Fungi-induced Alterations on Plant Biomass: Impacts on Carbon Sequestration Potential and Pollution Control





Introduction

- Microbial interactions with plant biomass contribute significantly to the cycling of nutrients and contaminants in the environment.
- Primarily among these interactions is the role of fungal-induced degradation of organic matter, its regulatory effects on the carbon cycle, and pollutant transport.
- This study uses fungal colonization of spent coffee grounds as a model for understanding fungi-plant biomass interactions and their relationship to carbon stability and pollutant removal capacity.

Materials and Methods

- Coffee samples molded for a year: 0 months (0m), 3 months(3m), 6 months(6m), 9 months(9m) and 12 months (12m) under average temperature of 21.9°C and 100% humidity were used as organic models for this study.
- To investigate the physiochemical properties induced by fungal activity on organic matter, the samples were characterized with the following analyses:
 - Scanning Electron Microscopy(SEM)
 - Thermogravimetric Analysis (TGA)
 - Elemental Analysis (EA)
 - Nuclear Magnetic Resonance (NMR)
- Spectroscopic experiments were conducted to assess the impact of fungal activity on the samples' sorption capacity (using gentian violet as a cationic sorbate).



Gentian violet absorbance at 500nm and a standard curve used to generate concentration profiles for analysis of sorption, quantity, kinetics, and dynamics

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Results





- Photographic and SEM images show fungi-induced physical changes on the coffee samples as a function of molding time.
- Fungal (spores and hyphae) growth result in observable physical disintegration of coffee.
- Physical disintegration followed the order 12 mths > 9 mths > 6 mths > 3 mths > 0 mths.



• NMR results show increased aromaticity and preferential loss of O-alkyls with increase in a fungal alteration



- Fungal activity increases the carbon sequestration potential of remaining material by 1.16.



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Results

$Q_{sorbed} = \frac{(k_1' Q_{max1}^2 t)}{(1+k_2 Q_{max1} t)}$	(1)	
$Q_{sorbed} = \frac{(k_1' Q_{max1}^2 t)}{(1+k_1 Q_{max1} t)} + \frac{(k_1' Q_{max1}^2 t)}{(1+k_1 Q_{max1} t)} + \frac{(k_1' Q_{max1}^2 t)}{(1+k_1 Q_{max1} t)}$	$\frac{2}{2} Q_{max2} t}{k_2 Q_{max2} t}$ (2)	
Where,		
• k_1 ' and k_2 ' are the apparture of k_2 ' are the apparture of k_1 ' and k_2 ' are the apparture of k_1' and k_2 ' are the apparture of k_1 and k_2 ' are the app	rent pseudo 2 nd order rate constants for step 1 ar	nd
• Q_{max1} and Q_{max2} are the respectively	e sorption capacities for step 1 and step 2	
t is the overall reaction	time (He MeKey 1008)	

ion						
	0m	3m	6m	9m	12m	
	0.0104	0.0128				
p 1(mg/kg)	37.0	42.6				
	2.26 x 10-4	7.82 x 10-4	7.94 x 10-6	8.27 x 10-6	1.04 x 10-5	
p 2 (mg/kg)	17.7	9.73	107	98.8	103	