Revisiting the Ultra-Processed Puzzle: What will the next generation of NOVA look like?

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Shares

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Making food safe and good to eat

Humans have been processing food since ancient times to make food

- More palatable
- Safer to eat
- Last longer (preservation)

Cassava (manioc, yuca) – an example where processing is necessary to remove toxic cyanogenic glucosides. Processing methods include boiling and fermentation with roots wrapped in banana leaves.

Aprilia, Ely et al. “2013 3rd ICICI-BME 292-295.

Most processing methods are not new……

Using fire began in the Stone age

Salting and pickling in Mesopotamia

Brewing and baking in ancient Egypt

……..although innovation is adding new methods of delivery

3D printing of foods

Cold plasma

- Shelling, dehulling, blanching, chemical lying, milling
- Fractionation and purification using air classification, isoelectric precipitation, chromatography
- Extremes of pH in pickling, lactic fermentation, nixtamalization, peel removal
- **Hydrolysis**: Acid, enzymatic, fermentation
- **Heating**: Blanching, boiling, baking, roasting, steaming, drying, smoking
- **Distillation**: Beverages, flavours, oils
- Freezing, freeze drying

What does processing do?

- Removes inedible parts
- Inactivates pathogens, spoilage organisms, toxins and antinutritional factors
- Provides enriched fractions with different technical properties and enhanced nutritional quality
- Changes the flavour and organoleptic properties

Savant-fou - //commons.wikimedia.org/wiki/

Industrial food processing – cellulose derivatives as an example

Cellulose derivatives are manufactured by

- Extracting cellulose from wood pulp using hot alkali
- Reacting cellulose with with methylene chloride and propylene oxide to produce derivatives such as carboxymethyl cellulose (E466; cellulose gum) and hydroxypropyl methylcellulose (E464; Hypromellose, Methocell)

- Used as emulsifiers, thickeners and stabilisers in food and pharmaceuticals.
- Safety concerns have related primarily to residues of propylene dioxide and heavy metals
- Health effects found with CVD for CMC and in in vitro human gut model

Cox, L. M. et al *Faseb J 2013, 27 (2), 692-702. Naimi et al Microbiome 2021, 9 (1), 66;*
Sellem et al BMJ *2023, 382, e076058.*

Ways of classifying processed foods EPIC

Potatoes

- Highly processed if deep fried, flakes/powder, extruded potato snacks.
- Moderately processed: vacuum packed potatoes, frozen cooked potatoes (including home prepared)
- Non-processed: none [who eats raw potatoes?]

Dairy products

- Highly processed: heat treatments (drying, pasteurization), isolates and includes yoghurt (unless homemade), cheese if deep fried, flakes/powder, extruded potato snacks.
- Moderately processed: None
- Non-processed: Raw milk

Slimani et al *European Journal of Clinical Nutrition* ***2009, 63 (4), S206-S225=***

Ways of classifying processed foods - NOVA

- Group 1 - Unprocessed or minimally processed foods : This includes processes such as dehulling, milling, pastuerisation, chilling/freezing, vacuum packing
- Group 2 - Processed culinary ingredients: includes pressing, refining, grinding/milling and drying to prepare food such as oils, butter, sugar and salt
- Group 3 - Processed foods: Made using combinations of group 1 and group 2 foods and then processed to improve sensory properties or for preservation. It includes bottled and canned goods, cheese, homemade bread
- Group 4 Ultra-processed foods: Made from foods and additives with little intact group 1 food to "*create branded, convenient (durable, ready to consume), attractive (hyper-palatable) and highly profitable (low-cost ingredients) food products designed to displace all other food groups.*"

Monteiro et al. Public Health Nutr 2018, 21 (1), 5-17.

Classifying foods using NOVA

A French study of found food and nutrition specialists were inconsistent in applying the NOVA classification even when given compositional information.

This is partly because of ambiguities in the NOVA classification system

- Yogurt with no added sugar or artificial sweeteners – is this
  - NOVA Group 1? or
  - NOVA Group 3 (non-alcoholic fermentation)? or
  - NOVA Group 4 (if ingredients such as casein or whey are included) ?
- Popcorn cakes
  - NOVA Group 3 based on simple ingredient list? Or
  - NOVA Group 4 based on its being produced using extrusion cooking.

Braesco et al *European Journal of Clinical Nutrition* ***2022, 76 (9), 1245-1253.***

Group 4 Ultra-processed foods – is it processing or nutritional profile?

Large overlap with foods high in fat, sugar and salt

Kesaite et al (2025). Overlap between ultra-processed food and food that is high in fat, salt or sugar: analysis of 11 annual waves of the UK National Diet and Nutrition Survey 2008/9-2018/19. https://doi.org/10.17863/CAM.116577

Nutritional profile of NOVA food classes

- SAIN,LIM nutrient profiling classified foods using a nutrient density score (SAIN) and a score of nutrients to limit (LIM)
- SAIN,LIM Class 1 foods have the most favourable nutrient profiles and Class 4 the least.

A large proportion of NOVA class 3 foods had a very favourable nutrient profile

Around a third of NOVA class 4 foods also had a very favourable nutrient profile

Braesco et al European Journal of Clinical Nutrition 2022, 76 (9), 1245-1253; Tharrey et al Proc Nutr Soc 2017, 76 (3), 237-246.

Nova Classification of Diets of US Infants and Toddlers

- Intake of fruit and dairy was dominated by Group 1 foods
- Intake of wholegrain and refined grains and sugars was greatest from Group 4 foods

- Iron and sodium intake was greatest from Group 4 foods
- Other micronutrient intake was dominated by Group 1 foods

NOVA classified wholegrain bread and breakfast cereals as group 4 yet these provide fibre and are often micronutrient-fortified – so NOVA classifications need to be interpreted with care

O'Connor et al , L. E.; Martinez-Steele, E.; Wang, L.; Zhang, F. F.; Herrick, K. A.. The J Nutr 2023, 153 (8), 2413-2420.

Prevalence of food allergy across Europe in infants

Challenge-confirmed cow's milk allergy was highest (~1.25%) in UK, The Netherlands and Lithuania

There is little allergy to cow's milk in Athens

EuroPrevall

Hydrolysis – one way of reducing allergenicity

- Extensively hydrolysed infant formula can be used to treat infantile cow's milk allergy
- Example process work-flow for a hydrolysate (bioactive peptides NOT infant formula).
- Additional steps in the manufacturing of EHF are filtration through a 5kDa filter to remove undigested proteins

Pa'ee et al Process Biochemistry 2015 50 302-310

Partial hydrolysis leaves IgE epitopes intact

Plasmin degradation of bovine and caprine β-casein with very large fragments remaining did not alter IgE binding

- IgE binding capacity of whey protein is reduced, but not abolished, as extent of hydrolysis increases
- This is the result of residual intact protein

Bernard et al . Mol nutri food res 2012;56(10):1532-40

Xu et al J Dairy Sci 2020 103 1141-1150

What will the next generation of NOVA look like?

- The Nova “system has problems as it is broad, but changing it substantially would invalidate research to date. Instead, **the four groups need to be further broken up to enable better defined research hypotheses around mechanisms and health outcomes**. ”
- Reframing research into UPFs “……may enable more collaboration between industry and regulators…… This would **require considerable ‘trust building’** first, given widespread suspicion in the media around conflicts of interest.“
- Some are addressing consumer perceptions by reducing no of ingredients – resulting in no fortification of breakfast cereals….

Provides 100% RI Thiamin (B1), Vitamin B12, B2, B5, B6, B9, Iron, Vitamin D, Niacin

NO fortification

https://www.gov.uk/government/publications/ultra-processed-food-upfs/ultra-processed-food-html

- **Trust building with more transparency and collaboration between industry, researchers, public health authorities, regulators and consumers will be essential to stand a chance of reframing UPFs.**
- Developers of alternative proteins will need to win the arguments with good quality data on the safety and nutritional quality of their products.

Thank you for listening!