

The taste of a healthy and sustainable diet: What is the recipe for the future?

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ABSTRACT: The world faces serious challenges and many of those involve current food behaviour. People have been seduced into liking food and drinks that are neither healthy nor good for the environment. Clearly we need a robust food system that is able to feed the growing population of the world. This food system should also be sustainable and good for the planet. What is the recipe for the future? There are no easy answers; everything is connected. According to the World Health Organization, the world needs bold and innovative solutions. This article gives an insight into the reasons the present food system is organised in the way it is and signals the problems. Climate change is a symptom of the malfunctioning of the present system. The food system, from farm to fork, is a major contributor to climate change. We need a systems change to fight climate change. This article presents a systems approach for food systems change and suggests a formula: C.A.T. The foods that are healthy both for the people and planet need to be: Convenient, Affordable and Tasty. These aspects influence food behaviour and are often overlooked. Nobody objects to eating something delicious; cooking, using fresh ingredients to create delicious dishes and to avoid ultra-processed foods, seems to be an important ingredient in the recipe for the future.

KEYWORDS: climate change, dietary guidelines, food, food system, gastronomy, system change, tasty, ultra-processed food

Introduction

Every single cause has an effect and every effect is the cause of something else. This universal law of cause and effect implies that things do not just happen, they are the consequence of something that happened before. Consequently, to comprehend the present, we need to look at what happened in the past. And clearly, the future is shaped by the decisions that we take today. Furthermore, we need to be aware that choices impact each other. This is the essence of an ecosystem — a fragile and dynamic equilibrium.

In retrospect, the decisions that we made in the past have had rather negative effects on the planet and the people, to put it mildly. This is widely recognised in, for example, *Come on!*, the most recent global publication of the Club of Rome (Weizsäcker & Wijkman, 2018), and the World Health Organization. In their news release of 1 March 2018, the WHO announced to look for “bold and innovative solutions to accelerate prevention and control of the leading killers on the planet: the non-communicable or chronic diseases” which are responsible for seven out of ten deaths these days (WHO, 2018). The World Economic Forum (WEF) formulated the “Transformative Twelve” to achieve the sustainable development goals (SDGs) to transform our world (WEF, 2018). These SDGs were adopted by the United Nations

in 2015 (i.e. the 2030 agenda) and include goals like climate action, life on land, life below water, good health, zero hunger, responsible consumption and production. At least 12 of the 17 SDGs contain indicators that are highly relevant to nutrition Scaling Up Nutrition (SUN, 2019). To quote the Secretary-General of the UN, Ban Ki-moon, “nutrition is both a maker and a marker of development. Improved nutrition is the platform for progress in health, education, employment, empowerment of women and the reduction of poverty and inequality, and can lay the foundation for peaceful, secure and stable societies” (SUN, 2016). There is no room to deny this. We need to act to stop chronic diseases and degrading the planet. The big question is “how?”. To answer that question we need to look more closely at food consumption and the underlying food system.

Everything is connected

A good recipe relies on a balance between the individual ingredients. The ingredients together create something new. The sum is bigger than the individual parts. This is called synergy and the essence of the concept of holism. Details matter. Even the smallest element has the power to destroy the balance. This implies that we do need to understand both the details and the “whole”. This has not been the practice in

nutrition science. It has predominantly been focused on the details, the nutrients, not on food, with the objective of solving specific health problems of individuals, or finding benefits (Nestlé, 2019). This bottom-up, reductionist approach and the linear cause-effect relationship between one food compound and one physiological effect have been predominant in research. It gave us the understanding of the fundamental mechanisms in nutrition (Fardet, 2016). Reductionism has its virtues, but we need to be "intelligently holistic". "Hyperspecialised technoscience" is not the only answer for the future. Foods are more than the sum of isolated nutrients and phytochemicals. Compounds within foods interact; their physical structure matters just like other physicochemical food properties. Comparable foods may have a different metabolic effect (Fardet, 2016; Fardet & Rock, 2014).

Marion Nestlé considers undernutrition, overnutrition, and the effects of food production and consumption on climate change to be the three most important problems in public health nutrition these days. These problems require a holistic, food systems approach. A food system is everything that happens to a food item from the time it is produced to the time it is consumed, a process that involves food transportation, storage, retailing, cooking, eating, and, eventually, wasting (Nestlé, 2019). This is confirmed by Fardet and Rock (2014) when they state that agriculture, nutrition and health are closely connected, but often seen and studied separately. The result is that practices in the one sector may have undesired effects in another. The interactions between the three fields are complex and must be based on multi-causal, nonlinear relations. It is important to consider food preparation and eating habits, and just on single food components in these relations, not simply the food components (Dwivedi et al., 2017; Fardet & Rock, 2014).

The bigger picture

Let us take a closer look at the current food system. To start at the origin, what we eat comes from some kind of agriculture or aquaculture, as broadly defined by the Food and Agriculture Organisation of the United Nations (FAO). Agriculture includes farming both animals (animal husbandry) and plants (agronomy, horticulture, and forestry in part). Similarly, aquaculture covers the farming of both animals (including crustaceans, fish, and molluscs) and plants (including seaweed and freshwater macrophytes). Therefore, what we eat has an impact on all kinds of agriculture, breeds and varieties, biodiversity, agricultural practices, distribution of wealth, cultures and landscapes. Agriculture occupies more than one-third of all potentially cultivable land, uses about 70% of freshwater and is reported to be responsible for up to 30% of greenhouse gas emissions (Aleksandrowicz et al., 2016). In particular, the current system of breeding and consuming bovine meat seems to contribute to environmental changes like global warming. Grain-fed animals, especially cows, have a poor conversion rate of feed to food which severely impacts the overall food supply. Of all the calories in the feed that cattle consume, humans receive just a tiny three per cent through beef (Cassidy et al., 2013). Precious land is dedicated to grow feed, not food. Humans and farm animals together represent a staggering 97% of the body weight of all living land vertebrates on earth. Or, all elephants and whales, bats and rats, birds, frogs, snakes and lizards and all other animals not mentioned together represent

just 3%. This figure has everything to do with our extensive meat consumption (Weizsäcker & Wijkman, 2018).

In agriculture, farmers have generally moved from traditional sources of nitrogen to synthetic sources. The extensive use of industrial, synthetic chemicals has been linked to numerous environmental hazards, including (again) global warming, groundwater contamination, and the loss of biodiversity. Furthermore, especially the production of fertilisers is highly energy intensive, which implies that agriculture has become increasingly dependent on the use of fossil fuels and varieties that fit in this particular food production system (Crews & Peoples, 2004).

Crops have even been engineered to withstand the chemicals that kill all other plants. An extensive review on the safety of GMO (genetically modified organism) crops reported by Marek Cuhra (2015) revealed that research about the safety of these new agricultural practices is planned, performed and reported by people employed by biotech companies that produce these chemicals. This bias is likely to lead to incomplete reports and health hazards. Glyphosate residues in glyphosate-tolerant plants have for instance not been reported. Independent research has investigated this issue and found unexpectedly high levels of glyphosate residues in glyphosate-tolerant plants. These residues are passed on to consumers and pose a potential health hazard (Cuhra, 2015). Likewise, the extensive use of antibiotics in livestock farming threatens human health due to antibiotic-resistant bacteria (Dwivedi et al., 2017).

According to the World Economic Forum, global food systems need to be transformed. Billions of people are poorly nourished; millions of farmers live at subsistence level; enormous amounts of food go to waste; and poor farming practices are taking a toll on the environment. The emission of greenhouse gases like CO₂ and methane needs to be reduced significantly. Achieving the sustainable development goals (SDGs) by 2030 will require food systems that are inclusive, sustainable, efficient, nutritious and healthy (WEF, 2018).

Health councils all over the world basically agree that a regular diet should be more plant-based and less meat-centric; people should eat more fresh, real foods and less (ultra-) processed foods. The recent Brazilian and Canadian dietary guidelines are based on these principles. This would implicitly also reduce the consumption of salt and sugar (Monteiro et al., 2018). Two documents published in *The Lancet* in 2019 describe the vision of the experts of the world that were joined by the EAT Foundation. The *EAT-Lancet* report presented a strategy to prevent malnutrition, reduce non-communicable disease risk, and lessen the impact of food production and consumption on climate change (Swinburn et al., 2019; Willett et al., 2019).

Coincidentally, this same diet would also be good for the planet. This is good news. Shifting the Western diet to a variety of more sustainable dietary patterns could potentially lead to reductions as high as 70–80% of greenhouse gas emissions and land use, and 50% of water use (Aleksandrowicz et al., 2016). Dietary change can improve health and reduce the environmental impact of food production. The way to achieve that is by adopting a less meat-centric diet, and by reducing food waste (Crews & Peoples, 2004). That is good news. Major problems could be solved with one solution: eat food, not too much, mostly plants (Pollan, 2008).

The systems approach for consumers: the C.A.T. formula

The world needs bold and innovative solutions. We need a robust food system that is able to feed the world in a healthy and sustainable way. And we know the answer: we should take a systemic perspective, and food behaviour should change; people need to change their diets to real foods with a predominance of vegetables, fruits and nuts. Better food choices will improve the vitality of the planet and the people. Governments, academics and gurus point out what people should do. Dietary guidelines and health books make headlines. There are TV shows like "Obese" that challenge people to lose weight. All of these efforts are focused on people, the consumer. And the consumer is interested in eating good, healthy food (Nielsen, 2015).

The consumer is merely at the end of the food system. The question is whether a singular focus on people can yield results if other elements of the system prevent people from making better choices. From a circular, systems point of view, the consumer may be at the end of the system, but by making choices, the consumer has the power to influence the food systems. How do we both motivate and empower people to make better choices? Can the people buy or afford the products that are good for them? And if so, do they know how to prepare these foods and eat healthily? Do we even know what healthy is? People are different, so should the dietary advice on what is good for them not also be different? Are people even willing to make other choices? For example, the *EAT-Lancet* report quantified the advised consumption of meat to less than 28 grams of beef, lamb or pork per day (Willett et al., 2019). That is about one-tenth of the quantity of meat that people eat on average in the USA (GlobalAgriculture, 2018). Considering the importance that people attach to meat on their plates and the sensory pleasure it provides, we need to address these questions.

To start, let us assume that the products people presently buy are found to be convenient, affordable and tasty. They are C.A.T. *Convenient* implies that people know how to use them and have the capacity to do so. *Affordable* means that people are able to buy them, and *tasty* has everything to do with liking what they have bought. If we take this common logic as a start, it follows that the better choices for the future also need to be C.A.T. If the better, healthy and sustainable food choice is either inconvenient, hard to prepare or not available in the desired quantity, or much more expensive, or not as delicious, it will probably not be a great success. So the better food choices need to be C.A.T.

The C.A.T. formula looks at the consumer from a broader perspective: product and people. A grid was developed to identify four segments. We consider product and people from two perspectives: the individual and the general level. This grid approach gives a better insight into how the food system is organised and what factors contribute to the present system (supply) and food behaviour (demand). This approach helps to understand the complexity of influencing the food choices that the regular consumer makes. It addresses aspects of food behaviour that are often overlooked by many health councils, and the EAT-Lancet commission for that matter. The consumer needs to be enabled and motivated to make other choices. There are no easy answers. The grid is shown in Figure 1.

Our ambition is to give an overview to show the relevance of this systems approach. Aspects that are involved on the product level and on the people level are discussed. It is

	PRODUCT (supply)	PEOPLE (demand)
INDIVIDUAL	<p>DELICIOUSNESS <i>product development & innovation</i></p> <p>i.e. plant characteristics, nutritional value, new varieties Culinary Success Factors</p>	<p>LIKING & WANTING <i>food choices</i></p> <p>i.e. brain & sensory research; neuro-aesthetics, pleasure, extrinsic factors</p>
GENERAL	<p>SYSTEMS THINKING <i>Knowledge development</i></p> <p>i.e., plant breeding, regulation (taxation/subsidies), education</p>	<p>FACILITATING <i>healthy food</i></p> <p>i.e. accessibility and the role of retail. The C.A.T. Formula: the 'right' foods should be Convenient, Affordable, Tasty</p>

FIGURE 1: Food systems grid

strongly suggested that future research look more closely at the interdependencies between products and people.

About products from an individual and general perspective

What we eat and drink comes originally from the land or out of the water. It has been harvested in some way or form. Mankind has come a long way from being hunter-gatherers. The modern food system is driven by commercial and economic motives. Factors such as consistency, predictability, low cost, and high yield have grown to be more important than taste and nutritional value (Dwivedi et al., 2017). Varietals have been selected that maximise yield and minimise crop failure. Uniformity promotes efficiency. Today, 95% of the world's calories come from just thirty species. Almost half of the global calorie demand is supplied by only three crops: maize, rice, and wheat, which of course have been carefully selected or engineered and partly modified to perform (Dwivedi et al., 2017). This loss of diversity alone has had significant negative health consequences. Local production and more biodiversity on farms need to find a place in this modern, globalised food system (Dixon, 2015).

Nutrients and taste have not been among the criteria that shaped modern agriculture. Most basic crops have grown to be commodities with as little variation as possible. Taste and varietal character are only sought after by people that love food, including food producers that are quality oriented, but are a nuisance for the food industry that operates on a large scale. To operate successfully, robust varietals are needed that reliably produce numbers, preferably at a low price. It is likely that the persistent pursuit of farming and marketing practices that emphasise cheapness, security and abundance over quality has led to a loss of micronutrients from our foods (Dwivedi et al., 2017; Thomas, 2007). Micronutrient deficiencies may significantly undermine our health. This is confirmed by research from all over the world (Gardner et al., 2019; Monteiro et al., 2018; Thomas, 2007; Valdes et al., 2018). To understand the health condition of an human individual, we should know more about the composition of the daily diet of that individual. Thomas (2007, p. 21) states that "a knowledge of the chemical composition of

foods is the first essential in the dietary treatment of disease or in any quantitative study of human nutrition". We should be able to assess the nutritional quality of our foods beyond calories.

Farming methods and what we grow require attention. The production of synthetic fertilisers is very energy intensive and requires large amounts of fossil fuels and enhances the emission of CO₂. An important part of the fertiliser is used for growing the most important crops that emit CO₂ as well. Many of these crops are used for feeding animals that emit large quantities of methane, a powerful greenhouse gas with a much larger effect than CO₂. The impact of methane in the atmosphere is rising more rapidly than expected, and requires action. Knowing the contribution that agriculture makes to the production of methane requires immediate action (Saunio et al., 2016).

There is debate around whether organic farming is a solution and if organic farming could feed the people of the planet. Quality-wise, we should. Results of meta-analyses based on 343 peer-reviewed publications indicate significant differences in composition between organic and non-organic crops/crop-based foods. Especially the concentrations of a range of antioxidants were found to be substantially higher in the organic ones (Barański et al., 2014). This is particularly important as antioxidants have previously been linked to a reduced risk of chronic diseases. Significant differences were also detected in, for example, minerals and vitamins. Furthermore, in conventional crops, pesticide residues were found to be four times higher, and they also contained significantly higher concentrations of cadmium, a toxic metal, and of glyphosate in relevant cases. The differences in antioxidants and cadmium are related to use of synthetic fertilisers (Barański et al., 2014).

Ultra-processed foods

Food safety and hygiene are also found to be more important than taste and nutritional value by mainstream agriculture. As Valdes et al. (2018) note, many ultra-processed foods are free from unwanted bacteria these days; the ingredients that are used have been refined, bleached, sterilised, and so on. In the process, not only bacteria, but also much of the fibre is removed. The fibre is important for the micro-biota in our gut. Fibre feeds the gut. By eliminating it from our food, the micro-flora in the gut deteriorate, which may explain the "metabolic syndrome", a chronic inflammation, the common denominator of most chronic diseases. The gut bacteria play an immense role in our immune defences, and one may speculate about the relation between diet and the incidence of allergies and other auto-immune responses in Western society (Valdes et al., 2018).

In the modern system, taste is provided by additives, sugar and salt, which are all easy to use and very cheap. The food industry prefers them over natural ingredients for reasons of chemical stability, availability and price. If vitamins, minerals or other health-promoting elements are found to be missing, they can be added, and consequently industry food has become a kind of Lego box which is adjusted to the consumer's need or demand and supposed health effects (Monteiro et al., 2018). It has led to a radical and abrupt change in what is commonly eaten. It is important to note the level of processing that the food has gone through. Food processing in itself is nothing new. Minimal processes such as washing, drying, grinding, pasteurising, chilling, freezing, fermenting, roasting, and packaging are often necessary or beneficial. But these days, all kinds of packaged foods and snacks, carbonated and sweet drinks, energy bars and

many other convenient and cheap foods have taken the place of minimally processed and freshly prepared meals (Monteiro et al., 2018).

The modern, hyper-palatable foods of the food industry should be classified as ultra-processed foods. Their production relies on complex processes in which molecules are fractionated, synthesised, hydrogenated, hydrolysed, bleached, etc. There is intensive use of cosmetic additives (flavours, colours, emulsifiers) and they are brought to the market with sophisticated marketing and packaging often using synthetic materials, including plastic (Monteiro et al., 2018). To conclude, these products are produced by transnational corporations, whose businesses have grown exponentially since the 1980s, and whose often colossal sales and profits come from intrinsically unhealthy products that cannot be made healthy by reformulation or a suggestion on the label (Monteiro & Cannon, 2012). Adding supplements may not be the answer. Vitamin D, for instance, needs magnesium to metabolise. About half of the population in the United States is assumed to be magnesium deficient, which implies that taking Vitamin D supplements is useless for these people. They may be better off to be outside, enjoying the sun when possible and eating magnesium rich foods like nuts, bananas, beans, broccoli, brown rice, egg yolk, fish oil, milk, mushrooms, and whole grains (Uwitonze & Razzaque, 2018). But then we need to be sure that these foods do indeed contain the supposed bioactive ingredients and deliver the supposed health effects. This requires innovative plant breeding programmes and methods to produce food (Dwivedi et al., 2017).

The role of governments and regulation

Governments are not passive. Some countries have introduced taxation on unhealthy foods or policies like limiting the size of soft drinks, or restricting the advertising of unhealthy foods especially targeting young children. Although such initiatives are in line with what needs to be done, they are reported to have minimal effects (Chan, Kwortnik, & Wansink, 2017). Furthermore, they are only targeted at the consumer and not at the system. The same governments that tax the consumer give subsidies to agriculture. And what is subsidised? The production of a select number of crops that are grown globally on a large scale, resulting in smaller biodiversity and negative health effects (Franck, Grandi, & Eisenberg, 2013). Subsidies go to farm starchy grains like corn, wheat, soybean, rice, and sorghum. Corn is mainly used to produce animal feed, high fructose corn syrup, other food additives and biofuels; soybeans are used to feed animals and furthermore to produce cheap oil to deep-fry snacks; and sorghum is mainly farmed for animal feed. Dairy and meat are also on the receiving end of subsidies. About 56 per cent of all calories consumed in the US come from subsidised foods according to Franck et al. (2013). The choice to subsidise these crops is surprising and does seem not to be in line with what is needed for a better world.

In Europe, the situation is not much different: around 40 per cent of the budget of the European Union is spent on agriculture, down from 70% in 1985 (Bailey, Lang, & Schoen, 2016). Clearly not all is spent on subsidising dubious elements in the food system. Nevertheless the role of the government in this respect should be taken seriously. Siegel et al. (2016) report that chronic diseases are related to the higher consumption of calories from subsidised food commodities, and suggest that agricultural and nutritional policies should be better aligned. Economic

development based on cheap calories overlooks the economic needs of the global rural population (3 billion people), 50 per cent of whom work in agriculture (Altieri, Funes-Monzote, & Petersen, 2012). Agricultural households need to earn a decent income, otherwise it is hard to imagine that they will stay in agriculture or that their children will take over (Dixon, 2015).

The ideal food system

In systems thinking, governments could (should) take a guiding role in shaping the ideal food system. This is the system that (1) offers adequate nutrition and health, (2) creates biodiversity and avoids negative ecological and environmental impacts, and (3) ensures a livelihood for farmers, diverse landscapes, and equitable access to land, water, seeds and other inputs (Dwivedi et al., 2017). Governments could promote healthy eating by educating the population and informing them about the essence of a healthy lifestyle. They could also promote healthy food choices by giving incentives to consumers, positive rewards like coupons, for healthy food choices. On the other hand, they could introduce a serious tax on the use of synthetic fertilisers and other products or methods that have a negative impact on the environment. After all, "the polluter pays" is a righteous principle. If the societal costs of the current system would be incorporated in food prices, it would quickly lead to innovative solutions, regenerative farming methods and the production *and* consumption of healthy foods.

Just imagine that there was a system that promoted good practices by giving subsidies in a star system:

- one star: for farms that do not use harmful chemicals, including synthetic fertilisers;
- two stars: for farms that actively promote bio-diversity and short supply chains;
- three stars: for regenerative farming, crop rotation, CO₂ fixing, use of own seeds;
- four stars: for extra efforts to support and revitalise the surrounding environment, promote circularity; and
- five stars: for inspiring farmers that do all of the above and dedicate time for the community, like teaching, educating other farmers, developing new methods and sharing their ideas in the media, etc.

Clearly the introduction of such a system requires a government that is aware of the urgency of a food systems change and dares to act. There will be resistance from actors that are likely to lose their position and power. To succeed, it requires the collective support of all actors involved and investments in education and applied research to support the transition. It becomes powerful when the consumer actively considers the star system in their buying behaviour.

Do we all need to become vegetarians?

We want to conclude our discussion on products with the question of whether there will still be meat on the menu in the future. The answer is a big "yes". It should not even be a question because animals are essential in a regenerative, circular agricultural system. They provide the natural phosphates that we need when synthetic fertilisers are no longer desired. Animals are a part of a well-balanced agricultural system. This implies that we need to consume less, but better meat and animal products.

About people from an individual and general perspective

We have looked at the supply side and seen that there has been a huge change in what people (are able to) buy. The food system has been organised to service the needs of the suppliers, not primarily the consumers. This has had detrimental effects. In affluent societies, food is no longer scarce. There is an abundance of cheap, palatable food that people like (too much). The ubiquity of food constitutes what is called the "obesogenic" environment which requires personal self-control to fight off all these tempting foods (Lakerveld et al., 2018). To be able to curb bad food behaviour, one needs to understand how food choices are made. People do the liking. Products can be delicious; liking is the positive response. When you take a bite into your favourite food, the look, taste, texture, and smell can give pleasure. This goes beyond the sensory properties.

Liking and wanting

In human evolution, food choice was dominated by the urge to fulfil physiological needs; food is fuel; one eats what is needed to keep the biological system going. We all know how "hunger makes the best spice". This phenomenon is thought to explain the liking for fat and sugar as rich sources of energy (Ventura & Worobey, 2013). However, in a modern society that is dominated more by plenty than scarcity, the motivation to eat and drink is no longer physiological, but driven by the search for pleasure. The world of pleasure is ruled by a different area of the brain than the one that monitors physiological needs. Usually, people want the things that they like and like the things that they want. In the world of pleasure, liking and wanting can become dissociated. This is what happens when the brain gets addicted. The search for reward, "wanting", takes over from liking, even to a level where it does not give pleasure anymore. Many of the modern industry foods have been designed to be hyper-palatable and contain sugar, generally without fibre, which would normally help digestion and prevent spikes in blood sugar. These foods lead to overeating, which is one of the primary causes of obesity (Robinson et al., 2015).

A recent study — the first randomised control trial in this field — shows a peculiar effect of eating ultra-processed foods. In an experiment, participants were first offered ultra-processed foods for two weeks. Then, the same people spent two weeks eating the same diet but composed of unprocessed foods, such as fish and fresh vegetables. When they consumed "junk food", people ate more quickly, ingested an average of 500 more calories per day than when eating unprocessed food, and gained roughly 1 kilogram (Hall et al., 2019). There are other health concerns associated with the consumption of ultra-processed foods. They have been reported to increase the risk of cancer and there are many more reports that point at the health problems that are associated with eating ultra-processed foods (Fiolet et al., 2018). These reports shed a new and different light on the desired shift in food behaviour. We need to rethink eating ultra-processed foods. This may ultimately be more important than cutting down on sugar, fat and red meat. This must be considered a formidable challenge. Ultra-processed foods are designed to be convenient, affordable and tasty. If we want to promote the consumption of vegetables, they need to be just lightly processed and C.A.T.

Health professionals and the consumer in general need to be aware that the proposed shift towards a plant-forward diet, and

a decrease in the consumption of animal-based foods, is well aligned with the promotion of human health. It is widely believed among both health professionals and the general population that certain plant foods are entirely devoid of specific amino acids and, thus, that protein adequacy cannot be supported by plant foods alone. In fact, all plant foods contain all 20 dietary amino acids (Gardner et al., 2019).

Learning to like

Mentioned earlier, food fibre should be an important reason for eating raw or lightly processed foods and especially a variety of vegetables, fruit, pulses and nuts. The mission is to make them just as delicious as the foods that most people have grown used to eating. Supposedly, nobody will object to eating something delicious. Therefore, knowing more about taste and deliciousness would help all kinds of educators and professionals in the world of food and beverages, from farmers to professionals in the food industry, including chefs in the culinary domain, marketers, food designers, and packaging experts would all benefit; just as health councils and dieticians need to find a way to motivate people to make different food choices.

Tasting is learning, so is liking. The brain is involved: we learn to like and to dislike. Some preferences come easily and others are "acquired tastes". The liking for beer, Brussels sprouts, coffee, and dark chocolate takes time to develop. Wine tasting can also serve as an example. People can learn to recognise flavours and build up experiences. In the process, it is likely that preferences and liking are going to shift (Kourouniotis et al., 2016). Unfortunately, this is exactly what has happened in the modern brain that has been fed the Western diet: the unhealthy food choices are liked; "healthy" is negatively correlated with "tasty". This means the word healthy can better be avoided in the description of foods. In general, the description of healthy food is often less attractive than the unhealthy choices. Using more appealing, indulgent descriptions of healthy and nutritious foods should be considered (Turnwald et al., 2017). Words are an important and overlooked ingredient.

When "wanting" food gets out of control, it may be called food addiction, and this could be a serious problem that is hard to cure (Robinson et al., 2015). Abstinence is an effective strategy to cure people from their addictions, but that is hard to do in the case of food. But even without being a food addict, people may develop habits that perpetuate unhealthy behaviour. A study by Cornell shows that such habits can be changed by traditional motivational marketing practices like giving reward points for healthy food choices (Chan et al., 2017). They are reported to be more effective in the long run than discounts. Furthermore, such a healthy-loyalty programme could be a win-win situation for food service providers. It would help to create a better image and stimulate return visits from people that are interested in healthy options (Chan et al., 2017). This example is mentioned in support of the C.A.T. approach. It shows that taxation is not the only tactic; motivating people to make better choices may be more effective than punishing them for making the "wrong" choices. A challenge in all of these cases will be to define what is healthy and what is not.

In regard to "tasty", the culinary success factors developed by Klosse et al. (2004) are useful in flavour design: developing delicious dishes that are likely to be found tasty. In this approach, flavour and tasting are distinguished. Taste and flavour are considered to be a product characteristic. Tasting

is what people do; flavour perception is therefore personal, but taste can be studied from a molecular point of view. Mouthfeel is the basis of the model that enables us to classify taste. Quality perception, liking or disliking, is an interaction between a person and what he or she is eating or drinking. Consequently, the commercial success of a product is a mix of the actual flavour (ingredients, preparation and so forth) and how it is perceived. A host of external influences such as its packaging, advertising, price, hospitality, atmosphere, etc. can influence taste. Likewise, aspects that affect people, such as culture, education, age, knowledge and experience, religion, sense of taste, etc. will have an influence. If we truly want to understand why people enjoy some products more than others, we need to take all of these aspects into account (Klosse, 2013; Klosse et al., 2004).

The role of supermarkets

To conclude our discussion of the grid approach, we focus on facilitation and availability: people need to have access to healthy foods and be able to buy and use them in a way that combines taste and health. Who can help the consumer? Look at the C.A.T. formula again. *Convenient* implies that people know how to use them and have the capacity to do so. *Affordable* means that people are able to buy them and *tasty* has everything to do with liking what they have bought. Looking to the future, we can say the better choices also need to be C.A.T. If the better, healthy and sustainable food choice is either inconvenient, hard to prepare or not available in the desired quantity, or much more expensive, or not as delicious, it will probably not be a great success. So the better food choices need to be C.A.T. The actors that we have described — farmers, producers, governments — can all have an influence.

We have not yet addressed the role of the (big) retail companies in the food system. Foods are predominantly bought in supermarkets. Retail companies are huge conglomerates with enormous buying power. It is suggested that they have unprecedented and disproportionate power in the food system. Nevertheless, Pulker et al. (2018) state that there is very little public health research about the impact of this power. Regardless, it is obvious that supermarkets shape food choices and food preferences by determining what is in the stores and by allocating how much space is made available for every product group. Furthermore, they determine food prices, not only for the consumer, but also in the system. With their buying power, they have an impact on the price farmers get for their products. But their influence goes further. For instance, offering low-priced meat not only stimulates sales, but also enforces meat producers to choose low-cost production methods, which means cheap feed and compromises on animal welfare. In general, low prices in the shops stimulate the relentless search for cheapness in the system, with all the undesired results. Retail organisations have the potential to improve public health, but just a few positive initiatives seem to be reported (Pulker et al., 2018).

It seems that retail organisations could use their supposed power in a positive way. Clearly, supermarkets do not just sell the infamous ultra-processed foods; real foods are on sale as well. There is no apparent reason that a conscious consumer that aspires to make healthy choices should not be able to make his/her choice in a supermarket. After all, supermarkets are commercial institutions and supposedly they can make money selling both the healthy and the unhealthy products. This is an important start, promoting healthy choices in the retail space

should not necessarily impede their commercial capacity. Considering their role in the food system, retail organisations have power and influence over the other actors, like food producers and manufacturers, and government. Consequently, they are in a perfect position to help guide food behaviour in the desired direction. They could be a partner instead of a threat.

The role of food service organisations

There are also other places where better food choices could be facilitated, for example, schools, healthcare institutions and within companies; in general, places where people need to be for a prolonged period of time and are dependent on others for providing a meal. Policies could be implemented in and by food service organisations to provide good foods, especially in places where governments are in charge. It even seems quite logical that young children at school and the elderly in nursing homes should be served the "right foods". Companies may have an interest as well: happy and healthy employees are likely to be productive (Krapivin, 2018). Google is an example of a company that takes responsibility and acts. On sustainability, the company's website states that "climate change is real" and mentions all kinds of measures that are taken to protect the planet. The Google Food Program has been installed to actively promote eating a plant-centric diet, all over the world. Ugly vegetables that would otherwise go to waste are used by restaurants. Food is free and "flavour rules" at Google.

Conclusion: roadmap to the future

Slowly but surely the food system has changed to accommodate the needs of the 21st century consumer. This development has advantages and seems to deliver what it should, but has negative aspects as well. These detrimental effects need to be faced and stopped. A systems approach is needed to achieve that. Food production is highly connected to major challenges like fighting chronic diseases and reducing environmental damages. We urgently need new models that focus on the vitality of the people and the planet, not only on growth, profit and GDP. In general, we need to organise a system that encourages both people and the environment to remain healthy, and prevents problems and diseases. According to Wessels (2006), it is a myth that progress depends on a growing economy. He challenges the belief that new technology is essential and inevitable and shows how systems can be regenerative and allow true progress. If we are on the wrong track, we need to change tracks. The grid approach shows where the tracks are and what is needed to change tracks.

There is reason to be optimistic about the future. There is at least global awareness of the both the problem and the solution. And there is new evidence that food can indeed be a medicine. Chronic diseases can be reversed by changing food habits and lifestyles (Pot et al., 2019). That does not mean that the food behaviour will change easily. Singular solutions and ones that are solely focused on the consumer are not likely to yield big effects. A systems approach will be more effective. The grid that is proposed in this article suggests considering products and people and looking at them on an individual and on a general level. People need to be able to make food choices that are C.A.T.: convenient, affordable and tasty. The recipe for a healthy and sustainable future requires that all actors play their part in the required transition. Farmers, food producers,

governments, retail organisations, chefs and educators should all work together to come up with bold and innovative solutions for a better food system.

References

- Aleksandrowicz, L., Green, R., Joy, E. J. M., Smith, P., & Haines, A. (2016). The impacts of dietary change on greenhouse gas emissions, land use, water use, and health: A systematic review. *PLoS One*, 11(11), e0165797. <https://doi.org/10.1371/journal.pone.0165797>
- Altieri, M. A., Funes-Monzote, F. R., & Petersen, P. (2012). Agroecologically efficient agricultural systems for smallholder farmers: Contributions to food sovereignty. *Agronomy for Sustainable Development*, 32(1), 1-13. <https://doi.org/10.1007/s13593-011-0065-6>
- Bailey, A., Lang, T., & Schoen, V. (2016). *Does the CAP still fit?* London: Food Research Collaboration. <http://openaccess.city.ac.uk/15039>
- Barański, M., Średnicka-Tober, D., Volakakis, N., Seal, C., Sanderson, R., Stewart, G. B., ... Leifert, C. (2014). Higher antioxidant and lower cadmium concentrations and lower incidence of pesticide residues in organically grown crops: A systematic literature review and meta-analysis. *British Journal of Nutrition*, 112(5), 794-811. <https://doi.org/10.1017/S0007114514001366>
- Cassidy, E. S., West, P. C., Gerber, J. S., & Foley, J. A. (2013). Redefining agricultural yields: From tonnes to people nourished per hectare. *Environmental Research Letters*, 8(3), 034015. <https://doi.org/10.1088/1748-9326/8/3/034015>
- Chan, E. K., Kwortnik, R., & Wansink, B. (2017). McHealthy: How marketing incentives influence healthy food choices. *Cornell Hospitality Quarterly*, 58(1), 6-22. <https://doi.org/10.1177/1938965516668403>
- Crews, T. E. & Peoples, M. (2004). Legume versus fertilizer sources of nitrogen: Ecological tradeoffs and human needs. *Agriculture, Ecosystems & Environment*, 102(3): 279-297. <https://doi.org/10.1016/j.agee.2003.09.018>
- Cuhra, M. (2015). Review of GMO safety assessment studies: Glyphosate residues in Roundup Ready crops is an ignored issue. *Environmental Sciences Europe*, 27(1), e20. <https://doi.org/10.1186/s12302-015-0052-7>
- Dixon, J. (2015). *IUHPE Position Paper: Advancing health promoting food systems*. International Union for Health Promotion and Education (IUHPE), Saint-Denis, France. http://www.iuhpe.org/images/IUHPE/officialstatements/IUHPE_Food_Systems_Position_Paper.pdf
- Dwivedi, S. L., Lammerts van Bueren, E. T., Ceccarelli, S., Grando, S., Upadhyaya, H. D., & Ortiz, R. (2017). Diversifying food systems in the pursuit of sustainable food production and healthy diets. *Trends in Plant Science*, 22(10), 842-856. <https://doi.org/10.1016/j.tplants.2017.06.011>
- Fardet, A. (2016). Towards a more holistic vision of human nutrition to prevent from diet-related chronic diseases: The reductionist drift. *International Journal of Food Science, Nutrition and Dietetics*, 5(1c), 1-2. <https://doi.org/10.19070/2326-3350-160005e>
- Fardet, A. & Rock, E. (2014). Towards a new philosophy of preventive nutrition: from a reductionist to holistic paradigm to improve nutritional recommendations. *Advances in Nutrition*, 5(4), 430-446.
- Fiolet, T., Srouf, B., Sellem, L., Kesse-Guyot, E., Allès, B., Méjean, C., ... Touvier, M. (2018). Consumption of ultra-processed foods and cancer risk: Results from NutriNet-Santé prospective cohort. *BMJ (Clinical Research Ed.)*, 360, k322. <https://doi.org/10.1136/bmj.k322>
- Franck, C., Grandi, S. M., & Eisenberg, M. J. (2013). Agricultural subsidies and the American obesity epidemic. *American Journal of Preventive Medicine*, 45(3), 327-333. <https://doi.org/10.1016/j.amepre.2013.04.010>
- Gardner, C. D., Hartle, J. C., Garrett, R. D., Offringa, L. C., & Wasserman, A. S. (2019). Maximizing the intersection of human health and the health of the environment with regard to the amount and type of protein produced and consumed in the United States. *Nutrition Reviews*, 77(4), 197-215. <https://doi.org/10.1093/nutrit/nyy073>
- GlobalAgriculture. (2018). Americans will consume a record amount of meat in 2018. *Global Agriculture* [online]. <https://www.globalagriculture.org/whats-new/news/en/32921.html>

- Hall, K. D., Ayuketah, A., Brychta, R., Cai, H., Cassimatis, T., Chen, K. Y., ... Zhou, M. (2019). Ultra-processed diets cause excess calorie intake and weight gain: An Inpatient randomized controlled trial of ad libitum food intake. *Cell Metabolism*, 30(1), 67–77. <https://doi.org/10.1016/j.cmet.2019.05.008>
- Klosse, P. R. (2013). *The Essence of Gastronomy: Understanding the Flavor of Foods and Beverages*. Boca Raton: CRC Press, Taylor & Francis.
- Klosse, P. R., Riga, J., Cramwinckel, A. B., & Saris, W. H. M. (2004). The formulation and evaluation of culinary success factors (CSFs) that determine the palatability of food. *Food Service Technology*, 4(3), 107–115. <https://doi.org/10.1111/j.1471-5740.2004.00097.x>
- Kourouniotis, S., Keast, R. S. J., Riddell, L. J., Lacy, K., Thorpe, M. G., & Cicerale, S. (2016). The importance of taste on dietary choice, behaviour and intake in a group of young adults. *Appetite*, 103, 1–7. <https://doi.org/10.1016/j.appet.2016.03.015>
- Krapivin, P. (2018). How Google's strategy for happy employees boosts its bottom line. *Forbes* [online]. <https://www.forbes.com/sites/pavelkrapivin/2018/09/17/how-googles-strategy-for-happy-employees-boosts-its-bottom-line/#300148ad22fc>
- Lakerveld, J., Mackenbach, J. D., Rutter, H., & Brug, J. (2018). Obesogenic environment and obesogenic behaviours. In C. Hankey, & K. Whelan (eds), *Advanced Nutrition and Dietetics in Obesity* (pp. 132–). New York: John Wiley & Sons. <https://doi.org/10.1002/9781118857991>
- Monteiro, C. A., & Cannon, G. (2012). The impact of transnational "big food" companies on the south: A view from Brazil. *PLoS Medicine*, 9(7), e1001252. <https://doi.org/10.1371/journal.pmed.1001252>
- Monteiro, C. A., Cannon, G., Moubarac, J.-C., Levy, R. B., Louzada, M. L. C., & Jaime, P. C. (2018). The UN Decade of Nutrition, the NOVA food classification and the trouble with ultra-processing. *Public Health Nutrition*, 21(1), 5–17. <https://doi.org/10.1017/S1368980017000234>
- Nestle, M. (2019). A food lover's love of nutrition science, policy, and politics. *European Journal of Clinical Nutrition* [online], 1–5. <https://doi.org/10.1038/s41430-019-0426-9>
- Pollan, M. (2008). *In defense of food: An eater's manifesto*. New York: Penguin.
- Pot, G. K., Battjes-Fries, M. C. E., Patijn, O. N., Pijl, H., Witkamp, R. F., de Visser, M., ... Voshol, P. J. (2019). Nutrition and lifestyle intervention in type 2 diabetes: pilot study in the Netherlands showing improved glucose control and reduction in glucose lowering medication. *BMJ Nutrition, Prevention & Health* [online]. <https://doi.org/10.1136/bmjnph-2018-000012>
- Pulker, C. E., Trapp, G. S. A., Scott, J. A., & Pollard, C. M. (2018). What are the position and power of supermarkets in the Australian food system, and the implications for public health? A systematic scoping review. *Obesity Reviews*, 19(2), 198–218. <https://doi.org/10.1111/obr.12635>
- Robinson M. J. F., Fischer A. M., Ahuja A., Lesser E. N., & Maniates H. (2015). Roles of "wanting" and "liking" in motivating behavior: Gambling, food, and drug addictions. In E. Simpson & P. Balsam (eds), *Behavioral Neuroscience of Motivation. Current Topics in Behavioral Neurosciences*, vol. 27. Cham: Springer. https://doi.org/10.1007/7854_2015_387
- Sauniois, M., Jackson, R. B., Bousquet, P., Poulter, B., & Canadell, J. G. (2016). The growing role of methane in anthropogenic climate change. *Environmental Research Letters*, 11(12) [online]. <https://doi.org/10.1088/1748-9326/11/12/120207>
- Siegel, K. R., McKeever Bullard, K., Imperatore, G., Kahn, H. S., Stein, A. D., Ali, M. K., & Narayan, K. M. (2016). Association of higher consumption of foods derived from subsidized commodities with adverse cardiometabolic risk among US adults. *JAMA Internal Medicine*, 176(8), 1124–1132. <https://doi.org/10.1001/jamainternmed.2016.2410>
- SUN (Scaling Up Nutrition). (2016). *Strategy and Roadmap*. https://scalingupnutrition.org/wp-content/uploads/2016/09/SR_20160901_ENG_web_pages.pdf
- SUN (Scaling Up Nutrition). (2019). Nutrition and the sustainable development goals. Message from the United Nations Secretary-General. <http://ucx3x320eshgjxppibt1rqg0.wpengine.netdna-cdn.com/wp-content/uploads/2016/06/SUN-Movement-Strategy-and-Roadmap-Ban-Ki-moon-message.pdf>
- Swinburn, B. A., Kraak, V. I., Allender, S., Atkins, V. J., Baker, P. I., Bogard, J. R., ... Dietz, W. H. (2019). The global syndemic of obesity, undernutrition, and climate change: *The Lancet* Commission report. *The Lancet*, 393(10173), 791–846. [https://doi.org/10.1016/S0140-6736\(18\)32822-8](https://doi.org/10.1016/S0140-6736(18)32822-8)
- Thomas, D. (2007). The mineral depletion of foods available to US as a nation (1940–2002) – A review of the 6th edition of McCance and Widdowson. *Nutrition and Health*, 19(1–2), 21–55. <https://doi.org/10.1177/026010600701900205>
- Turnwald, B. P., Jurafsky, D., Conner, A., & Crum, A. J. (2017). Reading between the menu lines: Are restaurants' descriptions of "healthy" foods unappealing? *Health Psychology*, 36(11), 1034–1037. <https://doi.org/10.1037/hea0000501>
- Uwintburn, A. M., & Razaque, M. S. (2018). Role of magnesium in Vitamin D activation and function. *The Journal of the American Osteopathic Association*, 118(3), 181–189. <https://doi.org/10.7556/jaoa.2018.037>
- Valdes, A. M., Walter, J., Segal, E., & Spector, T. D. (2018). Role of the gut microbiota in nutrition and health. *BMJ (Clinical Research Ed.)*, 361, k2179. <https://doi.org/10.1136/bmj.k2179>
- Ventura, A. K., & Worobey, J. (2013). Early influences on the development of food preferences. *Current Biology*, 23(9), R401–R408. <https://doi.org/10.1016/j.cub.2013.02.037>
- Weizsäcker, E. U. v., & Wijkman, A. (2018). *Come on!: Capitalism, short-termism, population and the destruction of the planet*. New York: Springer. <https://doi.org/10.1007/978-1-4939-7419-1>
- Wessels, T. (2006). *The myth of progress: toward a sustainable future*. Burlington: University of Vermont Press.
- Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., ... Murray, C. J. L. (2019). Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. *The Lancet*, 393(10170), 447–492. [https://doi.org/10.1016/s0140-6736\(18\)31788-4](https://doi.org/10.1016/s0140-6736(18)31788-4)
- World Economic Forum (WEF). (2018). Innovation with a purpose: The role of technology innovation in accelerating food systems transformation. <https://espas.secure.europarl.europa.eu/orbis/document/innovation-purpose-role-technology-innovation-accelerating-food-systems-transformation>
- World Health Organization (WHO). (2018). World leaders join new drive to beat non-communicable diseases. <https://www.who.int/mediacentre/news/releases/2018/world-leaders-ncds/en/>