Lessons for the sensory characterization of plant-based proteins

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Vineland Research and Innovation Centre

Improving the economic viability, sustainability and competitiveness of horticulture in Canada

- Vineland is a private, not-for-profit horticultural research center located in Niagara Region of Ontario, Canada. Established in 2007.

- Results-oriented organization dedicated to horticulture science and innovation

- Deliver products, solutions and services through an integrated and collaborative cross-country network

Plant-based protein powders (PBPP)

- Used as functional food ingredient and sold direct to consumer

- Growing in popularity and seen as a sustainable food choice

- Few studies on sensory profiles of these powders

- Challenges related to off-flavors and textures

Evaluate the flavor diversity of commercially available PBPP

Overview

Orientation

- Lexicon from Nishku, 2020 & Jakobson et al. 2023
- CATA
- Water & yogurt
- 4 PBPP
  - pea, hemp, pumpkin seed & brown rice

Descriptive Analysis

- Final lexicon
  - 13 aroma/flavor
  - 5 taste
  - 6 mouthfeel
- 10 PBPP
- Water

Difference from Control

- Pea protein in 4 backgrounds
- 5 PBPP in chocolate pudding

Key learnings

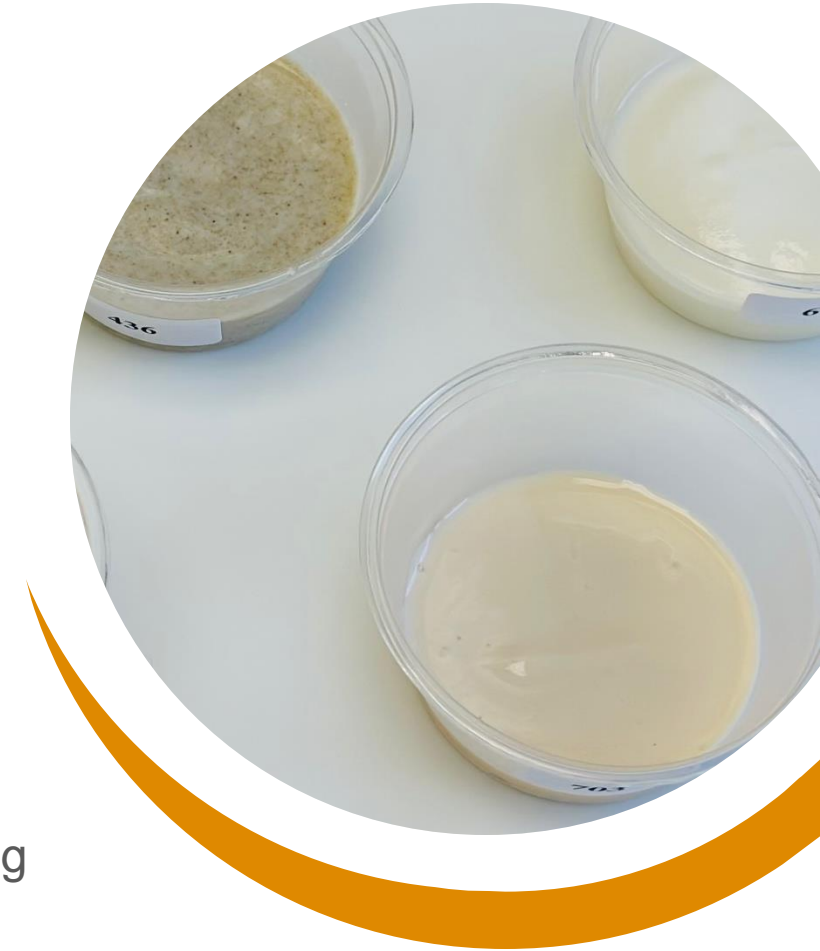# Lesson #1: Fatiguing product

- 2-minute forced break between each product

- Rinse with sparkling water

  – Crackers didn't work well

- Motivation elements at end of each session

  – DFC with protein powders in different products

    ▪ green smoothie, juice, vanilla yogurt, chocolate pudding

Lesson #2 Diverse and Intense Profiles

	Product set of Plant-based Protein Powders	Percent protein
1	pea	83%
2	brown rice	80%
3	spent grains	40%
4	sunflower seed	53%
5	hemp seed	75%
6	soy	83%
7	flax seed powder	33%
8	fava bean	55%
9	pumpkin seed	68%
10	mushroom	24%

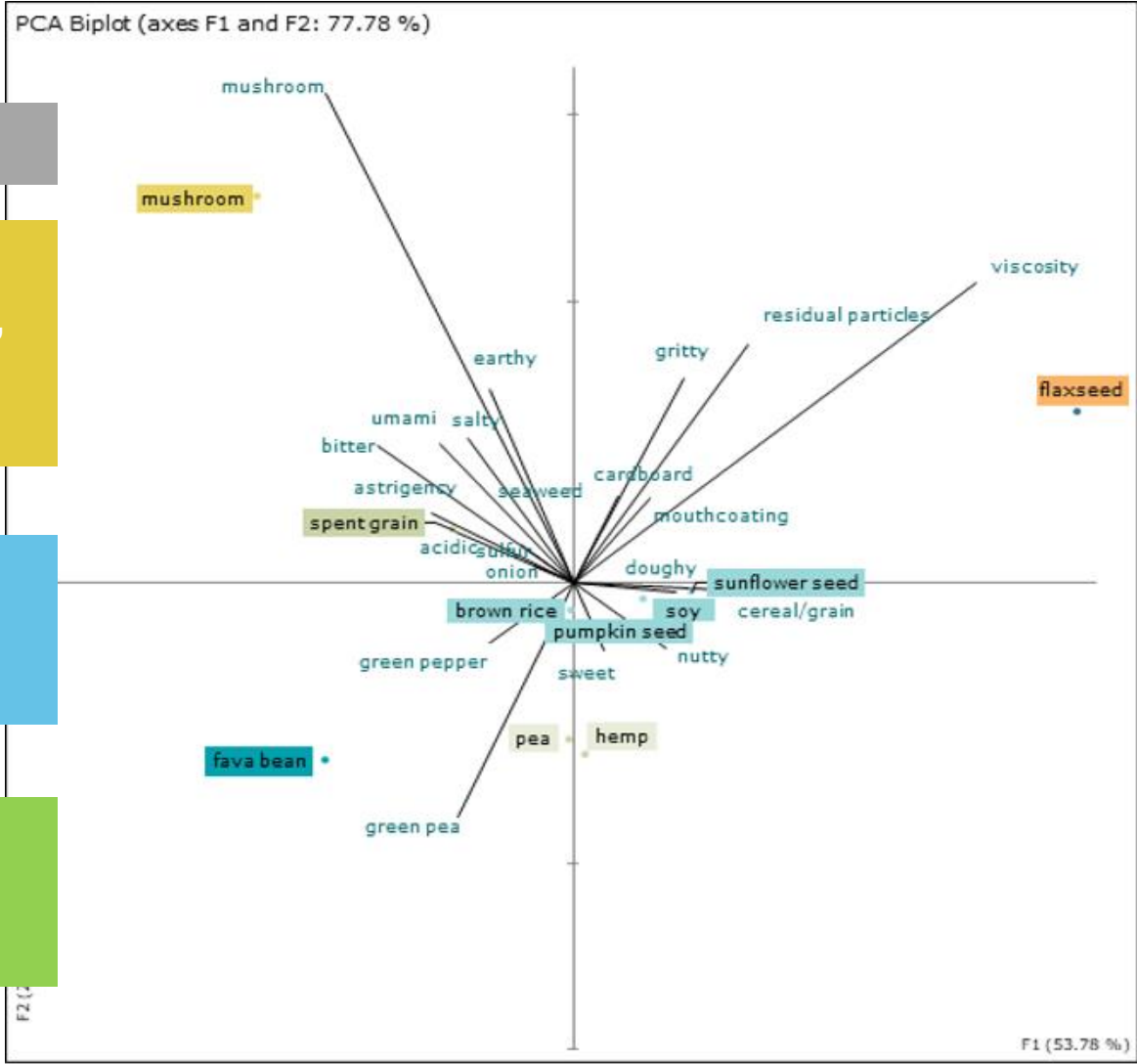- Purchased from commercial sources

- Evaluated in water

PCA biplot of 10 plant-based protein powders

6 product clusters

Cluster 1: Mushroom
- mushroom, seaweed, earthy flavors, acidic, bitter, salty and strong umami taste with astringent, thin and gritty mouthfeel.

Cluster 2: Rice, Pumpkin, Sunflower, Soy
- cereal/grain, doughy, cardboard, nutty. mouthcoating, chalky and medium-gritty

Cluster 4: Hemp, Pea
- cereal/gain, doughy, green pea, nutty and sweet with smooth mouthfeel.

PCA Biplot (axes F1 and F2: 77.78 %)

mushroom

mushroom

viscosity

residual particles

earthy   gritty

flaxseed

umami salty

bitter

cardboard

astringency   seaweed

mouthcoating

spent grain

acidic

onion   doughy

sunflower seed

brown rice   soy   cereal/grain

pumpkin seed

green pepper   nutty

sweet

pea   hemp
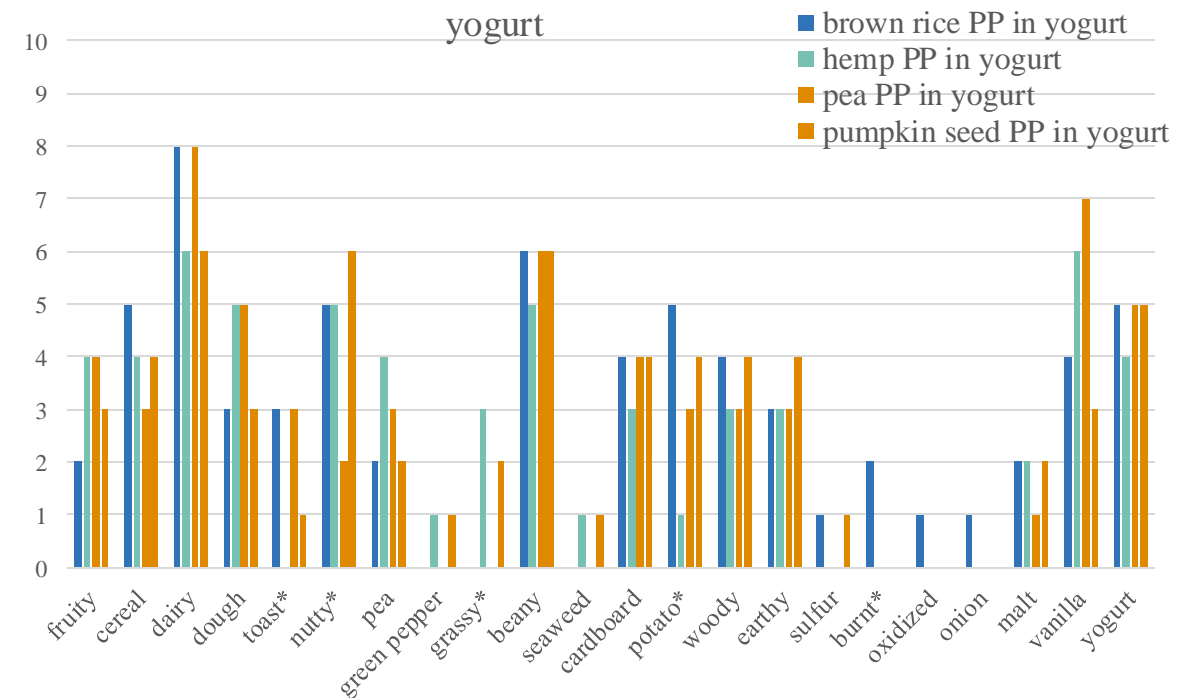
fava bean

green pea

F2 (

F1 (53.78 %)

Lesson #3: Background matters

Orientation (CATA) results: Aroma/flavor attributes used to describe PP in water (left) and in vanilla yogurt (right)

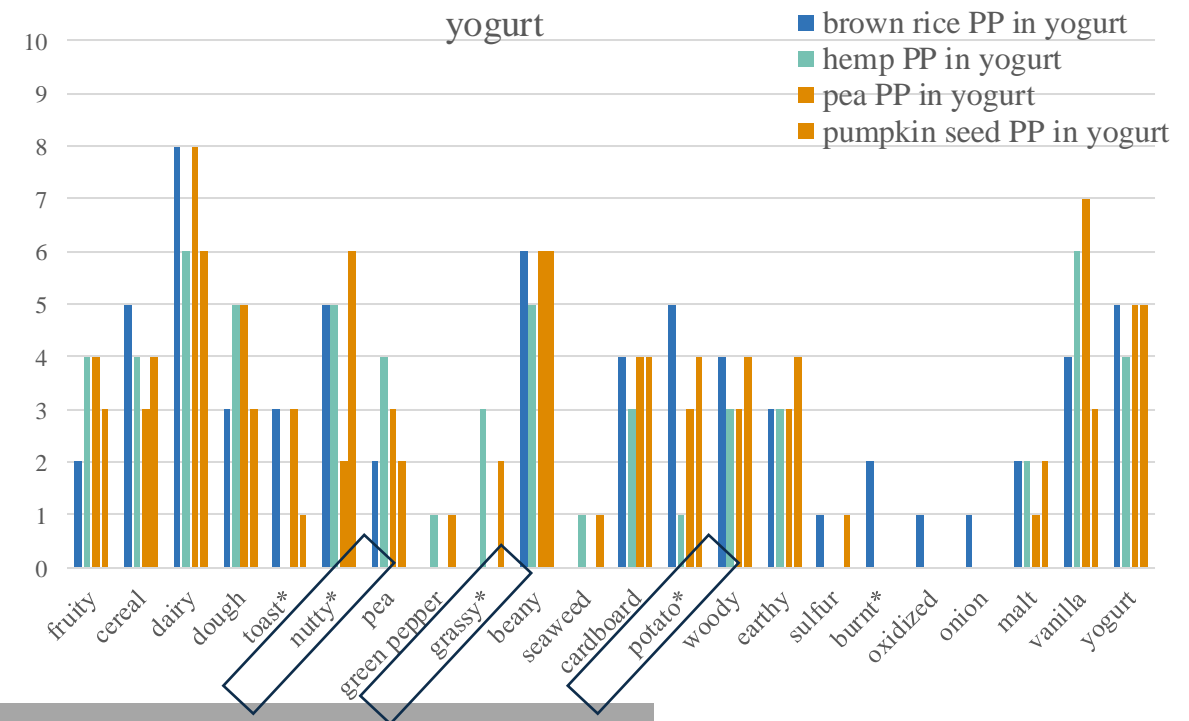Sum of aroma/flavour attributes selected for PP in water

- brown rice PP in water
- hemp PP in water
- pea PP in water
- pumpkin seed PP in water
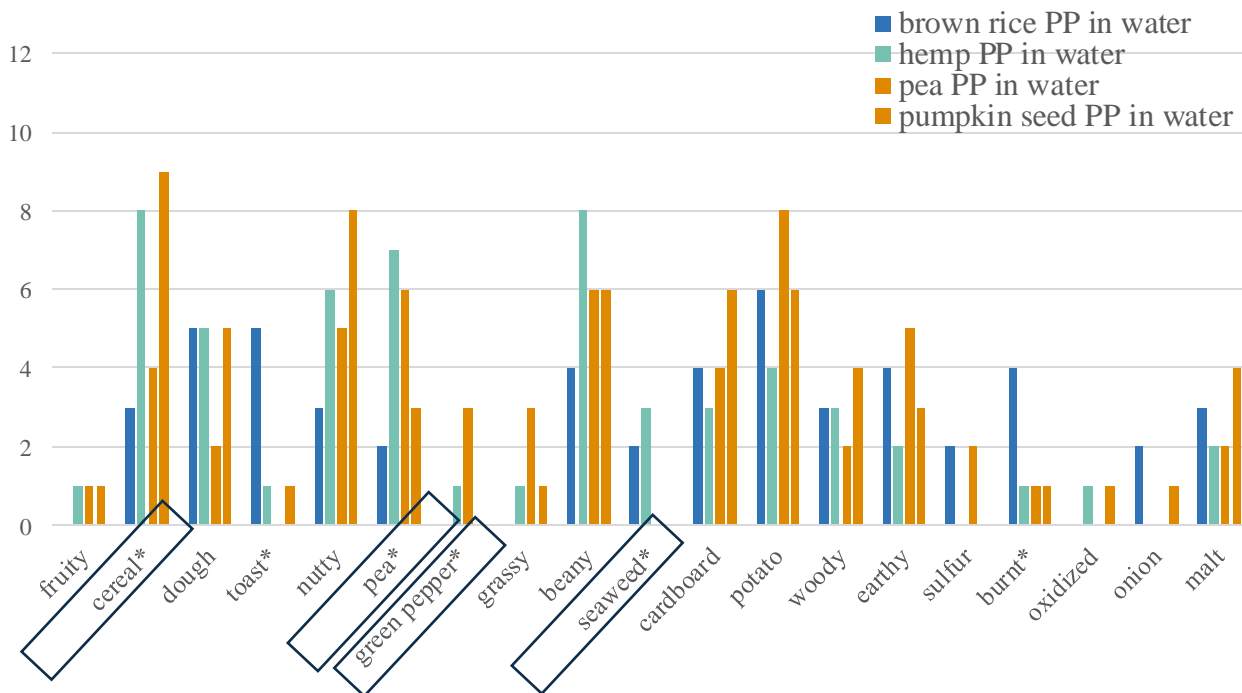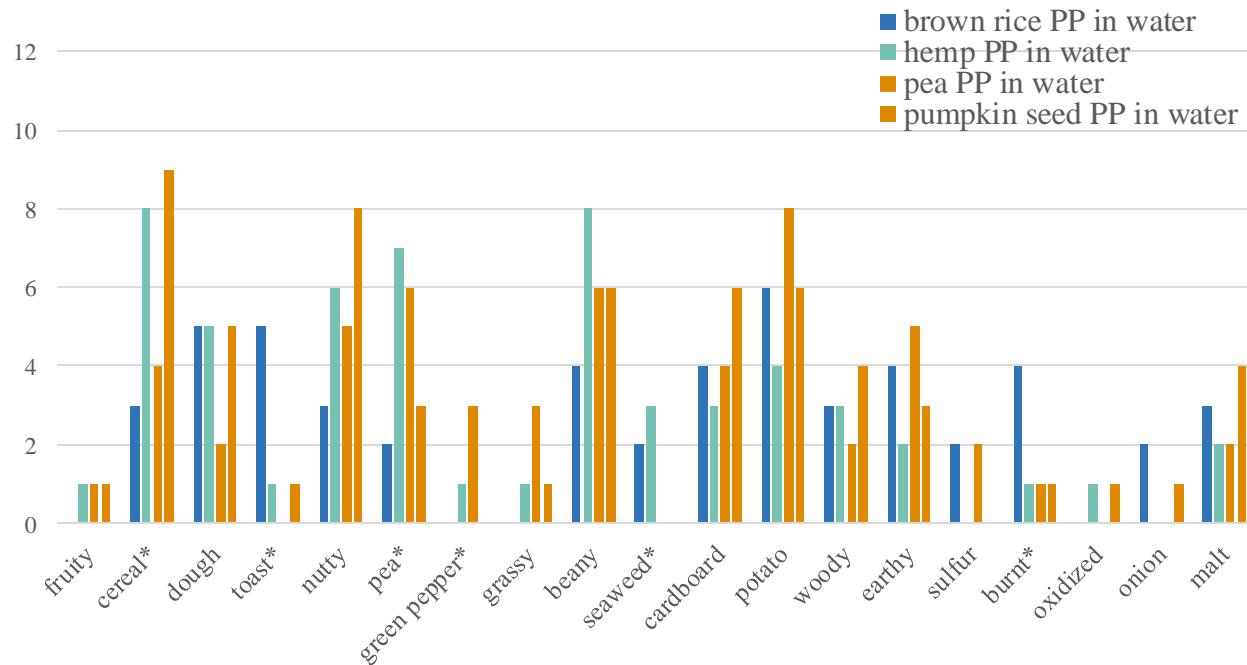
Sum of aroma/flavour attributes selected for PP in vanilla yogurt

- brown rice PP in yogurt
- hemp PP in yogurt
- pea PP in yogurt
- pumpkin seed PP in yogurt

Cereal and herbaceous aromatics (pea, green pepper and seaweed) differentiated products in water, but not yogurt

Lesson #3: Background matters

Orientation (CATA) results: Aroma/flavor attributes used to describe PP in water (left) and in vanilla yogurt (right)

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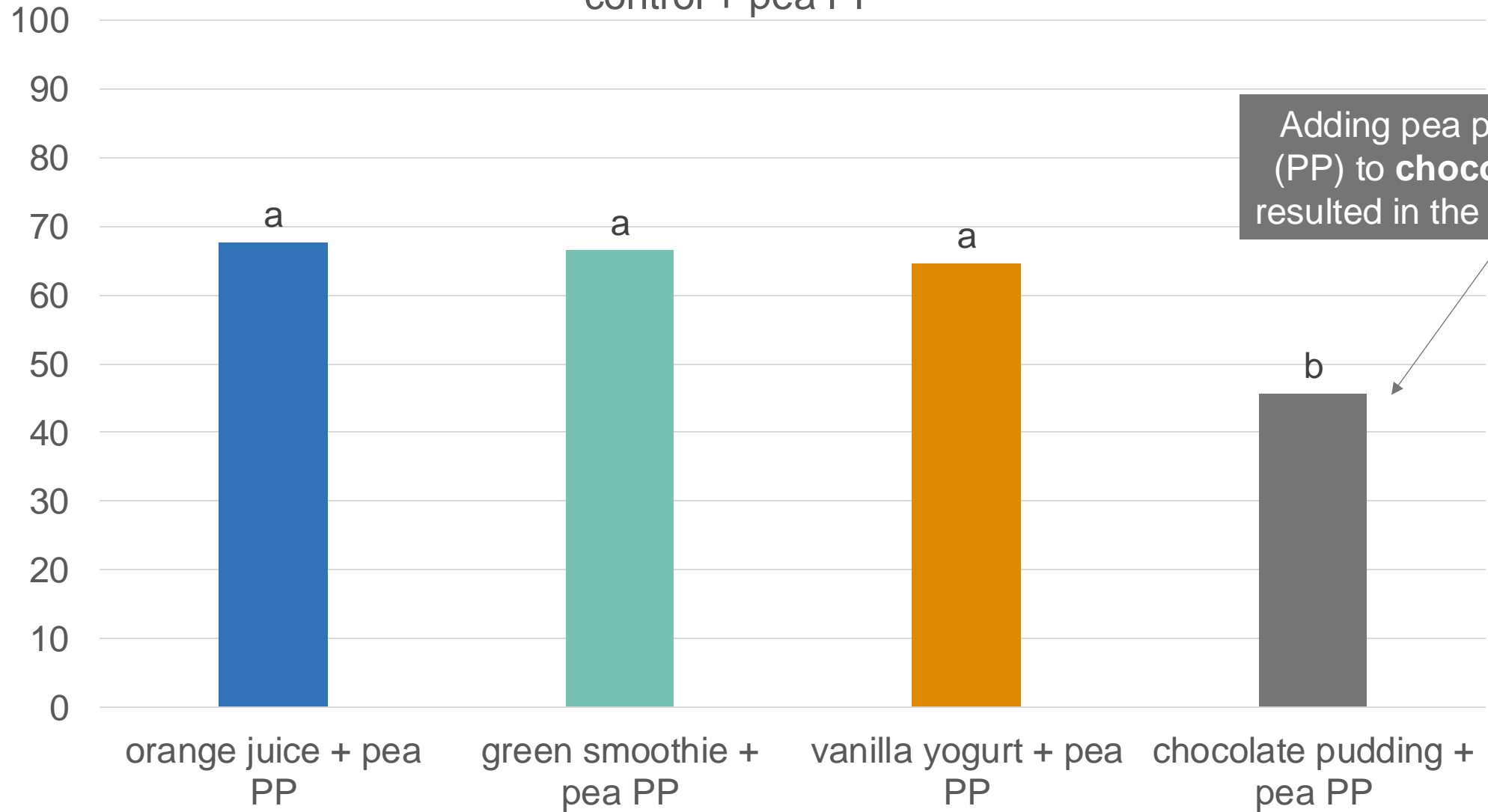
Lesson #4 Consider sensory interactions

Difference from control and relative to reference scaling of:

1. Pea protein in 4 different backgrounds:
   - orange juice, chocolate pudding, vanilla yogurt and green smoothie

2. Chocolate pudding with 5 different protein powders
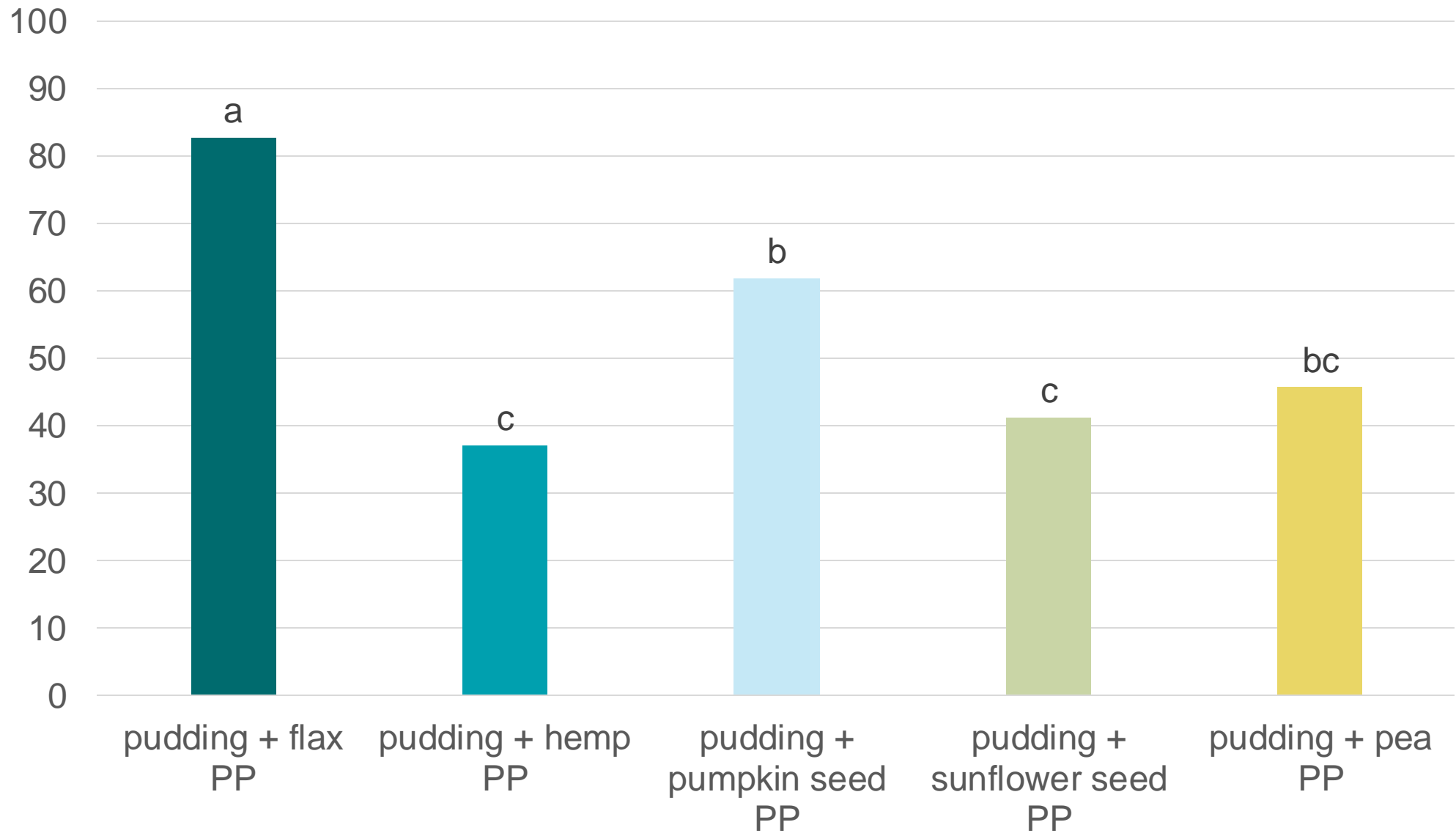   - pea, hemp, flax, pumpkin seed, sunflower seed

Overall difference from control (juice/smoothie/yogurt/pudding) vs. control + pea PP
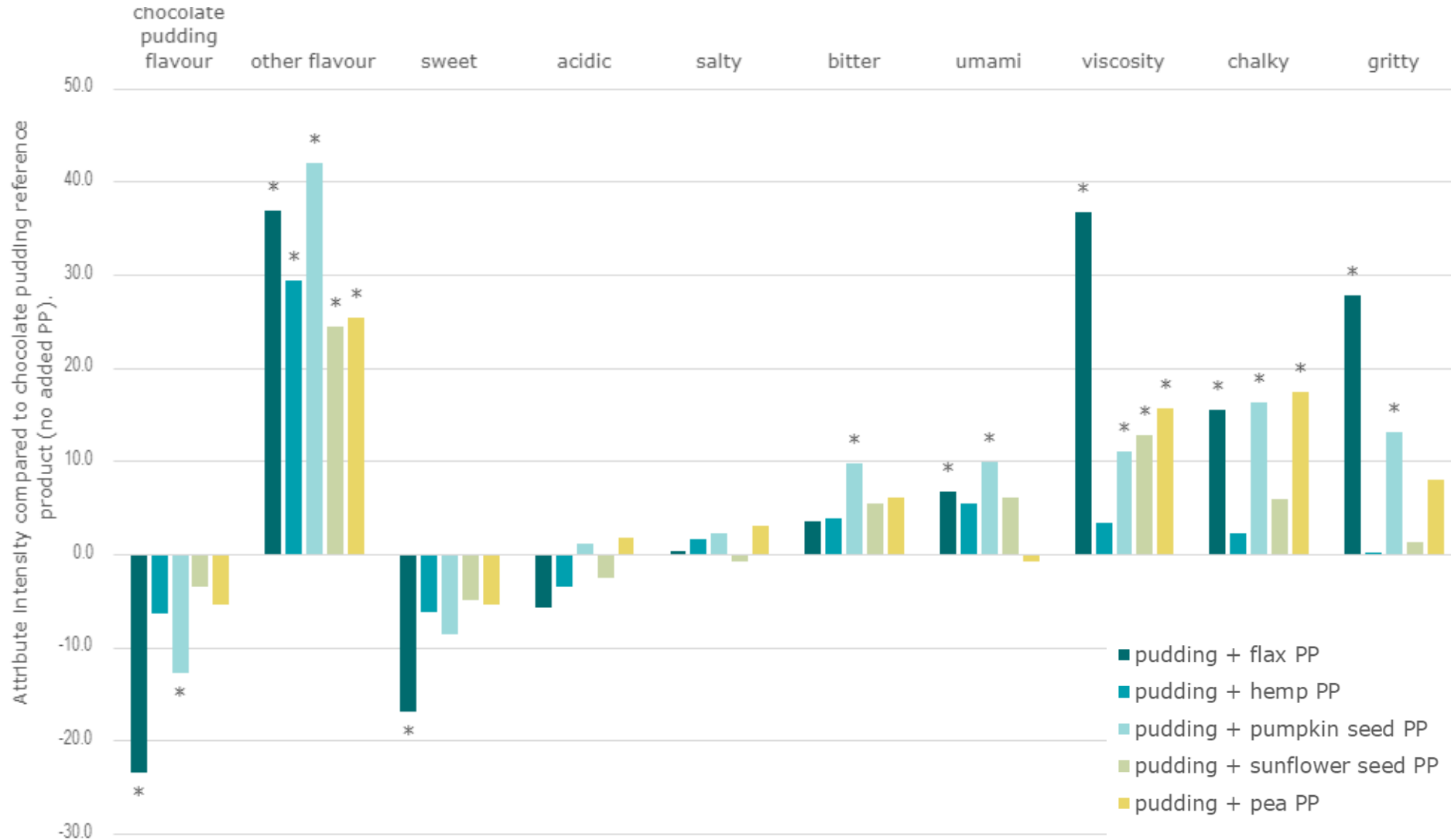
Adding pea protein powder (PP) to **chocolate pudding** resulted in the least difference

Overall difference from control (chocolate pudding) vs. chocolate pudding + PP

Relative to refence scaling for 5 PBPP in chocolate pudding

Key Learnings

1. Fatiguing product to evaluate

2. Diverse and intense sensory profiles

3. Context matters

4. Linking sensory profiles to consumer acceptance will be critical

To learn more about this project and our research please reach out.

Thank you