Physico-chemical properties of *Manihot esculenta*-based composite films

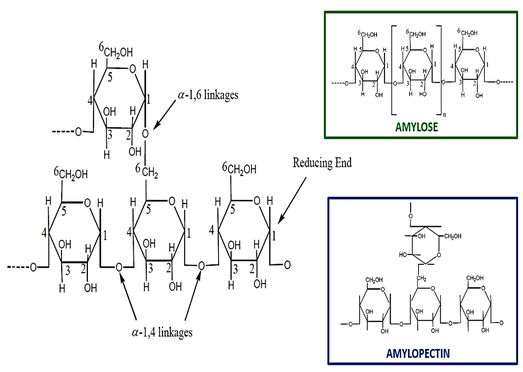
Jujen P. Bacotot*, Reynaldo M. Vequizo

Materials Science Laboratory, Department of Physics, College of Science and Mathematics, Mindanao State University-Iligan Institute of Technology, Iligan City 9200 Philippines

Nanoscience Group, Premier Research Institute of Science and Mathematics (PRISM), Mindanao State University-Iligan Institute of Technology, Iligan City 9200 Philippines

***E-mail: jujen.bacotot@g.msuiit.edu.ph**

Introduction



Manihot esculenta (Me)

Physico-chemical analysis is a good approach to understand the filmogenic characteristics of composite film. *Manihot esculenta* (*Me*) is composed of two structurally different polysaccharides; *amylose* and *amylopectin.* It has excellent renewability, availability, clarity and cost-effectiveness.

Focus Problem

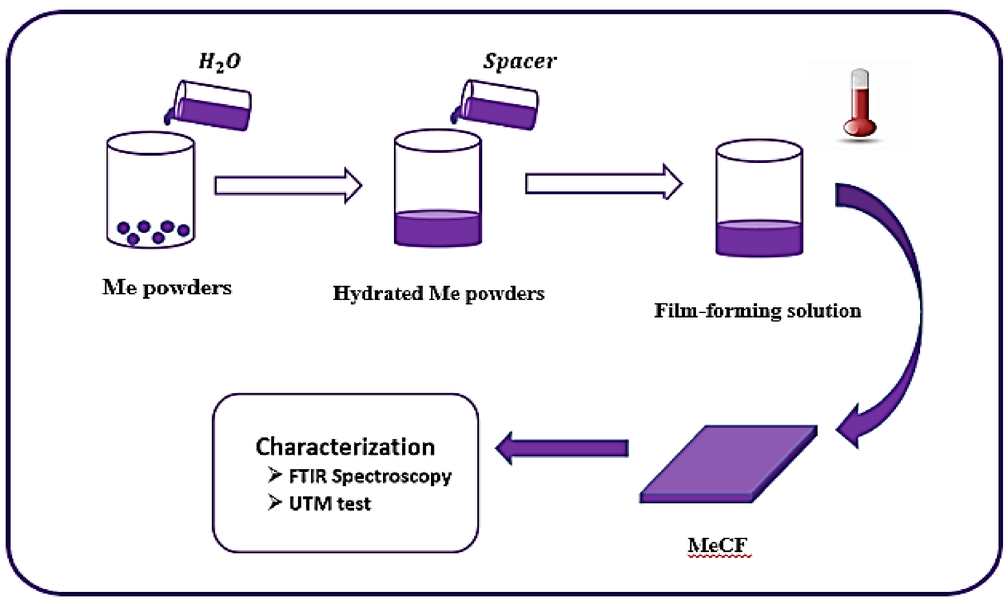
- ***Me*-based composite films (*MeCFs*) are brittle during long term storage**
- **Despite that various studies were done to improve the limitations of *Manihot esculenta*-based composite films (*MeCFs*), no reports were conducted on the correlation between its functional groups and mechanical properties.**

Application

Food industry

Household products

Methodology



References

- María Guadalupe Lomelí-Ramírez, Arturo Javier Barrios-Guzmán,Salvador García-Enriquez,José de Jesús Rivera-Prado,and Ricardo Manríquez-Gonzáleza, ISSN: 19302126.
- David Roylance, *Mechanical properties of materials*, 2008.
- Retrieve from: 1. https://www.bing.com/images

Acknowledgement

The authors would like to thank the following: DOST-PCIEERD for the equipment used in this study, DOST-ASTHRDP for the scholarship. PRISM, Department of Physics, MSU-IIT.

Results and Discussion

FTIR spectroscopy

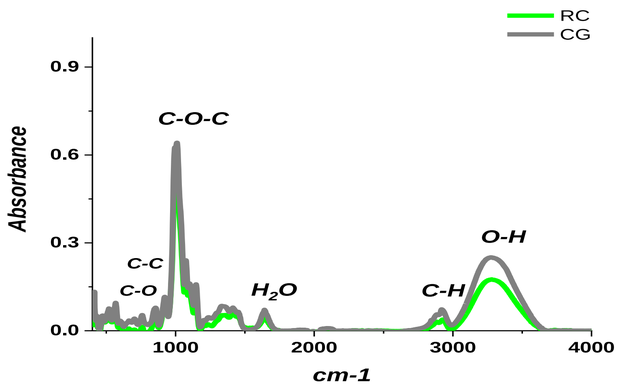


Figure 1. The mid-infrared spectra of *Manihot esculenta*-based composite films (MeCFs).

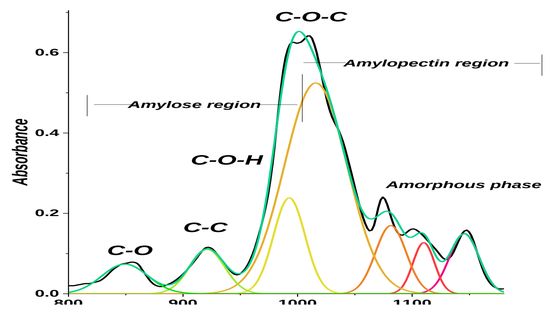


Figure 2. Fingerprint region of *Manihot esculenta*-based composite films.

- **RC-MeCFs exhibited fingerprint regions from 400-1200cm^{-1};**
- **CG-MeCFs showed high absorption peaks compared to raw films RC-MeCFs**
- **C-O, C-C, C-O-H stretching of amylose were observed;**
- **Broad O-H and C-H stretching of amylopectin were also observed, so as**
- **C-O-C stretching of $\alpha-$glycosidic linkages of amylose and amylopectin.**

- **MeCFs exhibited high elongation at break than the reported raw *Manihot esculenta* film.**
- **Spacer S1 solves the problem of brittleness of *MeCFs* by increasing the mobility and flexibility of molecules.**

Mechanical Properties

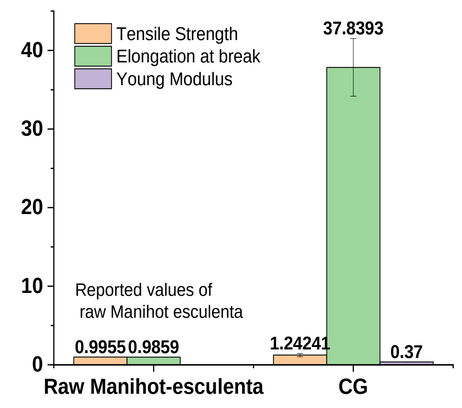


Figure 3. The Tensile strength, elongation at break and young modulus of *MeCFs*.

Correlation Analysis

The Pearson correlation *r* expressed below is the most frequent way to use in comparing numerical variables *x* & *y*; wherein it assigns a number between *1* and *-1*, where *0* is no correlation, *1* is entire positive correlation, and *-1* is total negative correlation.

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}}$$

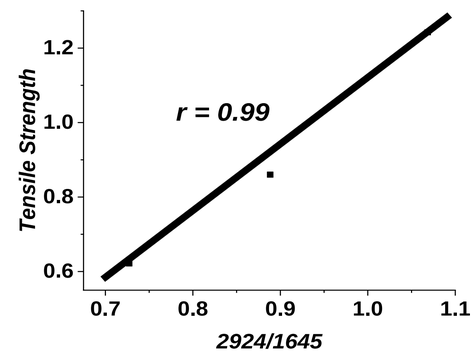


Figure 4. The correlation value of tensile strength and ratio of C-H and water uptake of *MeCFs*.

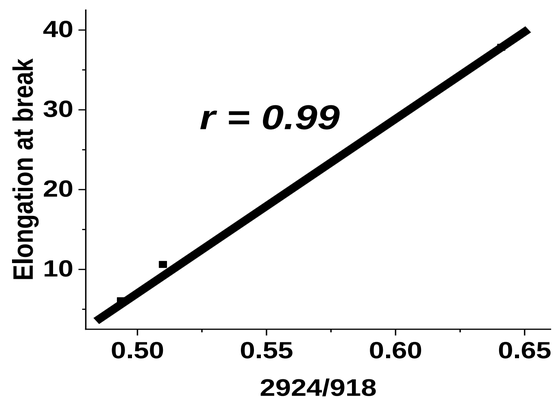


Figure 5. The correlation value of elongation at break and ratio of C-H and C-C of *MeCFs*.

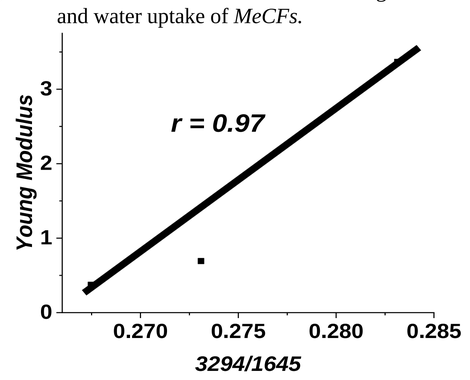


Figure 6. The correlation value of Young modulus and ratio of O-H and water uptake of *MeCFs*.

- **The aspect ratio of absorption peaks C-H, H_2O and C-O showed a high positive correlation of 0.99 indicating a good relationship between tensile and elongation at break as shown in Figure 4 and 5.**
- **The increase of elongation at break of *Manihot esculenta*-based composite films are attributed to the low mobility of C-H/C-C bond molecules where spacer S1 can occupy.**
- **The slight increase of tensile strength and Young modulus is accounted to high mobility of O-H and H_2O molecules in *MeCFs*.**

Conclusion

- ***Manihot-esculenta*-based composite films were SUCCESSFULLY prepared.**
- **Results showed HIGHLY POSITIVE CORRELATION between C-H/ H_2O , C-H/C-C, O-H/ H_2O and tensile strength, elongation at break, and Young modulus, respectively.**
- **The ratio of absorption peaks C-H/ H_2O , C-H/C-C, O-H/ H_2O , suggest that spacer S1 molecule serve as BOOSTER in improving the tensile strength, elongation at break, and Young modulus.**