



➤ STRATEGIC PLAN

SECOND CENTURY

2026-2036



**STEPHEN F. AUSTIN
STATE UNIVERSITY**
THE UNIVERSITY OF TEXAS SYSTEM

1 STUDENT EXPERIENCE



➤ STUDENT EXPERIENCE STRATEGIES

Ensure students have the opportunity for a transformative, student-centered experience that provides comprehensive support and an affordable education, and supplies a vibrant, engaging campus life — empowering every student to thrive personally and professionally before and after graduation.

1

Enhance Student
Recruitment and
Enrollment

2

Increase Financial
Literacy and Aid

3

Strengthen
Student Support
and Retention

4

Enrich Campus
Life and Social
Engagement

2 ACADEMIC PROGRAMS



➤ ACADEMIC PROGRAMS STRATEGIES

Refine academic programming to develop graduates who are versatile, creative thinkers with a broad range of skills — ready to thrive in a rapidly changing job market with the ability to solve complex, real-world problems.

1

Invest Strategically
in High-Growth
Academic
Programs

2

Elevate Career
Readiness Through
Real-World
Experiences

3

Foster Cross-
Program Innovation
for Versatile
Learning

3 RESEARCH AND CREATIVE ACTIVITIES

Calcium analysis of eggshells

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Abstract

The chemical content of eggshells is important for tracking the health of fowl, as the content of their eggshells reflects aspects of their diet, environment, and behaviors. Due to this, eggshells can serve as an indicator for environmental contaminants and the conditions in which the birds are found. Carbonic anhydrase plays a role in the development of eggshells and is affected by many environmental impacts, such as heavy metals. Calcium carbonate makes up a large portion of eggshells, yet heavy metals can replace calcium in eggshells, leading to deformations and contamination to the egg that can affect those consuming it. However, the analysis of calcium content has proven difficult. A common instrument used to determine elemental composition is the ICP-MS; however, calcium is difficult to analyze. The argon used to generate the plasma interferes as it has a similar mass to calcium, which leads to artificially high and inconsistent calcium concentrations. A new method for isolating the calcium from eggshell is being developed to analyze the environmental impacts on chicken health. Oxalate is used to precipitate calcium oxalate from the eggshells. Gravimetric analysis is done using STA and IR. This will be done in addition to a full characterization using ICP-MS, XRD, and C-N analysis.

Introduction

Eggs are a major component of the life cycle of avian species and the environment. The composition of the egg reflects the diet consumed by the animal and can be used as an indicator of the environment it lives in[1]. Proper calcium intake is imperative for the success of offspring and the production of eggs. Improper calcium intake or presence of heavy metals, like strontium, can disrupt the hatching success of the eggs[2]. Calcium carbonate is the main chemical component of eggshells and makes up about 94% of the eggshells in poultry chicken eggshells[3,4]. Other trace metals like Sr, Ba, Mn, As, Cd, Cu, Pb, Hg, Se, V, and Zn could also possibly be found in the chemical composition of the eggshells[2,5]. The presence of some of these heavy metals can lead to egg malformation, embryo death, transfer of the metal to the yolk and consumption by other species. The Ca^{2+} content of eggshells is surprisingly difficult to quantify. In the ICP-MS, there are many interferences with the Ca^{2+} signal, including the argon gas used to generate the plasma. ICP-OES is the preferred method to quantify Ca^{2+} but not every lab has access to this instrument. Oxalate preferentially precipitates Ca^{2+} as $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ and is being investigated as a method to determine Ca^{2+} content in eggshells.

Sample Preparation

- Collected eggs and washed with a mild detergent.
- Carefully scored eggs to divide eggs into sharp and dull ends then cleaned and removed inner membranes.
- Ground eggshells using a McCrone Micronizing mill and 200 proof EtOH for 3 minutes each to form an eggshell slurry.
- EtOH was evaporated from eggshell slurry and slurry was dried at 105°C in an oven.
- The dried eggshell was homogenized to a powder using an agate mortar and pestle.
- Approximately 0.15 g of eggshell was reacted with 10 mL of 1 M hydrochloric acid (HCl) and approximately 1.3 g of oxalic acid ($\text{H}_2\text{C}_2\text{O}_4$).
- Precipitate was collected via vacuum filtration.
- Powdered precipitate samples used for STA (Perkin Elmer STA 6000 coupled with Perkin Elmer Spectrum One FT-IR in nitrogen and air backgrounds).

Methods and Materials

Oxalate decomposition equation for STA
 $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O} (s) \rightarrow \text{CaC}_2\text{O}_4 (s) + \text{H}_2\text{O} (g) \rightarrow \text{CaCO}_3 (s) + \text{CO} (g) \rightarrow \text{CaO} (s) + \text{CO}_2 (g)$

Results

Figure 1. Chicken provided from Hobby Farm, Eagle Creek, Oregon. The eggs were used for the study.

Figure 2. Decomposition of Brown Egg 1 Dull end eggshell, and Brown Egg 1 Dull end after exchange with oxalic acid, and $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ prepared using the same procedure from stock CaC_2O_4 using Thermal Gravimetric Analysis by STA.

Figure 3. Stack plot of the accumulated FT-IR spectra of Brown Egg 1 Dull end before and after exchange using the oxalic acid. The peak at 1450 cm⁻¹ is the peak for $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$. The peak at 1450 cm⁻¹ is the peak for $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$. The peak at 1450 cm⁻¹ is the peak for $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$.

Figure 4. Comparison between the TGA peak of Brown Egg 1 Dull end before and after exchange and the TGA peak of $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ prepared using the same procedure from stock CaC_2O_4 using Thermal Gravimetric Analysis by STA.

Figure 5. Stack plot of the accumulated FT-IR spectra of Brown Egg 1 Dull end before and after exchange using the oxalic acid. The peak at 1450 cm⁻¹ is the peak for $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$. The peak at 1450 cm⁻¹ is the peak for $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$. The peak at 1450 cm⁻¹ is the peak for $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$.

Figure 6. Comparison between the TGA peak of Brown Egg 1 Dull end before and after exchange and the TGA peak of $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ prepared using the same procedure from stock CaC_2O_4 using Thermal Gravimetric Analysis by STA.

Discussion/Conclusion

- The Ca^{2+} found in the brown chicken eggshells was 95%, which was a little higher than expected based on literature[3]. This is probably due to the diet the hobby farmer provides the chickens.
- When the eggshells are exchanged with oxalic acid, 95% conversion is seen. Any loss is due to transfer loss during filtration and drying. Reductions in transfer loss are being investigated (washed filter paper and double filtration).
- Starting with pure MgCO_3 and oxalic acid, no oxalate was seen. MgC_2O_4 is not a consistent product. There was no significant difference between full ends of the eggshells or between dull ends of the eggshells.
- Analysis of the eggshells using ICP-MS and ICP-OES will determine the concentration of the elements in the eggshells and the composition of the eggshells.
- Confirm Ca^{2+} and $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ using standardization and back titration.

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References

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- (2) Mott, M. A. "Heavy Metals in Eggshells and Eggs of Various Birds from Various Sources." *Environmental Pollution* 2002, 122 (3), 453-460. [https://doi.org/10.1016/S0969-1328\(02\)00008-8](https://doi.org/10.1016/S0969-1328(02)00008-8)
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➤ RESEARCH AND CREATIVE ACTIVITIES STRATEGIES

Establish SFA as a nationally recognized hub for interdisciplinary research, scholarship, and creative excellence through strategic investment in infrastructure, partnerships, graduate education, and community engagement.

1

Promote a
Culture of
Student Research
and Creative
Achievement

2

Enhance Research
Infrastructure
and Faculty
Support

3

Cultivate
Interdisciplinary
Centers of
Excellence

4

Amplify Research
Visibility and
Community
Impact

4 INNOVATION



➤ INNOVATION STRATEGIES

Establish SFA as the regional hub for innovation that cultivates opportunities for students to meet the emerging needs of the future, allowing SFA to become the premier hands-on, experiential and service learning university that addresses the unique needs of our local and regional communities.

1

Partner with
Business and
Industry for Student
Experiential and
Service Learning
Opportunities

2

Establish SFA
as a Central Hub
to Address Critical
Needs of
East Texas

3

Leverage the
Economic and
Population Growth
within the Texas
Triangle

5 WORKPLACE CULTURE



➤ WORKPLACE CULTURE STRATEGIES

Foster an empowering environment that attracts and retains exceptional faculty and staff by championing professional growth and meaningful recognition.

1

Improve
employee
recognition

2

Enhance
opportunities
for professional
growth

3

Recommit to
clear, consistent,
transparent
communication
and institutional
shared governance



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