Neural Network-Enhanced Hydrolysis Process for Valorizing Spent Coffee Grounds

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INTRODUCTION

Rising Demand for Sustainability
Fossil fuel scarcity spurs quest for sustainable solutions.

LCB Potencial
LCB offers diverse options for bio-based products.

Utilization of SCG
SCG showcase LCB's potential with valuable components.

LCB Fractionation Challenge
Efficient fractionation of LCB requires pre-treatment due to its structural complexity.

ANN Optimization
ANN optimize pre-treatment for enhanced bioproduct extraction.

Valorization of agricultural waste

Spent Coffee Grounds

Lignin

Hemicellulose

Cellulose

Cosmetics

Pharmaceutical

Fertilizer

Bioethanol

OBJECTIVES

- Predict and optimize hydrolysis process of spent coffee grounds.
- Utilize neural network model for efficient conversion of waste components.
- Aim to produce high-value industrial and food products.

METHODOLOGY

Spent Coffee Grounds

Oven dried:
- 80°C;
- 3% moisture

Stored:
- Plastic containers
- 18 °C

Biomass storage

NREL standard method:
- 5 cycles of isopropanol (99.8%)

Chemical characterization

- temperature (140-190 °C);
- H_2SO_4(aq) (0–2% v/v);
- solid/liquid (1:4 – 1:40)
- reaction time (20–120 min)

- 10 min.;
- 2057 *x*g.

BIO-RAD AMINEX HPX-87P analytical column

Pre-treatment

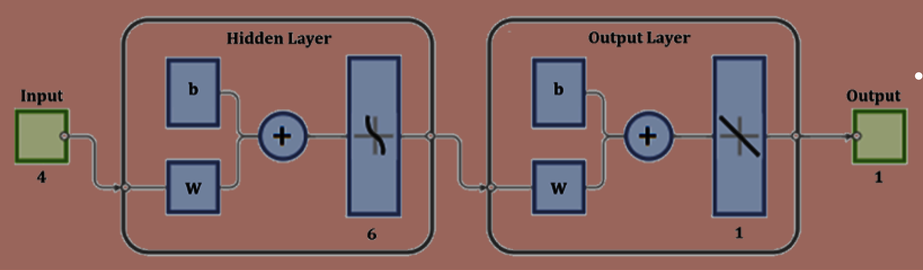
HPLC data

Extraction efficiency

$$EF(\%) = \frac{((0.9 \times H) + (0.88 \times P)) \times Vs}{W \times \%HE_i} \times 100$$

- H and P = the concentrations of hexoses and pentoses present in the hydrolysate
- Vs = the working volume (liters).
- W is the initial weight of the SCG
- HE(%) = % of the hemicellulose present in the SCG free from extractives.

Artificial Neural Network



- Resilient Backpropagation (RProp);
- Training (70%), validation (15%), and testing (15%) sets of the total data

RESULTS

Fig. 1 ANN training results of epoch 40.

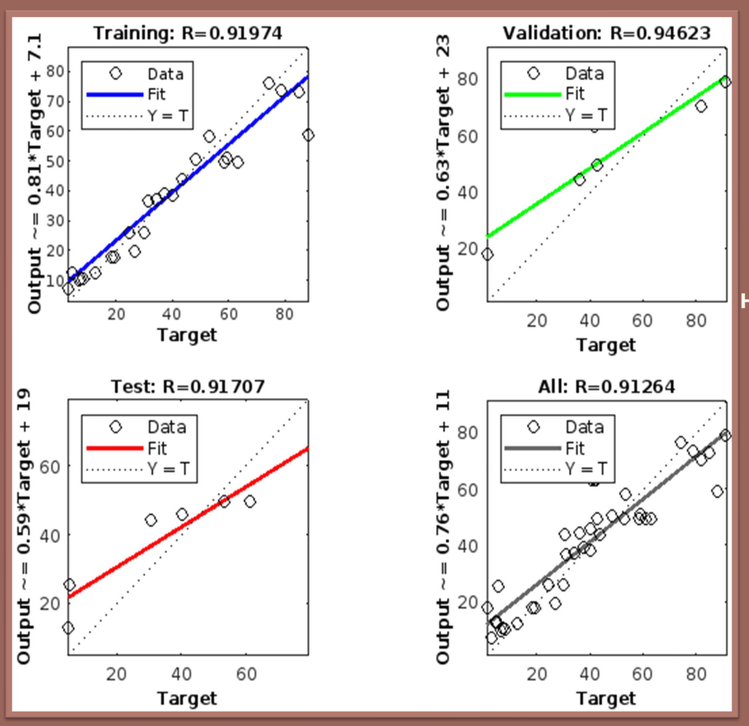
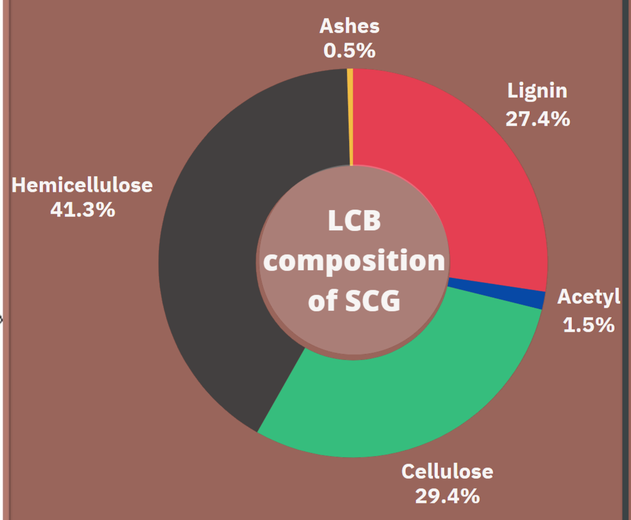


Fig.2: SCG Characterization Post-Extractive Removal.



- Optimization of pre-treatment phase vital for effective conversion of SCG.
- Achieved R^2 values demonstrate model reliability and predictive capability.
- Model performed well without overfitting, demonstrating reliability and predictive capability.

CONCLUSIONS

- Lignocellulose biomass holds promise for valuable product creation.
- Neural networks optimize hydrolysis, enhancing SCG conversion.
- SCG utilization offers sustainability benefits and economic opportunities.

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