Italian Committee for Biosafety, Biotechnology and Life Sciences (CNBBSV)

POSITION PAPER ON FOOD SAFETY

Food safety and security for a healthy, sustainable diet for the Italian population

Edited by

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Summary

This Concept Paper identifies actions to improve food security and food safety along the entire Italian production chain, by analysing the Italian food sector to identify its strong and weak points and the innovations it requires. The proposed actions have the common goal of **developing food safety and security for a healthy, sustainable diet for the Italian population**. They will be achieved through interventions targeting production (promotion and certification of food producers, development of unconventional protein sources, recycling of waste and subproducts, boosting productivity, genetic improvements and development of functional foods); storage/distribution (biopreservation and innovative packaging, development of mass catering); and consumption (revitalisation of the Mediterranean diet and healthy lifestyles, drivers that influence food behaviours, adoption of nutritional solutions for different consumer categories, intensification of university training and consumer information).

Contents

1. Introduction

1.1 The food sector in Italy

The food sector is the largest production sector in the European Union, with around 310,000 businesses and an annual turnover of around €965 billion. It guarantees employment to more than 4.4 million people, of whom 62% are employed by small and medium enterprises (SMEs) (Confindustria, 2019). The Italian food industry is the second largest manufacturing sector in the country in relation to turnover, amounting to more than €140 billion a year; it becomes the largest production sector if the drink industry, with an annual turnover of around €19 billion, is included (ISTAT, 2018). According to Federalimentare, in 2018 around 385,000 people were employed by the Italian food and drink industry.

Food products with an estimated value of €3.6 billion are exported every year (Federalimentare, 2019). Europe is the main destination, accounting for 70.6% of all exports. For years, the main market has been Germany (21.7% of exports), followed by France (16.2%) and the United Kingdom (12.8%). Outside Europe, the main markets are countries in North America and East Asia (6.4%). Broken down by type, drinks account for the largest share (26%), followed by confectionary (11%), dairy products and ice cream (10%), and fruit and vegetable products and preserves (10%) (Federalimentare, 2019).
The undoubted social and economic importance of the food industry in Italy derives from its historic tradition, its nutritional style (Mediterranean diet), the excellence of its foods and cuisine, and its cultural heritage, making it a model both admired and imitated in Europe and further afield. The Ministry of Agricultural, Food and Forestry Policies' list of local traditional food products (https://www.politicheagricole.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/15132) is emblematic of this heritage. This list, which was first produced in 1998, now comprises over 5,000 products, for which the traditional raw materials, other ingredients and manufacturing processes are described. Italy also has the highest number of foods with protected designation of origin (PDO) and geographical indication (PGI) in Europe. The list currently includes 311 PDO, PGI and TSG (traditional specialities guaranteed) products (https://www.politicheagricole.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/2090) and 526 DOCG (*denominazione di origine controllata e garantita* - controlled and guaranteed designation of origin), DOC (*denominazione di origine controllata* - controlled designation of origin) and IGT (*indicazione geografica tipica* - typical geographical indication) wines (https://www.politicheagricole.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/4625).

1.2 Food safety and security

Food safety refers to routines for the preparation, handling and storage of food meant to prevent foodborne illness and injury, while food security refers to access to sufficient food. These concepts and the activities that derive from them are inevitably complementary in some aspects, and include broad-ranging principles. From a social, economic and technological perspective, these principles identify highly relevant themes and actions, including: a) improving the efficiency of the food system in preventing and mitigating known and emerging food risks according to the "farm to plate" and "One Health" approaches; b) promotion and certification of food producers and protecting them from imitations; c) guaranteeing new unconventional protein sources and recycling of waste and subproducts; d) innovation and sustainability; e) promotion of foods, especially functional foods, as a factor in the prevention of various diseases, from a broader perspective of personal nutrition; f) guaranteeing food safety systems in broader, more diversified contexts (mass catering; restaurants and other unconventional production sites); g) training of food sector workers; and h) scientific, technological and nutritional information. Other activities of potential interest connected to those mentioned above are, in any case covered by them.

In general terms, Food Safety and Food Security are applied jointly in the One Health approach. This initiative aims to promote global health by tackling the needs of the most vulnerable populations on the basis of the relationship between human and animal health with respect to the environment in which they live, considering the broad range of determinants which emerges from this relationship.
The current challenges and priorities in food safety - including in Italy, which is an integral part of the European system, as an international model of risk assessment - are obviously associated with the global concept of food system and the priority areas in which both research and industry are called to respond with a new vision (Fig. 1). The relevance of this approach was recently underlined by the World Health Organization, in "*Draft WHO global strategy for food safety 2022-2030: Towards stronger food safety systems and global cooperation*" (https://cdn.who.int/media/docs/default-source/food-safety/public-consultation/draft-who-global-strategy-for-food-safety-13may2021.pdf?sfvrsn=ac480bb9_5).

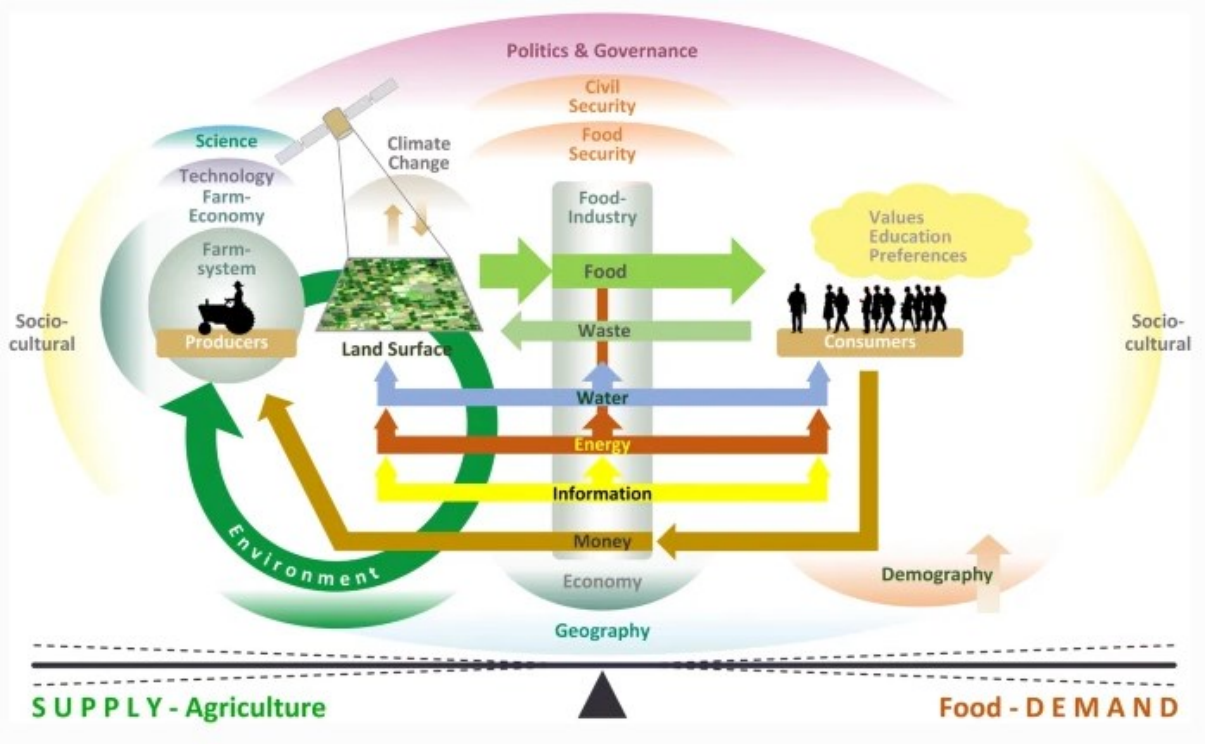

Figure 1. The global food system. From: King et al. 2017. *Trends in Food Science & Technology* 68:160–175.

1.3 Sustainability of the agri-food system

Food safety and security must necessarily be part of a system of global sustainability that includes environmental, economic and social sustainability. One of the primary objectives of Italy's National Recovery and Resilience Plan (PNRR) (http://documenti.camera.it/leg18/dossier/pdf/DFP25_parte_I.pdf?_1617289892348) is the development of a sustainable agri-food system within a circular economy (Mission 2 - Green revolution and ecological transition). It envisages: a) the development of sustainable agriculture, improving the competitiveness, energy requalification and logistic capacity of the Italian agri-food sector and b) promoting the development of a circular economy that champions integrated waste management (reducing the use of raw materials by replacing them progressively with materials produced from waste, residual materials and rejects).

This Concept Paper aims to analyse the various aspects characterising food safety and security along the entire production chain and to identify strategic actions for the development of a safe and sustainable food supply for the Italian population in accordance with the current National Research

Plan (PNR 2021-2027 https://www.mur.gov.it/sites/default/files/2021-01/Pnr2021-27.pdf), the main guidelines of the Ministry of Agricultural, Food and Forestry Policies (Mipaaf) and the priority themes identified in the European Union's *New Green Deal* (sub-topic *Farm to Fork*) and *Horizon Europe*.

2. Actions and scope

2.1 Production

2.1.1 Promotion and certification of food producers

As described above, the Italian food sector is highly diverse and (with the drink industry) is the country's largest manufacturing sector. This notwithstanding, its produce - whether mainstream or niche - has unique sensorial, textural and nutritional properties, and must be both promoted and defended from the innumerable imitations ("Italian sounding" foods) that abound worldwide. The most recent estimates of the value of fake "Italian" products amount to over €100 billion - a record-breaking increase of 70% over the last ten years, and a major risk for the survival of SMEs operating in this sector (Coldiretti, 2020). The methods for disguising counterfeit products have become so sophisticated that it is often difficult for non-experts to see or taste how they differ from the typical or traditional food. The categories most affected by "Italian-sounding" foods, above all in the United States and Australia, are dairy products, pasta, leavened baked goods, meat-based products, and ready-to-eat condiments and foods (e.g. sauces, preserves, vinegar, oil and wine).

The use of tools such as biotech and molecular techniques, mass spectrometry and magnetic resonance imaging (MRI) are needed in order to trace and authenticate food products. Simpler analytical techniques could also be developed to support producers, enabling both raw materials and the production process to be certified. Such an approach could enable a robust protection of Italian brands, thus boosting their image and safeguarding revenue. In this context, the impact of new processing technologies (see 2.1.4 and 2.2.1) on the authenticity and characteristics of traditional food products must also be evaluated. At the same time, it must be ensured that such traditional foods meet the highest safety criteria and that the production systems are able to respond promptly to emerging risks.

Objectives: to promote traditional and typical Italian products; to expand the list of Italian foods with a distinctive brand; to drastically reduce fake "Italian sounding" products; to assess technological innovations that are compatible with traditional products; to develop approaches to mitigate emerging food risks.

Indicators: the number of Italian food products with a distinctive brand; reduction of the economic impact of fake "Italian-sounding" products.

2.1.2 Food safety

It is imperative to improve efficiency along the food production chain. This is needed for various reasons, including the rising global population and the need to boost food production (by around 70% in the next 30 years - see paragraph 2.1.3), the constant mutation and growing complexity of the food production chain, climate change, urbanisation, evolving consumer choices and the urgent need to make the food sector ever more sustainable. In this context, Food Safety must facilitate global Food Security, not inhibit it.

Notwithstanding constant investment, the WHO estimates that there are around 600 million cases of foodborne diseases (1 for every 10 people) every year, resulting in 420,000 deaths. In general, the development of new processes and ingredients, the link between food and non-communicable diseases (NCDs), foods as a vehicle for exposure to chemical contaminants, endocrine disruptors, allergens and mycotoxins, the potential transmission of antibiotic resistance and the possible presence of pathogenic microbes and opportunistic pathogens are all drivers requiring the principles of food safety to be re-evaluated. Although all consumers are exposed to potential risk, some (such as pregnant women, adolescents, the elderly and people with immunosuppression or certain genetic profiles) are more vulnerable (see paragraph 2.1.6), and may suffer more severe consequences. It is also necessary to consider emerging or newly identified risks that cannot be eliminated, or at least reduced to acceptable levels for consumers, on the basis of the currently available scientific information. In general terms, scientific and industrial research is paying greater attention to various key points of Food Safety: a) the new concept of the food system, as described and oriented within the circular bioeconomy; b) the use of healthful nutrients; c) the control of emerging and re-emerging pathogens and multiple-drug-resistant bacteria; d) the onset of allergies and intolerances, especially in relation to the introduction of new food protein sources (see 2.1.3); e) chemical contamination of foods, here too with reference to emerging chemical compounds and a cumulative risk assessment; f) risk assessment for new technologies and new foods; g) the effect of changing lifestyles and consumer habits that might cause exposure to new risks; and h) the communication of risk to consumers (see paragraph 2.3.6).

With these objectives, and above all given the dynamic nature of the food sector, a variety of conventional and unconventional techniques (such as Hurdle Technology), some based on heat treatments (Fig. 2), have been proposed or have already been applied in the industry with the aim of restoring the healthfulness of foods without compromising their nutritional and sensory properties.

Recent technological and scientific advances in microbial metagenomics, the rediscovery of fermentation processes as a sustainable tool for controlling unwanted microbes and adding nutritional and sensory value, the conditioning and use of the microbiome from the soil to foods and humans (see CNMMSV's *Implementation Action Plan (2020-2025) for the Italian Microbiome Initiative*: http://cnbbsv.palazzochigi.it/it/materie-di-competenza/bioeconomia/microbioma/implementation-action-plan-2020-2025-for-the-italian-microbiome-initiative/), the development of innovative packaging (see paragraph 2.2.1), tracking and monitoring technologies, and the use of computer technology and Big Data Analysis can all significantly reduce risk and meet the needs of industry in relation to the current mandatory changes.

Objectives: to orientate research and industry solutions towards the new concepts of Food Safety; to apply emerging technologies that are safe and sustainable for Food Safety, to drastically reduce risks to human health; to develop rapid response procedures for emerging risks.

Indicators: Healthy and sustainable processes and products with a high nutritional value.

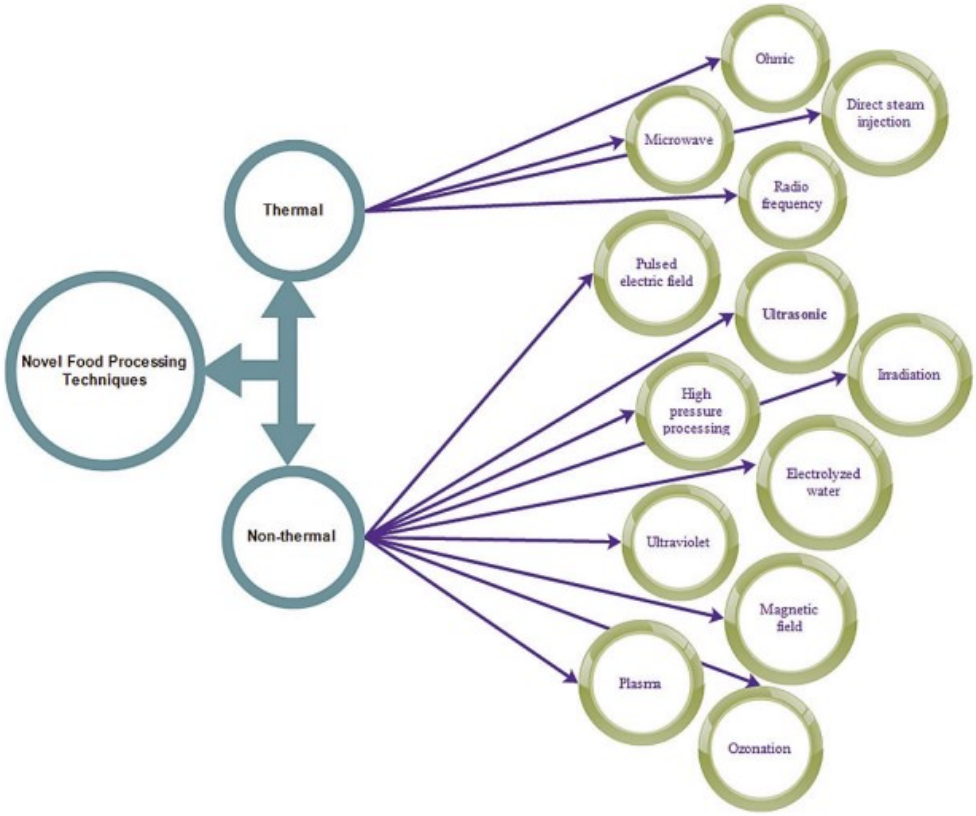

Figure 2. New food processing technologies. From: Kahn et al. 2017. *Food Control* 73:1426–1444.

2.1.3 Unconventional protein sources and recycling of waste and subproducts (Food Security)

The Food Administration Organization's projections for 2030 and 2050 forecast a daily protein consumption of 54 g and 57 g per person, respectively (OECD/FAO, 2017). Given that the global population is expected to increase from 8.5 to 9.7 billion over the same period, the demand for protein will rise significantly. However, it will be very difficult to increase the production of meat and meat products, given the costs and environmental unsustainability of the livestock farming and processing industry. The nutritional needs of a constantly growing human population must therefore be met by finding alternative, unconventional protein sources. From this perspective, researchers and food producers are looking at the use of protein sources deriving from grains, pseudo-grains, pulses, algae, fungi, bacteria and insects. These can be used both to replace animal proteins and, more prudently, in a hybrid approach enabling the partial introduction of these new protein sources, possibly mixed with animal proteins, in traditional foods. Although the process began many years ago - in part thanks to considerable investment by the European Union and various national governments - the new food processing methods are still somewhat uncertain and in need of development. Obviously, they must also deliver products that have satisfactory sensory properties and are nutritionally balanced and hygienically safe. Some unconventional matrices (such as algae, fungi, and bacteria) are considered "novel foods" (Regulation (EU) 2015/2283) and a careful risk assessment must be carried out before they can be marketed. There is thus a need to augment the scientific bases for these unconventional protein sources, in order to identify hazard assessment protocols and reduce any risk to consumers. Similarly, a risk assessment must be carried out for the consumption of plant-based foods (botanicals), which are marketed not only as foods per se, but increasingly often as a food supplement. The concentration of bioactive substances in the parts of the plant used and of potential environmental and processing contaminants could create new risks for consumers.

A balance between economic development and protection of the environment and resources is inherent to the concept of circular economy, with a focus on the more efficient use and recycling of resources, including waste and subproducts. This includes the recovery of food processing waste and subproducts to create raw materials for other processes (e.g. textiles, paper), to recover individual ingredients for use in animal feed, energy, cosmetics and pharmaceuticals, and to create new recycled foods.

Objectives: to increase the use of unconventional proteins; to increase the availability of food protein sources; to develop processes and products with new food proteins.
Indicators: healthy, sustainable processes and products with a high nutritional value that derive from unconventional proteins.

2.1.4 Productivity, sustainability and innovation

Italy is not self-sufficient in most agri-foods (Fig. 3). Production does not satisfy internal demand, meaning imports are required. This is particularly true for soft wheat, corn, oilseeds and vegetable proteins.

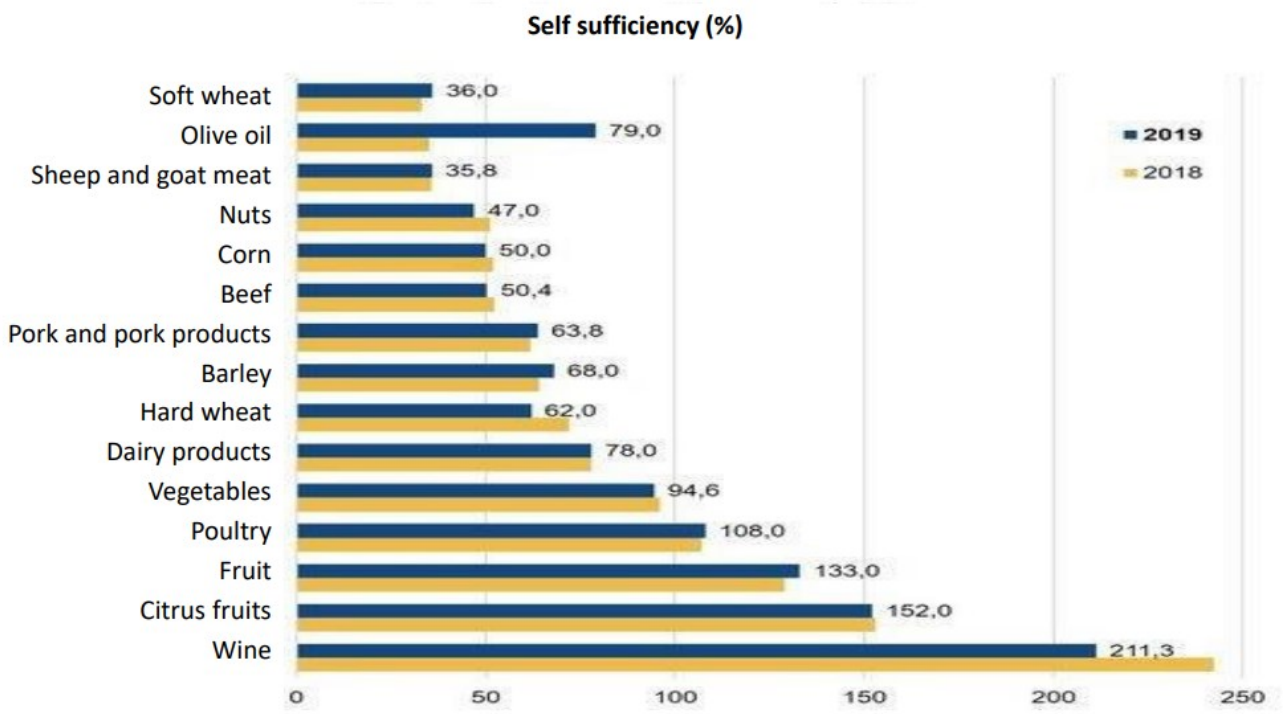

Figure 3. Level of self-sufficiency for various types of agricultural produce (http://www.ismeamercati.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/4537).

The lowest self-sufficiency is seen for proteins of vegetable origin, mainly soya and soybean cake: imports, above all from North and South America, amount to 3-4 million tonnes/year. This has inevitable repercussions for food security and sustainability. Dependency on imports and potential oscillations in supplies, for various reasons (such as epidemics), can cause instability that cannot be compensated for internally - especially for the sectors most reliant on these supplies, such as the

foodstuff and livestock industries. Importation from countries that are geographically distant and that make heavy use of fertilisers, insecticides, herbicides and fungicides is also in evident conflict with the European position on the sustainability of agricultural production and the guarantees demanded by consumers. Inevitably, agricultural productivity is associated with a need to improve sustainability in both primary production and food processing. Soil is threatened by unsustainable agricultural practices, pollution, urbanisation and climate change, with severe repercussions for the environment and agriculture. The objective is that by 2030 at least 75% of European soil will be healthy and able to carry out essential functions for the environment (*Mission Soil Health and Food*, https://ec.europa.eu/info/horizon-europe/missions-horizon-europe/soil-health-and-food_en). The Green Deal, as an element in the union between primary production and food processing, comprises sustainability indicators including the reduction of fertiliser and pesticide use, reduction of food waste (see paragraph 2.1.2) and the development of new sustainable diet models that are able to unite food safety and innovation.

The most plausible solution to the issues of productivity and sustainability lies in innovation in primary production and food processing and in sustainable intensification of agricultural production, including reduced soil use. Increasing the land destined for the agricultural production of crops for which self-sufficiency is limited would not truly resolve the problem, as it would take away land destined for other crops. An increase in yield thus requires innovative actions based, in general terms, on improving competitivity, introducing new plant species such as unconventional protein sources, and efficiently managing the resources and the environmental performance of the rural production chains and economic systems. A strategy is therefore needed that supports public and private research and facilitates their collaboration in the development of technologies that boost yields (see paragraph 2.1.5), reduce environmental impact and increase global sustainability in this sector.

Objectives: to introduce innovations in the primary production sector; to increase self-sufficiency; to improve the efficiency of resource use and environmental performance in rural production chains and economic systems.

Indicators: increased productivity and improved sustainability of primary production; reduced use of agricultural soil.

2.1.5 Genetic improvements in the agri-food sector

Historically, the biggest gains in the productivity and quality of both animal and plant species used in agriculture have come from genetic improvements. New discoveries in biology, bioinformatics, genetics and biotechnology, together with technological developments, now make it possible to

generate new species and varieties and to transfer beneficial properties faster than ever before. This knowledge can also be applied to improve the efficacy of fermenting microorganisms, used in food processing, and probiotics for animal and plant use. Consolidation of these results requires the support of research and the removal of various obstacles that hinder the development of various objectives. Increased, regular funding of both basic and specialist research is desirable, with verification of the results achieved. Some areas of research seem more ready and able to improve yields and sustainability. These include: a) the identification and use of disease-resistant or disease-susceptible genes and genes conferring tolerance of environmental stresses; b) the development of new pest control procedures that enable a reduction in tillage; c) the creation of new species (such as perennial crops) and fixing of hybrid properties; d) the development of fermenting microorganisms (e.g. producers of natural functional substances or microbes that inhibit the growth of pathogenic/harmful germs) and probiotics (capable of improving agricultural yields and sustainability); and e) assessment of the safety and efficacy of the use of microorganisms and plants obtained through synthetic biology processes.

Field tests are inevitably required to achieve and, ultimately, validate these results. Unfortunately, field tests with transgenic varieties (the so-called genetically modified organisms, or GMOs) have been banned for almost twenty years, and this ban was recently extended to varieties produced by site-directed mutagenesis using new genomic techniques (NGTs) such as genome editing and cisgenesis, although testing of varieties produced by random mutagenesis is permitted. There is thus an urgent need to approve technical protocols to enable field trials to be recommenced, especially for plants obtained using NGTs, whose modifications are similar to and indeed undistinguishable from those achieved through spontaneous mutations or induced random mutagenesis.

It will also be important to develop methods and protocols to assess the safety of organisms deriving from synthetic biology before they are released into the food system.

Objectives: field trials of varieties obtained through genome editing and cisgenesis; the creation of plant varieties that are resistant to diseases and environmental stresses; the creation of microbes with improved functional and/or probiotic properties; safety assessments of plants and microorganisms obtained through genome editing or synthetic biology in relation to the environment, animals and consumers.

Indicators: research on novel varieties; research on genetically modified microorganisms; number and variety of plant species (obtained by conventional genetic improvement and genome editing, NGTs and synthetic biology).

2.1.6 Functional foods and preventing the risk of disease

A food "can be regarded as functional if it is satisfactorily demonstrated to beneficially affect one or more target functions in the body beyond adequate nutritional effects in a way that is relevant to either an improved state of health and well-being or a reduction of disease risk" (*Functional Food Science in Europe (FUFOSE) Consensus Document, 1999)*. In the European Union, the market release of such foods requires a demonstration of efficacy based on scientific substantiation of their health claims (EC Reg. 1924/2006). The effects of a functional food may be limited to a given category of consumers or extended generically to everyone. A scientifically accepted classification of functional foods includes: a) foods that naturally contain compounds with beneficial effects or in which specific components have been improved through particular cultivation techniques; b) fortified foods with added vitamins, minerals or other substances (e.g. antioxidants) with a beneficial effect on health; c) foods from which potential allergens/components responsible for intolerances and negative effects on health have been removed; d) foods in which the structure of one or more components has been modified, either chemically or through other processes, to improve their impact on health; e) foods with increased bioavailability of one or more beneficial components; and f) foods that contain one or more prebiotic compounds alongside one or more probiotic microorganisms. To this classification may be added foods obtained following fortification with genetic techniques, whether through classic selective breeding or more modern transgenic or genome editing approaches.

The interactions of the bioactive compounds in functional foods, such as polyphenols, flavonoids, terpenoids, carotenoids, alkaloids, omega 3 and polyunsaturated fatty acids, with critical enzymes (e.g. α-amylase, α-glucosidase, angiotensin-I conversion enzyme, acetylcholinesterase and arginase) implicated in various degenerative diseases, including type 2 diabetes mellitus, cardiovascular disease and neurodegenerative disorders, offer a potential protective/preventive effect against the development of such diseases. The presence in functional foods of specific ingredients (such as fibre) and microbial metabolites, and their use as a vector for probiotic microorganisms, means that functional foods can also: a) improve gastrointestinal function (such as by lowering intestinal pH, improving the bioavailability of nutrients, reducing potentially mutagenic faecal enzymes and reducing lactose intolerance; b) reduce oxidative stress (e.g. carotenoids have a protective effect on

lipid peroxidation, reduce the risk of cancer and protect DNA); and c) prevent conditions of cardiovascular risk (for example, vitamins B6 and B12 and folic acid reduce homocysteine levels and the atherogenic risk associated with them).

Another highly important aspect concerns "food for special medical purposes" (Regulation (EU) 609/2013, article 2.2 g)), namely "food specially processed or formulated and intended for the dietary management of patients, including infants, to be used under medical supervision; it is intended for the exclusive or partial feeding of patients with a limited, impaired or disturbed capacity to take, digest, absorb, metabolise or excrete ordinary food or certain nutrients contained therein, or metabolites, or with other medically-determined nutrient requirements, whose dietary management cannot be achieved by modification of the normal diet alone." Essentially, these foods are used for the nutritional treatment of subjects with medical conditions that cause nutritional vulnerability, i.e. a difficulty in eating common foods (including food supplements) to satisfy their daily nutritional requirements. Under Directive 1999/21/EC, such foods are classified in three categories, depending on their composition: a) nutritionally complete foods with a standard nutrient formulation; b) nutritionally complete foods with a nutrient-adapted formulation specific for a disease, disorder or medical condition; and c) nutritionally incomplete foods with a standard formulation or a nutrient-adapted formulation specific for a disease, disorder or medical condition which are not suitable to be used as the sole source of nourishment.

Objectives: to produce new functional foods; to develop foods for special medical purposes; to develop protocols for the validation of functional foods that avoid speculation and are transparent for consumers.

Indicators: new processes and functional food products that can prevent or reduce the risk of human diseases.

2.2 Storage/Distribution

2.2.1 Biopreservation and innovative packaging

The last decade has seen profound changes in consumer behaviour and concerns in relation to issues such as hygienic safety, additives and the nutritional properties of foods. The general concept of diet and food as a factor in preventing health risks (see paragraph 2.3.1) has led to an enormous demand for healthy foods that have undergone minimal processing, contain no chemical preservatives or additives, are "clean label" and, preferably, are produced using sustainable, organic processing methods. These minimally processed, artificial preservative- and additive-free foods must also be of

high sensory quality and have an extended shelf life. All these demands have led to the widespread use of the innovative technique biopreservation, used to extend the shelf life of goods by applying a protective microbiota of (in most cases) lactic bacteria.

Lactic fermentation modifies the pH of foods and creates an unfavourable ecosystem for most pathogenic microorganisms. This, alongside the high cell density of lactic bacteria, prevents microbial contamination and sets biopreservation apart from other technological solutions. Important factors in this context are the simplicity, low cost and sustainability of the process, which is - or could be - applied to most foods of animal and plant origin.

The need for mass distribution and for consumers to monitor food quality constantly until it is consumed, avoiding any deterioration and/or contamination during the storage period, have favoured the development of modern packaging technologies such as intelligent packaging and active packaging, the evolution of more traditional packaging techniques. The main aims of intelligent packaging are to detect any deterioration and to monitor the quality and traceability of packaged food products from production to consumption. This is made possible through the use of time/temperature, gas and humidity sensors and indicators and the measurement of optical, calorimetric and electrochemical properties. The main aim of active packaging is to increase the shelf life of foods by using systems for the absorption and diffusion of various substances, such as carbon dioxide, oxygen and ethanol. Although the potential of these emerging techniques is undeniable, there are still some questions in relation above all to their cost, marketability and consumer acceptability and the sensory quality of foods treated using these techniques, as well as issues of environmental safety. Scientific and industrial researchers are thus called to work together to boost the application of packaging techniques that are more economically and environmentally accessible. It is essential that these innovative technologies do not expose consumers, and above all the most vulnerable members of the population, to new risks.

Objectives: to extend the shelf life of foods through sustainable techniques that are able to preserve sensory and nutritional properties; to reduce the use of chemical preservatives and heat treatments; to perform a risk assessment of the new technologies and materials.

Indicators: safe, sustainable food storage processes and products

2.2.2 Mass catering

Food consumption in Europe is worth €1,649 billion a year. Of this, 63.5% is for home consumption and the remaining 36.5% is spent in the food service industry. Italy is the third most important food

service market in Italy, after the United Kingdom and Spain. In Italy, 184,587 businesses are registered under the activity code 56.1 (restaurants and mobile catering activities) (Confcommercio, 2019). In addition to its undeniable social and economic value, the food service industry not only is intuitively linked with a society's wellbeing, but also depends to a large extent on cutting-edge processing and consumption models. In this context, food processing is progressively shifting away from research laboratories and industry to restaurant kitchens, under the responsibility and management of the chef and kitchen staff. While this trend may ensure gastronomic innovation and tradition, it also leads to significant issues in relation to controlling and guaranteeing food safety, which requires rigorous training and knowledge transfer.

Similar needs (albeit with a different target, given the processing methods and, above all, the user base) can be seen in mass catering, whether in schools, hospitals or companies. More than 97,000 people work in organised mass catering companies (Sole 24ore, 2020) in Italy, and over a million in the hospitality sector (PMI- Tutoring - https://www.pmitutoring.it/news/Il-settore-alberghiero-in-Italia-dati-tendenze-e-riflessioni).

The ever greater recourse to mass catering, in relation to changes in the organisation of labour, gives it a major role in orienting food processing and promoting industrial research (into foods, equipment and packaging) along the entire production chain. This integrated and complementary perspective can: a) influence the food behaviour of the user base and, in this way, become an important tool for promoting a healthy diet, helping prevent the onset of chronic degenerative diseases; b) improve the environmental sustainability of the food sector, optimising its processes and reducing waste; and c) encourage the training of new professional figures able to "bridge the gap" between the various parties, improving the management of the entire sector.

Objectives: to make mass catering an active tool for the promotion of "biologically" correct food behaviours (varied, balanced diet) and Italian foods; to promote low-risk food production techniques for mass catering.

Indicators: reduction in food waste, changes in the perception and type of users in relation to use of mass catering services.

2.3 Consumption

2.3.1 The Mediterranean diet

The Mediterranean diet is a key part, and one of the most positive and appreciated aspects, of the Italian lifestyle. (Re)-championing it means promoting a better relationship between people, food, the

environment and society. To do this, there is a need to involve all stakeholders in the food, nutrition, health, environmental and cultural sectors, as well as local producers, in research and innovation projects. The Mediterranean diet should not be considered as merely a healthy diet, but as a sustainable way of living and an expression of the culture (including culinary culture) of the Mediterranean area. Sustainability can be broken down into four broad areas: a) health, in the prevention of NCDs (such as atherosclerotic processes, dysmetabolic diseases, age-related cognitive impairment and frailty and neoplastic diseases); b) sociocultural, as an expression of local culture, traditions and knowledge; c) economic, to promote the typical characteristics of the Italian and Mediterranean regions by capitalising on local resources; and d) environmental, through a reduced production of greenhouse gases, lower energy and water consumption and reduced use of land (Fig. 4). The Mediterranean diet thus becomes a key element for a sustainable food system, as envisaged by the United Nations' Sustainable Development Agenda for 2030 https://www.un.org/sustainabledevelopment/development-agenda/).

Objectives: to encourage greater adherence to the Mediterranean model.

Indicators: adherence to the Mediterranean model.

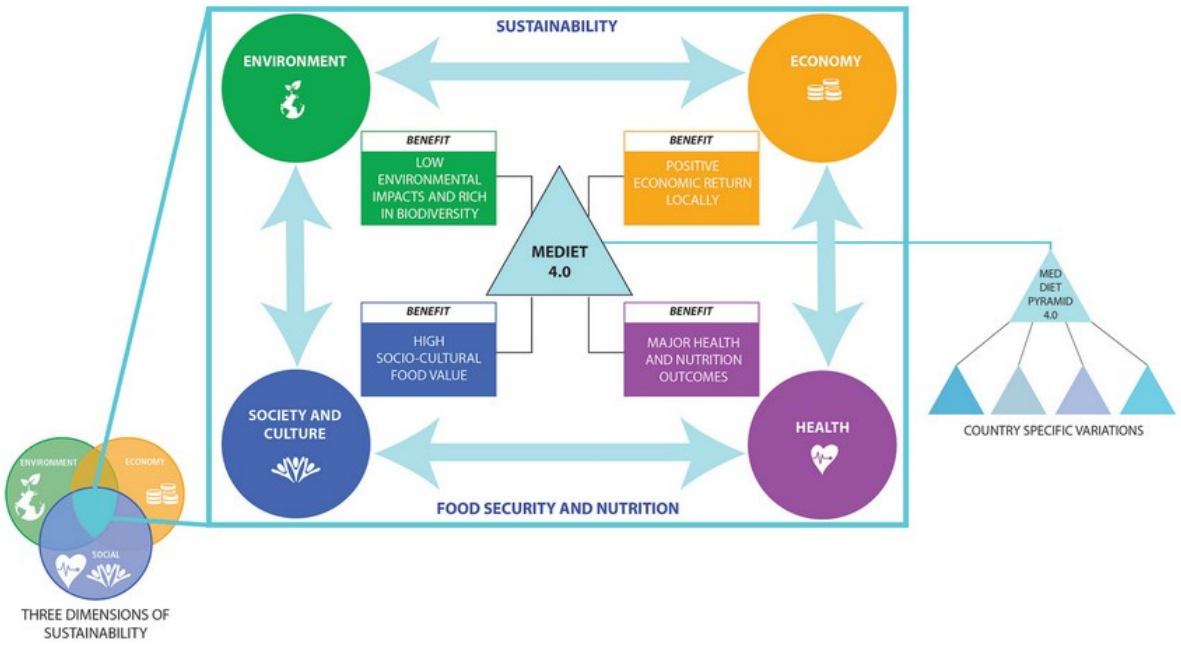

Figure 4. The Mediterranean diet and the four dimensions of sustainability. From Dernini et al. 2016. *Public Health Nutrition* 20:1322–1330.

2.3.2 Lifestyles

Scientific evidence clearly demonstrates the key role of prevention in reducing the incidence of chronic diseases and, consequently, the costs to the Italian National Health Service of managing such diseases. While some risk factors (environmental factors, age, sex, genetic susceptibility) cannot be changed, the control and/or management of others, such as physical inactivity, smoking, unhealthy diet and excessive alcohol consumption, can lower the risk of developing NCDs (Fig. 5). The WHO estimates that in Europe, the combination of seven determinants is culpable for over half of all deaths, 86% of disability-adjusted life years (*DALYS)* (number of years lost due to ill-health, disability or early death) and 60% of health expenditure. These determinants comprise four risk factors (smoking, sedentary lifestyle, high alcohol consumption, low fruit and vegetable consumption) and three diseases (arterial hypertension, hypercholesterolaemia, obesity) (Lear et al, 2017; Nyberg et al, 2018; Miller et al, 2017; Siscovick et al, 2017).

New dietary risks can also be created by the ever-greater variability of dietary choices that no longer reflect traditional models but are increasingly dictated by current trends, excluding entire categories of food (e.g. no carb, gluten-free) or promoting different ways of eating food (such as raw foodism). Moreover, these new trends have almost no scientific basis and are driven by a purely commercial logic: even worse, in addition to their often absurd promises, they may trigger and/or be driven by a food behavioural disorder (e.g. orthorexia).

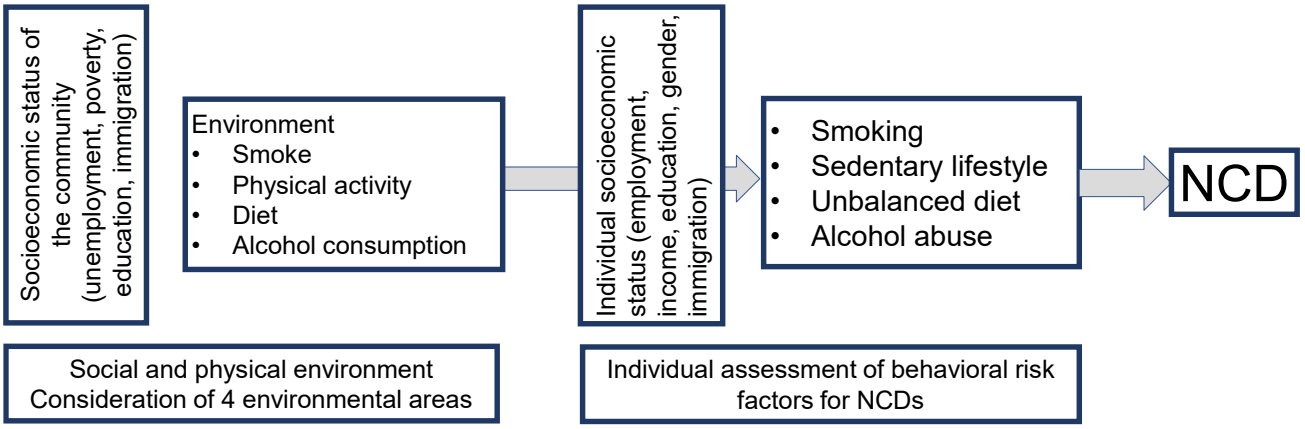

Figure 5. Features of urban environments and individual behavioural risk factors associated with non-communicable diseases (NCDs). From Franco et al. 2014. *Journal of Epidemiology and Community Health,* 69:509–511.

From a modern perspective, the promotion of health and prevention of disease and disability must be focused on joint actions capable of reducing modifiable behavioural risk factors. The FINGER longitudinal study (*Finnish Geriatric Intervention Study to Prevent Cognitive Impairment and Disability*) showed that a multifactorial intervention on various risk factors (diet, physical activity, cognitive training, monitoring of vascular risk) succeeded in preventing impairmenr (Ngandu et al, 2015). Furthermore, it is now known that variations in the genes that code for taste receptors, as well as in a number of genes involved in dietary preferences, are responsible for individual differences in taste perception, choice of foods and eating behaviour in a broad sense, with important long term implications for health.

Objectives: to promote lifestyle behaviours capable of lowering the risk of NCDs and reducing infections and food poisoning.

Indicators: incidence and prevalence of NCDs.

2.3.3 The drivers influencing eating behaviour

The marked abrupt change in lifestyle over the last few decades has caused a significant shift in dietary habits and behaviours, resulting in the consumption of excessive calories in parallel with an increasingly sedentary lifestyle. The end result has been a significant increase in the incidence and prevalence of NCDs such as obesity, metabolic syndrome, type 2 diabetes, cardiovascular diseases, arterial hypertension and some types of cancer. These diseases are characterised by complex and often interconnected multifactorial processes, and all cause frailty and accelerate the ageing process.

It is essential to identify the drivers that collectively and individually influence eating behaviour, and more generally lifestyle, including the social and cultural aspects linked to foods, methods of communication, collective and individual psychological aspects, trends and myths. This will enable consumers to be educated in relation to preferences, attitudes, needs, eating behaviours and lifestyles, especially in youth (see for example Fig. 6, which depicts the factors determining eating behaviour in university students) and thus help prevent the negative effects for health of a “biologically” unnatural lifestyle.

Objectives: to understand the mechanisms that control eating behaviour and how they interact; to identify tools that can change and guide eating behaviour towards a "biologically" correct diet

Indicators: measures of individual and collective behaviour

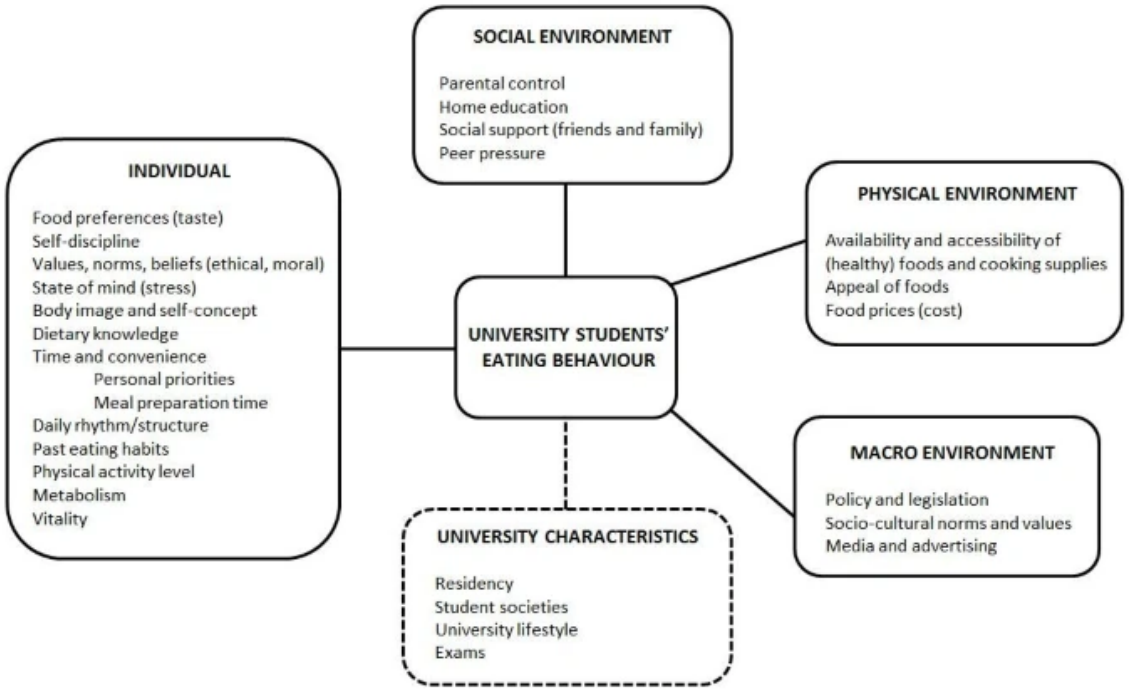

Figure 6. Determinants of eating behaviour in university students: a qualitative study using focus group discussions From Deliens et al. 2014. *BMC Public Health*, 18:14– 53.

2.3.4 Specific nutrition solutions for consumer categories (Precision nutrition)

Recent years have seen the need to develop new food categories for more vulnerable populations with specific nutritional needs (e.g. babies/children, menopausal women, the elderly, sportsmen and women, consumers with food intolerances, subjects at risk of disease or with specific deficiencies), who have a greater risk of developing food- or malnutrition-related diseases (over- and under-nutrition) (See paragraph 2.1.6). This need is comprised within the concept of precision nutrition (Fig. 7). From this perspective, a key part may be played by innovation, including through the use of "omics" techniques, to develop ingredients and foods using whose chemical, nutritional, sensory and health properties confer specific nutritional profiles suitable for the diet of these population sub-groups. Of equal importance is the development of services, digital innovation, new technologies and tools that can identify and characterise these sub-groups and help the development of personalised

nutrition plans and their adoption by individuals who might benefit from them.

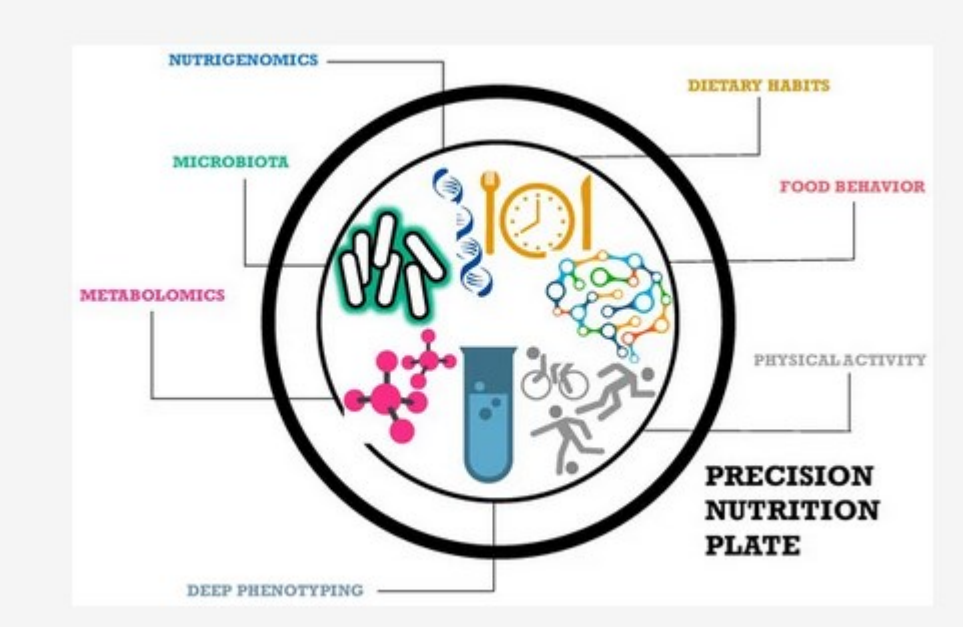

Figure 7 The Precision Nutrition plate. From Toro-Martin et al. 2017. *Nutrients* doi:10.3390/nu9080913

Objectives: the refinement of the services and tools needed for precision nutrition, specifically designed for some at-risk categories.
Indicators: change in eating behaviours and nutritional status of at-risk categories.

2.3.5 University training

University training in the food sector in Italy mainly takes place in the degree classes L/26 (Agri-food science and technology), L/GASTR (Gastronomic science, culture and policy), LM/70 (Food science and technology), LM/GASTR (Economic and political science of gastronomy) and L/25 and LM/69 (Agricultural science). Training on aspects that may also relate to food safety is also offered in other degree courses outside of food science and technology. For the academic year 2020/21 (https://www.universitaly.it/index.php/cercacorsi/universita), 37 level 1 (bachelor's) courses were offered in degree class L/26, of which 24 are on food science and technology, 7 on viniculture and oenology, 4 on gastronomic science and 2 on mass catering. Twelve level 1 degree courses with a general theme of gastronomic science are classified as L/GASTR. There are 31 level 2 (Master's) courses in degree class LM/70, of which 29 are on food science and technology and 2 on oenology. International courses specifically on the theme of Food Safety have recently been instituted in the

degree class LM/70. In general terms, this picture demonstrates that educational activity inevitably g the economic and social importance of the food sector, and more specifically, that almost every Italian university has at least one level 1 and level 2 degree course in food science and technology that reflects the local culinary traditions. It is also worth noting that, as a consequence of the trend described in paragraph 2.2.3, there has been a recent expansion in courses that touch on catering and gastronomy as environments in which to focus specific training. National coordination activities have shown their efficacy and organisation, especially in relation to courses in food science and technology, viniculture and oenology, oenogastronomic science and agricultural science. Advances in scientific knowledge and the mutation of the underlying contexts (e.g. restaurants, mass catering) reaffirm the importance of university training, and the need for coordination and differentiation between different university campuses and, at the same time, the establishment of a "core syllabus" that ensures a common knowledge base for experts and future workers in the food sector.

Objectives: to train new, highly skilled professionals who are capable of better connecting research with production and consumers.

Indicators: attractiveness of the new degree courses, postgraduate employment.

2.3.6 Information

It is probably a mistake, and certainly ineffective, to promote a healthy diet model through "negative" advertising and labelling. Discouraging or vetoing the consumption of individual foods is normally futile, and can encourage orthorexia. Furthermore, depending on the message and the "target" nutrients, tools (like the traffic light system) that suggest banning certain foods from the table risk labelling some foods as harmful, even though, if eaten as part of a balanced diet, they provide a favourable intake of nutrients and bioactive substances. A classic example is olive oil.

On the other side of the coin, eating foods labelled as healthy does not necessarily lead to a balanced diet. It is increasingly evident that what is important is the dietary pattern as a whole, rather than the value of individual foods or nutrients. In essence, "negative nutrition", in identifying nutrients/foods to be avoided, offers users information whose simplification risks becoming actually simplistic.

In contrast, positive nutrition (Fig. 8) concentrates on diseases in order to study their causes and risk factors, studying healthy people to learn the secrets that have assured them a long and healthy life. Positive nutrition tries to understand the environmental (especially dietary) and genetic factors that might be linked to successful ageing and the prevention of NCDs, in order to transfer them to the rest of the population. While identifying a dietary pattern and life style is more difficult to communicate,

it produces the best results in terms of improving a population's health without creating alarmism or imposing vetoes. It is thus important to involve consumers (consumer engagement), find out how they perceive the food system and develop specific communication strategies.

Objectives: to develop communication strategies centred on positive nutrition and consumer engagement

Indicators: verification of the impact of positive nutrition on individual food choices.

Figure 8. *Positive nutrition* (from http://understandingnutrition.com)**.**

3. Establishment of a National Centre for Advancing Translational Science for Food Safety and Security

The establishment of a National Centre for Advancing Translational Science for Food Safety and Security aims to promote the creation of translational sciences centres/departments in universities and research centres working in life sciences. In parallel, a working group on Medical Biotechnologies is proposed under the umbrella of the CNBBSV, which, in the specific case of food safety and security (foods - diet - human wellbeing), must promote the development and technology transfer of consolidated and easily applied protocols, processes and products to boost competitiveness in this sector. The institution must have a centrally managed annual funding programme to support these centres which can distribute resources ad hoc for research activities that are sufficiently advanced for technology transfer, with preference given to multidisciplinary approaches with foods, diet and

human wellbeing at their heart. Other activities connected with the establishment of such a centre are: a) intensive training activities for researchers on cutting-edge topics, in order to boost the system's competitiveness; b) events to encourage regular and frequent interaction between research centres and stakeholders (e.g. food industries, catering managers, food workers), including in collaboration with the Italian Cluster network; and c) the management of funds for public-private co-investment in projects with the highest chances of technology transfer.

4. Establishment of a Coordinating Centre for Food Safety and Security in Italy

The food system has always played a fundamental part in Italy's history, culture and economy. Given this core nature and the transversal character of its competences and interests, the establishment of a Coordinating Centre for Food Safety and Security aims to promote the harmonisation of these initiatives and the implementation of shared and standardised actions. This will favour the more rational management of resources and create competitiveness for the sector, consolidating/improving its leading international position.

The creation of the Coordinating Centre must jointly involve the Ministries of Health, of Agricultural, Food and Forestry Policies, of Economic Development and of the Environment, together with the research centres under the umbrella of these ministries (e.g. CREA, ISS).