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Understanding and Mitigating In-Shell Pecan Food Safety Risks

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Highlights

- Pecans are a specialty crop in Arkansas, as well as other southern states in the United States.
- Even though small pecan growers and shellers in Arkansas might be exempt from federal food safety regulations rules due to size and revenue, they are still responsible for the safety of their product. They should examine potential risks requiring mitigation to ensure the safest product possible.
- Potential contamination of in-shell pecans with foodborne pathogens, such as *Salmonella* and pathogenic *E. coli* can occur from soil and feces that spread through orchards by wind, water, and direct contact while harvesting.
- Data show survival of pathogenic *E. coli* is enhanced when contaminating through soil.
- Hot water is most effective at eliminating foodborne pathogens but is not affordable or cost-effective for some shellers.
- Antimicrobial washes are better than non-sanitized conditioning water.
  - Sanitizer could help to prevent cross-contamination of foodborne pathogens.
- Adding a washing step as a preventive control could be helpful for shellers. At the very least, an antimicrobial should be used in conditioning water to prevent or limit cross-contamination between pecans.

Value of Safeguarding Pecans

The tree nut industry in the United States is vibrant and a main supplier of nuts globally. In 2020, the United States produced upwards of 265 million pounds of shelled pecans, valued at $435 million (USDA NASS, 2021). Pecans provide economic value to many states across the South, including Arkansas. However, the pecan industry faces significant challenges maintaining microbial safety along the supply chain.

While pecans have not been directly implicated in pathogenic *E. coli* outbreaks, recalls due to *Salmonella* contamination highlight the importance of vigilance (Harris et al., 2019; Yada and Harris, 2022). Other nut industries with similar growing, harvesting and shelling techniques have already experienced negative outcomes of recalls and outbreaks. These outbreaks can be costly to both the company involved and the industry as a whole, resulting in damaged reputation and diminished consumer trust.

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Are Pecans at Risk?

The open-air growing environments of pecans expose them to potential pathogenic *E. coli* reservoirs like cattle and invasive wildlife, with studies indicating higher prevalence rates in grazed orchards (Diaz et al., 2022; Chaney, 2021). Even if cattle or other livestock do not have access to orchards, nearby population could still cause contamination through wind-blown soil or water runoff. During harvesting, pecans come in direct contact with orchard soil, potentially leading to cross-contamination with pathogens like *E. coli* and *Salmonella* (Bardsley et al., 2023).

Post-harvest processing steps, including conditioning in water, can also pose cross-contamination risks if not managed effectively (Farakos et al., 2017). If a batch of contaminated pecans is cycled through a washing tank, all subsequent batches using the same water for washing can become similarly contaminated.

Pecans often go through a wash and/or conditioning step which removes excess soil and increases the kernel moisture to avoid kernel breakage during shelling and cracking. Current industry practices use treatments such as chlorine-based sanitizers and hot water during washing and conditioning steps, yet research gaps exist in understanding their efficacy in reducing pathogenic *E. coli* levels and preventing cross-contamination (Kharel et al., 2018; Okla. Admin., 2021). Furthermore, the use of hot water sanitation is associated with large facilities, indicating that smaller shellers may not have the resources to implement preventive controls (Bardsley et al., 2024). Addressing these challenges is crucial to maintaining product safety and mitigating the economic impacts of potential outbreaks and recalls.

Pecan Contamination from Soil

Researchers with the University of Arkansas System Division of Agriculture recently evaluated the survival of pathogenic *E. coli* on in-shell pecans. They introduced the pathogens using two different inoculation techniques: directly through spraying and indirectly through contaminated soil contact. The pathogens survived for as long as 28 days on the in-shell pecans for both types of contamination. However, greater survival was observed on pecans contaminated with the soil, indicating that the soil matrix may have promoted or supported the survival. This study highlights the potential for contamination during harvest and the subsequent processing steps.

Can Washing Remove Contamination?

The second part of the UADA researchers' study was to evaluate the efficacy of washes in removing and inactivating the pathogenic *E. coli* from the surface of the pecans (Ramsay et al., 2024). After being contaminated with *E. coli*, the pecans were treated with various antimicrobial washes. Washes were chosen that could be incorporated into the conditioning or washing steps. The treatments tested were 2 percent lactic acid, 1,000 ppm sodium hypochlorite (common chlorine-based sanitizer; 0.1 percent), hot water (85±2˚C; 185±3.6˚F) and ambient water (control; 18±2˚C; 64.4±3.6˚F) for two, five or 10 min. The amount of pathogenic *E. coli* before and after the treatments were compared to determine pathogen reductions.

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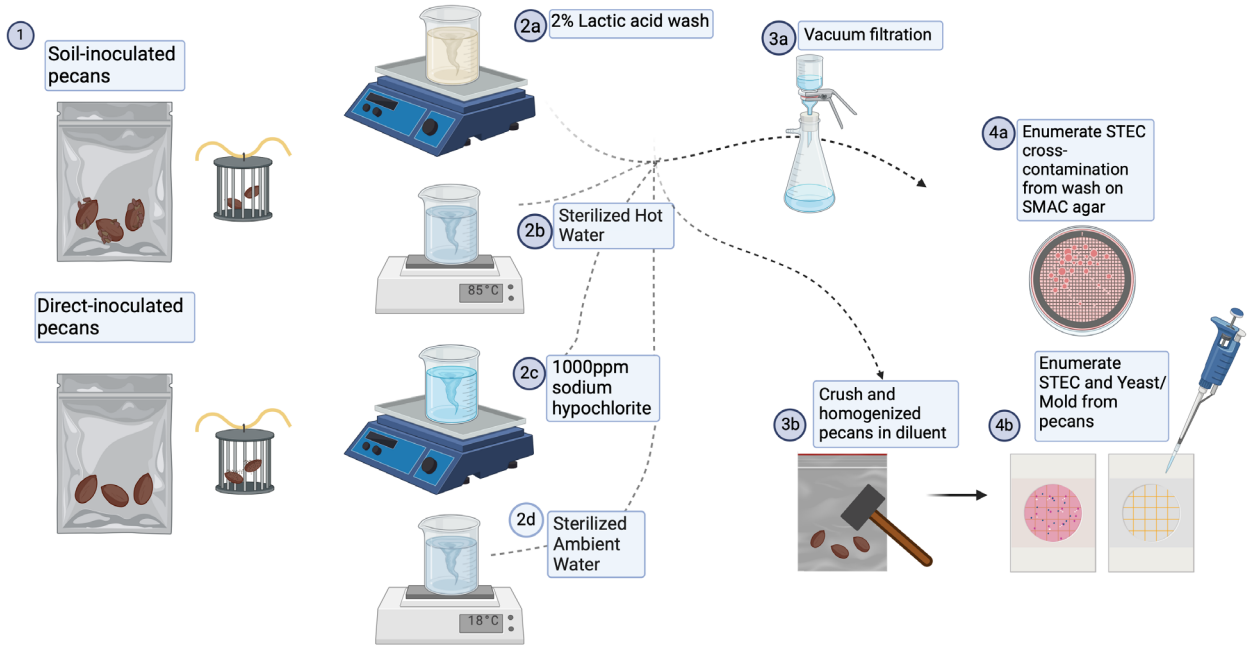

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The results showed that hot water completely reduced the pathogenic *E. coli* populations from both directly (spraying) inoculated and soil-inoculated pecans for most trials, regardless of the treatment time. Chlorine also demonstrated effectiveness, especially on directly inoculated pecans, but it did not show any difference in the pathogenic *E. coli* reductions compared to lactic acid or the ambient water treatments on soil-inoculated pecans.

Washes were also tested in sequential order to determine if a pre-wash with ambient water followed by a sanitizer wash (chlorine or lactic acid) was more effective at reducing pathogenic *E. coli* than the sanitizer wash only. Data indicated that a pre-wash did not offer greater pathogen reductions.

Can Sanitizers Prevent Cross-Contamination?

Although hot water was the most effective at decontaminating the pecans, the significant production cost of hot water must be acknowledged. Many smaller processors may not have the ability or desire to generate and maintain hot water due to cost. While the other sanitizers (sodium hypochlorite and lactic acid) evaluated were not as successful as the hot water at reducing pathogen populations on the pecans, they were successful in maintaining the cleanliness of the wash water.

The researchers tested the wash water following the trials and found that the spent sanitizer washes had significantly lower populations (often below detectable levels with approximately 99.99 percent reduction) compared to those detected in the ambient wash water. Based on these findings, the researchers recommend implementing sanitization protocols that include antimicrobial washes or sanitizers in conditioning water to prevent cross-contamination of pathogens between batches of pecans.

Pecan growers and shellers are encouraged to conduct internal risk assessments to determine if they can improve their processing and sanitation techniques, thus contributing to the overall quality and reputation of Arkansas' pecan industry.

More information about the conducted study can be found in the published manuscript (Ramsay et al., 2024). If you wish to learn more about how you can optimize and increase the safety of your pecan washing and conditioning processes or learn how you could be involved in future research, please reach out to Jennifer Acuff (jcacuff@uark.edu).

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