

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.

Three groups of processed foods

Almost all food and drink is processed in some way, and processed foods and drinks do not form a homogeneous group. Of great importance for human health are differences resulting from the type, intensity and purpose of food processing. There is of course nothing wrong with the modification of fresh foods by processing as such. This commentary is not suggesting a 'back to nature' approach. Much depends on the type and intensity of processing. Official and other authoritative guides may indicate that the less some foods (such as cereals and cereal products) are processed the better, without giving much guidance on what this means. It is proposed here to divide processed foods and drinks into three groups (from now on, 'foods' should be taken to refer to foods and drinks).

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 other group 1 foods and also oil; and table sugar is added to fruit- or milk-based desserts. FAO data (<http://faostat.fao.org>) show the global supplies per capita of sugar and sweeteners increased by almost 30 % between 1961 and 2003, whereas those of vegetable oils more than doubled.

Now the use of group 2 foods has been transformed. They have become the raw material bases for the third group, of ultra-processed foods. These are made up from group 2 substances to which either no or relatively small amounts of minimally processed foods from group 1 are added, plus salt and other preservatives, and often also cosmetic additives – flavours and colours. This group of foods includes breads, cookies (biscuits), ice creams, chocolates, confectionery (candies, sweets), breakfast cereals, cereal bars, chips (crisps) and savoury and also sweet snack products in general, and sugared and other soft drinks. Meat products such as nuggets, hot dogs, burgers and sausages made from processed or extruded

remnants of meat can also be classified as ultra-processed foods.

Ultra-processed foods are basically confections of group 2 ingredients, typically combined with sophisticated use of additives, to make them edible, palatable, and habit-forming. They have no real resemblance to group 1 foods, although they may be shaped, labelled and marketed so as to seem wholesome and 'fresh'. Unlike the ingredients included in group 2, ultra-processed foods are typically not consumed with or as part of minimally processed foods, dishes and meals. On the contrary, they are designed to be ready-to-eat (sometimes with addition of liquid such as milk) or ready-to-heat, and are often consumed alone or in combination (such as savoury snacks with soft drinks, bread with burgers).

Ultra-processed products are typically branded, distributed internationally and globally, heavily advertised and marketed, and very profitable. Growth in their production and consumption has been spectacular in the last decades in both higher- and lower-income countries. For instance, the share of biscuits and soft drinks in the total calories purchased by Brazilian families increased by over 200% and 400%, respectively, between 1974 and 2003⁽³⁾. In the USA, adolescents doubled their consumption of soft drinks between 1965 and 1996, whereas consumption of milk dropped by nearly 50%⁽⁴⁾.

Processed foods and human health

How foods affect health depends on a number of factors, one of which is their relative importance within diets. One important factor is food nutrient density (nutrient per energy unit) and food energy density (energy per volume). Commonly consumed foods with low nutrient density (of protein or vitamins, for instance) or high nutrient density (of saturated fat or sodium, for instance), as well as with extreme energy densities, unbalance diets and cause either nutritional deficiencies or chronic diseases (for example, obesity, dyslipidaemias and hypertension), or both.

Traditional diets wholly or mainly made up from unprocessed and minimally processed foods (group 1) usually have adequate nutrient and energy density when they contain a varied combination of plant foods (grains, vegetables, pulses, fruits, nuts), only moderate quantities of animal foods, and little salt. Even when the refined ingredients from group 2 become a substantial part of these traditional diets their overall quality may be still high.

As already indicated, diets are never made up just from the substances from group 2 (extracted and refined oils, fats, flours, starches and sugar), without any additions. These are ingredients rather than foods and as such, with the exception of refined sugar, by themselves are not palatable. Apart from some oils of plant origin they are

also grossly depleted or devoid of micronutrients. In themselves, and also as the basis of ultra-processed foods in diets containing almost no fresh foods, they are hardly compatible with survival.

This explains the problem with modern diets that contain a lot of the ultra-processed foods in group 3. While these diets usually do contain some group 1 plant foods and meat and milk, they usually keep several of the unhealthy features of the group 2 ingredients they are mostly based on: low nutrient density, little dietary fibre, and excess simple carbohydrates, saturated fats, sodium, and *trans* fatty acids. They are also energy-dense. What makes snacks, drinks, dishes and meals mainly made up from the ultra-processed foods in group 3 different from traditional dishes and meals that also use group 2 ingredients, is that they are inalterable; they come ready-to-eat or -heat. Diets that include a lot of ultra-processed foods are intrinsically nutritionally unbalanced and intrinsically harmful to health.

'Premium' ultra-processed foods are not a solution

The term 'premium' is used by the food manufacturing industry to refer to ultra-processed foods that, compared with 'regular' products, contain less fat, or no *trans* fats, or less sugar, less salt, more added micronutrients, or sometimes more whole foods such as fruits and nuts. Some of these modifications, such as absence of *trans* fats and limitation in salt content, are of course positive. Others are at best no worse, such as reduction in fat but increase in sugar content. Others may be harmful, such as the addition of synthetic vitamins and minerals into soft drinks or high energy-dense snacks: such 'fortification' with micronutrients will not make these products healthy foods, but consumers are induced to think they are.

The same concern applies to 'light' products whose 'reduced' density in sodium, sugar or fat is still far higher than recommended levels, and also to artificially sweetened drinks that stimulate cravings for sweetness, making people more likely to eat sweet foods. Increasing the proportion of whole foods in some 'premium' ultra-processed foods is positive, but such products are typically expensive and affordable only for a few. Higher prices (and higher profits) are a general characteristic of all 'premium products'. With few exceptions, 'premium' ultra-processed products are also unhealthy in themselves.

Ultra-processed foods induce unhealthy dietary patterns

Both 'regular' and 'premium' ultra-processed foods are 'fast' food, designed to be portable, convenient and accessible. They induce eating patterns such as 'grazing' and skipping main meals, eating when doing other things such as watching television, driving a car or working, and eating alone. Extremely convenient packaged products

such as caloric soft drinks have created diets in which a substantial amount of energy comes in liquid form. Liquid calories are not part of the regular diet of any mammal, except for milk during infancy, a period of rapid increase in weight⁽⁵⁾. There is growing evidence that consumption of large quantities of caloric soft drinks may fool the biological mechanisms responsible for satiety responses, and cause over-consumption of energy and thus overweight and obesity^(6,7).

A recent review of a vast array of sophisticated studies, from neuro-imaging of the brain to elegant behavioural human experiments, indicate that excess eating is largely the result of automatic and uncontrollable responses to unappreciated environmental cues such as food accessibility and food advertisement. These studies contradict the idea that eating and drinking behaviours are simply a matter of conscious choice that can be educated⁽⁸⁾.

Modern and sophisticated food marketing strategies are concentrated on ultra-processed products such as soft drinks, burgers and biscuits, not on minimally processed foods like traditional staples such as grains and legumes, or even on oil and sugar. The reason is well-known. Ultra-processed foods and drinks are very profitable. Their ingredients may cost the manufacturer a mere 5–10% of the product's retail price, and in the case of 'premium' products, even less.

Conclusion

From the point of view of human health, at present, the most salient division of foods and drinks is in terms of their type, degree and purpose of processing. Three main divisions are specified. Given this, the best dietary advice is to base diets on fresh and minimally processed foods, and on dishes and meals made up from such foods with the addition of refined ingredients extracted from whole foods.

If the aim is to prevent disease and enhance well-being, the best personal advice on ultra-processed products, irrespective of their nutritional profiles, is to avoid them or at least minimise their consumption. This approach implies systematic revision of current official and authoritative dietary guidelines and graphic guides to food, nutrition and health.

It also implies a concerted approach to public policies. There are no signs that leading food manufacturers are prepared to withdraw many of their leading ultra-processed products from sale, even those now aggressively marketed at children, and they may say that their duty to their shareholders prevents them from any such action. In

which case, the only rational approach for governments and other authorities responsible for the protection of public health will be fiscal and other formal policies similar to those that make cigarettes and alcoholic drinks more expensive and less accessible.

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References

1. World Health Organization (2003) *Diet, Nutrition and the Prevention of Chronic Diseases. Report of a Joint WHO/FAO Expert Consultation*. WHO Technical Report Series no. 916. Geneva: WHO.
2. World Cancer Research Fund/American Institute for Cancer Research (2009) *Policy and Action for Cancer Prevention. Food, Nutrition, and Physical Activity: A Global Perspective*. Washington, DC: AICR.
3. Levy-Costa RB, Sichieri R, Pontes NS & Monteiro CA (2005) Household food availability in Brazil: distribution and trends (1974–2003). *Rev Saude Publica* **39**, 530–540.
4. Cavadini C, Siega-Riz AM & Popkin BM (2000) US adolescent's food intake trends from 1965–1996. *Arch Dis Child* **83**, 18–24.
5. De Graaf C (2006) Effects of snacks on energy intake: an evolutionary perspective. *Appetite* **47**, 18–23.
6. Mattes R (2006) Fluid calories and energy balance: the good, the bad, and the uncertain. *Physiol Behav* **89**, 66–70.
7. Ludwig DS, Peterson KE & Gortmaker SL (2001) Relation between consumption of sugar-sweetened drinks and childhood obesity: a prospective, observational analysis. *Lancet* **357**, 505–508.
8. Cohen DA (2008) Obesity and the built environment: changes in environmental cues cause energy imbalances. *Int J Obes (Lond)* **32**, S137–S142.
9. Pollan M (2008) *In Defense of Food: An Eater's Manifesto*. New York: The Penguin Press.