste OW [2]. The TGA study revealed that the peak corresponding to the second degradation stage, which is linked to the breakdown of hemicelluloses, a part of lignin, and other non-cellulosic components, eliminated.

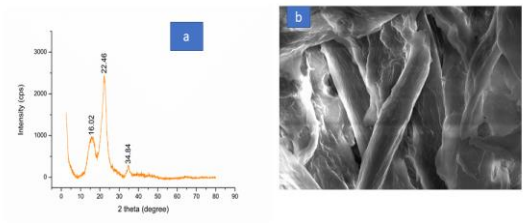


**Figure 1** X-ray diffraction (a) and Scanning electron microscopic (b) images of extracted cellulose.

### Conclusion

The findings of this work suggest that an MAE strategy using alkali has the potential to be a simple, environmentally friendly, and more efficient alternative to conventional methods for extracting cellulose from waste OW.

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