Glycemic Index and Ultra-Processed Foods:

Results from large-scale analysis using the NOVA classification

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THE UNIVERSITY OF SYDNEY

Disclosure

- I am a non-executive Director of the Glycemic Index Foundation (www.gisymbol.com)
- I manage a GI testing service at The University of Sydney
- I have received royalties from books about diet and health
  - The Low GI Diet Shoppers' Guide

Collaborators

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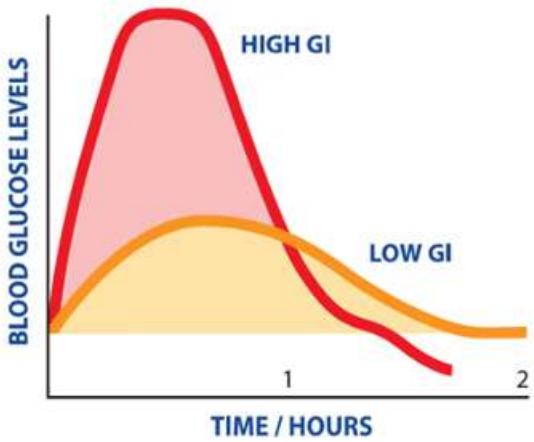
Carbohydrate Quality and Diet Quality

Glycemic index (est. 1981)



NOVA Classification (est. 2010)

Unprocessed or minimally processed foods	Processed culinary ingredients	Processed foods	Ultra-processed foods
Foods which did not undergo processing or underwent minimal processing technics, such as fractioning, grinding, pasteurization and others.	These are obtained from minimally processed foods and used to season, cook and create culinary dishes.	These are unprocessed or minimally processed foods or culinary dishes which have been added processed culinary ingredients. They are necessarily industrialized.	These are food products derived from foods or parts of foods, being added cosmetic food additives not used in culinary.
			
Legumes, vegetables, fruits, starchy roots and tubers, grains, nuts, beef, eggs, chicken, milk	Salt, sugar, vegetable oils, butter and other fats.	Bottled vegetables or meat in salt solution, fruits in syrup or candied, bread, cheeses, purees or pastes.	Breast milk substitutes, infant formulas, cookies, ice cream, shakes, ready-to-eat meals, soft drinks and other sugary drinks, hamburgers, nuggets.

Jenkins *et al*, 1981 Am J Clin Nutr 34:362-6. Monteiro *et al*, 2010, Cad Saude Publica 26:2039-49.

Diet Quality – Food Processing

Minimally Processed

Culinary Processed

Processed

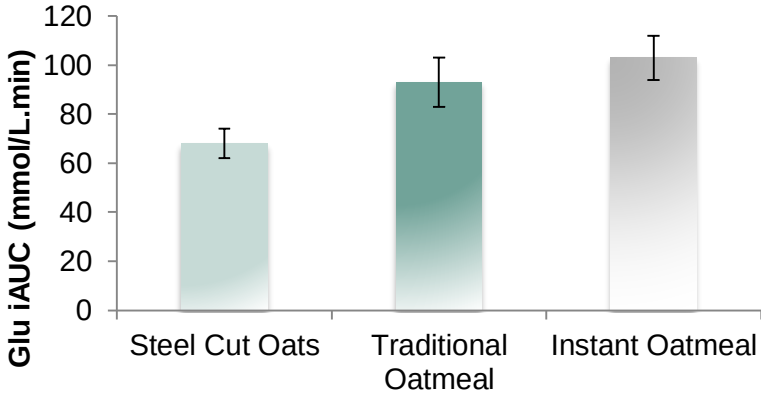
Ultra-processed

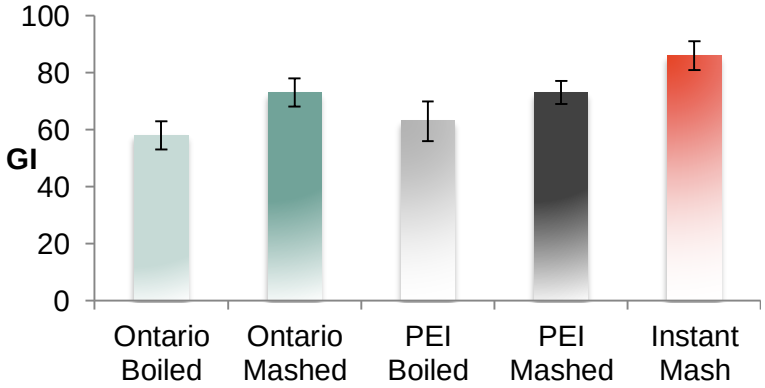
Monteiro *et al*, 2010, Cad Saude Publica 26:2039-49.

GI – Food Processing

- Starch gelatinization (heat + water) → ↑ susceptibility to enzyme digestion → ↑ GI
  - Lower postprandial responses with uncooked rice powder (3.5% gelatinised) vs cooked rice (76.9% gelatinised)[1]

- Physical disruption of fibrous cell walls (grinding, rolling) → ↑ digestion rate → ↑ GI
  - Oats: ↑ particle size → ↑ glucose response[2]
  - Potatoes: Mashing ↑ GI by a 13 – 20% vs boiled potatoes[3]





[1]Jung *et al*, 2009, Nutr Res 29: 457-61. [2]Wolever *et al*, 2019 Br J Nutr 121:1264-70. [3] Wolever *et al*, 1994, Nutr Res 14:651-9.

Rationale

- Ultra-processed foods (UPF) are a major component of the diet in many countries
- ↑ UPF associated with ↑ obesity[1], CVD[2], diabetes[3], all-cause mortality[4]
- UPF are energy dense, nutrient poor, linked with total & saturated fat and sugar intake
- Does NOVA classification improve beyond nutritional constituents already identified as risk factors for disease?
- ↑ GI associated with ↑ type 2 diabetes[5], CVD & death[6], obesity[7] & weight regain[8]
- Some evidence UPF and high glucose may be linked (n=89 or 280 foods)[9,10]

[1] Moradi *et al*, 2021 Crit Rev Food Sci Nutr 1-12. [2] Chen *et al*, 2022 Eur J Public Health 32:779-85. [3] Llavero-Valero *et al* 2021, Clin Nutr 40:2817-24. [4] Kim *et al*, 2019 Public Health Nutr 22:1777-85. [5] Livesey *et al*, 2019 Nutrients 11:1280. [6] Jenkins *et al*, 2021 N Eng J Med 384:1312-22. [7] Brand-Miller *et al*, 2002 Am J Clin Nutr 76:281-5S. [8] Zhu *et al,* 2021 Diab Care 44:1672-81.
[9] Fardet 2016, Food Funct 7:2338-46. [10] Fardet *et al,* 2017 Food Funct 8:651-8.

What is the GI and GL of foods assigned to the NOVA food processing groups?

Hypothesis:

GI and GL is lowest for minimally processed foods (MPF) compared to processed (PRF) and ultra-processed foods (UPF)

Methods

GI and GL values for 2,205 foods collated

Data from published & unpublished sources

2,159 foods used for coding

Some sugars, food additives & sweeteners excluded

Foods categorized into 9 food groups

- Dairy
- Meat/Poultry/Fish
- Beans/Nuts/Seeds
- Grains
- Fruit
- Vegetables
- Fats & Sweets
- Beverages
- Alcohol

Coded into NOVA processing level

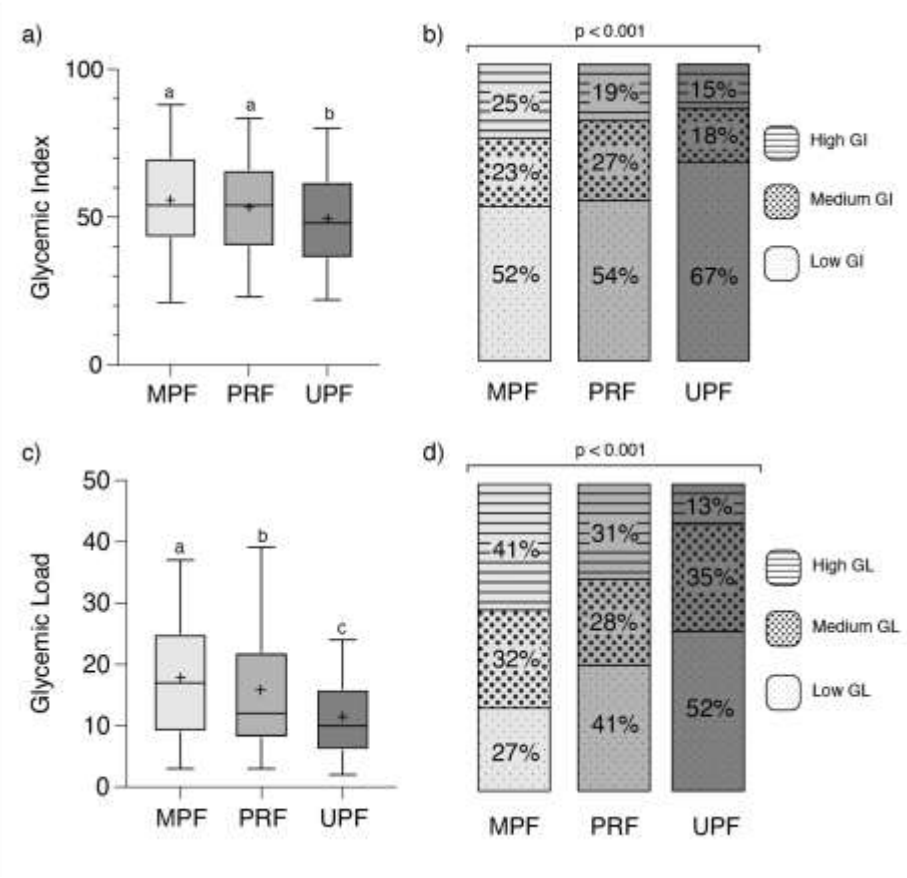
- Unprocessed & Minimally Processed (MPF)
- Processed Culinary (CPF)
- Processed (PRF)
- Ultra-processed Foods (UPF)

Final dataset: 2,123 foods

CPF (n=35) and alcohol (n=1) excluded

Results

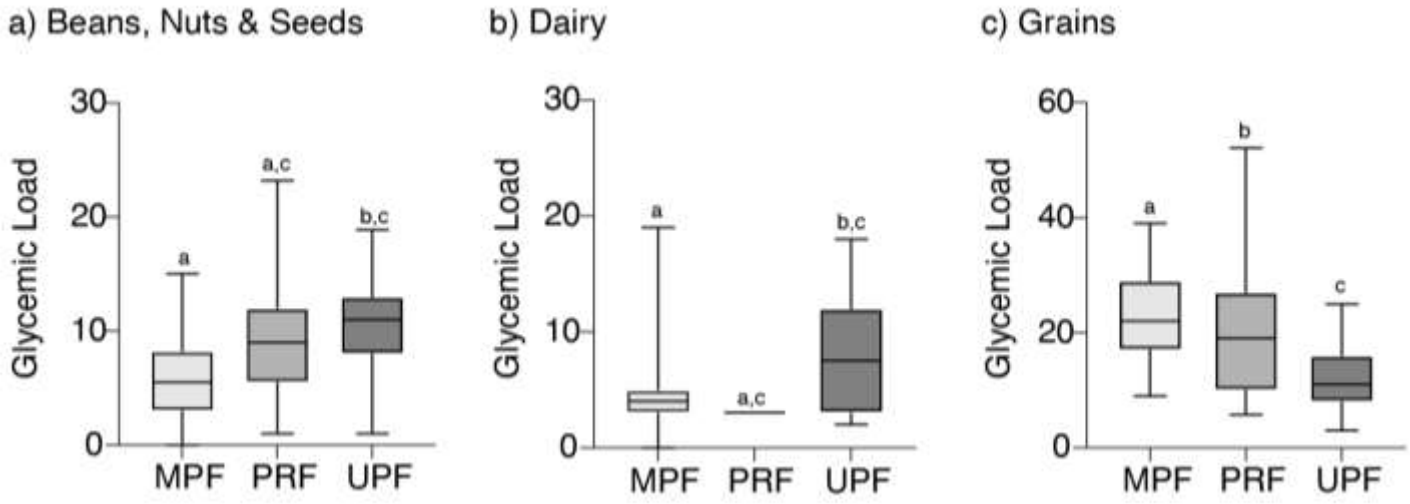
- UPF have lower GI and GL than MPF and PRF (GL only) foods
- UPF: GI 11% ↓, GL 36% ↓ than MPF
- Proportion of high, med, and low GI/GL foods varied across food processing groups



Basile et al., 2023; *in prep*

Results

- No difference in mean GI between processing groups for all eight food groups
- Mean GL was altered by food processing for three food groups



(Panel a, b, and c: p<0.001, Hierarchical Linear Model)

Basile et al., 2023; *in prep*

Interpretation of findings

- UPF did not have higher GI/GL – only ~15% had high GI/GL
  - Earlier study reported no correlation between GI and UPF[1] whereas another study found lower GI with MPF vs PRF/UPF[2]
  - Reduced intake may still be warranted due to other nutritional characteristics
- Processing may be adding beneficial components
  - Lower glycemia through added components (eg. proteins, fats, fibres)
  - Inclusion of ingredients that are lower GI (eg. sugars vs starches)
  - Alter starch digestibility (eg. retrogradation)
- "Ultra-formulated" foods may be the problem rather than processing *per se*[1]

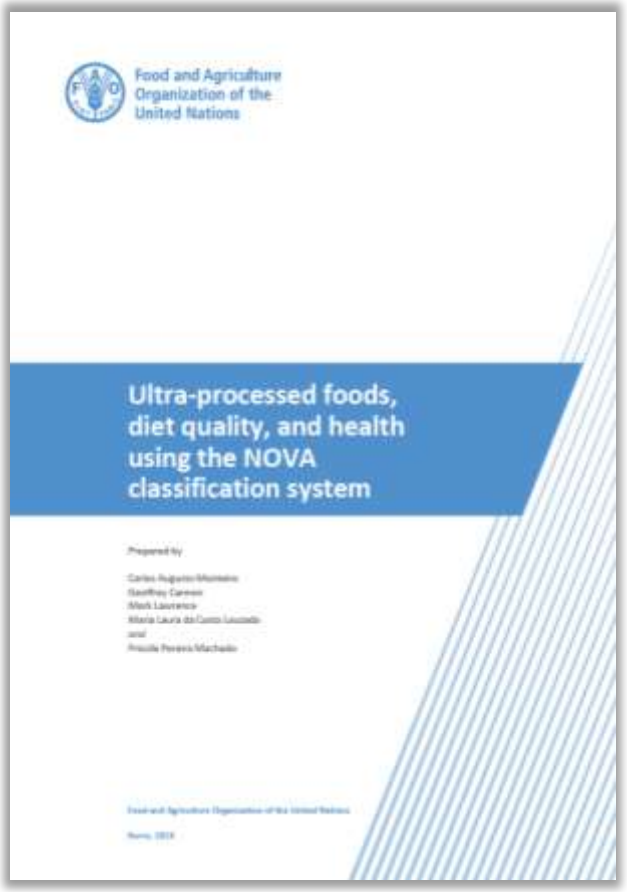
[1] Fardet 2016, Food Funct 7:2338-46. [2] Fardet *et al,* 2017 Food Funct 8:651-8. [3] Levine and Ubbink, 2023 Obes Sci Pract 9: 435-9.

Conclusions

- Adverse health outcomes associated with UPF do not appear to be linked to negative effects on postprandial glycemia

- Different types of processing included within ‘ultra-processing’ can produce varied effects on the glycemic potential of foods

- NOVA Classification may not capture food processing techniques or additives that increase the glycemic potential of foods



Randomized Controlled Trial

Does the concept of "ultra-pr
inform dietary guidelines, bey
classification systems? NO

A Astrup [1], C A Monteiro [2]

Does the concept of "ultra-processed foods" help inform dietary guidelines, beyond conventional classification systems? YES

A Systematic Review of Worldwi
Ultra-Processed Foods: Finding

Ultra-processed foods in human health: a critical appraisal

Ultra-Processed Food Intake and Obesity: What Really Matters for Health-Processing or Nutrient Content?

Food Processing at a Crossroad

Does the concept of "ultra-processed foods" help inform dietary guidelines, beyond conventional classification systems? Debate

Ultra-Processed Foods: Definitions and Policy Issues