Characterization and properties of cellulose microfibers and nanofibers from agave gigantea filled Polyvinyl alcohol biocomposites

Edi Syafri, Jamaluddin, Nasmi Herlina Sari

Abstract

Nanocellulose is a renewable and biocompatible nanomaterial that evokes much interest because of its versatility in various applications. This study reports the production of nanocellulose from Agave gigantea (AG) fiber using the chemical-ultrafine grinding treatment. Chemical treatment (alkalization and bleaching) removed noncellulose components (hemicellulose and lignin), while ultrafine grinding reduced the size of cellulose microfibrils into nanocellulose. From the observation of Transmission Electron Microscopy, the average diameter of nanocellulose was 4.07 nm. The effect of chemical-ultrafine grinding on the morphology and properties of AG fiber was identified using chemical composition, Scanning Electron Microscopy, X-ray Diffraction, Fourier Transform Infrared, and Thermogravimetric Analysis. The CMF and CNF from Agave gigantea fiber as a filler in Polyvinyl Alcohol biocomposites was investigated. Biocomposites were made by using solution casting. The biocomposites were also determined by tensile test, FTIR, X-Ray, thermogravimetric, SEM, and soil burial tests. The results show that the CNF sample has the highest tensile strength of 26,15 MPa than those other samples. Scanning Electron Microscope (SEM) images show that the strong interaction was formed between CNF AG and PVA matrix.


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Introduction

- Nanocellulose is a renewable and biocompatible nanomaterial that evokes much interest because of its versatility in various applications.
- This study reports the production of nanocellulose from Agave gigantea (AG) fiber using the chemical-ultrafine grinding treatment.
- The aim of the current study is

1. to extract and characterize cellulose nanofiber from Agave gigantea fibers
2. **Characterization and properties of cellulose microfibers and nanofibers from agave gigantea filled Polyvinyl alcohol biocomposites**

Methods

1

Fiber extract and preparation of CNFs

(Syafri et al., 2022)

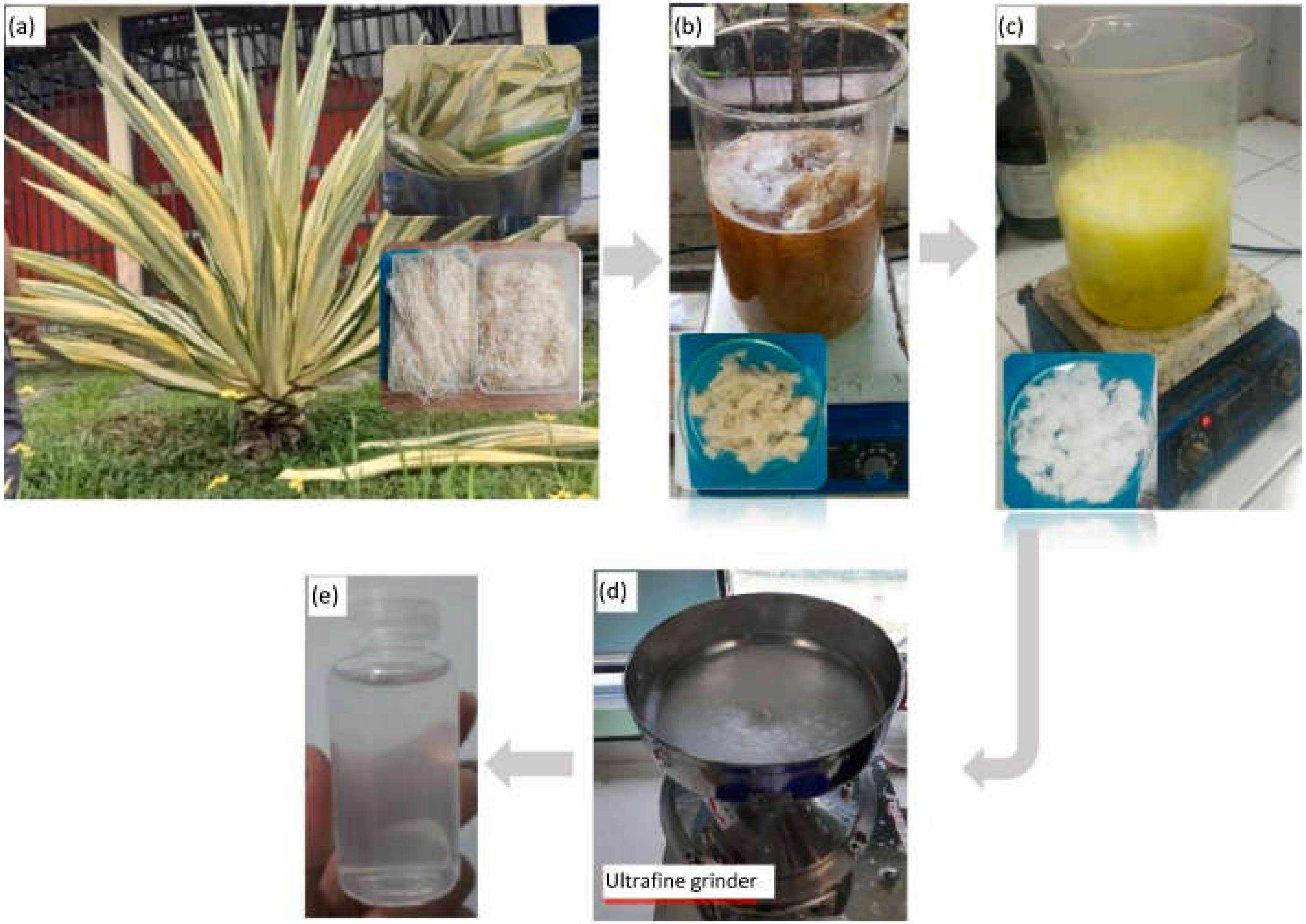


Fig. 1. (a) Leaves of AG fiber and AG fiber, (b) alkalization, (c) bleaching, (d) ultrafine grinding process, (e) CNFs AG.

II. PVA/Cellulose Microfiber (CMF/U1/U2) AG blend film:

- CMF (5%) and PVA (10 g) were incorporated into distilled water (100 mL). The blend was heated with the magnetic stirrer at 70 ° C and 500 rpm for 2 h until gelatinization.
- The resulting gel was treated with 600 W for 5 min using the ultrasonic .
- The sonicated gel in a Petri dish was dried for 20 h in a 50 ° C vacuum drying oven at 0.6 MPa.

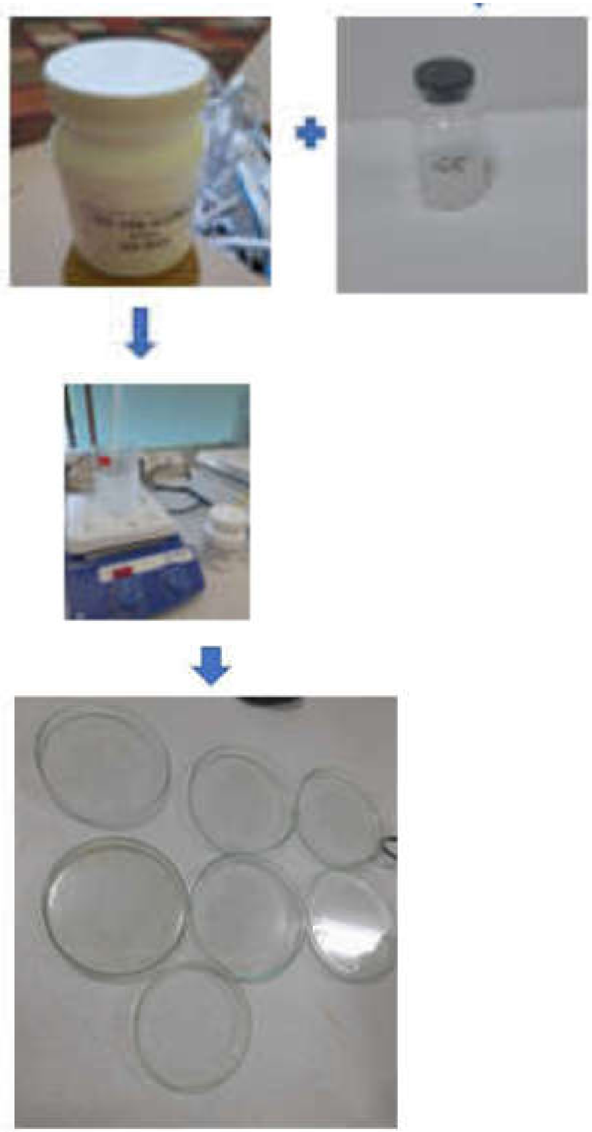


Fig. 1 (Pabrication of blend film)

Result and Disscussion

Table 1

Chemical composition of AG fiber.

Fiber treatment	Cellulose (%)	Lignin (%)	Hemicellulose (%)
Raw AG fiber	74.22	0.37	8.47
Alkalized AG fiber	88.54	0.41	3.54
AG fiber bleaching	89.39	0.53	3.73

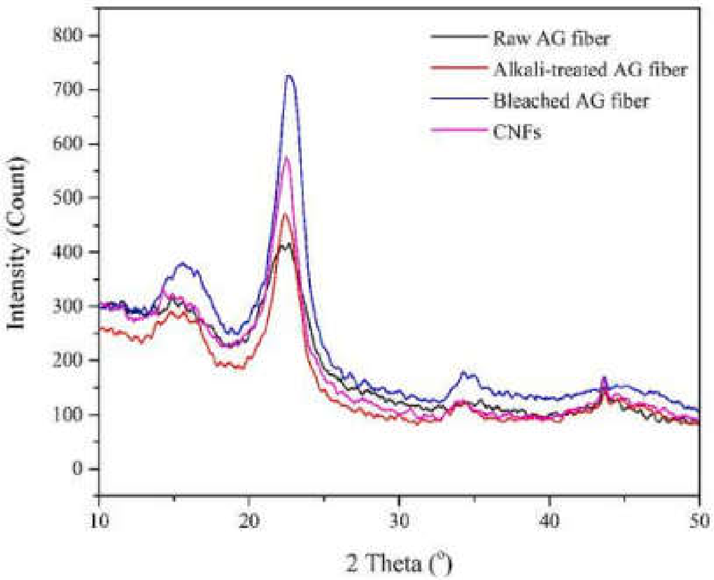


Fig. 1. XRD curves of raw AG fiber; alkalization, bleaching, and mechanical treatment.

Fig. 2 shows the intensity of the diffraction peaks indicated by two theta angles of about 15.6, 22.6, and 34.2°, indicating cellulose I

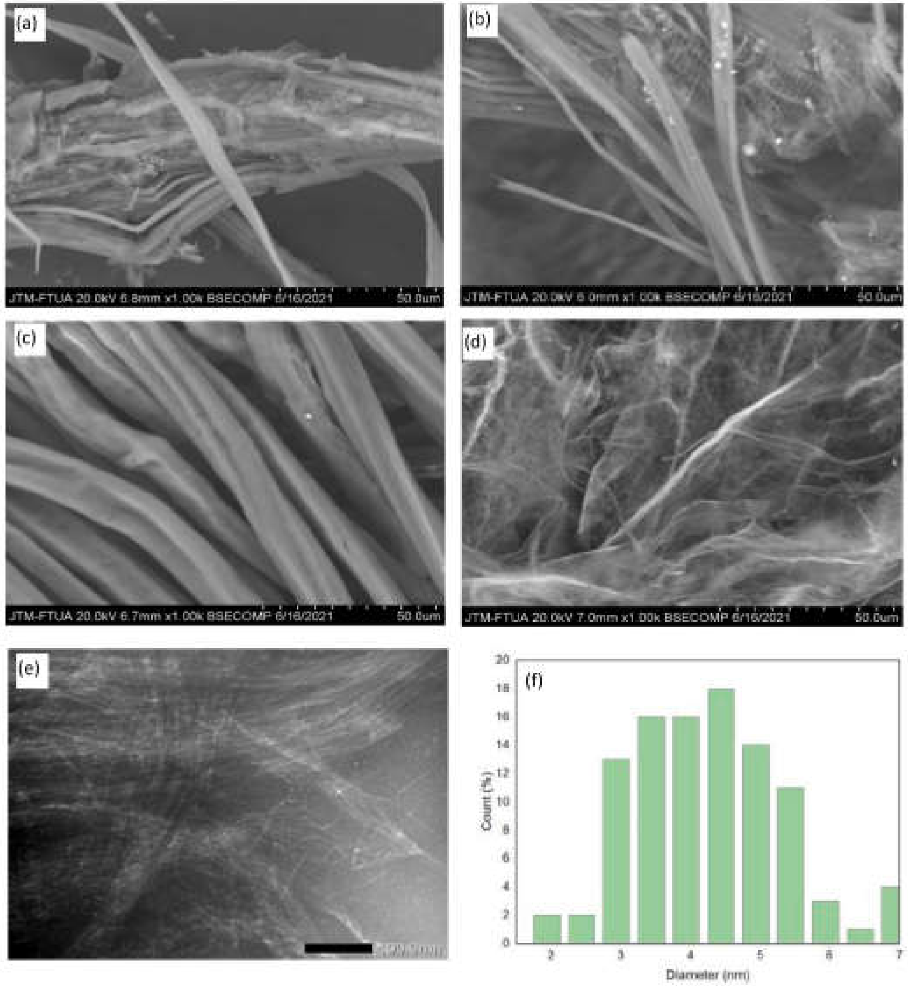


Fig. 2. SEM micrographs of AG fiber raw AG fiber (a); alkalization (b); bleached (c); ultrafine grinding (d); and TEM micrographs of CNFs AG (e); and size of CNFs AG (f).

3.2. Film Transparency

Fig. 3. PVA/CNF AG blend film

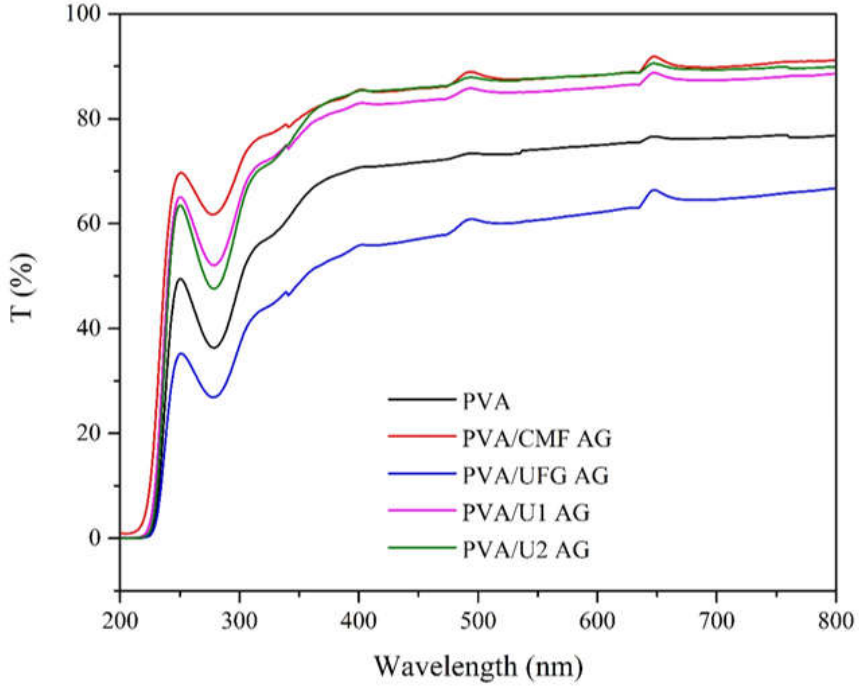
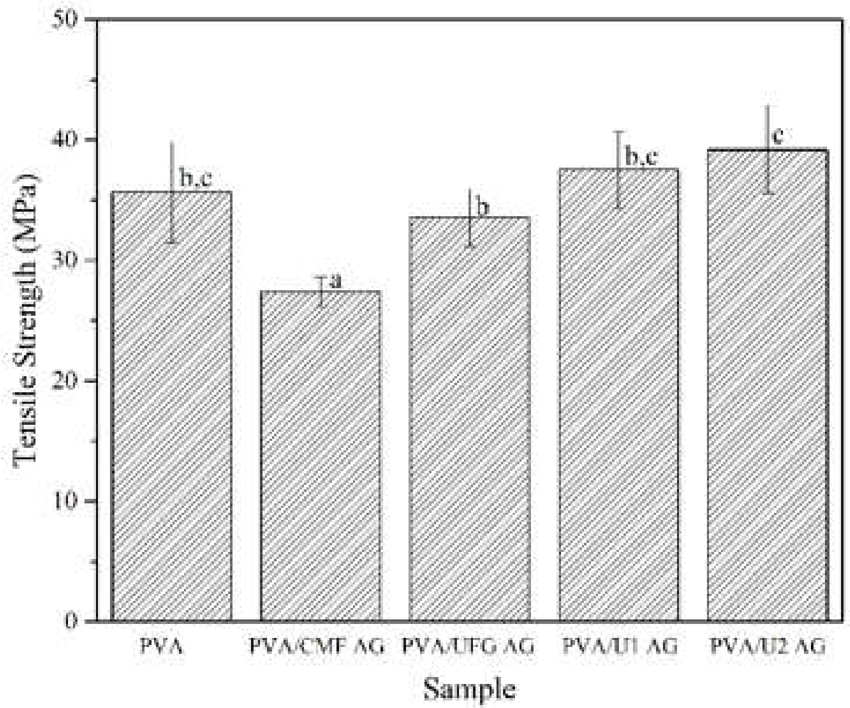
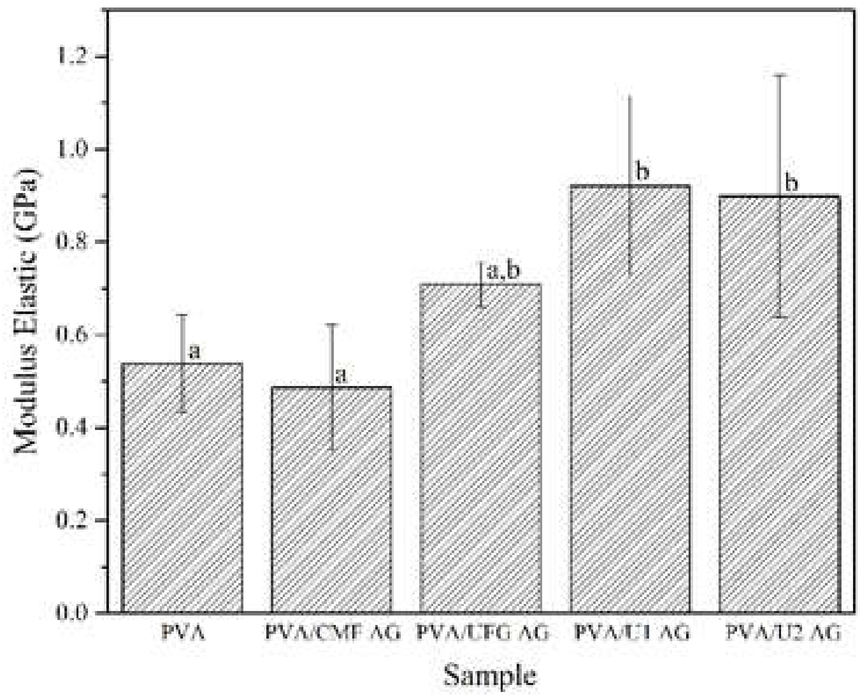


Fig. 4. Transmittance versus wavelength of all samples.

PVA films with a mixture of CMF, U1, and U2 AG fibers exhibited high transparency of about 90%, 87%, and 89%, respectively

3.3. Mechanical Properties





Regarding the tensile strength of the PVA film, it showed a value of 27.40 MPa. It did not increase significantly with the addition of UFG to 33.55 MPa. However, after adding U2 AG, the tensile strength increased by 17% (39.20 MPa).

This can be attributed to the intra or intermolecular hydrogen bonding of nanocellulose with PVA increasing its elasticity and tensile properties

Conclusion

- AG fiber treated with bleaching for 2 h showed the highest cellulose content after removing 56% hemicellulose. Mechanical treatment was successful in the production of nanocellulose with an average diameter of 4.07 nm.
- All PVA biocomposites the addition of AG fiber showed an increase in crystallinity compared to pure PVA films.
- The cellulose AG fiber's size can affect the PVA matrix's strengthening effect.

References

ASTM D1003. Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics. Am Soc Test Mater 2006.

ASTM D638-V. Standard Test Method for Tensile Properties of Thin Plastic Sheeting. Am Soc Test Mater 2012.

Mahardika M, Abral H, Kasim A, Arief S, Hafizulhaq F, Asrofi M. Properties of cellulose nanofiber/bengkoang starch bionanocomposites: Effect of fiber loading. LWT 2019:108554.

Syafri, E., Sari, N. H., Mahardika, M., Amanda, P., & Ilyas, R. A. (2022). Isolation and characterization of cellulose nanofibers from Agave gigantea by chemical-mechanical treatment. *International Journal of Biological Macromolecules*, *200*, 25-33.