Advancements in improving processed food classification

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Why to Process Foods?

"If you teach a person how to process food, you can feed a village"

(World Food Prize Laureate Philip E Nelson, personal communication, 2013).

Food security and Nutrient Security

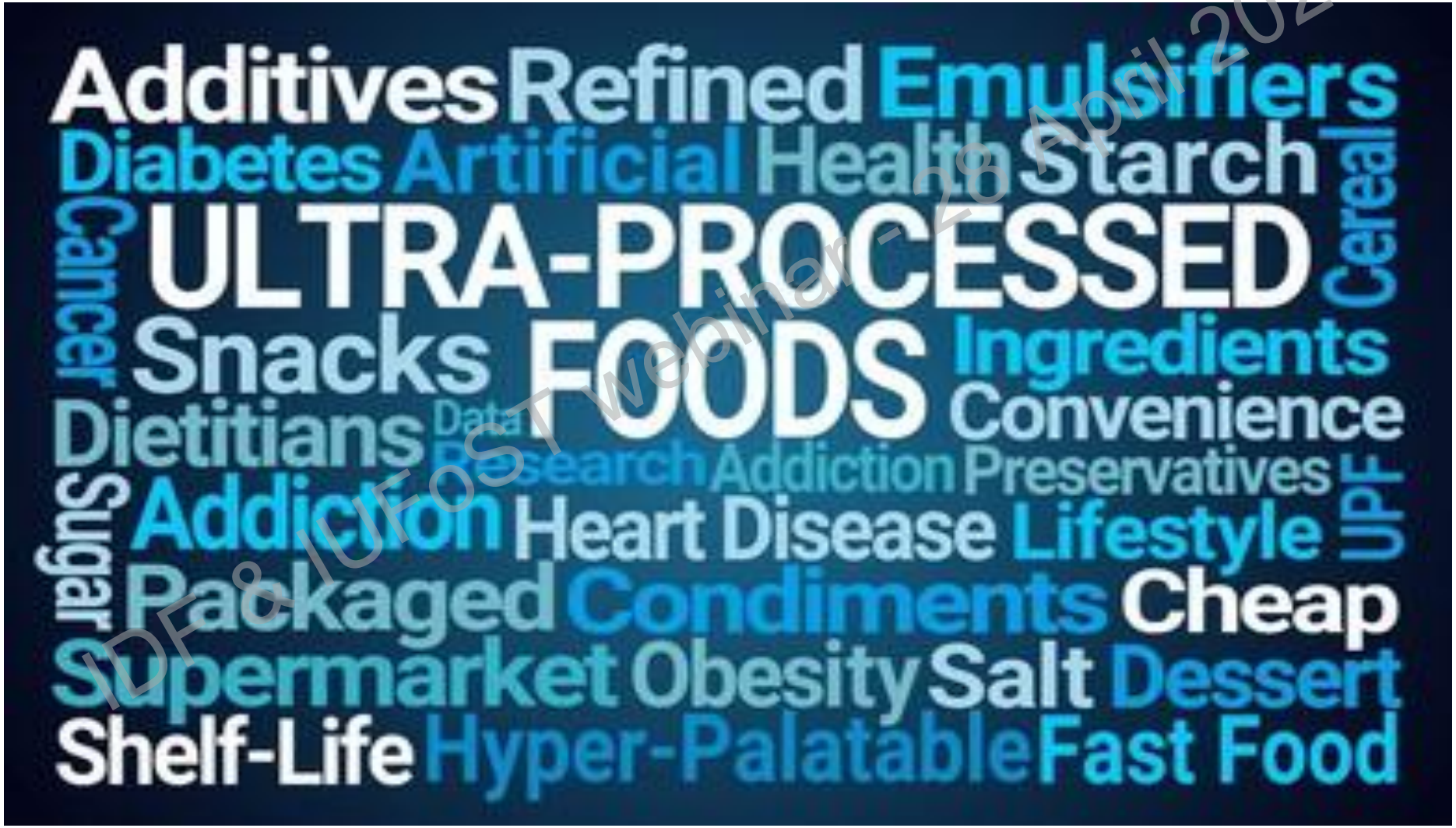
Food processing has been part of daily human lives since the beginnings of time and **is indispensable** to transform agricultural raw materials into safe, nutritious, stable, and enjoyable food.

~1.5 Million Years Ago	700,000 Years Ago	10,000 Years Ago	19th Century	20th Century	21st Century-1st Half	21st Century-2nd Half
Diet primarily unprocessed plant foods	Added meat – cooking, drying, salting, smoking	Agricultural revolution – more grains, dairy foods	Canning and milk pasteurization – increased shelf life	Dehydration, freezing, ultrahigh temperature, refrigeration, vacuum packaging, fast freezing, and use of additives and preservatives- increased shelf life and variety.	Both home and commercial processing and preservation soared.	Increased reliance on commercially processed food supply and globalization of food supply.
		The resulting increased sustainability of larger populations and decreased human workloads had consequences. With cereals providing most of the energy, rapid population growth and urbanization ensued, which led to more sedentary lifestyles, increased infections and dietary deficiency disease, high infant and child mortality, decreased adult stature, and poorer dental health.				More women entered work force shifting economy and demand for convenient readily available foods. Accessibility exploded with advances in transportation and shelf life.

Food processing as an industry was likely the stepping stone to urbanization.

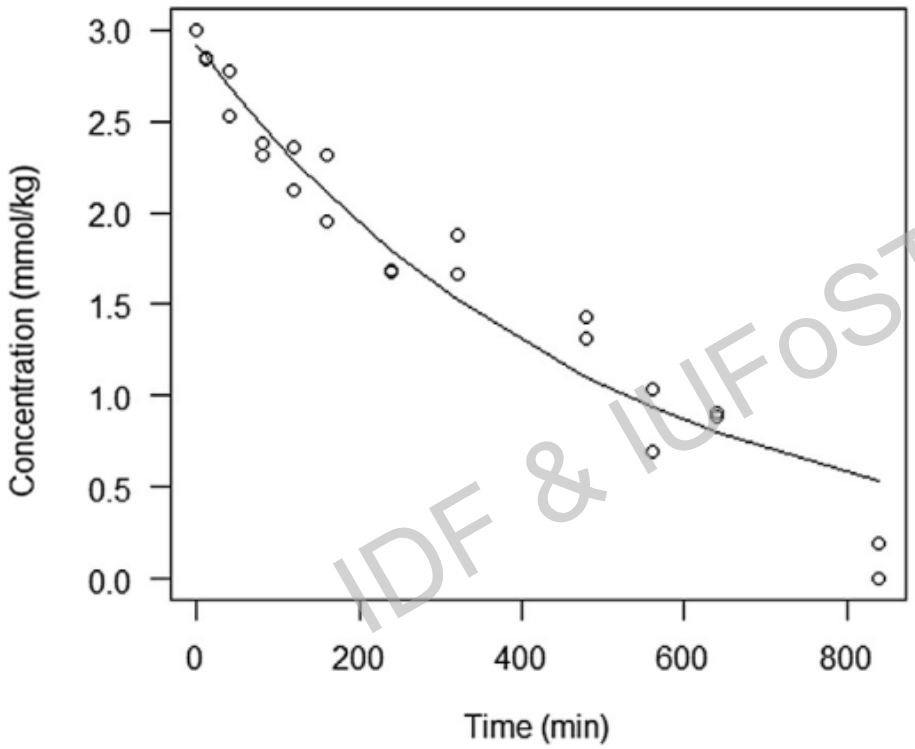
Weaver at a. (2014) Processed foods: contributions to nutrition Am J Clin Nutr. 99(6): 1525–1542.

Demonising Food Processing or Processed foods ?



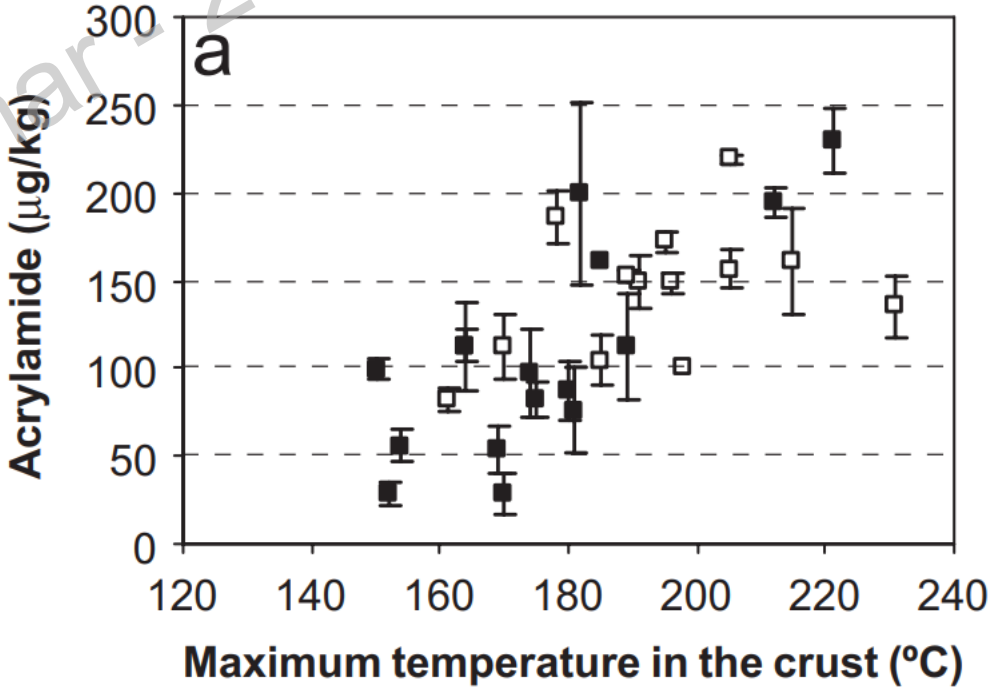
Food Processing and Nutritional Value

Thermal processing can degradate nutrients
e.g Vitamin C in apple puree



Herbig & Renard, Food Chemistry 2017

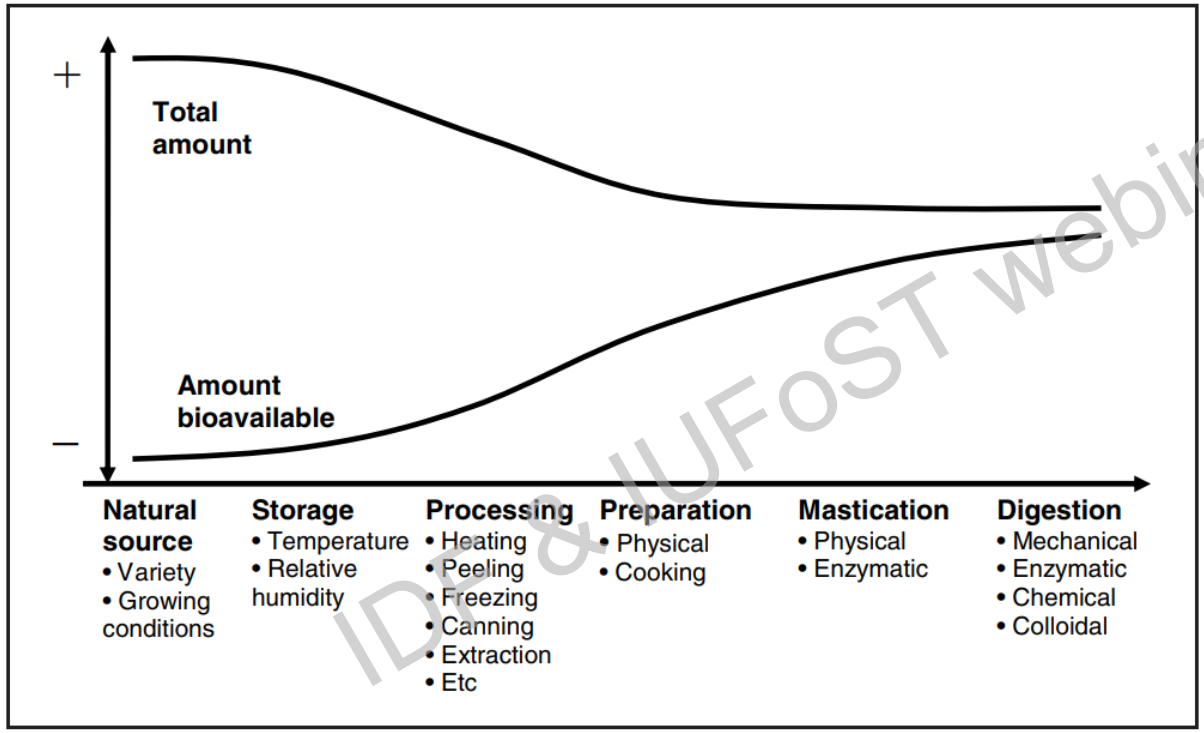
Thermal processing can induce formation of
Acrylamide in bread



Ahrné et al . LWT 2007

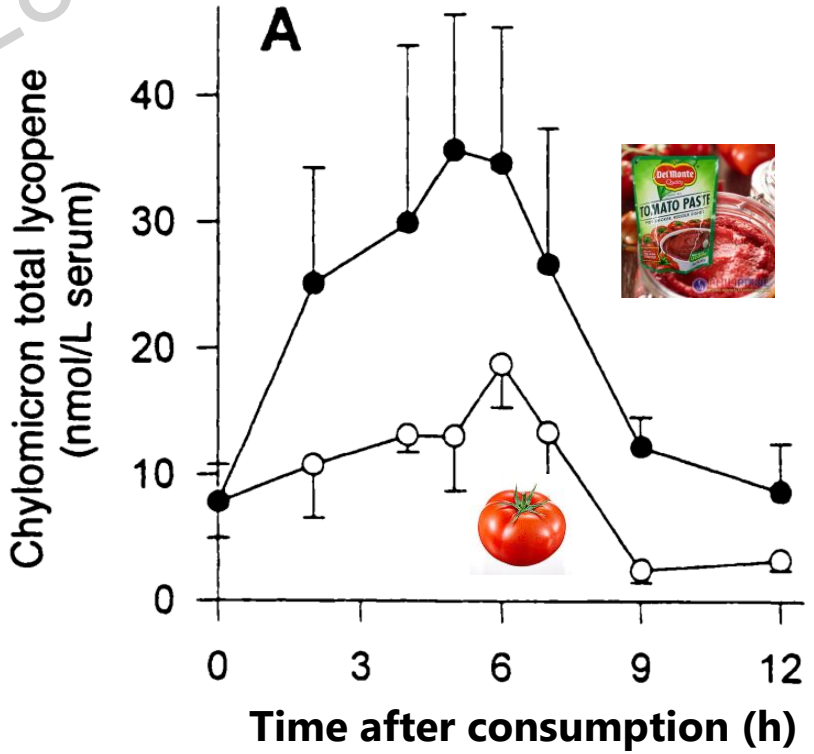
Nutritional Value & Health

Bioavailability of nutrients can increase due to processing



Parada and Aguilera, 2007

Bioavailability of Lycopene



C Gärtner et al. 1997 The American Journal of Clinical Nutrition, https://doi.org/10.1093/ajcn/66.1.116.

Processing is clearly important

We should not undermine the confidence in food processing but clarify and quantify its effect on nutritional value

- Nutritional Value
- Safety/ Shelf-life
- Affordability
- Palatability
- Convenience
- Sustainability

IUFoST task force

IUFoST (The International Union of Food Science and Technology) established a Task Force – "**Food Processing for Nutrition, Diet and Health**" – to address and clarify the role of food processing and the uses of terms such as ultra-processed foods (UPF) in food classification systems.

- **Chair: Erich Windhab,** Swiss Federal Institute of Technology Zürich (ETH), Switzerland
- Lilia Ahrné, Department of Food Science, University of Copenhagen
- Hongda Chen, National Institute of Food and Agriculture (NIFA), USDA, Washington D.C., USA
- Christiani Jeyakumar Henry, Singapore Institute of Food Biotechnology Innovation (SIFBI, Singapore
- Hyun-Sook Kim, Department of Food and Nutrition, Sookmyung Women's University, Seoul, Korea
- BarbaraSchneeman, Food Science and Nutrition, UC Davis

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NOVA Processed Food class designations:

non-processed, minimally processed, processed, ultra-processed

C. Monteiro et al. 2010

Processing Intensity Increase ➡ ???

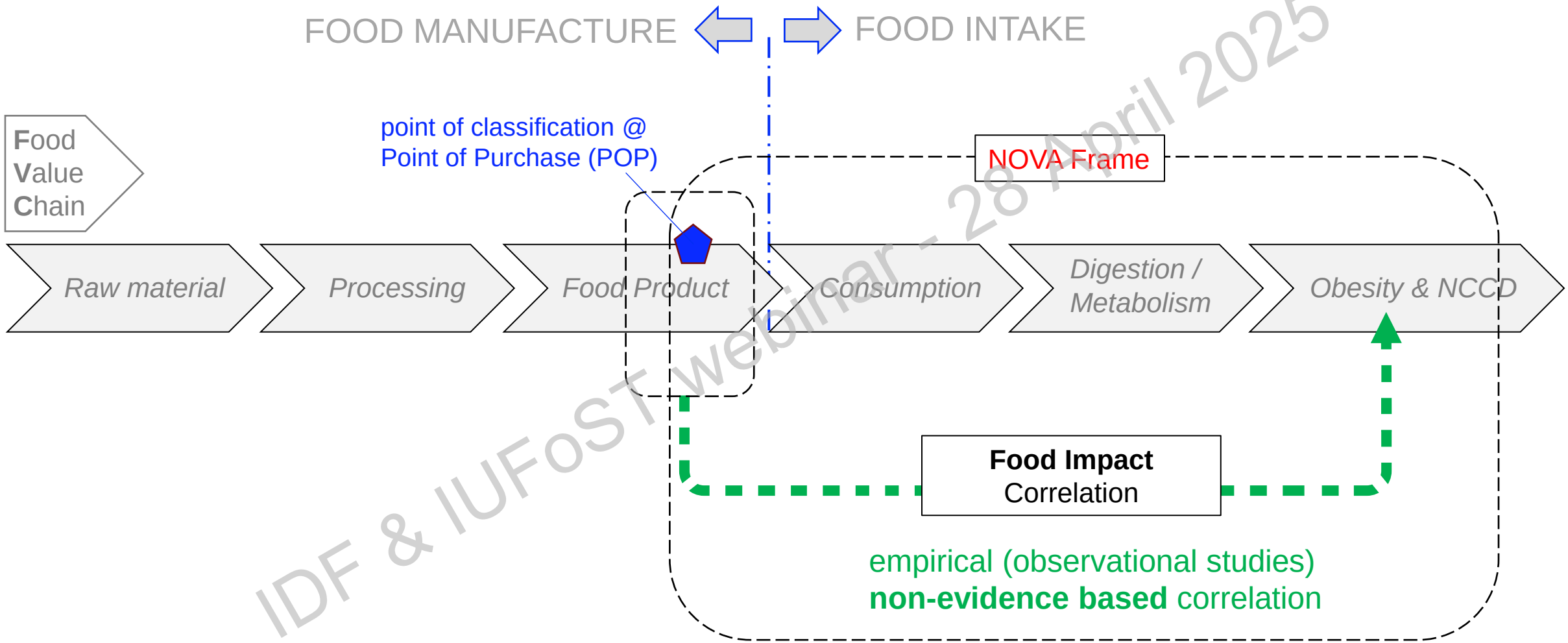
NOVA criteria for belonging to a class:

main criteria: addition of sugar, salt, saturated fats, additives

FORMULATION (recipe)

Confusion of Formulation (F) & Processing (P) and missing quantification of F & P

Identification of key issues



By differentiating DEFINITIONS:

Formulation (F) :

“Systematic selection of relative quantities of ingredients for a food product”

Processing (P) :

“Treatment of a food material to achieve a desired effect"

Nutrition Value Quantification of FORMULATION

Nutrient Rich Food Index (NRF)

e.g NRF9.3$_{100kcal}$

= NR9 – LIM3

LIM ⇦ Disqualifying nutrients — 3

- Sodium
- Added sugar
- SFA

NR ⇦ Qualifying nutrients — 5 -14

- Protein
- Fiber
- Vitamin A
- Vitamin C
- Calcium
- Iron
- Vitamin E
- Potassium
- ...

Standards FDA, FAO

- 100 g
- 100 kcal
- Serving

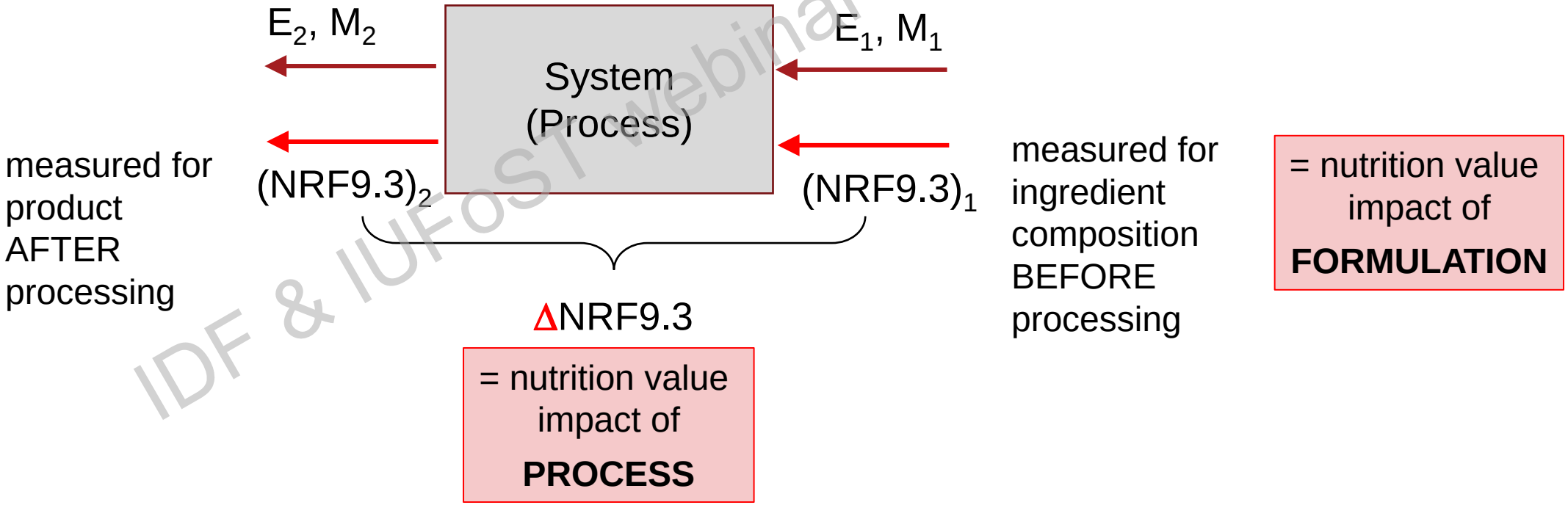
portion base

Range: ca. -200 to +300

A. Drewnowski (2017)

Quantification of Nutrition value impact by PROCESSING applying Process Analysis methodology:
(here: balance equations)

- enery balance: $E_2 - E_1 = \Delta E$
- mass balance: $M_2 - M_1 = \Delta M$



The IUFoST F & P Classification (IF&P) scheme

Classification Matrix Diagram (**CMD**)

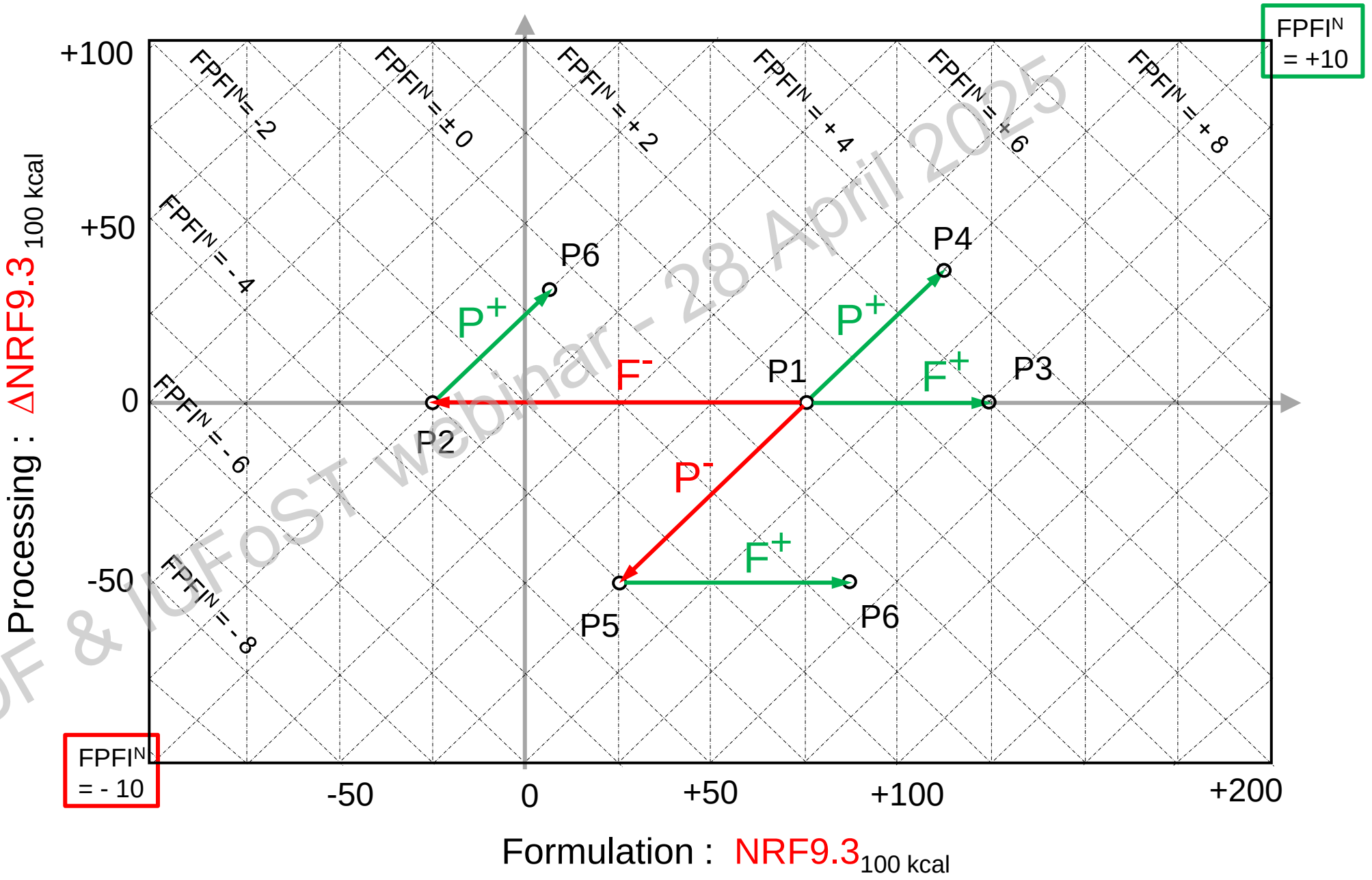
for two-dimensional and recoupled one-dimensional classification representation

horizontal lines:
± formulation impact

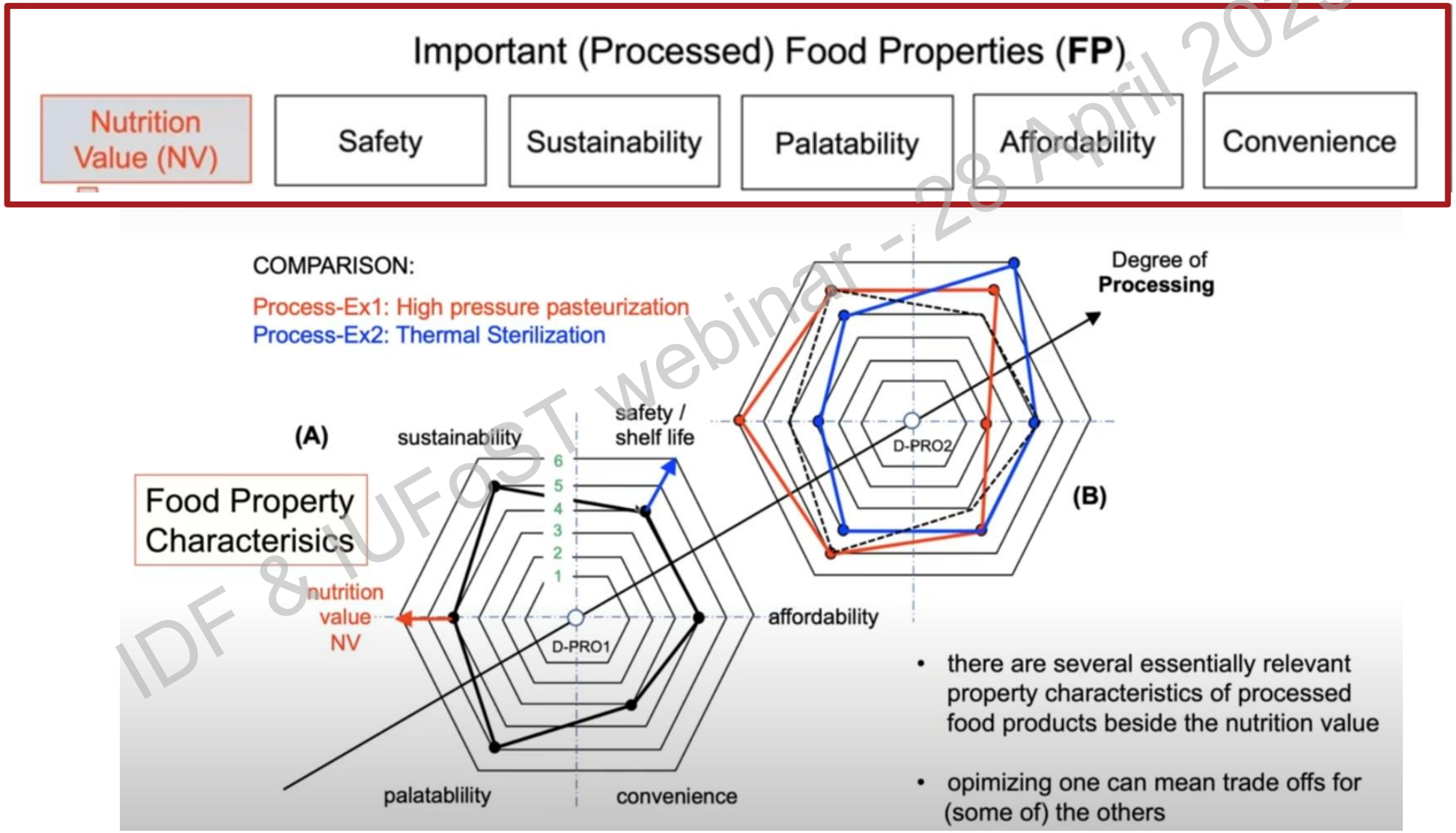
inclined lines (45°):
± processing impact

green: improvements

red: deteriorations

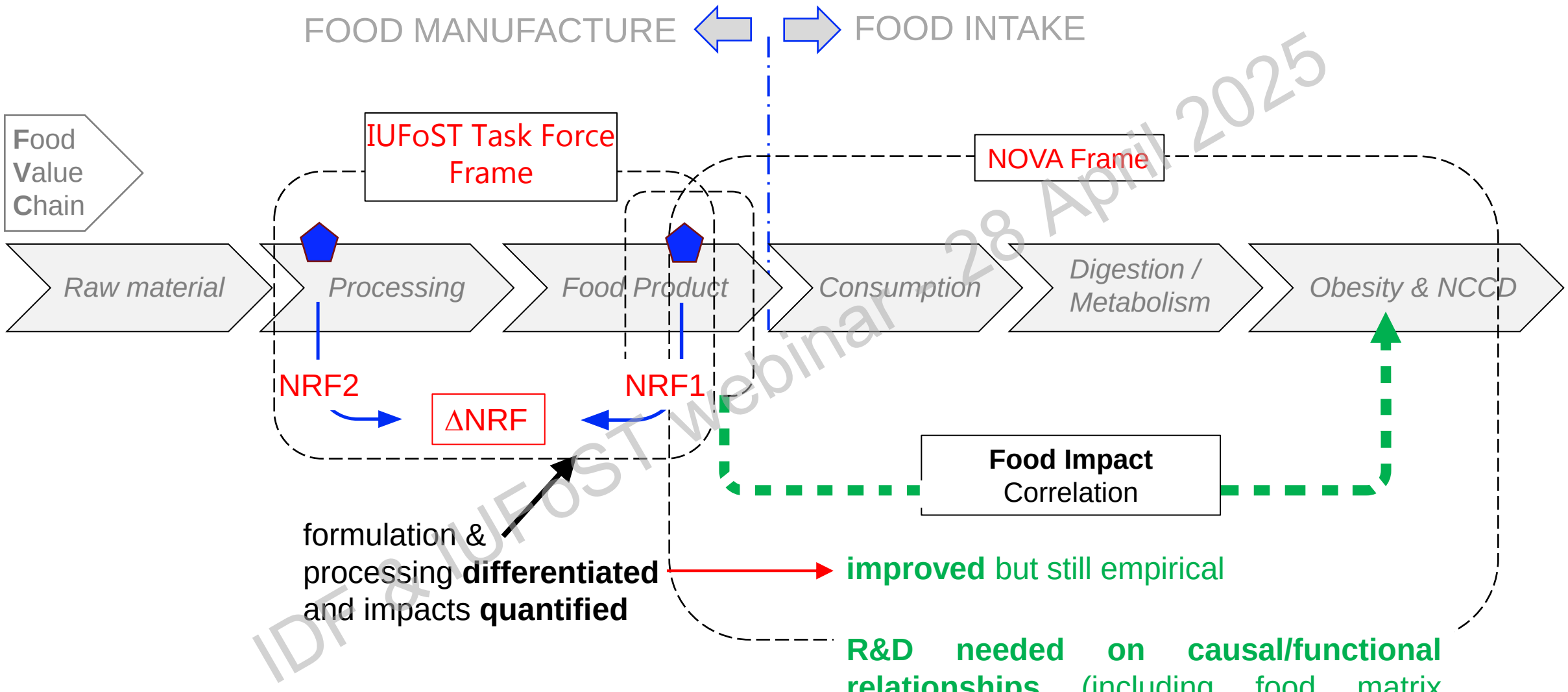


Important Food Properties – Multiple criteria



The IUFoST F & P Classification (IF&PC) scheme (**Transferability**)

Nr	Product Property (PP)	Formulation (F)	Processing (P)	F&P Coupling
1	Nutrition Value	e.g. NRF*x.y.z	ΔNRF*x.y.z	$FPFI^{N}$
2	Sustainability	e.g. Global Warming Potential GWP	ΔGWP (Global Warming Potential Difference	$FPFI^{SU}$
3	Palatability	e.g. Sensory Score SS Energy-/Volume-con-sumption for satiation EC-Sat or VC-Sat eating/mastication speed ES	ΔSS ΔEC-Sat; ΔVC-Sat ΔES	$FPFI^{SS}$ $FPFI^{EC\text{-}Sat}$ $FPFI^{VC\text{-}Sat}$
4	Safety	e.g. Colony Forming Unit (CFU) count	ΔCFU	$FPFI^{CFU}$
5	Convenience	e.g. Convenience Score CS	ΔCS	$FPFI^{CS}$
6	Affordability	e.g. Energy Consumption / $ or NRFx.y/$; NRF*x.y.z/$	ΔEC$ ΔNRF/$; ΔNRF*/$	$FPFI^{EC\$}$ $FPFI^{NRF\$}$ $FPFI^{NRF*\$}$
7	Digestibility: e.g. for proteins further	e.g. PDCAAS* DIAAS**	ΔPDCAAS ΔDIAAS	$FPFI^{PDCAAS}$ $FPFI^{DIAAS}$
8	static or dynamic (future) INFOGEST (IG) parameters $P_1 \ldots P_N$	e.g. IG-Pi	ΔIG-Pi	$FPFI^{IGPi}$



The IUFoST Formulation & Processing Classification (**IF&PC**) **scheme** allows **to quantify the impacts Formulation and Processing on the Nutrition Value:**

(a) **deliver a solid base** for non-ambiguous product classification
(b) be used for **improved correlations with obesity and health risks**

Moreover, the IF&PC scheme can be expanded:

(c) the use of an **extended** quantitative **Nutrition Value** e.g. the influence of **anti-nutrients** or **digestibility**

(d) include **other food properties** of consumer relevance than the Nutrition Value like safety, sustainability, palatability, affordability and convenience and,

Further reading at:

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