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NORTH CAROLINA AGRICULTURAL AND TECHNICAL STATE UNIVERSITY

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Computational Science & Engineering

Title: *"Mechanical Integrity of Biodegradable Metals During Degradation"*

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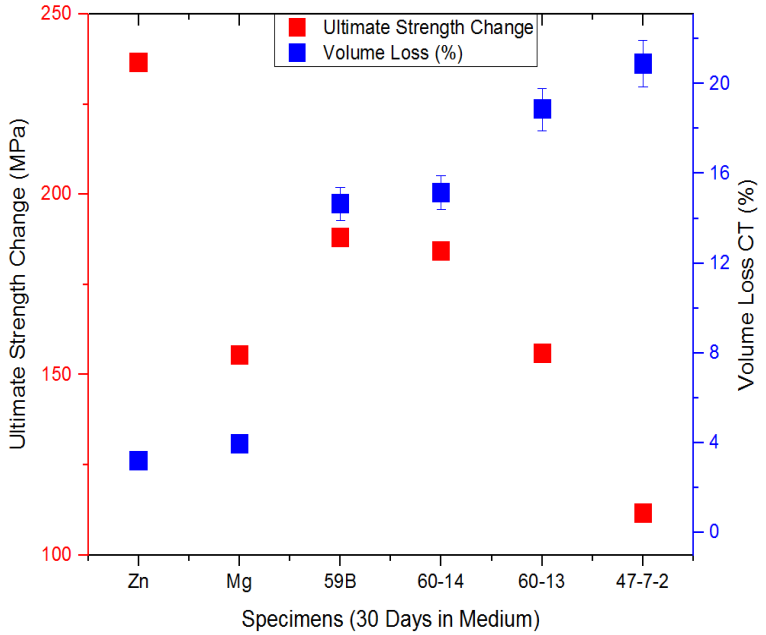

RESEARCH QUESTIONS / PROBLEMS:

- *Conduct in vitro* tests to obtain corrosion rates of biodegradable materials during a time laps by mass loss, μ-CT and evolution of hydrogen gas measurements
- Build computational models of corroded material geometries to characterize corrosion/degradation process through trends of mechanical integrity change. Investigate relationship between mechanical and volume loss of these biomaterials to understand long term load-bearing capacity for future design and potential clinical applications
- Develop statistical predictive model in association with selected feature engineering parameters obtained from empirical *in vitro* data to predict corrosion rates of biodegradable materials

METHODS:

- *Experimental (In vitro* tests and Instron)
- *In silico* experiment (Non-linear Finite Element Analysis)
- Supervised machine learning algorithm (Random Forest)

RESULTS / FINDINGS:

- *In vitro* study results indicates uncertainties between corrosion rates evaluations arise from hydrogen gas that may diffuse into physiological medium during experimental process and may not evolve for eudiometric calibration
- Ultimate strength change of corroded metals (Zn,2.3%; Mg,4.5%) while their volume loss exhibit (Zn, 3.2%; Mg, 4.0%). Biodegraded alloys suffer average (ultimate strength change of 26.4% and 16.8% volume loss) during immersion period
- Performance of validated statistical model predictability was 83.09% accuracy

SIGNIFICANCE / IMPLICATIONS:

- This research work on biodegradable materials opens gate way to have potential applications in orthopedics to avoid second surgery procedures for removal of metals after tissue rejuvenation