Chapter 7
Food Consumption and Technologies

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7.1 Introduction

Long time ago, the notion of a Great Transformation (Lee and Newby 1983: 26–39) made the nineteenth century Europe the centre of change in capitalist environment. The idea has to do with market economies and nation-states in which industrialization plays a central role. As Corrigan (1997:2) reminds us, though, those were the centuries of production, as the classic Marxist tradition imposes that the pivot around which all revolves (to be read as the economic, social and academic worlds) is production. So probably a new great transformation will entail consumption even more than what some thinkers might say. As reminded in the introduction chapter, consumption is now pivotal (Goodman and Dupuis 2002) and, consequently, affecting it can cause change in societal and economic organization more than a production patterns shifting. Arguably the main change in consumption happened in the 1950s of the last century; we know that the post-WWII imperatives of reconstruction were to produce more to avoid the communist perils (Patel 2013: 5) but this, as Campbell (1983) maintains, is counteracted by the fact that the Industrial Revolution involved a revolution in both production and consumption. In both of them, the role of technologies is paramount. Digitalisation, robotization, full automation are the imperative words of our time; robotics, genetics, blockchain technology, 3D printing and artificial intelligence have become familiar words, although the big audience might still not grasp all of them, and they are promised to change deeply our habits in the next decades. In writing this chapter we observed the many revolutions we see around us in everyday contexts about food technologies and food consumption.

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Whether we eat our own, self-produced food, cooked by ourselves or others in the same household, or we eat out more or less regularly, we are deeply immersed in the continued evolutions of food technologies, especially at the household level or in some public spaces such as catering places. We acknowledge that these simple acts are not only the result of our individual choices but depend on other factors. The pervasive character of technological transformations, of technology itself, makes it a quite exciting historical moment as well as quite worrisome, as they might change in unexpected ways the way we eat and consume, and since these activities do not happen in a vacuum, as Carolan (2012:281) reminds us, we can expect them to affect our personal, civic or professional relationships as well. The main critique to consumption is that it is a defining character of our age; currently though the environmental impact of our consumption styles has become an imperative, the quest for sustainability for which technology is considered to be the silver bullet, result in conflictual outcomes, as consumption has become an end in itself and is still is under scrutiny. Whether it is too early to talk about an effective disruption in our habits and ways of life, or whether this is already happening in a subtle way is beyond the scope of this chapter; in this chapter we want to reflect on food consumption and trends and scrutinize how some of the most promising new technologies and related trends might have an impact on them.

7.2 Consumption

Thompson (2016) argues that consumption of goods and services is embedded in our daily lives and we do not question it any longer, as it is considered as a given. If we take this as the consumer culture age, as Sassatelli proposes (2007) then we have to accept it as a defining feature of our modern lives; consumption highlights the range of social relations and interactions in which objects with specific functions are selected and used (Zelizer 2005); estimations of needs, wants and satisfaction are concomitant for addressing the role of consumption in modern industrial worlds and the role of status and reputation (Warde 2015:119). Food consumption, quite new in the realm of consumption theories, is analyzed from theoretical perspectives along the axis of culture, function, structure or development (Mennell et al. 1992; Holm 2013) and from empirical ones along culinary trends, class, ethnicity, religion, gender (Thompson, 1996; Germov and Williams 2010). Research has shown that there is a social differentiation in the way we consume food: for instance, Diner (2001) and Lupton (1996) have shown how social identities are defined by what we eat; Harrington et al. (2011) have shown how income and education affect food consumption, so for instance to abide to a healthy lifestyle and follow nutritional recommendations would be the result of a higher socioeconomic status. Little, though, has been said on the role of food technologies in the constitution, structuration or change of food consumption. Two main aspects are relevant for our understanding of food consumption and related role of technologies: one is the shift from

home consumption to eating out, a recurrent and shifting theme in many ages; the second is the individualization that consumption seems to have undergone in the past decades.

1. Holm (2013) traces the change of food consumption from the industrial revolution, moving from numerous daily meals to the quite stabile number of three, as a consequence of having to adapt to new working conditions and the restructuring society underwent consequently. The twentieth century was the period of rapidly transforming the experiment-based knowledge and science of food processing and technologies into the contemporary industrial forms and rapidly reshaping the traditional methods into refined techniques, e.g. cooking was transformed into canning technology, sun drying methods were improved into more hygienic mechanized processing techniques such as convective hot air drying, cold storages were evolved into refrigeration and freezing (Truninger 2013). As we have detailed in another chapter in this book (Chap. 2) and taking the industrial revolution as watershed moment, the basic cooking tools were transformed and the rise of a new generation of food processing technologies may be noted as the moment that scientific achievements in fields of biology, chemistry or physics coupled with the technological advances offered by industrial revolution, and progressively prospered to the current food production and consumption chain. In this trend, food technologies contributed to relieve (mainly) women from household duties, among which food preparation was significant. The development and improvement in the field of food processing from the twentieth century till the present moment evolved continuously. The number of appliances introduced in households have increased to meet the different needs of changing habits. As a result of commodification, though, meals are consumed far from households, making the time for food preparation declining (Warde et al. 2007). Eating out, though, is constantly on the rise (Warde and Martens 2000). And still, according to Lin (2015), food preparation is expected to be over vamped as the procedures of transforming a certain set of ingredients to different textures and meals in virtually limitless possibilities, will be a driving force to key adoption. How this will unfold is the subject of our investigation, as there is an overlapping, or better a contamination, of practices and tendencies in each which has influenced the other and viceversa.
2. Warde (2015: 122) maintains that food consumption is a domain rapidly changing, exemplifying "the intertwining of the forces of globalization, commodification and aestheticization". In particular, he indicates the role of the 'foodie' as paradigmatic because it symbolizes the role of enthusiasm in consumer culture, the ability to elevate an ordinary activity into a core of the luxury industry and of distinction. In this enthusiasm, mass media and social media have played a central role in contributing to wide diffusion of images, lifestyle, a travel-culture. Veblen's theories about emulation (1994) are of course relevant, as consumption patterns are a territory in which human emulation is evident, although constrained by income, taste, education, culture, as the literature on consumption

has highlighted consistently (for a review see Paterson 2006). Grignon (1996), though, argues that post-industrial societies have undergone a deregulation following the post-industrial politics, transforming eating into an individualized and flexible activity, although research in different countries have shown this is not evident everywhere (Holm 2013:330). Particularly, Soron (2010:177) considers food consumption as part of a vast process of individualization and identity; more importantly in his argument it is the ethos of greening and sustainability, of which organic food is paramount, that helps explaining the evident turns in consumption as factor of identity. Soron is skeptical, though, of greening consumption; his point is that this radicalizes even more hedonistic consumption and paves the way to contradictory behaviour as it might induce more consumption. Schor's (2007) research is in line with this last consideration, as he expressed concern about the high material and environmental impact of consumption patterns. On the basis of this framework, in the next section we will discuss the last trends of food consumption according to the technological innovations currently available.

7.3 Trends

How do we make sense of the innovations that involve food consumption in relation to the technologies currently available? The issue of food tech innovation involves raw material processing, packaging, additives, forms of hyper- nutrition and taste through different consumption. To make sense of the kind of change technology is pinpointing we have looked at those which have received more attention by experts in the field or which look most promising from a sociological perspective. Out of the theoretical framework that we have delineated in the previous section through literature research, we have triangulated the tendencies in food consumption (commodification, globalization, aestheticization, individualization upon which we inscribe the health-related food consumption, sustainable consumption). We began with a desk research, comparing results obtained from online search engines about food consumption and food technologies with those obtained from literature research on same themes. That allowed us to align the important trends emerging in both scientific and lay/non-scientific fields; we focused on English-language entries in both fields and narrowed down to westernized countries. Initially we separated and differentiated between refrigeration systems and heating ones, and innovations for either household or the industry, with a further differentiation with food processing and the professional categories such as medium-to-large scale possible final users like bakeries, confectionery, catering industry or restaurants catering, or the food processing industrial sector. It has to be clarified that we did not categorize 'catering' and 'restaurants' in the main innovations found here following, because there has been sometimes an overlap of innovations moving from the catering and hospitality industry into households. Also, we have registered a distinction between mass-attended dining places, such as diners or fast-food, and the so-called

'fine-dining', since the products offered by the industrial actors here proposed provide for two different needs: one is mass-production, popular and cheap meals; and the other is artisanal, highly-skilled production, elitist and expensive meals, a highly contradicting category. Of course, the different targeted markets translate into a different manufactured end product, which addresses and responds to different sectors.[1] We noticed that there is no univocal direction in how different technologies are diffused and adopted, one sector influences the other in terms of trends, practices, demands, so there is no a hierarchical or unilinear stream for diffusion and/or adoption; the same overlapping happens for the functional categories such as refrigeration or storage, therefore we dropped the initial coding and created categories in which one or the other appear, so that it could be reflected the blurring of categories and orders previously clearly defined. Consequently, we have not made any specific separation between the innovations destined to household and those to professionals; much of the research of our colleagues in crop science will serve both the food processing industry, which specializes in products for both catering and final customers, and the supply chain such as global distribution, but although obvious differences in terms of scale and investments remain much of the changes in technological adoption and food consumption are blurred in different domains. For instance, the boundaries can become saturated between robotization, 3D food printing, full automation and what expands the equivalent stakeholder field of view further.

7.3.1 Next-level Experience (Professionalization of Home Cooking)

If the 'foodie' is the epithome of the change in consumption, then the quest for new experiences matches with the entrance of professional appliances in our households. Kitchen equipment has become one of the targets of manufacturers who employ more and more sophisticated equipment. From the basic to the most complex ones, the evolution in the kitchen make it for more differentiation. Multi-function appliances work by implying the basic sciences and concepts of meal production and food preservation such as mechanical operations, heating, refrigeration and freezing, dehydration, fermentation, acidification, smoking. Rice cookers, slow cookers, electric stock pots, bread-makers or smart stoves, and so-called 'kitchen aid' (multifunction machines which can cut, knead or whip, among basic functions) have all made their appearance in the past decades and have all contributed to relieve

[1] The EU has also been actively involved in the field through the PERFORMANCE project (Cordis 2018) which aims to predominately help people that face dysphagia problems and is currently implemented in some 1000 households in Germany already. In America, NASA has been involved and actively engaged in developing the field since 2013 viewing advanced food technologies as the way to tackle space missions' nutritional demands effectively. Though the direct scope of the research is efficiently overcoming the aforementioned problems, greater humanitarian benefits were also stated to constitute indirect powerful drives for the generous funding (Dunbar 2013).

individuals from daily cooking duties. Two appliances introduced some years ago draw more attention. Probably the most famous of the last 50 years is the microwave oven, which has entered homes accompanied by some skepticism; although quite convenient it did not revolutionize home cooking as other gadgetry following it, but interestingly it has undergone a redesign towards a combination of functions allowing new models to have different combinations of cooking techniques (such as grill, steam, classic microwave) and allow for precision cooking. A brand new food technology along this line is ovens using light bulbs through a system initially developed in the solar industry, which reach 500 °C in seconds and without preheating; the innovations is in the technology which allows different and many ingredients, like proteins and vegetables, to be precisely cooked simultaneously (Brava 2019). Given the synergies between different industries of technology, this innovation represents an interesting cross-sectorial innovation; although quite appealing to both highly-skilled cooking-passionate and to no particularly skilled people, its launch price does not make it yet a popular option. Some observers have indicated sous-vide gadgetry as the new appliance which would have changed home cooking following the success in high-end restaurant cuisine. Sous-vide (French for 'under vacuum') has a range of uses for tenderizing textures through gently cooking as the food used is packed in special air-tightened bags (plastic pouches) or glass jars and cooked at low temperatures in a water bath. The resulted food can be consumed right after, although a previous quick searing through pan cooking is recommended, or conserved for some time at low temperature, therefore allowing preparations to be done in advance and make it quite convenient for people with busy schedules. Initially seen in fine dining restaurants, it was adopted by some cuisine lovers using thermal immersion circulators until when some companies have specialized in home equipment, making it a more common domestic equipment. Despite this, its diffusion is not universal. One futuristic innovation is the Sonicprep, a tool which emits ultrasonic sound waves to 'extract, infuse, homogenize, emulsify, suspend, de-gas or even rapidly create barrel-aged flavor' (Sonicprep, 2019). Composed of a generator, converter, probe and sound box, this tool applies low heat vibrations of sound energy, therefore avoiding the transformations given by heat, preserving colors, aromas and nutrients.[2] This one too represents an innovation originally introduced for professionals but then shifted to households. The high price constitutes a clear obstacle for wide adoption despite the appeal for foodies and healthy nutrition followers. Whether the share of consumers willing to buy and, more importantly, able to use these appliances is representative of all consumers is clearly not the case for the moment, but the industry seems to push in this direction.

[2] As listed in their website, this homogenizer can make vinaigrettes without using an emulsifier, give wine a fuller and rounder mouth feel, infuse cocktails and other liquids with volatile aromas of fresh herbs or spices, intensify fruit or vegetable pulp for sauces and puree, tenderize and marinate meat in quick time, boost flavor without overcooking fish and other delicate proteins (https://polyscienceculinary.com/products/the-sonicprep-ultrasonic-homogenizer).

7.3.2 Full-Connectivity

In here belong all those technologies which allow for high-end technological equipment both in the kitchen and along the supply chain. The main revolution in this group of technology applications comes from synergies of digitalization and AI technologies; this in fact allows connectivity. We have subdivided this in two groups, one focused on robotization and the other on automated services.

7.3.2.1 Kitchen Roboter and Robotic Chefs

The employment of robots in the catering industry is nothing new, but ultimate models have been employed also in the front-of-the-house operations, as they resemble human beings. Examples are quite common in countries like Japans, where human-shaped robots are now normal to be seen in hotels and also restaurants (Rajesh 2015). The prototypes of these robots mimic human-hand movements with the same efficiency.[3] Robotic chefs have been promised for quite some time apparently. The main incorporation of robotic chefs today happens on the business scale as price barriers hinder wide consumer adoption. Two main examples here: the first is a 'Bionic Bar' released on board of a cruise-ship in 2014 and consisting of a bar's mechanical arm which prepares cocktails ordered using a tablet placed in front of customers. According to the designer's website, the orders begin by "tapping their RFID [Radio Frequency Identification, a tool which uses electromagnetic fields to allow for identification and tracking] bracelet on one of the tablets on display. Besides choosing from standard and signature recipes, guests are able to entirely customize their drink with an almost limitless number of combinations, and have the possibility to personalize it, name their own creation, access their order history and reorder their favorite cocktails, all while rating and commenting on them" (Bionic bar 2018). The designers claims that the drinks that are served will be 'perfect', despite (or arguably because) there is no human involvement in this. The second example is the robotic kitchen developed by a UK-based company[4] and set for consumer releasing in 2019; consisting of two articulated arms, cooking hobs, oven and touchscreen interface, this robot is announced to be able to chop, whisk, stir, pour and clean. The data that guide the production process is being recorded through a multitude of onboard cameras that record human movements.

[3] One field-tested addition in the robotic chefs comes in the form of burger-cooking robots (under the anticipating name of 'Flippy'; Miso Robotics 2018). This flipper-robot uses thermal sensors and cameras to get feedback on the grilling process. Consequently, after the CPU evaluates the data, a robotic arm performs corrective adjustments and also serves the burger to the customer research and development already tread the final stages. Investments to implement this technology in the next 2 years in 50 restaurants has been notable (Condliffe 2017).

[4] Moley is a small UK company that through collaboration with Stanford University professors and miscellaneous reputable tech companies like Shadow Robot. The Moley device crosses the threshold of what is considered to be purely 3D food printing and introduces general robotics to the mix.

The patterns are afterwards reproduced by the articulated robotic hands so that each individual, as well as celebrity chefs, can produce and record recipes and meals to upload distribute on the internet (Andrew, 2016). The consumer can select the menu remotely -wirelessly through smartphone apps-, and once the recipe is chosen, pre-portioned ingredients will be delivered at home, so users will only need to place them onto the special containers in the kitchen for robot to begin cooking; it is supplied complete with appliances, cabinetry, safety features, computing and robotics, and fits regular kitchen spaces (Moley 2017). Connectivity with other users will enable bi-directional share of information, recipes and entire cooking patterns.

7.3.2.2 Automated Services

The same combination of technologies we mentioned for the smart kitchen allows also for new services created for consumers. A transition from product-centric to service-centric with focus on consumer is undergoing, driven by the desire for convenience. New routes to the market such as subscription services have become more common, as takeout and ordered food has boomed. For instance, famous sharing-economy transport service Uber has recently launched into food delivering under the name Uber-Eats, and most surprisingly Uber Eats has launched a whole service based on the concept of 'ghost restaurants', virtual restaurants without a full store presence (Tan 2019). Another one is a San Francisco based company specialized in sous-vide immersion circulators, as it has announced their fully connected cooking appliance and, like the final example in the previous section, a service that will deliver frozen, pre-cooked meals which will then be cooked through the same company appliances in brief time. The connected hardware device is in fact tied to a subscription meal service furnished with intelligent auto-reordering system, so once the package has arrived the products are simply scanned thanks to the same device and immersed in a water bath, as the sous-vide gadgetry explained in a previous section. Their website advertised it as a matter of convenience, taste, less food waste and sustainability (nomiku.com 2019). In fact, a section explaining their ethos says "the most delicious food comes from sustainable sources. Those are the people that care about the most holistic ways to feed people. The farmers and butchers we work with are thinking about and acting to create a more sustainable world" (ibid.). Although, strictly speaking, the following is not purely about food consumption but would be classified as service or grocery, a side-note goes in this section to grocery deliveries, as hassle-free grocery deliveries have become a reality. Shopping deliveries have existed for long time, and are now perfected through the means of full automation. In fact, an automated shopping list is also possible as American and Chinese companies such as, respectively, Amazon or Alibaba see the opportunity to fuse home delivery with smart home access control and automatically deliver groceries all the way to the fridge. The experimentation currently undergoing in selected American cities for Amazon (Holt 2019), together with the same company acquisition of natural-food retailer Whole Foods and the creation of unattended and fully automated shops, points at a fully planned change of services and consequently change of consumption habits.

7.3.3 Home-Made Food and Meal Production Modernization

As we said, some technologies are employed at both industrial and household level, making the second at an entry but promising level for adoption of tools which have the potential to redefine much of our relationship with food consumption. Additive manufacturers and 3D food printing are definitive central in this. Although this is covered in details in another chapter in this book, (Chap. 7) here we simply want to address some basics issues that could shed some clarity to make our review. Additive manufacturing of food is being developed by squeezing out food, layer by layer, into three-dimensional objects. A large variety of foods are appropriate candidates, such as chocolate and candy, and flat foods such as crackers, pasta, and pizza. But increasingly this technology is becoming a home appliance, as big machinery are now evolving in little tools to be adopted in the household. For example, a Spanish startup company founded in 2012 has just launched a food printer that can produce snacks comprised of healthy and fresh ingredients quickly, whilst offering complete control over the nutritional value to the consumer. The extruded ingredients are used for surface filling (e.g., pizza or cookie dough and an edible burger from meat paste) and graphical decoration. The company aims at automatizing manufacturing in time-consuming and remote activities (Foodini 2018). This also carries the possibility of creating a preservative-free savoury and crunchy snack on demand at the household level in the near future. This same company considers food printing as the most liable alternative to processed food by overcoming the obstacle of quick meal preparation and cooking, and also a product to reduce food waste thanks to their multiple ingredient capsules already filled with the necessary. This technology has drawn attention specifically when moving to the household segment of the market, for which prices have been lowered consistently.

Lastly, food production: on the front of self-food production many words have been spent. The very notion of backyard-, or rooftop- or community garden dear to the agri-food literature is usually understood as a way to escape mainstream provisioning and regain control over food choices; whether it is permaculture or organic gardening, though, a common theme is growing in spaces outside of the household, to which we can now add technology-based self-production to create food at home, in a hyper-localised fashion. The classic gardening is proposed to be practiced indoor through development of aquaculture and lighting techniques, for which solutions are made available as start-ups (e.g. Urban Leaf; geturbanleaf.com) or crowdfunding producers with prototypes (e.g. AVA Byte 2019; indiegogo.com) spread the word: in the first case with bindle kits made of colored bottles to prevent chemical reactions to light, and a bundle made of seeds, grow lights and accessories comprising soil replacements and germination kits; in the second case buying automated pods, equipped with LED lighting and a smart sensing technology controlled remotely via a dedicated app, and which are soil-free, pesticide-free, self-watering and compostable. In both cases, the drive behind these products, as advertised in respective websites, can be traced back to consciousness about food-related issues, urbanization, nutrition, sustainability, and appeal to like-minded consumers. This

particular form of gardening does not require any precedent and specific type of knowledge, and the price of both of them make it affordable to a vast number of consumers.

7.3.4 Enhanced Sensing Through Nanotechnology

Molecular gastronomy has been at the end of last century a brief but explosive example, during which some famous chefs mainly in Western countries have worked together with chemists and physicists to arrive at the transformation of ingredients in unprecedented ways using natural gums, hydrocolloids, nitrogen, dehydrators, enzymes, tools for sferification and other uncommon equipment and techniques. Farrimond (2018) in his article about future food uses the examples of British chef Heston Blumenthal, an exponent of this cooking trend, who had served at the beginning of the millennium a dish called 'Sound of the seas' made of seafood products and first models of mp3 player Apple Ipod to listen to a recording of sounds typical of seas and oceans, such as waves or birds screaming. The proposal was to enhance the enjoyment of that dish. The same chef has also worked on other senses such as sight, supplying customers with 3D glasses when visiting a sweetshop at his indication, as requirements for eating in his restaurant to be taken fully by senses. Farrimond (2018) proposes that senses will be at the forefront of food consumption; he writes that "it is well established that all senses inform the flavor of food: desserts taste creamier if served in a round bowl rather than on a square plate; background hissing or humming makes food taste less sweet; and crisps feel softer if we can't hear them crunching in the mouth. The emerging field of 'neurogastronomy' brings together our latest understanding of neurology and food science and will be a big player in our 2028 dining". Lastly, in this group we want to remind an experiment made at Parisian innovation centre 'Le Laboratoire' in which chefs and chemists worked on encapsulating flavors and developed a way of eating by aerosol, whose first output was an aerosolized chocolate, documented in a fiction book by a Harvard University professor who has then developed other scent additives and also food products (Edwards 2009). The idea behind this one, though, is that some flavor compounds can be combined to enhance the aromatic part of some ingredients through highly specialized technologies (Sensory Cloud, 2019) and creation of specific environments and experiences.

7.3.5 Nutrition and Food Substitution

The final group of food technology innovation comprises nutrition and food substitution. Currently, a branch of (and a huge part of investments on) technological innovation is devoted to biophysical and medicine-related fields. Human nutrition is one of them, for which applications in related food technologies have been tackled

extensively also in research (e.g. Dixon 2009). Nutrition is central for understanding the recent trends for both production and processing, as much of the contemporary anxiety for food-related issues can be traced back to it. Research has focused on personalized nutrition based on genetics tests to offer guidance for healthy eating (Farrimond 2018). 'Superfoods', as highlighted in Chap. 6, definitely constitute a major trend. Interest in novel or rediscovered crops indicated as extremely healthy per se (that is, without any need to provide for a balanced or reduced consumption of other less-healthy food, and with no mention of highly-recommended active life) has forced a change in agricultural fields and consequently has driven an adaptation in the global supply chain, to ensure demand could be met. Beside this, in here we focus also on food substitution, as it addresses some social anxiety over ethical issues in nutrition, such as animal eating. Chapter 6 has covered bioprinting as one technology-intensive sector to cover for food demand, with the specificities of in-vitro meat as a meat substitute. But in terms of meat-substitutes, in the past years a full range of plant-based products have emerged. Data tell us that in 2018 in general plant-based food sales rose 20% over the previous year reaching $3.3 billion (PBFA-Nielsen 2018), among which some innovative products stand out. Interestingly cow-milk and cow-milk based products are down, whereas plant-based milk (as it is referred to) gains some positions. Mainly plant-based substitute employ plants because of their characteristics such as less saturated fats, more fibres and Omega-3s, and help with vitamins-income and to reduce blood pressure. The main ingredients are protein-based (such as pea, or wheat, or potato or mung beans proteins) with the addition of some binders such as konjac and xanthan gum, whether it is for egg-substitutes or cooking dough (Ju.st.2019) or for patties to make up a burger.[5] For burgers, the process has started from the flavor of beef burgers and their texture, for which molecules responsible have been searched until the answer was found in so-called heme, an oxygen-carrying molecule present in living plants and animals, later derived only from plants for realizing these burgers. 'Impossiblefoods' website, probably the most pioneering one, explains that for their burger they have been using the heme-containing protein from the roots of soy plants, called soy legume hemoglobin, derived from the DNA of soy plants and then implanted into a genetically engineered yeast, which fermented and then produced more heme. Thus obtained heme are then added to the list of ingredients in their burger, all made from plant-based and vitamin-reach ingredients (impossiblefoods.com 2019). The advocates of these products share an interest in plant-based products driven by concern over animal-based food production for both ethical issues or its consequences on environment and health. These plant-based burgers are available for home consumption and in some eateries, at a quite affordable price.

[5] https://www.beyondmeat.com; https://impossiblefoods.com; https://movingmountainsfoods.com

7.4 Food Technology and Consumption Reloaded

As we have found in our research and highlighted in the section on methods, in terms of technologies used and by whom, a clear line is more difficult to be drawn, as many technologies overlap between industrial, catering and household levels (Truninger 2013). This does not mean that these technologies are the same in each sector, as the scale is still significant and it is quite understandable that machinery will be different according to the final destination and user, but many of the innovation of the industry have been and will be adopted elsewhere. Many of these devices are destined to the households, making Lin's (2015) expectations of new interest in home cooking seems correct. The quest to put together edible products from scratch in a mechanized fashion has brought together a mosaic of stakeholders, diverse in every aspect. At the household front, a great deal of competition is taking place to come up with the most ambitious and consumer-friendly device that will enable the forerunner to set foot in this niche - but of high potential - market. Up to now, the food tech field was an industrial solutions mosaic operating mainly on the industrial level and serving high demand food products like readymade meals, snacks and confectionaries. This though has changed heavily in response to the contemporary food trends, but interestingly the different levels of enquiries to which food technology pertains, namely the industrial and the household level, intermingles together with a third level, the one of 'eating out', whether it is as mass consumption or fine-dining. The employment of automated robots and the push for more automated services, as well as the development of tools for self-production, confirms it. For instance, until recently 3D printing has been sugar-based, but technology is emerging that reliably prints savory and fresh ingredients. Historically speaking, it was the American agency for spatial explorations, NASA, that in 2003 declared that they would develop a type of food that could be printed; the main goal of the agency was to ensure that astronauts could print out food, instead of consuming it out of tube, and for this they had to push the boundaries of production, and extend the range of ingredients to be used. In a film fashion, we could say that the predictions common during the 1950s and 1960s of eating capsules or weird products (in movies such as Soylent Green) seems to have been reversed in favor of more complex and tasty meals.

The example offered by 3D food printing is also apt as it pertains to many other experiments in self-production, which reflects the environmental concern and the health-related anxieties of the past 20 years. Nutritious as well as heathy food is at the centre of this. These latter are paramount for food-substitution as well, as much of the justifications employed by advocates of plant-based products employ the same sustainability trope, together with animal rights and ethical eating and living. Soron's (2010) note on green consumption, though, forces us to think that self-production and food substitution might pertain more to a sense of identity and hedonism, as they contribute to social differentiation. 3D food printing allows also to explain more of the professionalization of meal-creation. As technology becomes available in households and prices are lowered, expansion is to be expected. In a

consequential mode, this will further push for more professionalization, as a fragmentation of offer is accompanied by further specialization. Professionalization here means resembling the industry and the cooking professionals, as this figure embodies the new fashion for the media industry. Specialization and precision, both in the home-context and for hospitality and catering, will be pushed even further. The chances offered by more precise cooking, in which each operation can be further subdivided and defined, will open further spaces, as was the case for molecular gastronomy. A push on senses and sensory use is what characterizes this category. Increasingly, the industry has specialized in the natural compounds present in food products, their molecules and chemical composition to work on infinite combination that would give the industry more resources to work on. The food processing industry has employed and developed these techniques for decades now, as a matter of concentrating or enhancing flavors to provide for better and more mouth-watering products. Sensoring is promised to push the boundaries of our sensible knowledge of the world, as Farrimond (2018) has commented. The tendencies of globalization and aestheticization Warde (2015) mentions seems to be at play in many ways. The global phenomenon of celebrity chefs, as well as travel- and food- television shows and magazine articles, or the emerging figure of the bloggers, is testimony to this. Nice-looking dishes in which healthy as well as costly, inexpensive, traditional, authentic or ethnic food are displayed, are a consequence of this exteriorization. It is then correct to individuate foodies as the symbol of this tendency, as the foodie is probably the person who can embody transversally the main categories we have discussed before.

The main revolution of technology applications comes from synergies of digitalization and AI technologies, as it has been highlighted when talking about full connectivity. This allows interaction of equipment, voice assistants and chatbots helping with the cooking process. This presupposes that adopters know how to use these technologies, which have been rendered more accessible on the basis of the 'user-friendly' imperative rule. The outcome makes an observer think at a digital kitchen in which little human participation is necessary, as the instruction set for our appliances make the content becoming dynamic, atomized and personalized depending on our personal preferences and the context of our current day, meal plan, and food inventory. This has an impact on food-related literacy and knowledge, which seems to become redundant and in the hands of few. On the other side, though, users are able, and encouraged, to share their own cooking recipes and patterns (think about, for instance, the upper end of robotization that can be assumed in the introduction of computer chefs who mimic human movements to prepare meals, as human-hand patterns are efficiently reproduced and performed by employing pre-configured motion libraries that govern the mimicking of human movements like picking up, putting down or pouring) over the internet or download creations by celebrity chefs or other plain users (Andrew 2016). This would contradict Grignon's (1996) idea of further individualization, although it can be observed that the types of interaction are not spontaneous but always regulated through external factors independent of a specific context. Of course, and as a final note, the massive use of apps and related technology means that data are collected and used by the industry behind it, raising

questions over use of the same. This does not seem to bother users; the issues of data ownership that activists in the tech field are so vocal about, though, will definitely become reason for concern in this field too.

7.5 Conclusions

Consumption patterns are constantly changing, and arguably they will change even more in the coming decades. Food consumption changes according also to the technologies available, but at the same time it is clear that technologies themselves have changed according to the use and demand of consumers. The Science and Technology Studies we have mentioned elsewhere in this book are definitely able to provide more insights on the interaction between humans and non-humans, but this would exceed the defined boundaries of this chapter. After a scrutiny, it seems that much of the innovations in the way we eat and interact will come from factors outside of basic food products, as technology will have taken care of the preparation operations and, for both eating out or consuming food in our households, the next steps drive us toward immaterial, not tangible but technology-enabled landscapes. These of course are changing the way we interact and relate to each other, in both household and outdoor consumption; the example of apps that can act as a medium for sharing recipes or create a forum of course does not signal clear interaction or closeness other than a common interest; on the other hand, full automation can increase distanciation between final consumers and meal-producers, for instance, as there is no room for interaction. We can imagine, as many tech advocates do, full connectivity, an advanced internet of things to the point that it will be enough to just tap on our smartphones for organizing the week-meals of our children and dear ones from remote and maybe even distant places, which can be of great help for working mothers (mainly) and fathers or care-takers, but of course we should also ask what will be lost in terms of personal relationships, as the future envisioned by tech moguls is not unfolding in that precise direction. The trends in ethical eating, health concern, environmental issues are at the forefront, but adoption of new technologies are to be measured against disposable income and education/food and tech literacy, two of the main barriers common to many of the categories proposed. Although prices have dropped in many cases and is usually taken as a good sign for market development (or as some like to say, for democratization of consumption), it is yet to be confirmed that adoption will be immediate. Likewise, cooking as a family-caring or recreational activity is understood and experienced differently by different individuals, who might find the role of technology as foundational or intrusive on the basis of their relationship with it; where, then, is the line to be drawn to understand when has technology pushed too much? Should the market be the judge in this or we risk losing something out of full technologization of food-related activities? The same of course can be said for food consumed outside of the household, where a certain level of craftsmanship is still preserved as a marker of differentiation (think about high-end restaurants that can charge extremely high prices for a meal consumed there, on

the basis of artisan preparation and of a level of unique experience). Further, a clear line cannot be drawn easily on matters of 'naturalness', so dear to both environment- and health- concerned consumers, as the applications of further technologies complicates the debate: to what extent is a plant-based food substitute more 'natural'? Of course to answer this question it is necessary first of all to define what is 'natural', a task we will reserve for future research. Ethical issues in terms of animal welfare and rights are superseded here, but what sort of other consequences can come from allowing this kind of genetic research and application needs serious debates. Lastly, at the core of sociological research, although these technologies seem to make no specific difference in terms of gender, ethnicity or religion, these continue to play a role in terms of food choices and of task distribution (or labour division, if you prefer), whether it is in the household or in a professional environment. Despite the promises of technology to overcome the barriers provided by education or gender, hindrances will remain, as they are more profound that technological optimism might hope (see also Chap. 8 for social stratification consideration on consumption and adoption of new techs). So far, then, a final world cannot be spent, as it has to do with factors outside of the specific field of food consumption (namely, how much we perceive technology to be neutral or value free).

As a final consideration which could not be addressed in this chapter as it would exceed the scope of it, what will need to be addressed in the near future and is just at the beginning of societal concern is the implications that the use of modern technologies based on data collection will have on food consumption. As highlighted in other chapters in this book, data are valuable currency, and the pie is so large that no big player in the field will take a step back unless clear boundaries will be institutionally set.

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