The development and evaluation of puréed foods with added pulses.

MariaVictoria Estrella[1],Priya Kathirvel[1], Linda Manh[1], Alex Martynenko[2] and Bohdan Luhovyy[1]

[1]Mount Saint Vincent University, Halifax, Nova Scotia, Canada;
[2]Dalhousie University, Truro, Nova Scotia, Canada

Rationale

Hedonic pleasantness and visual appearance of the food are essential for adequate intake. Dysphagia is a condition that increases the risk of malnutrition and its consequences. Puréed foods are appropriate for people with dysphagia but might not appear appetizing or tasty enough. Puréed foods formulated with pulses as the main ingredients are not currently available for people with dysphagia. Pulses are high in protein, dietary fibre and micronutrients, but their inclusion in puréed foods is limited due to their taste, flavour and visual appearance. The formulation of pulse-containing tasty and nutritious purées that meet the requirements for food provided for people with dysphagia will provide more food choices and distinct sensory experiences, resulting in improved intake and reduced risk of malnutrition.

Objective

To develop and formulate pulse-based purée recipes and evaluate their sensory perception by adults, senior adults, and children.

Methodology

Design: Open-Label Randomized Trial

Participants:

136 participants: 35 adults 19-65y, (18 females, 17 males)
30 older adults ≥65y, (16 females, 14 males)
71 children 9-15y, (36 girls, 35 boys)

1 *Treatment Formulation*

Each recipe:
- 1 type of pulses
- 200 g pulses
- Plant only
- Animal and Plant Ingredients

5 different puréed samples formulated with pulses (dry and canned)

Tested in a random order

2 *Sensory Assessment*
- Intensity: 100 mm (VAS)
- Acceptance: 9-point hedonic scale

3 *Nutrient and energy (kcal) Content*
- Energy
- Macro, micronutrients

4 *Physio-Chemical*
- pH
- Particle Size

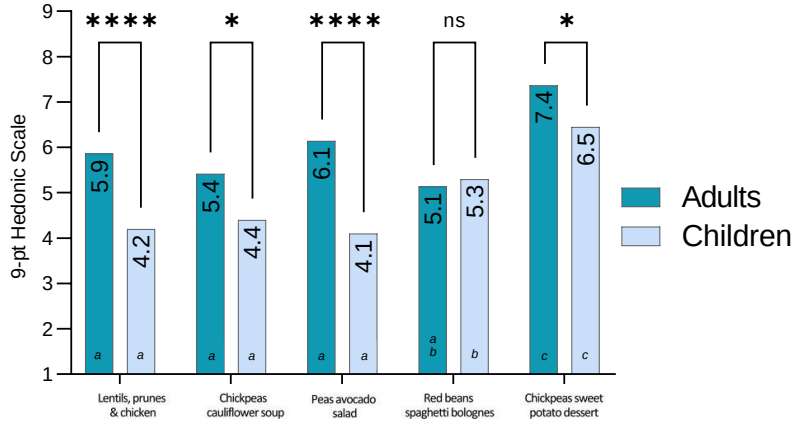
5 *IDDSI Framework*
- Spoon Tilt Test
- Fork Tilt Test

Results: hedonic perception

Pleasantness
9-point hedonic Adults and Children

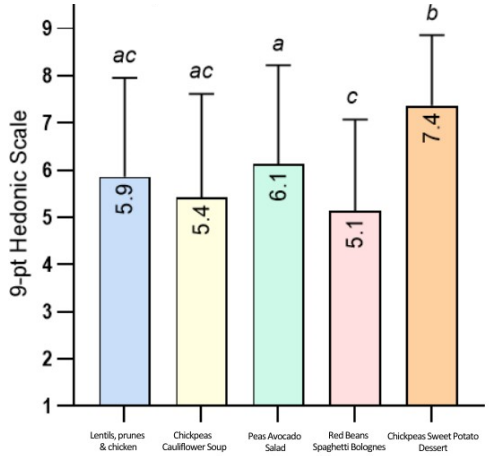
Hedonic Scale:

9: Like extremely
8: Like very much
7: Like moderately
6: Like slightly
5: Neither like nor dislike
4: Dislike slightly
3: Dislike moderately
2: Dislike very much
1: Dislike extremely



The difference between children and adults for each treatment: Two-way ANOVA with Sydak's post-hoc test: ns (P > 0.05), * (P ≤ 0.05), ** (P ≤ 0.01), *** (P ≤ 0.001), **** (P ≤ 0.0001).
The difference between the treatments within each age group: Two-way RM ANOVA with Tukey-Kramer post-hoc test: the treatments with different letters are different (P≤ 0.05).
ANOVA effects: treatment (P<0.0001), age (P<0.0001), treatment × age (P<0.0001).
Mean of Adults: 5.99. Mean of Children: 4.89. Difference between means: 1.10

Adhesiveness*
9-point hedonic Adults (≥19 y)

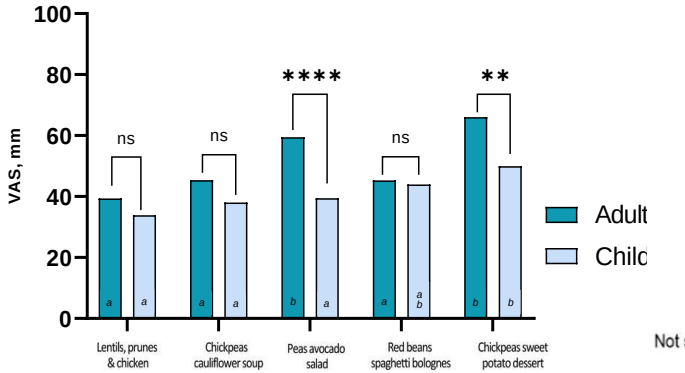


Perceived adhesiveness (9-point hedonic scale) in adults (≥19 y).
Values n=65. Friedman test. Treatment: P=0.002. Post-hoc Dunn's multiple comparison test: The difference between the values with different superscript letters is statistically significant (P≤0.05).

* Adhesiveness: The force required to remove the food that sticks to the mouth (palate and teeth) that varies from low (e.g., pudding) to high (peanut butter).

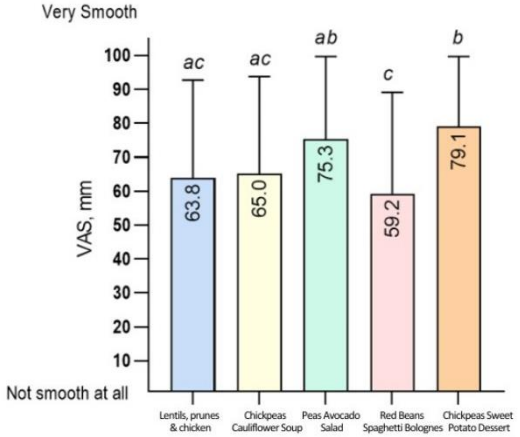
Results: Acceptance

Appearance
VAS* (100 mm) Adults and Children



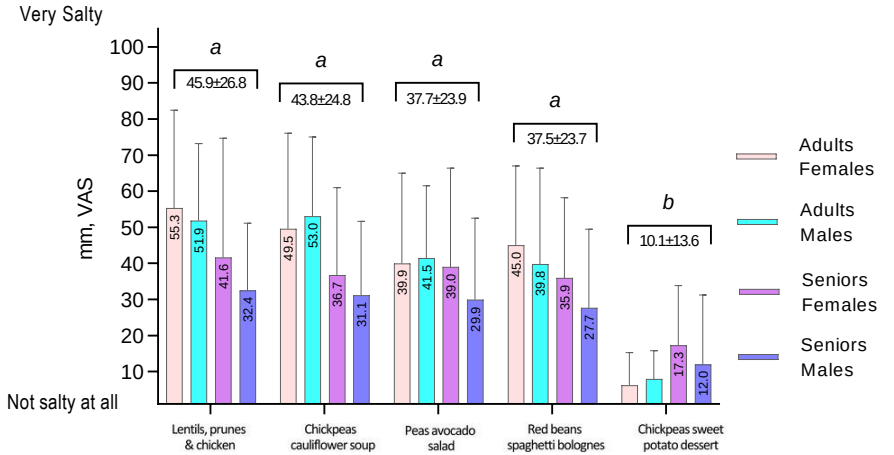
The difference between children and adults for each treatment: Two-way ANOVA with Sydak's post-hoc test: ns (P > 0.05), * (P ≤ 0.05), ** (P ≤ 0.01), *** (P ≤ 0.001), **** (P ≤ 0.0001).
The difference between the treatments within each age group: Two-way RM ANOVA with Tukey-Kramer post-hoc test: the treatments with different letters are different (P≤ 0.05).
ANOVA effects: treatment (P<0.0001), age (P<0.0001), treatment × age (P<0.0001).
Mean of Adults: 51.10. Mean of Children: 41.06. Difference between means: 10.05

Adhesiveness
VAS* (100 mm) Adults



Perceived smoothness (VAS) in adults (≥19 y) (n=65). Friedman test. Treatment: P<0.0001. Post-hoc Dunn's multiple comparison test: The difference between the values with different superscript letters is statistically significant (P≤0.05).

Saltiness
VAS* (100 mm) Adults (≥19 y).



Perceived saltiness (VAS) in adults (≥19 y) (n=65). Three-way ANOVA with Tukey-Kramer post-hoc test. Treatment (P<0.0001), age (P=0.03), sex (P=0.3), treatment × age (P=0.01), treatment × sex (P=0.9). The difference between the treatments is significant with different superscripts (P≤0.05).

* VAS: Visual Analogue Scale

Results: Food Product Development

Nutrition Facts / Valeur nutritive Per (250 g) / pour (250 g)		% Daily Value* / % valeur quotidienne*
Calories	420	
Fat / Lipides	15 g	20 %
Saturated / saturés + Trans / trans	2 g + 0 g	10 %
Carbohydrate / Glucides	48 g	
Fibre / Fibres	12 g	43 %
Sugars / Sucres	7 g	7 %
Protein / Protéines	23 g	
Cholesterol / Cholestérol	5 mg	
Sodium	350 mg	15 %
Potassium	350 mg	7 %
Calcium	150 mg	12 %
Iron / Fer	5 mg	28 %

*5% or less is **a little**, 15% or more is **a lot**
*5% ou moins c'est **peu**, 15% ou plus c'est **beaucoup**

Nutrition Facts / Valeur nutritive Per (250 g) / pour (250 g)		% Daily Value* / % valeur quotidienne*
Calories	380	
Fat / Lipides	7 g	9 %
Saturated / saturés + Trans / trans	1.5 g + 0 g	8 %
Carbohydrate / Glucides	68 g	
Fibre / Fibres	8 g	29 %
Sugars / Sucres	31 g	31 %
Protein / Protéines	15 g	
Cholesterol / Cholestérol	140 mg	
Sodium	270 mg	12 %
Potassium	550 mg	12 %
Calcium	175 mg	13 %
Iron / Fer	2 mg	11 %

*5% or less is **a little**, 15% or more is **a lot**
*5% ou moins c'est **peu**, 15% ou plus c'est **beaucoup**

Serving amount: 250 g
Labeling requirements for being considered a Meal replacement

Results: IDDSI*

Pureed Level 4

* IDDSI: International Dysphagia Diet Standardization Initiative

Results: pH

acidic pH ranging from 4.7- to 6.7

Results: particle size

Range of 566 – 1290 microns.

Conclusion

The development of the food recipes using blended pulses, in combination with other plant and animal ingredients, resulted in puréed products with acceptable sensory characteristics as evaluated by adults and senior adult participants. The overall perception of visual appearance and pleasantness of the recipes was lower in children compared to adults.

The texture assessment and particle size analysis demonstrated that the developed recipes meet the criteria set by the International Dysphagia Diet Standardization Initiative for purées. Future work is needed to reformulate the recipes to meet the regulations set for canned foods, and further improve the protein quality.

Presenting Author

Maria Victoria Estrella (she/her), originally from Ecuador holds a bachelor's degree in Human Nutrition from Pontifical Catholic University of Ecuador. She is currently a graduate student in the Master of Science in Applied Human Nutrition Program. This research project was completed as part of her master's thesis project under the supervision of Dr. Bohdan Luhovyy at the Department of Applied Human Nutrition, Mount Saint Vincent University in Halifax, Nova Scotia.

Acknowledgment

Dr. Jeff Dahn's Physics Laboratory of Dalhousie University, Departme
Physics and Atmospheric Michel Johnson, Laboratory Manager