



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

↗ STRATEGIC PLAN  
**SECOND  
CENTURY  
2026-2036**

# 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

**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 anhydride 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 in eggshells 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  $\text{Ca}^{2+}$  content of eggshells is surprisingly difficult to quantify. In the ICP-MS, there are many interferences with the  $\text{Ca}^{2+}$  signal, including the argon gas used to generate the plasma. ICP-OES is the preferred method to quantify  $\text{Ca}^{2+}$  but not every lab has access to this instrument. Oxalate preferentially precipitates  $\text{Ca}^{2+}$  as  $\text{CaC}_2\text{O}_4\cdot\text{H}_2\text{O}$  and is being investigated as a method to determine  $\text{Ca}^{2+}$  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**

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

**Figure 1** Chickens from the East Texas chicken farm, including Tree, Green, Blue, and Purple. Photo credit: M. Clevenger.

**Results**

**Figure 2** Decomposition of Brown Egg 1 Dull end eggshell, precipitate of Brown Egg 1 Dull end after exchange with oxalic acid, and  $\text{CaCO}_3$  prepared using the same procedure from stock CaCO<sub>3</sub> using Thermogravimetric Analysis (TGA).

**Figure 3** 3D plot of the measured FT-IR spectra of Brown Egg 1 Dull end before and after exchange with oxalic acid, and  $\text{CaCO}_3$  prepared using the same procedure from stock CaCO<sub>3</sub> using FT-IR.

**Figure 4** A comparison between the  $\text{CO}_2$  gas of Brown Egg 1 Dull and black teal after 10 minutes of being heated to 100°C. The  $\text{CO}_2$  gas was collected in a glass tube and then analyzed using FT-IR.

**Figure 5** 3D plot of the measured FT-IR spectra of Brown Egg 1 Dull and before and after exchange with oxalic acid, and  $\text{CaCO}_3$  prepared using the same procedure from stock CaCO<sub>3</sub> using FT-IR.

**Discussion/Conclusion**

- The  $\text{CaCO}_3$  found in the brown chicken eggshells was ~95%, which was a higher percentage than expected based on literature [3,5]. This is probably due to the diet the hobby farmer provides the chickens.
- When the eggshells are exchanged with oxalic acid, a massive loss of mass occurs. Any loss is due to transfer loss during filtration and ashing. Potential transfer loss are being investigated (ultra filter paper and double filtration).
- Stoichiometric amounts of oxalic acid and no excess was used.  $\text{MgO}$  is not a concern as there was no significant difference between the dull ends and the sharp ends or between the sharp ends and the black teal.

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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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