

Are Technological Processes the Best Friends of Food Health Potential?

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In nutrition science, notably in epidemiological studies, foods are generally ranked in food groups such as fruits, vegetables, legumes, cereals, meat, poultry, dairy, etc. And nutritional recommendations follow this ranking. For example, in France, the well-known “5 fruits and vegetables a day” is based on food groups. Food pyramids are also based on food groups. Such a classification seems at first view logical because food groups gather foods of common origin, either botanical- or animal-based.

Recently, we exhaustively review the relation between main food groups and beverages based on meta-analyses and systematic reviews from 1950 to 2013 [1]. Some strong tendencies could have been unraveled for beneficial or deleterious effect of some food groups when regularly and highly consumed. However, this approach is limited. Indeed, all food groups participate in the diet diversity and none is ‘bad’ or ‘good’ in nature. Interestingly, when we look at dietary patterns associated with main diet-related chronic disease risks, specific patterns are unraveled as beneficial (*e.g.*, Mediterranean and

prudent dietary patterns) while other not (*e.g.*, Western and ‘meat and refined grains’ dietary patterns) [2]. What characterizes these dietary patterns are not so much food groups but rather the degree of processing of these food groups. Thus, the Western diet is characterized by energy-dense and refined foods, and a high proportion of animal-based foods; and the prudent diet is characterized by minimally-processed, nutrient-dense and natural products with a higher proportion of vegetable products.

Therefore, this is not the food or food groups to blame but the proportion/amount of each food group consumed and the nature and intensity of the processing applied. The classification of foods based on their degree of processing first proposed by Monteiro et al. is very innovative in this way because the prevalence of main diet-related chronic diseases is correlated with a higher proportion of ultra-processed foods consumption [3,4]. They classified foods in 3 categories: Unprocessed or minimally processed foods, processed culinary or food industry ingredients, and ultra-processed food products [5].

Nature provides all kind of natural foods, either directly edible or not. For the latter, humans have developed various technological processes to render foods edible, but also to preserve them for being consumed later. These processes may be very simple, as boiling, to the most sophisticated as food fractionation and ingredient recombination *via* extrusion-cooking with added sugars, fat, salt, aroma and other additives. Most of the time, ultra-processed foods are energy-dense,

poorly satiating and poor in protective phytonutrient. In addition, the initial food structure is generally lost, modifying natural nutrient interaction and their subsequent bioavailability in human organism. Yet, idealistically, processing should improve nutritional quality of food products not degrade it.

Therefore, from a nutritional perspective with the aim to improve nutritional recommendations, foods should be classified according to their degree of processing, or the kind of process applied, *e.g.*, thermal treatments (either dry or with water), refining-recombination, fermentation or extrusion-cooking. This is what we performed for evaluating the impact of technological processing upon the lipotropic potential of plant-based foods: after having classified treatments in thermal, fermentation and refining processes, we showed that while refining is the most damaging processes for lipotropic potential, fermentation appears rather neutral or beneficial to nutrient-density irrespective of food groups considered [6].

Therefore, food engineering seems to be the key issue in preventive human nutrition [7]. By adopting such a classification, we should perform observational studies, not based on food group consumption, but based on the type of process applied. For example, it is interesting to note that generally vegetable and tea are considered good for health and prone to reduce prevalence of chronic diseases when regularly consumed except in some cases as pickled vegetable and very hot tea that are associated with increased digestive cancer risks [1]. These observations clearly suggest that the real issue is food processing, not the food in itself, *i.e.*, very hot infusion for tea or pickling for vegetable. Also, the tendency to publish observational studies based on dietary patterns rather than on food groups only reflect further, purposely or not, the impact of processing on health, not that of food groups.

So, we can wonder why to continue to degrade natural food products so much while we today know that ultra-processing is not so good for health. While innovation is necessary for human creativity, ultra-processing should not be the main way to chose, but rather minimal processing, *i.e.*, avoiding ultra-refining, favoring pre-fermentation/germination for grain products, limiting salt, sugar and fat addition, etc.

According to me, there are 2 reasons for the development of ultra-processing and the drastic degradation of natural foods: the desire to create the most palatable foods for increasing consumption and benefits, and an excessive attachment to a reductionist paradigm that consider that foods are a only sum of compounds [8, 9]. On the contrary, a more holistic view of foods will consider that the whole food is nutritionally better than the only sum of its constituents [9, 10]. Consequently, this new perspective naturally results in a will to preserve this initial food structure, or at least not to degrade it too much. We know today very well that a more preserved food structure increases satiety feeling (thus limiting snacking between meals, and preventing overweight), favorably influences nutrient bioavailability (*e.g.*, slow vs rapid carbohydrates, slow carbohydrates being beneficial for type 2 diabetic subjects), and allows a more important fraction of antioxidants to reach the colon for protection against free radicals (thus preventing from colon cancer) [11,12].

To conclude, we should first keep in mind to optimize nutritional value of foods based on the huge amount of data collected since decades of research in human nutrition and food science; then the adequate technological process should be chosen to reach this objective. Nutritional and sanitary qualities must be prioritized, not financial benefits. However, the final product should be acceptable by the consumer: maybe we need to re-learn how to appreciate the natural taste of foods without added salt, sugar, fat and aromas.

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