SCHOOL MENU DESIGN HANDBOOK

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SCHOOLFOOD 4CHANGE

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Abstract	The school menu design handbook is the reference text used in the training of trainers (4.3. In-person and online training for trainers of healthy and sustainable meal cultures) and in the cascade training (4.4. Designing and implementing training for replicability) within the SF4C project. The objective of the manual is to provide a systemic tool for the design, preparation and acceptance of healthier and sustainable meals in schools for training participants and for those who in turn will have to design and implement training in national contexts. It is organised in three chapters, corresponding to three relevant dimensions of the transition to healthier and sustainable nutrition: food preferences, progressive exposure and circular cooking and active learning. Each chapter brings is approached from theoretical, methodological and practical perspectives. The text was designed and developed by UNISG with the contribution of several experts to provide the most comprehensive and multifaceted perspective to support the design and promotion of tasty, healthy and sustainable meals in school canteens.
Keywords	School menu, school canteen, cooks, training, children's food preferences, progressive food exposure, active learning, circular cooking.
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By Franco Fassio, Nadia Tecco, Carol Povigna, Matteo Bigi and Nahuel Buracco

Introduction: A handbook for healthier and sustainable eating in schools

This handbook is one of the main tools produced by SchoolFood4Change and is designed to be used as a support and reference during the training of the different actors involved in the project. The main objective of the manual is to provide a systemic tool for the design, preparation and acceptance of good, healthy and resource-saving school meals. We see European school canteens as privileged spaces where the learning of healthy and sustainable eating habits and behaviours can be promoted.

The school meal has extraordinary potential as a tool for improving the well-being of the community, but only if it is seen as an opportunity for action and education to contribute to and invest in the health of today's children and tomorrow's adults. School meals are a part of the food system and local policy that can support the protection of the planet, social inclusion, local economic development and the construction of a food community based on values of health and sustainability.
In short, they can serve as a lever with strategic and pervasive effects that can impact many different fields. As many as 418 million children receive a school meal every day (WFP, 2023). Through the implementation of nutritional literacy interventions at school age, it is possible to establish healthy eating habits and ensure they endure over time.

In the face of the many challenges that food production systems and consumption patterns pose to the protection of our health and our planet, from greenhouse gas emissions to food waste to the rising incidence of child obesity and eating disorders, it is also and above all through school meals that the transition towards healthier and more sustainable diets must be channelled.

So school meals can become a catalyst for change, capable of accommodating the needs, resources and expectations of multiple stakeholders. But we must be aware that this transition will not happen automatically. Change is a slow and continuous incremental process that needs to be nurtured step by step with concrete actions aimed at fostering the process of acceptance that this change demands at the individual, school, family and collective level: an innovation that requires a shared vision and coordinated action within the school meal system.

We urgently need tools to navigate this complexity in order to understand which interventions have the greatest potential to generate broad and lasting change, adapted to the diversity and specificities of the stakeholders involved in the local food system (Graca et al., 2022).

Indeed, the school meal system, although composed of the same (or at least similar) categories of stakeholders, takes on different forms and connotations in each local context. This means there are different entry points to address this challenge and different intervention options.

Taking as its starting point the latest academic research on the main challenges related to meals for children of preschool and school age, as well as expert recommendations, this handbook presents a pathway of proposed actions and tools. It offers a new menu of options to bring pupils closer to an appreciation of a varied, balanced and sustainable school meal and to empower the actors that make up the school meal system and raise their awareness. It provides suggestions and encourages change, not through a list of uniform rules to be applied to everyone,

as each area has its own unique characteristics, but rather guidelines that can be adapted according to specific needs. All options, no matter how they are interpreted, are designed to implement a One Health vision.

TARGET ACTORS

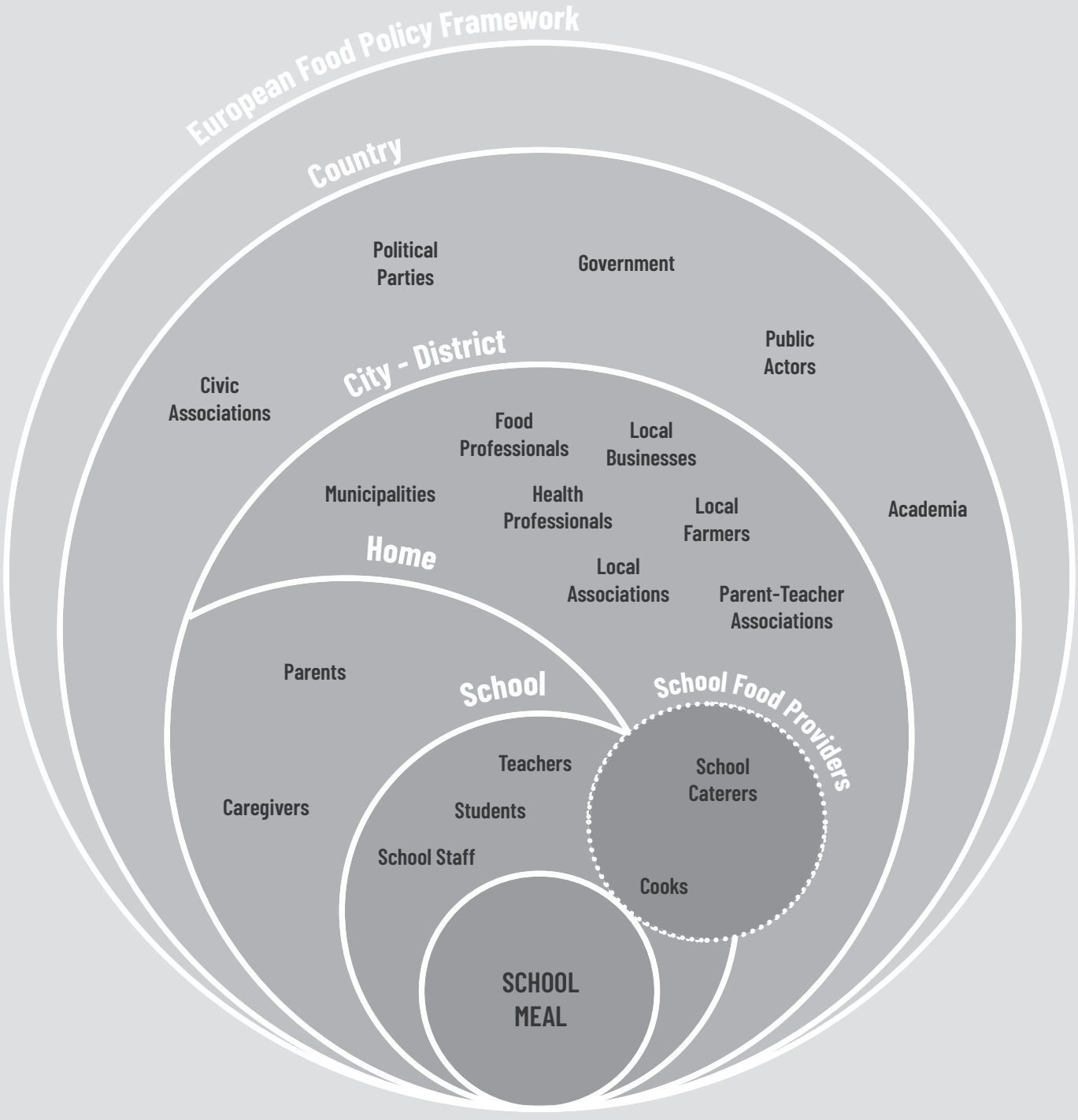
The school meal, as depicted in the figure below, is embedded in a broader system of relationships within which several areas of competence converge: the school, the meal service provider, the family, the city or district, the country and finally the European food policy framework. Professionals and actors operate in each of these areas, which, in a mutual relationship, influence each other. In addition to showing the nodes of this dense economic-social network, the diagram highlights how there are more restricted areas of proximity, directly linked to the school meal, and, moving further away, wider areas that contain the smaller ones. If it is true that the broader sphere – represented by the overarching European framework of food policies – encompasses all the others and thus increasingly guides and directs them toward a systemic vision of quality, at the same time change can also be triggered from the micro level of the school meal, creating a snowball effect that gradually influences each of the spheres of which it is part.

The primary audiences for this handbook (as per Figure 1) are cooks and assistant cooks, school canteen staff, teachers and educators, families and professionals involved in various capacities in managing meal services These are individuals who, through their skills and expertise in both operational and institutional routines, can help drive the transition toward the sustainability of the school meal system. Within the context of the SchoolFood4Change project, these roles are identified as ‘urban food enablers’, meaning facilitators of this change, which, to be effective, must work synergistically towards aligned, consistent and cross-cutting objectives.

Given the extensive network of stakeholders involved in the challenge of driving change, the target audience we are addressing is therefore broad and diverse. Similarly, this manual deliberately does not include sections specifically or exclusively dedicated to any one target group listed below. This is because it is crucial that knowledge is not compartmentalised into silos that would hinder dialogue and exchange between different areas of intervention and various skill sets. Thus, the decision was made to make the contents of this manual accessible and usable for all those involved and actively participating in the school meal system.
Let’s now take a closer look at the key figures essential to the project, the drivers of change that this handbook is intended to support.

FIGURE I: THE SCHOOL MEAL SYSTEM AND ITS STAKEHOLDERS

ⓒAdapted by UNISG from Graca et al., 2022
following discussion during the project



Cooks and assistant cooks, menu planners, catering staff
These are the individuals directly involved in the handling and processing of food in school canteens. They plan, prepare and serve school meals with a focus on sensory satisfaction and nutritional quality, efficiently utilising ingredients and cooking technologies, ensuring food safety and regulatory compliance and adhering to service schedules and procedures.
These key actors play a hands-on role in food preparation within school canteens, a critical function for which this manual provides support through suggested work methods and tools to be adapted to their specific operational context.
Take a look at: The creative matrix of the dish (p. 55), Recipe structure (p. 59), Progressive exposure (p. 86), Cyclicality as an operational framework (p. 100).

Teachers, educators, canteen staff
Teachers and staff play a key role in facilitating food acceptance through food literacy and taste education activities. They play an important role in ensuring students' home dietary patterns are enriched with new flavours, tastes and experiences, calmly and competently dealing with any initial difficulties some children may have in trying a food they have never eaten before or a flavour they do not like at first. They encourage students to take an active role in the school meal experience and positively direct their influence within their peer group.
The handbook is not just an opportunity to explore some topics of possible interest but also contains ideas for educational activities to be proposed in synergy with the school canteen and elements for better targeting their feedback on meals.
Have a look at: How our senses work (p. 6), Nutrition and One Health (p. 68), The classroom as a laboratory (p.160).

Families
In its broadest sense, the family is the primary socialising institution that introduces individuals to life within society.
Among its many roles, it holds the responsibility and ability to educate children about adopting a diverse and healthy diet. By coordinating with institutions, families can strengthen and make more effective the food education initiatives promoted in schools.
Moreover, families can actively participate in school life through representatives on the canteen committee, acting as a link between users, the municipality, the school and the local health authority. They also collaborate on monitoring the acceptance of meals and the quality of service delivery, relaying feedback on students' dining experiences.
This manual includes tools to support families in creating healthier and more sustainable meal options at home, as well as information on how to introduce commonly rejected foods into children's diets.
Take a look at: From neophobia to pleasure (p. 8), Progressive exposure (p. 86), Self-determined choices and the active role of the child (p. 153).

Professionals working in school meal management
This category includes individuals from various professional profiles (hygiene and nutrition, financial and economic, administrative and managerial, communication) who are involved in managing school food services and work within the contracting entity (school or municipality), the service provider or the local health

authority. Through their activities, they contribute to both cross-functional tasks related to the service (tender drafting, supervision and oversight, planning investments and resource allocation) and specific tasks (training and upskilling personnel, designing and planning menus, engaging with and understanding the local production context, ensuring the quality of spaces and managing relationships with other stakeholders).
These professionals, with their expertise, create the infrastructure and operational framework within which the other target groups previously mentioned operate. Their involvement is therefore crucial, both in aligning with shared objectives and in ensuring consistency across interventions. By doing so, they help build communication bridges and foster shared understanding within a system that remains complex and still too fragmented.
Take a look at: Sensory evaluation and acceptance (p. 17), Food waste in school canteens (p. 77), What to reduce and what to increase? (p. 82), Canteen Day (p.162).

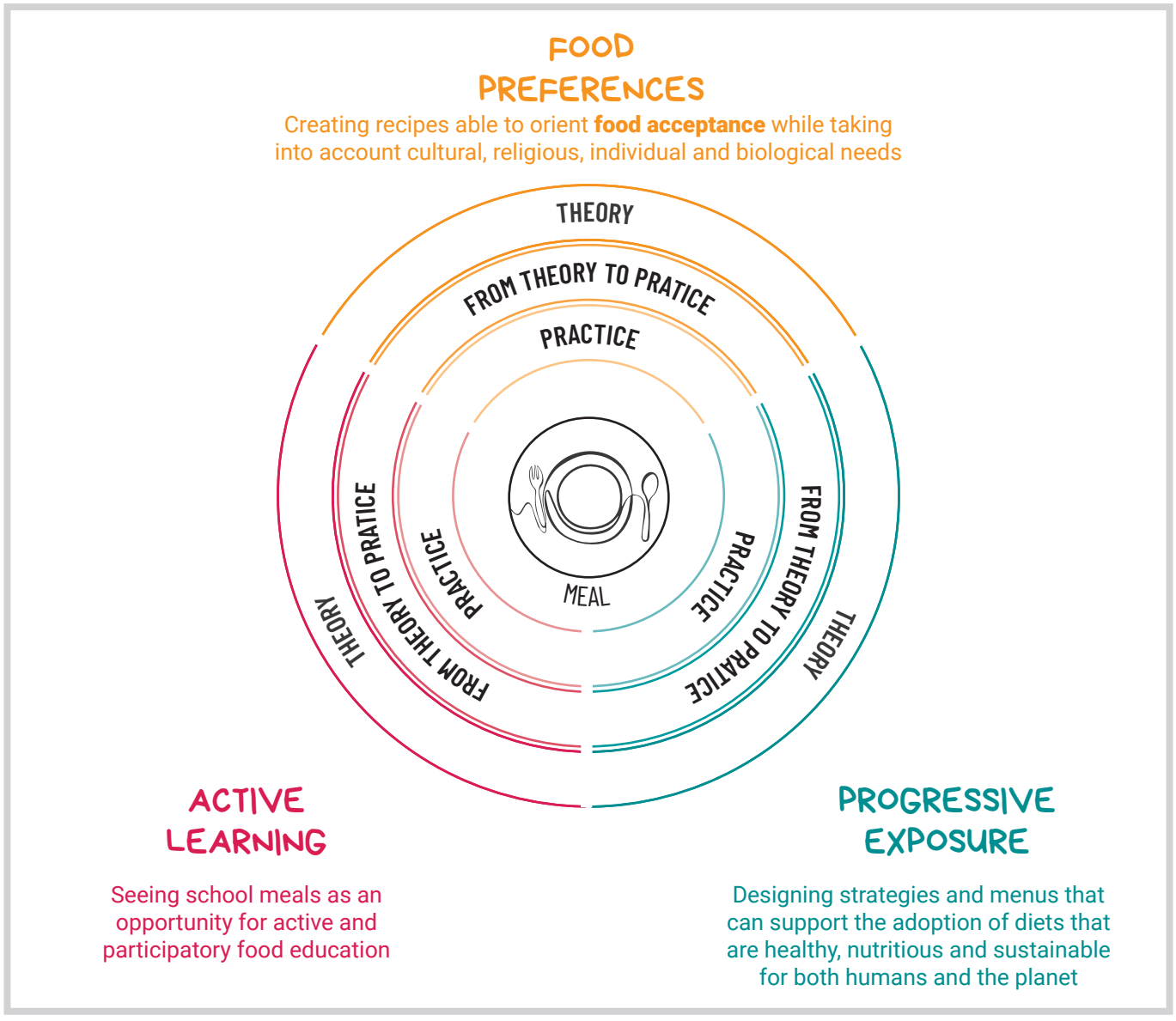
National and international institutions, civil community organisations, research centres
In various capacities, these professionals regulate, implement and uphold the values and best practices related to nutrition. They engage in dialogue with citizens, policymakers and the food production and processing sectors to promote virtuous actions. Within the SchoolFood4Change project, they play a key role in facilitating change at a macro level, both nationally and internationally.
This manual provides insights into the educational landscape and the reality of collective school catering, offering the necessary elements to develop more suitable legislative frameworks. These frameworks can better support, facilitate and simultaneously evaluate the performance of companies contracted to provide school meal services.
Take a look at: The political-economic-cultural paradigm of the circular economy (p. 88), The cook as educator (p. 138).

READING GUIDE

This handbook is comprehensive and multifaceted, addressing a variety of topics while merging diverse perspectives. Its goal is not to be all-encompassing, but to offer varying levels of depth so as to cater to the changing interests and needs of both individual readers and different groups of readers.
As discussed in the previous section, many of us will consult this text, and while in the short term each of us may use it for seemingly different purposes, the overarching aim remains the same: to promote healthy and sustainable meals within school canteens. With this in mind, we have chosen to establish a single theoretical and practical framework to ensure a common language and a shared methodological foundation.
The following pages are thus intended as a tool for seeking specific answers, without sacrificing the opportunity for deeper exploration and broader contextual understanding when interest and curiosity arise. The overall structure and approach of the manual are guided by a methodological logic that we hope will become a common foundation, fostering collaboration and dialogue among diverse stakeholders.
The handbook is organised in three chapters, corresponding to the three dimen-

sions of food preferences, progressive exposure and circular cooking and active learning (Figure II), each of which is addressed from perspectives that are theoretical (with multidisciplinary voices and contributions), methodological (from theory to practice) and practical (with tools for application that can be shared between the project actors).

FIGURE II: THE THREE DIMENSIONS OF THE HANDBOOK



DIMENSION 1 - FOOD PREFERENCES

The first chapter is the starting point for any act of culinary transformation and thus also the premise for the design of a school dish or menu: pleasure. Even before addressing the issue of health and sustainability, we felt it was essential to share a common understanding of how human beings, and therefore also children, approach food and identify, accept and recognise it as good.

Without acceptance and appreciation, we could not in fact guarantee that children have access to the nutrients necessary for their proper growth and development; sensory evaluation is therefore used as a tool to measure and validate the changes we will try to introduce into the school meal.

The theoretical section includes insights into how we perceive food and how neophobia and cultural influences affect the acceptability of food. The methodological section proposes a scientific approach to cooking as the basis for strategies for developing dishes and menus and presents the meal evaluation system that will be used to measure the validity of the changes made to the menu: the sensory test. In the practical section, culinary techniques will be systematically explored according to their influence on acceptability, and reference tables will reinterpret and apply cooking processes on the basis of specific sensory objectives. The chapter ends with the proposal of two tools: the creative matrix and the recipe structure. The creative matrix is a framework from which inspiration can be drawn (by adapting and modifying it according to contexts) to guide the development or adaptation of gastronomic proposals for the school meal. The recipe framework is the SF4C's shared format for collecting and exchanging recipes that represent our common goal: a healthy, sustainable and delicious school meal.

DIMENSION 2 - PROGRESSIVE EXPOSURE AND CIRCULAR COOKING

The second chapter addresses the health and sustainability of the school meal and frames the action of the kitchen as a key element within strategies for change aimed at integrating the well-being of the individual and the well-being of the planet.

The theoretical section opens with an analysis that offers a systemic key to the relationship between food and sustainability in order to understand its complexity and frame the vital role played by the school canteen. This is followed by an in-depth look at the nutritional aspects – emphasising the One Health approach – and the agroecological approach to the health of the planet so as to contextualise the need for a predominantly plant-based diet (protein transition) and design aimed at preventing food waste.

In the section that bridges theory and practice, we present two action-oriented systems for meal construction. On one hand, there is an operational guide on what to reduce and what to increase when planning a dish, along with the method of gradual exposure to introduce new (or previously rejected) foods into children's diets. On the other, we explore the application of circular economy principles to food, emphasising the centrality of ingredients and the value of relationships to minimise waste.

The practical section focuses on analysing the menu as a tool for planning and applying the principles introduced. It offers guidance on using the whole ingredient by building internal relationships within the menu (through cyclicality and the systematisation of preparation techniques based on the ingredient) and suggests strategies for introducing and encouraging the acceptance of ingredients, such as legumes and vegetables, that are often more challenging for children.

This approach provides those responsible for menu design and review with a tool to proactively plan for waste prevention rather than merely managing it. At the same time, it supports an educational journey that helps children's senses embrace and appreciate a healthy and sustainable diet.

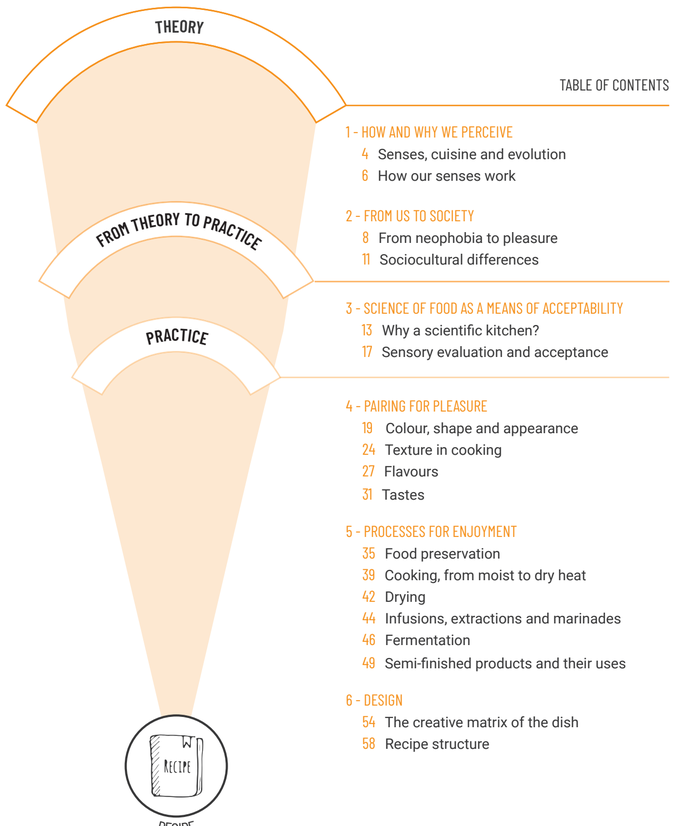
DIMENSION 3 - ACTIVE LEARNING

In the theoretical section, the third chapter embraces the concept that the menu can be an educational tool through which to accompany children in the acquisition and internalisation of healthy and sustainable ways of eating and extends the educational scope to the entire mealtime, positioning the canteen as an ally of the Whole School Food Approach. Thanks to the collaboration of all the actors involved in the project and the target audiences of this manual, the school canteen can become a place for supporting and guiding active learning through the meal experience and strengthening the educational pact of the entire community (co-evolution). The methodological part provides useful elements to understand how the learning process takes place so that it can be consciously supported and focuses on three aspects that connect it to mealtimes: the design and organisation of the canteen as an environment of knowledge and growth, the role played by direct experience (hands-on approach) in sedimenting and internalising the knowledge connected to a new healthy and sustainable way of life and, finally, the possibility of offering self-determined choices in the composition and construction of the meal so as to stimulate the application, responsibility and self-confidence of the children.

Finally, the practical part offers some examples and suggestions of educational activities and experiences and introduces the project's third and final key tool: Canteen Day. This is a day for inspiring the involvement of the project stakeholders, bringing together students, teachers, families, municipalities, associations, food ambassadors, food enablers, cooks and canteen designers around a common goal and evaluating the results obtained through sensory testing.

FIGURE III: SECTIONS OF THE THREE CHAPTERS/DIMENSIONS

Chapter 1
Food Preferences



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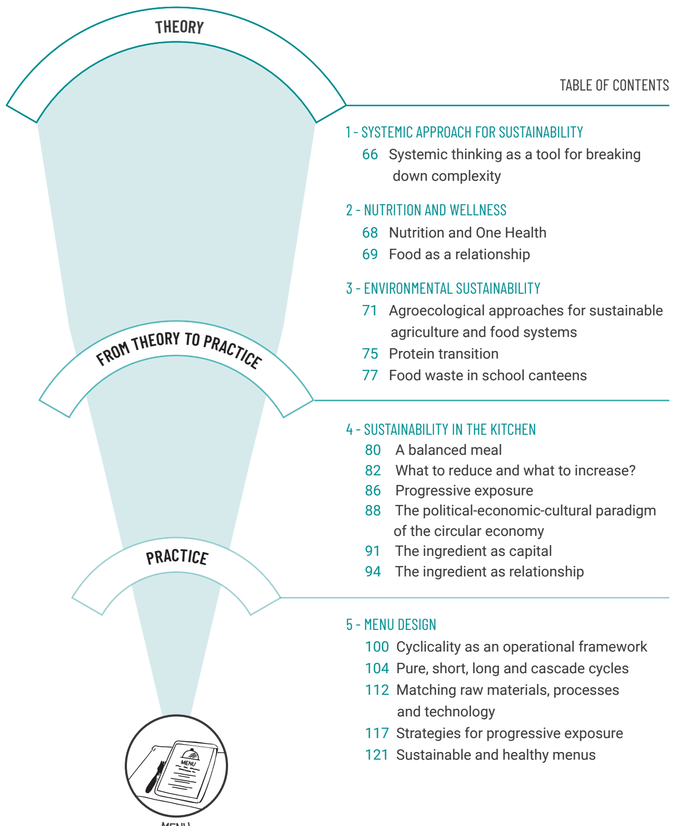
Chapter 2
Progressive Exposure and Circular Cooking



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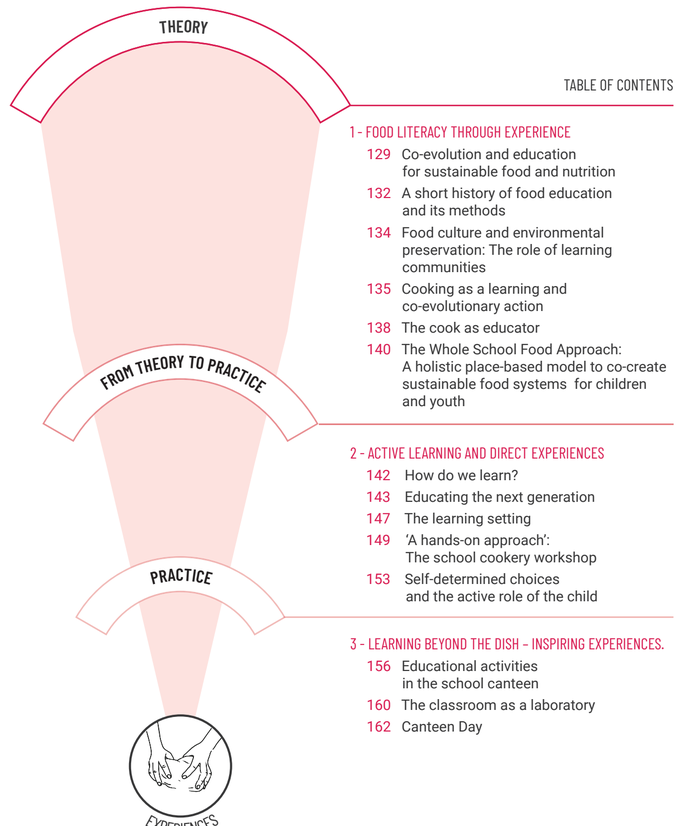
Chapter 3
Active Learning



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We encourage you to use this tool according to your respective needs, freely guided by the detailed table of contents to find the section of greatest interest and searching through pages and diagrams for practical guidance. At the same time, everyone is invited and encouraged to delve deeper, to question the reasoning behind the choices and proposals presented here and to embrace the complexity and multidisciplinary nature of the challenge we are tackling together.

HAPPY READING TO ALL, KNOWING THAT YOU ARE ALLIES, EQUIPPED WITH THE SAME KEY TO UNDERSTANDING AND THE SAME TOOLS TO DESIGN A NEW FUTURE, ONE THAT IS HEALTHY, SUSTAINABLE AND DELICIOUS.

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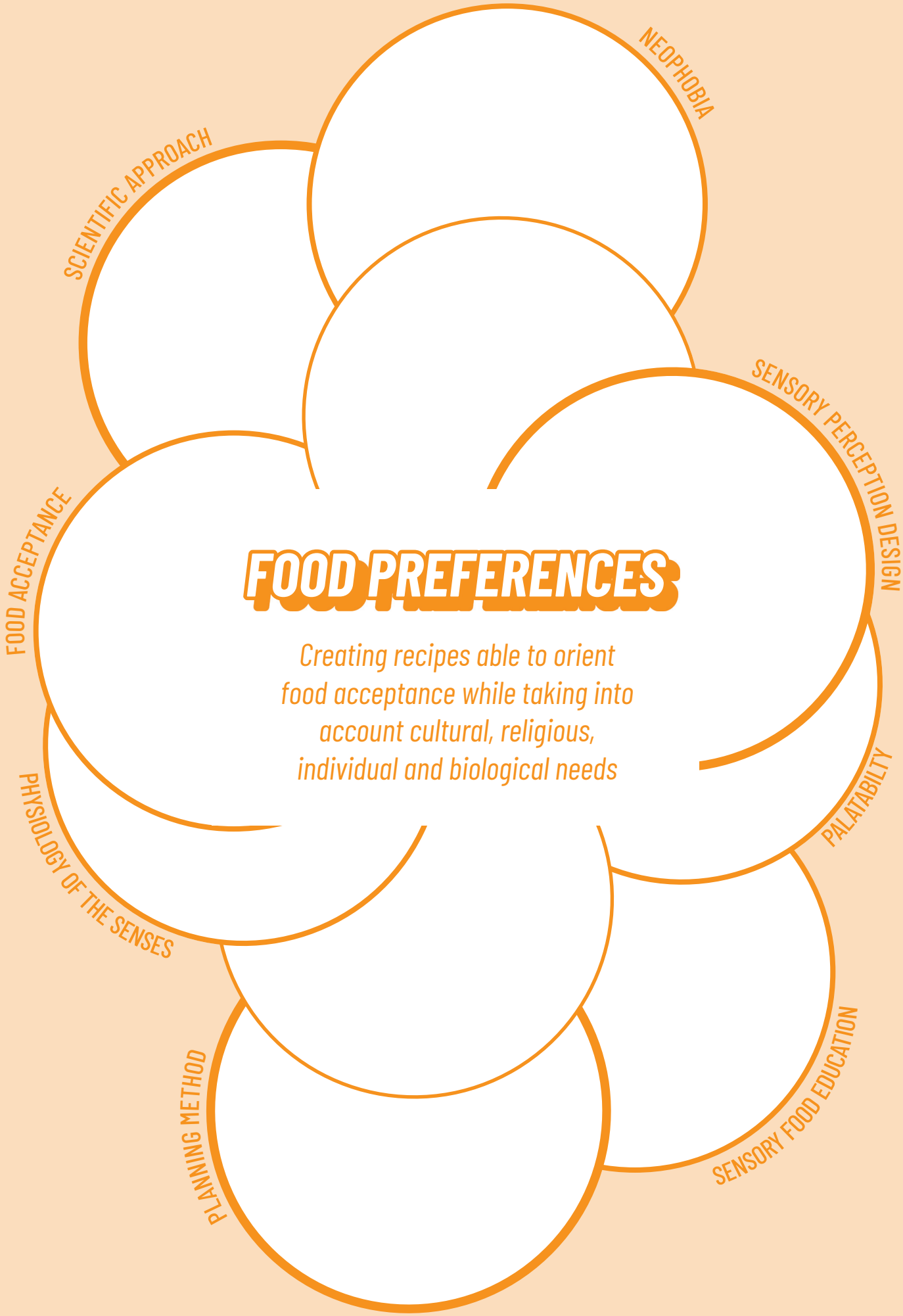

NEOPHOBIA
SENSORY PERCEPTION DESIGN
PALATABILITY
SENSORY FOOD EDUCATION
PLANNING METHOD
PHYSIOLOGY OF THE SENSES
FOOD ACCEPTANCE
SCIENTIFIC APPROACH
FOOD PREFERENCES
Creating recipes able to orient
food acceptance while taking into
account cultural, religious,
individual and biological needs

Chapter 1
Food Preferences

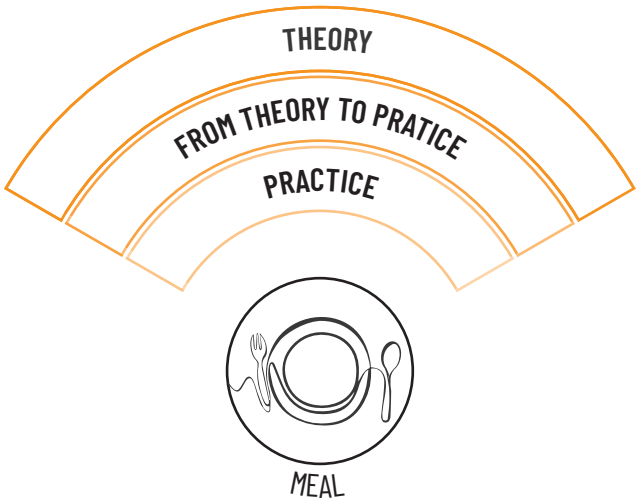
This first chapter presents the methodological premise through which we intend to lay out the foundations for promoting a diverse, healthy and sustainable diet. We start from the simple assumption that without enjoyment, no effective change can be proposed. Therefore, raw materials and transformation processes are analysed here through the lens of sensoriality and the construction of what is good to eat (and think about).

Food preferences are the centre of gravity around which the game of food acceptance is played, in which cultural, religious, individual and biological variables act and interact. In this sense, the kitchen, even more so in the context of school catering, can be seen as a creative tool to support strategies aimed at breaking down the barriers of neophobia and cultural influence.

In the first section, 'Theory', some definitions are provided in order to create a common language and set of shared meanings as a background to the whole handbook, with responses to questions such as:

- How do our senses work? What are the causes and characteristics of neophobia?
- How do sociocultural differences affect food choices?

In the next section, 'From theory to practice', the aim is to present cooking from a scientific point of view, so that ingredients and their processing can be approached consciously and critically. Sensory properties are also explored, showing how they can promote the acceptance of a food.

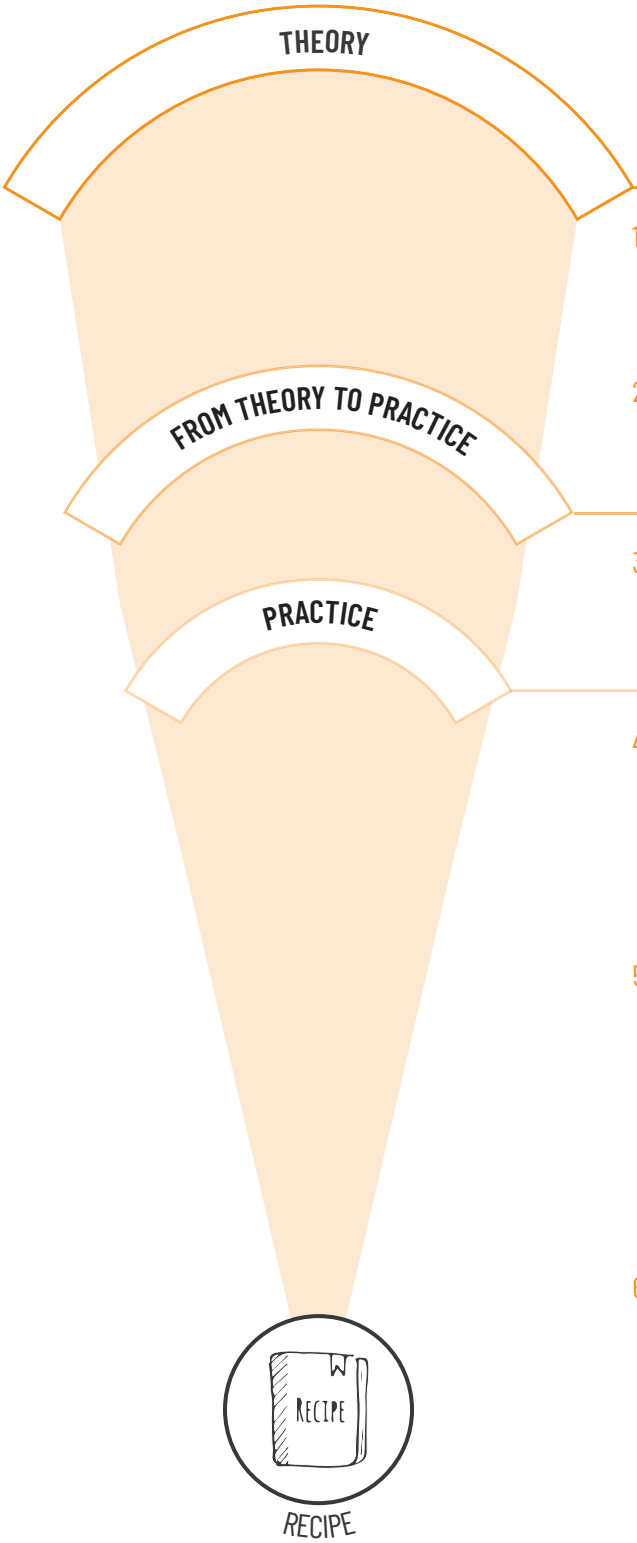


From a practical perspective, there is a systematic guide to creating 'goodness', or tastiness, through an in-depth study of processing techniques, looking at questions like:

- How do you construct goodness?
- How can we modify colours, aromas, flavours and textures through transformation processes?

The chapter concludes with the proposal of two tools – the creative matrix and the recipe framework – useful for the conception and design of new healthy and sustainable recipes.

Chapter 1
Food Preferences



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by Matteo Bigi

Senses, cuisine and evolution

The legacy of evolution in the context of school meals

Evolutionary scholars agree that the discovery of fire marked a significant turning point for the subsistence and cultural and perceptual development of human beings (James et al., 1989). Other experts add that the simultaneous discovery of the social nature of humans – through fire – was an equally important turning point (Scott et al., 2016; Gowlett, 2016).

Looking back over thousands of years of evolutionary history, we can identify fire and the cooking of food as being jointly responsible for a biological, anatomical, intellectual and cultural revolution for humans. Whereas previously food had been left raw or at most fermented, from the earliest use of fire and its domestication, food began to be cooked, making it easier to chew and digest, tastier, safer and more nutritious.

Over time, these new properties had some crucial effects. On the one hand, we see a physical metamorphosis of humans, marked by a now larger brain and a smaller chewing and digestive apparatus (Gowlett, 2016). On the other, we have a sociocultural transformation, as humans begin to develop a sense of community and belonging and a communal response to their surroundings. Between 500,000 and 1.5 million years ago, the daily processing of food using a communal hearth determined the way in which the same foods were consumed together, creating a sense of conviviality and the emergence of the first forms of social meals and language.

The slow evolution of food from raw to manipulated and then to cooked meant that humans, the only animals with a natural instinct to process food, underwent the cultural acceleration necessary for their survival and for the formation of communities as we know them today.

This legacy of the adaptive-evolutionary process has, over time, shaped humans who are born with a biological predisposition to certain likes and dislikes. While this topic will be discussed in more detail in the following paragraphs, it is important to note from the outset how the human senses have adapted to the need to instinctively identify and recognise in the environment:

- edible raw materials (sources of energy and substances essential to life)
- potentially harmful substances that pose a threat to the organism

THE EVOLUTIONARY PROCESS HAS ESTABLISHED NATURAL PREFERENCES AND AVERSIONS THAT INFLUENCE THE DAILY FOOD CHOICES OF INDIVIDUALS

As a result of this inheritance, the preference for sweet, salty and umami tastes and the aversion to sour and bitter tastes still persist (Chandrashekar et al., 2006).

To better contextualise the current historical moment, it is worth recalling how human evolution has always responded to the need to adapt to the environment. Humans as we know them today, the same 'children of fire' mentioned above, are the way they are because they evolved in a general and transversal environment of scarcity of energy resources suitable for their sustenance (Breslin, 2013; Mennella et al., 2016).

However, due to the excessive availability of food sources, these biological tools have now become obsolete, especially in the last decades in today's Western societies, and it is now very easy for these tools to be abused for the same reason.

When we talk about school meals, it is therefore necessary to understand what lies behind our innate propensity for certain tastes, aromas, colours and textures in order to deduce, on the one hand, the harmful potential of the abuse of substances that we innately like and, on the other, the possibility of using the same palatability drivers to encourage healthier diets, starting with early exposure among younger generations.

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by Riccardo Migliavada

How our senses work

The main processes involved in food perception

Credit: Photo by Nathan Hanna from Unsplash

FOOD PERCEPTION IS NOT LIMITED TO THE PROCESSING OF TASTE SENSATIONS, BUT IS THE RESULT OF THE INTEGRATION OF MULTIPLE KINDS OF SENSORY INFORMATION

From an evolutionary point of view, taste has probably evolved to identify the most nutritious foods and potential toxins in order to increase the chances of the survival and reproduction of individuals with these abilities (Breslin, 2013).

When food is placed in the mouth, taste, temperature and touch receptors assess its quality and intensity and stimulate the production of saliva in preparation for chewing, bolus formation and swallowing or, in the case of unpalatable or toxic materials, expectoration or vomiting.

The human taste system can identify five main tastes: sweet, sour, bitter, salty and umami. Contrary to what was mistakenly believed for many years, the tongue is not divided into five taste zones, i.e. specific regions dedicated to one taste. Instead, receptors are found in taste cells scattered across the tongue and, to a lesser extent, the palate and throat.

Taste receptor cells are grouped in clusters, each containing between fifty and over a hundred cells called taste buds, in turn contained in varying numbers in papillae, small structures visible to the naked eye on the tongue.

There are different types of receptors that code for different tastes and are based on different mechanisms. Humans have four types of papillae in the oral cavity, three of which contain taste receptors (fungiform, foliate and circumvallate), while one type (filiform) contains only tactile, thermal and nociceptive receptors, i.e. those related to pain perception.

The size and number of taste buds varies from person to person, with the average adult having between 2,000 and 10,000. Taste buds are lost with age, so children have more than adults.

These individual differences mean that although everyone can recognise the same five tastes, the perception and experience of these tastes can vary from person to person. For example, people with more taste buds will perceive the intensity of bitterness more than others with fewer taste buds and will therefore have more difficulty appreciating certain foods, especially as children.

The sense of taste encodes information about chemical identity, nutritional value and concentration of sensory stimuli through a complex system of receptors in the oral cavity. This information is then transmitted to the brain via the brainstem, the hypothalamus and finally the insula, where it is processed, interpreted and organised in the gustatory cortex.

However, the perception of a food is not limited to the processing of taste sensations (i.e. bitter, sour, sweet, salty, umami), but is the result of the integration of multiple kinds of sensory information. The taste of a food – what we usually refer to when we talk about the sensory experience of eating a food – is a complex neural image produced by the integration of sensory information from the five senses (taste, smell, sight, hearing, touch) with information from our previous experiences, which is processed at the cortical level. When we eat, all our senses are involved and the information we receive from them is integrated and mediated by our emotions, expectations and memories. The perception of taste is therefore the result of a multi-sensory experience involving genetic and physiological factors as well as personal memories and experiences.

However, information from one sense, such as sight, can influence how we process information from another sense, such as taste. The shape of a food, as well as its colour, can influence the taste we perceive. For example, a round bar of chocolate is generally perceived to be sweeter than a square bar (Spence, 2013). Similarly, hot chocolate drunk from an orange cup is considered to be sweeter than the same drink drunk from a blue cup (Piqueras-Fiszman & Spence, 2012). This not-uncommon phenomenon is called cross-modal perception.

Understanding how taste and perception work is crucial in the context of school catering in order to design efficient solutions and provide cooks with the necessary tools to encourage healthy and sustainable food choices among young people.

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by Carol Coricelli

From neophobia to pleasure

Food rejection and acceptance in childhood

In a supermarket aisle, we may ask ourselves whether we want to eat this or that food, but nowadays we rarely ask ourselves whether a food is edible or not. But this was a crucial distinction in the lives of our ancestors, who had to choose foods in a food-poor environment that were non-toxic and provided the maximum energy intake. Our brains have not changed since then, and it is precisely these mechanisms that underlie the cognitive processes that guide our brain's responses to food. These cognitive processes integrate perceptual information from our senses (sight, smell and taste, but also touch and hearing) with information about the pleasure associated with a food, accumulated through learning, memory, social interactions and emotions (Did we feel bad the last time we ate it? Was it tasty? Does it remind us of childhood meals?).

COGNITIVE PROCESSES INTEGRATE PERCEPTUAL INFORMATION THROUGH LEARNING, MEMORY, SOCIAL INTERACTIONS AND RELATED EMOTIONS

Credit: Photo from Freepik

NEOPHOBIA

Credit: Photo from Freepik

NEOPHILIA

THE REJECTION OF NEW FOODS IS A COMPLEX PROBLEM THAT EMERGES CLEARLY BETWEEN THE AGES OF 2 AND 6, A PERIOD OF LIFE IN WHICH CURIOSITY MUST BE NURTURED IF WE WANT TO ENCOURAGE SUSTAINABLE AND HEALTHY DIETS

Starting with perceptual aspects, such as the colour or taste of food, it has been shown (Foroni et al., 2016) that we are more attracted to red foods than green foods because they potentially give us more energy, and that we show an aversion to bitter foods from an early age (Berridge et al., 2009); this aversion would have protected us from ingesting poisonous plants or foods in nature, where it is not possible to proceed by trial and error and taste everything. These examples show the evolutionary basis of the well-known rejection of green and bitter foods by infants, such as certain types of vegetables, and this phenomenon is accompanied by a more general rejection of novel foods, known as neophobia. Neophobia should be distinguished from picky behaviour, which often involves foods that are already familiar and have been tried before. In child development, the 'peak' of neophobia seems to occur between the ages of 2 and 6 (Lafraire et al., 2016). Some strategies that have been successful in overcoming rejection of fruit and vegetables include paying attention to the presentation of the food from an early age ('the first bite is with the eye'). Cutting fruit and vegetables into geometric shapes seems to encourage their consumption, as does 'camouflaging' foods in the form of sauces or soups and placing them next to other foods more easily accepted by young children, such as pasta (Laureati et al., 2014).

Neophobia can sometimes persist into adulthood, with consequences for taste perception and health in neophobic individuals who continue to eat a diet with little variety, in contrast to neophiliacs who instead taste all foods with curiosity from an early age.

Along with an aversion to bitter foods, a sweet taste preference has been identified from birth: this pleasure is associated with neural responses from reward circuits that in turn promote actions that lead to greater consumption of such foods (Berridge et al., 2009). This preference was evolutionarily advantageous, but in today's food-rich environment it increases the risk of unhealthy food consumption. A mechanism found in the human brain (Kringelbach et al., 2003) shows how reward circuits respond positively to sweet-tasting or high-calorie foods, even when satiated: this not only leads to 'always leaving room for dessert', but also encourages people to eat more than they should and to eat for pleasure.

In this regard, it is important to distinguish between the pleasurable properties of food, liking and wanting, which involve different neural bases. Although they often coincide, as in the case of sweet or palatable foods, they can also be dissociated, as in the case of foods that the individual recognises as unhealthy and does not want to eat, even though they taste pleasant. Such behaviour towards food is similar to addiction to other substances such as nicotine or psychotropic drugs.

One aspect that cannot be overlooked in this context is the cultural traditions of the individual's home area. Earlier communities selected the foods that were safe to eat and tasted best, collecting cookbooks and traditions that made it easier for individuals to choose foods from their local area.

At the same time, in some cases where there are restrictions related to religious aspects, some foods are never tasted by the individual in the course of their life, so they develop an aversion to them not based on taste or emotional memory but on tradition (e.g. food that is regarded as 'treif' or forbidden under kosher rules). Looking to the future, when a transition to sustainable diets will be inevitable, it remains crucial to understand the cognitive mechanisms that drive food preferences in children and adults in order to promote the acceptance of new foods in the daily diet and avoid their rejection.

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by Maria Giovanna Onorati

Sociocultural differences

The influence of society and culture on food acceptance

In recent years we have witnessed significant changes in the way we interpret and approach food. In a profound and probably irreversible way, eating habits within the family have changed, with repercussions on consumption outside the home. Those most affected by these sudden changes in family routines are the youngest, especially children and adolescents, whose eating habits are still very dependent on adults, especially when it comes to rules governing meals and their consumption. Up to the age of 11, children are in a developmental phase characterised by cognitive conformism, a state in which the effort to adapt to the adult world is followed by the concrete application of the rules of this internalised world through construction and social games (Piaget, 1967). Conformist adherence to the cultural and behavioural codes of the group to which one belongs continues into adolescence, with the difference that the rules to be followed are no longer those of parents but of peers (Coleman, 2010).

IT IS WELL KNOWN THAT IT IS NECESSARY TO WORK ON THE CULTURAL APPARATUS IN ORDER TO INCREASE AN INDIVIDUAL'S ACCEPTANCE OF FOOD

Credit: Photos from Freepik

This highlights the importance of society and the sociocultural apparatus of belonging in defining individual taste and, consequently, the acceptability of a culinary offering. In fact, despite the 'innate' component of the predisposition to feelings of liking or disliking towards certain flavours, taste is largely a construction that is cultivated through habits and lifestyles. The cultivation of taste is in turn conditioned by the environmental context in which the individual grows up, their social environment and specific family conditions. Thanks to this awareness, we can come up with educational initiatives in school canteens able to modify tastes and dislikes, promoting positive reactions towards sustainable foods, such as plant-based foods. These are typically disliked by younger palates, often only because they are unusual in their daily meals. The construction of food acceptability indicators must therefore take into account the influence of sociocultural factors (such as group dynamics, environmental variables and socialisation models) on the construction of taste.

These indicators will need to be considered from a transcultural perspective, as an important dimension of sustainable food is linked to the use of local products, which can therefore appeal to very different tastes. To this end, when exploring the eating styles of the target group, it is important to identify the cultural universals that constitute the motivational core of each individual's actions within each culture and form a basis for personal preferences (Schwartz, 2006; Döring, 2010).

Cultural backgrounds characterised by hedonistic, self-directed or novelty-oriented values will predict more curious, adventurous, neophiliac food 'personalities'. Those more attached to conformist values of tradition and security will shape more conservative and neophobic food personalities. Values that are universalist and oriented towards the well-being of others will foster more responsible, ecological and intercultural food personalities.

All this will increase the effectiveness of food literacy training, make sustainable menus more compatible with pre-existing tastes and eating styles and make education more sustainable as it can be more easily integrated into daily eating habits.

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by Gabriella Morini and Matteo Bigi

Why a scientific kitchen?

Applied gastronomic sciences to support the development of healthy food preferences

Credit: Photo by Monstera from Pexels

Today, cooking according to a scientific approach and not (only) according to tradition is the commitment that cooks are making in the name of food acceptance, energy efficiency, resources, production flows and reducing food waste. This approach is also fundamental in giving them discretion and freedom from the traditional recipe system: through a scientific perspective, cooks become aware of the relationships and reactions between the ingredients of a meal and are able to plan their work according to the needs and environmental variables with which they are dealing.

In the following pages, we will look more closely at the act of eating to better understand the contribution of gastronomic sciences, starting with exploring the motivations that drive us to process food to make it good (why) then moving on to the influences of a scientific approach on individuals and culture (what) and its practical application in relation to the surrounding environment (how). The process concludes by highlighting the aspect of relationships, involving the community as a function of action and change (what if). These four strands, together with the skills underlying food processing (hard and soft skills), come together to create a gastronomic result (the dish), especially in a catering context such as the school canteen. This is illustrated at the end of this section.

In a scenario where cooking has been mediated and handed down by tradition for centuries, experience and custom have obscured the scientific foundations on which the transformation of food is based.

With the exception of the enlightened advances made by a few literary pioneers, Jean Anthelme Brillat-Savarin and Pellegrino Artusi in particular, the scientific discourse on cooking had to wait until the 20th century for wider diffusion and legitimisation (aided by the rise of the food industry). This led to a new interest in the study of food from the perspective of disciplines such as chemistry, physics, microbiology and food safety, concepts and fields that are still evolving today.

This debate on gastronomic discourse has thus helped to clarify the motivations that lead us to cook and to transform food itself. Instinctively, in order to satisfy our primary need for nourishment, we are in constant search of food that is safe, nutritious and tasty; food preparation responds to the need for the food that nourishes us to meet all these conditions. Given that cooking, since the earliest ancestral practices, has meant satisfying a biological as well as a cultural need, the human evolutionary legacy shows that the cooking of food by fire was a clear turning point. Cooking allows food to be:

- safe, by reducing microbial contamination and thus the risk of poisoning
- nutritious, by making nutrients more bioavailable and facilitating their digestion and assimilation
- tasty, by creating a sensory profile that can be appreciated transversally

Going further, we could ask: is it possible to scientifically determine what is 'tasty'?

On this last point, it is interesting to note that in the universe of food likes and dislikes, it is possible to trace a matrix of what is generally considered to be tasty. Here too, a look at the legacy of evolution helps us to understand how what is now appreciated is the result not only of the expression of a specific cultural identity applied to a dish, but above all of a human biological need. In fact, we are biologically predisposed to seek out sweet foods because they are a source of energy, umami foods because they are rich in protein, salty foods because they balance the fluids in the body and fats because they are also a source of energy and some are essential to the body's functioning. A leaning towards these flavours is therefore completely instinctive. As proof of this, numerous examples of ancestral recipes common among different, even very distant, gastronomic cultures show that these flavours are among the most popular and widely appreciated.

THE COMBINATION OF MACRONUTRIENTS AND MICRONUTRIENTS DETERMINES THE TEXTURE, APPEARANCE, AROMAS, FLAVOURS AND DIFFERENT SHADES OF COLOUR OF A FOOD

From a chemical point of view, there is a clear correspondence in the group of macronutrients that make up food (carbohydrates → sweet, proteins → umami, lipids → fat). In contrast, we do not seem to be predisposed to bitter and sour tastes, which are actually defined as learned tastes, i.e. tastes that we learn to appreciate through training. These two tastes are the object of a strong and instinctive aversion, because as they evolved humans learnt to recognise the former as an indicator of danger (potentially toxic compounds) and the latter as an indicator of an unripe or fermenting food (which can lead to the formation of harmful compounds). Despite this inherent 'defect' that we are born with, it is necessary and important to learn to eat bitter and sour foods, as they provide our body with beneficial micronutrients.

While it is true that tastiness is a universally shared concept, we must remember that we eat food, and therefore preparations, not flavours. Therefore, no product, preparation or traditional recipe will survive from one generation to the next unless it is considered tasty by the whole community and therefore worthy of being passed on. The search for the tasty and delicious in the kitchen thus becomes an expression of identity, with the products available in a given area and the knowledge and equipment available creating a recognisable local and traditional gastronomic culture. As proof of this, there is a common feeling that cooked (i.e. sliced, seasoned, marinated, boiled, etc., in a word: processed) is better. In fact, we are constantly looking for food that is first and foremost nourishing but at the same time is pleasing to the palate (to the point that the first condition is not always met).

In this respect, as shown in the diagram below, gastronomic sciences, first theoretical and then practical, are a fundamental part of the path that guides the act of eating and food processing.

With regard to school canteens and food processing, cooks must be aware of the fundamental role played by macronutrients (proteins, carbohydrates and fats) and micronutrients (vitamins, polyphenols, flavonoids, isoflavones, terpenes and glucosinolates) which, in combination, determine the texture, appearance, aromas, flavours and different shades of colour of preparations. All these aspects are factors that contribute to the gastronomic end result and therefore to the acceptance or rejection of a dish (recipe).

As we shall see in the course of this chapter, knowledge of the scientific reasons behind the act of food processing is therefore highly useful for a kitchen that, in the context of a school canteen, is able to control the chemical and physical behaviour of foods, based on their compositions. In this scenario, applied sciences in the kitchen study the variations of concepts of taste, pleasure and palatability in relation to context and system, adapting processes to needs and limitations.

The role of knowledge is seen as a source of creativity and self-empowerment to create something new, using our senses. Senses that are crucial in the decision to eat or not to eat.

In the same way, a community horizon made up of relationships, dialogue and exchange is a necessary condition for responding to scenarios other than those planned, which prevent them from succeeding, as in the case with food rejection.

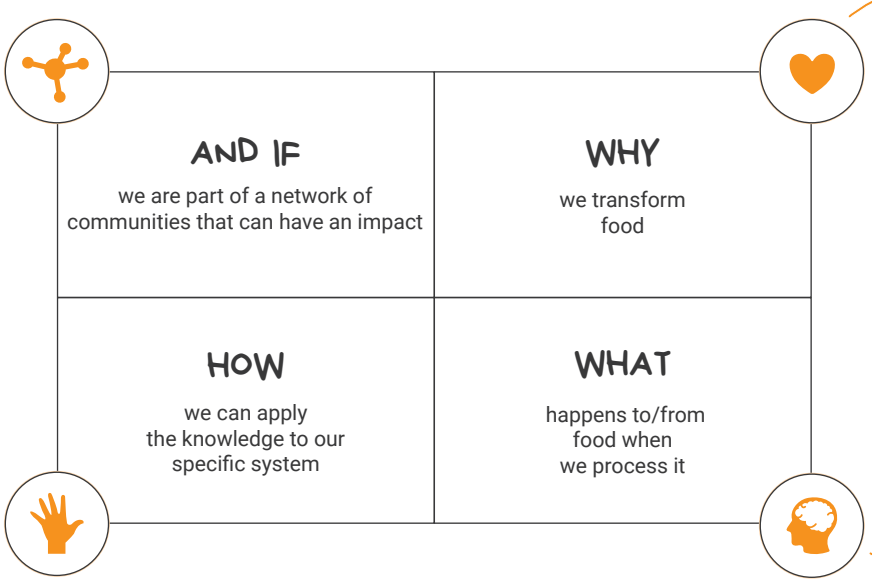
FIGURE 1: THE ROLE OF APPLIED CULINARY SCIENCE IN GUIDING FOOD ACCEPTANCE

COMMUNITY

Action and change are shared.
There is a network to share information, experiences and solutions to grow and improve.

HEALTHY, NUTRITIOUS, GOOD

Cooking is the manifestation of wisdom in adaptation. We transform food to make it safe and storable and to increase its nutritional value, and we do so while ensuring goodness and pleasure.



GASTRONOMIC SCIENCES: PRACTICES

The application of gastronomic science and its translation into practice is eco-logical: it takes place in relation to the context and the system. Knowledge makes it possible to design solutions by adapting processes to needs and constraints.

GASTRONOMIC SCIENCES: THEORIES

Food undergoes chemical, physical and microbiological transformations that have physiological and psychological effects on us. Food production is the result of history and culture and has an impact on the environment, society and the economy.

TO OBTAIN A FINAL RESULT (RECIPE):

Standardised and reproducible
Sensory quality
Nutritional quality and balance
Low-impact raw materials
Zero waste and sustainable processing
Educational and communicative function

HARD SKILLS

Planning and organisation
Chemistry, physics, microbiology
Technical skills
Nutritional knowledge
Ecology and production (animal and plant)
Pedagogy and learning processes

+

SOFT SKILLS

Resilience, adaptability
Curiosity, lateral thinking
Caregiving
Inclusion
Valuing diversity
'What if' approach

by Luisa Torri and Chiara Chirilli

Sensory evaluation and acceptance

Target parameters and sensations for children

Credit: Photo by Anastasia Shuraeva from Pexels

School canteens are a significant source of food waste, but also a great opportunity to promote better eating habits and educate about sustainability. This is in the current context of rapidly increasing rates of obesity and overweight in almost all developed countries, especially among young people (Derqui et al., 2018). We must consider that younger consumers are the least likely to compromise between the taste and health properties of food, so it is extremely important to identify some useful factors to improve the sensory acceptability of school menus. This consideration is essential to avoid food rejection, to ensure that pupils' nutritional needs are met and to avoid or at least reduce food waste.

Appearance is often the first sensory characteristic that arouses interest in a food, and children in particular pay more attention to visual input as a liking factor than adults. For example, finding the optimal combination of colour, size and shape could help to promote the consumption of vegetables for snacking (Olsen et al., 2012). In addition, there is a strong correlation between the intensity of food odour and the affective response of children, who are less attracted to foods with strong odours, as in the specific rejection of foods of animal origin (Donadini et al., 2021). Children have an innate preference for sweet and salty tastes and an innate aversion to bitter and sour tastes. In fact, they seem to prefer the taste of fruit to that of vegetables because of its sweetness, while they tend to dislike vegetables because they are characterised by sensory properties considered as 'warning' sensations that trigger aversion, such as bitterness, acidity and astringency. Therefore, modifying certain sensory properties of vegetables to make them more acceptable to children may be a possible solution to increase their consumption. For example, one can think about the type of preparation, such as the cooking method (e.g. boiling, frying), the use of flavourings or the addition of a condiment or another food to mask undesirable flavours or create desirable ones (Poelman et al., 2017).

THE SENSORY CHARACTERISTICS OF FOOD, SUCH AS APPEARANCE, ODOUR INTENSITY, TASTE AND TEXTURE, CAN PROMOTE ACCEPTABILITY

Food texture is another sensory characteristic that is particularly important for children, whose perceptions and preferences change with age. Children tend to reject textures that are difficult to process in the mouth and to prefer soft, smooth foods (e.g. sandy, floury and pasty textures) to chunky or grainy foods. On average, crunchy and juicy textures are associated with greater product acceptability and contribute to a greater preference for fresh, raw fruit and vegetables. In contrast, soft, slimy or too-hard textures are associated with a greater dislike of vegetables, especially when cooked, by children (Laureati et al., 2020).

In conclusion, an in-depth understanding of the role of sensory characteristics in influencing the consumption of healthy products provides important information for developing strategies aimed at creating dishes and menus that can increase the acceptability of school meals. This can have the double benefit of reducing food waste and educating young people about healthy and sustainable diets.

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by Matteo Bigi

Colour, shape and appearance

Managing and reducing the role of vision in the kitchen

SENSE OF SIGHT PLAYS A SIGNIFICANT ROLE IN JUDGING FOOD AND CREATING EXPECTATIONS

Credit: Photo from Freepik

We recognise a stimulus/object, decode it, immediate establish a set of expectations based on its appearance, colour and shape, decide how to approach it, decide whether to put it in our mouth and then potentially eat it.

All this happens in the few moments after a steaming plate of food is placed in front of us. The brain is responsible for this thinking process, and the instrument that feeds it most is sight. In fact, sight is one of the most used senses in everyday life. We use it so often that we have come to rely heavily on this precious ally, sometimes even overlooking other sensory inputs or letting ourselves be deceived by it. Knowledge and control of the key visual indicators responsible for forming a judgement about a food are therefore a fundamental part of the work of cooks when planning a recipe for acceptance and quality.

Sight makes it possible to quickly distinguish a food from a non-food and, just as quickly, to lean towards cooked (rather than raw) and/or high-calorie foods. This is due to the biological heritage we have inherited as a result of human evolution. We need only recall how diet – and many other related biological factors – changed after the discovery of fire, and how 'cooked' automatically became synonymous with healthy, digestible and nutritious.

This can be seen, for example, when, faced with a plate of lasagne, a panorama of expectations is immediately created by the sight and memory of similar dishes. Among the information received, the colour conveys the awareness that these dishes are harbingers of fatty tastes and umami, dictated by the brown colour which comes from the Maillard reactions generated during cooking. It is plausible that similar expectations can be created by the mere sight of roasted or fried foods, due to their golden colour and the dehydrated appearance of the surface. These two aspects are not only a portent of good flavour, but also suggest that the food will hopefully be crispy, another indication of palatability.

On the subject of colour, confirming what we have just seen, scientific studies show that biological heritage is a very powerful factor in food choice. People are naturally attracted to foods that are warm colours, especially red, as they are a presumed source of energy, while green is associated with unripe and potentially dangerous foods (Foroni et al., 2016). In the case of blue, on the other hand, the response evoked by foods of this colour is based on an innate mistrust that predisposes us to reject what we do not know. In fact, blue is not a colour that is naturally associated with anything edible, as evidenced by the scarcity of truly blue foods in nature. Moreover, this colour is naturally perceived as a potential threat: think of moulds, which in most cases are harmful to the organism and therefore repel us. It is no coincidence that cheeses that are inoculated with moulds and fungi during the ripening process are called ‘blue’.

While human beings have evolved innate attitudes and associations towards certain colours, equally culture and the environment influence our sight by creating expectations. These can often be helpful, acting as cognitive shortcuts to help us decipher the sensory stimuli around us, while at other times they can lead us astray. Such narratives and expectations are so ingrained in conventional wisdom that they can mislead our final taste judgement or prevent us from recognising it. This systematic error is due to the learning that is acquired after an event (such as eating a certain food) and the memory that one has of it. Let's take an example: when we unwrap a sweet labelled 'lemon flavour', we are likely to expect it to be yellow and would therefore have difficulty tasting it if it were red or blue. This 'expectation error' is due to the consistent construction of expectations that help us navigate reality. Learning and memory are key elements in the creation of an individual's eating habits (Coricelli & Rossi, 2021) and being aware of them can be useful when we decide to 'play' with the appearance of the food we serve in order to make it more acceptable. As we will see in the next chapter, natural attractions and aversions to certain colours, together with the expectations associated with them, can sometimes be played with, for example using certain stimuli on the plate that confirm an expectation of colour but then bring something new in terms of flavour or texture.

SHAPES AND COLOURS ARE KEY TO THE FOOD ACCEPTANCE PROCESS

It is not only colours that seem to play a role in final overall perception.

Shape can help us to increase the acceptance of a commonly refused food. This is the case with green vegetables, which have a poor acceptance rate among the youngest segments of the population. But vegetables cut and presented in geometric shapes are more likely to be accepted by young neophobes than irregularly cut vegetables (Coricelli & Rossi, 2021). Furthermore, the recognisability of individual elements within the dish, preferably kept separate, is also an effective strategy for increasing the acceptability of certain stimuli. Finally, shape is sometimes responsible for altering the perception of a particular flavour. Consider, for example, studies showing that a dessert tends to be sweeter when placed on a round plate rather than a square one (Steward & Goss, 2013; Fairhurst et al., 2015). A fact that can help us when it comes to limiting sugar in our diets.

Food is often seen as a means of communicating with others and there is no question that colours, which determine the final appearance of foods, play an essential role in this communication flow when it comes to expressing and delivering messages. Colours also help living organisms to orient themselves in their environment and to determine whether a food is safe or not and play a key role in the process of acceptance mediated by the sense of sight (think of how appealing brightly coloured food is to children rather than food in dull, dark colours). It is therefore important to know how colours work and, above all, to learn how to manage their changes. At a gastronomic level, knowing the compounds contained in our food allows us to make healthy choices, as each colour is an indicator of healthy properties for our organism (Khoo et al., 2017). At the same time, this knowledge is also useful in the kitchen, as knowing the polarity of different ingredients allows us to choose the right solvent in which to extract the colouring agent. Speaking of vegetables, let's take a look at the molecular characteristics responsible for the colours of fruits and vegetables, which are linked to the beneficial properties of micronutrients.

CAROTENOIDS

These are pigments, non-polar and therefore fat-soluble compounds. The most important are beta-carotene and lycopene. The former is responsible for the yellow-orange colour of foods such as apricots, melons, carrots, pumpkin, etc., and once it enters the body it is converted into vitamin A. Lycopene, which is responsible for the red colour of tomatoes and peppers, is closely linked to the umami flavour that comes from cooking these foods for a long time.

FLAVONOIDS

These are natural compounds produced by plants and include quercetin, responsible for the white colour of fruits and vegetables and important in protecting the body's cells from free radicals, and anthocyanins, water-soluble compounds responsible for the blue/violet colour of certain foods such as grapes, red cabbage, beetroot, plums and others.

These compounds are found in the flowers, fruits and leaves of plants and act as antioxidants. In the kitchen, their colour changes depending to the state of oxidation and the pH, from reddish tones in an acidic environment to pink in a neutral environment to blue-green in an alkaline environment, returning to their previous colour when the acidity or alkalinity changes again.

CHLOROPHYLLS

These non-polar compounds are the pigments responsible for the green colour of chard, spinach, parsley, cabbage and other vegetables. They are not very stable because they are sensitive to:

- high temperatures
- acidic pH
- enzyme activity

In fact, when these vegetables are cooked, the chlorophyll they contain naturally tends to darken, and in an acidic environment this process can be accelerated. To preserve their vibrant colour, here are some strategies:

- Blanching, i.e. briefly cooking in boiling water, allows thermal denaturation of the enzymes that act on the chlorophyll, thus preventing the undesirable browning of, for example, spinach leaves.
- Another effective method is to use sodium bicarbonate (baking soda) together with a large amount of water during cooking: vegetables naturally contain organic acids that tend to dissolve easily in water, causing the dark green/brown colouring. Bicarbonate is therefore useful for balancing the pH of the water in which food is cooked. For the same reason, many recipes recommend changing the cooking water frequently; as the cooking liquid becomes more acidic, leaves tend to darken more quickly. A large quantity of alkaline water is therefore important to dilute the organic acids and prevent the water temperature from dropping too much after the vegetables have been added.

Speaking of enzymes, here are some more practical examples of food colours. Enzymes are specific proteins known in the kitchen less for their direct contribution to structural change in foods than for the way they modify certain food components. In fact, they are defined as biological catalysts because of their ability to speed up certain chemical reactions that would otherwise be much slower. So these particular proteins are responsible for sudden and sometimes undesirable changes in the appearance of food, such as enzymatic browning. Certain foods, when exposed to oxygen, tend to lose their original colour and turn brown: this is the case, for example, with apples, bananas and basil, which, once cut or broken, quickly turn dark. For example, if basil pesto is a dull, dark colour, this is due to the oxidation of the surface of the basil leaves exposed to the air after cutting, greatly accelerated by the action of the enzymes contained in the food itself.

To prevent this, it is advisable to use cold processing and oil in the first stages of the process.

Once we have understood this dynamic, we can prevent it by using ingredients rich in vitamin C (where their flavour works with the recipe), such as lemon juice or parsley stems. These oxidise instead of the food, without changing the colour. This is why artichokes, for example, are soaked in water and lemon juice after being trimmed and cut. The reactivity of most chemicals increases with temperature. The same is true of enzymes, which have an optimum activity temperature of 20° to 60°C, above which they are inactivated. Therefore, by bringing the vegetables to a higher temperature (even for just a few seconds), the enzyme will no longer be active and this will ensure that the original bright colour is retained.

Therefore, in order to avoid enzyme browning, it is essential to minimise the time that food is exposed to the 20° to 60°C temperature range (except in the case of desired reactions such as proteolytic marinades, acid, lactic or alcoholic fermentation and meat and fish tenderisation).

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by Nahuel Buracco

Texture in cooking

Sense of touch and states of matter

STATES OF MATTER CAN INFLUENCE THE ACCEPTANCE OF A DISH

In the context of a school canteen, in order to define a process and create a recipe that is both delicious and part of a sustainable diet, it is essential to understand the technical functions of molecules in the kitchen and how they react to different stimuli during their transformation, taking advantage of changes in the state of matter to create new shapes and textures. Macronutrients (proteins, carbohydrates and fats) and micronutrients (mineral salts, polyphenols, terpenes, etc.) play a fundamental role in food processing: their combination defines the texture, appearance, flavour, aroma, chemistry and colour of different ingredients and processed products.

Full knowledge of the reactions and changes in food structures that occur during processing allows the sensory profile of a recipe to be planned from the outset. This knowledge is a key ally in the design of sustainable recipes and menus for school canteens, which integrate plant-based, organic and seasonal ingredients into young people's diets, offered in different shapes, colours and textures.

STATES OF MATTER IN THE KITCHEN

The 'good' is sought in the kitchen, by the cook and the consumer, and knowledge of the molecules, processes and ingredients means it can be consciously constructed for the creation and production of a semi-finished product, recipe, dish or product, thanks to the technical functions, chemical reactions and changes in states of matter that occur during food transformation processes.

Here we will take an in-depth look at the different states of matter in cooking, obtained thanks to the functional properties of fats, proteins and carbohydrates.

FOAMS

Foams are dispersions of one fluid in another. In this case, one of the two fluids is a gas and the dispersed particles are air bubbles. The structure of the foam and the large surface area in contact with the air increase aromatic perception and give the mixture a light, evanescent consistency. The macromolecules that can be used to create foams are fats (as in whipped cream or liquids with added lecithin) and proteins (as in meringue or zabaglione). Different processing techniques to obtain foams in the kitchen involve the use of whips or siphons using either carbon dioxide or compressed nitrous oxide.

One method of stabilising a foam is to subject it to heat treatment, depending on the type of processing and the nature of the stabilising molecule. For example, to make Italian meringue, egg whites are beaten until stiff (physical denaturation) and then hot sugar syrup at 121°C is added to the mixture, which fixes the structure and coagulates the protein (thermal denaturation).

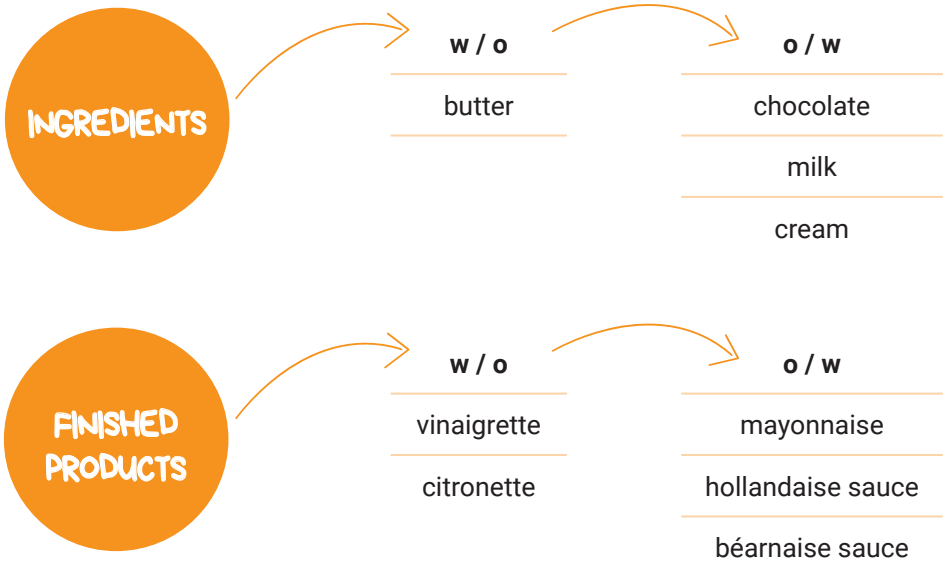
EMULSIONS

An emulsion is a more or less stable mixture of two incompatible liquids (by dispersing droplets of one – the dispersed phase – into the other – the continuous phase). An emulsion can only be obtained from two liquids that do not dissolve into each other and thus keep their two identities separate.

The first 'ingredient' to bring these two liquids into contact is the mechanical energy generated by a fork, a whisk or an immersion blender, which is necessary to reduce the two liquids into progressively smaller droplets, thus increasing the possible surface area of contact between them.

An emulsion is therefore a liquid dispersed in microdroplets into a continuous liquid. Depending on which is the continuous phase and which is the dispersed phase, we can define two different types of emulsion: oil in water (o/w, or oil dispersed in a continuous phase of water) or water in oil (w/o, or water dispersed in a continuous phase of oil). The presence of a third element, the emulsifier, is required to stabilise the mixture. There are two groups of emulsifying molecules: lecithins (phospholipids) and proteins such as collagen. The characteristic feature of emulsifiers is their ability to reduce the surface tension between the continuous and dispersed phases.

In nature, some raw materials are already emulsions. By mixing and transforming them, the cook can create and reverse different emulsions with the help of emulsifiers and energy. Below are some examples of emulsions, both in the form of ingredients and complex recipes.



GELS

Gels are compounds that contain dissolved gelling molecules that give them their final consistency. These molecules bind together to form a continuous, wide-meshed network capable of trapping water between them. When cooled, this effect is even more pronounced. The thickening agents used are carbohydrates such as starches (depending on their origin, they have different effects on the compound) and gums (xanthan gum, gellan gum, etc.) or proteins (collagen or aquafaba). In order to obtain the thickening effect, the molecules often have to be heat-treated to between 60° and 70°C, depending on their nature. Many preparations in the kitchen are in fact gels, such as puddings, custards, béchamel, mashed potatoes and polenta.

Credit: Photos from Pexels

FOAM
Meringue

EMULSION
Butter

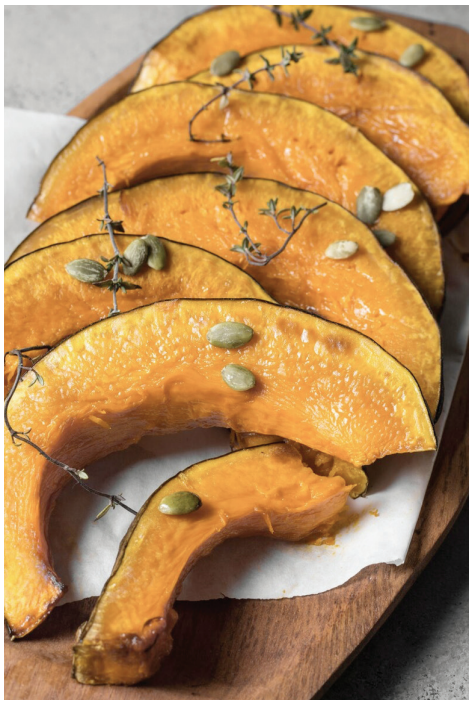
GEL
Mashed potatoes

by Carol Povigna

Flavours

Techniques to preserve flavours and enhance their perception

FOOD AROMAS HAVE THE POWER TO EVOKE EXPERIENCES, CONDITION JUDGEMENT AND INFLUENCE THE SENSES OF TASTE AND SMELL



Credit: Photos from Freepik

Aromatic compounds are naturally present in food and influence our liking, determining preference or rejection and interacting with our perception of taste. Food odours have the power to evoke experiences and to make us associate those memories with the current tasting. So, odours that evoke unpleasant elements alarm us, while odours that characterise positive experiences in the past make our mouths water. The interplay between smell, memory and acceptance/rejection is particularly relevant when the recipient of the food preparation is very young: many children's rejections are in fact motivated by the presence of an unpleasant odour (smelly or stinky), usually aggravated by a vivid association with an element that is a source of disgust (such as socks or feet). The presence of recognisable odours and positive associations (vanilla in cake, oregano on pizza), on the other hand, is reassuring and makes it easier to offer new ingredients, reducing their level of danger.

Cooks have always deliberately used these aromatic compounds to characterise and identify preparations by extracting and concentrating the odours of ingredients and transferring them to other ingredients or semi-finished products (see 'Infusions, extractions and marinades' in section 5). Professionals working in school canteens will find that the conscious use of the aromatic component can be a valid tool for enticing and stimulating those who are reluctant to taste, for reassuring those who are suspicious and for improving the nutritional quality of dishes without affecting their acceptability.

In order to plan and manage the use of flavour components in the most effective way, it is necessary to know which processing parameters influence the volatile compounds responsible for the flavour of various ingredients.

The two parameters that most influence the extraction and transfer of aromas are temperature (which, in turn, is influenced by time) and the polarity of the compound.

TEMPERATURE (AND TIME)

Some flavour compounds can withstand high temperatures without change (heat resistant), while others (heat sensitive) are partially or completely destroyed by heat treatment. For the latter, it is essential to plan extraction and use low, controlled temperatures, knowing that this will require longer processing times: maceration, drying at temperatures below 40°C, ultrasound treatment. On the other hand, if the aromatic compounds are heat resistant, heat treatments can be used to speed up extraction or direct use in cooking: infusions, high-temperature drying, microwaves. Aromatic compounds in leaves and flowers are generally less heat resistant than those in roots and the woody, resinous parts of a plant.

POLARITY OF THE AROMATIC COMPOUND (SOLUTE)

The structure of the aromatic compound, and in particular its polarity, determines the choice of solvent to be used for extraction. The similarity rule applies to solutions: polar compounds can be extracted and/or dissolved in polar solvents such as water (and all water-based ingredients such as vinegar, wine, stock, fruit juice, etc.), whereas non-polar compounds require non-polar solvents such as fats (oil, butter, cream, etc.). Alcohol, although a polar molecule, is less polar than water and allows both polar and non-polar compounds to be extracted. Aromatic compounds found in the more water-rich parts, such as leaves, flowers and fruits, are mostly polar, whereas aromatic compounds found in less water-rich or more fatty parts, such as roots and seeds, are non-polar.

This information can be translated into a fairly straightforward example of application: infusing a tomato sauce with basil flavour. A bunch of basil can be divided into two parts: the leaves (with largely polar and heat-sensitive aromatic compounds) and the stems (with non-polar and more heat-resistant aromatic compounds). So, when preparing our tomato sauce, we can infuse the basil stalks in hot oil (possibly with garlic or onion, bulbs that have heat-resistant and non-polar aromatic components) in order to extract the aromas in a non-polar solvent. The tomato puree is then added and cooked; only when this has been done and the heat has been turned off do we add the leaves, which, in an aqueous solvent and at a decreasing temperature, can complete the aromatic profile of the sauce.

Knowledge of the specific aromatic compound is therefore a prerequisite for choosing the most appropriate gastronomic transformation process, bearing in mind that each ingredient contains several aromatic compounds. Together these contribute to defining its olfactory profile, and each of these compounds reacts differently during processing.

HOW TO RELEASE AND PRESERVE FLAVOUR

To preserve the aromatic compounds in fresh products for as long as possible, they can be concentrated by removing activity water.

KNOWLEDGE OF THE AROMATIC COMPOUNDS OF CULINARY INTEREST IS A PREREQUISITE FOR CHOOSING THE GASTRONOMIC TRANSFORMATION PROCESS

By drying herbs and spices, an aromatic palette can be made available out of season or in places far from production areas. It is important to note, however, that the removal of water results in the loss of many of the polar compounds dissolved in it, and that the temperatures at which the process is carried out are critical, especially for leaves and flowers.

The rupture of the tissues (cell membranes) is in fact the first step in releasing the aromatic compounds and exposing them more easily or directly to oxygen, which brings them into contact with our nasal mucous membranes (this is why the fragrance released by basil is more intense when we shake the plant slightly or rub a leaf between our fingers). The greater the crushing, the greater the amount of volatile compounds released, but the quicker they perish: spices are more intense when used in powder form, but the aroma of freshly crushed peppercorns is very different from that of pepper that has been ground some time ago. Rapid perishability is the reason why aromatic compounds are often extracted by physical and chemical processes that combine the mechanical action of breaking with chemical dissolution in a solvent (water, fat or alcohol).

Cell membranes can be broken directly by cutting and crushing (mortars, spice mills, food processors) or by inducing cell rupture through heat, microwave or ultrasound treatment. In some products, such as garlic or onions, the (physical) rupture of the tissues triggers enzymatic (chemical) reactions that lead to the formation of certain aromatic and pungent compounds: whole garlic has a more delicate smell (and taste) than garlic rubbed on bruschetta.

AROMATIC COMPOUNDS DELIBERATELY DEVELOPED THROUGH TRANSFORMATION

Some aromatic compounds that are perceived as pleasant are not naturally present in food, but are created during cooking. The smell of grilled meat, for example, diffuses only when we start cooking and causes an almost immediate preparatory response in all of us, namely increased salivation. There are many examples of this phenomenon: coffee and chocolate develop their distinctive aromas through fermentation, as do cured meats and cheeses; biscuits, cakes and roasts are all subject to the high-temperature cooking process that triggers Maillard reactions.

In this context, fermentation and enzymatic processes lead to the creation of new flavours: the case of sourdough bread is an excellent example to show the complexity developed by the combination of these two processes, especially when compared with the result obtained by the alcoholic fermentation of brewer's yeast alone. Enzymatic processes, thanks to the action of a group of proteins (enzymes), act on the macromolecules that make up food, breaking them down into smaller, simpler parts that are easier for our body to process, in terms of both digestion and perception (greater intensity of aromas and flavours). Enzymes are naturally present in food; they are slowed down by cold temperatures and are inactivated above 70°C. The addition of salt makes it possible to inhibit microbial growth at room temperature (the optimum for enzymatic processes) and to obtain new products with very intense aromas and flavours (garum or fish sauce, koji, pickled lemons).

During fermentation, yeasts and bacteria digest the substrate, producing lactic acid, acetic acid, carbon dioxide or alcohol; however, the secondary metabolites of this process include many aromatic compounds, which vary greatly depending on the type of substrate and the composition of the microbial colony. The importance attached to spontaneous and natural fermentation, far from being a mere technical process, is fully justified by the infinite range of aromas and flavours that the biodiversity of microbial colonies is capable of producing.

Among the cooking processes used to create new flavours, caramelisation and roasting (Maillard reactions) are perhaps the most common and widespread. Both are chemical processes triggered by temperature. Caramelisation is essentially a non-enzymatic browning process that starts at temperatures above 120°C (although the threshold is lowered to 110°C for fructose alone) and involves only the sugars that break away from the water molecules, creating new colours, aromas and flavours that recall all the nuances of caramel. Maillard reactions, on the other hand, take place thanks to the interaction between amino acids and reducing sugars in the presence of heat: the first reactions take place even at room temperature, but as the temperature increases, they become faster and faster, reaching an optimal situation at around 120° to 140°C. This interaction produces a large number of new aromatic and flavouring compounds, which are also concentrated by the evaporation of water and have always been used in cooking to enhance flavour. Broths and cooking juices, widely used in every gastronomic culture, are in fact a concentrate of Maillard reactions, and can be used to give flavour and roundness to various preparations.

by Carol Povigna

Tastes

The role of taste in the construction of goodness

CHILDREN HAVE HAD LESS TIME THAN ADULTS TO GET USED TO CERTAIN FLAVOURS (SOUR, BITTER) AND SENSATIONS (HOT, SPICY) AND ARE THEREFORE MORE LIKELY TO REJECT FOODS WITH THESE SENSORY PROFILES

Credit: Photo by Juan Pablo Serrano Arenas from Pexels

As human beings, we have an inclination – which takes the form of preference and appreciation – for the taste of the macromolecules that make up our bodies. We need carbohydrates, proteins and fats, so we look for foods with sweet, umami and fatty tastes. Our body also needs sodium, which is why we like salty foods so much. In contrast, evolution has taught us to distrust bitter tastes as a possible indicator of poisonous or harmful substances and to limit the consumption of acidic products because their taste indicates incomplete ripeness and consequently a lower availability of nutrients. Tactile sensations in the mouth, known as warning sensations, which evoke perceptions of heat, spiciness or cold, are also associated with possible danger. Compared to adults, children have had less time to culturally acquire familiarity with these tastes (sour and bitter) and sensations (hot, spicy), so they are more cautious and likely to reject foods with such sensory profiles. At the same time, very young children are particularly attracted to sweet, umami, fatty and salty tastes, which makes it essential to provide them with a taste education, not leaving them at the mercy of the highly processed offerings of the food industry and instead guiding them towards healthy food choices.

For centuries, gastronomic production has developed techniques and recipes with the aim of offering healthiness and nutrients in a form that ensures their enjoyment. Haute cuisine, like the food industry, is full of examples of this, but even traditional cuisine can easily be read as an embodiment of what we like. If, when analysing a processed product, we can easily identify the elements that make it palatable (high levels of sugar and fat, flavour enhancers and additives that influence colour, texture and aroma), it may be less obvious to read a classic lasagne as a deliberate sum of desirable flavours and textures.

However, in a traditional dish such as lasagne (but this example can easily be replaced by other examples from local gastronomic cultures), we find beef ragù and Parmigiano Reggiano cheese, which perfectly represent umami and our quest for protein, juxtaposed with béchamel sauce – whose roundness provides fat – and sweet, carbohydrate-rich pasta. Flavours that are more difficult to accept are, with rare exceptions, completely absent from industrial products and restaurant offerings, while local gastronomies instead offer interesting food for thought on the possibility of mitigation and building objects of social value.

These premises are useful for understanding how, beyond the cultural and community background of each individual, certain sensory characteristics are universally recognised as good, and how, at each level of gastronomic transformation (domestic, professional, industrial), strategies can be identified that aim to increase the perception of sweet, salty, umami and fat and to reduce or eliminate the presence of bitter and sour tastes. Today, however, the challenge is not only to produce something pleasant, but also to guarantee the presence of the fibre and micronutrients that are essential for mental and physical well-being. In fact, the systematic enrichment of the food we eat with refined sugars and fats and the excessive consumption of animal proteins are endangering our health and that of the planet. We must therefore develop cooking techniques with the aim of balancing flavours and creating complex taste experiences, capable of including foods rich in essential bitter, sour and spicy substances.

The first element to be taken into account is the size of the molecules: the larger they are, the less intense the perception (and the more difficult the digestion). Chewing is the first action we can take as consumers to reduce size, but as processors we know that all cooking processes modify the structure of the molecules, making them more immediately perceptible.

Enzymatic processes and fermentation act on the molecules, breaking them down into their smallest parts, which has a double benefit: the food is partially digested (and therefore easier to assimilate) and the flavour molecules are free to reach our receptors with greater intensity. Creating the conditions for the safe and correct initiation and execution of these processes allows us to obtain products that, once added to preparations, offer a concentration of flavours that appeal to us and whose presence allows us to reduce the amount of added sugar and salt. For example, bread that has undergone a long fermentation process (involving enzymatic processes), thanks to a mixed population of yeasts and bacteria, is more flavourful than its counterpart that has undergone only a short alcoholic fermentation. This means a lower percentage of salt is required to reach the threshold of acceptability.

TRANSFORMATION PROCESSES MODIFY THE STRUCTURE OF MACRO- AND MICROMOLECULES IN FOODS, THUS INCREASING THEIR PERCEPTIBILITY

In turn, aromas and tactile sensations in the mouth have a major impact on perception, particularly of sweet and salty flavours. Heat (or the sensation of heat) makes us perceive more sweet and salty intensity at the same concentration, while cold reduces the sensation. Ingredients that stimulate heat-related chemesthetic sensations can therefore be valuable allies in reducing salt and sugar content. Many flavourings – particularly those we associate with foods with a distinctive sensory profile – contribute to our perception of a food as saltier or sweeter.

The aroma of cinnamon or vanilla, for example, causes us to perceive a product as sweet. In foods containing these flavours, it is therefore possible to significantly reduce the amount of sugar while maintaining enjoyment. Sweeteners with complex flavour profiles (such as honey or raw sugar) achieve the same result. Aromatic herbs and spices such as oregano, thyme or sumac – as well as those that combine flavour with pungency such as chives or garlic mustard – allow us to reduce salt in the same way.

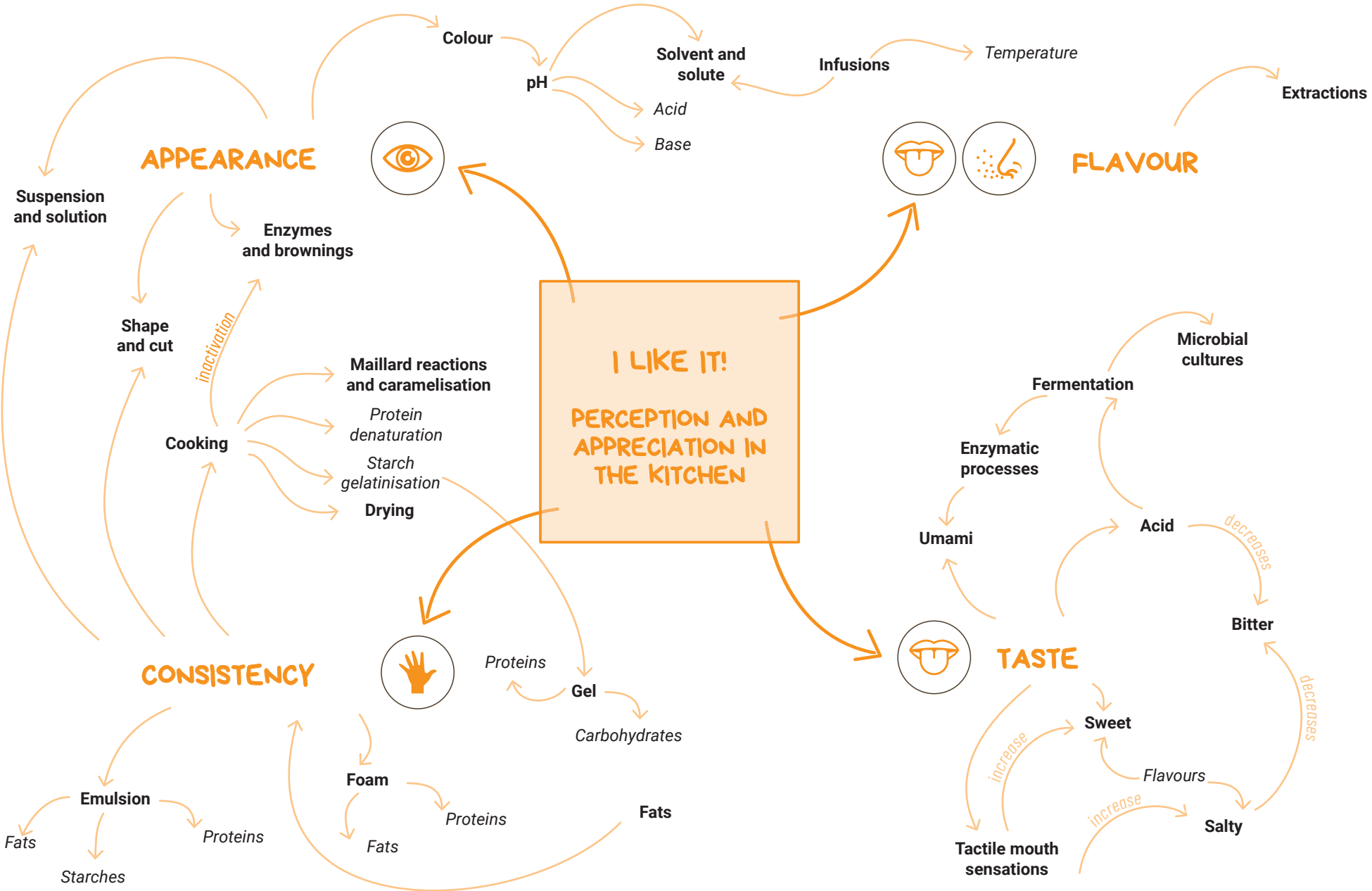
The use of heat, and in particular controlled roasting at moderate temperatures (140°C), which develops the characteristic aromas without producing dangerous substances such as acrylamide, produces highly palatable compounds that increase salivation and can prove to be allies in the acceptance and enjoyment of preparations that might otherwise be trickier due to the reduction of sugar or salt or the presence of bitter or sour flavours.

The mistrust of bitter and sour tastes, combined with the need to increase the intake of the nutrients that these tastes signal (micronutrients and microorganisms involved in fermentation processes), makes the introduction of ingredients characterised by these tastes very delicate. It is necessary to develop progressive exposure strategies (see the next chapter), taking into account the sensory interactions which, in this case, allow us to increase the amount of bitter and sour components. Bitterness is softened by the presence of other bitter ingredients, saltiness/savouriness and acidity: instead of a single bitter product we can try a mixture of ingredients with different levels and types of bitterness (mixed vegetables) and the addition of savoury and rounded products (soffritto, miso) or acidic products (vinegar or fermented dairy products). Fat and bitterness are good allies: while bitter is able to support the longer digestion of fat, the latter softens and sweetens the bitter making it more acceptable. Bitterness is also perceived less at low temperatures.

Finally, acidity is less appreciated on its own, and can be softened by mixing it with sweet or savoury ingredients.

When selecting and combining ingredients for a meal to be offered to a group of young people, it is important to take this information into account in order to improve the nutritional quality of the food and minimise its rejection. We know, for example, that preparations containing fat and umami are popular, and that the presence of these two flavours helps to mitigate the perception of bitterness that characterises many vegetables. Therefore, to offer a new bitter vegetable in the canteen, it may be useful to combine it with ingredients or processes that develop umami flavours. Similarly, to reduce the amount of refined sugars offered in a school meal, we can use flavourings such as vanilla or play with temperature.

FIGURE 2: PERCEPTION AND APPRECIATION IN THE KITCHEN



by Nahuel Buracco

Food preservation

Techniques and parameters for producing a stable and versatile semi-finished product

Credit: Photo by azerbaijan_stockers from Freepik

Culturally and instinctively, humans are driven to seek the tasty, the nutritious and the safe. These are very relative terms. There is no real universal definition of 'safe', as it depends, for example, on the customs and eating habits of a particular place and the level of exposure to different types of gastronomic products. However, there are common scientific guidelines for food processing and preservation that ensure that every category of consumer has access to products that are safe to eat.

Various preservation techniques have been discovered and developed in response to the changing seasons and the availability of large quantities of certain products at certain times of the year in specific locations. The possibility of preserving raw materials in various forms for a long time and using them at different times allows processors, cooks and consumers to widen the range of available products and to diversify the diet by enriching it with seasonal and biodiverse products.

Processes for preserving raw ingredients and their constituent parts make it possible to conserve and create new aromas, flavours, colours, textures and shapes. These new products become tools to stimulate creativity, curiosity and consumer acceptance, reduce food waste generated during processing and create versatile semi-finished products for the creation of multiple recipes that are delicious, nutritious and safe for everyone.

Preserved products are stable, ready-to-use semi-finished products, and their usefulness lies in their versatility for creating many different recipes. For this reason, the use of semi-finished products is a functional tool in large catering facilities, such as school canteens, because they can be stored for a long time and used in combination with other semi-finished products to create a dish.

CHEMICAL AND PHYSICAL FACTORS CONTRIBUTING TO MICROBIAL GROWTH INCLUDE NUTRIENTS, TEMPERATURE/TIME, ACIDITY, OXYGEN AND HUMIDITY

The production of shelf-stable semi-finished products requires knowledge of the parameters that control microbial activity and different preservation techniques.

PRESERVATION PARAMETERS

When handling food, cooks are dealing with organic compounds rich in enzymes and various sources of food for microorganisms. The latter cover every surface. Additionally, every inanimate object and living being has its own virome, or collection of viruses. Some microorganisms and enzymes are necessary for certain food transformation processes, such as fermentation and enzymatic processes, while others are undesirable and, to prevent their activation, contamination and proliferation, various combined strategies must be implemented to render them inactive or eliminate them.

Microorganisms can feed on various macro- and micronutrients such as simple carbohydrates and sugars, proteins and amino acids, lipids and fatty acids. Enzymes, which are naturally present in raw materials, can trigger enzymatic processes that cause sensory changes. Both are responsible for food spoilage. The inactivation of enzymes requires heat treatment above 70°C. In the case of microorganisms, however, there are many more variables to consider.

The main chemical and physical factors that contribute to microbial growth are:

- Nutrients: Raw materials are naturally composed of micro- and macromolecules that are essential for human health. The same molecules serve as nourishment for different microorganisms; preservation and processing techniques tend to deal with their presence and activity in such a way as to preserve the healthiness of the ingredients.
- Temperature/time: The relationship between these two parameters is highly interdependent; microbial growth depends on temperature and exposure time. Each microorganism has optimal growth temperatures (danger temperature, +5°C → +60°C), temperatures at which its activities are slowed down (0°C → +5°C) and temperatures at which microbial activities are stopped or microbes cannot survive (T°< 0°C or T°> +60°C).
- Acidity: Different microorganisms behave differently depending on their nature and the pH of a given environment. Most ingredients used in gastronomy are acidic; there are only two ingredients in the kitchen that are alkaline by nature (fresh eggs and sodium bicarbonate or baking soda). A healthy pH is 4.5, a level below which pathogens cannot survive due to the acidic environment. Yeasts, moulds and lactic and acetic acid bacteria can multiply even at a pH of 3.5. As with temperature, microorganisms have their own pH range: minimum, maximum and optimum. The pH of a compound is easily measured using a pH meter or litmus paper. For example, the average pH of vinegar is 2.5, but this varies depending on the ingredients and the production process.
- Oxygen: Some microorganisms need oxygen to survive (aerobic) while others can grow in the absence of oxygen (anaerobic).
- Moisture: Water is a source of life and movement for microorganisms. Water bound to starches, proteins, fats, salt or sugars is not very corruptible.

The presence of activity water (aw), i.e. unbound water, can lead to more rapid spoilage. Finally, the presence of alcohol may inhibit or favour certain micro-organisms, depending on the percentage present in the total mixture.

Given the various variables, it is often necessary to intervene on several fronts (oxygen, aw, pH, T°/time), combining different techniques and processes in order to preserve a food for a long time.

PRESERVATION TECHNIQUES

Cooking is a preservation technique, but in order to obtain a stable and safe semi-finished product, it is necessary to modulate the processes according to the raw ingredients and the final product to be obtained. The various preservation techniques, which affect the various control parameters in order to give a preserved product stability over time, are discussed below.

ACTIVITY WATER (AW)

Concentration: During long cooking times, flavours are concentrated and excess water evaporates. Vegetable, fish and meat stocks or concentrates are obtained by concentrating and almost completely evaporating flavoured liquids, thus reducing aw values. The presence of salt, sugar or a combination of both inhibits bacterial growth and helps to reduce the activity water present due to their osmotic power and the fact that they are water soluble.

Drying: In this process, the food is subjected to heat treatment at low or high temperatures, depending on the process, in a dry and ventilated environment (fan ovens or dryers). During this treatment, all the water evaporates and powders, chips and coloured and aromatic substances can be obtained.

PH VALUE

Addition of additives: Acidic marinades or storage in different vinegars are techniques to avoid the presence of pathogens and reduce microbial growth.

Fermentation: The microorganisms responsible for acetic and lactic fermentation produce acids as metabolites, acetic and lactic acid respectively. These lower the pH and inhibit the proliferation of pathogenic bacteria.

OXYGEN

Vacuum: Vacuum storage in special sealed bags or jars protects foods from oxidation that can be caused by to prolonged exposure to air and inhibits all aerobic microorganisms.

Confit: Preservation in fat (oils, butter or other animal fats) prevents the preserved food coming into contact with oxygen.

These two techniques are often combined in professional circles or used as a starting point for cooking processes for recipe standardisation and mass production.

TEMPERATURES

Cold

At the end of cooking, it is advisable for any cooked food not to remain in the danger temperature range of between 5° and 60°C for more than 2 hours. It can therefore be useful to use a blast chiller to significantly reduce the temperature in the shortest possible time.

- Positive T°: This is a storage temperature range from 0° to 5°C, the temperature of refrigeration. This temperature has a bacteriostatic effect on most micro-organisms, slowing down their activity and extending the shelf-life of a fresh product.

- Negative T°:

✓Freezing: Negative cooling temperatures aim to achieve a core T° of -18°C for a bacteriostatic effect. If this process is too slow, it can cause the formation of macrocrystals of ice, which damage the cell walls of the food and cause a noticeable loss of consistency and liquid in the thawed product.

✓Deep-freezing: Chamber cooling temperatures of -40°C. These temperatures have a bactericidal effect, i.e. they eliminate pathogens and other microorganisms. In addition, these temperatures allow the formation of micro-crystals of ice, which have a minimal effect on the consistency of the product once it has been tempered.

Hot

- Pasteurisation: A thermal process (T°< 100°C) in which a core temperature of 65° to 85°C is reached. The end product is considered 'semi-preserved' because the treatment prolongs shelf life, but the product still needs to be stored at refrigerated temperatures.
- Sterilisation: This takes place at T° > 100°C or higher (up to 121°C in an autoclave) and is defined as commercial sterilisation. Products must reach 100°C at the core to be considered conserves and can be stored for long periods at room temperature.

Preservation techniques are many and varied, and the design of a stable semi-finished product must take due account of all the parameters governing them, depending on the ingredients used and the possible applications. Thanks to their ease of preservation and use, semi-finished products can be a fundamental tool in the design of recipes and menus, in the creation and promotion of good relationships with local food businesses and in the diversification of the food on offer in school canteens.

by Carol Povigna

Cooking, from moist to dry heat

Choosing the cooking technique according to the raw material

WHAT ARE THE PARAMETERS TO BE TAKEN INTO ACCOUNT WHEN COOKING FOOD?

Cooking processes have a major impact on the nutritional and sensory profile of food: incorrect temperatures and times in relation to the ingredients used can alter colours, affect consistency and lead to the development of unpleasant aromas and flavours. In food service, thermal processes are even more delicate because they are repeated: the need for cooking, blast chilling and reheating makes the impact of heat on the end result more complex. For this reason, in the context of school catering, it is particularly important to define processes capable of preserving nutrients and creating pleasant and durable sensory profiles.

The transfer of heat from the energy source to the surface of a food product occurs in three ways: conduction, convection and radiation. In conduction, the heat is transferred by direct contact between the hot surface of the pot or pan and the food itself, while in convection, the medium in which the food is immersed (water or air) transfers the heat by its own movement. In the case of radiation, there is no need for direct contact or a medium to transfer the heat; the source (fire, oven or salamander heating element) emits electromagnetic radiation that can travel even in a vacuum, but in order to overcome the heat exchange of conduction and convection, the heat source must reach very high temperatures. Although we tend to separate the two, it is difficult for our usual cooking processes to involve only one type of heat exchange. With the exception of boiling, frying and a few other processes, all cooking techniques involve two or more types of heat transfer. When baking in a ventilated oven, heat exchange is mainly by convection, due to the movement of the air in the oven; however, the oven's heating element emits radiation, which partly contributes to browning, just as the baking tray, once heated, transfers heat by conduction. While this applies to the surface of the food, the heat inside the food is always transferred by convection: all the food we consume contains significant quantities of water, and it is the convective movement of this water that causes the temperature inside the food to rise in a centripetal direction, from the surface to the core. It is important to note that heat always moves from the hottest area to the least hot area: thermal inertia means that once the heat supply has stopped, some of the energy will continue to be exchanged towards the centre of the food. The direction of this exchange is reversed (i.e. from inside to outside) when the surface layers have reached a lower temperature.

In heat management, the most important parameters to consider are temperature – in the form of the temperature applied and the temperature to be reached in the food – and the time for which heat must be applied to reach a given temperature, usually in the food. Time and temperature are two interdependent parameters, since one influences the other: if we are in a hurry and need to reduce the cooking time, we will necessarily have to increase the temperature, while on the other hand, if we want to keep the temperature lower, we will have to take longer.

Almost all the changes we want to achieve through cooking take place at relatively low temperatures, below 100°C. Above 75°C, most of the pathogens on food are eliminated and the conditions are unfavourable for microbial proliferation, so our food can be considered safer. Proteins begin to denature and coagulate at 50°C, and at 70°C most of these macromolecules have changed their structure, with the exception of collagen, which requires a temperature of 80°C for a long time to denature.

The addition of other ingredients – sugar or dairy products – can affect denaturation temperatures by raising them, but not above 90°C. Carbohydrates change their structure (gelation) in a temperature range between 70° and 85°C. This information is useful for understanding what happens inside the food in terms of core temperature: in the presence of water, the temperature never exceeds 100°C, and we can determine which internal temperature is most suitable for achieving the desired type of transformation.

On the other hand, in terms of surface temperature (i.e. energy delivered), the most important discriminator is surface water and its evaporation. Dehydration of the surface of the food by the application of heat allows the critical temperature of 100°C to be exceeded on the outermost layer, resulting in the transformations known as caramelisation when sugars are involved and Maillard reactions when sugars and proteins are involved. Caramelisation begins at 120°C, while Maillard reactions are most effective at 140°C and increase in speed as the temperature rises. In both cases, the result is a threefold change: the colour turns brown, the characteristic aromatic compounds become increasingly strong and the flavour becomes rounded and intense. The most obvious example of caramelisation is the typical treatment of sugar, which, at temperatures above 120°C, turns into caramel, becoming blonde and then darker as the temperature rises. Maillard reactions are usually associated with grilling meat, but they are also responsible for the crust of bread and other yeast products and the sensory profiles of chocolate and coffee. The aromas and flavours developed by these changes are very complex and are universally recognised as pleasing to the human palate.

With this in mind, it is possible to classify and select cooking techniques on the basis of the expected sensory results.

Dry cooking is defined as thermal processes aimed at superficial dehydration and the development of caramelisation and Maillard reactions: the temperatures applied are above 100°C and the cooking medium is dry (air or fat) so that the water can evaporate. As these are surface reactions, the greater the surface area exposed, the greater the development of these reactions. The pH affects the development of Maillard reactions, speeding them up in an alkaline environment and slowing them down in an acidic environment; in some cases, ingredients can also be added to the surface to facilitate the process, like simple sugars (honey or fruit juices) or mixtures of sugars and proteins (egg wash). Deep-frying, roasting, spit roasting and grilling are all examples of dry cooking to create the sensory profile resulting from caramelisation and Maillard reactions. However, temperatures that are too high (or not evenly applied) can lead to the formation of compounds that are unsafe for human consumption, such as acrylamide, or undesirable internal texture changes (especially in the case of animal proteins). For this reason, it can very often be useful to work with equipment that allows the temperature applied to be controlled (such as an oven) or to thermally treat the food in order to achieve the other desired changes in terms of wholesomeness and consistency (core temperature) and then cook only the surface in order to develop Maillard reactions before (braising) or after (reverse searing).

On the other hand, moist cooking – which includes boiling, steaming, pressure cooking and stewing – takes place in a liquid medium, either an added liquid or the food's own liquid. For this reason, even if the temperature applied is above 100°C, the water cannot evaporate and the surface and internal temperature cannot exceed 100°C. In these cases, all the desired structural changes (improved consistency and digestibility) can be obtained, but the colours, aromas and flavours typical of caramelisation and Maillard reactions are not developed, so the sensory profile will be more delicate and similar to that of raw food. Moist cooking therefore takes place at a low temperature and requires longer times, which vary according to the temperature: shorter for boiling, steaming and pressure cooking; longer for stewing or vacuum cooking at controlled temperatures (in ovens, thermostatic baths, etc.). These types of techniques are essential for treating foods rich in collagen, starch and complex fibres and for large pieces of food.

As with heat transfer, cooking techniques are often a combination of methods: the reverse searing of a steak, for example, which can be cooked at 60°C to achieve the desired protein denaturation and then browned in a pan for a few seconds to develop Maillard reactions, or sautéing, where the food is partly browned and partly stewed in the juices released.

The last variable to be taken into account when cooking is the medium chosen or available for the process. From the pot, its shape (more or less suitable for allowing water to evaporate) and its material (more suitable for transferring heat in the case of good conductors, or good at maintaining a constant temperature in the case of poor conductors), to the technological instruments that make it possible to create environments in which temperature and time can be properly controlled (oven, steamer, thermostat-controlled water bath), it is possible to define precisely which cooking process is best suited to the needs and possibilities of the context. In fact, it is possible and desirable to combine different methods of heat transfer, different cooking equipment (oven, pans, thermostat-controlled baths, etc.), planning temperatures and times in relation to the composition of the food to be processed and the type of sensory result expected, as well as in relation to the availability of equipment and the competence of the operators.

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by Nahuel Buracco

Drying

Main methods for preserving the flavour and quality of ingredients

Drying is a process that can take place at different temperatures, both positive and negative, and for different lengths of time. Dehydrated food is a product from which almost all the water has evaporated due to a specific heat treatment, continuous ventilation and a valve through which the extracted moisture can be expelled, resulting in a dry and stable product. The absence of water means that the microorganisms responsible for spoilage are deprived of a source of life and movement and so cannot multiply. In fact, dried products can be easily stored at room temperature in closed containers for medium to long periods.

The semi-finished products that can be obtained from the various drying processes include aromatic and coloured vegetable powders, vegetable leathers using vegetable fibres as a binder, fruit and vegetable chips or flakes, granulated broths obtained from vegetable waste and even fruit peel powders that can be used as a sugar substitute. These are just a few examples that can be used when designing recipes and menus for school canteens. Plant-based garnishes, toppings, seasonings and natural colourings can increase young people's acceptance of fruit and vegetables.

The drying process must be adapted to the type, shape and mass of the raw material to be dehydrated in order to best preserve the sensory properties of the product. The various drying methods are described briefly here:

Hot drying:

- Drying: This technique is the most widely used because it is easy to carry out. It can be done either at low temperatures (30°C → 60°C) or at high temperatures (T°>60°C), the latter being more aggressive and involving partially cooking the food. The first method is more suitable for delicate raw materials because of the aromatic and colouring compounds they may contain (herbs like basil, lemon balm or parsley, for example) or because of their delicate consistency (fruits and vegetables), as it preserves most of the aromas, colours and flavours of the raw material. At high temperatures, on the other hand, it is possible to dry products that contain heat-resistant compounds and have a more resistant consistency (fresh pasta, breadcrumbs). In professional kitchens, there are various ways of drying at high temperatures: professional driers, trivalent ovens (small foods can even be dried in ovens that have just been switched off and are still hot), plate warmers that have been switched on or even off until they have cooled down.

- In fat: Frying is a drying method; the temperatures at which it is usually carried out, between 140° and 180°C, allow the surfaces of the food in contact with the oil to be partially dried. At these temperatures, specific reactions take place, such as Maillard reactions, which give the finished product a specific texture, aroma and colour. It is also possible to dry in oil by keeping the oil at 100°C and gradually, in a less aggressive way, evaporating all the water contained in the food.

DRYING IS A PROCESS THAT CAN TAKE PLACE AT DIFFERENT TEMPERATURES, BOTH POSITIVE AND NEGATIVE

Cold drying:

Also known as freeze-drying, this is a very expensive technique to carry out in the kitchen because it requires special machinery. This process uses drying at negative temperatures (T°< -20°C) and low pressures to reach the sublimation point, i.e. the direct transition of water from a solid state (ice) to a gaseous state (steam). The products obtained, which are available on the market, are of excellent quality because they preserve the authentic taste, aroma and colour of the original ingredient. Vegetables and fruit are suitable for this treatment and the results are very interesting and versatile, as they change shape and texture and can be used creatively in many recipes.

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POWDERS

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CHIPS

DRIED PRODUCTS CAN BE EASILY STORED AT ROOM TEMPERATURE IN CLOSED CONTAINERS FOR MEDIUM TO LONG PERIODS

by Carol Povigna

Infusions, extractions and marinades

Main techniques for flavour transfer

The techniques for extraction and transfer of colour and aromatic compounds are many and varied, depending on the type of compound(s) one is interested in working with (and, consequently, the parameters that may influence their degradation and solubilisation). Extraction can be either cold or hot. Below are the main techniques useful in the context of a school canteen to increase the likelihood of a meal being acceptable to a young person.

MACERATION AND INFUSION

(cold and hot extractions)

Macerations and infusions are carried out by directly immersing the ingredient whose aromatic compounds are to be extracted in a solvent capable of solubilising them. Since the aromatic and colouring compounds are contained in the cells, the more the cell structure is damaged (by breaking, crushing or agitation by waves), the more intense the extraction will be. After chopping or processing, the ingredient is immersed in solvents, which in cooking can be water (and all its analogues), alcohol or fat.

The more aerial parts of the plant (leaves and flowers) are characterised by a greater presence of polar aromatic compounds and therefore have higher extraction yields in polar compounds (water and sometimes alcohol), whereas the more resinous parts, such as roots, seeds and woody stems, have a high number of non-polar compounds that can be treated in alcohol or fat. Among the colouring substances, chlorophyll (green colour) and carotenoids (yellow and orange colour) are non-polar compounds and are extracted and transferred from alcohol and fat, while anthocyanins, responsible for the purple colour, are soluble in water as they are polar. Gases – including CO_2 and nitrogen, which we find with relative availability in kitchens – are non-polar and can assist in the water extraction of non-polar compounds.

Once the most suitable solvent for extracting the compounds in the ingredient (or parts of it) has been identified, consideration can be given to whether heat should be applied for faster extraction (infusion) or not, for cold extraction (maceration). Infusion in water can be carried out at 100°C (decoction) or at lower temperatures, usually between 60° and 90°C, depending on the heat resistance of the compounds to be extracted. Extraction in fat, on the other hand, is carried out at lower temperatures, between 40° and 75°C. In both cases, it can be interesting to combine heat with the action of waves – microwaves or ultrasound – which, by damaging the structure of the cell membrane, make extraction even faster and more efficient. Hot extraction can also be carried out under pressure, as in the case of a moka coffee pot: the solvent is heated, pressurised and forced through a filter containing the ingredient to be extracted. In the case of pressure, extraction is very rapid and violent: heat-sensitive compounds are irreparably damaged, but the resulting concentration of flavour is very high.

INCREASING THE LIKELIHOOD OF FOOD ACCEPTANCE THROUGH THE USE OF FLAVOUR PROPAGATION TECHNIQUES

Maceration, on the other hand, is carried out at room temperature (common alcohol macerations for the production of spirits, for example) or at refrigeration temperature for periods ranging from 12 hours to several days.

An alternative to maceration, but governed by the same guidelines, is percolation: the passage of the solvent through the ingredient in a continuous or discontinuous flow can be hot (as in the case of V-filter extraction for 60 seconds) or cold (cold brew: maceration followed by percolation).

MARINATING

In addition to modifying the structure of the tissues by partially denaturing the proteins due to the nature of the ingredients generally used, marinades are used to transfer flavours from one ingredient to another. With the exception of proteolytic marinades, which in some cases are deliberately carried out at temperatures between 50° and 60°C, these processes are cold and last from a few hours (for small ingredients or limited flavour transfer) to several days (for whole cuts). There are three main techniques for achieving this flavour transfer between foods: dry marinades (dry rub), wet marinades (acid/alcohol or brine) and proteolytic marinades.

Dry marinades usually involve a combination of salt and/or sugar with mixtures of spices and herbs, which are placed in direct contact with the food. The salt and sugar exert an osmotic force that partially extracts water from the food, while the flavours penetrate superficially. This process is useful for flavouring, modifying particularly intense flavours and extracting water from vegetables.

Wet marinades can be either acid/alcoholic – with the function of partially denaturing the proteins in the food – or brine (with a salt content of 3 to 6%). Acid and alcoholic marinades use ingredients such as citrus or fruit juices, yoghurt or wine to dissolve spices and flavourings. Meat marinades help to tenderise the tissue and limit weight loss during cooking: the flavoured water penetrates the meat and can increase its weight by up to 10%.

Finally, proteolytic marinades take advantage of the presence of proteolytic enzymes in the flavour blend to act on proteins. Fig and kiwi fruit and leaves, pineapple and papaya, for example, are very rich in proteolytic enzymes which, in addition to carrying and releasing flavours, tenderise muscle tissue.

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INFUSION

MARINATING

by Nahuel Buracco

Fermentation

Developing desired flavour compounds and increasing shelf life

FERMENTATION AFFECTS THE TASTE, TEXTURE AND NOT LEAST THE DIGESTIBILITY OF FOOD

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Fermentation is the process by which the macromolecules (carbohydrates, proteins and lipids) in ingredients are converted into their essential components (simple sugars, amino acids and fatty acids) so that they can be tasted. Macromolecules are metabolised and transformed by microorganisms such as bacteria, yeasts and moulds. These transformations affect the taste, texture and not least the digestibility of fermented foods.

In this case, the cook becomes a negotiator, who knows and controls the variables that allow the different microorganisms to proliferate according to the conditions created, and who is able to decide on the most appropriate type of process in terms of ingredient, fermentation type and desired end result.

Fermentation gives rise to new and curious colours, textures, flavours and aromas. This is, in fact, a preservation technique that, thanks to the activity of the yeasts and bacteria involved, modifies the sensory aspect of the food and gives it stability over time. These products can therefore be included in the school canteen diet to increase the number of occasions and ways in which vegetable products are consumed.

There are many species of microorganisms that are recognised as gastronomically interesting and that are widely used in fermentation processes, in some cases working in synergy during the fermentation process.

The main microorganisms used in gastronomy are:

- Bacteria: lactic and acetic acid bacteria, responsible for various lactic and acetic products respectively.
- Fungi: yeasts such as *Saccharomyces cerevisiae*, used in the production of sourdough bread, beer and wine, and fungi such as *Aspergillus oryzae*, used in the production of koji, miso, soy sauce, shoyu and garum.

Fermentation: acetic, alcoholic and lactic

The three most common and reproducible fermentations in a professional kitchen are acetic, alcoholic and lactic. The products that result from these processes include bread, yoghurt, kefir, cheese, pickles and vinegar. These fermented products, like many others, can be tools for strategies to increase young people's acceptance of plant-based products. Knowledge of the different fermentation techniques, control parameters and microbial activity depending on the ingredient is crucial for good management of fermentation processes.

ACETIC FERMENTATION

The necessary elements for the production of vinegar are a liquid with an alcohol content of around 5% to 8%, an inoculum of acetic acid bacteria and the presence of oxygen. Acetic acid bacteria are able to use alcohol as an energy source by converting it into two by-products: acetic acid and water.

Alcohol + Oxygen → Acetic Acid Bacteria → Water + Acetic Acid

Acetic acid bacteria need oxygen to survive and multiply best between 28° and 30°C. At the end of fermentation, when the desired level of acidity has been reached, the vinegar can be pasteurised at temperatures between 65° and 70°C.
Vinegar can be made from various liquids, such as extracts or centrifuged fruit and vegetable juices, by adding an inoculum of acetic acid bacteria (20% of an unpasteurised vinegar) and alcohol (pure food alcohol, spirits or liqueurs) until a total alcohol content of 8% is reached. In order to speed up the fermentation, it is advisable to use an oxygenator capable of constantly introducing oxygen into the liquid. The process can be considered complete when all the alcohol has been converted into acetic acid (measurable with an alcohol meter) and when the solution has reached a pH of at least 4.5 (pathogens are inhibited at lower pHs). A range of seasonal vegetable and fruit vinegars can be kept in the pantry and used for marinades, emulsions and dressings.

ALCOHOLIC FERMENTATION

Fermentation is carried out by yeasts such as *Saccharomyces cerevisae*. During the first phase of fermentation, in the presence of oxygen, they convert sugars into carbon dioxide. When the fermentation chamber becomes saturated with gas and oxygen is no longer present, the yeasts start another type of fermentation and convert the simple sugars into alcohol.

Glucose (presence of oxygen) → Yeast → Carbon dioxide

Glucose (absence of oxygen) → Yeast → Alcohol

Yeasts require a moist environment for fermentation, the presence of sugars for reproduction and temperatures between 20° and 30°C. Yeasts do not survive at temperatures above 60°C. Products such as beer and various home-made fruit ciders can be the basis for creative drinks or the production of vinegar from alcoholic fermentation. Yeast activity is also crucial in leavened bakery products. It is the carbon dioxide produced by the yeast that allows the dough to increase in volume, so for dough to rise properly, it is essential to carry out activities that introduce oxygen, such as shaping, folding and kneading.

LACTIC FERMENTATION

Lactic fermentation is made possible by the presence of lactic acid bacteria, widely found in unpasteurised yoghurt and naturally on fruit and vegetable peels, which convert sugars to lactic acid in an oxygen-free environment.

Glucose and the absence of oxygen → lactic acid bacteria → lactic acid *

Lactic acid bacteria tolerate low pH and high salt environments and thrive in the absence of oxygen. In order to select the lactic acid bacteria according to the desired final flavour, the reference salt content is 2% by weight of the food to be fermented. The most suitable ingredients for this fermentation process are usually dairy, for the production of yoghurt, kefir, butter, sour cream and cheese, or fruit and vegetables, for the production of various pickled and lacto-fermented products that create new textures and flavours.

The previous pages have covered the most common fermentation types and only a fraction of the products that can be produced. Fermentation makes it possible to change the shape of fruit and vegetables, the texture of the final product (from hard to soft, dense to spongy or still to sparkling), and the colours by changing the pH of the mixture and discovering how the coloured compounds respond to increased or decreased acidity. These are useful tools for exploring all the possibilities that can be created when a cook's creativity and knowledge are applied to ingredients.

Glass jars and bottles of sparkling juices or chopped fruit and vegetables and sourdoughs that double their volume are ideal for practical workshops in the classroom or for setting up an experimental table in the canteen to attract the curious. By their very nature, fermented products evolve over time, changing their appearance, colour and consistency, so care is essential to their success. It is a good idea to involve children and young people in this process, so that they can become familiar with these products, watch them evolve and eventually accept them more easily as part of their diet.

by Nahuel Buracco

Semi-finished products and their uses

A new paradigm in recipe design

THE STRENGTH OF THE SEMI-FINISHED PRODUCT IS ITS VERSATILITY

Functionality of use and speed of consumption are two characteristics required in the field of food processing that lead to an increasingly saturated food supply of multiple monofunctional products, usually designed for a single occasion of consumption, whether in the professional or household sector. This mechanism nullifies the participation of the final consumer and the processor at all levels, as they become recipients and assemblers, two passive roles. In addition, it drastically reduces the possibilities of reusing and redirecting scraps or leftovers generated at the bottom of the supply chain, which becomes one of the causes of food waste.

Instead, the roles of the cook and the consumer are very different. Both are active players, co-producers, in the food chain, which becomes bidirectional, i.e. a meeting of needs and intentions.

In professional kitchens, mise en place determines the daily work, with cooks trying to complete it before service, so all the semi-finished products necessary for the composition of the dishes are ready. Semi-finished products are individual, versatile elements in the kitchen, the combination of which gives rise to a variety of recipes and preparations. This concept can be extended to create a production system for several multifunctional semi-finished products and a dynamic and flexible structure. The various transformation processes applied to the different ingredients give rise to a long list of functional products, fresh or preserved, obtaining different elements that can be used in many final preparations.

Coloured and aromatic powders or chips, various plant- or animal-based flavourings, thick vegetable purees or other ready-to-use ingredients can be created, ready to be combined in different ways to generate recipes and thus menus. These products can become tools for creating conscious dishes, focusing on shapes, colours, flavours, textures and choice of ingredients, thus building sustainable diets and food education models.

The strength of the semi-finished product is its versatility. Let us consider a puree obtained from pumpkin pulp, a thick starchy cream without any additions. This puree can be thinned to make a velouté or a base for a minestrone, seasoned to make a sauce for pasta or risotto or mixed with eggs, milk or cheese to make a base for a flan, a savoury pie or a dessert. Starting from a single element, it is therefore possible to produce different and predictable results, which has a positive impact on work management and the creation of different recipes and menus. The semi-finished product also makes it possible to take into account the possibility of producing products (spices, food colouring, etc.), which are usually purchased separately, by exploiting the characteristics and functionalities of the various ingredients.

Pre-organising the production of semi-finished, preserved and stable products and their use is a strategy for reducing waste in the production and management phases, as it makes it possible to create a quantifiable system between semi-finished products and producible portions. Thinking in these terms means no longer having to deal with unexpected waste or leftovers, but rather allows planning by replacing the concept of 'food waste' in the supply chain with that of 'new functional ingredients', acting from the beginning and not at the end of the supply chain. In this sense, it is the menu that adapts to the ingredient and not the other way around.

The table below is intended to be a useful working tool to identify possible semi-finished products that can be obtained through different transformation processes, with some of their relative uses and purposes.

FIGURE 3: SEMI-FINISHED PRODUCTS AND THEIR USES

The table below is intended to be a useful working tool to identify possible semi-finished products that can be obtained through different transformation processes, with some of their uses and purposes.

WHY	WHAT	*Semi-finished product name*	HOW	AND IF	
	Process		*Transformations*	*Conservation*	*Variations/use*
 APPEARANCE	INFUSION AND EXTRACTION	Paste concentrates	Water infusion, concentration and homogenisation	Pasteurisation, freezing	Replacement of part of the wet portion in doughs, dissolution in water
		Coloured compounds	Extraction in appropriate solvent, separation from solvent	Refrigeration	Replacement of wet part in doughs, dissolution in fat
	DRYING	Powders	Low temperature drying	Dry storage	Dissolution in water, replacement of part of dry portion of doughs and breadcrumbs
	ENZYMATIC PROCESSES (inactivation)	Blanched semi-finished products	Thermal inactivation in boiling alkaline water	Pasteurisation, refrigeration	Subsequent cooking
 CONSISTENCY	DENATURATION	Reverse searing	Low temperature cooking until the desired temperature is reached	Refrigeration, freezing	Subsequent flavouring (dry, aromatic oils, etc.)
	GELIFICATION	Rouxes, gels and amides/ polysaccharides	Dissolving, hydrating and gelling of polysaccharides or starches	Dry, refrigeration, freezing	Addition to doughs to maintain softness or increase cooking, addition to liquids for thickening
		Solid creams	Starch gelatinisation in water and homogenisation	Pasteurisation, refrigeration, freezing	Dilution in water to obtain purees or veloutés, addition to liquids for thickening, replacement of part of the wet portion in dough
	MARINADES AND BRINES	Acidic marinades	Cold wet marinating in an acidic environment (yoghurt, wine, vinegar, etc.)	Refrigeration	
		Proteolytic marinades	Hot wet marinating with proteolytic ingredients (kiwi, fig, etc.)	Refrigeration	
	ENZYMATIC PROCESSES	Maturing	Dry or wet browning at low temperatures		

CONSISTENCY	DRYING	Puffed cereals	Gelling, drying and subsequent heat treatment	Dry	Baking, adding to dough, garnishing
		Dried seeds	Low or high temperature drying	Dry	Adding to doughs, garnishing
		Petals, tissues, chips	Low or high temperature drying	Dry	Garnishing
	ROASTING/ CARAMELISING	Crumbles, granolas, chips	High temperature roasting and caramelisation or Maillard reactions	Dry, freezing	Baking, adding to dough, garnishing
AROMAS	MARINADES AND BRINES	Dry marinades (dry rubs)	Salt + flavourings	Dry	Marinades/ seasonings
		Wet marinades/ buttermilk marinades	Acidic ingredients or brines (3-6%) + flavourings	Refrigeration	
	DRYING	Dry seasonings and spices	Low temperature drying	Dry	Infusions and macerations in fat or water, extractions, condiments, garnishing
	INFUSION AND EXTRACTION	Aromatic fats	Infusions or macerations in fat	Dry, refrigeration	Pastes, emulsions, seasonings
		Hydrolates	Distillation or Soxhlet/ultrasound extractions	Dry, refrigeration	Doughs, emulsions, seasonings
	ROASTING/ CARAMELISATION	Brown butter	Caramelisation and infusion in fat	Refrigeration, freezing	Doughs, emulsions, seasonings
		Caramel	Caramelisation at 120°C<T<150°C		Replacement and reduction of sweeteners
		Stocks and soffrittos	Roasting (Maillard reactions: T>140°C), infusion in water or oil, water concentration	Refrigeration or freezing	Water or fat content in a preparation
	FERMENTATION	Vinegars	Fermentation with acetic inoculum of liquid at 8% alcohol	Dry	Modification of water/seasoning ratio
		Lactic fermentation flavours	Fermentation with lactic inoculum and 2-3% salt	Refrigeration	Replacement of water/seasoning ratio

FLAVOUR ENHANCERS	ROASTING/ CARAMELISATION	Stocks (meat, fish, vegetable)	Roasting (Maillard reactions: T>140°C), water infusion and 1/10 concentration	Refrigeration, freezing	Share of water in a preparation
		Soffrittos	Roasting (Maillard reactions: T>140°C), oil infusion	Refrigeration, freezing	Share of fat in a preparation
	ENZYMATIC PROCESSES	Saporita	Addition of salt in 1:1 ratio, refrigeration for at least 10 days	Refrigeration	Dissolution in water for each preparation or seasoning
	FERMENTATION	Koji	Inoculation of *Aspergillus oryzae* on a substrate rich in gelatinised starch (steamed barley, rice, etc.), maintained at 30°C and 80% humidity for at least 24 hours	Refrigeration for 3-4 days	Starter for different preparations based on different ingredients such as garum (animal protein), soy sauce and miso (vegetable protein)
		Vinegars	Fermentation with acetic inoculum of liquid at 8% alcohol, temperature 24-28°C	Dry	Seasoning
		Fermented vegetable products	Fermentation with lactic inoculum and 2-6% salt, temperature 24-28°C	Refrigeration	Seasoning
		Dried stocks	Selection of ingredients with high glutamate content, drying at low temperature	Dry	Dissolution in water for any preparation

Pollenzo Food Lab: Povigna, C.; Bigi, M.; Buracco, N. | University of Gastronomic Sciences of Pollenzo

FIGURE 4: STUDY OF A WINTER VEGETABLE SOUP

TRADITIONAL APPROACH

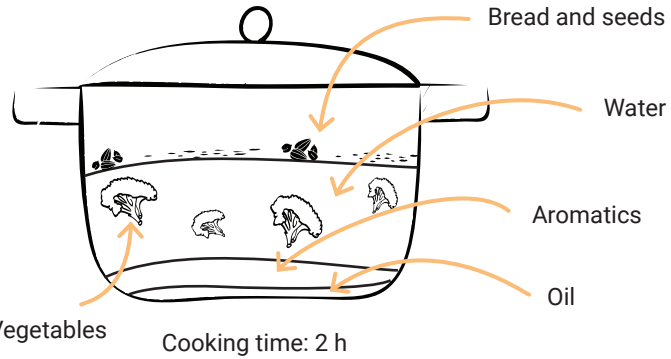
Vs

WHOLE INGREDIENT APPROACH

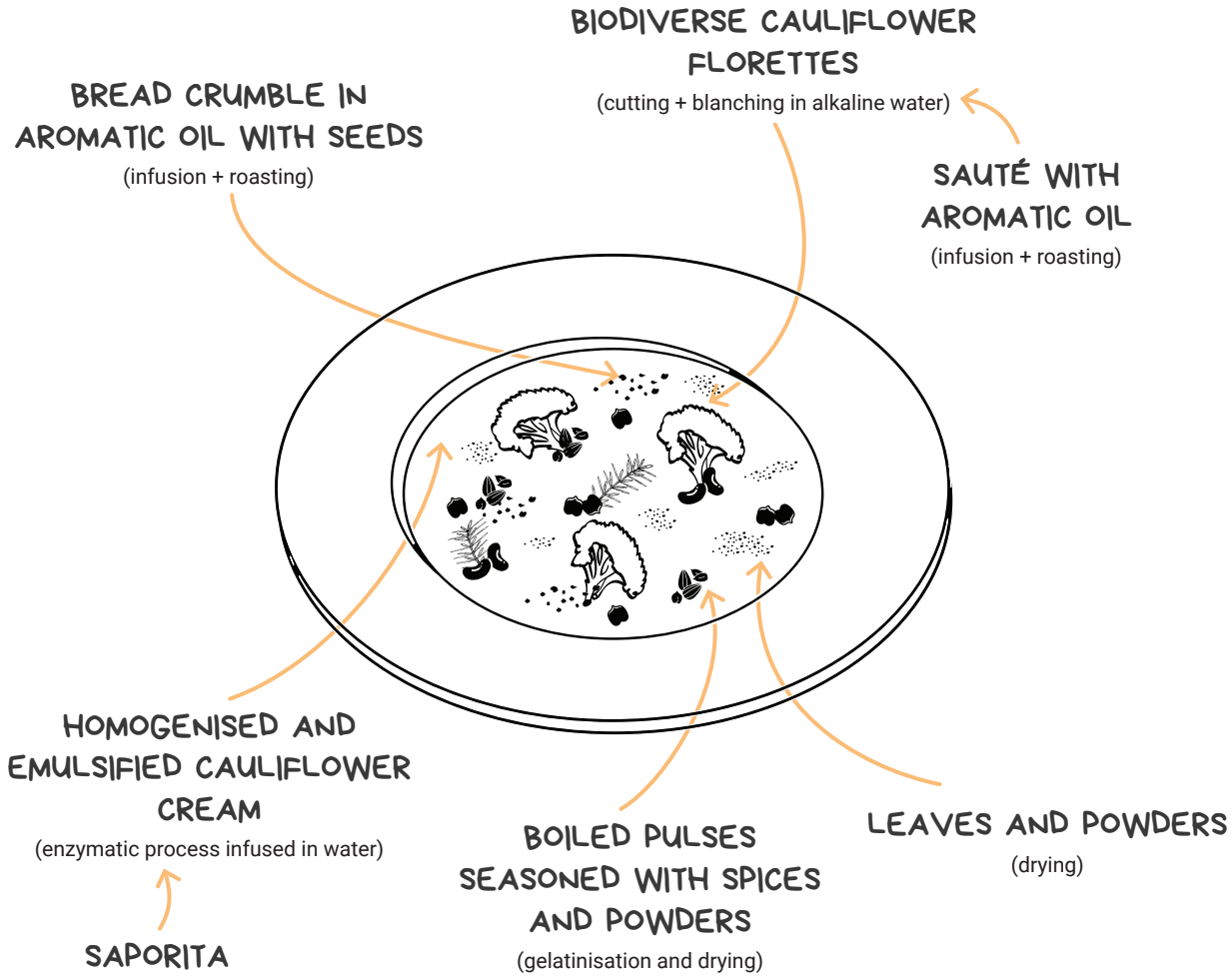
INGREDIENTS

Cauliflower, broccoli, kale,
Black or cannellini beans
Onion, carrot, celery
Extra-virgin olive oil
Salt
Bread
Mixed oil seeds
Garlic
Thyme

PROCEDURE



- HOMOGENEOUS BROWN COLOUR
- UNRECOGNISABLE COMPONENTS
- ONE CONSISTENCY



- BRIGHT COLOURS
- RECOGNISABILITY OF COMPONENTS
- DIFFERENT TEXTURES

by Carol Povigna

The creative matrix of the dish

The stages of gastronomic planning for the development of a recipe

RECOGNISABILITY OF THE DISHES ON OFFER IS A KEY ELEMENT OF ACCEPTABILITY AND REASSURES CHILDREN ABOUT EDIBILITY

Understanding why and how gastronomic changes occur, and being able to relate them to the gastronomic outcome they can lead to, is a prerequisite for developing effective kitchen planning. In the case of school catering, where the challenge is to produce and serve meals that are as good for the individual as they are for the planet, knowledge of gastronomic science is the basis on which recipes and menus are built.

Choosing to serve menus and dishes that allow young people to follow and learn a healthy and sustainable lifestyle does not mean rejecting what has been proposed in the past or starting from scratch. The proposed change is first and foremost a maturing of awareness and the assumption of responsibility and leadership. What we need is the summary and embodiment of a structured network of interactions and indications concerning cultural acceptance, enjoyment, mental and physical well-being and impact on the environment and the community. Many typical dishes, as well as traditional diets in different parts of the world, are already the result and expression of the evolutionary need to ensure survival in harmony with the ecological context and to provide a balanced intake of locally produced nutrients in accordance with the seasons. The recognisability of the proposed dishes is also a key element of acceptance and reassures children about the edibility and safety of what we are offering them. The first step in defining a healthy and sustainable gastronomic offer is therefore a critical re-reading of what already exists, in order to understand what can be preserved and enhanced, what needs minor modifications and adaptations, what can be introduced to enhance local traditions and what can instead be developed in a totally original way.

Credit: Photos by cottonbro studio from Pexels

This process of reinterpretation, like the development of a new dish, is essentially a creative and learning process that follows specific steps. What drives the action is motivation, the awareness of an expressed need or necessity that requires our direct involvement and commitment (why?). We then need to gather the tools and information needed to support and guide our action (what?) and then move on to the practical application of these elements and knowledge in a specific context (how?). Finally, by analysing our learning and creation journey, we can question ourselves about the actual effectiveness of what we have done and hypothesise improvements or alternative strategies to achieve the goal at each level (what if?).

In the construction of a dish – or in its reinterpretation and implementation – we unconsciously follow the same path: we have a motivation to push ourselves (e.g. we want to come up with a lactose-free version of a certain recipe), we have tools at our disposal (plant milks, lactose-free ingredients and a range of possible substitutes), we follow procedures that allow us to transform correctly and avoid contamination. Our working hypotheses and the techniques we use are validated or re-examined after tastings and/or discussions with colleagues and users.

The creative matrix for the construction of the project dish follows this flow, intended as a preparation for the definition of the recipes to be acquired and integrated into the menu proposal. It includes sub-categories and useful points to guide the creative process and relate it to the working method proposed by the project and its objectives.

STAGES IN THE CULINARY DESIGN OF A RECIPE

In detail:

1. The creative process begins when there is a stated need. Who do I want to prepare this dish for? Who is my audience and what are their specific needs? The act of cooking is inherently altruistic, presupposing someone other than oneself and a willingness to care: asking questions of those who will consume the dish triggers the process of inclusivity and brings attention back to the needs of acceptance and wholesomeness.
   Why am I preparing this food? What do I want to communicate? Declaring one's intentions at an early stage is fundamental to directing the action effectively and to relating the project to the key elements that should guide it (local products, seasonality, relationships, etc.).
   The name of the dish is a crucial element because it is through this that the first communication with the users and the community will take place: the name must therefore bear a message, but above all it must offer recognition and reassurance.

2. The tools of the creative process are the ingredients (local, seasonal, sustainable, etc.) and the semi-finished products obtained from them. The presence of an ingredient in a preparation must always be justified by its function in the preparation: a new ingredient is used when its addition is necessary from a sensory or nutritional point of view.
   Enjoyment, through the satisfaction of each sense, invites us to relate each ingredient to the sensory dimension on which it will have an impact.

Which ingredient will bring colour (sight)? Which element will bring crunch (touch)? How will sweet, bitter, sour, salty and umami be incorporated (taste)? Even if only one ingredient is used, questions need to be asked about each of its sensory aspects in order to construct something delicious.

3. Once the dish's ingredients and sensory functions have been defined, it is necessary to look at how to achieve the desired result for each ingredient (applying the relevant scientific knowledge). The techniques used, with emphasis on the key process elements, are the third step in defining the dish. This includes an initial definition of the mise en place and identification of all the line elements required to achieve the desired end result. The latter is defined and represented in order to visualise how it will present itself to the user and how it will act as a meeting point between expectation and message. Narrative and experience related to the realisation are part of this design phase: what attention can be paid to communication (visual or narrative) to facilitate acceptance and enjoyment? What are the value elements of this meal? Does it support teaching? Is it significant in terms of upcycling? Does it allow for meaningful relationships between production and consumption?

4. The creative process ends with a double evaluation. The first is internal and relates to the feasibility of the project within the specific kitchen (with its limitations of equipment, staff, time, etc.): sustainability is also relative to the work and the recipe – before it becomes such – must be validated by the context. The second evaluation comes from looking at the community: does the dish support or create synergies with teaching? Is it possible to involve students and teachers in the implementation process? Through comparison (internally and with the extended community), refinement strategies can be identified, leading to the final evaluation. The recipe can then be formalised and become part of the educational heritage of the SchoolFood4Change system.

FIGURE 5: CREATIVE MATRIX

4) CAN I IMPROVE?

MY ASSESSMENT of sustainability within the kitchen ecosystem (feasibility)	ACTIVE LEARNING (possibility of links with the classroom) + EXCHANGE WITH THE COMMUNITY (students and teachers)	Possible NEW IDEAS for implementation ↓ RECIPE DEFINITION (see framework)

1) THE RECIPE

Recipe title:

For WHOM am I preparing this dish?
(▹ Indication of allergens + inclusion: dietary, cultural, religious requirements)

WHY am I preparing this dish? / What do I want to communicate?
(▹ Key words for narrative and internal classification. E.g.: season, main ingredient, field/table relationships, etc.)

3) WHAT TECHNIQUES WILL WE USE? ▹ MISE EN PLACE

HOW Transformation procedures and techniques (key process elements + mise en place)	**Service line**
Notes relating to any enhancement elements (upcycling, relationships with production, connection with teaching, etc.)	**Placing + narration**

2) WHAT INGREDIENTS WILL WE USE? ▹ SHOPPING LIST

WHAT		WHY			
Ingredient/ semi-finished product	Quantity				

by Carol Povigna

Recipe structure

Design, evaluation and communication of a gastronomic product

THE RECIPE IS THE DOCUMENT IN WHICH SEVERAL NEEDS CONVERGE WITHIN THE KITCHEN

The recipe is the first form of practical translation of the indications for a healthy and sustainable diet, in which the scientific knowledge of the principles governing the transformation processes and the sensory functionalisation of each process converge. Creativity, guided by an awareness of sensory pleasure, enables us to identify the most appropriate techniques for obtaining the most appreciated sensory characteristics and to hypothesise which components will be included in the final recipe to enhance its appearance, texture, aroma and flavour. The structuring and systematisation of these hypotheses is the recipe, which becomes a tool with several functions:

- Validation of the hypotheses for the construction of the dish, useful for evaluating the final result in relation to certain criteria for a healthy and sustainable diet.
- Standardisation and internal communication, useful for sharing key process and service points between different production areas.
- Project sharing between food-service operators, useful for sharing application strategies and processes with colleagues and implementing the offer with other project members.
- Communication and storytelling for the community, useful for bringing some of the decisions made out of the kitchen and involving the community of teachers, parents and other citizens as a lever for change in school catering.

The recipe is the document in which several needs converge; in the professional kitchen it is usually used to define a repeatable standard and represents a tool for internal communication between people working in different areas. The recipe makes it possible to ensure the correct supply of ingredients, to define the operations that characterise the process and to give instructions for portioning and serving. Outside the professional sphere, however, the recipe is a narrative text in its own right, which makes it possible to trace directions of value and to offer testimony and communicability. In the context of a project such as SchoolFood4Change, the recipe can also become an object of exchange and implementation for different contexts, making it possible to replicate projects based on the same principles.

For all these reasons, it is essential to recognise that the recipe has a central role not only at the operational level, but also at the level of dissemination and validation. It must use a common language and a common structure that will allow it to fulfil all the functions assigned to it and be easily used and read by the various recipients.

For this reason, the SchoolFood4Change project is planning to produce a collection of supporting recipes. The first section will be intended for consultation by all members of the community (teachers, parents, other citizens) with the aim of self-assessment and validation; the second, based on the working methods proposed within the project, is more operational and intended to provide indications for replicability in other geographic areas and school contexts.

The first part of the recipe structure consists of:

- The title of the recipe: as the first element of recognisability and familiarity for the user, this has a high communicative value.

THE FIRST PART: SELF-EVALUATION AND VALIDATION

- Seasonality: an indication of the season in which the recipe can be proposed (taking into account all the ingredients).
- Keywords/communicated values: this field is aimed at guiding the why of the preparation, managing a catalogue and highlighting for the community the message conveyed by the dish.
- Indication of allergens: to encourage reflection on the inclusivity of the dish and to ensure correct, safe communication at all stages along the production and service line.
- Image of the dish: to guarantee standardisation at the serving stage and to ensure effectiveness of communication and acceptance through appearance.
- The correlated educational experience: here the aim is to encourage an educational alliance between the serving of the meal and the objective of the school, to help the cooks reflect on the strategies that can be implemented at the serving stage, to feed into workshops in the classroom and to share with parents the projects that have been implemented.
- Self-assessment and sharing of welfare and sustainability criteria: the data provided here are necessary in the planning phase in order to evaluate the recipe and identify which aspects potentially need to be worked on, while also providing an important opportunity to make transformation processes transparent to teachers, parents and other community members.

THE SECOND PART: EVIDENCE OF REPLICABILITY

The second part of the recipe – the origin of the information reported in the first part and therefore in fact the starting point – consists of a structure capable of relating the ingredients on the basis of their functional role within the recipe, by presenting:

- The parametric percentages of each ingredient. The main ingredient is identified as 100% and the other ingredients are expressed as percentages relative to the main ingredient to highlight their functionality for the specific sensory result. The parametric percentages, in addition to demonstrating the technological relationships that exist between the ingredients to obtain a given sensory result, allow the cascading measurement of all the data of interest (quantity per batch, quantity per portion, nutritional value), eliminating the need for calculations during the operational phase.
- Production quantities useful for working at full capacity in each specific context. In fact, the quantities per batch represent the contextual application of the recipe and are made up of ecologically negotiated data in a context that takes into account the size of the machines, the number of operators, production times and any combinations of processing techniques.
- The relative quantities of each ingredient per portion, obtained by dividing the batch quantities by the number of portions obtained.
- The nutritional value of the portion, which systematises the intake of each ingredient and highlights not only calorie requirements but also nutritional quality in terms of fibre, saturated fat, sugar and sodium.
- The percentage of waste generated during processing.

The preparation steps are reported according to the whole ingredient approach, starting with the individual semi-finished products that make up the recipe.

For each semi-finished product, the key elements of the process, the preservation and storage methods and the possible other uses of the same product in different recipes are indicated. This aspect is useful for communication within the kitchen (with useful information for checking critical points and guaranteeing health and safety), for preventing food waste by evaluating possible upcycling strategies right from the planning stage and for cross-cultural exchange with other processing centres.

Finally, the recipe contains useful information for service to ensure correct maintenance, recovery and design coherence during serving and presentation. The recipe can thus be a useful reference document for all the elements involved in the production process: from the sourcing of ingredients to preparation and finally service.

Each member of the SchoolFood4Change community is invited to test the proposed model without being intimidated by the amount of information required at the design stage. In fact, a greater analytical effort made in advance will allow for a validated product with a measurable impact. The content produced will be shared within the project and will become a collective asset, gathered in a second participatory handbook containing recipes and good practices from the schools building the canteen of the future.

FIGURE 6: STRUCTURE OF THE RECIPE

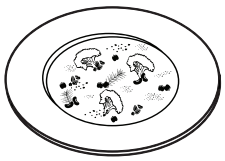
EVALUATION AND COMMUNICATION SHEET
(School community, parents, municipality, etc.)

RECIPE TITLE

_____

AUTUMN WINTER SPRING SUMMER

PLATE



RELATED EDUCATIONAL EXPERIENCE
(MAX 130 CHARACTERS)

- KEYWORDS/COMMUNICATED VALUE

(= why am I preparing this dish)

- INCLUSION AND ALLERGENS

GF LF V VEGAN OTHER .....

(= for whom am I preparing this dish)

FOR A DIET

HEALTHY → NUTRITIONAL PROFILE

Nutritional value: _____ (KCal/portion)
Fibre content: _____ (grams/portion)
Fruit and vegetables %: _____ (% of total)
Plant-based protein: YES NO
Polyunsaturated fats: YES NO

SODIUM (grams/portion)	SUGARS (grams/portion)	SATURATED FATS (grams/portion)

SUSTAINABLE → ENVIRONMENTAL AND SOCIAL PROFILE

Main ingredients (n): _____
Upcycling processes: YES NO
Organic: YES NO
Biodiverse/traditional: YES NO
Within 200 km radius: YES NO

OPERATIONAL AND EXCHANGE SHEET

INGREDIENTS:

INGREDIENT	PARAMETRIC PERCENTAGE	QUANTITY PER BATCH (gr)	QUANTITY PER PORTION (gr)	NUTRITIONAL VALUE (grams/portion)					% KITCHEN WASTE
				Fibre	Sodium	Sugars	Saturated fat	Calories (KCal)	

PREPARATION:

	SEMI-FINISHED	KEY PROCESS ELEMENTS	CONSERVATION/ STORAGE	OTHER POSSIBLE USES/RECIPES
1				
2				
...				

DIRECTIONS:

_____

_____

SERVICE LINE	RECEPTION INFORMATION	SERVICE NOTES

RECOMMENDED TEXTS

Coricelli, C., Rossi, S.E. (2021). *Guida per cervelli affamati. Perché da bambini odiamo le verdure e altri misteri neurogastronomici che ci rendono umani.* Il Saggiatore. 9788842829492

Gonzalez Crespo, C. (2020). *What is Cooking: The Action: Cooking, The Result: Cuisine*". Phaidon Press Limited.

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Myhrvold, N., Young, C., Bilet, M. (2011). *Modernist Cuisine: The Art and Science of Cooking.* Cooking Lab.

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This, H. (2006). *Molecular Gastronomy: Exploring the Science of Flavor.* Columbia University Press.

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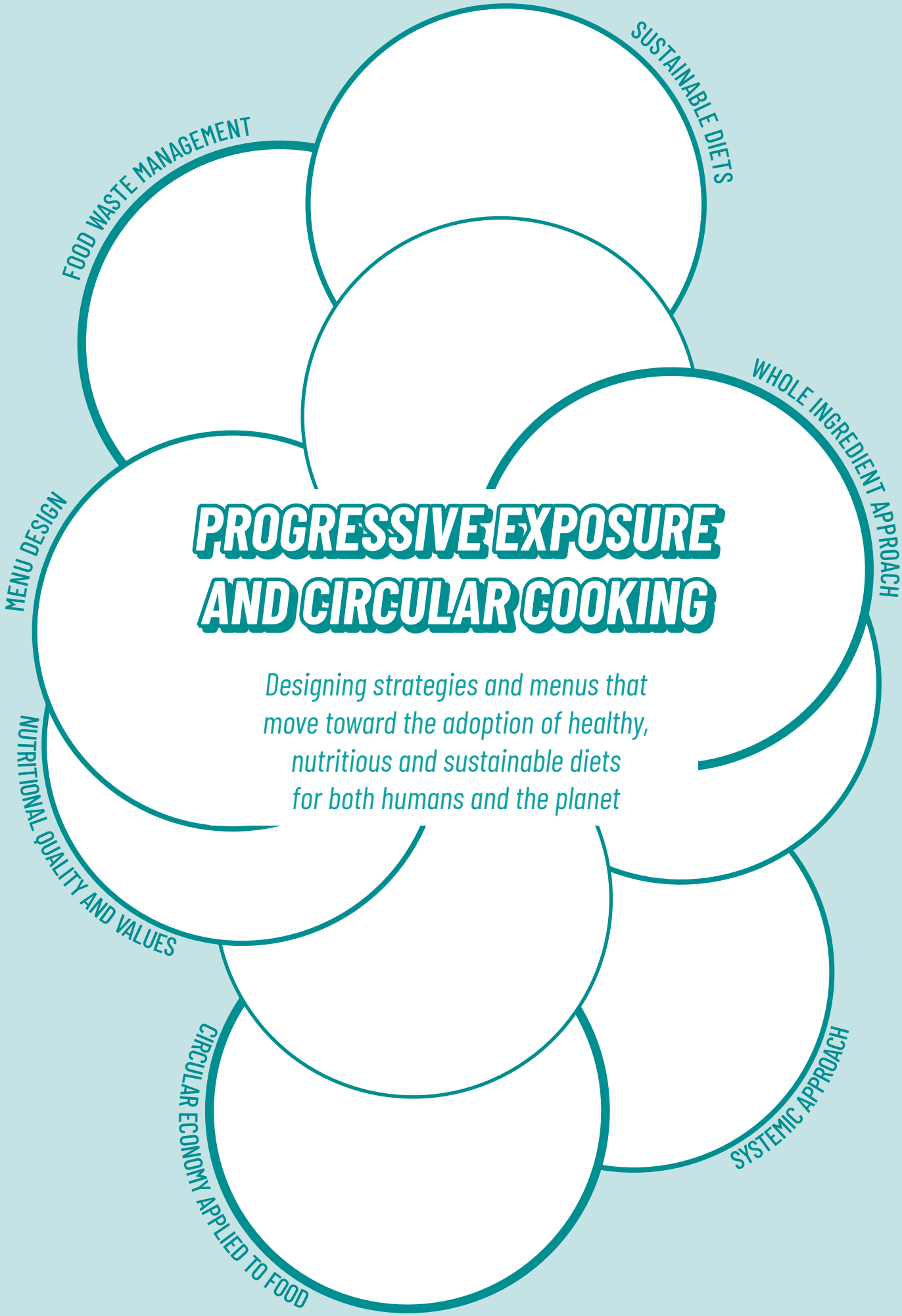

SUSTAINABLE DIETS
WHOLE INGREDIENT APPROACH
SYSTEMIC APPROACH
CIRCULAR ECONOMY APPLIED TO FOOD
NUTRITIONAL QUALITY AND VALUES
MENU DESIGN
FOOD WASTE MANAGEMENT
PROGRESSIVE EXPOSURE AND CIRCULAR COOKING
Designing strategies and menus that move toward the adoption of healthy, nutritious and sustainable diets for both humans and the planet

Chapter 2

Progressive Exposure and Circular Cooking

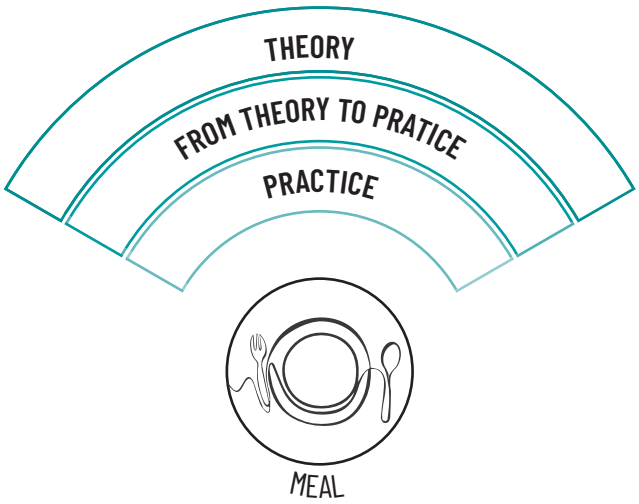
This second chapter proposes a systemic view to understand the complexity of the food system and the multiple challenges affecting school food systems, and presents some models for analysis and possible interventions. Food-related issues and their close relationship with the well-being of individuals and the planet are addressed.

The theoretical part starts with the topic of sustainable nutrition, reflecting on issues related to health, well-being and the environment, and answering the following questions:

- What dimensions and variables must be taken into account to make a school meal sustainable?
- Why is a systemic approach essential?
- What is meant by One Health? What is healthy and sustainable food?
- What are the environmental challenges of school meals, from the impact of production systems to food waste?
- Why is it increasingly urgent to address the protein transition today?

In the next section, 'From theory to practice', we aim to outline strategies that can be implemented in the preparation and consumption of school meals to address the following challenges:

- How can we substitute and reduce nutrients and ingredients that are harmful to health and the environment while preserving the good ones?
- What strategies can be implemented in food processing and serving to increase children's acceptance of food?
- How can circular economy principles be applied to school meals, starting with a systemic approach to ingredients?



The last section describes a working model in which food waste prevention strategies (at the processing and serving stages) can coexist with food education actions. To this end, a guide to healthy and sustainable menu design is proposed at the end of the chapter. This tool complements and follows on from the Creative Matrix and Recipe Framework (Chapter 1, pages 54 and 58).

Chapter 2

Progressive Exposure and Circular Cooking

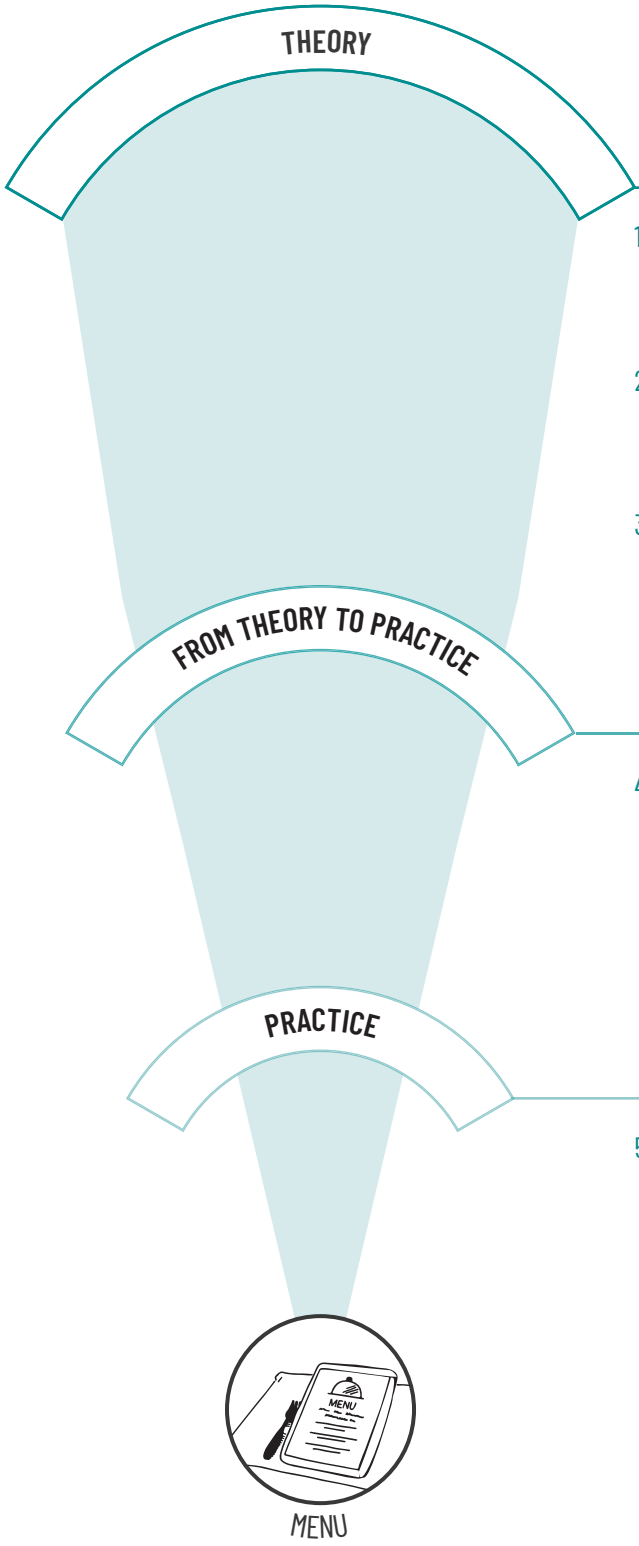


TABLE OF CONTENTS

by Nadia Tecco and Franco Fassio

Systemic thinking as a tool for breaking down complexity

Focusing on the relationship between school meals and sustainability

In light of the many challenges that food production systems and consumption models (including school catering) pose to our health and that of our planet, to be explored in more detail in the rest of this chapter, systems thinking is recognised as a key approach to addressing the complexity of sustainability issues. Indeed, the European Competence Framework for Sustainability, developed by the Joint Research Centre in 2022, recognises systems thinking as an indispensable skill for delving into the nature of the problems to be addressed, understanding the elements to be analysed in order to assess their interaction, taking into account the effects of context and space and time variables and designing effective and sustainable measures (Bianchi et al., 2022). At the same time, many organisations and institutions active in policy and programming interventions in the areas of nutrition, food security and reduction of environmental impacts stress the importance of systems thinking in overcoming the narrowness of approaches that, although technical, remain overly sectoral and compartmentalised and run the risk of having little impact or failing to foresee how interventions in one area may actually exacerbate problems in another.

But what is systems thinking? What does it mean to use it to understand the relationship between school meals and sustainability and to design interventions capable of triggering the changes needed to integrate health, environment, social inclusion and so on?

First of all, it means trying to look at school food as a whole. If we are accustomed to analysing a whole by breaking it down into its component parts, we must try to reassemble them in order to obtain an overall view, taking into account a series of variables: time (from the production of the ingredients to the consumption of meals), space (from rural to urban areas and the continuum between them), the specific characteristics of the canteen context and its target group (the age groups the service is aimed at, the socio-economic context, the meal delivery model, etc.).

SYSTEMIC THINKING MAKES IT POSSIBLE TO WORK ON ALL THE ACTIVITIES THAT CONTRIBUTE TO PERFORMING THE FOOD FUNCTION OF A GIVEN SOCIETY, AVOIDING THE RISK OF LOSING SIGHT OF RELEVANT ELEMENTS

The articulation of subsystems in constant interaction with each other and in turn with other systems (health system, commercial system, energy infrastructure system, etc.), the multiplicity and diversity of stakeholders involved (see Figure I, page III) and the multi-sectoral impact of school meals on society, including direct benefits for education and public health, agricultural production, economic development, social protection and environmental sustainability, become immediately apparent. This is the only way to grasp the opportunity and potential of school meals to act simultaneously on several fronts and contribute, for example, to the fights against childhood obesity, the increase in the number of children and young people suffering from eating disorders, the loss of biodiversity, land consumption, climate change, food waste and the overexploitation and depletion of natural resources due to increasingly energy-intensive diets and a growing world population.

All these aspects must be integrated into the vision of a healthy and environmentally sustainable meal and a strategy that can be translated into a win-win logic: what we eat at school is good for our health and the planet, and the way it is

produced, managed, processed and consumed guarantees the conservation and regeneration of resources.

From this vision it follows that in order to move from analysis to the design of interventions that have a 'systemic' scope and are capable of contributing to structural change, it is necessary to ensure the involvement of the various stakeholders and to intervene according to a multi-level and multi-scale logic. This means constructing change by taking advantage of the relationships between stakeholders, understanding how improvements and changes in a given area of action can bring benefits to the whole system, and choosing strategic areas to use as levers. After an initial focus, these can have cascading effects once developed.

In addition to considering the already complex workings of food preferences, it will also be necessary to design interventions that can stimulate a change in students' consumption habits, making dishes more appealing through different recipes and attractive presentations and thus widening the range of foods. This must take place alongside a process in the kitchen of mastering techniques and understanding ingredients, so as to make the most of the raw materials and use and balance them as resources for the preparation of a meal that nourishes and regenerates the body and the environment (or at least seeks to minimise its impact).

Once the direction has been identified, and imagining a gradual change made up of small steps alongside a re-evaluation of ingredients from a circular perspective, the chapter will look at the theme of the menu as a systemic design tool to plan and optimise the management of resources, the relationships between recipes and the incorporation of ingredients that are not only good for the environment and health but also the palate.

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by Andrea Pezzana and Andrea Devecchi

Nutrition and One Health

The importance of nutritional quality in school canteen food

IN EUROPE, 8% OF CHILDREN UNDER 5 AND 25% OF CHILDREN AGED 10 TO 19 ARE OVERWEIGHT OR OBESE

The food supply chain has undergone profound changes since the post-war period, becoming a real industry on a par with other economic sectors. This has led to major changes in diets, especially for people living in the West. Their diet has become more animal-based and richer in calories, sugar, saturated fats, salt and highly processed foods. This has led to numerous negative health, social, economic and environmental consequences. One of the main effects of this change in dietary habits has been an exponential increase in the rates of obesity and related non-communicable chronic diseases such as diabetes, hypertension, cardiovascular disease and some types of cancer. Even children are being affected, to an alarming extent: in Europe, 8% of children under 5 and 25% of children between 10 and 19 are overweight or obese (WHO, 2022). This phenomenon not only has immediate impacts, whether physical, psychological or in terms of school learning, but also brings long-term consequences such as the rise in chronic non-communicable diseases mentioned above (WHO, 2016).

In this scenario, the school canteen plays a key role, as it not only provides one of the most important meals of a student's day, but can also play an educational role in terms of nutrition. The school canteen is a potential tool for communicating and teaching about often 'neglected' foods such as fruit and vegetables, for spreading a greater awareness of the importance of food quality over quantity and for rediscovering forgotten tastes and flavours, which have often been replaced by more immediately appealing standardised foods. Finally, the school lunch offers one of the most important opportunities to understand the importance of One Health, i.e. the concept that human health, the environment and animal welfare are intimately linked and that a diet must be both healthy and sustainable, not only to preserve the planet, but also our own species, whose survival is threatened by climate change, biodiversity loss and the depletion of natural resources. Particularly in our geographical context, the Mediterranean diet is an example of a way of eating that has nutritional and health benefits and is also attentive to environmental aspects. It can be an excellent ally in the fight against obesity, including among schoolchildren, while at the same time respecting the needs of nature.

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by Maria Giovanna Onorati

Food as a relationship

Self-acceptance and 'body positivity', inclusion and eating disorders

AN ESTIMATED 20 MILLION PEOPLE IN EUROPE SUFFER FROM EATING DISORDERS AND 2021 SAW A 36% INCREASE AMONG YOUNG PEOPLE, 90% OF WHOM WERE FEMALES AGED 15 TO 25, WITH A 48% INCREASE IN HOSPITALISATIONS

Credit: Photo from Freepik

The profound changes in the way people interpret and approach food that we have witnessed in recent years have led to a social landscape that is particularly conducive to an increase in risk factors for eating disorders, especially among young people (Devoe et al., 2023). The social isolation that has taken young people away from their peers, forced cohabitation in potentially unfavourable housing or family conditions, an exponential increase in the amount of time spent alone in front of tablet and smartphone screens, the proliferation of challenges on social networking sites encouraging exercise and weight loss, the general disruption of routines especially around meals, the lack of access to face-to-face psychological services: all these social and relationship-related changes have produced generalised anxiety and post-traumatic stress syndrome, among the main causes of eating disorders that persist over time (Solmi et al., 2021). According to a recent review of 53 international scientific studies, in 2021 there was a 36% increase in eating disorders among young people, 90% of whom were females aged 15 to 25, and a 48% increase in hospitalisations in the countries participating in the studies (Devoe et al., 2023). According to a question to the European Parliament on 15th December 2021, an estimated 20 million people in Europe suffer from eating disorders.

With the inclusion of nutrition and eating disorders in the Diagnostic and Statistical Manual of Mental Disorders in 2013 (DSM-5), these eating disorders have been classified as psychiatric pathologies and therefore the therapeutic response must be medical and specialised. However, a conscious gastronomic offering in school canteens can support the therapeutic work, especially if it is able to meet the specific nutritional needs of people suffering from these pathologies, for example by proposing a correct balance of nutritional values and playing an important educational and re-educational role. Moreover, social media, which according to recent research is one of the main culprits in the growth of such pathologies

(Derenne & Beresin, 2018), can be transformed from a dangerous enemy into a valuable ally in promoting an inclusive culture of 'body positivity', i.e. acceptance of body image and self-acceptance.

Finally, thanks to a combination of different types of gastronomic expertise, social media could contribute to the dissemination of a food culture that stimulates the creativity of individuals, shifting the focus from the mere ingestion of food to taking pleasure in its preparation, promoting the skills needed to create dishes that are not only good but also sustainable, highlighting the relationships that are created during preparation and, finally, having a positive impact on self-esteem.

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by Paola Migliorini

Agroecological approaches for sustainable agriculture and food systems

Topics relevant to school canteen management

The selection and choice of ingredients in the kitchen is one of the most important actions to ensure the success of the final result, both in terms of quality and environmental and social impact. But to understand this, we need to be clear about the role of agriculture and food systems today.

In Europe, agriculture means producing food for both the European population and the export sector. Some 10.5 million farms manage 38% (160 million hectares) of the EU's total land area, with two-thirds of them having less than five hectares. The Green Revolution and the intensification of European agriculture have created significant environmental and social problems. These include the loss of biodiversity and natural habitats (at genetic, species and landscape level), the contamination of soil, water and food with pesticides and the eutrophication of bodies of water. The continuing loss of biodiversity in many European countries, much of which can be attributed to agriculture, includes the loss of pollinators, insects, birds and other species. A major problem since the 1970s has been the increasing deterioration of water quality due to rising concentrations of nitrates and pesticides. In particular, high levels of nitrate contamination have been found in groundwater resources. The high use of antibiotics in the livestock sector is another serious problem in Europe, leading to the spread of antimicrobial resistance with dangerous side effects for human health. Climate change and environmental degradation also pose an existential threat to Europe and the world. Changes in temperature and precipitation, as well as extreme weather and climate conditions, are already affecting crop yields and livestock productivity in Europe. The agricultural sector is both a source and a sink for the greenhouse gases responsible for climate change. In the EU-27, agriculture (crops and livestock) contributed 382,449.70 kt CO_2 equivalent to greenhouse gas emissions in 2020 (11.78%), further altering weather patterns and thus threatening the ability to produce food in the future. Globally, however, the food system contributes up to 37% (HLPE, 2019): 9% to 14% from agriculture, 5% to 14% from land use and land use change, including deforestation and peatland degradation, and 5% to 10% from supply chain activities (storage, transport, packaging, processing, retail and consumption). Together with ageing farmers, industrialised agrifood systems are one of the main causes behind the continuing rapid decline in the number of farmers and farms in Europe.

AGROECOLOGY, AS A SCIENTIFIC DISCIPLINE AND A SOCIAL MOVEMENT, CAN PLAY A CENTRAL ROLE IN RETHINKING, REDEFINING AND RESHAPING THE ROLE OF AGRICULTURE, INCLUDING IN SCHOOL CATERING

This situation is directly reflected in school canteens, places where the right to food sovereignty and sustainable diets should be a priority.

The current situation clearly shows that major changes are needed to develop sustainable agricultural and food systems in Europe and around the world, and arguably this awareness must start in schools. In this sense, agroecology can play a central role in redefining the operational limits of an economic model that exploits natural resources without giving them time to regenerate.

Agroecology is an important approach to understanding how to rethink and redesign the role of agriculture in developing and promoting the transition to biodiversity and socially healthy agriculture and food systems based on external inputs. The challenge now is to demonstrate its relevance in the context of the

food system. Its strength is that it does not consider ecology and social justice in isolation. How we treat land, water and our environment reflects how we treat each other, and vice versa. If we exploit workers, we tend to exploit the animals in our food system; if we exploit animals, we tend to exploit the land; if we extract resources from the land, we extract wealth from communities. Today, agroecology is considered an academic discipline, an approach to agroecosystem and agricultural management and, more recently, a movement that promotes radically different agricultural and food systems, including a transformative approach in both the socio-economic and environmental spheres. In 2019, the High-Level Panel of Experts on Food Security and Nutrition, in its paper 'Agroecological approaches and other innovations for sustainable agriculture and food systems that improve food security and nutrition' (HLPE, 2019), defined a concise set of 13 agroecological principles: recycling, input reduction, soil health, animal health, biodiversity, synergy, economic diversification, knowledge co-creation, social values and diets, equity, connectivity, land and natural resource governance and participation.

Ten teaching topics

What are good practices to follow in order to choose ingredients and food products that are not only good for the environment but also good for society? One of the simplest things that can be done to offer more sustainable food is to make conscious choices. In particular, these ten topics could be discussed in the classroom with the aim of raising awareness among new generations about an agroecological approach to food. Let us look at them below:

1. LOOK LOCALLY

Exploring farmers' markets will help you find fresh, locally grown produce, but just as importantly, you can meet the people who produce your food. Such relationships are opportunities for education: you can learn how your food was grown, when it was harvested and even how to prepare it.
Another way to deepen the relationship between producer and product is by addressing the topic of the social and ethical value of imported exotic goods. Gathering information about production contexts or visiting a fair-trade shop can become a learning opportunity to discuss how small producers, even when far away, can protect their local areas through trade practices that ensure a fairer price compared to the international market.

2. BUY ORGANIC

Better still, develop stable, long-term relationships with organic producers (certified and non-certified), who you can get to know and with whom you can develop a mutually beneficial relationship economy. Setting up a CSA (community-supported agriculture) scheme or a communal fair-trade buying group is a good way to do this.

3. GROW YOUR OWN FOOD

If you have a small garden or even a balcony, you can grow many useful plants – herbs, fruits and vegetables – to enrich the variety of ingredients and flavours in the kitchen. What could be better than fresh produce from your own garden? As well as being healthy and delicious, it is free from the carbon footprint of store-bought food.

4. GIVE PRIORITY TO PLANTS: LEAVES, FRUITS, ROOTS, STEMS, SEEDS AND FLOWERS!

The Healthy Eating Plate suggests filling half your plate with fruit and vegetables as part of an optimal diet, but planning our meals around produce is also good for the planet. Switching to a more plant-based diet will help reduce freshwater use and deforestation, making it a positive move for the environment as well as our personal health.

5. EAT MORE PULSES

The Healthy Eating Plate already suggests cutting down on red meat, and now there is another reason to treat it more like a seasoning rather than the main focus of a dish. The production of meat, especially beef, is a major contributor to greenhouse gas emissions, and the environmental impact is also high because raising and transporting livestock also requires more food, water, land and energy than plants. We can choose proteins other than meat, such as pulses and nuts. There are hundreds of different legume species and, as nitrogen fixers, they are very useful plants for maintaining soil and environmental fertility.

6. MORE DIVERSITY

Just twelve plants and five animal species are responsible for 75% of the world's food supply. Increasing the diversity of our diets is essential as the lack of diversity in agriculture is both detrimental to nature and a threat to food security.

7. CHOOSE SEASONAL PRODUCE

Seasonal produce is grown with less harm to the environment. As well as supporting your local economy, it brings you closer to the producers, is cheaper and connects you with the local cuisine.

8. REDUCE WASTE

Food waste is a huge problem, with 30% of all the food produced being thrown away, and has serious environmental consequences. In fact, if food waste were a country, it would be the third largest emitter of greenhouse gases after China and the US. Reducing waste is easy: freeze anything you can't eat while it's still fresh and, where possible, buy products in bulk so you can choose the exact amount you need.

9. CHOOSE FISH AND SEAFOOD WISELY

Fish can be a healthy choice as part of an overall healthy diet, but 90% of fish stocks are overfished or produced in ways that harm the marine environment, and aquaculture has its own problems. Choose species from well-managed sources (local and organic if possible) that are further down the food chain (not tuna, salmon, etc., but small fish like sardines and anchovies and other little-known species). Establishing sustainable links with fishing cooperatives is one way to choose seasonal products.

10. NO PLASTIC

Plastic has infiltrated our natural world and even our diet. Use reusable bags when shopping, select unpackaged fruit and vegetables where possible and choose brands and retailers that have found alternatives.

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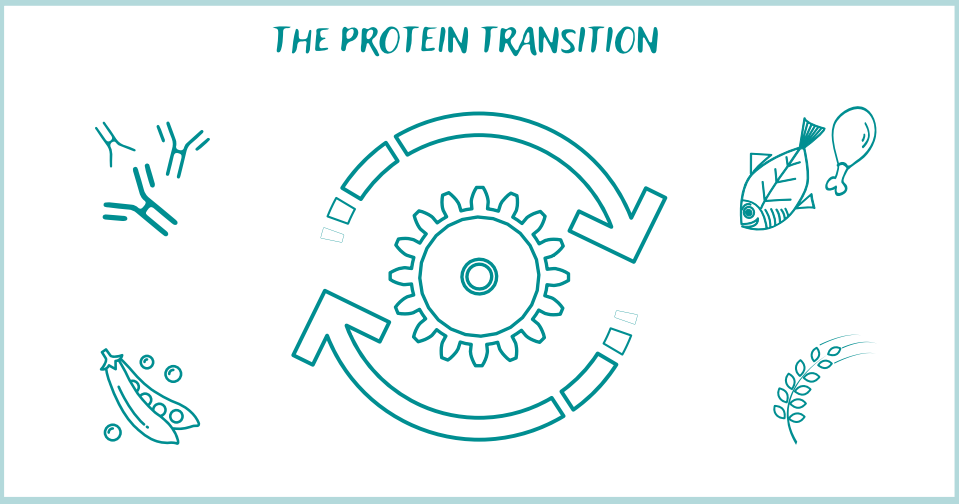
by Nadia Tecco and Franco Fassio

Protein transition

What are the implications for school canteens?

FIGURE 7: PROTEIN TRANSITION



In the last decade or so, the intensity of debate and the attention of scientific research have increased around one macronutrient in particular: protein. This is part of the broader discussion on the protein transition, i.e. the process of gradually replacing animal sources of protein with plant sources. Since the post-World War II economic boom, animal protein consumption in Europe and the United States has grown strongly (quadrupling in terms of per capita and absolute consumption, according to FAO data), driven by population growth, industrialisation of production and intensive livestock farming, standardisation of consumption and supply in general. Currently, meat consumption continues to grow, especially in emerging economies, due to increased affordability (Whitton et al., 2021). Estimates show that the global population will reach 9 billion people by 2050, by which time meat production will be as high as 338 billion kilograms per year (Alexandratos & Bruisma, 2012).

AN ECOLOGICAL TRANSITION MUST BE ACCOMPANIED BY A PROTEIN TRANSITION THAT REDUCES THE CONSUMPTION OF ANIMAL PROTEIN

The unsustainability of the estimated evolution of these production and consumption patterns comes from the disproportionate environmental impact of the production of animal proteins compared to plant proteins. This is due in particular to the use of resources (soil, biodiversity, fresh water) and pollution (climate change, pesticides, eutrophication) (Sabatè & Soret, 2014). For example, it takes between 2 and 15 kilos of plant protein to produce 1 kilo of animal protein, depending on the species and the specific situation. It is estimated that on average 25 times more fossil energy is required to produce animal protein for human consumption rather than plant protein (Pimentel & Pimentel, 2003).

The production of meat, farmed fish, eggs and dairy products uses approximately 83% of the world's agricultural land and contributes between 56% and 58% of the various climate change emissions associated with the food system, despite providing only 37% of the world's protein and 18% of the world's calorie needs (Poore & Nemecek, 2018). In contrast, the production of plant proteins is more environmentally efficient, as it uses significantly fewer natural resources and has a lower environmental impact in terms of emissions and pollutants. In addition, a shift to a new type of diet in which animal products are replaced (partially or

completely) by plant products would not only offer environmental benefits (less competition for land use for human food and livestock production, with the possibility of land use conversion with less loss of habitat and biodiversity) but would also reduce emissions and water and nitrogen use. It would also benefit human health, by helping to reduce obesity and diseases associated with excessive meat consumption (cardiovascular disease and increased mortality from cancer in the long term), and animal welfare, for example by reducing the risk of disease and antibiotic resistance.

While the rationale for the shift is clear and largely agreed-upon by the scientific community, what is less obvious is the consumer acceptance of this change and how to implement an operational strategy leading to greater consumption of plant proteins. This is especially true in the context of school catering, where vegetable consumption is known to be a critical issue. The lack of appreciation of plant-based dishes, often resulting in non-consumption, leads to a loss of nutritional intake and a high production of food waste, two sides of the same problem. It is therefore of paramount importance to consider the issue of the sensory properties of food (Van Bussel et al., 2019) and the expectations and sensory preferences of students from preschool to school, considering that they are in the process of building preferences and taking into account all the complex variables that contribute to their determination and change depending on the age group and the specific learning context of the school canteen. This must be done alongside actions that can be carried out to progressively train the senses to greater acceptance and increased curiosity in trying new foods.

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by Nadia Tecco and Franco Fassio

Food waste in school canteens

Recognising a 'wicked problem' in order to deal with it

Credit: Photo by Eva Bronzini on Pexels

Recent studies to quantify food waste in school canteens have found a percentage loss ranging from around 15% to up to 40% of the weight of the total meal (Boschini et al., 2018; Eriksson et al., 2017). When a meal is not consumed, its nutritional value is lost, as well as its social and educational value (Kowalewska et al., 2018; Niaki et al., 2017). The resources (land, energy, water, money) time and labour used from production to consumption are also lost. It is therefore necessary to study the nature and structure of the phenomenon, the categories of foods that are most frequently rejected and the factors and situations that contribute to the generation of food waste in order to adopt counter and preventive measures aimed at safeguarding the purpose of school meals. Research has identified some recurring factors in different countries that can help to identify concrete interventions to reduce food waste. Empirical results have shown that these can prevent between 20% and 40% of waste (Tocco Cardwell et al., 2019; Malefors et al., 2002). Let us therefore try to answer these simple questions: where, what, how and why waste is generated in a school canteen?

THE PROBLEM OF FOOD WASTE IN SCHOOL CANTEENS IS THE RESULT OF MANY VARIABLES, INCLUDING MISTRUST OF FOOD OTHER THAN THAT CONSUMED AT HOME

WHERE?

Food waste is generated in the kitchen and in the eating area. In the kitchen, waste is generated from the cooking and processing of ingredients during the preparation of meals, while in the dining hall, waste is generated from food that is served but not consumed or left unserved (plated or in serving pans). In some cases, the place where the meal or snack is consumed may be the classroom itself, so we may place the food prepared but not served in a continuous space between the kitchen and the classroom.

WHAT?

Legumes, vegetables and fish make up the most critical triad of leftovers. This depends very much on the 'liking' of the dish and, above all, on the distrust of foods other than those consumed in the domestic context. There is a tendency for chil-

dren who do not eat vegetables to also not eat legumes or fish, and this highlights the fact that many children, especially in countries with a more Mediterranean diet, run the risk of not eating a main course several times in a week. Fruit and bread are also critical categories that are often wasted when they are either served but left on the tray or simply left unserved.

HOW AND WHY?

The reasons for food waste in school catering are numerous, but can be traced back to the interactions between three factors: food (palatability and acceptability), students (eating preferences and habits, satiety) and the organisation of the service and mealtimes in the canteen (meal duration, canteen environment, serving methods, portioning, communication between users and operators and between operators themselves) (Blondin et al., 2014).

WE MUST WORK TO ENSURE THAT MEALTIMES HAVE AN EDUCATIONAL FUNCTION, STIMULATING CHILDREN'S CURIOSITY AND IMAGINATION AND CALLING INTO QUESTION THE ESTABLISHED HABITS THAT ARE SOMETIMES THE REAL OBSTACLES TO SUSTAINABLE DEVELOPMENT

The interactions between these three factors can contribute to the generation of food waste at three interdependent levels: operational, contextual and behavioural (Cordingley, 2011; Boschini et al., 2018). The operational level includes those variables that determine the ability to manage the service and to respond promptly to the demand for the supply of school meals (in terms of production quantities, portioning and palatability on the part of the students, net of nutritional requirements, methods of coordination between the kitchen and the canteen and bureaucratic constraints on the use of the unserved meal). The contextual level brings together all the environmental and practical factors that hinder the enjoyment of the meal. These are aspects that are not directly related to the content of the meal, but to the way it is presented, its accessibility (for example, foods that are difficult to peel or cut), the time available, the time of serving and the variables that affect the agreeability of the environment (pleasantness of the dining room, noise level). The behavioural level refers to the impact of pupils' choices, taking into account the influence of tastes, familiarity with the consumption of certain categories of food, previous individual experience (especially in the family context), the role of the servers and teachers, peer influence, the possibility of choice, the number of alternatives and the previous level of satiation. In general, we can say that those who do not like eating in the canteen are those who go once or twice a week and find the mealtimes uncomfortable, boring, long and noisy. This influences the fact that they leave a lot of food on their plates and do not like eating different food from what they are used to. On the other hand, those who eat lunch at school three to four times a week tend to be more satisfied, to be less disgusted, to not be annoyed, to feel free, to experience the place as comfortable and fun and to like to eat different types of food, which reduces the likelihood of producing waste. In conclusion, therefore, we can say that frequency makes people perceive the setting and the meal differently, with consequent impacts on the generation of food waste.

Even in school catering, it is therefore evident that food waste takes on the characteristics of a 'wicked' problem (Rittel and Webber, 1973), i.e. a phenomenon in which the solution is not easily identifiable, as critical issues arise from the inte-

raction and interdependence of several factors within the same system, recurring day after day (without the possibility of a definitive or immediate solution), with variable geometries created by the influence of specific contextual factors (Narvanen et al., 2020). In order to tackle a problem configured in this way, it is therefore necessary to identify and implement a set of countermeasures that are capable of responding to the problems identified following a case-by-case reading of the context in which one operates and that are subject to constant monitoring during their execution.

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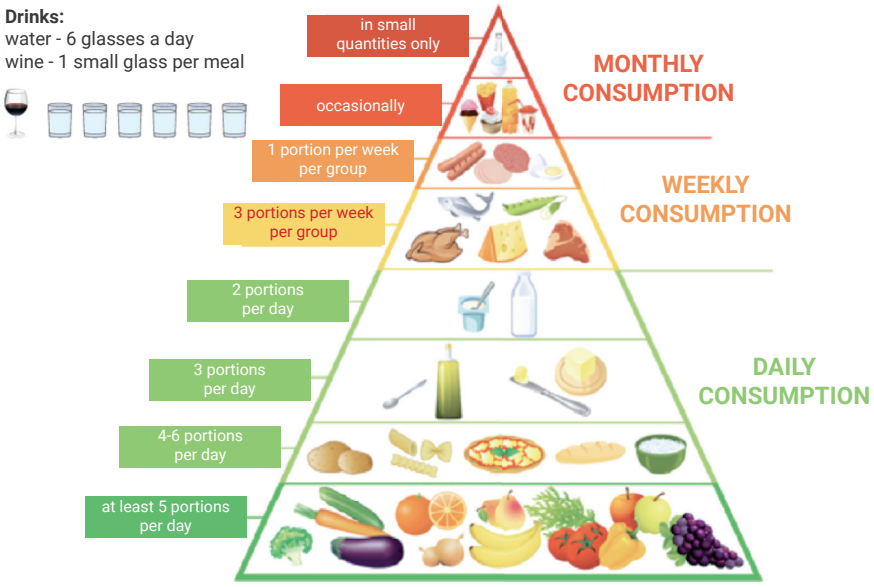
by Riccardo Migliavada and Dauro Zocchi

A balanced meal

What to consider when planning a nutritionally appropriate meal

Starting in the second half of the 20th century, the world of research and institutions has paid increasing attention to the design and development of models that favour a transition towards healthier and more sustainable diets. One of the first tools used to promote healthy eating was the food pyramid, and it remains one of the most widely used and globally recognised approaches.

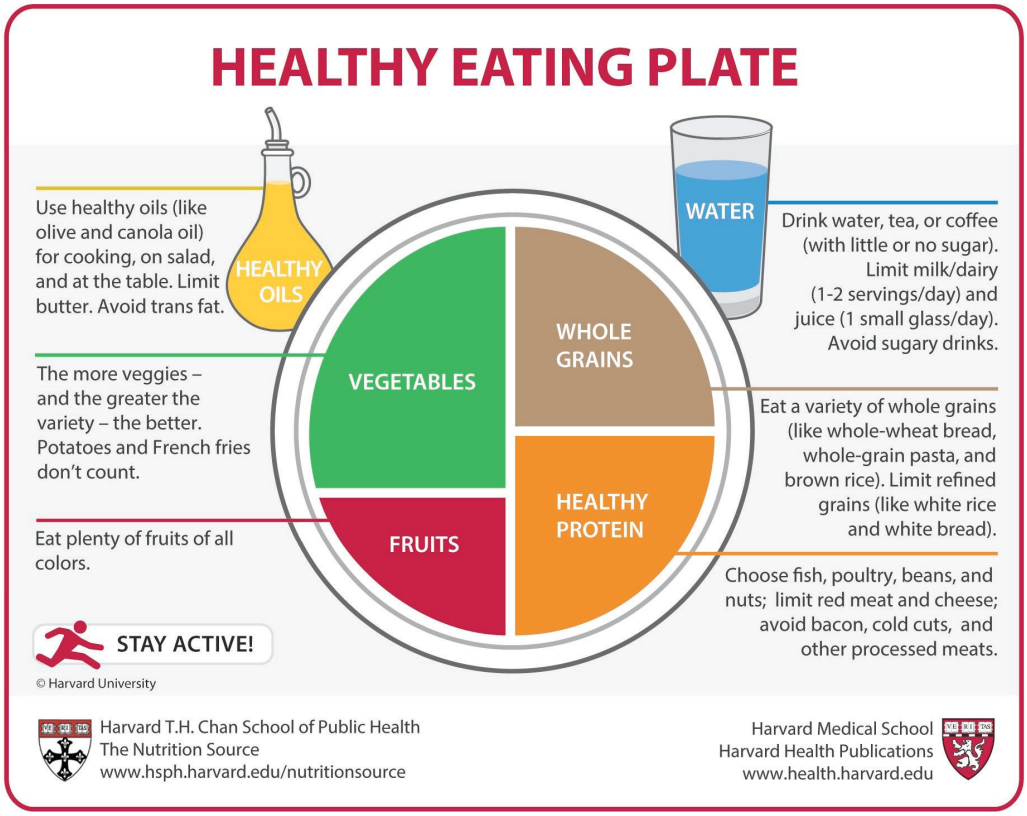


Introduced in Sweden in the 1970s under the title 'Healthy and Good Food at Reasonable Prices' and later adopted worldwide, the pyramid graphically depicts the variety of foods that should be present in the daily diet, assigning different levels of importance to different food categories.

The pyramid gives us an idea of how our shopping basket should be made up to properly prepare our daily meals. At the base of the pyramid we find fruit and vegetables, which should form the bulk of our meals, followed by other foods to a lesser extent, with particularly sugary and salty products at the top of the pyramid, to be consumed in limited quantities. In recent decades, the pyramid, as simple as it is imprecise, has been the subject of much criticism, leading to the development of alternative graphic and conceptual solutions. Among the most famous of these is the 'Healthy Eating Plate' model, created by nutrition experts at the Harvard T.H. Chan School of Public Health, which shows a plate divided into four sections of different sizes, representing the proportions of fruits, vegetables, grains and protein that should be consumed in a meal. This may seem like a more practical tool for caterers, but it does not give any indication of the quantity or calorie intake that each section should represent. Furthermore, unlike the pyramid, the Harvard plate does not suggest the variety of products that should be consumed, but only the proportions of the four macro-categories within the meal.

PROPER EATING PATTERNS AND THEIR GRAPHIC TRANSLATIONS HAVE EVOLVED OVER TIME

In fact, variety, as well as quantity, remains a key aspect in ensuring the correct intake of micronutrients such as vitamins, minerals and antioxidants, which play a crucial role in maintaining human health.



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Understanding the role of a given product within food landscapes and cultures is equally important to encouraging a more conscious and holistic approach to food. This is why the promotion of gastronomic culture in a broader sense, especially in educational and school catering contexts, is crucial. Categories and proportions are not enough; knowledge of ingredients, their origins and production methods as well as recipes and processing techniques is needed to maximise the benefits of consuming certain foods. A variety of products, translated into a variety of recipes, encourages the combination of different foods and preparation methods, which, in addition to allowing for a better assimilation of nutrients, can contribute to the enrichment of the gastronomic experience in today's school canteens.

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Copyright © 2011 Harvard University, for more information on the Healthy Eating Plate, please consult The Nutrition Source, Department of Nutrition, Harvard T.H. Chan School of Public Health, http://www.thenutritionsource.org and Harvard Health Publications, health.harvard.edu.

by Gabriella Morini and Nahuel Buracco

What to reduce and what to increase?

Points to focus on for a healthier and more sustainable diet

GUIDELINES FOR DESIGNING SCHOOL MENUS AND ALTERNATIVE STRATEGIES

Credit: Photo by Piret Ilver on Unsplash

Poor nutrition is one of the main risk factors for the development of non-communicable diseases and conditions (such as diabetes, obesity, wasting and underweight). In addition, poor nutrition impedes growth and healthy development of the individual and negatively affects several bodily functions.

In contrast to increasingly widespread and only partially balanced dietary patterns, healthy and sustainable diets are diverse. They are shaped by culture, traditions, religious orientations, dietary habits, food preferences and needs, such as intolerances and allergies, but all share the fundamental characteristic of supporting the highest levels of accessibility, food security, health and well-being. Global organisations such as FAO and WHO have been working for years to develop general guidelines for healthy and sustainable diets, based on scientific evidence that increasingly recognises the close link between human and planetary health (Burlingame & Dernini, 2012; FAO & WHO, 2019).

The dietary models that have emerged from their research are defined as the set of possible amounts, types and therefore combinations of different foods, beverages and nutrients in a diet, including the frequency with which they are habitually consumed. They have also shown that diets low in vegetables, high in animal products and high in ultra-processed products are associated with negative outcomes.

As parents, cooks, teachers and consumers, we have a responsibility to embrace good nutritional practices by translating them into strategies that can be implemented on a daily basis. Children are the consumers of the future and the responsibility for the impact of their food choices on the community and the environment falls on them. Through the ingredients, recipes and menus they are exposed to at home and at school, we have the opportunity to influence their current and future food choices and promote diets that are good for individuals and ecosystems. In

fact, sustainable diets must be designed by reducing the consumption of over-processed products when creating recipes and menus. In this way it is possible to shorten food supply chains, use whole foods (which also reduces waste) and focus on the nutritional quality of the output.

When designing recipes and menus, nutritional requirements should be taken into account with the aim of reducing the overconsumption of certain macronutrients, favouring and increasing the consumption of seasonal and biodiverse plant-origin foods and paying particular attention to micronutrients.

Below is a list of the products and compounds whose consumption should be reduced, and the strategies that can be implemented to replace them in a viable and creative way.

- **Refined sugars:** Also known as empty calories, they have little or no nutritional value and are one of the main causes of diabetes and obesity in young people. The first step is to reduce the consumption of refined sugars by favouring ingredients that naturally contain sugars, such as fresh fruit. In recipes where sugar is still necessary, both for taste and functional reasons, white sugar can be replaced with smaller quantities of other ingredients such as honey, molasses, natural syrups and raw sugars. The use of spices and flavourings such as cinnamon and vanilla also helps to reduce the use of refined sugars.

- **Animal protein:** Data from the FAO and WHO show that in order to mitigate the environmental impact of our diets it is essential to cut back on the consumption of proteins of animal origin so as to reduce the greenhouse gas emissions produced by livestock farms and the entire meat chain (FAO and WHO, 2019). This planetary imperative coincides with good nutritional practices to promote human health and a varied diet that includes diverse legumes and other ingredients rich in plant proteins. Meat consumption is not to be completely avoided, but it must be appropriate in quantity, responsible and conscious. The meat should ideally be sourced from local and virtuous farms with a transparent supply chain.

- **Saturated fats:** A diet too rich in saturated fats, which are more abundant in animal fats, leads to an increased susceptibility to cardiovascular disease (FAO & WHO, 2019), so it is becoming increasingly clear that reducing the consumption of animal products is closely linked to promoting the well-being of the individual, not just the planet. It is advisable to reduce the consumption of saturated fats in favour of unsaturated and polyunsaturated fats of plant origin, such as extra-virgin olive oil and other seed oils (sunflower, flax, sesame, pumpkin, hemp, etc.) and nuts, either whole or in butters.

- **Salt:** The recommended daily salt intake is no more than 5 grams, to reduce the risk of diseases such as hypertension and cardiovascular dysfunction (FAO & WHO, 2019). Particular attention should be paid to the amount of sodium consumed each day, as it is not only present in table salt, but also found in many foods, especially processed foods. It is therefore essential to drastically reduce the amount of salt added to dishes and instead to achieve the desired

flavour by using specific cooking techniques such as concentration and long cooking times and by adding natural flavour enhancers such as herbs, spices, mirepoix and soffritto, reductions, products that have undergone natural enzymatic processes and plant-based powders.
In addition to these general guidelines, when designing balanced diets, it is essential to consider the balance of all macro- and micronutrients to avoid unbalanced intakes. The nutritional calculation of recipes and menus should be based on the portions actually served, which should favour quality over quantity, while still allowing for satisfaction and satiety at the end of the meal.

In conclusion, a diet can be defined as sustainable if it is based on seasonal and biodiverse plant products, ingredients that are mostly whole foods and unrefined for a higher fibre and micronutrient content and a reduced quantity of animal products, which should come from high-quality, controlled supply chains. Particular attention should be paid to sour and bitter flavours and to a range of colours to ensure the correct intake of micronutrients, prebiotics (compounds that promote the development of intestinal flora) and probiotics (microorganisms with a positive effect on health). Sourness is characteristic of fermented foods such as yoghurt, kefir and sauerkraut, which, when eaten fresh and unpasteurised, are still 'alive' and beneficial to the gut flora. On the other hand, bitterness, like colour, indicates the presence of micronutrients that enrich the diet with healthy compounds (e.g. antioxidants) or those with a prebiotic effect. Finally, bitter-tasting compounds are able to contribute to glycaemic control and slow down intestinal peristalsis, allowing a more complete absorption of the nutrients contained in the ingested food and resulting in a greater feeling of satiety.

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FIGURE 8: THE MEAL MUST BE

THE MEAL MUST BE:

ACCESSIBLE FOR ALL
/ use of the whole ingredient
/ less input
/ shorter supply chains

SAFE AND INCLUSIVE
/ allergies and intolerances
/ religious orientations
/ different cultures
/ individual choices

BALANCED
/ digestibility
/ nutritional quality
/ preventing malnutrition and disease

NUTRITIONAL QUALITY, LESS AND MORE:

DECREASE

REFINED SUGAR

SALT

SATURATED FATS

UMAMI FROM ANIMAL PROTEINS

PORTIONS

/ Replace with honey and raw sugars
/ Use sugars from fruit and vegetables
/ Combine with spices such as vanilla and cinnamon

/ Enzymatic processes and fermentations
/ Combine with spices and herbs

/ Prefer extra-virgin oils

/ Prefer products for which animal welfare is guaranteed

INCREASE

CONSUMPTION OF BIODIVERSE PLANT PRODUCTS
(higher content of unrefined sugars, mineral salts and micronutrients)

POLYUNSATURATED FATS

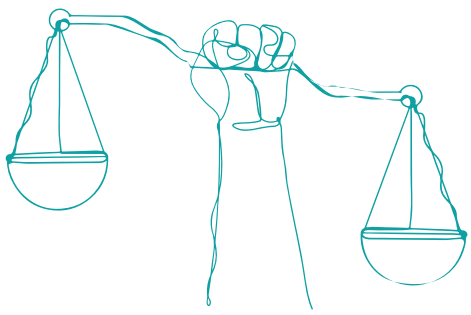
PLANT PROTEINS

BITTER FLAVOURS
(disease prevention)

COLOURS
(micronutrients)

FIBRE
(whole and minimally refined products)

ACID
(fermented products)



by Gabriella Morini and Nahuel Buracco

Progressive exposure

A step-by-step approach to nutrition education

EARLY AND GRADUAL INTRODUCTION OF FOODS THAT TEND TO BE REJECTED AIMS TO INCREASE FAMILIARITY AND ACCEPTANCE OVER TIME

In recent decades, a doubt seems to have taken hold of the food consumption landscape: in our daily choices, we are often invited – and sometimes forced - to choose between what we like and what is good for us. This dichotomy is easily seen in advertising rhetoric, which responds to the need to position a food as either delicious (to make up for its lack of beneficial properties, as it tends to be junk) or healthy and beneficial for our body (to make up for its supposed lack of enjoyability and hedonistic appeal: the first step to food rejection).

School catering, for its part, is no stranger to this dilemma, with the need to ensure a healthy and varied meal service meeting the need to limit the dramatic effects on the environment caused by pollution and the waste of resources. However, giving in to these two parallel impulses, in the canteen as well as at home, can often mean sacrificing taste and pleasure in the name of health, only to be faced with an even more serious problem: empty bellies and overflowing bins. The question then arises: is a good, healthy and sustainable school lunch possible?

This is where the discourse on food acceptance becomes central. In the first chapter, we proposed a methodological framework for designing healthy and delicious meals: we reviewed cooking processes and techniques to guide food preferences, with the aim of transcending the good versus healthy dialectic. We will now see how we can increase students' familiarity with foods that are healthier and sustainable but often rejected. Coercion, blackmail and psychological pressure are strategies often used to push food. However, given the established fact that we (only) eat what we like, forcing us to eat something may produce immediate results, but it will certainly not have a positive effect on our appreciation of the food in the long term. So, if I eat because I am forced to, it does not mean that I like it and want to eat it in the future. On the contrary, such attitudes can contribute to childhood traumas associated with the rejection of certain foods, to the point where they are completely absent from adult eating habits.

Alternatively, we have the strategy of gradual exposure to specific foods and thus to a healthy and sustainable diet. In this framework, in order to curb widely described phenomena such as 'picky' eating, neophobia or an innate aversion to certain tastes (Dovey et al., 2008), creating the conditions for progressive exposure means gradually introducing a given food stimulus to a young target audience in order to increase its familiarity and acceptance. The growing scientific literature on the subject has shown how the sense of taste, although innate and a result of the human evolutionary process, can be trained (DeCosta et al., 2017). How can this be done? Here we will run through the key points.

The education of taste is an ongoing process that starts during in utero and continues into adolescence with the definition of future eating habits. It is therefore crucial to bear in mind that a conscious process of progressive exposure must necessarily begin at the time of pregnancy: first the amniotic fluid and then the mother's milk are crucial 'taste education vehicles'. The foetus has shown through facial expressions that it reacts differently to different tastes. It therefore begins to develop its own knowledge and memory of taste during pregnancy. This means the mother's diet is very important at this stage, just as it is during breastfeeding: the more varied it is, the better prepared the child will be for their first real exposure

to food from weaning onwards. It is in the transition from breast milk to a varied diet – in terms of tastes, aromas and textures – that the child begins to develop a real relationship with food, which can change depending on the type of weaning chosen. Spoon-fed weaning and baby-led weaning are examples of how, in the first case, one can begin to introduce vegetables into the diet (in order to reduce calorie intake) or, in the second case, one can begin to create a physical relationship with food and a dynamic of self-determination. We will return to weaning and associative conditioning in the next few pages. What we want to make clear at this stage is that based on the evidence in the literature, not giving up an initially rejected stimulus can be key to increasing intake.

Progressive exposure means the early and timely presentation of a taste stimulus (which tends to be rejected) in order to make it increasingly familiar over time. Another side of the same coin is exposure in a broader sense to the themes and meanings surrounding the sensory stimulus and the actions and activities associated with it. The aspect relates to the importance of creating a repeated positive sensory and emotional experience that gradually contributes to the acceptance and appreciation of a food that could otherwise be difficult to offer. Exposure takes place mainly through the sharing of reasoning and its narration. It is essential to use the language and cultural horizons of the target group: direct experience, games, fairy tales and the visual representation of an idea are all tools for progressive exposure aimed at children. This is discussed in more detail in the third chapter of this handbook.

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by Nadia Tecco and Franco Fassio

The political-economic-cultural paradigm of the circular economy

A tool for rethinking school meals

The circular economy is a political-economic-cultural paradigm that supports and accompanies the ecological transition, contributing to the achievement of the goal of climate neutrality by 2050 enshrined in the Green Deal (European Commission, 2019) and the 17 Sustainable Development Goals adopted by the United Nations in September 2015. The circular economy has become part of the process of reviewing waste legislation launched by the European Commission in 2014 (European Commission, 2020a), and has also gradually been included in the process of transforming the agrifood system along the path set out in the Farm to Fork strategy (European Commission, 2020b). But what is it exactly and how can it be integrated into the actual school-meal production and consumption system?

A SUSTAINABLE ECONOMY CAN ONLY EXIST IF IT IS ACCOMPANIED BY AN ADEQUATE KNOWLEDGE ECONOMY, SO THE ROLE OF SCHOOL CANTEENS IS TO ACQUIRE INFORMATION, TO PUT IT INTO PRACTICE AND TO GIVE KNOWLEDGE BACK BY PROMOTING THE AWARENESS OF EACH OF ITS USERS

If we consider the economy as a tool that allows the human species to satisfy its needs by adapting to the environment, the current linear economic model has been able to guarantee high (if unevenly distributed) rates of production and consumption for a rapidly growing population, but at the cost of strong environmental pressures in terms of energy consumption, the depletion of resources (to the point of jeopardising their ability to regenerate), the upsetting of balances that characterise the synergic dialogue between the various ecosystems and the production of pollutants. It is a model in which the life cycle of products is too short compared to the huge quantities of virgin raw materials and energy used and the pollutants produced.

The result of this imbalance is a distorted perception of abundance in the face of increasing fragility and loss of resilience in natural, food and social systems.

The circular economy, on the other hand, proposes as an alternative a cyclical economic model in which the principle of regeneration is put into operation, applied both to everyday products and to the management of natural capital. Production and consumption are possible when resources are used according to their regenerative capacity. Resource extraction is minimised by preserving the value of resources, optimising and extending the use of products or services, and using outgoing resources (waste and by-products) as inputs in subsequent cycles or as part of other production sectors (we will look at the classification of cycles and their operational use in the following paragraphs). Thus, by rethinking the production process upstream, the amount of waste produced downstream is reduced, thus also reducing the ecological footprint on the planet. The circular economy is therefore a proposal with political, cultural and economic implications that aims to rebalance the metabolism of energy and material flows in production systems, including the food system and, consequently, the school lunch system (Jurgilevich et al., 2016; Fassio & Tecco, 2019).

In fact, in terms of its functions and structure, school catering is an area in which the circular economy can be strengthened and consolidated and find fertile

ground, given the coexistence of areas of competence and spheres of influence that are well integrated. For this reason, the circular economy can contribute to a rethinking of the 'school lunch system', starting from the choice of regenerative agricultural models and supply chains capable of regenerating the local economic-productive fabric as well as looking at the way ingredients are selected and managed, packaging, how menus are constructed, actions to reduce food waste in the processing and consumption phases (Sehnem et al., 2023), adding value to by-products and many other actions that should be applied in the context of canteens and included as discussion topics in school curriculums. Let us illustrate this reasoning with reference to 'nutrition' and 'metabolism', key concepts in both school catering and the circular economy.

Starting from the fact that the term 'diet' is derived from the Greek *diaita* (way of life) and the Latin *dies* (day), it is clear that the role of school catering goes far beyond simply providing a meal. It also provides a service that every day offers a space and a time appropriate for the care of health and the environment and enables a healthy, sustainable way of life, within a framework of educational coherence in the school-family relationship. In this way, a correct diet, like the quality of the food we eat, is linked to the health of the environment and society, if we think systemically.

Metabolism, on the other hand, is one of the requirements to be taken into account when designing school menus, and is linked to the needs of those who will consume the meal and to how energy is produced from the nutrients introduced with the food in relation to the specific needs of the body. The aim is to create a 'dynamic balance' in the body, a balance between inputs (food) and outputs (energy expenditure). In this sense, there is a parallel with the circular economy, which seeks to satisfy basic needs (including food) while maintaining a balance between the regeneration of resources and their consumption. For example, just as we do not allow ourselves to ingest substances that cannot be metabolised by our bodies (e.g. microplastics), we should not produce objects that cannot be metabolised by the waste collection system. Nature does not know the meaning of the word 'waste', as everything is metabolised by the flow between the five natural kingdoms (plants, animals, monera, protista, fungi). From this point of view, the meal in the canteen should be nothing more than the expression of an action that responds to the needs of the proper functioning of the human metabolism, but also of the environment.

In conclusion, the circular economy is one of the possible tools at our disposal to apply a systemic approach to the school meal supply chain and to combine economic efficiency, environmental sustainability, health and social inclusion, provided that we engage in a complex transformation involving all actors in the supply chain. In the following sections, we will try to focus on the introduction of circula-

rity in the process of managing and transforming raw materials as a complement to a strategy of taste education that, in a cyclical and gradual way (over the school year), promotes the acceptance of foods that are good for health, the environment and the palate through the experience of eating in the canteen.

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by Franco Fassio and Nadia Tecco

The ingredient as capital

A political and systemic approach to raw materials

INVESTING IN THE QUALITY OF INGREDIENTS AND RECOGNISING THE CORRECT VALUE OF THE NATURAL, CULTURAL, HUMAN, SOCIAL AND RELATIONAL CAPITALS INVOLVED IS AN INTEGRAL STRATEGY FOR INCREASING HUMAN WELL-BEING THROUGH THE REGENERATION OF NATURAL AND CULTURAL ECOSYSTEMS

Credit: Photo by Joanie Simon on Unsplash

Addressing the issue of the quality of ingredients in the gastronomic preparation of school meals necessarily leads us to address the issue of capital, understood in its various meanings (natural, cultural, human, social, relational).

Each ingredient, part of the 'natural capital', whether it is a raw material or already the result of a transformation process, is a resource whose potential must be exploited in the execution of the recipes (cultural capital) in order to realise the school meal (service) and the well-being it generates (benefit).

Even earlier, it is the result of an interaction between natural capital, i.e. the total stock of goods of natural origin that directly and indirectly provide goods (including food) and services of value to people (Costanza & Daly, 1992), and human capital, which in turn includes built capital, human capital and social/cultural capital (Costanza, 2020).

This interaction affects human well-being and is necessary for the survival of the environment that generates it. In its borrowing from the economic sector, capital should therefore be understood in physical and monetary terms and in terms of well-being that biodiversity provides to humanity, also in order to guide the choices of public policy makers.

Maintaining and improving human well-being therefore requires a balance between all our assets: individuals, society, the built economy and ecosystems. This rethinking of how we look at 'nature' and what we mean by capital is essential to solving the problem of how to build a sustainable and desirable future for humanity.

Just as we have learnt over time the importance of not separating the three main spheres of sustainability – environmental, economic and social – by adopting as ecocentric a perspective as possible (Lozano, 2008), so we should not separate the different essences that give substance to the word 'capital', for example by separating the natural from the cultural and human.

In the specific case of the school lunch, this revision also involves our approach to the ingredient, which should be understood not only as a productive input, but also as a source of nourishment to support the mental and physical well-being of the students, and as a tool for the protection, regeneration and improvement of the environment, culture, local area and community relationships.

Variables such as the method of production and its environmental impact, origin, seasonality, freshness, belonging to a system of knowledge and traditions that must be protected and preserved, the scale of production, the price's fairness, logistics and the ability to manage the ingredient efficiently and effectively within the balance of the meal and the menu take on a political value in the management of public life and the common good. It is necessary that all those who participate, from the selection to the management and transformation of the ingredient, are aware of the responsibility they bear and of the regenerative contribution they can make to the various capitals involved.

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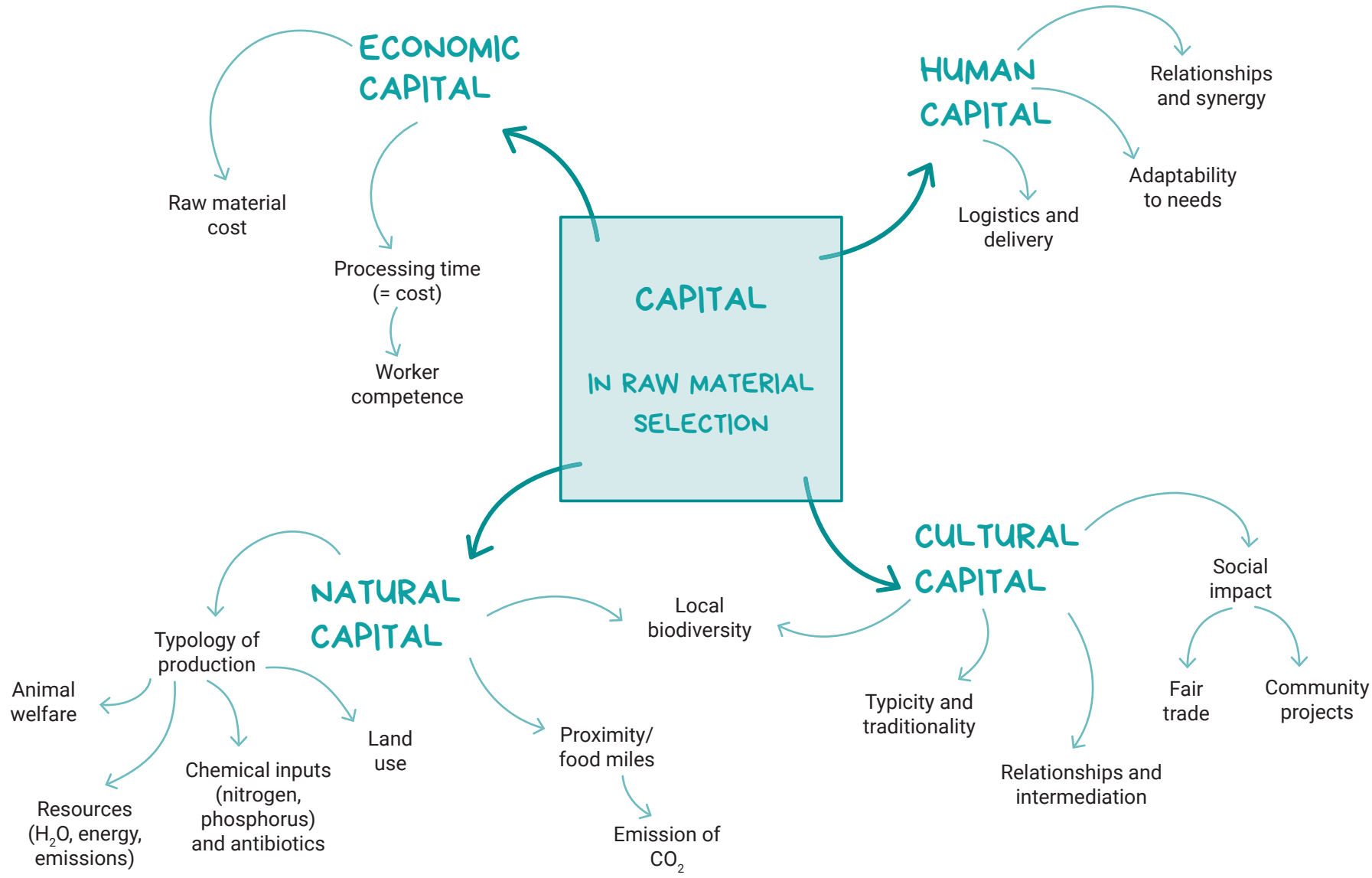
FIGURE 9: CAPITALS



by Nahuel Burraco

The ingredient as relationship

From a whole approach to semi-finished products

The concept of the 'Circular Economy for Food' can be applied in the kitchen through the sciences used in food processing, leading to a profound rethinking of the natural and cultural capital inherent in the ingredients and the processes and the knowledge that generated them and will contribute to the creation of the school meal. Looking at the recipe as more than just a list of raw materials and steps allows us to understand the relationships between ingredients and to achieve new end results. This awareness gives the cook a complex view of natural and cultural capital and transformation processes, allowing an interpretation that can enable us to eradicate the habits and standard operating procedures that automatically, and often unconsciously, lead us to use, transform and consume. Each ingredient can be seen as a functional element in the system, with its own role and potential that just needs to be identified and embraced. The philosophy behind 'Circular Cooking' is that there is no such thing as unconscious waste, only new ingredients and new possibilities.

EACH INGREDIENT CAN BE SEEN AS A FUNCTIONAL ELEMENT IN THE SYSTEM, WITH ITS OWN ROLE AND POTENTIAL

This idea translates into what can be defined as the 'whole ingredient' approach: each raw material must be considered in its entirety, defining the different parts that make it up and their characteristics and relating them to gastronomic transformation techniques for creating interrelated preparations. It is a system that, by its very nature, is not afraid of the unexpected, but is well suited to managing it. The idea is to transform each part of a plant and product obtained from a multi-purpose perspective, which means that by imagining multiple uses for a single element in the design phase, cooks have more ingredients and tools at their disposal for menu and recipe design.

This approach has been, and still is, common practice within the gastronomic culture associated with animal proteins. In fact, there are various strategies for making the most of all parts of the animal, such as brown or clear meat stocks, fish broths or bisques, offal stews or pâtés and many others, which stem from the popular cultural heritage of 'throw nothing away' or the more modern restaurant approach of 'from nose to tail'. Different rules seem to apply to vegetables. Because of their abundance and lower economic value, these ingredients are treated more superficially and the work/result ratio for their integral use is not considered worthwhile. But the world of vegetables is in fact very complex and full of possibilities; we need only think of all the biodiverse vegetables that each season offers. However, unlike for animals, there is no simple, common gastronomic classification. They can be classified by botanical family, by colour or by plant part (leaf, flower, stem, fruit, root, bulb, seed, pod). Each of these classifications provides useful information that can be applied in the kitchen. For example, looking at the different botanical families, we can learn that when their cell walls are damaged (by chopping, for example), brassicas (such as cauliflower, broccoli and cabbage) and alliums (such as garlic, onions, leeks and shallots) produce new aromas and flavours by enzymatic means, a factor that can be useful in managing the acceptance or rejection of these vegetables. For example, chopping a clove of garlic creates and releases a more intense, pungent and sometimes spicy flavour. But if the garlic clove is fully cooked and then chopped, the result is a sweet and aromatic paste. Colours, meanwhile, allow us to identify the type of pigment (chlorophyll, carotenoids, anthocyanins, lycopene) present in vegetables and thus to adapt the transformation process to preserve their bright colour, as in the case of chlorophyll in green vegetables like spinach, chard and courgettes.

CLASSIFYING INGREDIENTS IN ORDER TO USE ALL THEIR PARTS AND ADD VALUE THROUGH SEMI-FINISHED PRODUCTS

Finally, the classification by plant part, together with the other information, allows us to define the most appropriate processing techniques and the type of semi-finished product that can be obtained depending on the plant and its part. The effectiveness of a semi-finished product lies in its simplicity and versatility. The creation of an intermediate product without too many characterisations (e.g. sugar, salt, spices, transformation processes) defining its use expands the possibilities for each of these products and encourages combinations of semi-finished products. This method of working can therefore be useful both during the phase of planning purchasing and processing procedures and in managing storage and refrigeration. Finally, the semi-finished product can be a fundamental tool for the creation of interconnected menus, composed by combining several semi-finished products. For example, a thick puree obtained from a starchy vegetable (cauliflower, pumpkin or celeriac) can be combined with vegetable garnishes (such as seeds, powders or chips) obtained from peels, seeds and trimmings recovered during processing.

The diagrams below provide a guide to breaking down vegetables into their constituent parts in relation to the total weight of the starting ingredient for the production of different semi-finished products. Tomato, cauliflower, beetroot and spring onion are used as examples. Each part of the vegetable can be processed according to the optimum process, depending on its characteristics.

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FIGURE 10: FROM THE WHOLE INGREDIENT APPROACH TO SEMI-FINISHED PRODUCTS

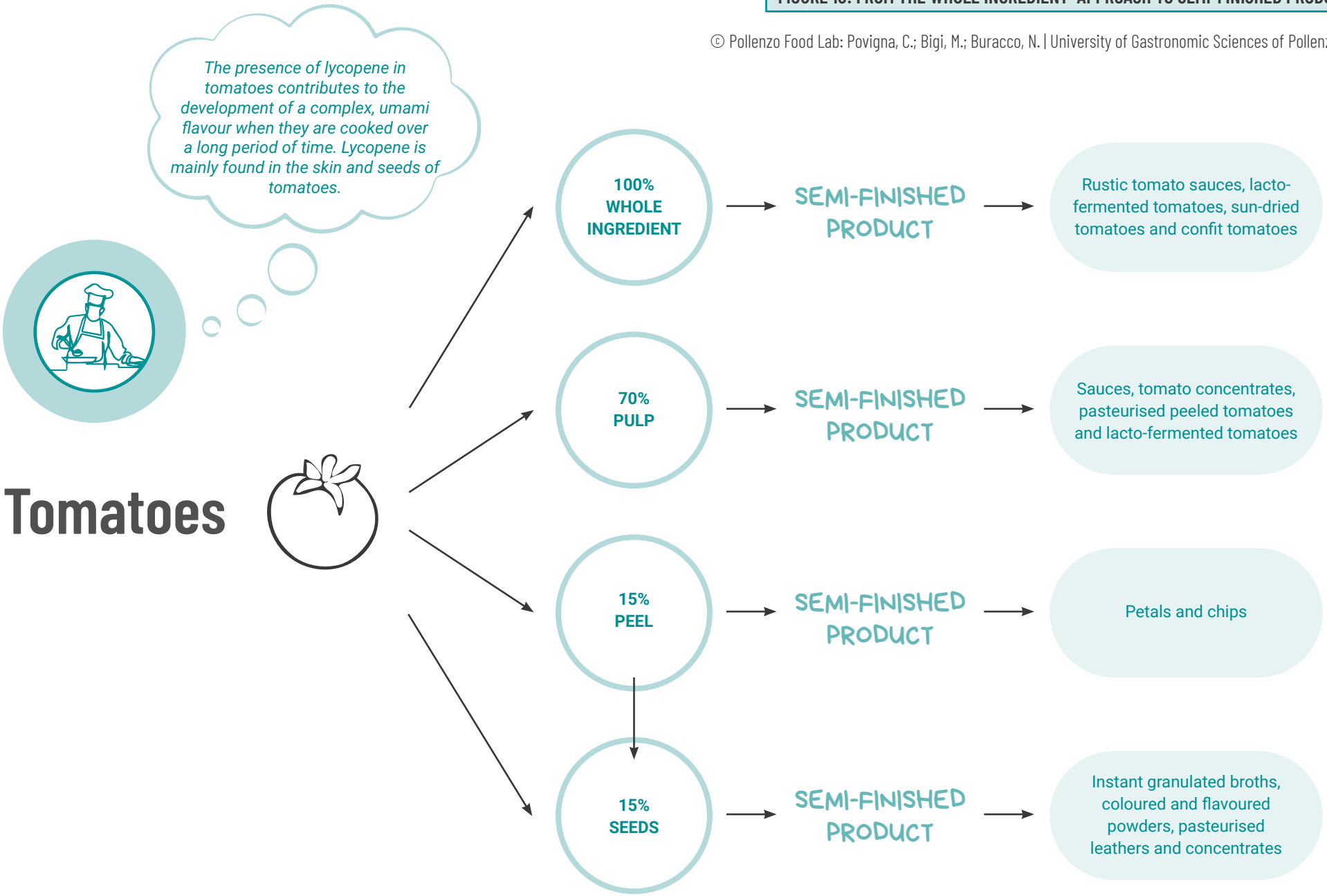


FIGURE 11: FROM THE WHOLE INGREDIENT APPROACH TO SEMI-FINISHED PRODUCTS

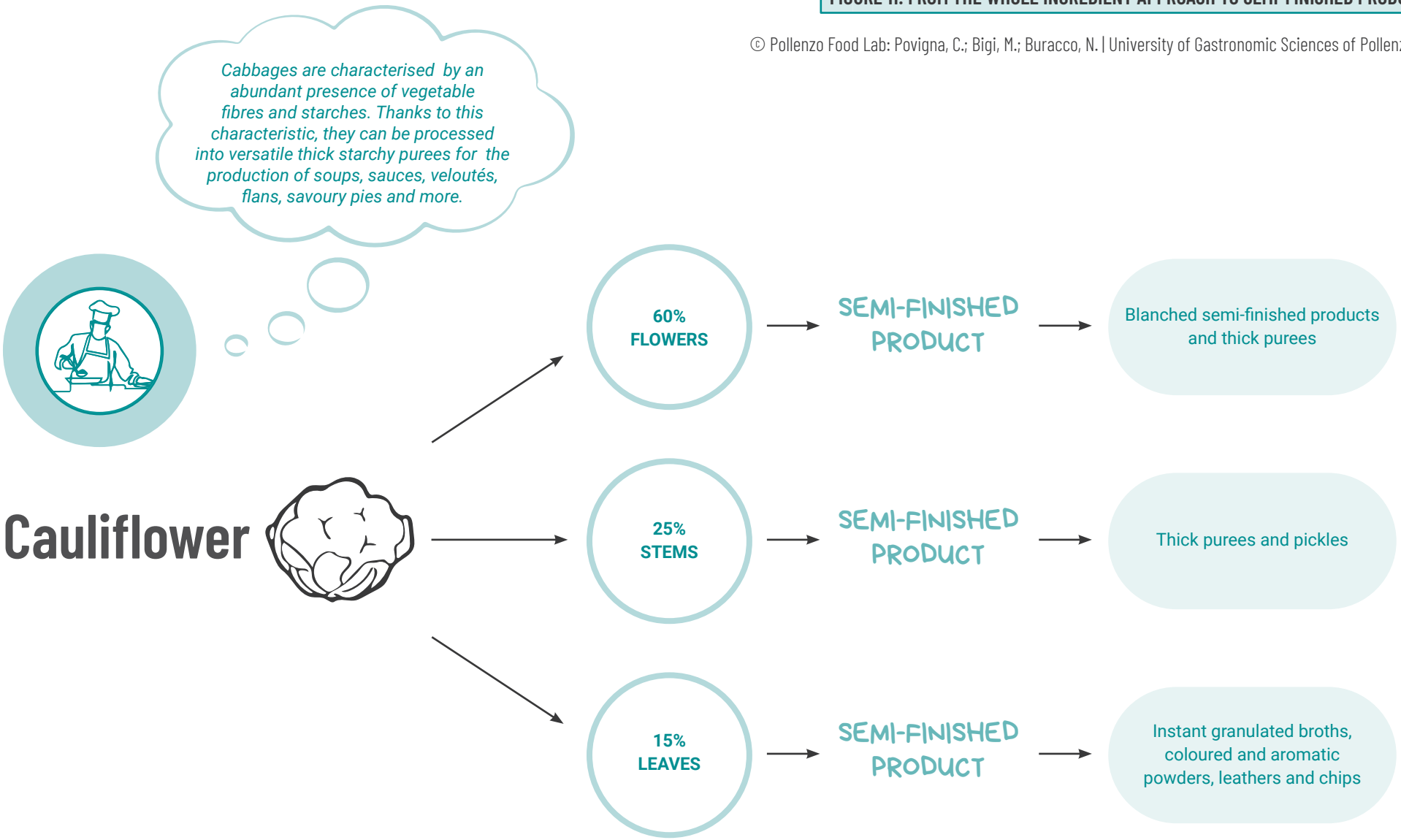


FIGURE 12: FROM THE WHOLE INGREDIENT APPROACH TO SEMI-FINISHED PRODUCTS

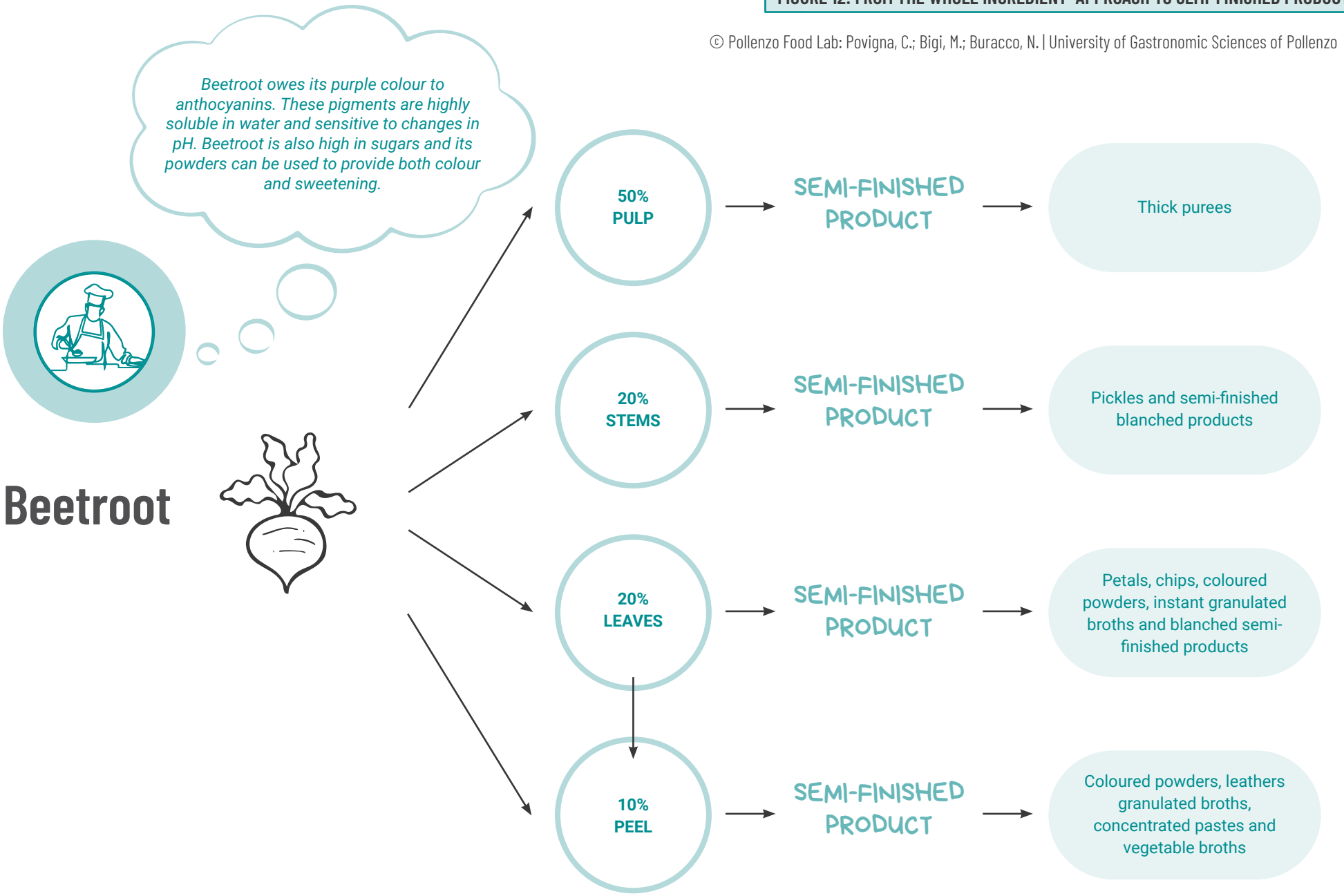
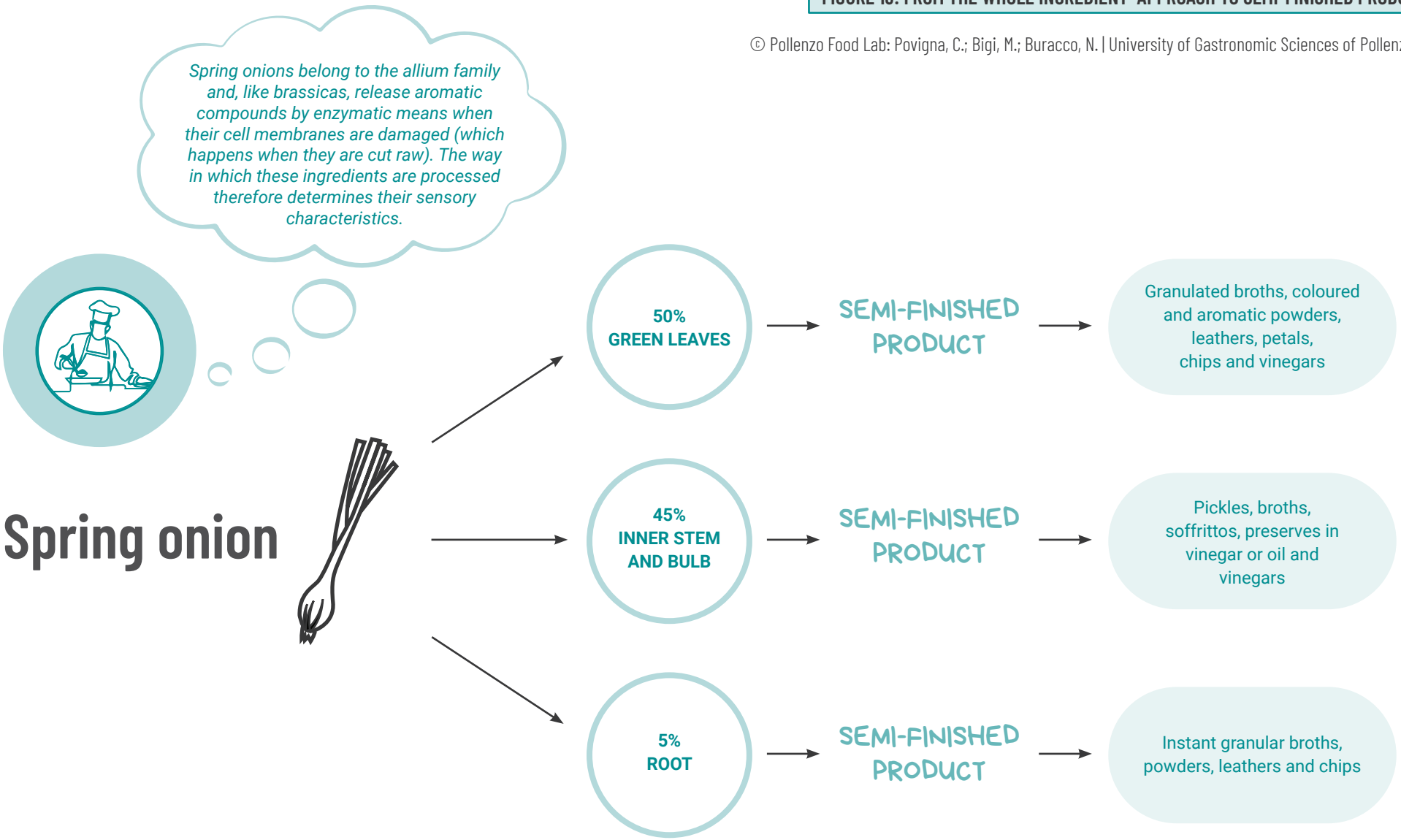


FIGURE 13: FROM THE WHOLE INGREDIENT APPROACH TO SEMI-FINISHED PRODUCTS



by Franco Fassio and Nadia Tecco

Cyclicality as an operational framework

Priorities for applying the circular economy in the kitchen

The circular economy, especially when applied to food, is achieved by rethinking the entire supply chain of a product or service in a regenerative way. The concept of 'cyclicality' is that operating mode that aims to reduce the negative impact of a product or service to zero, adopting ecodesign strategies to extend its life cycle, taking care to ensure that any waste (output) becomes a resource (input) for the same or other production systems and using energy from renewable sources as much as possible.

But what does 'cyclicality' mean in a school canteen, and what does it mean to use ingredients according to a circular logic?

In contemporary language, we are used to the term 'cycle' to refer to a phenomenon or a series of phenomena that occur in an orderly fashion and are repeated at more or less regular intervals (the cycle of the seasons, the lunar cycle, the water cycle). The circle is used to represent cyclicality, describing a sequence that is self-contained, has no precise starting and ending point and can be repeated indefinitely. Contrary to the line, which clearly defines start and end points and the distance between them, in the circle the process of transformation brings the system back to its initial conditions, infinitely regenerating itself.

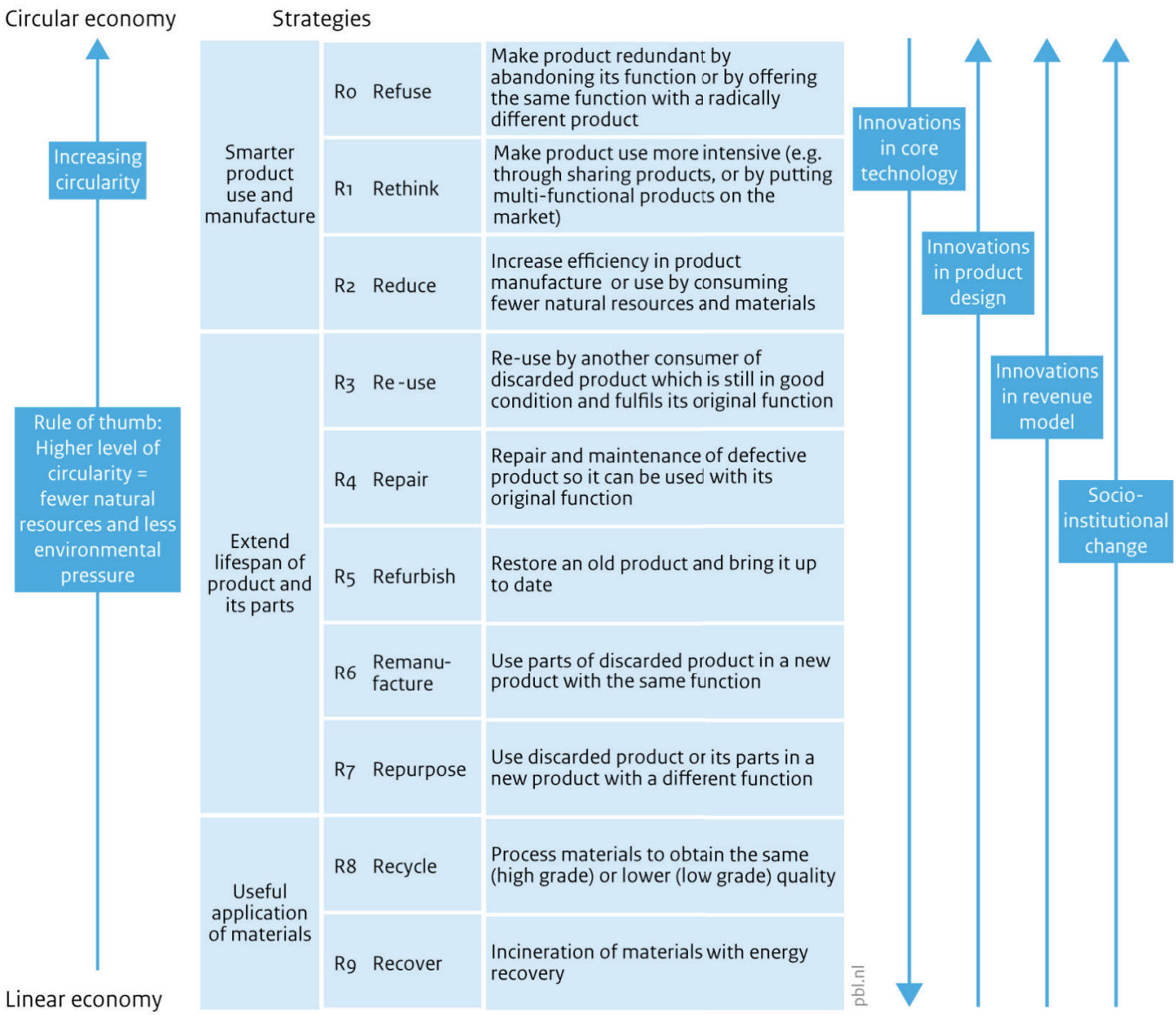
IN THE CIRCLE THE PROCESS OF TRANSFORMATION BRINGS THE SYSTEM BACK TO ITS INITIAL CONDITIONS, INFINITELY REGENERATING ITSELF

We know that, according to the second principle of thermodynamics, during the transformations of matter, entropy and the rate of degradation of the qualities of matter increase, leading to a progressive loss of value (downcycling). Applying the logic of cyclicality to the food system (including the different phases of production, as well as the production inputs, from ingredients to packaging, energy to water resources) might not eliminate waste completely. But it does at least make it possible to significantly reduce waste (which in turn reduces the need to extract and produce new resources) and to assign new values and meanings according to an upcycling logic (Aschemann-Witzel et al., 2023; Serventi, 2020) to what – through habit, standardised procedures or simply haste – all too easily becomes waste.

It is therefore clear that this is an approach that looks at waste and energy from a long-term perspective, in a preventive, regenerative, renewable way that must be managed to ensure that the natural capital at our disposal can also be used by future generations. They too must be taught how to keep it 'alive' for generations to come, and so on, in a cyclical way.

To do this, it is necessary to start upstream and try to apply some guidelines that, also in the context of school catering, can be translated into strategies to be implemented in order to make the system circular. In this respect, the '9 Rs' framework of the circular economy (Potting et al., 2017) can help us. This tool can be used to understand the priority of the actions that should be implemented, highlighting the importance of understanding that circular thinking goes far beyond the simple action of 'recycling'.
This classification has become increasingly relevant internationally over time.

Circularity strategies in order of priority



Source: Potting et al., 2017

Here they are ranked from the most relevant to those (R8 and R9) that can still be classified as belonging to a linear economic model:

0) REFUSE
Refuse to buy or produce new goods. We are called to protect and regenerate natural capital by trying to use it wisely.

1) RETHINK
Rethinking the way we produce, buy and manage a resource means questioning certain established habits that can be the main obstacle to sustainable development.

2) REDUCE
It is essential to reduce the pressure of our economic model on ecosystems. We must learn to use fewer raw materials and less energy to produce the same product, and understand how to minimise environmental impact and waste at all stages of the production and use of goods and services.

3) REUSE
Reuse means recognising and extending the value of a good over time by ensuring that when it becomes superfluous to its owner (a discarded but still functional product), it can be passed on to a new user without becoming waste, or its functionality rediscovered by the same person who wanted to throw it away.

4) REPAIR
Repairing and maintaining a product that is not working so that it can be used for its original function.

5) REFURBISH
A strategy aimed at restoring a defective product and updating it to perform the same function for which it was intended.

6) REMANUFACTURE
The use of discarded products or parts thereof in a new product with the same function.

7) REFURBISH
The use of discarded product's or parts thereof in a new product with a different function.

8) RECYCLE
To recycle means to make a second raw material of the same or lower quality from an existing product that is collected separately.

9) RECOVER
Recovering energy by incinerating materials.

As you may have noticed, the model actually uses 10 R's to explain the main actions that characterise the Circular Business Model, considering the action of 'Refuse' (R0) as the most noble, since it comes from a need to refute an economic model that continues to act as if our limits were infinite.

In conclusion, in line with the application of the 9/10 R's framework (Potting et al., 2017) adapted to the school food context, it will therefore be necessary, following a principle of relevance and priority, to move towards:

- more efficient production and use of raw materials and other production inputs (refuse, rethink, reduce)

- extending the useful life of the product and its components (reuse, repair, refurbish, remanufacture, repurpose)

- adding value to unavoidable waste/waste by incorporating it, where possible, into new production cycles (recycle, recover)

In the following chapters, we will analyse in more detail how cyclicality can be applied in the kitchen by adopting four main cycles: the pure cycle, the short cycle, the long cycle and the cascade cycle. These four operating modes put into practice what the 9/10 R's model suggests. These four main forms of cyclicality, understood as a continuous circular creation of value, apply to all processes and phases

and can be summarised as follows (in a form not yet applied to the kitchen, as we will do in the next chapter):

- **PURE CYCLES:** The ease of disassembly of a product and the purity of each of its components are relevant factors in enabling each part to be metabolised in biological or technical cycles. In practice, the more materials are designed to retain their purity, or at least to be easy to separate and recover, the more cyclicality can be translated into economically and environmentally beneficial flows. In order to generate maximum value, it is therefore necessary for the raw material to have a certain purity (e.g. no pesticides on the peel) and for the product and its components to have a good quality so that they can be valued in their entirety.

- **SHORT CYCLES:** These can be defined as short in that the material re-enters the production process in a limited space and time. Since the cost of collecting, reprocessing and restoring a product, component or material is lower than the linear alternative, implementing short cycles is highly advantageous from an economic point of view and the benefit increases as resource prices rise.

- **MULTIPLE OR LONG CYCLES:** The benefit comes from keeping a product, component or material in use for as long as possible. This can be done either by running several successive cycles or by spending more time within a single cycle. Prolonged use obviously replaces virgin material flows and counteracts the dispersion of materials from the active economy.

- **CASCADING CYCLES:** The creation of value from the use of a pure raw material can also be achieved by using it in successive cycles belonging to the same industrial sector or even to different sectors. By adopting a symbiotic logic between two different industries (industrial symbiosis), the raw material is used in its entirety, minimising the possibility of generating waste.

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by Carol Povigna

Pure, short, long and cascade cycles

How to apply cycle theory in the kitchen when designing a menu

The concept of upcycling, in its most widespread and common sense, refers to waste that has already been produced and that, thanks to commitment and creativity, can be reinterpreted and have value added to it so it can re-enter the production chain and be re-signified and re-functionalised (see, for example, tyre rubber transformed into belts, empty plastic containers into decorative vases, etc.). Meanwhile, cyclicality applied to food and particularly to ingredients can allow us to systematise and completely redefine our approach to gastronomic transformation.

In the past, whether in ordinary homes, professional contexts or the kitchens of the wealthy, food waste did not exist, and every gastronomic tradition is full of examples that demonstrate this. Stale bread was used to thicken soups, to pad out meatballs or to cover and protect delicate ingredients during cooking; meat was reworked over time in almost endless upcycling processes. An Irish verse is emblematic in this regard; the subject is roast lamb, served:

"Hot on Sunday, Cold on Monday, Hashed on Tuesday, Minced on Wednesday, Curried Thursday, Broth on Friday, Cottage pie Saturday"

The pie – from Sunday's hot roast – is now more commonly known as shepherd's pie (the very similar cottage pie is generally made with beef). The meat, whose juices have been extracted in Friday's broth, is topped with mashed potatoes (perhaps also leftover) and broiled to turn it into something appetising.

THE FOUR CYCLES (PURE, SHORT, LONG, CASCADE) REPRESENT DIFFERENT WAYS OF PLANNING THE USE OF RAW MATERIALS: THEY COEXIST IN THE DESIGN OF A MENU STRUCTURED OVER SEVERAL DAYS, AIMING TO ENHANCE EACH PART OF AN INGREDIENT

The four cycles defined by the circular economy, applied to food, come to our aid in today's world, where many of the motivations of the past have disappeared: hunger and scarcity are no longer the driving forces of gastronomic imagination, and much of the knowledge and skills typical of traditional cuisine have been forgotten. However, new motivations and a new awareness of our relationship with the environment and our responsibility to the community make it necessary not only to invent (or reinvent) dishes in which leftovers take on new forms, but also to change the way we cook. The ingredient, as an object of value, is edible in its entirety, and as such, thanks to the skills of transformation, it must be interpreted in its entirety. Those involved in the processing are familiar with the by-products of each transformation, which lend themselves to further processes of great interest for the definition of sensory profiles oriented towards acceptance and enjoyment. Perishable consumable products, such as bread and dairy products, are versatile and functionally suitable for multiple processes. We have technologies to support storage and guarantee temperature maintenance, we have the possibility to plan work by using semi-finished products in the menu and, overall, we are able to prevent waste instead of managing it.

The four cycles represent different ways of planning the use of ingredients and are a lens through which to construct a dish and organise the mise en place (and therefore the work). They coexist in a menu structured over several days, since the variable that differentiates them is the distance (temporal and/or spatial) that elapses between the critical moment in which the waste could occur and its re-entry into the system. It is therefore common for some ingredients used in the preparation of a dish to produce no waste and to be used in their entirety (pure cycle) and for others to be used, in their various parts, in different dishes within

a single day (short cycle) or over several days (long cycle). Finally, the kitchen, which fits into a dense network of relationships that link it to food production and the community, can lend itself to a re-adding of value as the result of exchange, transforming by-products from other production lines in the same centre or from neighbouring businesses (cascade cycle). Let us take a closer look at each of the four cycles to better understand their application as a design tool in the kitchen.

Pure cycle

The pure cycle emphasises the value of the raw material in its entirety: each part of the ingredient is used functionally within a single dish, recognising the role and value of all the elements that make up the dish. The sensory quality of the ingredient as a whole is emphasised, its nutritional properties are preserved through careful processing and it demonstrates in a practical way that contamination with additives and other processed ingredients is unnecessary, since the ingredient itself offers all the possibilities for creating a product of value. The purity of the resource is thus maintained throughout the processing steps.

Take celeriac, for example. The preparation process begins with thorough washing, followed by the removal of the irregular, fibrous skin. The starchy inner heart is sliced and the edges of the slices trimmed to obtain regular rectangles or rhombuses that can be cooked as steaks. So far, we have three parts: the skin, the outer flesh and the inner heart. The skin can be roasted in the oven to develop the aromas and flavours characteristic of Maillard reactions, then immersed in water for extraction at 80°C and the resulting liquid concentrated by evaporation to obtain a richly flavoured glaze. The remains of the roasted peels are rich in cellulose and fibre and have been softened by the long infusion process. Once pureed, they make an excellent base for a sauce, emulsified with extra-virgin olive oil and the peel cooking juices. While the celeriac heart steaks are steamed and then roasted (in a pan or in the oven), some of the trimmings are julienned and candied in a 2:1 syrup of water and sugar, while the rest are boiled and mashed with some of the cooking water to make a creamy sauce. This interpretation of celeriac can then be composed with the creamy sauce as the base, the celeriac heart steak, the emulsified sauce and the candied strips. Finally, a drizzle of glaze is added to enhance the flavour.

The case of celeriac is an example of how the only other ingredients used in the recipe are oil, salt and sugar. The elements that give the dish different textures, aromas and flavours all come from the ingredient itself. There is no need to complicate the recipe with other processed products, nor to alter the purity of the base ingredient.

In a context such as a school canteen, this type of recipe can be developed with the collaboration of pupils, involving them in the analysis of the parts that are usually thrown away and encouraging them to question the reasons why: if the peel is discarded because it is fibrous, what elements of interest can we find in its composition and what cooking processes can be used to minimise the negative qualities and instead extract its full sensory and nutritional value?

Short cycle

The short cycle is realised in a context of physical and temporal proximity, when there is spatial and temporal continuity between the moment when an output from the production system (waste) could be generated and when it can re-enter into the same system (becoming a resource). In other words, the by-products or waste generated from the preparation of a dish are used to prepare another recipe on the same menu or on the same day.

To give a practical example, when the school year starts in late summer, peppers are in season. Along with carrots, potatoes, aubergines and courgettes, the flesh of the peppers can be sliced and sautéed to be used in any local stewed vegetable recipe (like ratatouille) as a starter or main course. The irregularly shaped tops and tails of the peppers can be roasted in the oven, then separated from the skin (either by hand or with a food mill) and pureed. The liquid released during the roasting process can be strained and concentrated to be used as a flavouring liquid. The pepper skins, once removed, can be dried. The puree and liquid can be used to make a pepper risotto (or couscous or timbale), while the dried skins can be used as petals to garnish and flavour the ratatouille. It is therefore possible to have two dishes on the same menu that both use peppers, with the trimmings from the ratatouille (the tops and tails of the peppers) used for the risotto and the skins leftover from the risotto's puree used to flavour the ratatouille. There is maximum proximity in time and space, and even in this case the contamination is minimal, but what is important is that one recipe – and its by-products – leads to the other dish on offer.

Long cycle

In the long cycle, the output is used in successive cycles, spread over several days, menus and consumption opportunities. The same ingredient is used in a variety of preparations and any by-products are used as resources in other dishes on the following days. This is what happens in menus planned on a weekly or monthly basis: the ingredient is broken down into its constituent parts and used as required, and a careful analysis of the various products resulting from the cooking processes allows the re-channelling of cooking liquids or semi-finished products that require lengthy preparation. A simple example is the use of half or whole animals which, once cut up and stored, can be offered in various preparations over a relatively long period: this strategy allows a policy of cost containment and maximises the use of the resources used in production and processing, reducing the negative impact of meat consumption. The same approach – using semi-finished products produced in-house – can be applied to vegetable products.

Let us assume that in autumn we have a large quantity of pumpkins available. The local supplier has harvested the local variety, which has a particularly interesting sensory and nutritional profile, and has no way of storing it. Their only option is to sell it in bulk at a reduced price. In this case, the virtuous intervention can be to take the whole batch of pumpkins and process the peel, seeds, filaments and flesh separately. The skin can be used as the base for a vegetable broth, as already described for celeriac, and the resulting liquid can be used to reduce the amount of salt added to a barley and autumn vegetable soup offered on Monday. The flesh,

once boiled or steamed, can be pureed into a thick cream which, with the addition of eggs and milk, can be used to make a flan served with a cheese sauce (and, why not, cauliflower stalks). The seeds are dried and separated from the filaments. The latter can be ground and added to a dough for focaccia (or sweet rolls) served on Wednesday, while the seeds, after being toasted, can be used to make crackers or biscuits for Thursday's snack.

Cascade cycle

The cascade cycle occurs when the transition from output to input takes place between two distant segments (e.g. two production lines in the same production centre or two production centres in the same company supplying different canteens or educational establishments) or belonging to different sectors (e.g. the school canteen and a food production company located nearby). In this case, the waste from one production line cannot be processed within the system itself for various reasons (availability of equipment, safety guarantees, storage limitations), but represents a useful resource for another production context that has an appropriate structure to manage it and add value. Leftover food from a school canteen can be donated to charitable organisations or, less favourably, used to produce animal feed or compost (downcycling). The cascade cycle requires the establishment of stable relationships between different actors in the same community to facilitate mutual exchange and support. Managing these relationships requires a great deal of effort, analysing mutual needs and defining procedures to ensure the safety of the output to be reused, but once a proper network of exchange has been developed, the cascade cycle represents the very essence of the extended community taking up the challenge of a healthy and sustainable diet.

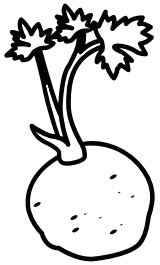
Imagine, then, that a collective catering service is responsible for managing the meals as well as the café space in a school. In this case, the processing lines serving the two centres are likely to be separate and autonomous, each with its own supply network and the need to manage its own processing waste. In a logic based on cyclicality, the work groups in the two areas could benefit from dialogue and cooperation in order to add value to their respective processing by-products: trimmings from fruits and some vegetables could become compotes for healthy and seasonal snacks in the cafeteria, while citrus peels from juices could go to the kitchen where they could be transformed by an enzymatic process into a sweet-and-sour paste to be used to enrich salads or sauces.

Figures on the next page

FIGURE 14: PURE CYCLE

Pure cycle

The pure cycle is all about maintaining the purity of the resource at the various stages of the value chain, and in particular its quality, as well as the nutritional and sensory properties of the foods in a meal. It is therefore also reflected in the techniques used to prepare the meal.



Celeriac

PEELS → BROTH → USED-UP PEELS → EMULSION

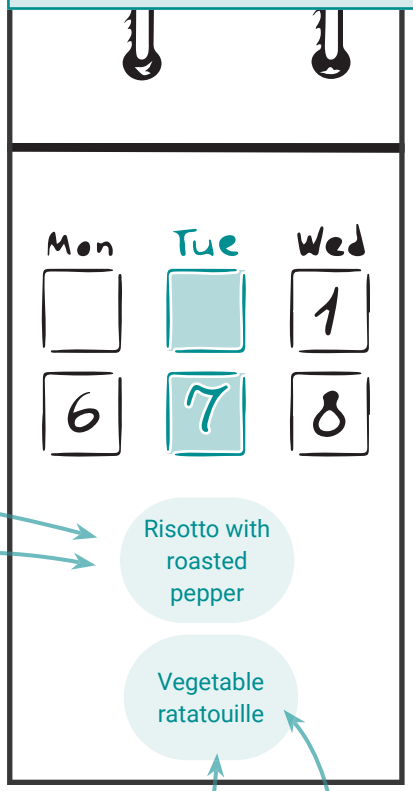
PULP → STEAK → SCRAPS → THICK PUREE

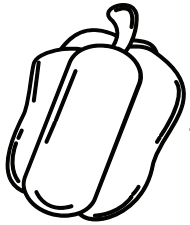
SCRAPS → CANDIED STRIPS/ CHIPS

FIGURE 15: SHORT CYCLE

Short cycle

A short cycle exists when there is physical and temporal proximity between the points of output (waste) and re-entry into the production system (resource).





Pepper

PULP

THICK PUREE

SAUTÉ

FILTERED LIQUID

BROTH

USED-UP PEELS

FIGURE 16: LONG CYCLE

Long cycle

There is a long cycle if the time of use of the output (waste) is increased by improving it over several successive cycles.

Pumpkin

PEEL → BROTH

PULP → THICK PUREE

FILAMENTS → POWDER

SEEDS → CRUMBLE

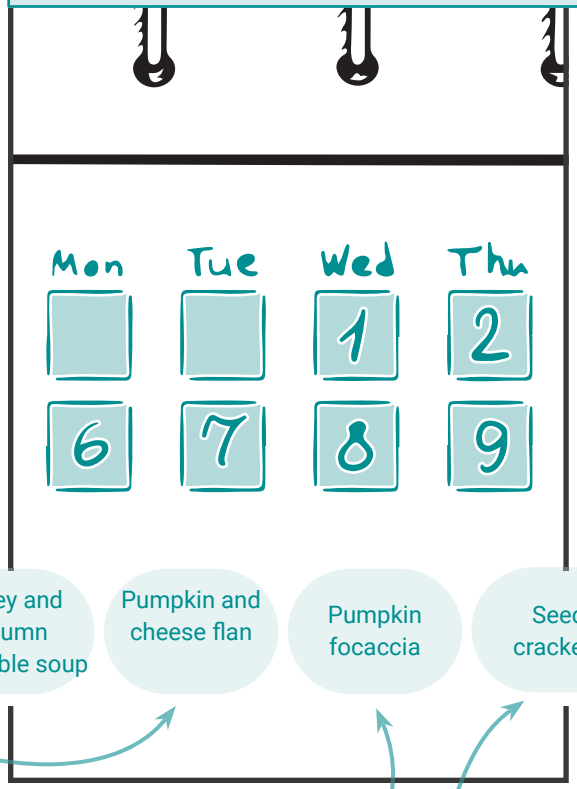


FIGURE 17: CASCADE CYCLE

Cascade cycle

In a cascade cycle, there is an upcycling (ideally) or downcycling (less preferred) of output-input between distant segments within the same value chain or belonging to different value chains (different industries).

Artichoke

HEART

STALK

Artichokes in oil

Artichoke and potato pie

by Nahuel Buracco

Matching raw materials, processes and technology

Gastronomic change as a function of ingredients

Credit: Photos by Mockup Graphics on Unsplash

A PROPOSAL TO ADD VALUE TO INGREDIENTS BY INTERPRETING COMPONENTS, FUNCTIONS AND TRANSFORMATION PROCESSES

A more conscious approach to food – an awareness of the criteria for selecting ingredients, their characteristics and the macro- and micromolecules involved in the chemical reactions that take place between ingredients during handling – allows the cook to act on flavours, aromas, textures and colours. This is a replicable and systematic way of working, in which the local environment, local resources and communities are strengthened through the generation and dissemination of good practices that can be applied to the construction of sustainable diets. From this perspective, the relationships between people, ingredients, processes, available technologies, consumption opportunities and social, environmental and economic impacts are strongly interrelated.

The 'whole ingredient' approach, applied to both plant and animal products, makes it possible to obtain semi-finished products that use 100% of the raw material, very often replacing products that would otherwise have to be specially ordered and purchased.

Vegetables are classified according to the botanical family to which they belong, their colour and their composition. This last classification allows us to deduce the gastronomic use and, in addition to the other information, to identify the macro- and micromolecules present in a given vegetable or in a single part of it. Aware of the limits, variables and possibilities, we can design a transformation process that takes them into account and relates them to the daily work of a cook and the equipment in the kitchen. The result will be semi-finished products, recipes and menus that are 'systemic' in the sense that they are in dialogue with each other.

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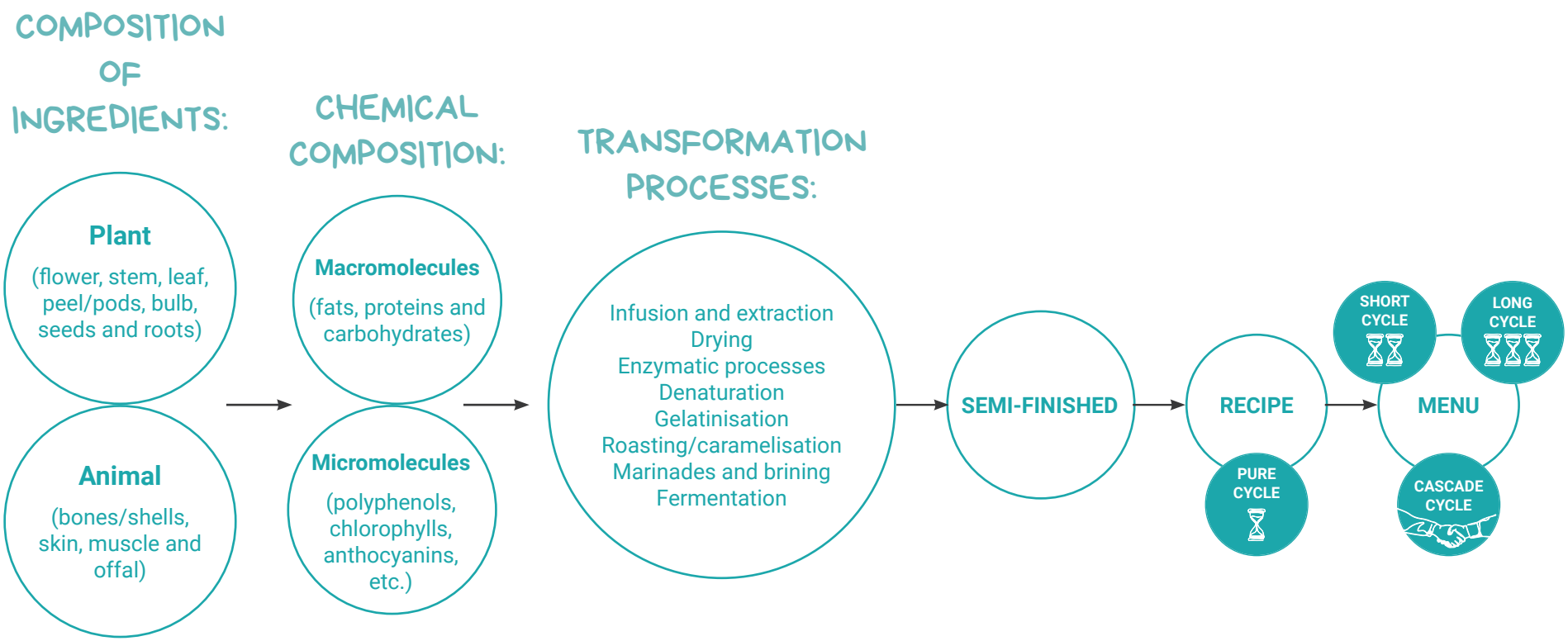
FIGURE 18: GASTRONOMIC TRANSFORMATION ACCORDING TO THE INGREDIENTS



Let us take a practical example by analysing spinach, a vegetable generally used as a side dish, often taken for granted and not appreciated. Its dark-green colour and earthy taste make it difficult to include in a school canteen menu without bringing grimaces of disgust to some faces. However, spinach is in fact a versatile vegetable with many uses in the kitchen.

spinach → green leaf → fibre, chlorophyll, organic acids and minerals

On the basis of this information, it is possible to define the most suitable processing method for the vegetable. The various possible transformation processes with their different roles come into play, such as:

infusion and extraction → extraction of the coloured compound → natural colourant

drying → in oven or dryer to reduce aw → stable dry compound

enzymatic processes → short cooking in boiling water for enzyme inactivation (T°>70°C) → blanched semi-finished product with bright colour retained

Fresh finished products can be stored at a low temperature for a few days or frozen for a long period. Otherwise, in the case of a dry product, room temperature in closed containers is sufficient.

The various semi-finished products obtained can be used as ingredients in many recipes and thus introduced into a menu system. Here are some different options:

natural colouring → vegetable and animal fats, coloured sweet or savoury doughs

stable dry compound → coloured and aromatic vegetable powders or chips, instant granulated broths

blanched semi-finished products → ready-to-use vegetable garnishes and vegetable purees for the production of meatballs, flans, soups and sauces

Similar operations can be carried out for each ingredient and its components. Menus are thus created by combining products according to their functions.

In the following tables we have listed the components of the ingredients with their chemical composition, suitable transformation processes and the semi-finished products that can be obtained. These are tools that cooks can then apply to the creation of recipes and menus, drawing on their creativity and know-how.

FIGURE 19: STUDY OF RAW MATERIALS AND PROCESSES FOR THE PRODUCTION OF FUNCTIONAL SEMI-FINISHED PRODUCTS

COMPOSITION		MACRO- AND MICRO-MOLECULES	PROCESS	SEMI-FINISHED PRODUCTS
PLANT	FLOWER	Carbohydrates (polysaccharides and fibre), colourings, flavourings	Enzymatic processes	Blanched semi-finished products (green broccoli florets)
			Drying	Dried flavourings, spices and broths (made with herbs and flowers)
			Fermentation	Lacto-fermented vegetables
	STEM	Carbohydrates (polysaccharides and fibre), mineral salts, flavourings	Enzymatic processes	Blanched semi-finished products (green broccoli florets)
			Drying	Powders, petals, leathers, chips
			Infusion and extraction	Aromatic fats
			Fermentation	Pickled vegetables, vinegars
	LEAF	Carbohydrates (fibre), colouring and aromatic compounds, mineral salts	Infusion and extraction	Extracts of coloured and aromatic compounds (chlorophyll), aromatic fats (pesto), hydrolates
			Drying	Dry powders, aromas and spices, dry marinades (dry rub), instant granulated broths, petals, leathers, chips
			Enzymatic processes	Flavourings, blanched semi-finished products
	PEEL/ PODS	Carbohydrates (polysaccharides and fibre), minerals	Gelatinisation	Thick purees
			Infusion and extraction	Concentrates (pumpkin peel paste)
			Drying	Powders, petals, leathers, chips
			Roasting/ caramelisation	Vegetable broths
			Fermentation	Vinegars
			Enzymatic processes	Saporita
	BULB/FLESH	Carbohydrates (polysaccharides and fibre)	Gelatinisation	Thick purees (cauliflower cream)
			Infusion and extraction	Concentrates (tomato paste)
			Fermentation	Fermented vegetables
			Roasting/ caramelisation	Vegetable broths, soffrittos
	SEEDS	Fats, carbohydrates (polysaccharides and fibre	Drying	Dried seeds, puffed cereals, crumble, granola, crunchies
			Fermentation	Miso, soy sauce
	ROOTS	Carbohydrates (polysaccharides and fibre)	Drying	Powders, dried broths, chips
			Enzymatic processes	Saporita

SCHEME 20: STUDY OF RAW MATERIALS AND PROCESSES FOR THE PRODUCTION OF FUNCTIONAL SEMI-FINISHED PRODUCTS

COMPOSITION		MACRO-NUTRIENTS		
ANIMAL	BONES	Proteins and fats	Roasting/ caramelisation	Meat and fish stocks
			Enzymatic processes	Garum
	SKIN	Fats	Drying	Chips
	MUSCLES	Proteins and fats	Marinating and brining	Wet marinades, dry marinades, acid marinades and proteolytic marinades
			Enzymatic processes	Frying
			Denaturation	Reverse searing
	OFFAL	Proteins and fats	Enzymatic processes	Garum
			Denaturation	Reverse searing

by Matteo Bigi

Strategies for progressive exposure

Acceptance techniques and their practical application in the kitchen

WHEN IT COMES TO THE INTRODUCTION OF UNFAMILIAR OR DIFFICULT FOODS, A PLAYFUL EDUCATIONAL EXPERIENCE BECOMES FUNDAMENTAL AND COMPLEMENTS THE TASTE EXPERIENCE

Having described the phenomenon of progressive exposure as a strategy for reducing the distance between younger generation and foods subject to rejection and mistrust in the context of school meals, it is now useful to examine the main techniques for promoting acceptance and their practical application in the kitchen. We know that individuals tend to react differently to an unfamiliar stimulus: either by rejecting it (neophobia) or by being curious and open to novelty (neophilia). Here we examine the situations in which, when faced with something unfamiliar, rejection tends to be used as a weapon of self-defence (this attitude is entirely instinctive and not exclusive to the food sphere or to children). In the first chapter, we looked at the natural inclinations and aversions of human beings to certain tastes. However, we learnt that the judgement of a food or a dish is something more complex and cannot be attributed to the sense of taste alone. Rejection of a food is not an a priori judgement, but rather the sum of each individual sensory evaluation of that particular food. Therefore, in order to implement useful strategies to curb this dynamic, it is necessary to be able to identify the specific characteristics that indicate aversion to that particular food. The green colour of vegetables, the strong smell of blue cheese, the slimy consistency of mushrooms or the bitterness of coffee are examples. Let us now look at some solutions to ensure a high proportion of positive exposure to a food.

CAMOUFLAGE

Camouflage is based on identifying the specific sensory characteristic of a food that could potentially alarm an unfamiliar audience, then disguising it within a culinary preparation that is already familiar and therefore accepted.

Let us take broccoli: this vegetable, particularly controversial for its green colour and sulphurous taste, is, like other brassicas, a great source of vitamins, minerals and, in particular, sulforaphane, a powerful anti-cancer agent. Given that a green colour is one of the main deterrents to vegetable consumption among children (Foroni et al., 2016), it may be useful to target its appearance and taste. For example, finely chopped raw broccoli florets can be incorporated into the mix to form vegetable meatballs. The general concept of a meatball – be it actual meatballs, potato croquettes or chickpea falafel – is certainly one of the most popular. But why? There's their round shape, the possibility of eating them with one's hands, their double texture of crispy on the outside (a signaller of umami flavour) and soft on the inside: all attributes that ensure a food preference.

The idea is to gradually introduce a vegetable in an initially minimal amount, then progressively increase the quantity, with the aim of raising the threshold of acceptance. The underlying discourse is therefore about the possibility of using camouflage to change canteen meals gradually over the course of the school year, rather than imposing a drastic and sudden change in menus. But back to broccoli. By using a familiar and popular shape such as a meatball, we can begin to introduce a vegetable ingredient, reducing the final caloric intake and diluting the vegetable's colour and flavour with the other ingredients in the mix. At this point, why not accompany the meatballs with a starchy puree of boiled broccoli stalks and a carrot sauce?

According to this logic, the design of recipes and menus is a function of the public's familiarity with the ingredients to be proposed: hence the need to identify the preparations that are most familiar and appreciated by the public we are targeting (which age group? which gastronomic culture?). Beyond the proposed example of a recipe, it is important to be able to extrapolate a versatile model that allows us to design a path of gradual approach and exposure to certain stimuli during the school year. Note that what has been said so far is not intended as an invitation to hide from the child the true nature (appearance, texture, taste, etc.) of what would otherwise be easily rejected. Rather, it is a way of opening a dialogue, creating an approach and hopefully saving some waste. In fact, it is worth remembering that this technique, both at home and in the canteen, sees its effectiveness (also) in the decreasing progression of its use. In other words, the techniques described are preparatory techniques for creating a habitual familiarity with a healthy and varied diet, so they can be reduced and then stopped once the child has acquired a certain degree of familiarity with the food.

HABITUATION

When it comes to proposing the consumption of novel foods, a strategy widely used in experimental designs in the recent scientific literature is associative conditioning (Anzman-Frasca et al., 2012). This consists of proposing a stimulus by associating it with a food that tends to be liked. The first is what is known as flavour-flavour learning, which consists of associating the taste of a food that tends to be difficult to accept with a flavour to which we are naturally predisposed: for example, foods that have a strong bitter or sour character paired with others that are sweet or rich in umami. Similarly, flavour-nutrient learning involves associating sources of calories to which we are naturally attracted, such as fats, with the same novel stimuli that are a barrier to food acceptance. An equally recurrent strategy, used as a control for the first two conditions described, is 'mere exposure', in other words the repeated presentation of a stimulus as it is (without any flavour association) over time. In this respect, we know that, for a vegetable, depending on how the stimuli are presented, it tends to take about seven to eight positive episodes to increase intake (Hausner et al., 2012; Caton et al., 2014) and thus to ensure future acceptance and maintenance of the same result over time.
Other studies of novel food introduction have focused on the concept of positive exposure, which involves visual analysis and tasting of the unfamiliar food, followed by a positive response from the child. In children of around six years of age, the number of positive exposure trials required to accept a food increases to between 10 and 15 trials (Birch et al., 1987; Dovey et al., 2008).

Whether through mere exposure or associative conditioning, we can consider offering our vegetables (or any other food that is difficult to introduce) in gradually increasing amounts over time as part of an exposure project during the school year. The idea is to introduce the food in very small, even imperceptible, doses to begin with and then increase the amount over time to build up tolerance. At the same time, progressive exposure refers both to the increasing amount that appears on the plate and to the level of visibility and recognisability of the ingredients

themselves: vegetables and legumes can first be incorporated into a dish (e.g. as flavour enhancers) and then gradually made more recognisable and left closer to their original appearance.

Furthermore, to support the gastronomic design of meals, recent studies show how episodes of positive exposure can also result from situations in which the stimulus is presented in visual form, in a playful and experiential moment, such as reading an e-book (Masento et al, 2023). This enriches the concept of progressive exposure by extending the possibilities of positive exposure before or during the actual gastronomic encounter.

SELF-DETERMINATION

Some of the most important pedagogical approaches in use today agree on the importance to development of an individual being able to fully and freely express themselves (see, among others, the Montessori method and the Reggio Emilia approach). Similarly, when it comes to children's diets, scientific studies are beginning to provide evidence of the importance of allowing young people to express voluntary and self-determined choices in constructing their relationship with food. It is therefore strategic to give children, where possible, the space to personalise their meals, so that they are directly involved in the production and composition of what they are going to eat. This allows the individual to express themselves through the search for deliciousness and their own food preferences. This strategy is based on the assumption that we (only) eat what we like, so it is good to have a small degree of involvement in the creation of our meals according to our tastes. Returning to the food industry, this dynamic is widespread in restaurant formats that allow for the customisation of a meal, sometimes to an extreme degree, offering a wide range of possibilities within the individual variables that make up the meal.

In the third chapter on active learning, thinking about the meal, service methods and the school canteen environment, we will look in more detail at some of the strategies for self-determined food choice by young people.

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by Carol Povigna

Sustainable and healthy menus

Advantages to work-process optimisation and progressive exposure and practical examples

THE MENU IS THE TOOL THAT MAKES IT POSSIBLE TO PUT INTO PRACTICE THE PRINCIPLES AND METHODS OF PROGRESSIVE EXPOSURE AND CYCLICALITY, SO THAT AN OFFERING CAN BE DESIGNED AND IMPLEMENTED THAT CAN TRANSFORM THE DIET OF A LARGE PART OF THE POPULATION INTO A HEALTHY AND SUSTAINABLE WAY OF LIFE

The menu is the tool that makes it possible to put into practice the principles and methods of progressive exposure and cyclicality; in fact, it makes it possible to design and create an offer that, representing the diet of a large part of the population, can be transformed into a healthy and sustainable lifestyle.

The construction of an educational and circular menu begins with the identification and selection of the ingredients used in the various offerings. It is not a question of choosing recipes, but of highlighting the context: the surrounding local area should be the first source of supply. What products and varieties are available in the area during the current season or period for which we are planning? Are there virtuous supply chains, conscious producers or biodiversity that culturally deserve to be supported and promoted? These initial questions, which set the boundary within which to make purchasing choices, allow us to start working on foundations that have less impact in terms of emissions (seasonality, organic production, short supply chains) and greater value in terms of cultural and economic impact on the community.

The number of products from which to start must be limited, and any additions can only be assessed at a later stage, after considering the possible recipe variations and the need to introduce a new ingredient. In fact, the smaller the number of inputs to our menu, the less waste to manage and the greater the possibility for adding value. And that's not all: a smaller number of raw materials allows us to focus our efforts on creating direct and positive relationships in the supply chain for all those involved, both in economic terms (reducing the burden of intermediaries and transport) and in terms of quality (freshness, nutritional value, reduction in packaging, etc.). Seasonal products that are cooked a few hours or days after harvesting are richer in micronutrients, do not require energy or other inputs for storage and are, quite simply, tastier.

In addition, when choosing the limited number of ingredients on which to focus, the weight of each ingredient must be made according to the following general distribution: vegetables and fruit 50%, protein (preferably plant-based) 25%, carbohydrates (preferably whole grain) 25%. This macroscopic breakdown makes it possible to ensure the correct intake of nutrients in the menu: it is not the dish or the individual meal that must be balanced, but the whole diet, understood as a food lifestyle. A greater availability of vegetables and a reduced presence of animal proteins and refined sugars, for example, effortlessly leads to the development of a health-oriented and wellness-focused proposal.

Once the raw materials have been identified, the next step is to look at the ingredients as a whole: what are their components and in what proportions, what processes can be used to obtain semi-finished products and what sensory function can these semi-finished products play in a recipe. Defining the parts and their semi-finished products allows us to identify the actual material we have at our disposal to build our menu.

The semi-finished products can be turned into initial ideas for recipes, constructed with the help of the creative matrix (page 55). To ensure acceptance of the propo-

sal to be developed, it must be familiar or, if it is new, it must be introduced as part of a progressive exposure strategy. The recipe is developed by assigning a sensory role to each of the elements and semi-finished products that make it up: shapes that make it recognisable, bright colours, different consistencies (soft, crunchy), defined aromas that can emerge, co-existence of all the basic flavours. The cooking processes for the semi-finished products are chosen and carried out with the aim of preserving colours, varying textures, extracting aromas and enhancing flavours, while at the same time preserving the nutritional properties of the food as much as possible.

Based on the first recipe hypotheses, two additional planning systems are grafted onto the menu construction: cyclicality and progressive exposure. Preparations are evaluated on the basis of the possible by-products and the use of each part of the ingredient by weight: an ingredient can be used completely in a single dish (pure cycle) or in several preparations planned for the same day (short cycle). By-products or unused parts of the ingredient can be the starting point for a recipe to be offered in the following days (long cycle). Once the first draft of the menu has been completed, it is necessary to assess whether there are any problematic areas: parts that are difficult to use, such as the fibres of fresh legume pods, which can be given value in other channels (cascade cycle), or perishable products that have not been used in their entirety, such as uneaten bread, which can be used, depending on the quantity, in dishes over the following weeks (long cycle).

Completely vegetarian proposals, green vegetables or those less common in local consumption and flavours such as sour or bitter could be rejected. Certain ingredients or gastronomic variations must therefore be treated and incorporated into the menu as part of a broad and systematic strategy of progressive exposure. In the following examples of two weekly menus, cauliflower is first proposed in a puree as an accompaniment to tortillas with roasted pumpkin – a preparation that nods at both street food and special-occasion food – and only later is it proposed in its entirety in a recognisable shape, as an accompaniment to another well-known and popular preparation, meatballs. In this case, the cauliflower is presented in all its diversity: different colours, shapes and fractals, with different textures making the proposal even more appetising. The possibility of eating only the meatballs remains open, however, guaranteeing safety, and the stimulus to individually evaluate the proposed varieties is an invitation to discovery and adventure: perhaps you don't like normal cauliflower, but if you try green romanesco, you may discover that it is more interesting. Camouflage, the gradual introduction of certain flavours and the layering of elements that allow you to get to know and recognise a particular ingredient over time all help to give order and sequence to the proposals on the menu.

What has been presented so far is a useful workflow for constructing a menu, regardless of the type of modularity that characterises each context. We start with the ingredients, laying the foundations for a sustainable and healthy diet. We then move on to the definition of the recipe, with the aim of achieving acceptance and liking. The recipes are then formulated in such a way as to prevent and eliminate waste and to support the process of taste education. The entire process of defining

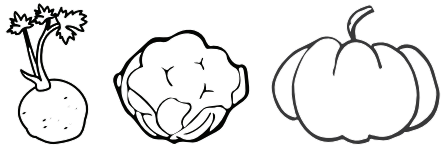
the menu is aimed at minimising waste from a circular perspective: the selection of ingredients is based on the recognition of the capital (economic, environmental, cultural, human and relational) of the ingredients, and enjoyment is the only guarantee that what is served will actually be consumed. The composition of the ingredients respects the proportions of a balanced diet, while their correct processing preserves their nutritional quality and the introduction of flavour-enhancing semi-finished products in the recipe makes it possible, for example, to significantly reduce the added salt. Therefore, there are no elements that can be separated from the whole system and the menu, much more than the recipe, is the area of implementation, verification and correction of the whole strategy for the paradigm shift towards a healthy and sustainable diet.

Below are two examples of a week's menus constructed using this approach. For the sake of clarity and ease of reading, only the main courses (or single-course meals) have been listed to make the cyclical links within the menu visible and understandable. One menu represents a starting point for the autumn-winter period, while the other represents the spring-summer period. The ingredients used are highlighted at the top and are deliberately generic so that they can be adapted to local differences; it was decided not to introduce animal proteins in order to better illustrate the strategies for managing the introduction of plant proteins for younger consumers.

Figures on the next page

FIGURE 21: WINTER MENU

MAIN INGREDIENTS:



OTHER INPUTS:

Bread, potatoes, beans, lentils, rice, barley, maize flour

Winter menu

Mon 6

- Diced pumpkin pulp — SHORT CYCLE
- Tortillas with roasted PUMPKIN, CAULIFLOWER cream and kidney beans
- Thick puree made from cauliflower stalks — SHORT CYCLE

Tue 7

- PURE CYCLE — Steak, chips and candied celeriac strips
- CELERIAC steak with chickpea puree
- Broth and emulsion with peel — PURE CYCLE

Wed 8

- Coloured CAULIFLOWER meatballs
- Sautéed cauliflower florets — LONG CYCLE
- With potatoes, grains and legumes

Thu 9

- Vegetable stock and broth made with peel
- Seed crumble — LONG CYCLE
- PUMPKIN soup with rice and lentil crackers
- Thick puree from flesh — LONG CYCLE
- Grain and legume crackers

Fri 10

- Unsold bread from local production — CASCADE CYCLE
- BREAD SOUP
- Made with surplus pulp from vegetables used during the week — LONG CYCLE

FIGURE 22: SUMMER MENU

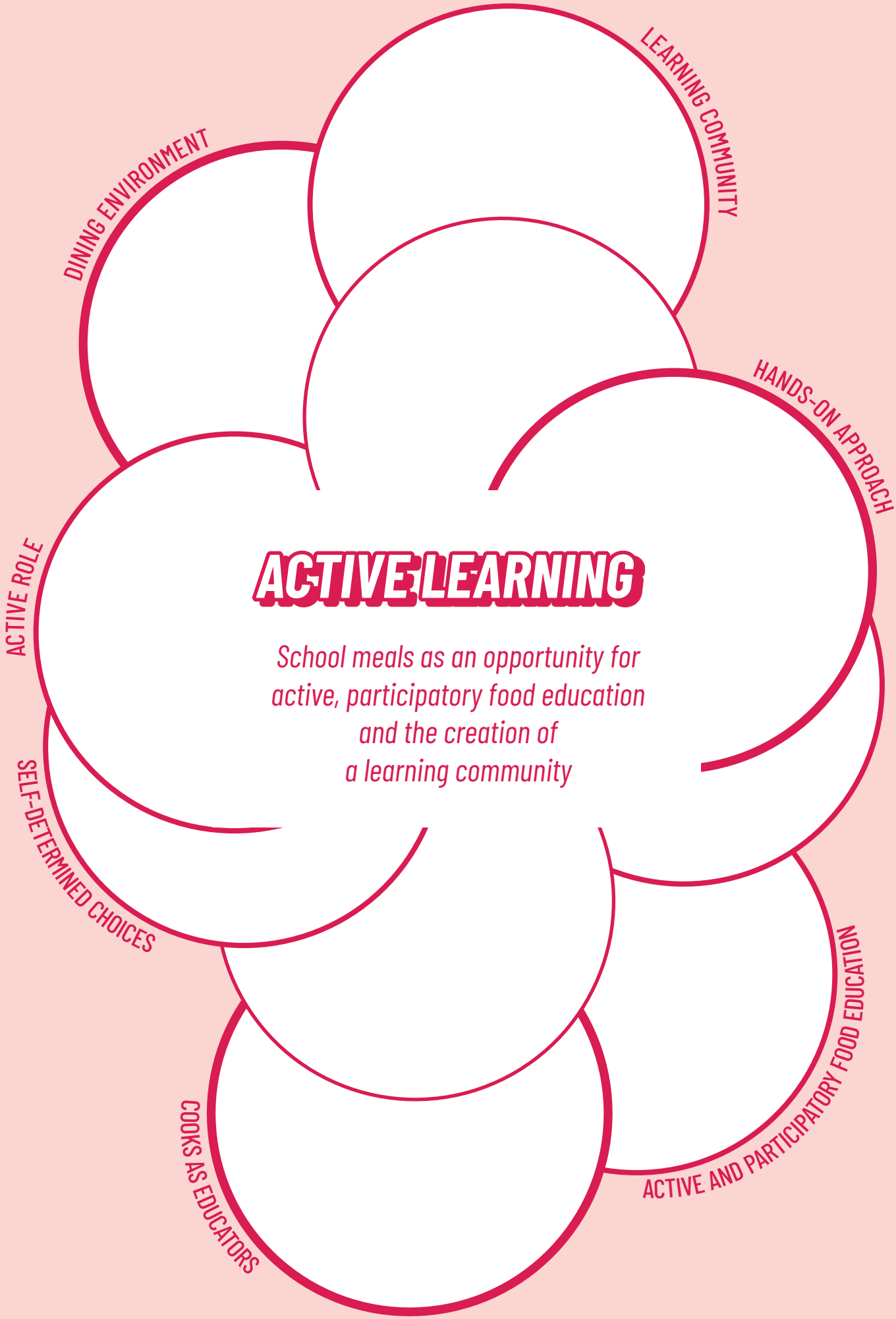
MAIN INGREDIENTS:

OTHER INPUTS:

Bread, potatoes, cannellini beans, red lentils, chickpeas, rice, wheat flour, lettuce

Summer menu

Mon 6	Tue 7	Wed 8	Thu 9	Fri 10
Sliced and marinated coloured tomatoes (SHORT CYCLE)	Thick puree of roasted peppers and spring onions (SHORT CYCLE)	Coloured with beetroot peel powder (LONG CYCLE)	Sautéed spring onion tops (LONG CYCLE)	Unsold bread from local production (CASCADE CYCLE)
Hamburger with BEETROOT steak, sliced TOMATO and cannellini cream	Spelt salad with pepper pepper puree and red lentils	Flatbread with BEETROOT hummus, grilled SPRING ONIONS and lettuce	Baked stuffed TOMATOES	BREAD and COLOURED TOMATO salad (i.e. panzanella)
Beetroot burger with potatoes and breadcrumbs (SHORT CYCLE; CASCADE CYCLE)	Red lentil crumble (SHORT CYCLE)	Grilled spring onions (LONG CYCLE)	Stuffed with fresh tomato pulp, rice and lentils (LONG CYCLE; PURE CYCLE)	Made with surplus pulp from vegetables used during the week (LONG CYCLE) / Dressed with tomato water and seeds


LEARNING COMMUNITY
DINING ENVIRONMENT
HANDS-ON APPROACH
ACTIVE ROLE
ACTIVE LEARNING
School meals as an opportunity for active, participatory food education and the creation of a learning community
SELF-DETERMINED CHOICES
ACTIVE AND PARTICIPATORY FOOD EDUCATION
COOKS AS EDUCATORS

Chapter 3
Active Learning

This manual concludes with a last section dedicated to food literacy, active learning and educational approaches applicable within the school, considering both the canteen and classroom environments.

The first part is primarily theoretical; after dealing with the evolution of food education from a historical perspective and emphasising the importance of direct experience in sedimenting and internalising knowledge related to a healthy and sustainable lifestyle, we look at the answers to the following questions:

- What is the role of schools and the learning environment in educating and promoting healthier and sustainable diets?

- What is the role of the kitchen and cooks?

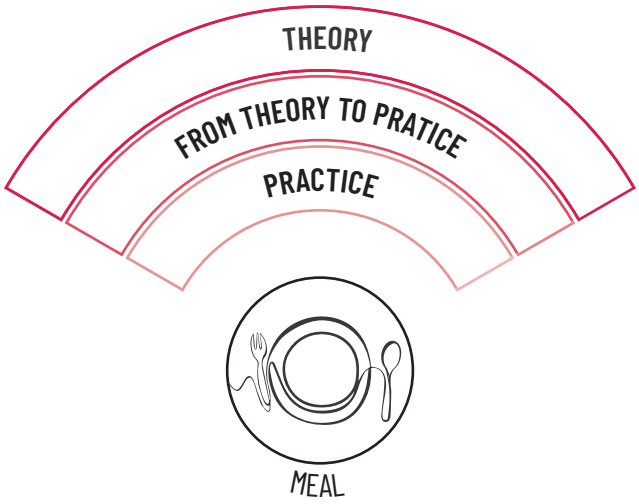
- What educational approaches, strategies and practical activities can we apply and implement in the canteen and classroom?

The next section moves from theory to practice, exploring questions such as:

- What does it mean for students to have an active role and self-determined choices during a school meal?

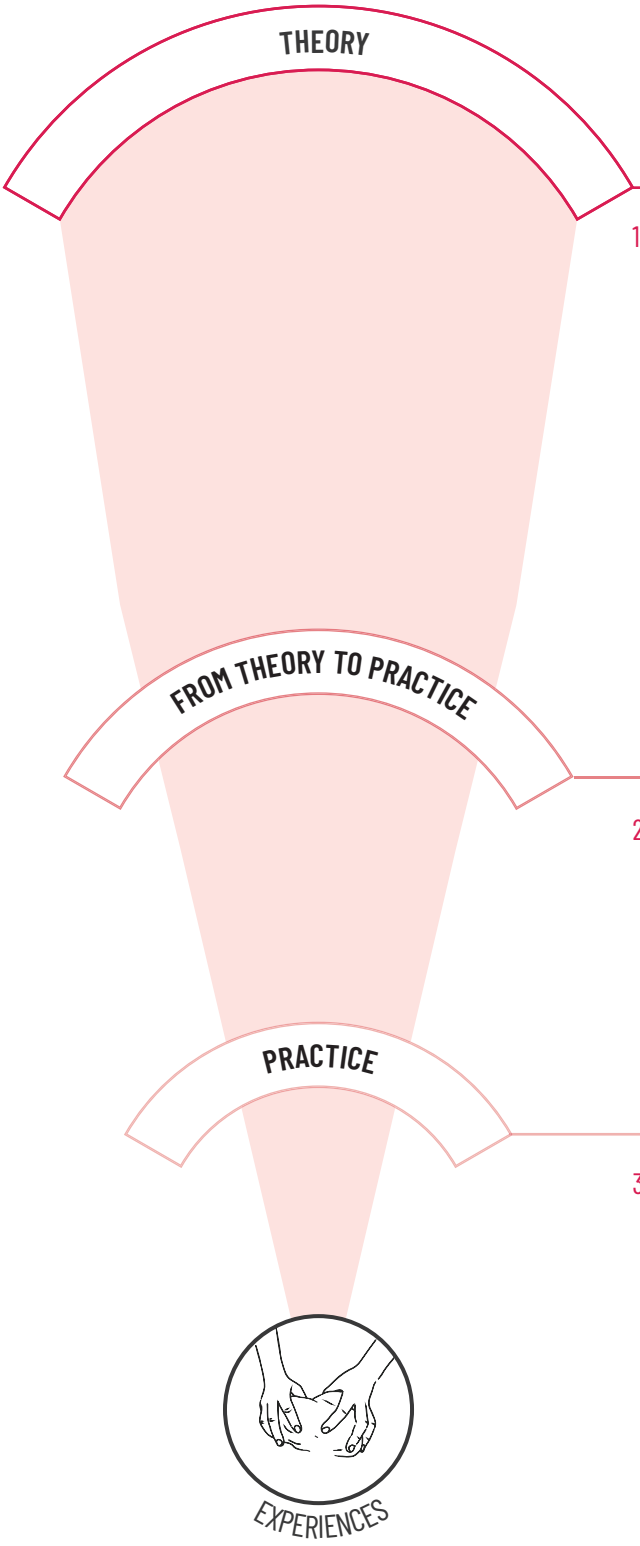
- Why and to what extent can cooking be a form of positive exposure and learning?

- How can the canteen and school environment positively influence the school meal?



The chapter and the manual conclude with a final section on the concept of a Canteen Day, when the canteen can be opened up to the outside world, an event aimed at all the actors involved in the school meal system, from students to families to teachers.
This opportunity for sharing and exchange revolves around the school canteen, where every day the challenge of offering healthier and more sustainable meals can be met.

Chapter 3
Active Learning



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by Nadia Tecco and Franco Fassio

Co-evolution and education for sustainable food and nutrition

The need to recover the big picture

Credit: Photo by Noah Buschers on Unsplash

In evolutionary biology, co-evolution is defined as a relationship in which at least two species influence each other in their evolutionary process. Classic examples are the competitive relationships between species, such as predator-prey and host-parasite, but co-evolution can also result in mutually beneficial win-win adaptations, such as the mutualistic symbiotic relationship between flowering plants and their associated pollinators (bees, birds, insects).

SCHOOL IS ONE OF THE PRIVILEGED CONTEXTS FOR LEARNING ABOUT THE RELATIONSHIP BETWEEN FOOD AND HEALTH AND THE MUTUAL ADVANTAGES OR DISADVANTAGES THAT LINK THEM

If we try to move away from the relationships between species within an ecosystem and extend the concept of co-evolution to the dynamics between socio-technical and natural systems, such as those that characterise the dynamics of the food system (including specifically school catering), the current outcome of co-evolution is certainly not reassuring. The competition between elements is harming human and planetary health, turning into a lose-lose situation on both fronts. That our economy survives mainly thanks to a parasitic symbiosis is evident when we observe the phenomenon of 'land grabbing' (https://landmatrix.org/) or 'water grabbing' (https://www.watergrabbing.com/). The model of production-consumption-disposal (linear economy) has been consolidated at the expense of certain sectors of the population; war, hunger, poverty and environmental and social degradation are essentially the result of competitive relationships.

It is therefore necessary to recover an overall vision of the parts, of the interrelationships between the actors within a system, and to move towards those changes that bring a mutual benefit to the parties involved (in other words the species, of which humans are one). We need to move towards a 'One Health' approach, which brings advantages to the three dimensions of human, animal and ecosystem health.

Solidarity, dialogue, cooperation and sharing must be priorities if we want to reduce social inequalities while at the same time working to regenerate usurped natural capital and reduce the asynchronicity of the linear economic model with natural cycles.

But let us return to the guiding question of this handbook: how can we foster this kind of change in the context of a school canteen and chart a convergent course in which values and intentions are shared and coherent?

Among the possible answers, this chapter will specifically address the issue of education for sustainable food, aimed at making people understand the link between actions at the table and the health of people and the planet. School is one of the privileged contexts for learning about the relationship between food and health and the mutual advantages and disadvantages that it entails. The meal, from its preparation to the moment of consumption and post-consumption, can become a learning tool that is particularly effective in addressing the issue of health and well-being, both of the individual and of the environment and other living beings. 'Food is an integral part of the ecology of education' (Weaver-Hightower, 2011) and the school, and more specifically the canteen, can be the place to create the conditions for learning to feed concrete hope, mutual trust and respect for all forms of life.

In this regard, several studies have shown their effectiveness in bridging the gap between nutritional awareness and positive food choices. Experiences that can combine peer exchange and the active participation of students as well as canteen staff (Osowski et al., 2013; Just et al., 2014), the co-creation of educational content and dishes and the creation of hands-on experiences to increase familiarity with food and culinary skills (Ehrenberg et al., 2019), while involving the sensory apparatus as a whole, are all activities that accelerate learning and overcoming neophobia through shared experiences. Furthermore, it is well known how a sustainable food programme in the classroom environment is reinforced by actions taken in other contexts of the school environment (canteen, kitchen, workshops, educational visits, school gardens) and in the family context (Burke, 2002; Hayes-Conroy & Hayes-Conroy, 2013). This consideration brings us back to the importance of the Whole School Food Approach, i.e. the construction of experiences to be lived, both inside and outside the school context, where we find the coherence and reinforcement of cultural messages.

However, these interventions require greater recognition of the educational value of school meals (which is not always obvious) and the educational role of each participant in the meal in its various functions (Benn and Carlsson; 2014). Again, this is a process of co-evolution in which cooks, teachers, canteen staff and parents – all the actors that make up the 'school system' – acquire information, share perspectives and goals, ask the right questions and, where necessary, allow change to happen.

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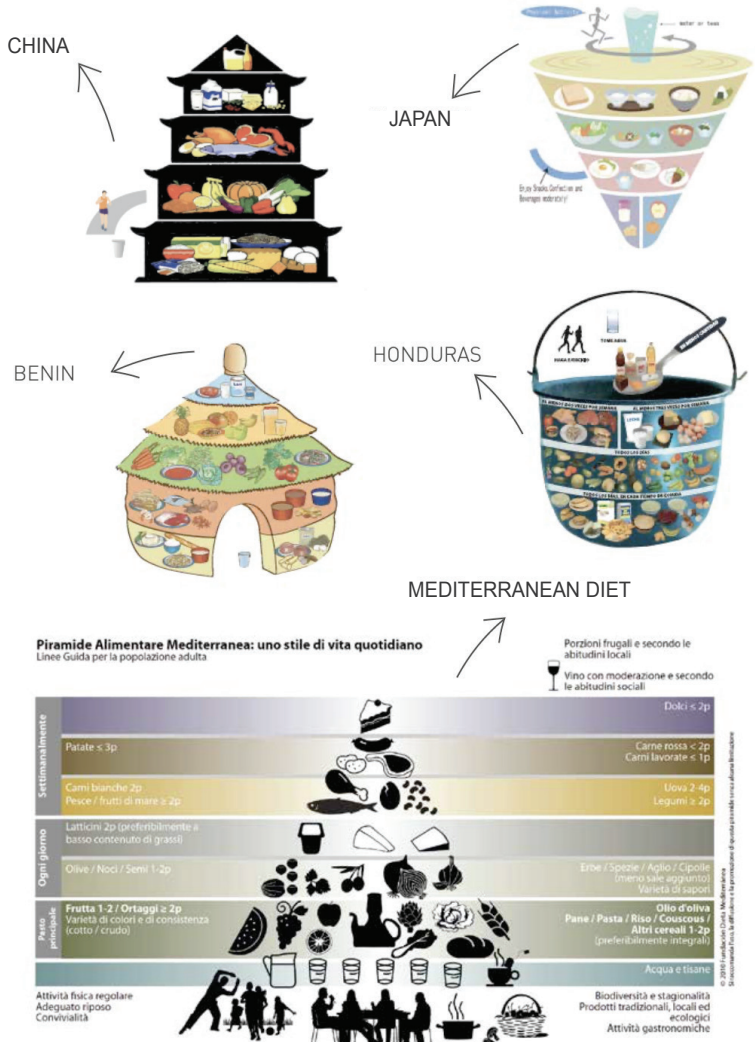
by Annalisa D'Onorio and Stefania Durante

A short history of food education and its methods

The importance of gastronomy and food awareness

Until the late 1990s, nutrition education programmes focused on biology and nutrition, with food tables and nutrient lists the only useful information. There were few references to micronutrients and no reference at all to the quality of the food in which these components could be found. No attention was paid to the mechanisms of internalisation, that is, the actual impact of these principles on daily food choices (Welch & Leahy, 2018; Welsh, 1994).

The transition from this approach to the current one, characterised by a widespread model of nutrition education, is evidenced by the evolution of the food pyramid itself (Davis et al., 2001).



Credit: Image by the Italian Ministry of Health, 2019

GASTRONOMIC AWARENESS IS BASED ON EXPERIENCE, ON THE APPRECIATION OF THE SENSES, ON THE ABILITY TO RECOGNISE SENSORY PLEASURE AND TO KNOW HOW TO SHARE IT

Until a few decades ago we had a single pyramid model, which generally indicated the foods present in a Western diet, arranged according to their ideal consumption.

The new approach to nutrition education is based on the assumption that there are several pyramids, each relating to a specific food culture, and that they all include lifestyle, particularly movement and conviviality, as a fundamental component of a healthy diet.

There is therefore a gap between the nutritionist model, based on what you 'should' or 'should not' eat, and a model based on health and mental and physical well-being, not only of the individual, but of humanity in its relationship with the environment and other living beings. In this way, the environmental impact of food choices is made explicit. On the one hand, there is the concept of One Health, with which today's generations are growing up: we cannot strive for well-being if we do not include the health of the planet. On the other hand, there is the idea of a holistic/systemic approach, which is necessary to codify the complexity of the food system.

Food education has therefore become more complex and less dogmatic. To be effective, it must focus on experience and the promotion of sensoriality as a tool to be used consciously to identify organoleptic pleasures (Gordon and Shepherd, 2013). The education should be aimed at promoting relationships in the local area, stimulating dialogue between the actors of the supply chains from a co-evolutionary perspective. This is why there are many projects that revolve around the garden, cooking, emotions and an awareness of who is producing, cooking and processing food (Barzanò, 2016).

The challenge today is to raise a generation that is aware of its food choices and to guarantee them the possibility of eating in a good, clean, fair (Petrini, 2005; Nistri, 1998) and healthy way. If young people find that they cannot use the tools we have given them because they require purchasing power they do not have, the entire educational framework will collapse under the weight of contradiction.

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by Annalisa D'Onorio and Stefania Durante

Food culture and environmental preservation: The role of learning communities

Comparison, knowledge and exchange for renewed food sustainability

We live in a world of intangible relationships, virtual communities and induced needs, within multicultural societies that chase after homogenising models. Education is the best way to build a critical and constructive outlook, to make citizens of all ages stop and reflect in order to understand the logic that drives and characterises this reality. Today, more than ever, education means building the future and facing the present with renewed energy. When institutions are no longer capable of responding to educational needs, it is necessary to activate other actors, e.g. associations, cooperatives, cultural centres and families, to propose complementary educational paths and to create synergies in the local area. It is important to rediscover and promote the role of communities as guarantors of the transmission of knowledge linked to material and social cultures and as nerve centres for the reactivation of healthy and virtuous economies, including cultural and food economies. To engage in agrifood education in a context that proposes a standardising model of food, it is necessary to engage with the actors along a food's production and distribution chain, proposing sensory experiences and moments of direct knowledge of the 'food system' involved.

The promotion and exchange of knowledge, the comparison of cultures and the appreciation of diversity are all elements that can contribute to the development of a co-evolving learning community. These educational activities are designed to be fun and to encourage critical thinking and more sustainable consumption. Food is the ideal tool for testing out and promoting an articulate, complex and creative education that values principles such as interdependence, balance between humans and nature and respect for the common good.

EDUCATION TODAY, MORE THAN EVER, MEANS BUILDING THE FUTURE AS A COMMUNITY AND FACING THE PRESENT WITH RENEWED ENERGY

In school catering, in order to offer a good, healthy, appreciated and shared meals, it is necessary to promote, create and constantly nurture relationships between the various stakeholders in the service, such as farmers and producers and the school world (pupils, teachers, families), through the continuous commitment of cooks and kitchen staff. This means creating moments for dialogue, knowledge-sharing and collaboration among those who manage the catering service and, at the same time, with the users of the service. It is about creating one or many Food Communities that make it feasible, replicable, and scalable to implement a sustainable food model through school catering.

Credit: Photo by Hannah Busing on Unsplash

by Gabriella Morini and Carol Povigna

Cooking as a learning and co-evolutionary action

Knowledge, skills and being in the kitchen

Credit: Photo by Christian Bowen on Unsplash

In recent decades, we have witnessed a gradual recognition of the importance of food education within the school system, as part of the broader framework of health and environmental education. A series of experiences that can familiarise children with food production and products are now being introduced into the classroom and integrated into the teaching programmes of various subjects. Sensory workshops, cultivation activities and food trails reach younger students in ways that vary in complexity and structure. However, cooking activities, understood as the direct processing of the products being studied into another form (to be consumed on site or at home), remain a minority among the food education initiatives available in schools. While this can be partly explained by the obvious logistical complexity and valid concerns about safety (such as the risk of injury and hygiene issues), the question remains whether the difficulty in overcoming these problems has more to do with a lack of attribution of value than the actual impossibility of offering students courses that include cooking in their food education.

A GRADUAL MOVE AWAY FROM THE KITCHEN HAS LED TO AN EDUCATIONAL VOID

The question that emerges from this picture, then, is whether the act of cooking has had, and still has, a role to play in the education and growth of the individual: does the observation or practice of cooking teach us anything? Can we learn about ourselves and our environment through the transformation of food?

If such a question was superfluous in the past, when food production was something everyone experienced first-hand, the answer is not so obvious today. In the not-too-distant past, the place where food was cooked was the centre around which the whole family gathered and to which everyone contributed according to their abilities: the management of resources (water or fire), the gathering of ingredients and the preparation and convivial sharing (extensive and inclusive) of the meal concerned every member of the community.

This relevance was determined by necessity, which made direct participation unavoidable, but it added fundamentally important social and relational elements. Over time, although excluded from the school environment, the kitchen continued to be the primary setting for education imparted by the family. It served as the means for conveying lessons on managing and administering the economic and social aspects of the household. This knowledge and know-how was part of 'that body of knowledge concerning the economy of nature' (Haeckel, 1866), or rather of ecology: the science of the relationships between the organism and the external world surrounding it. In the kitchen, and through it, people learned to recognise limits (set by the season or scarcity) and to make them a resource. They knew and accepted the needs of individuals and learned to share on the basis of each one's nutritional needs. The origin of ingredients, the composition of dishes, the anatomy of animals and the structure of plants, the influence of food on health, were all assimilated directly or indirectly through the experience of cooking, while experimentation and creativity, acceptance, curiosity and a sense of individual and collective responsibility flourished.

Far from an abstract sense of nostalgia for lost times, it should be noted that the progressive distancing from the kitchen, which is the result of the convergence of certain factors (such as the concentration of populations in urban areas, increased time spent outside the home, the proliferation of devices for automating domestic processing, the widespread availability and low cost of processed and preserved food products from the food industry, etc.), has led to an educational vacuum which, from generation to generation, has repercussions on a planetary scale. The family has increasingly ceased to provide guidance by direct example and daily practice, while schools have only recently recognised the urgency of their role in food education. In little more than half a century, several generations of the elderly, adults, adolescents and children have lost all familiarity with food. They have lost the habit of cooking and the practical skills associated with it, they have forgotten the reference models for recognising a healthy, balanced and sustainable meal and they have left the food industry to guide and inform their choices. This lack of awareness is at the root of the consumption patterns that have direct and indirect costs for public health and environmental sustainability.

IN THE CONTEXT OF THE KITCHEN, WE FIND A BODY OF KNOWLEDGE AND THE POSSIBILITY OF DIRECT EXPERIENCE SO WE CAN LEARN HOW TO MANAGE THE LIMITS OF A PLANET WITH FINITE AND FRAGILE BOUNDARIES

There is therefore a clear need to recover the time necessary to understand and appreciate what cooking is, in places such as school canteens, but also in home kitchens. In this context, let us try to analyse what knowledge we find in the act of cooking, by reading it on three levels. First of all, when we cook, we have to refer to a body of knowledge that belongs to different disciplines: we encounter and draw on botany and zoology, we need rudiments of anatomy, we perform mathematical operations, we control chemical, physical and microbiological transformations. We perform actions that have been defined over centuries of history and have characterised different cultures. We exchange this knowledge through language, be it oral or written, and we approach all this knowledge not in an abstract form but in an active way. We recognise the value and importance of this knowledge in our lives and therefore internalise it.

Secondly, the kitchen is an area of know-how: knowing how to cut, how to mix, how to cook and, in a broader sense, how to preserve, how to ferment, how to balance nutrients including through taste, how to correctly use the various technologies that modernity has put at our disposal. Doing, knowing how to do and knowing how to teach is the meeting of theory and practice, the harmonisation of thought and action. Head and hand must coexist in order to design (a recipe or a meal), to relate to others (in time and space), to manage limits (of resources), to act creatively. This brings us to the third and final level of interpretation, which is less literal and more profound: the transformation that comes from knowing about being. In the kitchen you experience curiosity, you learn to ask the right questions, you learn to build relationships and to think in terms of systems. In the context of the kitchen there is the possibility of experiencing the ecosystem directly, of experiencing relationships, of understanding the limits and possibilities of one's own being in terms of being a protagonist and taking responsibility. In cooking, we become aware of the existence of an otherness (ourselves in the act of eating in the near future, the people with whom we will share the meal we are preparing) and we infuse our actions with affection, connection and trust. The kitchen thus becomes the means by which we take care of ourselves and our neighbours, the latter understood as a complex set of variables and actors that populate the planet.

The challenge we face is therefore to renew the alliance between school and family and, in a broader sense, between humanity and the planet, through a food education that does not abandon or marginalise cooking, but instead restores its central role. The school canteen can and must be the place and the means of restoring to the adults of tomorrow the wealth of knowledge necessary to know how to manage relationships with ecosystems so as not to jeopardise relationships with the best supplier of raw materials known to humanity, namely nature (Hawken et al., 1999).

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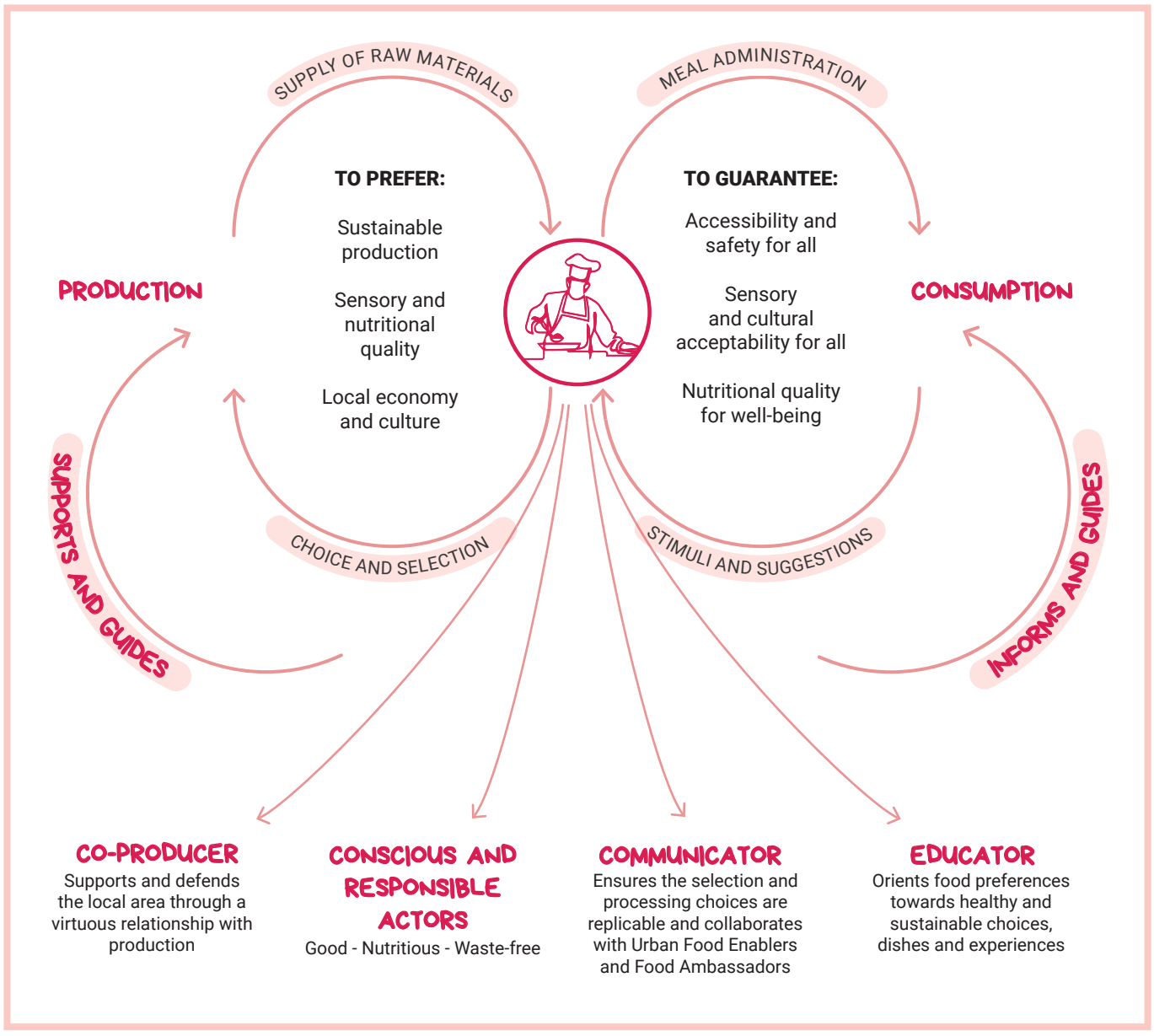
by Matteo Bigi

The cook as educator

Lunch as a learning module

The figure of the cook today has a very different and broader functional and political potential than it did a few decades ago. Today's cooks and chefs embody multiple roles that increasingly define them and bring them into the public eye. Once cooks, now they are chefs and at the same time farmers, activists, writers, actors, TV presenters and influencers, out of the kitchens and less often embedded in the mists of bubbling pots and pans.

FIGURE 23: THE ROLE OF THE COOK



TO EDUCATE WITH COOKING IS TO TRANSMIT VALUES THROUGH THE ACT OF GASTRONOMIC TRANSFORMATION

By seizing the opportunity offered by this excessive representation in the media agenda, chefs today have the chance (and the duty) to carve out the role of educator for the recipients of their work.

At the same time, the gastronomic discourse, as well as being a pretext for media entertainment, has become a crucial crossroads of political-economic-cultural reflection due to or because of the obvious problems linked to climate change, wars and migratory phenomena. In this dramatic scenario, while the figure of the cook is changing, the way we look at food is also changing, especially the food distributed in canteens, where there have been significant changes at the regulatory level. The criteria for designing menus have changed in recent years as we move towards more plant-based diets, presenting the cook with a major challenge: serving healthy, nutritious and sustainable meals that can also be appreciated by an untrained public, reluctant to give up less-than-ideal eating habits.

It is therefore necessary to strengthen the skills of a figure whose field of action is both specific and transversal: in other words, a cook working in the institutional catering sector, within a system of tenders, procedures and large numbers, often with limited budgets and with a very sensitive target group: children.

The role of the cook is therefore crucial. Teaching through cooking means transmitting values through the act of gastronomic transformation. All this can be made possible by the relationship of trust that is hopefully established between those who cook and those who eat (think of the caregiver-child relationship in a domestic setting), and it is precisely the canteen cook who can help educate about these issues. In a scenario where food education in many schools still seems to be optional and discretionary rather than a priority, allowing cooks to become teachers is a revolutionary act of encounter and education between two often-distant worlds.

The educator-cook is therefore a figure who makes sharing their knowledge and the reasons for their choices in the context of the school meal an opportunity to understand and deepen the relationship with food that the youngest children are constructing slowly and sometimes laboriously. They represent a bridge between the worlds of food production and consumption: cooks and chefs choose, select, transform and serve food with awareness, ensuring its acceptance, accessibility and nutritional quality. In addition to their great responsibility, they have the opportunity to support and defend local cultures and those committed to environmental protection, to optimise production flows and to minimise food and energy waste. In turn, through their work, they can transform the school meal into an educational module for promoting a healthy, personalised diet for pupils, thus raising awareness and spreading the virtuous example of their work to the community that surrounds the school.

It is essential to truly know the food we eat in order to appreciate it and make informed choices. Knowing its origin, its history, the route it has travelled, the energy used and the hands that have picked, processed and served it is necessary to understand its complexity and be able to respect and value it.

by Annelies Smets and Katharina Beelen

The Whole School Food Approach: A holistic place-based model to co-create sustainable food systems for children and youth

Long-term healthy sustainable food for all

THE INTERDISCIPLINARY INTEGRATION OF FOOD IN PRIMARY AND SECONDARY SCHOOLS IS ESSENTIAL IF WE ARE TO MAKE A REAL DIFFERENCE TO THE SCHOOL FOOD SYSTEM AND, BY EXTENSION, THE FOOD SYSTEM AS A WHOLE

The Whole School Food Approach (WSFA) is a framework that supports all actors in the school environment in their efforts to develop and implement a healthy and sustainable (school) food culture, i.e. a culture that reduces inequalities in students' nutrition and health and enables pupils to develop nutritional awareness.

The WSFA is based on scientific evidence supporting a Whole School Approach as well as evidence-based findings resulting from the Czech/Slovakian Truly Healthy Schools model, Food 4 Life in the UK and the Belgian GoodFood@School programme. The WSFA framework is also linked to UNESCO's Education for Sustainable Development programme. The model has been developed with partners from 12 EU countries.

The Whole School Food Approach Framework consists of four interrelated pillars.

PILLAR 1: POLICY & LEADERSHIP

This pillar is about ensuring the participation of all relevant stakeholders. It also looks at how a school approaches healthy and sustainable food in its plans, policies, activities, values and teaching.

PILLAR 2: FOOD & SUSTAINABILITY

This pillar focuses on creating safe, appropriate spaces in schools where all children, regardless of their background, can enjoy a healthy lunch in peace, either offered by the school or brought from home. The food and drinks offered in schools should be tasty, healthy, balanced and (where possible) based on sustainable criteria that aim for a positive environmental and social impact.

PILLAR 3: EDUCATION & LEARNING

Education about food and food systems touches on all three dimensions of sustainable development: environmental, social and economic. By teaching children and school staff not only theory, but also how to cook and grow food, pupils gain the skills and knowledge to make informed choices that directly affect their own health and that of the planet.

PILLAR 4: COMMUNITY & PARTNERSHIP

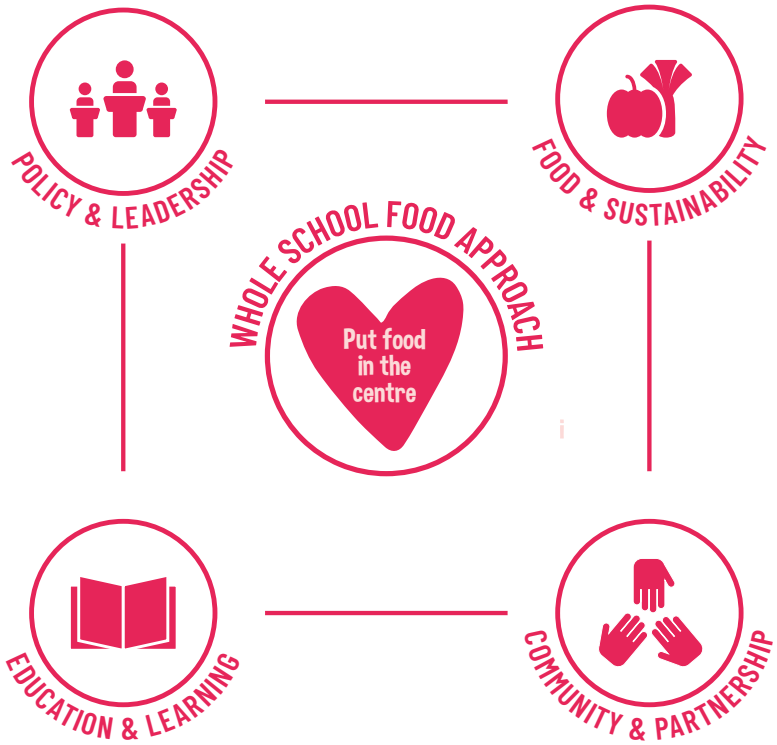
This pillar focuses on cooperation with a wide range of actors in the school's environment.

The interdisciplinary integration of food in primary and secondary schools is essential if we are to make a real difference to the school food system and, by extension, the food system as a whole.

School cooks and their teams play an important role in the implementation process of the WSFA: not only are they the main actors for pillar 2, they can also build bridges with the school community (pillar 4), e.g. by sourcing ingredients locally from local farmers, giving these farmers a face and ensuring that children, and by extension the whole school community, know where and how the ingredients for school meals were produced.

In this way, they contribute to education and learning (pillar 3) and can also make an important contribution to the school's vision on nutrition and policies in this direction (pillar 1).

FIGURE 25: WHOLE SCHOOL FOOD APPROACH



by Annalisa D'Onorio and Stefania Durante

How do we learn?

The role of the senses and learning by doing

Credit: Photo by Hannah Tasker on Unsplash

The sensory sphere of contemporary humans has been considerably impoverished. Touch, taste, smell, sight, hearing – in other words, the tools that can give us a deeper, more varied and authentic knowledge of the world around us – have suffered a profound decline.

New generations are in danger of losing the pleasure of the act of eating, as well as a connection with the land and relationship with the seasons. For this reason, experiences that focus on training the senses, studying how they work and becoming aware of their important role in food choices should increasingly form the basis of food education programmes. We cannot delegate the power to choose how we eat to third parties, let alone artificial intelligence. If this were the case, humanity would be reduced to a standardised pawn on the economic chessboard, a subject whose sole purpose is to advance the mechanisms that govern consumerism. The senses are the tool that can awaken curiosity and the most important lever for building independence and consolidating the natural learning process.

This is why it is necessary to adopt an approach that goes beyond the nutritional perspective, to look at food holistically: not only as food, but also as culture, pleasure, conviviality. In other words, as a transmitter of values and attitudes, as a vehicle for relationships, as a catalyst for emotions. The use of active and participatory teaching methods, which allow the comparison and circulation of knowledge, adopting the method of 'learning by doing' and direct knowledge of the food system, is the best strategy for awakening the senses and inspiring critical thinking about food.

THE SENSES CAN STIMULATE CURIOSITY AND SERVE AS THE MAIN LEVER FOR BUILDING INDEPENDENCE AND CONSOLIDATING THE NATURAL LEARNING PROCESS

In school catering, for example, preparing, cooking and delivering good food to schools does not in itself guarantee that the food will be enjoyed by the children. Catering staff, teachers, parents and the children themselves need to be made aware of the value of food as a nutritional, cultural, environmental, economic and social tool. Parents and teachers need to be familiarised with local produce and the recipes on the proposed menu, so that they can prepare and encourage the children. Organising cooking and sensory workshops for children, teachers and parents, with the participation of local producers and farmers, can be a way of activating the natural learning process using the five senses as the main filter for acquiring information and processing thoughts.

by Paola Migliorini

Educating the next generation

Teaching methods and strategies

Credit: Photo by Filip Urban on Unsplash

IN THE EXPERIENTIAL APPROACH AND ACTION LEARNING, THERE IS NO ACTIVE SENDER AND PASSIVE RECEIVER, BUT A RECIPROCAL PROCESS BASED ON QUESTIONING, SHARING, RESPONDING, EXPLORING AND CREATING INPUT FOR BOTH PARTIES, AIMED AT ENHANCING CREATIVITY AND THE ABILITY TO RESPOND TO THE NEED FOR CHANGE

The extreme complexity of the current situation and the unpredictability of the future make sustainability a multifaceted concept with a variable focus. There is clear evidence of the need for relatively radical change. However, there is still much debate about how radical the change should be, ranging from optimising or overhauling current systems ('doing things better') to completely redesigning the system ('doing things differently and better'). The complexity of the interplay between political, cultural, biological and economic issues in natural resource management, compounded by the different worldviews of the actors involved and by uncertainty, makes the transition to a future vision of sustainability an enormous challenge. It is essential to foster interaction between often competing interests in order to achieve possible common goals and expectations. 'Embarking on the path to sustainability requires a profound change in the way we think and act' (Rieckmann, 2017). This means that we need new knowledge, skills, values and attitudes, which we can call 'sustainability competencies' (Frisk & Larson, 2012). Education is therefore fundamental to the pursuit of sustainability and 'it is not just a matter of knowing more, but also of learning and knowing differently', as 'the analysis of complex, purposefully managed natural systems is essentially a skill related to the reflective and critical learning systems embedded in them' (Bawden, 2016).

ACTION LEARNING

Although theories of experiential learning can be found in ancient Greek and Chinese philosophy, since the 1960s it has generally been understood as a systemic approach to learning: students processing and reflecting on various experiences, both inside and outside the classroom. According to Dewey, an important task for educators is to enable students to supplement their prior knowledge with new skills through the experience of reflection (Dewey, 2005).

THE CHALLENGE IS DESIGNING AND IMPLEMENTING AN EFFECTIVE LEARNING STRATEGY THAT BRIDGES THE GAP BETWEEN KNOWING AND DOING

To this end, sustainable agriculture, or rather agroecology, is broad in nature and encompasses several principles (HLPE, 2019), including an experiential approach and action-oriented learning (Kolb, 2014). Dolci proposes that reflective experience is not a unidirectional process in which there is an active sender and a passive receiver, but a reciprocal process based on questioning (the generating question), sharing, responding, exploring and creating for both, which he calls 'reciprocal maieutics', referring to the Socratic process (Dolci, 1988). Education is therefore not just the transmission of knowledge, but a dialogue between parties to enhance the creativity of individuals and groups. It focuses on people's ability to discover their vital interests and allows them to freely express their thoughts based on their experiences. According to Freire, traditional education sees the student as an 'empty bucket' to be filled by the teacher. He notes that this view of education 'turns students into receptive objects. It tries to control thought and action, makes men and women conform to the world and inhibits their creative power' (Freire, 1970). Instead, in a course based on active learning, both students and teachers learn from each other in a process in which they work together to improve situations in the field and also reflect on their own experiences of being involved in such activity (Revans, 2011; McGill & Beaty, 2001).

In the context of agricultural and food systems, which are sites of complex challenges, including interacting biophysical, economic and social dimensions (Francis et al., 2003; Francis et al., 2004), students need to be directly involved in order to learn how to deal with complex and dynamic issues. 'If you really want to understand something, try to change it' (Lewin, 1948; Snyder, 2009). Thus, the need for a multi-perspective approach (Rickerl & Francis, 2004) becomes immediately apparent when a group of students from different countries and educational backgrounds try to learn together about agriculture, food and sustainability (Migliorini and Lieblein, 2016). Experiential learning is essential to enable students to acquire the necessary skills to constructively support the sustainable development of agricultural and food systems (Lieblein et al., 2004; Ostergaard et al., 2010). An experiential learning process allows students to observe, act and interact. Moreover, we do not learn from these experiences as such, but by reflecting on them (Dewey, 1938).

INNOVATIVE RESEARCH TO PROMOTE EXPERIENTIAL LEARNING

The challenge, therefore, is to design and implement an effective learning strategy that bridges the gap between knowing and doing, improving both students' understanding of complex situations and their individual and collective skills and abilities to take informed and responsible action. Since skills cannot be taught, but must be developed by learners themselves through action and reflection on experience, the understanding and skills needed to address sustainability challenges are best conveyed when learning is action-oriented in real-world situations. Education for sustainable development therefore requires the implementation of phenomenology and a 'shift from teaching to learning' (Migliorini & Leiblein, 2016).

Important goals of sustainability education therefore include skills in creativity and visionary thinking, observation and reflection, participation, dialogue and systemic thinking.

Such 'action learning' has been successfully applied in numerous research projects carried out by the University of Gastronomic Sciences of Pollenzo, in particular for agroecology training. These include the H2020 NEXTFOOD project (www.nextfood-project.eu), the Master in Agroecology and Food Sovereignty (https://www.unisg.it/corsi-iscrizioni/master-agroecology-food-sovereignty-private/) and the educational vegetable gardens (https://www.unisg.it/en/campus/orti-ecologici/). These projects, and the experiential education approach in general, aim to create changes in the current food system, locally and globally, that can be addressed and translated into action. There is a strong need to change our food system and the starting point is to rethink the relationships between producers and consumers, between people in their relationship with food. Therefore, we need to help prepare students, future citizens and future generations for the challenges outside school by activating their creativity and helping them to develop basic skills.

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by Riccardo Migliavada

The learning setting

How environmental variables influence the eating experience

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Credit: Photo by Ron Lach on Pexels

Credit: Photo by Amy Lane on Pexels

In addition to the physiological mechanisms that regulate appetite, there are countless other factors that influence our food intake and eating experience. Some have to do with our state of mind, our memories and our expectations, while others depend on external variables such as the context in which we find ourselves or the company we keep. Eating at home or in a restaurant, alone or in company, on the sofa watching television or at the table are all very different eating experiences that can influence how and how much we eat.

EATING IS A COMPLEX ACT THAT TRANSCENDS PHYSIOLOGICAL MECHANISMS AND IS HEAVILY INFLUENCED BY EXTERNAL FACTORS SUCH AS CONTEXT AND SOCIALITY

For example, eating while watching a film or working at a computer can cause us to eat up to twice as much as if we were sitting at a table with the sole purpose of eating (Robinson et al., 2013). This is because the physiological mechanisms that regulate food intake are slow and imprecise in telling our brain that we have consumed enough calories. At the same time, our attention is limited, and when we are engaged in multiple tasks, we struggle to process all the information correctly. Therefore, even when we eat together, we pay less attention to the signals coming from our bodies and tend to eat more (Hetherington et al., 2006). We are also likely to adapt our eating behaviour to that of our dining companions (Higgs, 2015).

In addition to the diners, the characteristics of the context, such as the background music or the table setting, can profoundly influence our experience (Bilman et al., 2017). The shape, colour and weight of a plate can influence the amount of food we eat as well as our perception of a food (Spence, 2015). Similarly, the sounds we are immersed in can affect the overall experience as much as the taste perception of a particular food (Spence, 2015).

If the company and context are pleasant, it will be easier to appreciate what you are eating and develop a positive memory of the experience.

Conversely, the best meal eaten in bad company and an unpleasant context will not be perceived in the same way. Eating is a complex act that goes beyond physiological mechanisms and is largely influenced by factors external to us, such as context and sociality.

In an environment such as the school canteen the context, made up of sounds, lights, colours, smells, shapes and weights, together with virtual or real company, can play a crucial role in the assimilation of information that completes the act of eating. Learning, which as we have seen takes place through the senses and by doing, is positively or negatively conditioned by the context in which it takes place. This highlights the importance of the canteen environment, having the right tools to enjoy food and finding the spaces and times that can nourish the mind as well as the body.

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Interview with Barny Haughton

‘A hands-on approach’: The school cookery workshop

Interview with Barny Haughton, chef at the Square Food Foundation

Credit: Photo by Square Food Foundation

We need to get schoolchildren learning about food, while making school meals healthy, tasty and sustainable. The question should no longer be why, but how?

If you asked me to name the most important subject a child should learn in school, it would not be reading or writing, maths or history, but the history of food. Through the history of food, a child can learn about the world. This learning begins with the simple activity of cooking: learning to cook is the beginning of a life's journey. Just like learning to ride a bike.

Just like when we learn to ride a bike, once we understand the mechanics, we never forget how to do it again, right?

THE RECIPE IS A STORY, AND THE COOKERY COURSE IS HOW THE STORY IS TOLD

Correct. The exact moment is when the person who was holding us in the saddle of the bike to keep us balanced believes in us and lets us go. In an instant, without really knowing what it was, we defied gravity and started pedalling. In that moment, our place in the world changed in a subtle and inexorable way, and the road to freedom and independence unfolded before us. On closer inspection, the psychology of learning to cook is the same. The key point is that we could never learn to ride a bicycle by watching someone else do it, or by being taught the theory of gravity and balance. Teaching a child to cook involves the interactive and physical process of teaching and learning by doing.

So, once you have learnt how to keep your balance, how to be independent and how to explore all the avenues of gastronomy, you have to pedal, everyone at their own pace and with the tools that life has given them?

We explore everything that normally happens in a cooking class: whisking, chopping, stirring, the clatter of pots and pans, a palette of colours, textures, smells and flavours that join you in the scene. More predictable learning skills certainly emerge – such as slicing an onion very thinly, knowing when to turn the heat up or down and why – but at the same time so do less obvious learning skills, such as an increased ability to concentrate or ask a question, the dynamics between one child and another and the differences between them, the moments of triumph and disappointment. Then there are the conversations, the chatter and the constant excitement of observation, which are as much the alchemy of a cooking class as the dish the children are preparing. Through the practice of cooking, we learn the language of food, which is how to pedal the bicycle we have been given on the roads we are on.

In your experience as a chef, but especially as a teacher, is there a practical example that you often refer to when teaching children the value of food?

At the Square Food Foundation, we often use recipes to illustrate all that there is to know about this language. A recipe is a story, and a cookery lesson is how the story is told. I will illustrate one that involves many skills, is popular for many reasons and is suitable for all ages of children and different food cultures. The vegetables used can reflect the season: think broad beans, green beans, beans, leeks, celery, celeriac, parsnips, sweet potatoes, turnips, boiled lentils or borlotti beans. It's also a good way to use up leftover cooked vegetables and cheese scraps. But before we show you the recipe, a few tips for teachers: prepare the dough and filling the day before and assemble it with the children. This recipe makes six pies. You can double or triple the amount and freeze the unbaked pasties. You could also think about turning the pasties into empanadas or samosas, with spices instead of cheese.

Cheese and Vegetable Pasties

DOUGH

400 grams of type 2 (semi-wholemeal) flour
a pinch of salt
200 grams of cold butter, cut into 1 cm cubes
80 ml of cold water

TO MAKE THE DOUGH

Sieve the flour and salt into a bowl. Rub the cold cubed butter into the flour with your fingertips until you have a mixture similar to breadcrumbs. Pour

the water evenly over the mixture and stir gently until the dough is formed (if the dough is too dry, add more water). Then shape into a cylinder, wrap in cling film and refrigerate.

FILLING

2 medium onions
1 celery stick
2 carrots
150 grams of potatoes
150 grams of Swiss chard
2 garlic cloves
100 grams of cooked lentils, tinned borlotti beans or frozen peas
50 grams of grated Cheddar, Emmental or Comté cheese
25 grams of grated Parmesan cheese
50 grams of goat's cheese or cottage cheese
Herbs: thyme, basil, chives, parsley
Salt and pepper

TO MAKE THE FILLING

Cut the onion, celery, carrot and potato into 1 cm cubes and chop the Swiss chard. Crush the garlic into a paste. Gently sauté the onions, celery, carrot and garlic in a frying pan with a little extra-virgin olive oil for about 20 minutes. Add the potatoes and a splash of water and cook, covered, until the potatoes are tender, stirring occasionally to prevent the vegetables from sticking. Season well. Add the lentils, beans or peas and herbs and mix well until all the ingredients are well combined. Transfer to a bowl and leave to cool.

TO SHAPE

Cut the dough log into 6 equal slices and roll out into flat discs 15 cm in diameter. Place a little of the vegetable filling in the centre of each disc. Do not overfill – the leftovers can always be used to make a soup. Moisten the edges of the dough, fold the dough into a semicircle and press the edges together. To make a traditional pastry crust, roll the pressed edge towards the centre to form a ridge.

TO COOK

Brush with a little milk and beaten egg and bake at 185°C for 35-40 minutes or until golden brown.

Is there any other tip you would like to share to help children feel more confident about cooking on their own?

When you try this recipe with children, ask them to cut out their initials from the leftover pastry and stick them on their pies. It's a simple gesture with a double benefit: on the one hand, it's the right thing to do from a health point of view, so that everyone eats what they have produced and touched with their own hands. But it's also a gesture of co-creation and allows a dialogue to take place between the teacher and the child, what outside of school we would call a conversation between producer and consumer.

by Matteo Bigi

Self-determined choices and the active role of the child

Personalisation of the meal and use of services and facilities

Credit: Photo by Andres Ayrton on Pexels

What could be more counterproductive than forcing people to eat a certain food with the intention of making them accept it? Although we are aware that we are offering a healthy, sustainable and therefore necessary diet, imposing it can have an opposite effect from what one might expect. What's more, forcing something unwanted can cause a trauma leading to aversion and the total absence of the food in question in an adult's diet. Offering but not forcing is therefore a rule to be observed, dictated by the fact that the child should increasingly experience food as a discovery in which he or she is the protagonist and not the passive recipient.

We should therefore talk about children's self-determined choices to express the possibility of choosing what and how much to eat, as they put themselves in the position of a producer-consumer ('prosumer') of their own food (Toffler, 1980). Within reasonable limits, it is indeed necessary to create the conditions, both at home and in the canteen, for a child to be free to explore, touch, smell, taste and hear their meal and to make choices accordingly, living an experience that involves them in active, direct learning.

This perspective can have positive effects on both sides: the children are free to express their tastes and personalities while the school also gets to know its pupils better and can adapt its menus and teaching to what the children express through their choices.

A practical example of this can be found in the many types of restaurant where the customer can customise their choice, like an ice-cream parlour that offers a range of toppings for decorating your own ice cream cone or cup or a fresh pasta restaurant where the customer can choose the type of flour, the shape of pasta, the sauce and even the toppings, making for a wide variety of possible combinations. Similarly, children should increasingly have access to this kind of choice, to feel listened to, supported and closely involved in the process of discovery. The choice of what to eat and how much to eat, the number of ingredients chosen, the pattern to follow when arranging the plate, the hierarchy of value between the different ingredients (mixing them or leaving them next to each other?), the aesthetics of the arrangement: these are all aspects of a dynamic of autonomy with increasing responsibility leading to the expression of one's own identity.

PERSONALISING THE MEAL, THE VENUE AND THE SERVICE ENCOURAGES THE PARTICIPATION OF THE CHILD, WHO WILL FIND IN THE PLAYFUL DIMENSION THE CURIOSITY TO EXPLORE FOOD FROM DIFFERENT PERSPECTIVES

This formula is an opportunity to offer more and more discretionary power, thus expanding the possibility of approaching something that corresponds to your own tastes and allows you to explore new ones.

Turning now to the supply of the meal, there are again interesting possibilities for designing a type of service that encourages and stimulates the active role of pupils in the context of school meals. By rethinking the service line in a child-friendly way, pupils can be gradually introduced to new foods. It could be as simple as the cooks (or teachers) offering a sample to taste of a food the children have never tried before or a preparation that is difficult to accept. This gesture, when queuing in the food distribution line, allows the more daring to take the plunge and those who do not feel ready to do so to know that there is a chance to start a gradual approach to this type of food. In this context, kitchen equipment designed specifically for the size of small children guarantees accessibility to the choice of food offered on the distribution line, for example a counter with a wide range of items with which they can make up their own salad. This also helps fight food waste in the canteen.

Offering the possibility of personalising the canteen space is another good way for children to feel the space is welcoming and their own: preparing and caring for the environment set aside for the social meal is part of the child's active participation. Certain small daily actions, such as setting the table, therefore imply awareness and responsibility on the part of the children in charge, who get to take on the role of mediator between the canteen kitchen, if it exists in the school, and the rest of their class group. Finding out about the dishes that are to be served at lunchtime, communicating them verbally to the class group and discussing them and setting the table accordingly with the appropriate cutlery and shared utensils are some examples of how children can be involved in the process. Similarly, decorating the table and the room with items from the garden or vegetable patch, with semantic references to the current season or directly to the typical dishes being served at the moment, helps to engage the children and highlight the fact that lunch in the canteen is not just part of the everyday routine, but also as an opportunity to stimulate play, discovery and an awareness of healthy eating. These enhancements can be further enriched by cross-disciplinary links with other subjects, to be explored more once back in the classroom.

Finally, other examples bring us to the present scenario, where food is sometimes undervalued and stripped of meaning, and where there never seem to be too many opportunities to bring attention back to the subject. Letting ourselves be influenced by the stories and reasons behind each and every habit, practice and ingredient that crosses the threshold of a canteen kitchen can help lay the foundations for a critical consciousness in tomorrow's consumers. It offers the chance to introduce themes such as the rhythm of the seasons, local crafts and crops, their qualities and biodiversity and why they benefit people and the planet. In practice, providing a narrative about the food that nourishes us every day along with the meal, starting from the cognitive effort involved in questioning and specifying many basic assumptions often taken for granted, is another good strategy.

However, if we look closely, taking things for granted is not at all a child's way; rather, they use 'Why?' as a magnifying glass to seek explanations about the unfamiliar reality around them. Indeed, it is children's curiosity that turns the encounter with new foods and tastes into a valuable opportunity to playfully explore the unknown. Young explorers have the opportunity to test themselves against new and difficult stimuli (not without sacrifices and sometimes holding their nose), while learning to take their first autonomous steps in the universe of food.

The playful dimension is fundamental here: the game, with its story, its disguises, its rules and its parts, gives the child the magical role of discoverer of flavours. The caregiver must be an ally in the game: a participant in the challenge of discovering new healthy foods and not a strict guardian demanding a clean plate. The support of the family is therefore essential for the child's imitation process, as they rely on the family in making decisions about what to accept, as well as ensuring continuity and consistency with what is experienced in the school canteen environment.

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by Matteo Bigi

Educational activities in the school canteen

Stories of care and active participation

The school institution can play an important role in familiarising students and families with a sustainable, healthy and varied diet and helping them appreciate its value. This can be achieved through the organic design of food education programmes, consisting of practical actions that directly involve students. Sometimes, just learning the theory related to good nutrition is not sufficient for it to effectively translate into the acquisition of virtuous habits.

Since there is no guaranteed consequential relationship between the acquired knowledge and daily practices, it becomes clear that poor dietary choices among young school-aged children are difficult to change. This makes it necessary to employ an approach that communicates in a different way from the traditional classroom lesson. In this context, a taste education and food literacy programme cannot ignore the physical place that best demonstrates this: the school canteen. The canteen is, in fact, the place where one is greeted by the smells of the dishes of the day, the place filled with the chatter of the classes, the peer group. It is the place where the liturgy of the social meal takes place, with its actors, rules and customs, and it becomes a place of socialisation and identification in the group dynamic. It is in the canteen that we learn and grow.

To this end, we need to talk first of all about how important it is to create a solid relationship of trust between those who eat the food produced every day and those who cook, distribute and serve it. In fact, it is necessary to break down the age-old metaphorical wall that separates the kitchen from the dining room in order to bring the two parties together and start a dialogue. It is essential to establish a relationship of trust in order to provide pupils with a sense of comfort and familiarity (this is even more important and urgent in school canteens without their own kitchen!) In turn, this trust must be reciprocated with care and listening on the part of the cooks and operators, who are entrusted with the task of serving delicious food every day (often on a very limited budget). In the specific dynamic of the school canteen, a high degree of empathy is required on the part of the kitchen staff towards their 'guests'. We are not talking about what happens in any other restaurant situation, where customers with fairly developed, trained tastes deliberately choose to go to a certain place to sample a chef's creations, but about an environment with completely different needs and responsibilities: it's not simply a question of serving good, aesthetically appealing food, but first and foremost about nourishment and care during what for many is the main meal of the day, and for some the only.

ONCE AN AD-HOC AREA HAS BEEN PREPARED WITH BASIC EQUIPMENT, IT'S EASY TO USE A LITTLE CREATIVITY TO TRANSFORM THE CANTEEN INTO A CHILD-FRIENDLY LABORATORY

Children need to see and explore the kitchen environment and the frenetic 'ballet' that takes place in it every day. In the canteen, as at home, children should be exposed to this type of situation, while respecting safety regulations, and should be involved in some simple everyday operations relating to the procurement of ingredients, their processing and serving. The canteen is the place where care and trust meet, the perfect place to organise activities and hands-on experiments that allow children to learn more about food while having fun.

Wow! What a colour / This is so colorpHul

This experiment shows us the effect of a change in pH on anthocyanins, special pigments from the flavonoid family found in purple vegetables. If we take the outer leaves of a red cabbage, puree them with some water using an immersion blender and then strain the liquid, we will obtain water with an intense dark purple colour. Pour the liquid into three clear glasses, adding a dash of vinegar (or lemon juice) to the first, a pinch of bicarbonate of soda to the second and nothing to the third glass. The colour of the first glass will instantly change to bright fuchsia and the second to sea-blue. By arranging the three jars, we have achieved a colour scale from pink to purple to blue, giving the children an instant WOW effect. Even more fun: by adding bicarbonate to the glass to which we have added vinegar, and vice versa, we can return to the original colours, thanks to the reversibility of pH. This experiment, with its undeniable visual effect, helps children to understand the importance of colours, how they behave in the kitchen and, above all, the beneficial properties they bring to our diet.

The same activity can also be done with turmeric powder: dissolved in water, it produces an orange liquid which, as before, changes colour depending on the acidity or alkalinity of the water, in this case thanks to curcumin rather than anthocyanins. 'But what is curcumin, and why do we need it in our diet?' is then the inevitable question to ask, giving the activity educational continuity and a link with other subjects.

Credit: Photo by Jingxi Lau on Unsplash

Let's have a tomato coffee break

This experiment helps children to expand their imaginations and at the same time exposes them to the wealth of possibilities for reusing food waste.

We know that coffee is for grown-ups, but when made with the right ingredients, even little ones can appreciate it! The waste from making homemade tomato puree – seeds, skins and fibres – can be dried in the oven to make a deep red powder with a fresh tomato flavour. Apart from sprinkling it on plates or mixing it into focaccia dough, we can also use it to make a coffee-like drink. To demonstrate, simply take a moka pot, fill it with water and put tomato powder, and a pinch of salt if you like, in the filter. Then put it on the stove and wait for the tomato coffee to bubble up. We've discovered a curious alternative use for the moka pot! It can be fun to serve this very tasty broth, piping hot, in small coffee cups. The lycopene in the dried tomato skins and seeds is the main ingredient responsible for the umami flavour of the 'coffee'. Once you've tried it, you can repeat the experiment with other powders made in the canteen from the leftovers of everyday recipes.

Photo by Brenda Godinez on Unsplash

Tell me what you put in it and I'll tell you who you are!

Less of an experiment, this is more a chance for the children to express their creativity and undertake a small mission: to create their own personal veggie burger. Time to wash hands and get involved! Working in groups, they have to come up with their own recipe, choosing the type of bun (with different shapes and flours), the burger (a mixture of chickpeas, lentils, beans, potatoes, carrots, broccoli, spinach and – why not – a little spice), the condiment or side dish (sauces and other colourful seasonal vegetables). Once the burgers have been prepared with the help of the canteen cooks, each group should present its creation to the class. This activity gives the children, who have to work as a team, the opportunity to explore and strengthen their relationship with food as they see a product being made from start to finish and get to control every single variable in the recipe.

The most successful one could be featured on the school lunch menu!

Credit: Photo by Pavel Danilyuk on Unsplash

by Nahuel Buracco

The classroom as laboratory

Pushing the boundaries of the classroom and creating an educational and practical demonstration experience

A DIRECT LINK CAN BE MADE IN THE CLASSROOM TO WHAT IS HAPPENING IN THE CANTEEN

In this chapter we have seen how it is possible to go beyond the canteen by turning lunchtime into an educational opportunity through experiments and experiences that can stimulate creativity, curiosity and self-awareness. What about the class-room? By definition, the classroom is a safe place dedicated to learning, consisting of desks and chairs, blackboards and tables, posters and shelves of books. The classroom, understood as a physical place, takes on different forms and characters according to different needs. It can, if desired, be directly linked with what is happening in the canteen and at home, for example by creating joint learning modules between lunchtime, lessons and practical experiences. Sometimes the classroom can take the form of a workshop for cooking, horticulture, fermentation or much more. In this respect, a multidisciplinary and interdisciplinary approach to food makes it possible to create an inclusive system of sciences and to use food as a tool to gradually demonstrate the central role it plays in our daily lives. Applied food sciences lead to the discovery of the complexity of the food system and the central role of processors and consumers, revealing the complicity of their relationship. The only way to save the world is one step at a time, and the classroom is an excellent place to start.

Teachers, canteen cooks, laboratory technicians (where they exist) and other school staff, working together, can put on a scientist's coat, a gardener's overalls or a cook's apron to design and bring into the classroom educational modules that combine theory and practice. The hands-on approach, as a method for structuring practical experiential learning activities, has the ability to create cooperative peer learning dynamics, object-mediated learning and learning through direct experience. Therefore, group work, projects to be monitored over time to analyse developments and practical activities enable the creation of a strong, active and collaborative sense of community. A clear method for approaching the various possible topics in a holistic way must be simple and effective; pointed and apparently simple questions make it possible to stimulate the interest of the students and to build up a relationship of trust and understanding. The starting point, as every scientific researcher and explorer knows, is questions, not answers. Let's have a look at some of these questions, with the aim of designing activities that can turn the classroom into an experiential workshop:

WHY?

All learning processes start with good motivation, so understanding and creating a common 'why' by analysing critical issues and potential is fundamental. Let us take as an example the concept of sustainability, a term that is now being misused and can very often appear at first glance to be a distant and untranslatable concept. A mere list of parameters, statistics and numbers only serves to make the topic feel even more foreign, when instead it should arise from a shared vision. A strategy to overcome this hurdle can be to start with a blank piece of paper and collectively build a definition of sustainability in the classroom. By translating this definition into practical and understandable actions and concepts, it can be related to familiar contexts and suggest tools for understanding how we can take an active role. This contributes to creating a sense of shared responsibility.

WHAT?

When the going gets tough, the 'hard sciences' come into play. Practical activities in the classroom, in the canteen, in the vegetable garden or on the farm to discover the meaning of biodiversity, seasonality, local traditions, food waste, science in the kitchen and the workings of the agroecological system enrich students' knowledge, raise their awareness of reality and stimulate their creativity and curiosity.

HOW?

The exact means will vary from place to place and season to season. For example, some key activities could focus on the importance of the role of seeds in conserving biodiversity, experimenting with different techniques for extracting and preserving vegetable and fruit seeds, seed germination and plant growth. Or we could talk about local traditions and science applied to cooking, involving professional chefs if possible, experimenting with fermentation through the discovery of micro-organisms, producing, like real scientists and chefs, experimental ferments using seasonal fruits and vegetables or even dairy products (obtaining yoghurt, ayran, labneh, sour milk, sour cream, viili, ymer, yakult and many others, depending on where we are in the world).

WHAT IF...?

Once the windowsills have been filled with pots of tomato, garlic, onion, pumpkin and bean shoots and the cupboards have been turned into fermenting chambers, it's time to mix things up. Let's give space to the pupils and make them the communicators of what they've learnt. Why not let them be teachers for a day? They could be tasked with telling other classes, friends, family or even strangers at open days or social events what they have discovered. Let's leave them an open channel of discussion with canteen cooks and teachers, so that they can not only understand the critical issues, but also propose solutions. In short, let them surprise us.

by Annalisa D'Onorio and Stefania Durante

Canteen Day

A time to share knowledge

Credit: Photo by Max Fisher on Pexels

Canteen meals can be a game changer in terms of nutrition, well-being and sustainability; school meal statistics affect local economies and policies, and can positively impact public finances, the economy, health and the environment. However, if we look at the situation from the point of view of individual benefits, the fundamental prerequisite is the involvement of the family. The educational input received at school must be reinforced by family choices. The aim is to educate conscious future parents; the challenge is to achieve this through the active participation of current parents. The lever of participation is based on motivation and interest, which is why, in addition to the interventions in the canteen and in the classroom for the pupils, it is necessary to plan attractive and engaging promotion, information and awareness-raising events for the community. One such event in the SchoolFood4Change project is Canteen Day, an occasion entirely dedicated to activities related to school meals, involving different target groups (pupils, families, parents, teachers), in different contexts (the school, the local market, the town hall) and held on the best day for individual schools and towns (e.g. International School Meals Day, an open canteen day, a food day, the local patron saint's day).

THE AIM IS TO CREATE CONSCIOUS FUTURE PARENTS THROUGH THE ACTIVE PARTICIPATION OF CURRENT PARENTS

Involving children in the activities is easy, especially as Canteen Days are an opportunity to show family or peer groups what has been done as part of the Whole School Food Approach actions. However, if peer education activities are planned, it is important to prepare the pupils well in advance so that they can experience the event independently, consciously and enjoyably. The Canteen Day therefore takes advantage of the lever of pleasure as a tool for food education actions that actively engage families. Whether it's the pleasure of tasting, the pleasure of discovering new recipes or the pleasure of sharing gastronomic experiences and traditions, food unites us all!

For the event to be appealing and engaging, it will be necessary to focus on the emotions around the sharing of food and to remember some of the elements that underpin calm, healthy meals: time, attention to people and ingredients. The youngest participants can be asked to reflect on the environment and food.

Short biography of the authors

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SCHOOLFOOD 4CHANGE

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