

Microbial Analysis of Chickpea, Lentil, and Pea Crops Cultivated in the United States.*

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Why This Research Matters

Pulse crops support sustainable agriculture, yet little is known about their microbial populations. The presence of certain organisms may be indicative of pathogenic risks or environmental hazards. Therefore, conducting a pulse microbiological analysis is essential for assessing food safety concerns. An evaluation of the pulse microbiome will allow pulse processors to determine requirements for processing pulse products to minimize potential foodborne pathogens.

Study Objectives

- Determine effects of geographic region
- Compare microbiome for pulse (pea, lentil, chickpea) types
- Assess spoilage and pathogen indicators

Methods Overview

- Regional sampling was done in the upper great plains



Pea

Lentil

Chickpea

- Selective agar enumeration
- Identification using Matrix-assisted laser desorption ionization-time of flight (MALDI-TOF) mass spectrometry.



Major Findings

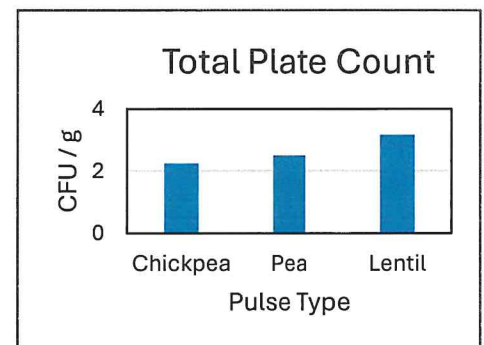
- Lentils had significantly higher aerobic plate counts than peas and chickpeas, regardless of geographic region.

- Microbial total count was most affected by geographical region

- Yeast and mold count

was most affected by pulse type.

- Chickpea and pea bacterial isolates were characterized as *Bacillus* spp. >70% of samples
- Spoilage and pathogenic indicator organisms were characterized in all pulse types



Microbiome Highlights

- Chickpea isolates were primarily *Bacillus* spp. with occasional *B. cereus* detections.
- Pea samples showed the greatest *Bacillus* predominance and consistency across regions.
- Lentils displayed the greatest microbial diversity, including bacterial and fungal genera.

Common Microorganisms Identified

Bacillus cereus group
Bacillus subtilis,
Bacillus pumilus,
Fusarium spp.
Penicillium spp.

Pea Microbiome

Key Takeaways:

- 77.5% characterization of *Bacillus* spp. Highest rate of *Bacillus* organisms among chickpea, pea, lentil samples.
- *B. pumilus* is only organism to be characterized in all 5 pea region samples.
- *B. cereus* group repeatedly characterized in individual region samples.
- *Bacillus* spp. are common in soil and environment. Capable of both food preservation and spoilage (Lee et al., 2019).
- *B. cereus* groups, *B. subtilis* can cause spoilage in foods, such as ropiness in bread products (Pacher et al., 2022)

Lentil Microbiome

Key Takeaways:

- Less *Bacillus* characterization, more microbial diversity (27 total bacteria, mold, and fungal species).
- More microbial diversity is indicative of a functional ecosystem and healthy soil (Delgado-Baquerizo, 2016)
- *Pantoe* spp., *P. simplex*, *P. megaterium* accounted for 26 of 60 sample isolates
- *Fusarium* and *Penicillium* spp. Characterized. Highly virulent, may cause head blight and reduce yield.
- Mycotoxin-producing organisms, such as *P. citreonigrum*, were identified and are known to produce toxic metabolites harmful to humans

Chickpea Microbiome

Key Takeaways:

- *Bacillus* organisms account for 73% of total isolates.
- *B. cereus*, a known food safety hazard, was characterized in two different chickpea samples.
- *Alternaria* spp. May cause spoilage in pulse products under proper environmental conditions (Lee et al., 2015).

Overall Take Home Message:

- Microbial analysis indicates pulse growth varies based upon both pulse type and geographical region, which support the hypothesis.
- Microbiome of chickpea, lentil, and pea analyzed for general growth, yeast and mold, *Bacillus*, and coliform growth indicated differences in microbial populations between pulse type.
- Soil and pulse crops sustain a symbiotic microbial relationship.
- Microbial analysis of Pulse crops in Northern Plains and Palouse regions of US indicated minimal number microorganisms of food safety concern.

Food Safety Significance

Bacillus spp. were the most common organisms identified. *B. cereus* group organisms are notable because spores can survive in unfavorable conditions and may germinate if pulse products are improperly stored. According to the FDA (2018), *B. cereus* is a food safety hazard for pulses and cooked pulses.

Fungal genera such as *Fusarium*, *Penicillium*, *Alternaria*, and *Aspergillus* are important because some species are associated with spoilage and mycotoxin production.

Recommendations

1. Maintain low moisture content and water activity during storage.
2. Monitor environmental and harvesting conditions that may increase microbial contamination.
3. Apply good manufacturing and sanitation practices across the supply chain.
4. Continue research on pulse-specific microbial standards and mitigation strategies.

Funding Source: U.S. Department of Agriculture's (USDA) Agricultural Marketing Service via the South Dakota Department of Agriculture and Natural Resources through sub-recipient award 2023 SDSU 02. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the USDA.