



# THE METABOLIC MATRIX

Re-engineering ultraprocessed foods to feed the gut, protect the liver, and support the brain

A visual summary of Harlan et al., Frontiers in Nutrition (2023)



The paper argues that ultraprocessed foods are a major metabolic disruptor — and that food companies can use a science-based framework to redesign products for better health outcomes.

## 1. THE PROBLEM



Ultraprocessed foods are linked to obesity, diabetes, heart disease, cancer, dementia and other NCDs



The issue is not just calories — it is food quality, processing, additives, toxins and metabolic impact



Simple sugar/salt/fat swaps are not enough



Food systems need a more scientific redesign approach

## 2. THE SOLUTION: THE METABOLIC MATRIX



### FEED THE GUT

- Increase soluble and insoluble fiber
- Reduce processed carbohydrates
- Strengthen the whole-food matrix
- Support prebiotics and probiotics



### PROTECT THE LIVER

- Reduce fructose and total sugar
- Lower glycemic load
- Reduce toxins and harmful exposures
- Support healthier hydration



### SUPPORT THE BRAIN

- Prioritize nutrient-dense foods
- Improve healthy fats, especially omega-3s
- Provide quality proteins and amino acids
- Include brain-supportive nutrients

## 3. HOW THE FRAMEWORK WORKS

### 1 Collect data



Ingredients, recipes, packaging, processing, specifications

### 2 Test products



Nutrients, fats, sugars, fiber, vitamins, minerals, heavy metals, glyphosate, additives

### 3 Analyze with food data science



Standardized product data + criteria-based evaluation

### 4 Assign TIERS



Progressive classification from conventional to best-in-class

### 5 Re-engineer products



Targeted recommendations for reformulation or replacement

## 4. PROOF OF CONCEPT AT KDD



180 products evaluated



>75,000 data points assembled



258 food additives reviewed



38 criteria programmed



5 progressive levels in the TIERS system



The system was built with cross-functional collaboration across science, product development, IT, operations, marketing and leadership.

## 5. WHAT THE TEAM PRIORITIZED



Sugar



Fiber



Omega-3s



Emulsifiers & stabilizers



These were identified as high-impact areas for product redesign across the portfolio.

## 6. WHY THIS MATTERS



### FOR FOOD COMPANIES

- ✓ Moves beyond basic nutrition labels
- ✓ Guides product reformulation with science-based criteria
- ✓ Helps identify quick wins and long-term redesign priorities
- ✓ Supports commercially viable healthier portfolios



### FOR PUBLIC HEALTH

- ✓ Addresses upstream drivers of metabolic disease
- ✓ Links food design to prevention
- ✓ Offers a scalable model for healthier processed foods
- ✓ Could help reduce NCD burden and healthcare costs



**KEY MESSAGE:** The Metabolic Matrix is a practical, transferable model for redesigning processed foods — moving from harm reduction toward food products that better support metabolic health.