

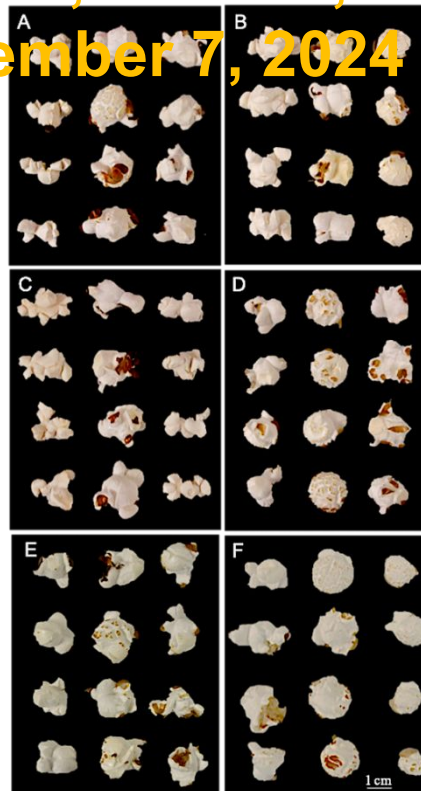
Nutritional innovations in popcorn and sweet corn breeding

David R. Holding

WHEAT FIBER FOR RURAL WEALTH AND HEALTH ROUNDTABLE
Graduate Hotel, Lincoln, Nebraska



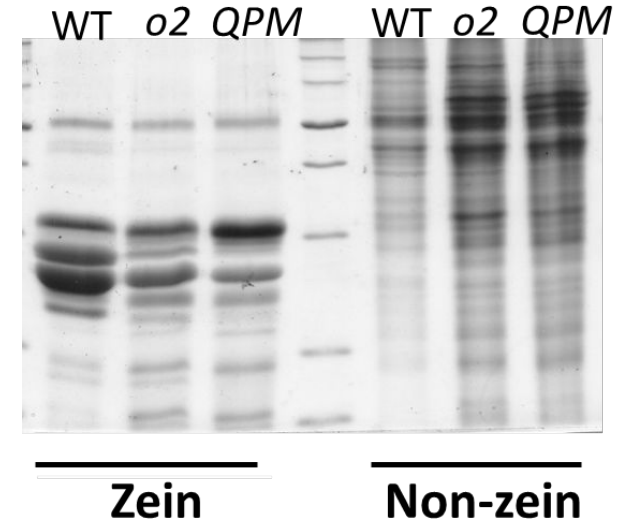
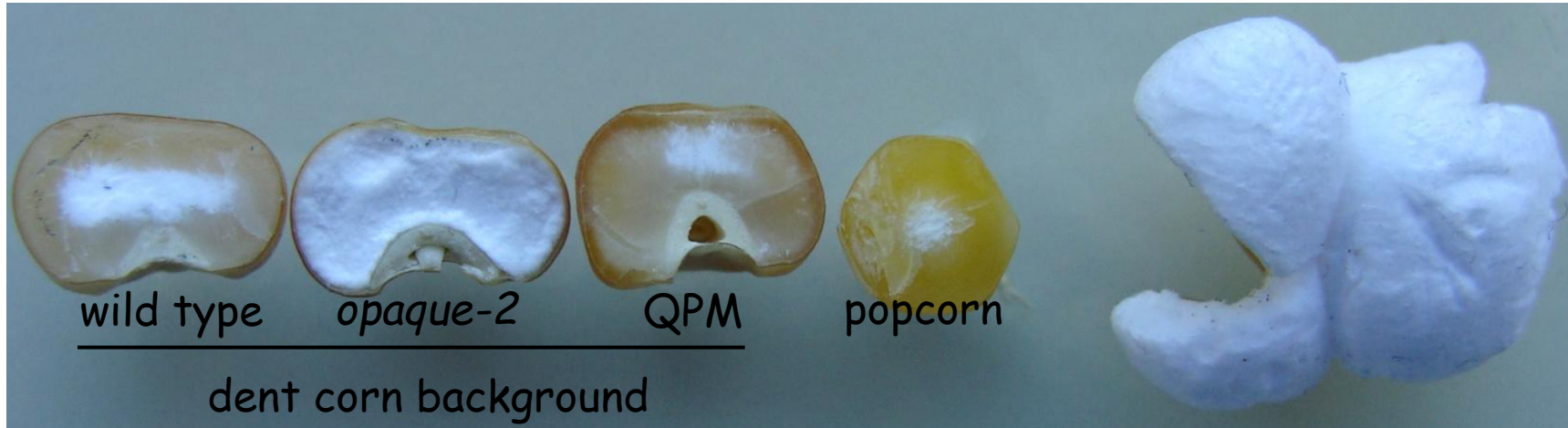
September 7, 2024



UNIVERSITY OF
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High-lysine Quality Protein Maize (QPM) was bred at CIMMYT by selecting for genetic modifiers of the *opaque-2* variety



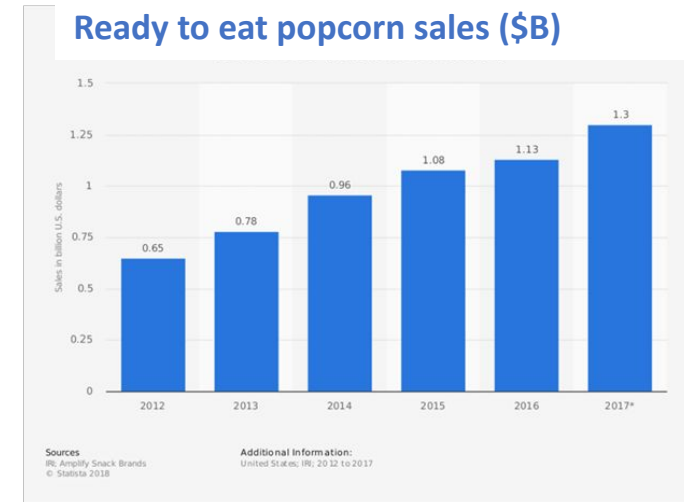
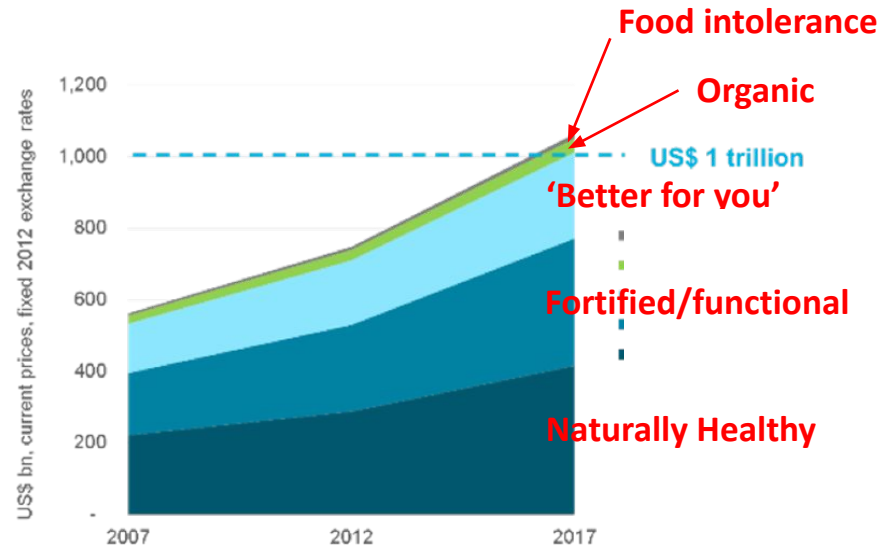
- *Opaque-2* and QPM have low zein storage proteins
- Which causes increased non-zein proteins
- Which causes increased essential amino acids
- QPM used for improving human and livestock nutrition Latin America, Africa, Asia
- Great potential in drive to more 'Plant Based Protein'

	wild type	<i>Opaque2</i> and QPM
lysine	1.6	3.7
tryptophan	0.3	0.7



Is Quality Protein Popcorn (QPP) possible and why do it?

- Popcorn is high fiber, high protein snack
- Extensive natural diversity for flavor, color and texture
- QPP fits into all expanding 'healthy food' categories and fits well with RTE popcorn
- Convenient source of 'Plant Based Protein'
- Ideal for conventional and organic production
- Huge export potential for developing countries





2018

Generation and Evaluation of Modified *Opaque-2* Popcorn Suggests a Route to Quality Protein Popcorn

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Edited by:

Introducing traits from dent corn to popcorn is challenging because it is difficult to recover adequate popping characteristics. QPM (Quality Protein Maize) is a dent corn variety carrying the *opaque-2* (*o2*) mutation, specifying increased amounts of normally limiting essential amino acids, and modifier genes which restore the wild type vitreous



2020

Production and Selection of Quality Protein Popcorn Hybrids Using a Novel Ranking System and Combining Ability Estimates

Leandra Parsons^{1,2}, Ying Ren^{1,2}, Abou Yobi³, Preston Hurst^{1,2}, Ruthie Angelovici³, Oscar Rodriguez² and David R. Holding^{1,2*}

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Popcorn varieties are agronomically sub-optimal and genetically limited compared to other maize subspecies. To increase genetic diversity and improve popcorn agronomics, dent germplasm has been introduced to popcorn with limited success

2021



Final Selection of Quality Protein Popcorn Hybrids

Leandra Parsons^{1,2}, Ying Ren^{1,2}, Abou Yobi³, Ruthie Angelovici³, Oscar Rodriguez⁴ and David R. Holding^{1,2*}

¹ Department of Agronomy and Horticulture, University of Nebraska–Lincoln, Lincoln, NE, United States, ² Center for Plant Science Innovation – Beadle Center for Biotechnology, University of Nebraska–Lincoln, Lincoln, NE, United States, ³ Division of Biological Sciences and Interdisciplinary Plant Group, University of Missouri, Columbia, MO, United States, ⁴ ConAgra Brands, Springfield, IN, United States

Quality Protein Popcorn (QPP) BC₂F₅ inbred lines were produced through an interpopulation breeding system between Quality Protein Maize dent (QPM) and elite popcorn germplasm. In 2019, five QPP F₁ hybrids were selected for further evaluation due to superior agronomics, endosperm protein quality, and popping quality traits. Though these BC₂F₅ QPP hybrids were phenotypically similar to their popcorn parents,

2021

ORIGINAL ARTICLE

Improved taste and texture in novel popcorn varieties compared to conventional lines

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Abstract

Quality Protein Popcorn (QPP) varieties were bred out of a unique germplasm pool derived from Quality Protein dent Maize and conventional popcorn lines. To identify and compare distinctive characteristics within this population, a new sensory method was employed that coupled hedonic sensory ratings of common sensory traits

2022



The Unique Seed Protein Composition of Quality Protein Popcorn Promotes Growth of Beneficial Bacteria From the Human Gut Microbiome

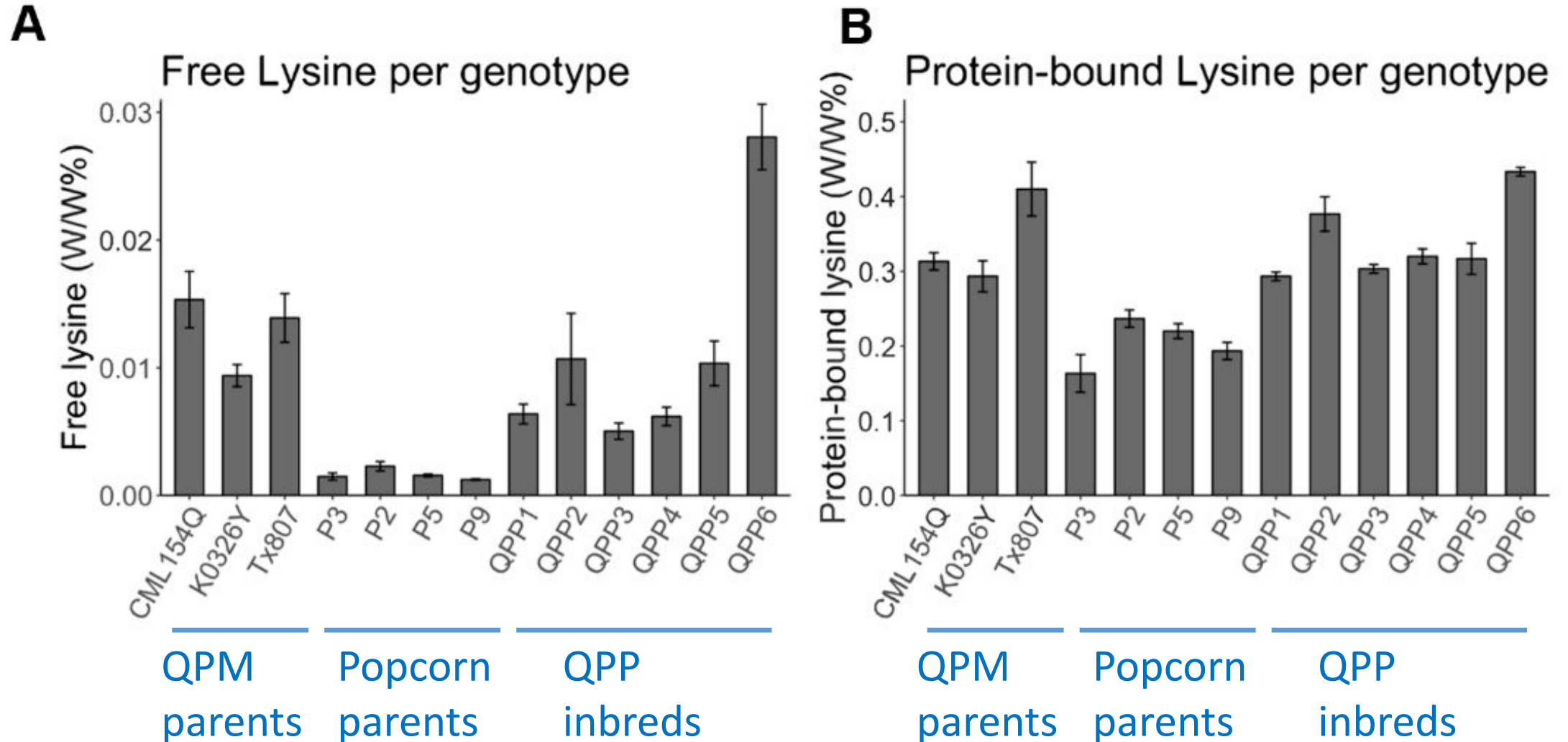
Nate Korth^{1,2}, Leandra Parsons^{3,4}, Mallory J. Van Haute^{1,2}, Qinnan Yang^{1,2}, Preston Hurst^{3,4}, James C. Schnable^{1,2,4}, David R. Holding^{3,4} and Andrew K. Benson^{1,2*}

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QPP conclusions

- **QPP hybrids show:**
 - ✓ comparable yields to CAG hybrids
 - ✓ slightly reduced expansion volume to CAG hybrids
 - ✓ Complete protein profile (double lysine and tryptophan)
 - ✓ Positive consumer preference with taste and texture
 - ✓ Positive human microbiome effects

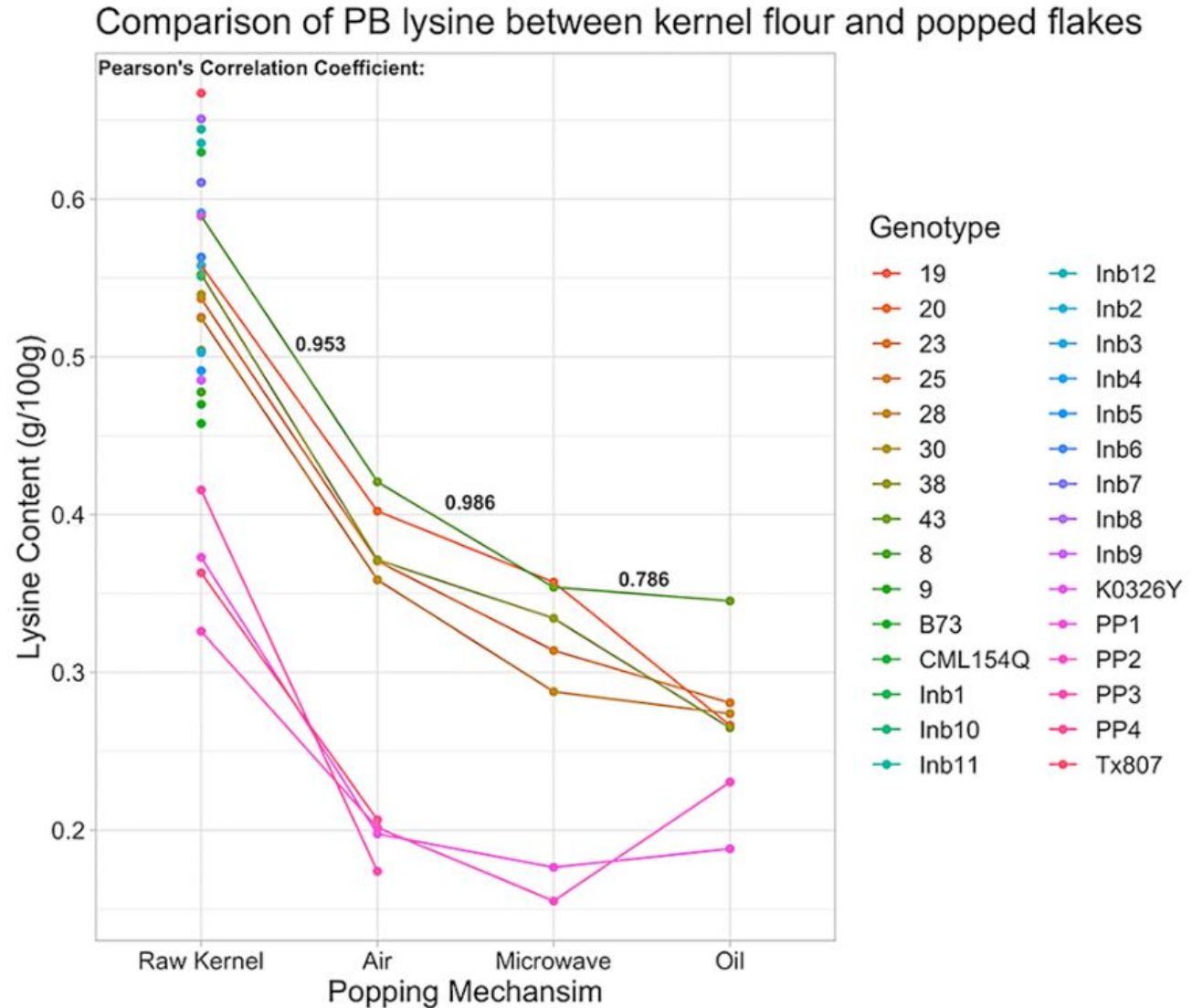
QPP protein bound and free lysine content match original QPM parents



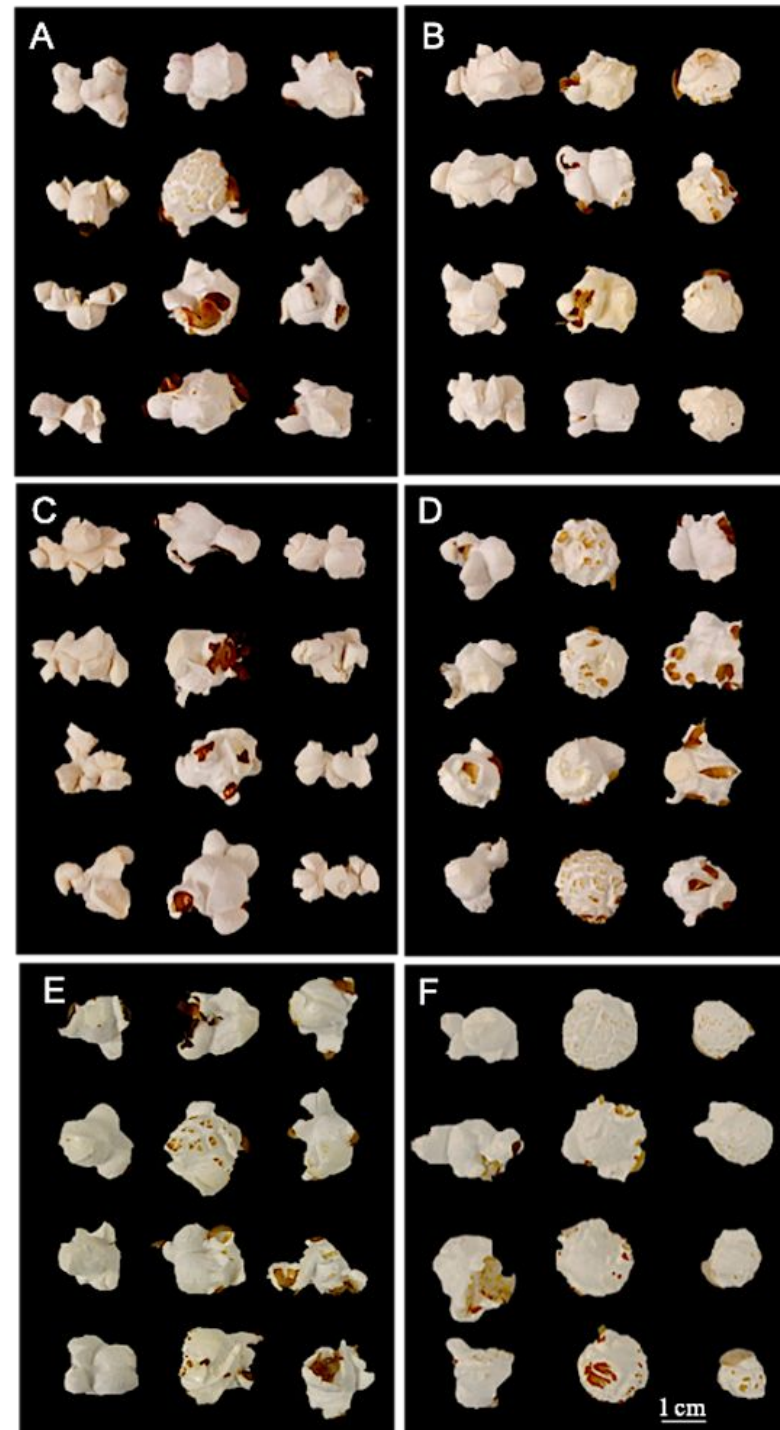


- Different popping methods variably reduce lysine
- But QPP has doubled lysine across raw and all popping methods

Con Agra currently conducting large scale yield trial and consumer tests with best five hybrids

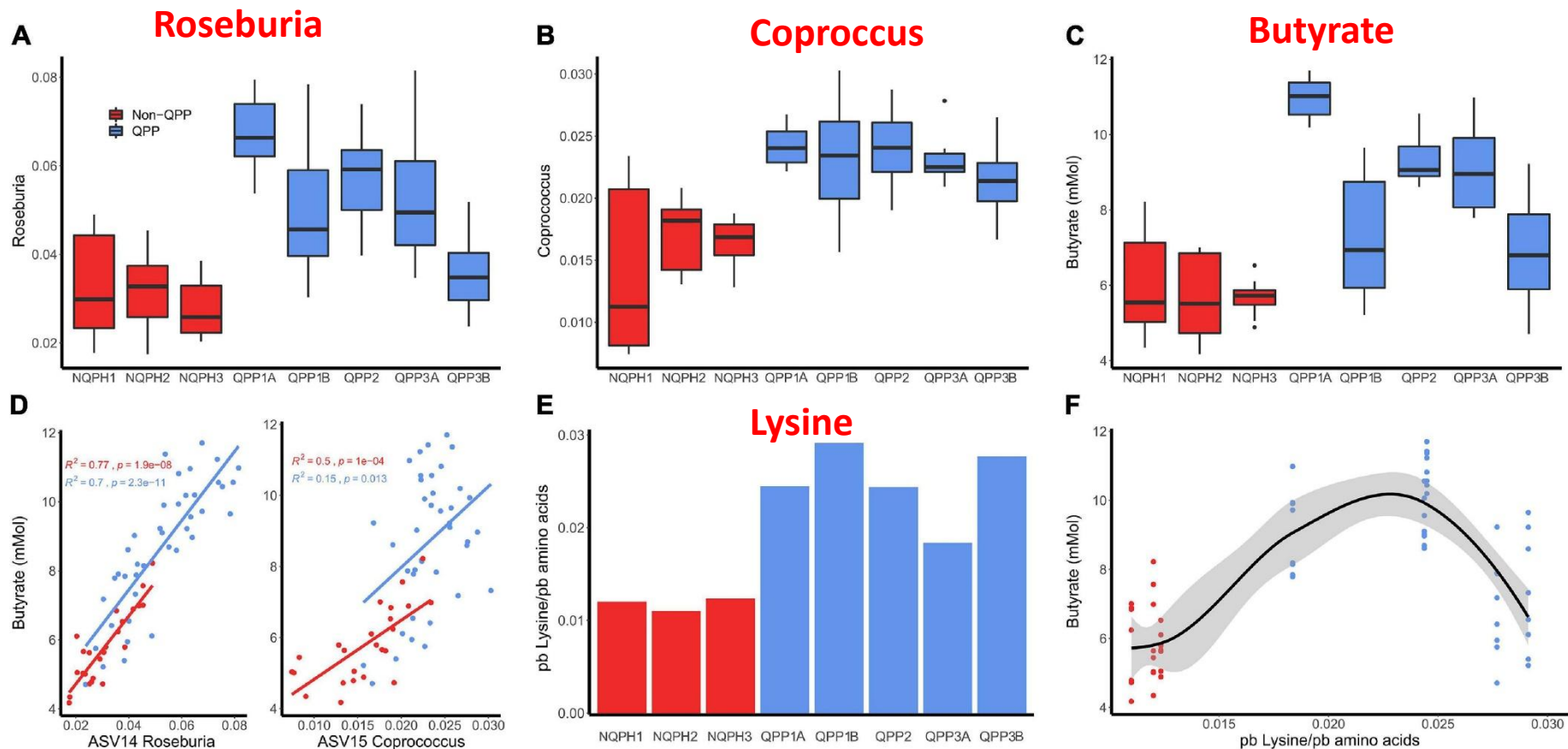


QPP hybrids have a variety of flake types from butterfly to mushroom to composite and a variety of flavors and aromas!



Novel Beneficial Prebiotic Qualities!

In vitro cultures with popped QPP vs normal popcorn show enhanced proliferation of 'good' gut bacteria and butyrate



New QPP popcorn. Selection for color, modified *opaque2* (vitreous and high gamma zein), and selfing of BC3 (3x with selection), then hybrid production



Quality Protein Sweetcorn (QPS) breeding

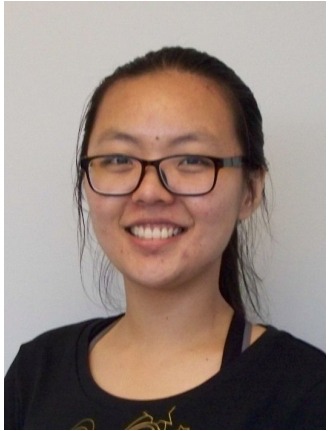


- Currently at hybrid testing stage
- Testing for sweetness and texture
- Biochemical tests for sugar, starch, resistant starch, amino acids and microbiome ongoing

The quest for Big Red Sweet corn!



Acknowledgements



Ying Ren



Leandra
Parsons



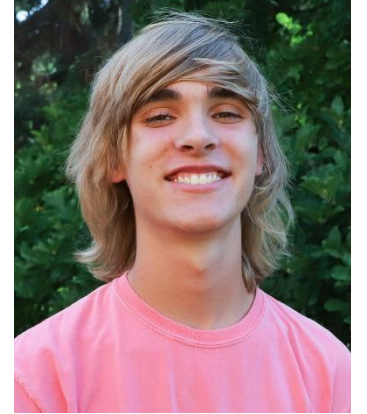
Caleb
Wehrbein



Jonathan
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