A new food classification based on the extent and purpose of industrial food processing

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• Why group foodstuffs according to (industrial) processing?

• The classification: three types of food processing leading to three main food groups

• Potential benefits and harms of each type of food processing

• Application to national data in six countries
Invited commentary

Nutrition and health. The issue is not food, nor nutrients, so much as processing

Orthodox teaching and practice on nutrition and health almost always focuses on nutrients, or else on foods and drinks. Thus, diets that are high in folate and in green leafy vegetables are recommended, whereas diets high in saturated fat and in full-fat milk and other dairy products are not recommended. Food guides such as the US Food Guide Pyramid are designed to encourage consumption of healthier foods, by which is usually meant those higher in vitamins, minerals and other nutrients seen as desirable.

What is generally overlooked in such approaches, which currently dominate official and other authoritative information and education programmes, and also food and nutrition public health policies, is food processing. It is now generally acknowledged that the current pandemic of obesity and related chronic diseases has as one of its important causes increased consumption of convenience including pre-prepared foods\(^1\)\(^2\). However, the issue of food processing is largely ignored or minimised in education and information about food, nutrition and health, and also in public health policies.

A short commentary cannot be comprehensive, and a general proposal such as that made here is bound to have some problems and exceptions. Also, the social, cultural, economic and environmental consequences of food processing are not discussed here. Readers’ comments and queries are invited.

Group 1 is of minimally processed foods. It is of whole foods that have been submitted to some process that does not substantially alter the nutritional properties of the original foods which remain recognisable as such, while aiming to preserve them and make them more accessible, convenient, sometimes safer, and more palatable. Such processes include cleaning, removal of inedible fractions, portioning, refrigeration, freezing, pasteurisation, fermenting, pre-cooking, drying, skimming, bottling and packaging. Fresh meat and milk, grains, pulses (legumes), nuts, and fruits, vegetables, roots and tubers sold as such, are usually minimally processed in various ways. Data from national food balance sheets compiled by the FAO from 1961 to 2003 (http://faostat.fao.org) do not indicate uniform trends for these foods: global supplies per capita of meat and vegetables have increased, whereas those of pulses and starchy roots have decreased.

Group 2 is of substances extracted from whole foods. These include oils, fats, flours, pastas, starches and sugars. Mostly they are not consumed by themselves. Traditionally they are ingredients used in the domestic preparation and cooking of dishes mainly made up of fresh and minimally processed foods. Thus, oil is used in the cooking of grains, vegetables and pulses and is added to salads; flour is made into pastry and used as a covering for meat or vegetable dishes or as a basis for cakes; pastas are the base for dishes that include vegetables, meat and
Food groups: the big five

- Milk and dairy products
- Veggie and veggie products
- Meat and meat products
- Fruits and fruit product
- Cereals and cereal products


Definitions

- **Food**: any substance intended to be, or reasonably expected to be, ingested by humans, which provides nutrients needed to maintain life.

- **Unprocessed foods**: parts of plants (seeds, leaves, roots, fruits …) or animals (muscles, offal, milk, blood …), fungi, and algae shortly after harvesting, butchering, extraction or gathering from the nature.
Most unprocessed foods:

- 1) are highly perishable and cannot be stored for a long time and
- 2) require intense culinary processing (preparation, seasoning, mixing with other foods, and cooking) to be digestible, safe, and palatable.
Most unprocessed foods:

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Definitions

- **Food processing**: a series of operations by which unprocessed foods are converted into foodstuffs to prolong their duration, enable storage, and reduce (or abolish) time/effort spent in culinary procedures.
<table>
<thead>
<tr>
<th>Type</th>
<th>Extent/purpose</th>
<th>End product</th>
<th>Trade-offs with health and well-being</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Minimal modifications of whole foods to prolong their duration, enable storage, and reduce time/effort in their culinary preparation</td>
<td><strong>Minimally processed FOODS</strong> <em>(cleaned, chilled or frozen, vacuum-packed fruits and vegetables; dried and packaged grains, pasteurized milk, plain yogurt, frozen meat …)</em></td>
<td>Positive</td>
</tr>
</tbody>
</table>
## Types of food processing

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</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Extraction of substances from whole foods enabling the manufacture of highly storable ingredients used in the culinary elaboration of dishes/meals made from whole foods</td>
<td>Processed culinary INGREDIENTS <em>(refined oils, fats, sugar, starches, flours …)</em></td>
<td>Positive if used wisely</td>
</tr>
</tbody>
</table>
# Types of food processing

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<td>3</td>
<td>Extraction of substances from whole foods followed by their subsequent assembling (usually with lots of additives and little or no whole food), enabling the manufacture of long shelf-life, ultra-palatable, ready-to-consume products</td>
<td><strong>Ultra-processed PRODUCTS</strong> (breads, cookies, cakes, pastries, chips, cereal bars, and savory or sweet snacks in general, pizza, burgers, nuggets and ready dishes and meals in general, soft drinks … )</td>
<td>Increasingly negative</td>
</tr>
</tbody>
</table>
Ingredients: sugar, enriched wheat flour, canola/palm/soy oil, cocoa (processed with alkali), high-fructose corn syrup, cornstarch, baking soda and/or calcium phosphate, salt, soy lecithin (emulsifier), vanilla (artificial flavor), chocolate.

Ultra-processed products

INGREDIENTS: SUGAR; WHOLE GRAIN CORN FLOUR; WHEAT FLOUR; WHOLE GRAIN OAT FLOUR; OAT FIBER; SOLUBLE CORN FIBER; PARTIALLY HYDROGENATED VEGETABLE OIL (ONE OR MORE OF: COCONUT, SOYBEAN AND/OR COTTONSEED OILS)†; SALT; SODIUM ASCORBATE AND ASCORBIC ACID (VITAMIN C); NIACINAMIDE; REDUCED IRON; NATURAL ORANGE, LEMON, CHERRY, RASPBERRY, BLUEBERRY, LIME AND OTHER NATURAL FLAVORS; RED #40; BLUE #2; TURMERIC COLOR; YELLOW #6; ZINC OXIDE; ANNATTO COLOR; BLUE #1; PYRIDOXINE HYDROCHLORIDE (VITAMIN B6); RIBOFLAVIN (VITAMIN B2); THIAMIN HYDROCHLORIDE (VITAMIN B1); VITAMIN A PALMITATE; BHT (PRESERVATIVE); FOLIC ACID; VITAMIN D; VITAMIN B12.

† LESS THAN 0.5g TRANS FAT PER SERVING.
Ultra-processed products
Ingredientes: Batata, óleo vegetal, condimento preparado sabor idêntico ao natural de churrasco [farinha de arroz, sal, dextrina, maltodextrina, amido modificado, cebola (alimento tratado por processo de irradiação), aromatizante, realçadores de sabor glutamato monossódico, inosinato dissódico e guanilato dissódico e antiiumectante dióxido de silício
**Ultra-processed products**

*Ingredients:* chicken, water, food starch-modified, salt, autolyzed yeast extract, wheat starch, natural flavoring (botanical source), safflower oil, dextrose, citric acid, sodium phosphates, natural flavor (botanical source), enriched bleached wheat flour, yellow corn flour, baking soda, sodium acid pyrophosphate, sodium aluminum phosphate, monocalcium phosphate, calcium lactate, spices, wheat starch, dextrose, corn starch.

Prepared in vegetable oil (Canola oil, corn oil, soybean oil, hydrogenated soybean oil with TBHQ and citric acid added to preserve freshness).

Dimethylpolysiloxane added as an antifoaming agent.

What is wrong with ultra-processed products (UPP)?
Overall, when compared to whole or minimally processed foods plus culinary ingredients, UPP have:

- less protein
- less fiber
- more free sugar
- more total, saturated and trans fats
- more sodium
- and, for solid products, more energy per volume

Indicators of the overall diet by fifths of the UPP share. Canada 2001

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
<th>Q5</th>
<th>GOAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein (% of calories)</td>
<td>14.9</td>
<td>14.1</td>
<td>13.8</td>
<td>13.4</td>
<td>11.6*</td>
<td>10-15</td>
</tr>
<tr>
<td>Fiber (g/1,000 kcal)</td>
<td>11.2</td>
<td>10.1</td>
<td>9.7</td>
<td>9.1</td>
<td>8.0*</td>
<td>&gt; 12.5</td>
</tr>
<tr>
<td>Free sugars (% of calories)</td>
<td>9.2*</td>
<td>11.6</td>
<td>12.0</td>
<td>13.5</td>
<td>15.1*</td>
<td>&lt; 10</td>
</tr>
<tr>
<td>Sodium (mg/1,000 kcal)</td>
<td>1.1</td>
<td>1.4</td>
<td>1.5</td>
<td>1.6</td>
<td>1.6*</td>
<td>&lt; 1</td>
</tr>
<tr>
<td>Energy density (kcal/g)</td>
<td>1.8</td>
<td>2.0</td>
<td>2.1</td>
<td>2.1</td>
<td>2.3*</td>
<td></td>
</tr>
</tbody>
</table>

Source: Moubarach et al 2012 (submitted). * p < .001 for linear trend
Mechanisms linking **UPP** to overeating and obesity

- **High energy density (all UPP)**

- **Liquid calories (all sugared beverages)**

- **Hyper-palatability (all UPP)**

- **Super size servings (several UPP)**
  Report of the DGAC on the Dietary Guidelines for Americans 2010

- **Mindless eating (all UPP)**

Mechanisms linking UPP to overeating and obesity

✓ High energy density (all UPP)

✓ Liquid calories (all sugared beverages)

✓ Hyper-palatability (all UPP)

✓ Super size servings (several UPP)
  Report of the DGAC on the Dietary Guidelines for Americans 2010

✓ Mindless eating (all UPP)

✓ Aggressive marketing (all UPP)

See also Public Health Nut 14(1): 5-13, 2011
and World Nutrition, Nov 2010; 1, 6: 237-269 (www.wphna.org)
Aggressive **marketing** strategies (advertisements, discounts etc) change social norms concerning serving sizes of **UPP**!

*The Wall Street Journal, March 18, 2010*

McDonald's spokeswoman Danya Proud ... said more than 90% of U.S. restaurants sold drinks for $1 last summer, which "should give you an indication of its success for our business."
... and social norms concerning when, where and how much to eat!
Hiper-palatability of **UPP** is “reinforced” by marketing messages!

*The biscuit full of filling.*

*It is difficult to resist to Bono.*

*Choose one taste and surrender yourself!*
Sorvete de baunilha, calda com pedaços de morango e amendoim crocante. Simplesmente irresistível.
The marketing of **UPP** promotes compulsive overeating

It is one after the other!

The name says all.
Non-stop is simply irresistible.

New Non-Stop brand from Nestlé
Changes in the share of food groups in urban household food acquisitions. Brazil: 1996-2009

Δ % TOTAL KCAL

G1: Whole or minimally processed foods

G2: Processed culinary ingredients

G3: Ultra-processed products

RICE
MEAT
SAUSAGES
SOFT DRINKS/SWEETS
COOKIES
BREADS
MILK
BEANS
READY MEALS

OILS/FATS/FLOURS/SUGAR
**Δ % TOTAL KCAL**

-6
-4
-2
0
2
4
6

**Snacks and fast meals**

('mindless eating')

- **OILS/FATS/FLOURS/SUGAR**
- **RICE**
- **BEANS**
- **MEAT**
- **MILK**
- **BREADS**
- **COOKIES**
- **SAUSAGES**
- **READY MEALS**

**Shared, complete meals made from scratch**
Caloric share of food groups in total household food acquisitions in Brazil

Processed culinary ingredients 37.5%  
Ultra-processed products 20.0%  
Whole or minimally processed foods 42.5%

Processed culinary ingredients 31.8%  
Ultra-processed products 27.7%  
Whole or minimally processed foods 40.5%

Brasil 2002-3  
Brazil 2008-9

Source: Monteiro et al 2010 and Moubarac J-C et al (submitted) based on Brazilian Household Budget Surveys
Caloric share (%) of ultra-processed products in total household food acquisitions
Caloric share (%) of ultra-processed products in total household food acquisitions*

* Estimated from national food expenditure surveys: Brazil (HBS), UK (LCF), Canada (FOODEX), Chile (EPF), Colombia (ENIG) y Mexico (ENIGH).
Obesity among adults and the caloric share of ultra-processed products in six countries*

\[ y = 0.2701x + 9.7782 \]

\[ R^2 = 0.6582 \]

* Estimated from national food expenditure surveys and health and nutrition surveys around the same years.
Future work ...

• Redesign of questionnaires (24-hour recall and FFQ) to distinguish factory-made, ready-to-consume preparations (Group 3 products) from preparations made from scratch from whole foods (Group 1) plus culinary ingredients (Group 2).

• Completion of the ecological study on national caloric share of UPP and national obesity rates.

• Cross-sectional, prospective and quase-experimental studies on UPP consumption and obesity and other nutrition-related chronic diseases.