Food processing

Summary factsheet

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Food processing, such as fermentation and boiling, is useful and often necessary to increase edibility, digestibility, perishability, microbiological and other safety characteristics, composition (nutritional value), palatability, sustainability and convenience[1]. In recent years, the extensive processing of food has been subject to criticism and the concept of ultra-processed foods (UPF) has been introduced. Some consider UPF to be not nutritious due to a low level of fresh ingredients, dietary fibre, and micronutrients, and supposedly harmful ingredients such as additives. There is a great deal of debate among nutrition experts concerning the role of UPF in public health[2,3].

Definition

There are several different definitions (and therefore classifications) of UPF. The UK Health Council (Scientific Advisory Committee on Nutrition, SACN) analysed seven classification systems[1]. Only the so-called NOVA classification met all five pre-established criteria, including a workable definition and use in research into health effects. NOVA is the most commonly used classification system with four categories of foods, of which UPF is one of them. Examples of UPF are crips, meat substitutes and (diet) soft drinks.

The creator of the NOVA classification system, Carlos Monteiro[2], uses the following definition of ultra-processed foods: ''Industrial formulations made mostly or entirely with substances extracted from foods, often chemically modified, and from additives, with little if any whole food added. Sequences of processes are and must be used to obtain, alter, and combine the ingredients and to formulate the final products (hence 'ultra-processed')." Gibney *et al.*[4] believe that this definition makes several interpretations possible and according to Gibney[5] and Forde[6], each classification is subjective to some degree.

Health effects

UPF allegedly has negative effects on public health, especially the development of obesity and chronic diseases[7,8]. Observational (epidemiological) research shows a link between the consumption of UPF and an increased risk of chronic lifestyle diseases, including cardiovascular diseases, type 2 diabetes and cancer[9]. In one experimental study, weight gain and a higher energy intake were observed with a higher consumption of UPF. The extent to which the aforementioned relationships can be attributed entirely to food processing or may be caused by the underlying suboptimal nutrient composition and high energy density of many UPF is unclear. The indications of associations are based on epidemiological (cohort) research and have the inherent disadvantage that they do not provide sound evidence of cause and effect. For example, the consumption of UPF is related to numerous other factors, including the existing guidelines for a healthy diet, such as less salt, as well as socioeconomic status. A study by Cordova *et al.*[10] shows that it is unwise to treat UPF as one group,

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as the effects of different food groups vary. The consumption of plant-based substitutes for meat and dairy, for example, did not demonstrate a significant association with multimorbidity. In addition, results are often not corrected for energy-density of the food product.

Thus far, only one intervention on UPF has been performed (by the American Kevin Hall[11]). In his study, weight changes were found to have a strong correlation with energy intake. The energy density of highly processed foods in solid form was nearly twice as high compared to unprocessed foods. The energy intake rate of UPF was around 50% higher. This suggests that the increase in energy intake is associated with the softer texture/ faster eating rate and higher energy density of UPF. Eating rate and energy density have long been known as very important causes of obesity and associated diseases.

Mechanisms

If there is little to no evidence of a link, it does not make much sense to speculate about underlying mechanisms. Consequently, little is known about the numerous mechanisms of action that may be responsible for the link between UPF consumption and weight gain. According to Gibney and Forde[12], the current data suggests that a high energy intake rate in combination with the energy-density of UPF is the mechanism for this link. A high energy density appears to be an important factor in excessive energy intake and, consequently, weight gain. It is known that the consumption of foods and drinks has a consistent total weight, even when the energy density of these products is reduced, leading to a lower energy intake. Softer foods (due to preparation) can be eaten more quickly than raw foods because raw foods require more chewing time. Little to no chewing of soft or liquid food increases the eating rate. Liquid food has a lower satiating effect than (semi-)solid food. The eating rate can be influenced by the texture of the food. Hard foods are associated with lower energy intake and slower eating rate compared to soft foods. A well-known example of this link is a study involving the consumption of an apple, apple sauce or apple juice, which show significant differences in eating rate and energy intake. The whole apple increases satiation more than the consumption of apple sauce or apple juice[13].

Consumption of ultra-processed foods

The consumption of UPF increases with a rise in prosperity. In Europe, an average of approximately 27% of total daily energy intake comes from UPF, with significant differences between the different countries. The lowest intake has been calculated for Italy (approx. 13 en%), while the highest calculated consumption is in Sweden (approx. 43 en%). From 2012-2016, Dutch adults derived around 37% of their daily energy intake from UPF[14]. Vellinga *et al.*[15] estimate that the percentage for the Dutch population is 61% among 1 to 79-year-olds. Children (ages 1 to 18) even derive 75% of their energy from the

consumption of UPF and the difference in age composition is an important explanation for the higher estimate by Vellinga *et al.*[15] compared to Mertens *et al.*[13].

Dietary recommendations

Due to an increase in overweight and obesity, the Brazilian government has recommended avoiding the consumption of UPF since 2014. Their example was followed by other South American countries (Uruguay, Peru and Ecuador) a few years later. In Belgium, France, Israel, Malaysia and Canada, the population is also advised to limit the consumption of UPF. The dietary guidelines established by the Health Council of the Netherlands do not contain any recommendations related to UPF, although a number of specific guidelines point in a comparable direction: replace refined grain products with whole grain products, limit the consumption of processed meat and drink as few sugar-containing drinks as possible. The SACN, the Nordic Recommendation Committee and recently (2024) the Finnish Food Authority state that differentiating UPF does not have any added value to the existing food classifications and recommendations. It is unclear to what extent food processing, independent of food composition, is related to diseases. Various experts indicate that the focus should continue to be on products for which it has been proven that their consumption among an important percentage of the population has a negative effect on public health, and there is indeed some overlap with UPF. On the other hand, reformulated foods with an improved composition may be labelled as UPF, which could prevent consumers from recognizing the intended effect of better nutrition.

Consumer behaviour

Consumers must understand dietary advice in such a way that they can put it into practice[16]. Various studies have raised questions about the NOVA classification, as it uses complex, inconsistent, and broad or ambiguous definitions[17]. Knowledge, perceptions, and behavioural intentions regarding UPF vary among different consumer groups[18]. A UPF logo can be helpful for consumers, but its effectiveness depends on an accurate classification of UPF and the importance consumers attach to (the health effects of) food processing.

Conclusions

UPF is a broad and heterogenous group of foods, making it difficult to formulate a uniform definition. The evaluation of UPF differs across various consumer groups.

In spite of this, various cohort studies show a consistent relationship between the consumption of UPF and development of chronic diseases, but not a causal relationship.

Since there is little to no evidence of a link between the consumption of UPF and chronic diseases, it is also unclear which mechanism would be underlying this. Eating rate and energy density are important factors for weight gain.

The specific added value of UPF for the (existing) dietary guidelines based on existing scientific research has not yet been demonstrated. There is increasing evidence that known nutritional risk factors (refined grains, sugary drinks, and processed meat) are responsible for the health effects of UPF consumption. There is no consensus among nutrition experts regarding advice to limit the consumption of UPF, partly because from a nutritional perspective, food processing has beneficial effects on issues such as food waste and the sustainability of food chains.

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References

1. **SACN.** SACN statement on processed foods and health. 2023 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1168948/SACN-position-statement-Processed-Foods-and-Health.pdf
2. **Monteiro CA, Astrup A.** Does the concept of "ultra-processed foods" help inform dietary guidelines, beyond conventional classification systems? YES. Am J Clin Nutr 2022;1-6.
3. **Astrup A, Monteiro CA.** Does the concept of "ultra-processed foods" help inform dietary guidelines, beyond conventional classification systems? NO. Am J Clin Nutr. 2022, 116:1482-1488https://doi.org/10.1093/ajcn/nqac123.
4. **Gibney MJ et al.** Ultra-processed foods in human health: a critical appraisal. Am J Clin Nutr 2017, 106: 717-724.
5. **Gibney MJ.** Ultra-processed foods in public health nutrition: The unanswered questions. Brit. J. Nutr. 2023, 129:2191-2194.
6. **Forde CG.** Beyond ultra-processed: considering the future role of food processing in human health. Proc Nutr Soc. 2023 doi:10.1017/S0029665123003014.
7. **Pagliai G et al.** Consumption of ultra-processed foods and health status: a systematic review and meta-analysis. Br J Nutr. 2021.125(3):308-318. doi: 10.1017/S0007114520002688.
8. **Dicken SJ, Batterham RL.** The role of diet quality in mediating the association between ultra-processed food intake, obesity, and health-related outcomes: a review of prospective cohort studies. Nutrients 2022. 14(1)23.
9. **Elizabeth L et al.** Ultra-processed foods and health outcomes: A narrative review. Nutrients 2020. 12(7), 1955; https://doi.org/10.3390/nu12071955.
10. **Cordova R et al.** Consumption of ultra-processed foods and risk of multimorbidity of cancer and cardiometabolic diseases: a multinational cohort study. Lancet Regional Health. 2023. DOI:https://doi.org/10.1016/j.lanepe.2023.100771
11. **Hall KD, et al.** Ultra-processed diets cause excess calorie intake and weight gain: An inpatient randomized controlled trial of ad libitum food intake. Cell Metab. 2019. 30(1):67-77.e3. doi: 10.1016/j.cmet.2019.05.008.
12. **GibneyMJ, Forde CG** Nutrition research challenges for processed food and health. Nature Food 2022 (3): 104–109. https://doi.org/10.1038/s43016-021-00457-9.
13. **Flood-Obbagy JE, Rolls BJ.** The effect of fruit in different forms on energy intake and satiety at a meal. Appetite. 2009 Apr;52(2):416-22. doi: 10.1016/j.appet.2008.12.001.
14. **Mertens E, Colizzi, Peñalvo JL.** Ultra-processed food consumption in adults across Europe. European Journal of Nutrition 2022. 61:1521–1539. https://doi.org/10.1007/s00394-021-02733-7
15. **Vellinga RE et al.** Different Levels of Ultraprocessed Food and Beverage Consumption and Associations with Environmental Sustainability and All-cause Mortality in EPIC-NL. Am J Clin Nutr. 2023 Jul;118(1):103-113. doi: 10.1016/j.ajcnut.2023.05.021.