PREPARATION OF NATURAL-BASED HYDROGEL BIOMATERIALS WITH ANTIOXIDANT AND ANTIMICROBIAL PROPERTIES

TEMMY PEGARRO VALES[12]*, JIGO BIYOYO[1], ANGEL MITCHALER[1]

1 DEPARTMENT OF CHEMISTRY, CARAGA STATE UNIVERSITY, BUTUAN CITY, AGUSAN DEL NORTE, PHILIPPINES, 8600

2 MINERAL RESOURCES MANAGEMENT RESEARCH AND TRAINING CENTER CARAGA STATE UNIVERSITY, BUTUAN CITY, AGUSAN DEL NORTE, PHILIPPINES, 8600

*corresponding author email address: tpvales@carsu.edu.ph

ABSTRACT

In this study, hydrogels based on chia seed (*Salvia hispanica L.*) mucilage were prepared. Subsequent modification of the hydrogels with active compounds (gallic acid and amoxicillin) rendered the resulting hydrogels as antioxidant and antimicrobial biomaterials, respectively. The incorporation of the active compounds was investigated using Fourier-Transform Infrared Spectroscopy (FTIR). The equilibrium swelling ratios revealed that the hydrogels have swelled approximately >100 times their original weight. Surface morphological and elemental analysis of the prepared hydrogels was carried out using Scanning Electron Microscopy-Energy Dispersive X-Ray spectroscopy (SEM-EDX). Using the 2,2-Diphenyl-1-picrylhydrazyl (DPPH) assay, the produced hydrogels' antioxidant potentials were demonstrated to be >80% effective. This inhibition also increased with the amount of gallic acid added to the hydrogels. Moreover, the amoxicillin-containing hydrogels have shown excellent antimicrobial properties against the Gram-negative bacterium, *Escherichia coli*. Collectively, the results presented herein demonstrate that naturally prepared hydrogels can be utilized to develop biomaterials with excellent antioxidant and antimicrobial properties for various biomedical applications.

Keywords: antibacterial, antioxidant, biomaterials, chia seed, hydrogels

WHY HYDROGELS?

- **Hydrogels =** 3D polymeric networks with high water content (>90%)
- **Highly biocompatible -** mimic tissue properties

RESEARCH AIM

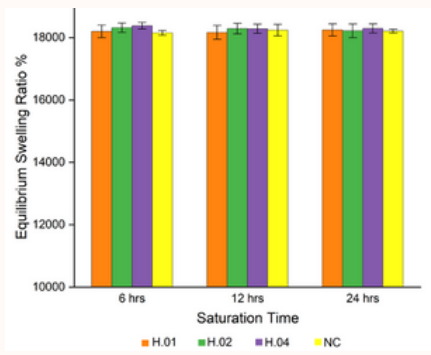
To develop Chia seed-based hydrogels with biofunctional properties

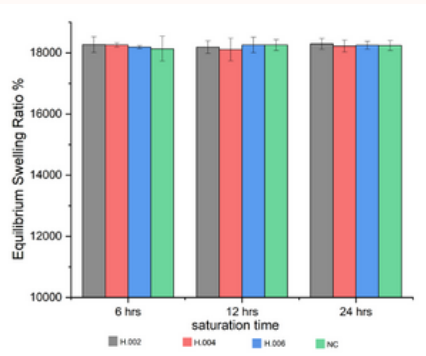
- Antioxidant
- Antibacterial

Component	Function
Chia Seed Mucilage	Natural polymer base
Amoxicillin	Antimicrobial agent
Gallic Acid	Antioxidant agent

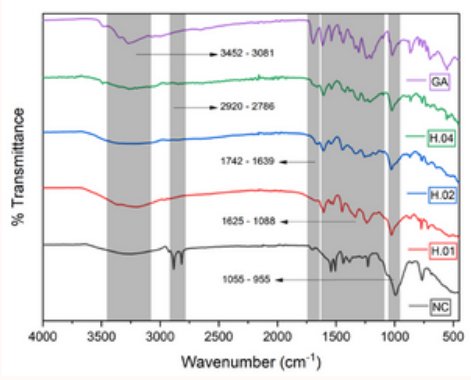
RESULTS & DISCUSSION

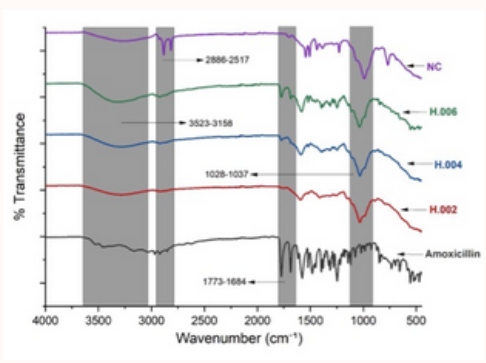
1 Hydrogels Equilibrium Swelling Ratios



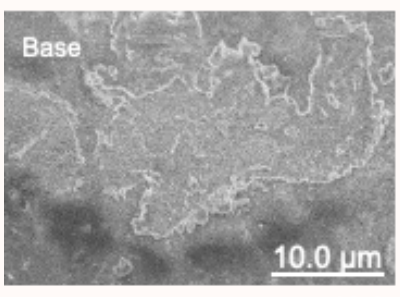


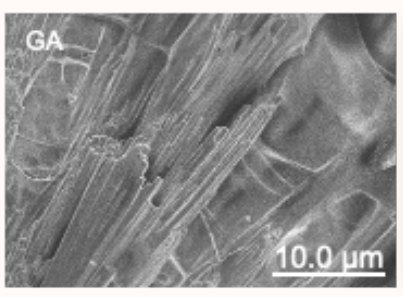
2 FT-IR Spectroscopy

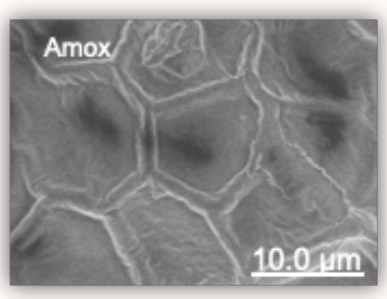




SEM Imaging

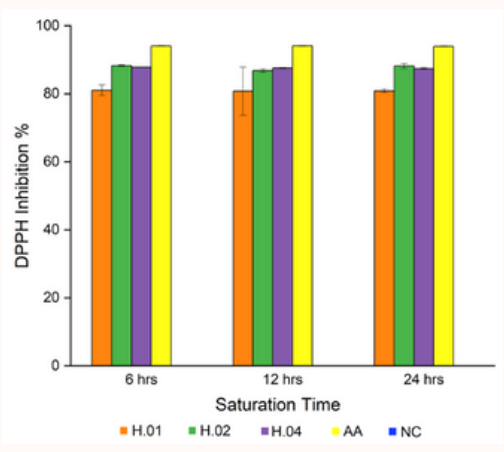






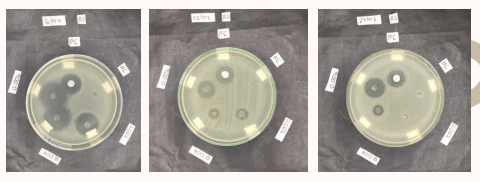
Bioassays

DPPH Assay



Disc Diffusion Assay

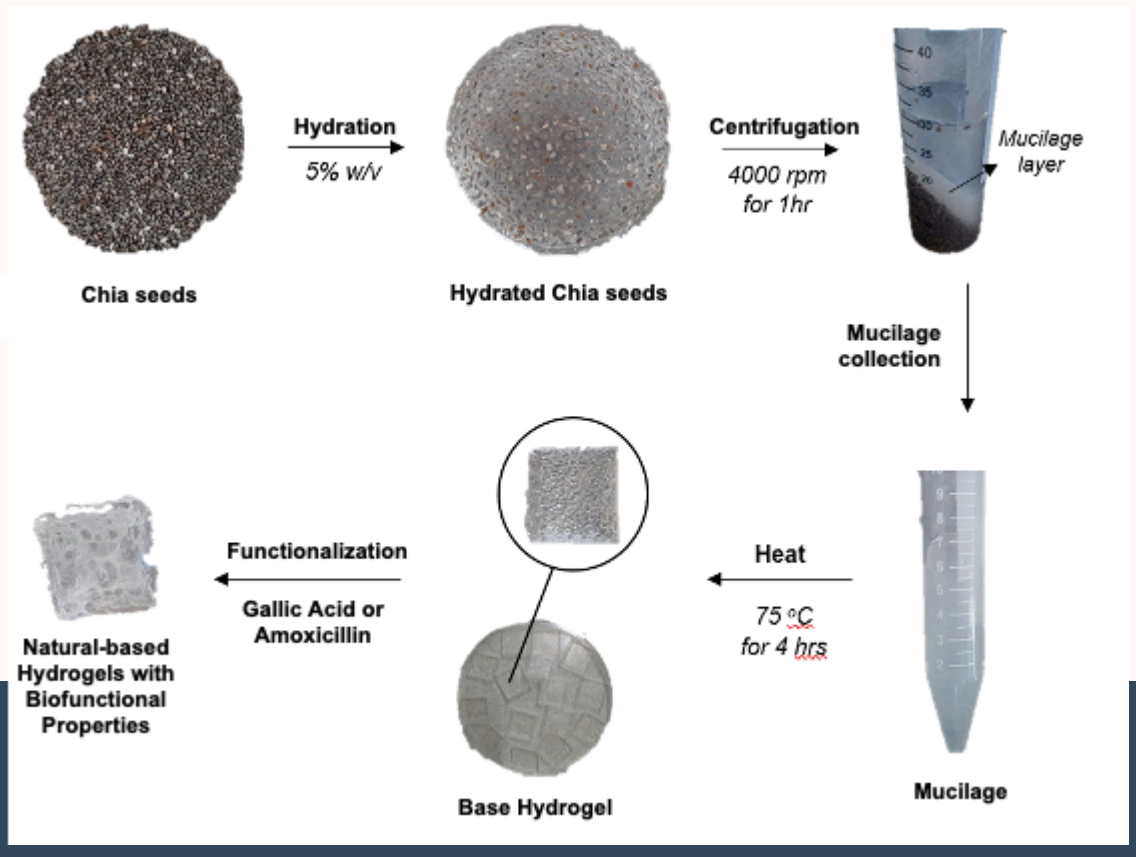
Incubation Time	Zones of inhibition mean ± SD				
	H.002	H.004	H.006	Negative Control	Positive Control
6 hrs	10.33 ± 0.58	10.67 ± 3.51	16.00 ±9.17	0	18.00 ± 2.65
12 hrs	23.33 ± 2.52	26.33 ± 4.04	28.67 ± 4.04	0	17.67 ± 5.13
24 hrs	9.67 ± 0.58	10.33 ± 1.53	20.67 ±1.53	0	20.0 ± 1.00



CONCLUSIONS

- **Chia seed mucilage serves as a sustainable and effective natural polymer base for developing biofunctional hydrogels with minimal chemical processing.**
- **Functionalization with amoxicillin and gallic acid successfully imparts dual antimicrobial and antioxidant properties, enhancing the therapeutic potential of the hydrogels.**
- **The resulting biomaterials demonstrate strong potential for biomedical applications such as wound healing, infection control, and antioxidant delivery, promoting their use in next-generation biocompatible platforms.**

METHODOLOGY



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