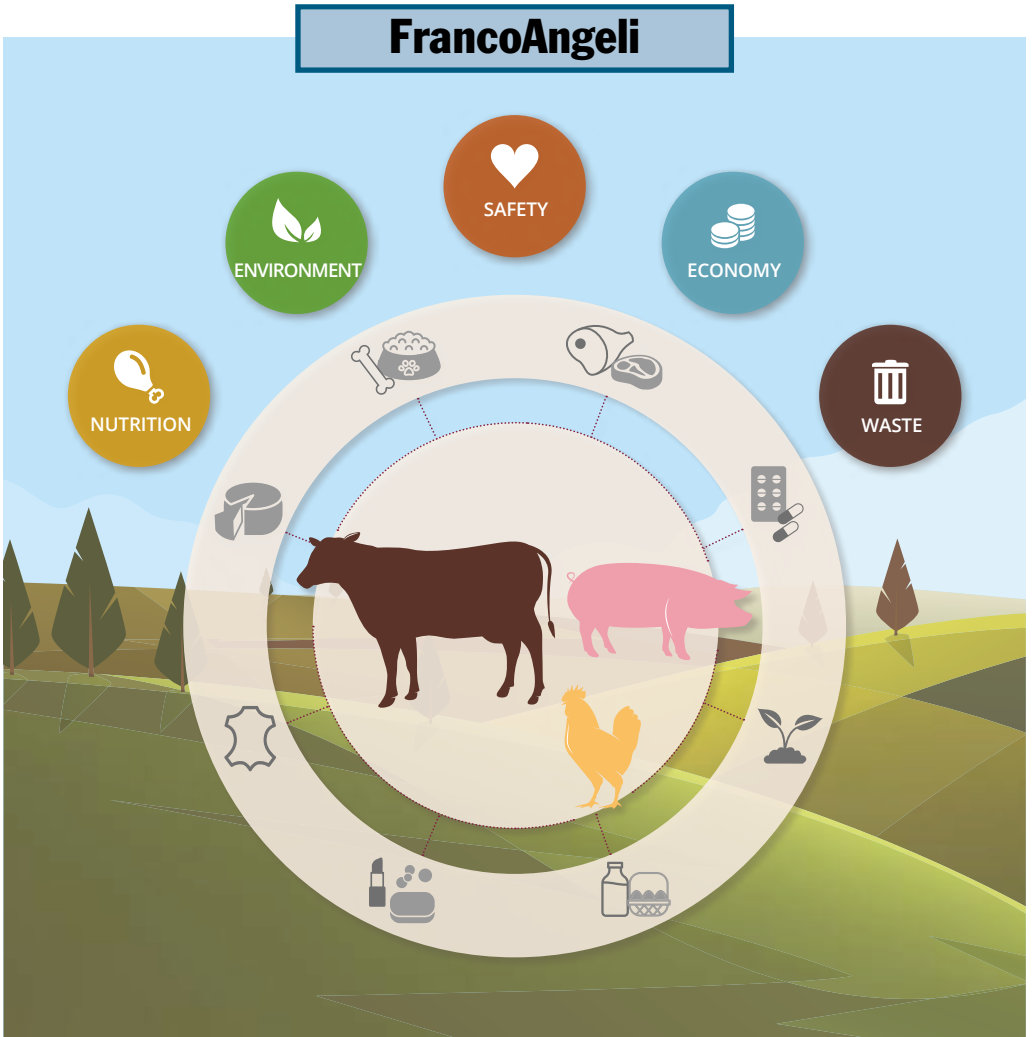
Elisabetta Bernardi, Ettore Capri,
Giuseppe Pulina

THE SUSTAINABILITY OF MEAT AND CURED MEATS IN ITALY

NUTRITION ASPECT, FOOD SAFETY, ENVIRONMENTAL IMPACT, ANIMAL WELFARE, CIRCULAR ECONOMY, NO WASTE

FrancoAngeli



Copyright © 2019 by FrancoAngeli s.r.l., Milano, Italy. ISBN 9788891793324

Elisabetta Bernardi, Ettore Capri,
Giuseppe Pulina

THE SUSTAINABILITY OF MEAT AND CURED MEATS IN ITALY

NUTRITIONAL ASPECT, FOOD SAFETY, ENVIRONMENTAL IMPACT, ANIMAL WELFARE, CIRCULAR ECONOMY, FIGHT AGAINST WASTE

FrancoAngeli
OPEN ACCESS

 ISBN 9788891793324

Book printed with the financial contribution of Carni Sostenibili Association

CONTRIBUTIONS

Life Cycle Engineering

Andrea Bertaglio, *environmental journalist*

Manila Bianchi, Maria Caramelli - *Istituto Zooprofilattico Serimentale del Piemonte, Liguria e Valle d'Aosta*

Susanna Bramante, *agronomist and scientific populariser, PhD in Animal Production, Health and Food Hygiene in Mediterranean Climate Countries*

Silvana Chiesa, *professor in the Faculty of Agricultural Sciences and Technologies, Agri-Food and Forestry, University of Parma*

Valentina Massa - *Dalma Mangimi*

Massimo Montanari, *full professor, Department of History, Culture, Civilisation, University Alma Mater, Bologna*

Cover image: graphic processing by Life Cycle Engineering

Copyright © 2019 by FrancoAngeli s.r.l., Milano, Italy. ISBN 9788891793324

CONTENTS

 ISBN 9788891793324

 ISBN 9788891793324

THE "SUSTAINABLE MEAT" PROJECT

The consumption of meat is increasingly subject to attention and criticism principally linked to nutritional, ethical and environmental reasons. To this international debate organisations and stakeholders participate inspired by different motivations: there are animalist and/or environmentalist associations, research centres, the media, etc. In this context, at least in Italy, the point of view of meat producers has never been introduced, who should instead participate in the discussion by providing information, details and objective data useful to correct, where necessary, some positions that are on occasions prejudicial or not completely correct. With this objective, in 2012, the Sustainable Meat project was born, which in uniting the main Associations of producers, has the intent to bring to people's attention the results of the commitments of the various operators of the sector offering a point of view for a constructive and transparent confrontation, free from preconceptions and extreme positions, and driven by the desire for scientific and objective analysis. The purpose is not to convince those who for personal reasons choose not to consume meat, but to inform those who include animal proteins in their diet, conscious that a balanced consumption of meat is sustainable both for health and for the environment. Analysing the sustainability of meat and cured meats means studying, in the most objective way possible, different topics concerning both the consumer and livestock production. For this reason, the contents of this book analyse nutrition, environmental impacts, food safety and animal welfare, economic aspects and food waste.

WILL WE SAVE THE PLANET BY NOT EATING MEAT?

We have heard it repeated for years: to win the fight against climate change we must banish meat and cured meats from our tables. Yet, for however praiseworthy it is to want to contribute in stopping the ongoing climate chaos, the decision to convert to veg will not only not save the planet, but it is also a profoundly wrong message, for several reasons.

The most evident, if we consider the data on the emissions of greenhouse gases, is that the production of meat and cured meats (including the cultivation of food, breeding, and processing) is responsible for 15-18% of emissions as can be seen from the statistics published regularly by the FAO (www.fao.org/livestock-environment/en/). This leads to the consideration that it cannot be an individual choice, such as quitting meat, which can solve the problem above all if you ignore all the others responsible for the current climate crisis, like the transport and energy sectors that affect the remaining 65-70%. Reminding us of this is not a meat fan, but Professor Michael E. Mann, a climate scientist, "Distinguished Professor" of Penn State University as well as one of the authors of the famous Climate Change Report of the IPCC, the Intergovernmental Panel on Climate Change which, to date, perhaps better than anyone else, illustrates the point about the climatic upheavals in progress. Referring to the "despotic" idea of the American multinational WeWork to banish meat from all its employees, Mann reminds readers how objectively absurd it is to think of helping the climate in this way. WeWork, or rather, its billionaire CEO and founder Miguel McKelvey, not only forced his employees into this choice, that appears rather ideological than eco-sustainable, but he did it stating that this change in the menu is for example much more useful than passing to a hybrid car. An affirmation that

 ISBN 9788891793324

is inaccurate under many points of view, but also deceptive. "Fossil fuels are left out of the discussion. Accepting implicitly the idea that climate solutions are voluntary measures", explains Mann to NBC News: "They are important. But it is really frustrating for me when they say to eat less meat".

According to Professor Mann, who recently wrote another excellent book against climate negation, "The Madhouse Effect", it is much more important to reduce our dependence on fossil fuels rather than not becoming vegetarian, especially if, as WeWork does, one concentrates only on meat and cured meats without instead touching on foods that are equally impactful on the environment, nor by banishing eggs and cheese which generally have upstream breeding just like meat products.

"It is incredibly irresponsible to suggest that hybrid cars do not represent an important step in the fight against carbon emitters", emphasises the Penn State professor. Equally irresponsible is advising individuals not to eat more meat, I add, neglecting the damages which this can cause to health, especially in certain age groups. All this making the belief that the fight against climate change can be exempt from precise political and economic choices.

A mistaken message also because whoever promotes it probably does not know at all the agricultural and livestock sector and therefore does not know that "there exists in reality responsible ecological ways for producing meat", as Mann emphasises. In Italy we know something about this, since (I know from direct experience) we vaunt one of the most sustainable livestock models on the planet, also thanks to the commitment made in promoting good practices. Furthermore, "if all farms all over the world would adopt good practices - concludes Mann - the percentage of carbon emitted 'from the farm to toilet' could be reduced from 18% to only 10%". Not enough, if you want to save humanity.

Passing off the veg choice as more sustainable on an environmental level, but never considering the contribution of the livestock sector in preserving landscapes, territories, traditions and cultures is one of the most superficial, inaccurate and indeed irresponsible messages of our time, which seems to have breached the common imagination. It is therefore pleasing to see how also scientists that deal seriously with the defence of the climate finally take a position against the rampant and senseless anti-meat obsession of the western world.

Ettore Capri
Full Professor of Agricultural and Environmental Chemistry, Università Cattolica del Sacro Cuore

 ISBN 9788891793324

INTENSIVE OR EXTENSIVE, IS THIS THE PROBLEM?

Meat has been a part of human nutrition since the dawn of human history.
For hundreds of thousands of years, hominids have based their livelihood on the products of hunting and plants grown spontaneously; subsequently the progressive reduction of hunting and gathering in favour of agricultural practices laid the foundations for the birth of agriculture. With it man has modified both his lifestyle, which from predominantly nomad became stable, and his eating habits along with the management of the environment settled. Cultivation practices are accompanied by the first forms of animal domestication, that are selected and bred to help work in the fields and to provide food, wool and leather. Nutrition becomes more and more varied, having now bread, cereals, fruit, vegetables, fish and meat.
With the passing of centuries, first the roman-barbarian influences, then the medieval, the idea of meat consumption as an essential requirement for a healthy diet are strengthened. Meat remains a longed for and desired food over time, even if with very variable consumption habits depending on historical period and social class. Given that until the 13th century the practice of an agro-silvo-pastoralism offers a diversified diet and makes meat accessible to the whole population, successively one assists to the formation of a gap between the rich and varied nutrition of the nobles in the cities, and that of the rural population where economic difficulties relegate the consumption of meat to festive occasions only. The culinary culture of the countryside is developed as a consequence, giving precedence to cereals, bread, legumes and vegetables, and devising recipes to reuse all the edible parts of the animal, minimising waste.
The scarcity of meat in the nutrition of the rural population remains constant up to the early twentieth century. In Italy, it is only starting from the Sixties of the last century that the strong economic development increases the consumption of meat, that becomes the symbol of liberation from misery and poverty. To cope with the growth in population and food consumption an intensification of meat production is undertaken: the food industry is structured to meet the increase in demand, on farms the password becomes production efficiency. Since the Eighties, in Italy, the consumption of meat has stabilised and, on the base of a well-established food security, we are witnessing a changing sensitivity on ethical issues, such as animal welfare and the environmental impacts of farms.
In this context, current consumption on a worldwide level is to be evaluated by taking into account both global factors and data related to the various eating habits in the world. There is no doubt that the growth in world population, forecast more than 9 billion individuals in 2050, compared to over 7.5 billion currently (in 1960 it was around 3 billion), will inevitably result in a greater demand for food and in particular for animal proteins, for which an increase is foreseen of around 60%. In evaluating current global meat consumption, however it is not just the absolute value that needs reflecting on as instead the extreme difference between the average consumption per capita in various areas of the world, with values ranging from about 120 kg/year in North America to less than 40 in Asia and Africa. The context has therefore changed profoundly over the years and today's need is to guarantee food for everyone on sustainable economic and qualitative terms. It is inevitable, therefore, the crossing of these concepts with those of intensive breeding, which is probably the main object of contention of those who debate on the sustainability of livestock production.
But it is necessary to clarify what is meant by the concept of intensive: more often it tends to link the intensity of a breeding

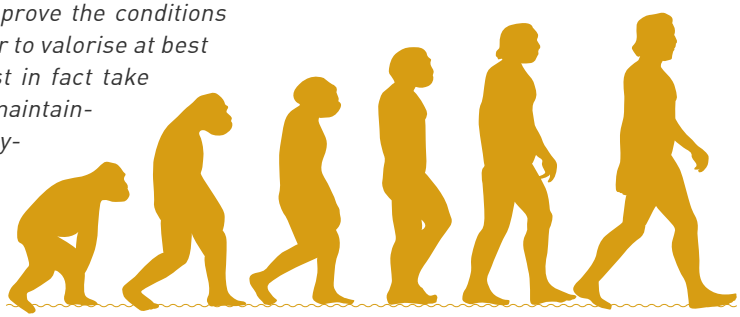
 ISBN 9788891793324

farm to number per surface unit and animal space. This type of approach is outdated and needs a methodological update which texts of agricultural economy can offer some solutions. The intensity of a breeding farm, in fact, can be defined by basing the relationship between the direct cost of labour and the total costs, the so called "capital intensity". The lower this relationship is, so with a low incidence in the cost of labour respect to the total, the more farm can be considered intensive, that is capital-intensive; on the contrary when labour costs become a factor primary we are facing an extensive usually consisting of small family-run businesses.

This approach is thus incoherent with the typical equation "many animals in a small space equals intensive farming". There are bovine or sheep farms, with thousands of animals, where animals have a lot of space at their disposal (think for example of the farms in Australia or Ireland), while family-owned farms have very few head confined to very restricted surfaces. Judgment on the quality of breeding should therefore not be based on the concept of the intensiveness or extensiveness of capital use in the livestock enterprise but on its objective characteristics that are a consequence of breeder's behaviour. It is more appropriate, therefore, the distinction between good and bad breeder. In the case of intensive farms, considering the economic meaning of the term, breeders have a greater availability of resources, also economic, that can (when they are good breeders) be allocated to maintain and improve the conditions of the farms. A breeder to valorise at best his farm animals must in fact take care of their welfare; maintaining a good state of psycho-physical health in animals is an indispensable requirement in guaranteeing adequate living conditions, but it is also a crucial element to guarantee the security of the foods derived from them.

A meat of quality with the ability to achieve a higher sales price derives, in most cases, from farms "economically" intensive managed by longsighted farmers who are capable of investing in safety and food quality, on processes and farm innovation. Obviously, in all this it is also the consumer who plays an important role: if the choice of meat, and in general of food, is driven solely by the research for saving it is very difficult to guarantee adequate remuneration for the players in the supply chain, foremost the breeders. The challenge the meat sector must face today, is that of a greater "sustainable" offer that can guarantee an efficient production, attentive to the environment and the welfare of animals, breeders and all those who participate in the creation of value in Italian supply chains.

Giuseppe Pulina
Full Professor, University of Sassari
President of Carni Sostenibili Association



 ISBN 9788891793324

THE NUTRITIONAL VALUE OF MEAT

- DIET AS A FOOD MODEL: THE FOOD PYRAMID
- THE NUTRIENTS OF MEAT
- THE NEEDS DURING THE DIFFERENT PHASES OF AN INDIVIDUAL'S LIFE
- FOOD AND HEALTH
- IS MEAT CONSUMPTION SUSTAINABLE?

 ISBN 9788891793324

Introduction

MEAT IS AN IMPORTANT SOURCE OF PROTEINS, OF ESSENTIAL AMINO ACIDS AND OTHER MICRONUTRIENTS USEFUL TO THE HUMAN ORGANISM

THE MEDITERRANEAN FOOD MODEL SUGGESTS A MODERATE CONSUMPTION OF MEAT

THE PER CAPITA MEAT CONSUMPTION IN ITALY IS SIGNIFICANTLY LOWER RESPECT TO OTHER DEVELOPED COUNTRIES

When it comes to nutrition it is important to start from the concept of diet understood according to the model of Greek medicine, namely a ***way of life*** *aimed towards health, which provides indications respect to every aspect of daily life, from food, to physical exercise, till rest. Therefore, not a therapy of weight loss as a temporary remedy for an excessive consumption of food, nor based on specific diseases. Nutritional education should therefore exhort people to follow a balanced "food model", that foresees the consumption of all foods without excessing. In this sense the* ***Mediterranean Diet*** *is of great help because the suggestions that are obtained* ***from this model help to consume all foods in a balanced way****, including meat and cured meats, necessary for people's healthy nutrition.*

If one enters more specifically, each food supplies ***nutrients to the organism*** *useful to the physiology of the body.* ***Meat and cured meats*** *are for example* ***sources of essential proteins****, but also of many* ***micronutrients*** *and* ***bioactive compounds*** *that support some special functions. Sometimes these components are more bioavailable (i.e. better assimilated) compared to plant-based sources, in some cases (for example* ***vitamin B12****) they are present only in foods of animal origin like meat and cured meat. It is therefore interesting to investigate the functions of the individual nutrients, relating them to the needs of the human body during the* ***different stages of life****.*

Moving from the nutritional to the medical field one enters the area of ***clinical diseases****, which in many cases can be related more or less directly to food consumption. In the case of meat, the most attention regards the alleged correlation between the consumption of meat and cured meats with some cancer pathologies. Despite the many hypotheses in this field,* ***the relationship between disease and moderate consumption is not currently demonstrable*** *and scientific studies lead to non-definitive conclusions, if not those of keeping consumption within the levels suggested by most common nutritional models. It is interesting to investigate the reasons for these alleged relationships, in order to understand the possible ways to control them.*

Consumption *is therefore precisely a fundamental link to relate a food with its repercussions on health and sustainability in general. To the question "how much meat do you eat?" it is not easy to answer, because there is little available data and refers very often to food availability (****apparent consumption****) and not to* ***real consumption****. With a thorough analysis of the information available one can however draw some general considerations: the first is that the real consumption of meat and cured meats in Italy is lower than that communicated by normally used data that refers to apparent consumption; the second is that* ***the consumption of meat (per capita) in the world presents important differences between North American and Asian countries****.*

 ISBN 9788891793324

1 DIET AS A FOOD MODEL: **THE FOOD PYRAMID**

The Mediterranean Diet is the result of millennia of exchanges of food and cultures between people from all the countries bordering the Mediterranean basin. This model, known to be one of the healthiest and most balanced, in the twentieth century has characterised the eating habits of the inhabitants of the Mediterranean region, originally based on agricultural and rural models.

The **Mediterranean nutritional model** foresees the **consumption of all foods**, without any exclusion and suggests a high intake of vegetables, legumes, fresh and dried fruit, olive oil and cereals (mostly wholemeal); a moderate consumption of fish, dairy products (especially cheese and yogurt), meat and occasionally sweets. For this reason, it must be seen as **a model** in which no single nutrient or food should predominate, but the overall effect of diet. Not surprisingly, the benefits of the Mediterranean Diet are due to the synergistic combinations of the nutrients and protective substances contained in the foods, to an adequate daily intake of **energy** and **water** and the **practice of physical activity** in order to maintain a healthy physical and mental state.

The food pyramid defined by the Mediterranean Diet Foundation.
Source: IFMeD

 ISBN 9788891793324

Other strengths of the Mediterranean model are the consumption of traditional and local food products, the preference for wholemeal grains and unsaturated fats, seasonality and food biodiversity.

1.1 The food pyramid

Starting from the first definition of the Mediterranean Diet, made after the Second World War by the scientist Ancel Benjamin Keys who first highlighted how cardiovascular diseases in Italy, Spain and Crete were almost unknown compared to the disturbing levels already reached at that time in the United States, and that such a low rate was due to the different eating habits of those countries[1], many examples of graphical representation of the Mediterranean nutritional model followed. With one objective always: make communication simple and educate people. After the recognition of the same Mediterranean Diet as an Intangible Cultural Heritage of Humanity by UNESCO in 2010[2], and taking into consideration global interest, the Mediterranean Diet Foundation and its International Scientific Committee have developed in 2011[3] a position of consensus, by presenting a new pyramid with which scientists hoped to contribute to a better adherence to this healthy nutritional model and the Mediterranean basin lifestyle.

The food pyramid shows the lifestyles to be adopted and the food consumption frequency to adhere faithfully to the Mediterranean nutritional model and maintain in this way a nutritional balance. As shown in the diagram, the base of the pyramid provides a set of skills, knowledge, rituals, symbols and traditions in the **field of agriculture, fisheries and animal husbandry**, and in particular valorises the sharing of food consumption. **Eating together** is indeed one of the fundamental elements to be privileged as well as an active lifestyle, adequate rest and foodstuff consumption preferably following seasonality. The pyramid is structured so as to make obvious the frequencies of consumption, with at the base foods to be taken every day and at the apex those to be consumed weekly.

Every day we should drink at least 8-10 glasses of water, which equals 1.5-2 litres, but if the nutrition is rich in fruit and vegetables the recommended amount drops to 1.2 litres per day, i.e. 6-8 glasses, to be consumed at meals and during the day.

Climbing up the pyramid one meets the vegetables group, fruit and nuts, foods that provide fibre, vitamins, minerals and chemical compounds such as flavonoids, phytosterols, terpenes and phenols, which offer protection against oxidative processes, thus reducing the incidence of cardiovascular diseases[4]. Here can also be found cereals, which provide low glycaemic index carbohydrates, as long as you choose wholemeal often.

The consumption of fibre-rich products has been associated with a lower risk of diabetes, especially type 2, coronary heart disease and cancer, while refined grains are linked to an increased risk of diabetes, obesity, coronary heart disease and other chronic diseases[5]. **Extra-virgin olive oil** should be the predominant seasoning, because it provides a high content of oleic acid and polyphenols, which have atherogenic, antioxidant and anti-inflammatory effects[6].

Halfway up the pyramid are milk and its derivatives such as yogurt and cheese, which provide high quality protein and

 ISBN 9788891793324

easily assimilated calcium. In addition, the lactic bacteria contained in yogurt can help improve gastrointestinal health and immune response, as well as inducing changes in intestinal flora associated with a reduction in the risk of colon cancer[7]. The upper part of the pyramid includes the group of "**protein**" foods. Foods like **meat, fish and eggs** are precious sources of high quality proteins, easily digestible and they are rich in many essential micronutrients such **as iron, zinc, vitamin A and vitamin B12**, which can contribute substantially to ensuring the adequacy of the diet, preventing any nutritional deficiencies[8]. In addition these foods contribute to a **positive impact on growth, cognitive function and physical activity, especially in children**.

This model, in addition to providing the advantages related to a high consumption of antioxidants and polyphenols, is characterised by an excellent ratio between omega-6 and omega-3 essential fatty acids. Polyunsaturated omega-3 fats (PUFA), contained in fish (for example, eicosapentaenoic and docosahexaenoic acid), regulate the haemostatic factors and provide protection against cardiac arrhythmias, cancer and hypertension[9], and play an important role in the preservation of cognitive functions[10].

Another important aspect of the Mediterranean dietary model is the reduced consumption of sodium which, when taken in high quantities, can cause disorders related to high blood pressure; the high consumption of preserved salty foods has been linked by several studies with a higher risk of stomach cancer and coronary heart disease[11-12].

1.2 Mediterranean Diet and health

The Mediterranean Diet has been scientifically proven to improve health by increasing protection against the most common chronic diseases, such as hypertension, diabetes, obesity and cancer, reducing the onset of cardiovascular disease and preventing neurodegenerative diseases, such as Alzheimer's and Parkinson's. By now all the most important and influential scientific societies consider it the ideal style of diet to preserve the status of health and to reduce the occurrence of the most important chronic diseases. According to the World Health Organization, the Mediterranean Diet is one of the most promising strategies to prevent major diseases and improve the quality of life[13].

Like traditional Asian diets, the Mediterranean Diet has also had a prominent place in the study that characterises the so-called "Blue Zones" regions, where lifestyle models, including traditional dietary approaches, have been associated with longevity and vitality[14].

A study published in the British Medical Journal[15] observed that a sample of over 4,000 middle-aged women, for example, showed a relationship between the Mediterranean Diet and a slowing down of the aging process. Beyond these specific quotes, one can observe how the scientific world is extremely cohesive in observing the close correlation between the beneficial effects on health and the Mediterranean nutritional model.

Inflammation is now recognised as an important factor in the development of many chronic diseases, including cardiovascular diseases, cancer, type 2 diabetes, metabolic syndrome, Alzheimer's disease, and is also associated with obesity. The Mediterranean Diet has a preventive

 ISBN 9788891793324

effect also in this case, as demonstrated by recent studies which concluded that a low adherence to the Mediterranean Diet is associated with greater quantities of inflammatory markers[16], while adopting the Mediterranean style offers greater protection against oxidative stress and inflammation and platelet aggregation[17].
In general, following the Mediterranean Diet means having a significant reduction in mortality from cancer, as well as a lower incidence of different types of cancer[18]: colorectal cancer, in particular, but also cancer of the aero digestive pathways (pharynx or oesophageal cancer) and prostate cancer.

In addition, specific food nutrients or micronutrients characteristic to the Mediterranean Diet can play a role in the prevention of breast cancer: the intake of foods containing phytosterols, vitamins C and E, beta-carotene and calcium can exert a protective action, including the reduction of cell proliferation. Consumption of substances such as ascorbic acid, carotenoids and other antioxidant vitamins is inversely related to gastric cancer and neoplasms of the upper digestive tract and respiratory tract.
The PREDIMED[19] study, an international survey that assessed the effects of the Mediterranean Diet on primary prevention of cardiovascular disease, demonstrated for the first time in a randomised clinical trial that the Mediterranean nutritional model protects against cardiovascular disease and confirmed that it reduced classic and emerging cardiovascular risk factors.
An important lesson of the study is that it is never too late to change eating habits and improve cardiovascular health, and that part of the study's positive results can be attributed to extra virgin olive oil and dried fruit and nuts, foods rich in unsaturated fats and rich in antioxidants.
Other potentially beneficial effects of the Mediterranean Diet concern a greater defence against neurodegenerative diseases and the conservation of cognitive functions, reduced inflammation, the improvement of insulin sensitivity and a possible role in the prevention of dementia and Alzheimer's disease[20].
In recent years, some authors have indicated that adherence to the Mediterranean nutritional model reduces the incidence of the onset of diabetes and the main protective compounds are vegetable fibres and fats such as olive oil; in particular, this protection is guaranteed by the consumption of extra virgin olive oil for cooking, seasoning, baking and frying food. It would seem that diets rich in monounsaturated fats, such as the Mediterranean Diet, improve insulin sensitivity[21].

1.3 Portions and frequencies of consumption

Globalisation, urbanisation, changes in lifestyle and in the food chain have led to a change in eating habits and the loss of traditional food cultures. These changes, together with greater availability and marketing of products of low nutritional value, highlight the need for a coherent, simple and practical food guide to allow the population to choose a healthy diet, to prevent diseases and to guide countries in the development of policies regarding food, health and agriculture.
The guidelines for healthy eating show how you can follow a healthy, balanced diet that meets your nutritional needs. The indications are often **summarised in graphical form as a pyramid (Spain), a plate (USA) or a wheel, and vary from**

 ISBN 9788891793324

country to country depending on their cultural heritage. France has a scale with nine rules (9 Repères), Sweden has a Circle of Foods (Matcirkeln) accompanied by an ideal diet for men and women, while the United States has the dish (MyPlate); but in general the representations try to make the concept of a balanced diet easily understandable: we eat to satisfy the **need for essential nutrients such as carbohydrates, proteins, fats, vitamins, minerals, fibre, water**.

To facilitate the task of meeting the needs of essential nutrients every day, the food has been divided into groups, based on the substances they contain and give to the organism. A diet complete from a nutritional point of view, is the result of a choice of foods that, with quantities adapted to the personal needs of nutrients and energy, comes from all the food groups. Although they are coherent with the needs of the local population, many nutritional guidelines have common rules. The majority of them promotes variety and a high consumption of plant foods as well as a reduced intake of saturated fats, salt and sugar.

The guidelines in fact give indications also on the dimensions of the portions and on their consumption frequency, but how many adhere to such indications? It is now clear that the size of the portions of food in general and those packaged in particular have increased over the last 30 years[22], so much as to suggest that this is one of the factors that has contributed to the increase in obesity.

In 2014, the SINU (Italian Society of Human Nutrition) published the new LARN[23] (Levels of Reference Assumption for the Italian population) which contains, among other things, suggestions relating to the portions of each food.

 ISBN 9788891793324

GROUPS OF FOOD	FOODS	STANDARD PORTIONS (g)	PRACTICAL UNITS OF MEASUREMENT
MEAT FISH EGGS	"red" meat fresh/frozen (bovine, ovine, pork, equine)	100	1 slice, 1 hamburger, 4-5 pieces of stew, 1 sausage
	"white" meat fresh/frozen (chicken, turkey, other poultry, rabbit)	100	1 slice of chicken or turkey breast, 1 small chicken leg
	cured meats	50	3-4 medium slices of ham, 5-6 medium slices of salami or bresaola, 2 medium slices of mortadella
	fish, shellfish, fresh/frozen shellfish	150	small fish, 1 medium fillet, 3 prawns, 20 shrimps, 25 mussels, fish, molluscs, crustaceans
	fish, molluscs, preserved crustaceans	50	1 small tin of tuna in oil or brine, 4-5 thin slices of smoked salmon, ½ fillet of cod
	eggs	50	1 egg
LEGUMES	fresh or canned legumes	150	half a plate, a small box
	dry legumes	50	3-4 tablespoons
DAIRY PRODUCTS	milk	125	1 small glass, 1/2 medium cup
	yogurt	125	1 jar
	fresh cheese	100	1 small mozzarella cheese
	aged cheese	50	-

Portions of reference for protein foods.
Source: SINU (Società Italiana di Nutrizione Umana - Italian Society of Human Nutrition), 2014

MEAT IN THE MEDITERRANEAN DIET

The Mediterranean Diet has always included the consumption of animal proteins. In fact, in the Mediterranean Dietary pattern, **meat, fish, eggs and legumes** are considered part of the group of foods that provide proteins, as well as naturally the milk and derivative group. This model invites you to select a variety of protein foods to improve your intake of valuable nutrients for health. The suggestion is to limit their consumption according to **portions and frequencies that depend on age, sex and levels of physical activity**. Especially for meat, the fundamental suggestions are to prefer lean cuts and to prepare seasoning using only extra virgin olive oil, limiting sodium intake.

 ISBN 9788891793324

2 THE NUTRIENTS OF MEAT

Meat and meat products have been among the most important food products for human nutrition for centuries. The type and quantity of meat consumed have been conditioned in the past by various factors (religion, social status and supply), but there is no doubt that meat consumption has played a key role in the development of human civilisation. For example, **the development of the brain and its functionalities was only possible thanks to an omnivorous diet**, which guaranteed a lot of energy and specific nutrients[24] typical of meat and fish.

The human digestive system is typically omnivorous, as it has developed functionalities and enzymes useful for assimilation of animal and vegetable food. Precisely the development of the brain and the sociality connected to hunting-related practices have contributed to the evolution of intelligence, to the development of language and to the skills of planning, cooperation and socialisation.
Homo sapiens is therefore the perfect example of an **omnivorous species**. Only later did the environmental constraints, such as the need for supporting a high population density, accompanied by cultural adaptations (food restrictions and taboos, usually present in religious commandments), have transformed meat into a relatively rare food for most people in traditional agricultural societies.
A return to higher meat consumption worldwide began in Europe and North America with the acceleration of industrialisation and urbanisation during the second half of the nineteenth century; during the last 100-150 years, in fact, the fastest form of evolution has been recorded compared to the rest of history: **in a short time, people have reached a greater height and greater longevity**.
Not only did health care and medical knowledge improve, but nutrition also played a key role. In the second half of the nineteenth century there was still a widespread diet problem in Italy. In fact, one could observe a substantial differentiation in weight and height, depending on the economic and therefore nutritional availability (in particular the availability of meat and other noble foods): a poor man at 17 had the height of a rich man at 14; at 19 the poor man had the stature of a rich man aged 15 and the difference in height between a poor and rich 19-year-old was on average 12 cm[25].

In general, a balanced diet that includes both animal and vegetable foods promotes harmonic growth, **but removing any of the essential nutrients causes the body to stop growing: just only iron deficiency** during the first years of life and development can lead to reduced growth and a **reduction in the IQ of a boy in relation to his potential.**

 ISBN 9788891793324

THE ROLE OF MEAT IN THE MEDITERRANEAN DIET
A SOCIAL HISTORY OF MEAT IN ITALY

edited by Silvana Chiesa - University of Parma

The presence of meat in human nutrition has been demonstrated from the fossil evidence found in all the archaeological sites, from the Upper Palaeolithic to the Neolithic, showing that even hominids were omnivorous, that is, they alternated their diet of foods of vegetable origin with the consumption of meat. The concomitant presence of findings of broken animal bones and sharp instruments to cut the carcasses, however, does not say much about the methods of procuring meat. It seems indeed that Homo habilis as well as Homo erectus consumed both those deriving from carcasses of already dead animals (killed by other predators) as well as those obtained by hunting in groups. We know nothing about the quality and quantity of plant foods in relation to those periods, because unfortunately there are no "remains" to be subjected to chemical/physical analysis.

The arrival of Homo sapiens and his settling permanently in temperate areas, seems to have initially resulted in an increase in meat consumption to compensate for the periodic shortage of plant foods in adverse seasons: autumn and winter[26]*. Later, with the constant use of fire to cook food and the gradual phasing out of hunting and gathering in favour of agricultural practices, the foundations of what has been called the "**birth of agriculture and civilisation were created**" and, from the point of view of nutrition, the fundamentals of what we call today "**Mediterranean Diet**". By choosing to practice agriculture to produce their own food, not only humans gradually changed their **lifestyle, which from nomadic became stable**, but also profoundly changed the natural environment in which they decided to settle. To create areas to cultivate they practiced systematic deforestation, control and deviation of water courses, levelling and fencing of soil, artificial seeding, harvesting and conservation of seeds gathered and finally the transformation of seeds into food. All this work found its maximum expression in the production and consumption of a new food, that is BREAD, which does not exist in nature and which symbolised the abandonment of mankind's "wild" state. If bread as a result became a symbol of civilised men, who no longer consumed what nature gave them, but what they had invented themselves, even meat could no longer be derived from hunting alone. Meat became symbolically the product of "choice", from the domestication and selection of some animal species. The breeding of sheep, cattle and pigs was itself a symbol of civilisation and detachment from a "wild" life, so much so that **humans decided to build fences and shelters for the animals, to defend them from wild predators, and ensure that they always had food and water available, in a word they became breeders**.*

*The "proximity" between men and animals (**synanthropy**) posed, perhaps for the first time, the problem of "guilt" inevitably resulting from the killing/slaughtering of animals, in particular towards the cattle considered "Ox plough" therefore a precious collaborator for mankind. Ritual sacrifices dedicated to the gods have been interpreted as a way of justifying the violent act against a synanthropic animal, and the subsequent division and consumption of meat as a moment of sharing and social recognition*[27]*. In fact, men were differentiated in "partic-*

 ISBN 9788891793324

ipants" and "excluded" from the sacrificial banquet, and subsequently the distribution of the meat distinguished those who were entitled to the first and more abundant portions (princeps) from those who divided the rest (populus)[28]. Naturally from such a significant context a movement of rejection of sacrifice and the consequential consumption of meat is born and identified. Among the first that we can identify are the Orphic and Pythagorean movements which, in turn, applied strategies of cohesion and identity, refusing to participate in sacrificial rites.

In the Roman world, from the Republican to the late Imperial age, there is a progressive increase in the consumption of meat, especially in the cities and among the upper classes. This can be partly justified by urban procurement policies and in part by the progressive disengagement from slaughter of religious rituality, to be incorporated into a series of rules that today we would define "hygiene and protection of public health". Even the progressive affirmation of the Christian religion freed the consumption of meat from sacrificial rites, but preserved (and sometimes strengthened) the use of celebrating the "major" religious festivals with meat banquets. The so-called "Mediterranean Diet" became questioned in its principles of identity (bread as the main food, then porridges of cereals, vegetables, dairy products and little meat) by the establishment in Italy of the Roman-Barbaric Kingdoms (from the fifth century AD) that brought forward the cultural, economic and food values of the populations from northern Europe. These, while practicing agriculture (cultivating barley to produce beer), are represented as meat eaters, and in particular pork and/or hunted game.

The barbaric culture, which will be assimilated and elaborated in the ***Italian medieval culture, considered meat as the most important source of strength and energy for mankind and in this logic it became the prerogative of great warriors, leaders and powerful people.*** *Even the conversion of the Barbarians to the Christian religion, in a certain sense strengthened the symbolic value of meat because penitence obliged the respect of the days of abstinence, in which the consumption of meat was forbidden (Lent, Wednesday and Friday of each week), which became fasting and assumed great importance and significance only if inserted in a strongly carnivorous culture. The same consideration can be made regarding the food choices of the origins of monasticism (5th-6th century) which considered abstention from consumption of meat an obligation for religious men and women who, in this way, marked the difference in lifestyle between themselves and those who lived "in the world". Even* ***medieval medical thought*** *believed that the consumption of meat was necessary to restore the "****health of the body****" and was shared and widespread knowledge found in dietetic rules such as the Regimen sanitatis, but also in other monastic rules:*

«I dare neither forbid nor allow you to eat meat because of your weakness ... Those who have sufficient strength are abstained from the meat ... Those who need physical force make use of meat; for example, those who work in mines, who fight in war, who build tall buildings or those who struggle in different jobs. / The use of meat helps recreate the forces»[29].

«You never eat meat. Do not distribute chickens or any other kind of birds to the community / they are to be obtained only for the sick and those of delicate health»[30].

The centuries therefore from the ninth to the twelfth are those of the greatest prestige for meat consumption, and represent also a period in which almost the entire population (without class distinction) is able to access this resource thanks to a defined ***agro-forestry-pastoral*** *economy that supported, as*

 ISBN 9788891793324

well as agriculture (almost entirely absorbed by the production of cereals and legumes) breeding and the exploitation of uncultivated spaces where hunting was practiced both of large prey (noble hunts) and of small mammals (peasants and villagers). The fact that almost everyone could eat meat, however, does not mean that this was the same for everyone: different "quality and quantities" for the various social classes indicate, referring to the studies of ***J.L. Flandrin***[31]*, how the* ***statute of meat****, has been defined, meaning by this term the set of* ***social, economic, political and cultural values that the consumption of meat represents****. If in fact from the ninth to the twelfth century the warriors, nobles and rich people consumed meat of large mammals (cattle, bears, deer, fallow deer, wild boar) and in large quantities, or at least in banquets a great abundance of meat was shown, the lower classes ate chickens, geese, rabbits, hares and especially pork, which provided meat reserves with* ***cured meats and sausages also for the winter****.*

Even the religious, and in particular the upper hierarchies of the monasteries and the major dioceses, while scrupulously respecting fasting in the days of abstinence, show intolerance towards the prohibition of consuming meat and a fine example is what Pietro Abelardo wrote in the twelfth century:

«If the popes themselves, the guides of the Holy Church, the clergymen communities can eat meat without committing sin, because they are not bound by any vote, who could blame us for being condescending with women, especially if they endure a greater restraint than the rest?... We, therefore, considering both the possibilities of men and their nature, do not forbid any food but only excess. We wanted to adopt a measure for the use of meat: do not eat more than once per day, do not offer different portions to the same person, nor are other dishes added to it, it is not allowed to eat it more than three times a week, that is on Sundays, Tuesdays and Thursdays, even if they interpose with feast days» [32]*.*

From the 13th century onwards, a series of political and economic changes began, where the nobles, owners of the lands and forests, forbade access to the woods to villagers and peasants, who then could no longer obtain meat freely. This fact led to the radicalisation of two opposing food models, namely that of the countryside, which consumed very little meat, and that of the city in which every food (including meat) was always available and the only limit consisted of economic wealth. Even gastronomy was organised on the same basis developing an urban and "bourgeois" model that focused on the cooking of meat (especially beef) as an emblem of wealth, refinement and sophisticated elegance, while rural gastronomy provided very few meat dishes, mainly pork, chicken and rabbit, and above all was characterised by an attention to the use of all the parts of the animals (muscles and viscera) and an abundance of recipes of "second processing" (from ***meatballs and meatloaf*** *to "redone" meat) just to* ***avoid wasting food so rare and highly desired****.*

The chronic lack of meat in rural areas in the diet of Italian populations became a constant that lasted until around the beginning of the twentieth century, and the information received unfortunately disregards any type of qualitative/quantitative surveys, relying mostly on narratives, or dramatic reports of doctors and nurses.

With the birth of the Italian nation (1861) and then with the establishment of the Institute of Statistics (ISTAT) we finally have also available numerical data which, if on the one hand in an irrefutable way confirms the paucity of meat consumption (about 11 kg/year per person),on the other does not differentiate the consumption of citizens in towns from those in rural areas[33]*.*

 ISBN 9788891793324

That meat was anyway one of the most desired foods can be seen above all from the testimonies of Italians who, because of hunger and misery, found themselves facing a migratory adventure since the Eighties of the nineteenth century, which involving Piedmontese, Venetian, Calabrian, Sicilian, etc. The destinations were mostly Argentina, United States, Brazil and the common news was almost always the amazement about the food consumption in the countries of destination and above all for the abundance of meat and the possibility of consuming it even every day (!).

Lastly, even the Calabrian labourers that arrived in the United States were amazed by the "equality" of eating habits, and this equality consisted precisely in the fact that everyone could indiscriminately have access to the consumption of meat daily. In 1890, the results of the Inquiry into the hygienic and sanitary conditions of the workers of the earth were published in Italy by Mario Panizza (a summary of the more famous Jacini-Bertani Inquiry) which stigmatised once again the constant lack of food for rural populations with a strong emphasis on the lack of an adequate consumption of meat that was limited to religious festivals, weddings, baptisms and little else. This situation lasted until the first third of the twentieth century; in fact, what Ancel Keys saw at the end of the Second World War in central and southern Italy was a chronic habit of not consuming meat, but what he did not see was the fact that this was not a "life choice", but rather the result of centuries of "chronic impossibility of accessing meat consumption".

*The period of the **Sixties** of the twentieth century **in Italy** were years of great economic development and finally hunger was defeated as well as areas of undernourishment. The consumer food model spread and **meat, so desired for centuries, finally became available to everyone**.*

Eating meat was a kind of declaration of freedom from misery and poverty. Doctors and paediatricians continued to suggest the consumption of meat as a factor to improve the growth of children and young people. The daily meat ration of military conscripts was 200 g (even today this is the daily ration as by OG), canteen meals always provided a meat dish, and throughout the next decade what was the "second course" of Italian gastronomic tradition, became almost exclusively meat (steak, slice, roast, boiled, cutlet, escalope) making them forget, for a certain period, the gastronomic variety that the traditional and poor alimentation had developed over the centuries.

From the Mid-Eighties of the twentieth century the attitude against the consumption of meat began to change: forgotten the initial enthusiasm, the first signs of damage due to excessive consumption of meat and animal fats were also discovered in Italy and inevitably triggered the same and opposite reaction for which the consumption of meat was considered cause of the main health problems. Partly supported by the large producers of pasta, a new model of Mediterranean Diet was re-elaborated which, taking as an example the gastronomic culture of the Mediterranean countries, proposed as a food base, bread, pasta and the use of the rich heritage of vegetables, fruit and cheeses that characterises the Mediterranean basin, bringing the consumption of meat to be a necessary complement of a balanced diet.

***Since the beginning of the 21st century, meat consumption is therefore recommended in limited quantities** during the week, but it is fully present in the Mediterranean Diet as it has always been for millennia.*

 ISBN 9788891793324

THE CONSUMPTION OF ANIMAL PROTEINS AND THE CO-EVOLUTION OF MAN AND HIS DIET

edited by Giuseppe Pulina

Paleoanthropologists all agree that hominins, a term that recently substituted that of hominids in order to encompass all the extinct species related to Homo, evolved from species that were nurtured almost exclusively with unripe leaves and berries. Our ancestors, however, did not have only one food pattern, but were non-specialised frugivorous: the dental coating, in fact, although changing in the various evolutionary stages, suggests that our ancestors never turned into strict carnivores, but kept always a certain degree of vegetarianism, therefore remaining always omnivorous[34].

This versatility in the diet resulted in the ability of hominins to inhabit a wide variety of different food niches, even though they have a poorly developed digestive system, small teeth and weak jaws.

The comparison between the teeth of H. sapiens and P. boisei shows that the latter had to spend 6 to 8 hours a day chewing fibre-rich vegetable foods[35] (fig. 1). Likewise, the cranial ridge of P. boiesi was particularly developed because the powerful maxillary muscles were attached to it, a feature that has completely disappeared in modern man (fig 2).

Fig. 1 Comparison between the teeth of Homo sapiens and Parantropus boisei

Fig. 2 The cranial ridge of P. boisei, disappeared in modern man, indicate the presence in this hominin species of powerful masticatory muscles for the crushing of vegetables

Modern man preserves the memory of this prevalence of vegetables in the diet with a tract of the intestine (the colon) that is responsible for the fermentation of fibre, which cannot be digested by gastric juices, of which vegetables are rich. But if today we try to nourish ourselves with the foods selected in nature by our distant cousin, the chimpanzee, we would discover that the time dedicated to chewing is enormous (6-8 hours), that our teeth and muscles are inadequate and that fruits are too immature to please us[36]. Among other things, as anthropologists

 ISBN 9788891793324

know well, the chimpanzees themselves, are passionate hunters, spending about 10% of their time hunting small mammals, mostly baboons, other species of monkeys and porcupines.

The introduction of food cooking, around 800,000 years ago, was certainly a fundamental turning point to make a large number of foods safe and more digestible including the meat of large animals, which men began to hunt by organising themselves into communities and therefore starting a fundamental phase of social evolution.

*Why has mankind during his evolution moved his own preferences from a substantially vegetarian diet to a more diversified one that foresees a substantial contribution from foods of animal origin? One of the most reliable hypotheses is the so-called "**hungry brain**" put forward by Robert Martin in 1996. Man has a brain mass, if compared to body weight, about twice that of other mammals. This means a large constantly hungry brain that **consumes about 20% of the energy spent daily by an adult** (up to 50% in a new-born) and therefore needs to feed on foods that are highly digestible and of higher biological value than those of leaves and unripe fruits. Because the development of the intestinal mass is inversely proportional to the quality of the foods consumed, **the reduction of the size of the intestines in favour of the development of the brain mass was only possible thanks to an overall improvement in the quality of the diet due to the introduction of foods with a high concentration of nutrients such as meat**. Thus, despite not having the dentition of a carnivore, mankind, thanks to the discovery of fire, was in the condition to consume large animals and, therefore, to organize themselves to hunt, giving life to an evolutionary advantage of the groups better organised and capable also of transmitting this prerogative orally.*

*According to paleoanthropologists, the Neolithic man assumed **more than 35% of total daily calories from meat and this**, translated in quantity, means more than **800 g per day, which is about 4 times the amount consumed on average by the North American population in our own time**. At the same time, cholesterol intake was twice that of the current one, but the total amount of fat was about half. The meat of the animals hunted by the Neolithic man, in fact, was characterised by a low fat content compared to body mass (less than 5%) and a very rich fat composition in polyunsaturated acid fats[37].*

*These selective pressures, environmental as well as later cultural, have made sure that the genotype of man, selected over a period of at least 2-3 million years, is that of the "saver", that is to say **an organism accustomed to eating a protein based diet, unsaturated fats, vegetable fibres, fructose and a large quantity of secondary metabolites of plants.** Until the Neolithic, only occasionally it happened that men had large quantities of carbohydrates, which are able to trigger the mechanism of insulin response to promote the deposition of lipid reserves. This mechanism has allowed the activation of another great selective advantage that derives from the ability to accumulate fat in periods of excess energy and then mobilise it during periods of shortages. It is in fact known that the mobilisation of lipids in the phases of negative energy balance permits the maintenance of cognitive work even in conditions of food shortages, thanks to the capacity of the brain to efficiently use the ketone bodies formed as a result of the oxidation of mobilised lipids for energetic purposes.*

Our evolutionary adaptation to meat consumption has had as confirmation,

 ISBN 9788891793324

in addition to cerebral and physical development *(from the analysis of the archaeological finds, the adult physique in the Neolithic era was comparable to that of current professional athletes),* ***also an extraordinary increase in longevity of the human species compared to chimpanzees.***

Finch (2010) asserts that ***longevity is the result of the adaptation of the human genotype to a diet rich in meat****: the genes involved, in fact, are those of resistance to inflammation and parasites, but also coding for longevity. The result was that the current Neolithic populations (with cultures at pre-agricultural stages) are hunters and include in their diet a quota >50% of proteins of animal origin. In vast areas of the planet the only agricultural practice is breeding. Populations such as the Inuit, the Masai, the Lapps, the Andes Indio's and the Himalayan natives survive a totally hostile environment thanks to the interface with animals, usually ruminant herbivores, who explore feeding niches absolutely useless to humans. These peoples derive more than 90% of their daily energy requirements from animal products, without showing the slightest sign of the diseases that afflict us Westerners. It was the forced "modernisation" of their diet, vice versa, which led to severe metabolic disorders and in extreme cases to the total disruption and the loss of traditional cultures.*

Agriculture has only recently intervened in human history: in the face of an evolution that began about 4 million years ago, ***the processes of domestication of plants and animals began only 10,000 years ago. Over 70% of daily ingested calories by modern humans derive from food*** *(especially simple sugars, starches, milk and alcohol)* ***that simply did not exist for the Neolithic man****. To this is added that about 50% of the total calories of our diet are made by only three types of cereals (rice, wheat and maize).*

Furthermore, modern man gets 90% of animal origin food from only 14 of the over 40 species of bred animals and of this 90% the majority is taken from only 5 species (cattle, sheep, goats, pigs and poultry). In fact, agriculture over time has greatly reduced the nutritional multiplicity to which man had access in his pre-agricultural evolutionary path. Of the approximately 300,000 generations who have made us what we are, only 400 have known agriculture, too few for an overall adaptation of our genome to this artificial food niche.

 ISBN 9788891793324

2.1 The fundamental nutrients of meat and cured meats

The positive nutritional value of meat and cured meats can be summarised in two fundamental aspects: on the one hand, the presence of **proteins (complete as a composition in essential amino acids),** on the other hand the high concentration of micro-nutrients always considered essential for human growth and development. Many of the **micronutrients** supplied by meat are involved in processes of **regulation of energy metabolism**. A further very important feature is the simultaneous presence of many of these micronutrients that can be of great importance: **vitamin A** (present in large quantity in offal) and **riboflavin** are, for example, both necessary for **iron mobilisation and haemoglobin synthesis** to the point that the sole administration of iron cannot successfully treat anaemia, if these others nutrients are lacking. Protein-energy malnutrition, sideropenic anaemia and vitamin A deficiency can be avoided if sufficient quantities of meat are consumed.

Many of the nutrients of meat are obviously also found in foods of plant origin, although in some cases plant nutrients have less bioavailability, or are absorbed to a lesser extent by the body and used by cells. When comparing the strengths

DIET COMPARISON BASED ON MEAT AND VEGETABLES

VEGAN AND VEGETARIAN DIETS

ADVANTAGES

- *High fibre content*
- *Generally lower energy content*
- *Ingestion of superior antioxidants*

DISADVANTAGES

- *Less bioavailability of iron*
- *Risk of vitamin B12 and zinc deficiency*
- *Risk of lack of EPA + DHA sources*
- *Proteins of lower biological value*

MEAT CONSUMPTION

ADVANTAGES

- *High nutritional density*
- *Proteins of high biological value*
- *Best source of iron, zinc and complex vitamin B groups, in particular B12*

DISADVANTAGES

- *High fat/saturated fat content in some cuts*
- *Sodium content (cured meats)*

Source: Pereira P.M., Vicente A.F., 2013

 ISBN 9788891793324

and weaknesses of **vegetarian diets and meat consumption**[38], it is evident that only the **presence of both in the nutrition** of an individual can effectively contribute to a **healthy and well balanced diet**. To obtain, for example, the adequate amount of essential amino acids from an exclusively plant diet, you risk introducing at the same time an excessive amount of other nutrients compared to the needs of your body.

The combination of cereals and legumes is often referred to as an appropriate substitute for meat because of its protein intake, as the deficiencies of essential amino acids in cereals are covered by those of legumes and vice versa.

But to get the same protein quality of amino acids contained in 70 grams of meat, a small slice that bring less than 80 kcal, one would have to consume 2 portions of pasta and beans, with a contribution of over 700 kcal.

	KCAL	PROTEIN (g)	FAT (g)	CHOLESTEROL (mg)	SAFA (g)	MUFA (g)	PUFA (g)	VITAMIN B12 (µg)	IRON (mg)	ZINC (mg)
Beef front cuts	145	20.5	7	66	2.20	2.27	1.55	2.00	1.30	4.47
Beef rear cuts	117	21.5	3.4	60	1.14	1.12	0.68	2.00	1.60	3.30
Veal lean meat	92	20.7	1	70	0.42	0.48	0.04	2.00	1.20	2.80
Pork, fat meat, without fat	268	17.2	22.1	88	7.81	8.64	3.44	1.00	1.40	1.80
Pork, semi-fat meat, without fat	141	19.9	6.8	61	2.17	2.31	1.77	1.00	1.70	1.80
National raw ham*	235	27.8	13.7	75	4.84	6.35	1.89	0.38	0.80	2.10
Baked ham*	138	15.7	7.6	49	3.20	3.52	0.50	0.09	0.50	1.10
Whole chicken with skin	171	19	10.6	93	3.27	4.12	2.29	TR	0.60	1.10
Whole chicken without skin	110	19.4	3.6	75	1.23	1.08	0.81	1.00	0.70	1.30
Whole turkey with skin	135	18.2	6.9	195	2.22	1.66	2.96	2.00	0.90	2.80
Whole turkey without skin	109	21.9	2.4	63	0.90	0.62	0.60	2.00	1.00	2.70

*The nutritional composition of the meat and its micronutrients varies according to the animal species and the different types of cut. Data from the Bank of Food Composition Data for Epidemiological Studies (BDA) or *INRAN food composition tables containing 100 g of food*

 ISBN 9788891793324

Obviously not all types and cuts of meat have the same characteristics. Muscle portions are richer in essential amino acids (with greater biological value and more digestible) than connective tissues; the amount of fat (especially saturated) varies from species to species and so on.

Proteins: the bricks of our organism

Proteins are essential nutrients, as they provide the amino acids used by our body to synthesize the proteins necessary for the different vital roles:

- **structural** (skeleton, skin, tissues and supporting tissues, cells)
- **protective** (barriers, immune system, anti-inflammatory)
- **transport and communication** (plasma proteins, hormones, membrane receptors)
- **enzymatic** (digestion, metabolism, homeostasis, synthesis)
- **energy** (energy source)

The **amino acids necessary** for the synthesis of proteins useful to humans are 20, but they are not all the same: **9** of these **are considered essential**, because the body is **not able to produce them and must necessarily be ingested with food**. Furthermore, it is essential to remember that every protein synthesized by the body has its own specific amino acid composition and when it needs to be synthesized it needs the presence of all the amino acids that compose it: if even just one of these is deficient, protein synthesis is limited. In reality there is no specific food requirements for proteins, but these must be taken in such a way as to provide in sufficient quantity all the amino acids necessary for synthesis by the body. **In children semi-essential amino acids** are also considered **cysteine, taurine, tyrosine and arginine,** since synthesis mechanisms are not yet fully developed.

On the basis of the amino acid characterisation of proteins it is therefore possible to identify which foods have proteins of high biological value, and are therefore capable of supplying all the essential amino acids. It is said that a food has proteins of high biological value when it provides all the amino acids mentioned that we need, even those that we are unable to produce, and in the right quantities. And not all achieve this! Only meat, fish, eggs and milk have proteins of high biological value.

Among the essential amino acids, **methionine** plays a fundamental role in the growth of the individual.

The proteins of the vegetables are generally poor in sulphur amino acids such as methionine, on average 0.6g/100g of protein, while red meat, poultry meat and fish contain between 1 and 1.26g of sulphur amino acids/100g of protein. More gen-

ESSENTIAL AMINO ACIDS	NON-ESSENTIAL AMINO ACIDS
Phenylalanine	Aspartic acid
Isoleucine	Glutamic acid
Histidine	Alanine
Leucine	Arginine
Lysine	Asparagine
Methionine	Cysteine
Threonine	Glycine
Tryptophan	Proline
Valine	Serine
	Tyrosine

Essential amino acids and non-essential amino acids: essential ones must necessarily be assumed through food, because the human organism is not able to produce them

 ISBN 9788891793324

erally, vegetable proteins are considered of lower quality because they are **unbalanced in the ratio between cysteine and methionine** necessary for growth, which should be in favour of methionine. Considering the total of amino acids containing sulphur, red meat, poultry meat and fish have 30-40% of cysteine and 60-70% of methionine, while soybeans, beans, peas and lentils have 60% **cysteine** and 40% **methionine**[39].

Another method of protein evaluation recently developed by the scientific world is the DIAAS (Digestible Indispensable Amino Acid Score), which defines with a numerical index the protein quality of some foods: the higher the value, the better is the protein quality.

If it is therefore clear that the nutritional value of animal proteins is high, it is also interesting to evaluate the protein content respect to the portions suggested by the new LARN[40] and compared to caloric intake. **Fish and meat have the high-**

FOOD OR PROTEIN ISOLATES	VALUE OF DIAAS
Whole milk	139
Beef	131
Whey protein isolate	125
Soy isolate	102
Chickpeas	66
Peas	64
Rice	64
Corn	52
Barley	51
Wheat	43

Protein value index of foods.
Source: Caballero B., Finglas P.M., Toldrà F., 2015. Encyclopaedia of Food and Health. Academic Press

AMINO ACIDS (g PER 100g OF PROTEINS)	RAW HAM	BEEF TENDERLOIN	SEA BREAM BRED (FILLET)	WHOLE COW'S MILK	WHOLE EGG	FRESH BORLOTTI BEANS	PASTA
Phenylalanine	4.02	3.84	7.66	5.03	5.34	5.89	4.97
Isoleucine	5.18	4.13	4.33	5.49	5.30	5.45	4.17
Histidine	3.61	3.69	2.37	2.66	2.40	2.97	2.07
Leucine	8.31	8.02	7.58	10.14	8.40	8.68	7.65
Lysine	8.62	8.62	9.89	7.77	7.10	7.00	2.01
Methionine	2.51	2.77	3.88	2.31	3.53	1.18	1.68
Threonine	4.53	3.93	4.37	4.69	5.03	4.20	2.88
Tryptophan	1.05	1.04	1.29	1.43	1.59	1.11	0.96
Valine	5.27	4.49	4.82	6.66	6.63	6.04	4.99

Composition of amino acids of some foods (grams per 100g of protein).
Source: Food Composition Tables - INRAN, Rev. 2000

 ISBN 9788891793324

est caloric protein efficiency (Proteins/Kcal*100), meaning that per portion they have a higher quota of excellent quality proteins, but with a reduced caloric intake: a **notable advantage in terms of overweight and obesity prevention**.

Proteins of plant origin are often associated with a reduced content of saturated fats and are therefore recommended as an alternative to proteins of animal origin. But **if we wanted to cover our protein needs only with foods of plant origin**, we would have to take **3 to 5 times more calories than the calories obtained with foods of animal origin**, in particular from lean cuts of meat or fish. The protein requirements for an individual have however been defined by the experts (LARN) in the daily amount of 0.9 g per body weight (e.g. a 70 kg adult man needs a protein intake of 63 g per day). But it is also important to remember that 100 g of meat are sufficient, which provide an average of 22-25 g of high biological value proteins, to cover more than 1/3 of the daily requirement.

FOOD	PORTIONS (g)	PROTEINS (g)	KCAL	ENERGY PROTEIN EFFICIENCY
Fish, molluscs, crustaceans (bream)	150	29.70	141	21
Meat (bovine fillet)	100	20.70	107	19
Preserved meat (raw ham)	50	13.90	117	12
Eggs	50	6.20	64	10
Seasoned cheese (parmesan)	50	16.75	193	9
Fresh or canned vegetables (borlotti beans)	150	15.30	199	8
Fresh cheese (mozzarella)	100	18.70	253	7
Dried legumes (borlotti beans)	50	10.10	145	7
Yogurt	125	4.75	82	6
Milk	125*	4.12	80	5
Pasta	80	8.72	282	3
Corn	80	7.36	282	3
Bread	50	4.30	144	3
Rice	80	5.36	265	2

** The milk portion is expressed in ml.*
Protein, energy and protein energy efficiency per portion of some foods
*Source: data processing Food Composition Tables - Add 2000 - INRAN *Rev. 2013*

 ISBN 9788891793324

Fats: an important source of energy, but without exaggerating

According to the main nutritional indications, fats should cover **between 25 and 35%** of the total energy consumed by an individual because, if ingested in appropriate quantities, they play a number of important roles: they supply **essential fatty acids (such as linoleic and alpha-linoleic acid) and fat-soluble vitamins (A, D, E and K)**; they represent one of the main sources of energy; **promote a sense of satiety** due to the effects on the slowing of gastric emptying and reduce, for the same reason, the bioavailability of carbohydrates (and, therefore, the glycaemic response); finally, they improve the taste, smell, and consistency of foods. But all fats are high in calories. If you take more calories than necessary, you gain weight. The World Health Organization estimates that excess weight is responsible for 21% of cases of ischemic heart disease, 23% of ischemic stroke, 58% of type 2 diabetes and 39% of cases of hypertension. Obesity also increases the risk of some types of cancer, as well the risk of non-fatal diseases, such as joint problems and infertility[41].

Saturated and unsaturated fats, stearic acid, no effect on total cholesterol and LDL

Saturated and unsaturated fats are differentiated by the composition of their molecule: a saturated fat has single chemical bonds between the atoms that compose it, while unsaturated fat has at least one double bond. It is this double bond that makes it unsaturated, not complete, because there is a possibility to add hydrogen to the double bond and make it saturated, i.e. devoid of space for new additions. **Liquid fats** are composed mostly of **unsaturated fats, such as olive oil** which is monounsaturated (i.e., has only one double bond) and **solid** ones (**margarine**, **butter** or **palm oil**, for example) **are mostly saturated**. Fats are found both in plant-based foods and in foods of animal origin. Apart from some exceptions, such as tropical oils (palm and coconut), vegetable fats are mostly unsaturated, while those of animal origin are composed of about half of saturated fatty acids.

For several decades, dietary guidelines have recommended reducing the consumption of saturated fats, believed to be among those responsible for certain cardiovascular diseases, thus leading to significant reduction in the consumption of animal products, especially meat. It should be remembered that saturated fats are not all the same, because some contribute more than others to cardiovascular risks, in addition to considering the increasing evidence of the role of carbohydrates for this pathology. Recently, the PURE[42] study, a study involving more than 135,000 people on 5 continents, concludes that a high carbohydrate intake is associated with increased mortality.

In contrast, a **higher intake of saturated and unsaturated fats has been reported as associated with a lower total mortality**. The authors observe that saturated fats do not necessarily need to be limited. The healthiest diet should include no more than 50-55% of the calories derived from carbohydrates and no more than 35% from fat, including both saturated and unsaturated. In practice, according to the study, there is no evidence that taking less than 10% of energy from saturated fats is beneficial, but going below 7% can be dangerous. The right amount of saturated fats should be around 10 to 13%.

In addition, the largest constituent of saturated meat fats, **stearic acid, has been**

shown to have a neutral effect on cholesterol and LDL totals (low-density lipoprotein).

Growing attention to the quantity and quality of fats contained in meat has led producers and **breeders to study productive practices** (cutting techniques) and **breeding** (animal diets), in order to **produce generally leaner meats** and also to favour an ever more balanced fat composition. Cooking can have a great influence on the meat fat content, as well as in the composition of fatty acids. Some authors have shown significant reductions in the amount of fat in different cuts of meat that are grilled or pan-fried without added fats. In particular, as regards to the fatty acid composition, there has been an increase in the polyunsaturated/saturated ratio, probably because polyunsaturated fatty acids are part of the cell membrane and therefore tend to remain in the meat fibres.

 ISBN 9788891793324

FOOD	FATS (g)	OF WHICH SATURATED (g)	OF WHICH SATURATED (%)
Parmesan cheese (50 g)*	14.05	9. 27	66%
Salami (50 g)*	19.15	7.24	38%
Milk chocolate (30 g)*	11.28	6.75	60%
Croissant, brioches (50g)*	9.15	5.10	56%
Butter (10 g)	8.34	4.87	58%
Palm oil (10 g)	10.00	4.71	47%
Sponge cake type snacks (50 g)*	11.15	4.70	42%
Margarine (10 g)*	8.28	4.25	51%
Shortbread biscuits (40 g)*	8.40	4.18	50%
Pork steak (100 g)	8.00	3.66	46%
Whole chicken with skin (100 g)	10.60	3.27	31%
Cheese crackers (30 g)*	7.65	2.83	37%
Raw ham (50 g)	6.85	2.42	35%
Beef front cuts (100 g)	7.00	2.2	31%
Peanut oil (10 g)*	10.00	1.93	19%
Egg (one egg 61 g) *	5.30	1.93	36%
Baked ham (50 g)	3.80	1.60	42%
Extra virgin olive oil (10 g)	10.00	1.44	14%
Whole chicken without skin (100 g)	3.60	1.23	34%
Beef rear cuts (100 g)	3.40	1.14	34%
Veal fillet (100 g)	2.70	1.14	42%
Cocoa and hazelnut cream (10 g)*	3.24	0.99	31%

Fat content of some of the main foods
Source: Food Composition Tables - Research Centre for Food and Nutrition;
** Source Food Composition Database for Epidemiological Studies in Italy - BDA-IEO*

 ISBN 9788891793324

MEAT
IS INCREASINGLY LEAN

It is estimated that in the United States alone the total quantity of fats in products derived from cattle has decreased by 44% since 1970[43]. Even in Italy meat is noticeably "slenderised". If you compare data from food composition tables (INRAN - National Institute of Research for Foods and Nutrition) related to 1996 and 2005, it turns out that fats in ***beef tenderloin*** *has gone* ***from 5% to 2.2% (-56%)****, those of loin from 5.2% to 2.9% (-44%). A reduction that affected all beef cuts, also those of pork and cured meats. The new nutritional values of Italian cured meats emerging from the analyses carried out by INRAN and ASSICA (Experimental Station for the Food Preservation Industry) in 2011, confirm that cured meats are even more nutritious than in the past and have a better nutritional profile, because of less fat, with less cholesterol, salt and preservatives and more proteins, vitamins, minerals and essential fatty acids.*

Pork meat from the Eighties has reduced its fat content by about 30%, also in order to meet the wishes of consumers. The loin is the leanest part of both beef and pork, while the breast is generally the leanest part of poultry meat. The skin is the main source of fat in poultry meat. The fat content in the major retail cuts of the poultry ranges from 1 to 17%, and the cuts containing the skin have the highest values. In particular, the energy value of poultry meat varies between chicken breast and chicken thighs with skin: the presence of the skin (due to its fat content) increases the caloric value by about 25-30%. Fats, mainly found in the skin, can therefore be easily removed. The lipid content of chicken and turkey is about 1% in leaner cuts, such as chicken and turkey breast, and about 17% in chicken wings cooked with skin. However, compared to other types of meat, poultry appears to be relatively low in fat.

BEEF	FAT (%)		REDUCTION
	1996	2007	
Round steak	2.8	1.1	-61%
Fillet steak	5.0	2.2	-56%
Sirloin steak	5.2	2.9	-44%

PORK	FAT (%)		REDUCTION
	1993	2011	
Baked ham	14.7	7.6	-49%
Raw ham - San Daniele PGI	23.0	18.6	-19%
Mortadella	28.1	25.0	-11%

Comparison of the reduction of lipids contained in meat

 ISBN 9788891793324

Cholesterol: new research completely rehabilitates meat

To determine the nutritional value of meat it is best to consider also the cholesterol content, which in red meat is between 49 and 88 mg/100 g, while in poultry it is between 63 and 95 mg/100 g.

Lean meat has a low energy value which, in an appropriate diet, also reduces the concentration of plasma lipids, as indicated by several authors. For example, one study assessed how **lean beef and skinless chicken** have similar effects on plasma lipoproteins and how **they are interchangeable in cholesterol-lowering diets**.

In a similar research, other authors have compared the effect of lean red meat and lean white meat. **In the long experiment, which lasted 36 weeks, diets with one of the two types of meat reduced the level of LDL cholesterol and increased the level of good HDL cholesterol in the plasma**[44].

The use of meat in diets to lower the level of cholesterol in the blood is only valid for lean meat.

Vitamins and Minerals: essential micronutrients for metabolic functions

Meat is an excellent source of different vitamins and minerals, fundamental micronutrients present in biochemical forms that make them easily digestible. About 25% of the recommended daily allowance is covered with 100 grams of red meat (RDA) for **riboflavin, niacin, vitamin B6 and pantothenic acid and two thirds for vitamin B12**.

Chicken breast is a particularly good source of niacin (100 g provides 56% of the RDA) and vitamin B6 (27%), while 100 g of turkey breast provide 31% of niacin and 29% of vitamin B6. Meat is also one of the best sources of **zinc, selenium, phosphorus and iron**: the lean cuts of beef provide

NUTRIENTS	RECOMMENDED DAILY ALLOWANCE (RDA)[45]	BEEF	VEAL	PORK
Thiamine (mg)	1.1	source of	-	rich in
Niacin (mg)	16	rich in	rich in	rich in
Vitamin B12 (µg)	2.5	rich in	rich in	rich in
Vitamin D (µg)	5	-	source of	-
Iron (mg)	14	-	source of	-
Selenium (mg)	55	-	-	source of
Zinc (mg)	10	rich in	rich in	rich in
Potassium (mg)	2000	source of	source of	source of

Micronutrient content of red meat, classified as a source of or rich in (EC REGULATION No. 1924/2006 on nutrition and health claims given on foodstuffs)

 ISBN 9788891793324

about 37% of the reference intake of selenium, 26% of zinc and 20% of potassium in a 100g portion.

Lean red meat contains a number of vitamins and minerals that are important for all stages of life. For some of these nutrients, the meat could be defined as[46] **"source of"** or **"rich in"**, using the evaluation of the European Union, which is based on the recommended daily allowance (RDA). Food can be defined as "**source of**" if it contains ≥15% of the RDA per 100g for a particular vitamin or mineral, or as "**rich in**" if it contains ≥30% of the RDA.

An iron mine

Iron plays a crucial role in maintaining health, since one of its deficiencies is connected to the malfunction of different biological mechanisms of the organism, as well as disturbances in the growth of a child and during development. Taking into account physiological losses through the skin, intestines, urinary tract, airways and menstruation in women, diet plays a key role in maintaining the balance of iron.

Heme iron and non-heme

Iron can be found in a wide variety of foods, but it is essential to note that it can take two different forms: **heme iron** e **non-heme iron**. The substantial difference concerns the greater ease of assimilation of the heme form: **the bioavailability of heme iron is greater than 15%** and is absorbed at enterocyte level as an intact molecule, while the absorption of **non-heme iron** is linked to other components of the diet, which can increase or reduce absorption, and is estimated at around 5%.

In fact, the assimilation of iron by the human organism can be facilitated or inhibited depending on which other components are present in foods. An example is

VITAMIN B12

Meat and cured meats bring to our body a significant amount of **vitamin B12**, important for various functions of the body especially with **regards to red blood cells**. It is in fact involved in the synthesis of haemoglobin, where it acts in combination with folic acid in the formation of blood cells.

Vitamin B12 deficiency is the main cause of megaloblastic anaemia and is strongly associated with high levels of homocysteine in the blood, which is a **risk factor for cardiovascular disease**. It can also **cause depressive symptoms and neurological disorders**. In children, vitamin B12 deficiency may be a risk factor for **neural tube defects**.

Vitamin B12 is found exclusively in foods of animal origin, mainly in liver, kidneys, meat, fish, eggs, milk, clams; however, it can also be found in some types of algae. For **people** who follow **diets without food of animal origin**, with a complete abolition of meat, fish, eggs and milk, it is essential to **use vitamin B12 supplements** to avoid the development of hypovitaminosis. The situation is to be monitored also for **vegetarians who, while eating some products of animal origin (eggs and dairy products), do not get enough.**

 ISBN 9788891793324

given by the role of **meat proteins, which contribute to an increase in the absorption of iron and zinc from other food sources.**
The sources of **vegetable iron,** on the other hand, are particularly **rich in potential inhibitors of iron absorption, such as phytates**, and of some phenolic compounds such as polymerised flavans, which are found in legumes such as beans and broad beans. Legumes are also an important source of non-digestible carbohydrates, which can compromise iron absorption. Although **ascorbic acid (vitamin C) can improve the absorption of non-heme iron**.

Heme iron is present in haemoglobin and in myoglobin, so it is present only in some foods of animal origin. In particular

		RAW MEAT		COOKED MEAT	
		IRON TOTAL	HEME IRON	IRON TOTAL	HEME IRON
CHICKEN	Breast	0.40	0.12	0.58	0.16
	Thigh	0.70	0.20	1.34	0.30
TURKEY	Breast	0.50	0.14	0.70	0.21
	Thigh	0.99	0.49	1.46	0.57
ADULT BOVINE	Sirloin	2.07	1.72	3.59	2.64
	Fillet steak	2.35	2.11	3.36	2.86
	Roastbeef	2.04	1.77	3.74	3.14
	Topside	1.93	1.68	2.88	1.89
VEAL	Filet	0.85	0.71	1.58	1.33
LAMB	Cutlet	2.23	1.68	3.20	2.25
HORSE	Filet	2.21	1.75	3.03	2.16
OSTRICH	Filet	2.43	1.76	3.78	2.85
RABBIT	-	0.45	0.25	0.60	0.31
PORK	Loin	0.36	0.20	0.46	0.21
	Steak	0.49	0.32	0.79	0.56

Total iron and heme iron content in raw and cooked meat (mg / 100 g) (Lombardi-Boccia et al., 2002)

 ISBN 9788891793324

meat is the best source of heme iron, because more than half of the iron in meat is of the heme type. The adult bovine has the highest content of heme iron, the loin contains about 77%. Both heme and non-heme iron is present in much lower quantities in poultry meat. The dark parts, like the thigh, contain them in slightly larger amounts. Pork meat, defined as red meat, may contain the same amount or even less iron than the chicken or turkey thigh, which fall into the so-called white meat. From the examination of the data it is deduced, moreover, how the iron content in the meat of different animal species depends on the use of the muscle by the animal itself. It is evident, therefore, that the classification of meat as generally defined has a limited importance from the nutritional point of view and that it would be much more informative to use the adjective referring to the species of belonging (beef, pork, poultry, sheep, etc.).

Meat and meat products can contribute **up to 18%** of the daily iron requirement, an important contribution to a healthy and balanced diet that is fundamental in preventing one of the most common nutritional deficiencies.
Despite its vital role in the human body, an excessive dose of iron can be dangerous. High doses of iron can cause damage to the intestinal mucosa and lead to systemic toxicity. This excess can also induce damage from the free radicals to different tissues, and recently several studies have associated very high doses of iron to an increased risk of colorectal cancer, cardiovascular disease, infections, neurodegenerative diseases and inflammation.
The maximum level of **iron** intake in order to avoid negative health effects in **adults equals 50 mg/day**[47]**: the amount contained in two kilos and a half of beef!**

Bioactive compounds of meat

In addition to a variety of biologically active phytochemicals present in plants (e.g. fruit and vegetables), it is good to know that there are several interesting bioactive compounds in meat and cured meat [48], such as **carnosine, choline, L-carnitine, acid conjugated linoleic acid, coenzyme Q10, glutathione, lipoid acid, bioactive peptides, taurine and creatine**, which have been studied for their physiological properties.

Conjugated linoleic acid (CLA): anti-carcinogenic properties

In meat there are also trans-fatty acids, which are formed as a result of bio-hydrogenation by bacteria in the rumen. The most common is conjugated linoleic acid (CLA), a trans-fatty acid that has been linked to several health benefits in the prevention of cardiovascular disease, diabetes and obesity. Almost 40 years ago, a substance that was capable of inhibiting the activity of mutagenic substances was discovered in roasted meat extracts. Subsequently, it was demonstrated that this substance was indeed **conjugated linoleic acid**, which in experimental studies has repeatedly demonstrated **strong anti-carcinogenic properties**[49].
Conjugated linoleic acid shows its anti-cancer activity already at relatively small concentrations, equal to less than 1% of food. It is interesting to note that among the other effects of CLA there is also the influencing of fat metabolism and that in experimental animals it reduces the amount of body fat.
The content of conjugated linoleic acid in milk and ruminant meat is influenced by diet, especially in the content of polyunsaturated fatty acids and by rumen conditions. **The intake of CLA food in our diet is completely dependent on the con-**

 ISBN 9788891793324

sumption of meat and milk of ruminants, in particular the consumption of milk and meat fats, with higher values in pasture animals, which generally also have higher levels of polyunsaturated fats.

Coenzyme Q_{10}: an antioxidant to fat levels

Coenzyme Q_{10} is a component of the mitochondrial electron transport chain and to it is attributed antioxidant properties in fat, protein and DNA. Meat is an important source of coenzyme Q_{10} and its content is closely related to the number of mitochondria present in muscle cells. The best sources are meat and fish, but cooking can cause a loss of about 15-32%.

Carnosine: anti-aging and antioxidant properties of cells

Carnosine is a dipeptide formed from the amino acids B-alanine and histidine. It possesses strong antioxidant and anti-genotoxic activities, as well as anti-aging properties of cells. In studies on mice fed with carnosine-supplemented diets, a lower oxidative and inflammatory progression induced by neurodegenerative diseases has been observed, from which it derives a possible role in the prevention of diseases such as Parkinson's disease. In muscle tissue it performs a buffer function and participates in various biological functions. It is located in meat and fish, but not in vegetables. Cooking meat reduces its content by 25-40%.

Taurine: a stimulant of the endocrine and immune system

It is a sulphured amino acid synthesised by methionine, found in the liver that can be both as a free acid and as a constituent of proteins, and is present in high quantities in most animal tissues. Taurine plays an essential role in the synthesis of bile acids that derive from cholesterol and facilitate its elimination. Bile is also essential for the absorption of fat-soluble vitamins. Along with zinc, taurine is also important for vision. A critical role was revealed in 1975, when it was discovered that retinal degeneration occurred in subjects with a deficiency of taurine and it was found that consumption of formula-free milk without taurine could cause cardiac and retinal dysfunction in preterm infants. Both of these problems can be prevented by adding synthetic taurine to artificial milk.

It is now recognised that taurine plays an important role in human physiology and nutrition, and that its positive effects are found in the digestive, endocrine, immune, muscular, neurological, reproductive, visual and cardiovascular systems. Studies in rats subjected to intense physical activity have shown that it reduces oxidative stress at muscle level and, therefore, the damage of muscle cells. Taurine seems to counteract the aging process thanks to its anti-free radical action. This amino acid is important for the synthesis of nitric oxide, a powerful vasodilator; as a result, it seems to stimulate efficiency and cardiac contractility, increasing myocardial blood supply. Taurine is only present in food of animal origin.

Creatine: for the improvement of muscle performance

Creatine and its derivative, creatine-phosphate, play an important role in muscle energy metabolism. So much so that, under certain circumstances, the addition of creatine to the diet promotes muscle performance. Muscle creatine is slowly converted into creatinine by the removal of water, with the formation of a ring structure, a phenomenon accelerated during the cooking of meat. Not being present in vegetables, those who follow a strictly

 ISBN 9788891793324

vegetarian diet have lower levels of creatine than non-vegetarians, and this can lower the level of muscle performance.

Glutathione: the most powerful antioxidant

It is a tripeptide formed by cysteine, glycine and glutamic acid. According to many authors it is the most powerful endogenous antioxidant: inside the cell, glutathione has the ability to inactivate free radicals such as hydrogen peroxide, thus protecting the cell from lipids or oxidised proteins and preventing DNA damage. Glutathione also exerts a detoxifying activity, blocking heavy metals such as lead, cadmium, mercury, aluminium and other toxic substances (drugs, alcohol, tobacco, etc.), so as to make it easier and faster to eliminate and preventing de facto that these poisons bind to the SH groups of tissue proteins and enzymes deteriorating them. Furthermore, it favours the bioavailability of iron. Finally, glutathione carries out a pro-immune activity and protects the central nervous system. Some fresh vegetables, eggs and meat, especially pork and beef, have high glutathione contents.

Lipoic acid: antioxidant molecule

Lipoic acid is an antioxidant molecule capable of protecting both the membranes and the organelles of the cell; it is present in the mitochondria of animal cells, then in larger quantities in the muscles of the animals that move the most. **Lipoic acid is also a powerful chelator**, capable of removing excess metals, such as iron and copper, and toxic metals such as cadmium, lead and mercury.

L-carnitine

L-carnitine is a small molecule derived from lysine that plays an important role in the metabolism of fatty acids, facilitating their entry into the mitochondria and their consequent oxidation. L-carnitine is produced from methionine and lysine and its synthesis is strongly influenced by the bioavailability of these elements. After its biosynthesis, the L-carnitine passes into the blood and is distributed to organs and tissues, depending on their energy capacity, especially to the muscles and the heart. In addition to its endogenous origin, L-carnitine is supplied by foods. With an omnivorous diet, at least 80% of the L-carnitine present in the body derives from the diet.

The percentage decreases dramatically in vegan diets because most of the L-carnitine is supplied by meat, fish and dairy products. It is considered to be a vitamin-like nutrient and the lack or insufficient supply of L-carnitine in muscles or in cardiac cells can cause myopathies and cardiac disorders.

Choline: the memory of a lifetime

Choline is an essential nutrient that is found in many food sources and plays a critical role in the development of the central nervous system. Pregnancy and breastfeeding are periods in which the choline maternal reserves tend to run out. Animal studies have shown that the pre- and post-natal choline status can have long-lasting effects on the attention and memory of the unborn child. Choline during pregnancy and during the early stages of life can change brain functioning, resulting in improved memory throughout life. This change in memory function seems to be the cause of changes in the development of the memory centre (hippocampus) in the brain, with long-term effects so much so that memory in the elderly may, in part, be determined by what the mother ate during pregnan-

 ISBN 9788891793324

cy. The richest choline foods are beef liver, chicken liver and eggs, but also pork meat.
Choline as a precursor of acetylcholine is involved in the regulation of sleep, in the control of muscle activity, in the regulation of anxiety states, in learning and may be linked to a slowing of the loss of cognitive abilities in the elderly.

Bioactive peptides of meat: immune system strengthening with a protective activity

In addition to bioactive compounds, in meat there are peptide derivatives of proteins that are another group of compounds functional with protective activity. When evaluating the quality of a protein, in addition to the composition of essential amino acids, it is also important to consider their ability to generate specific bioactive peptides during digestion. Bioactive peptides are sequences of 2-3 amino acids with protective effect on consumer health and play an important role especially in the prevention of diseases associated with the development of the metabolic syndrome and mental illnesses. Meat contains different proteins and peptides with important physiological activities. Although the activity of these peptides is latent, when they are part of the protein sequence, during digestion in the gastrointestinal tract they are released and activated. The same happens during fermentation, seasoning or food processing. Peptides modulate physiological functions through the binding interactions to specific receptors on cells that lead to physiological responses.
For example, it has been demonstrated that collagen-derived peptides have a positive effect on bone function, but in general the beneficial health effects of meat peptides include **antihypertensive, antioxidant, antithrombotic, modulating immune response and antimicrobial effects**.

2.2 Are there any alternatives to meat consumption?

In all parts of the world, the Guidelines for Healthy Eating recommend a high consumption of fruit, vegetables, cereals, legumes, foods rich in essential nutrients and protective substances, essential for the health of the organism[50].
An exclusively vegetable nutrition must be integrated with a careful selection of foods and supplements[51]. Some nutrients like mineral salts, vitamins like A, D or B12, essential fatty acids (especially omega-3) or essential amino acids (for example, methionine and threonine in addition to tryptophan and lysine) may not be consumed in optimal quantities, especially in more restrictive vegetarian diets[52].
An example can also be that of iron which is present in many plant foods. By consulting the composition tables of foods, it turns out that spinach is the vegetable that contains more (2.9 mg/100g), and in legumes, lentils and beans are the richest (8-9 mg/100 grams of dried legumes). **Unfortunately, for metabolic reasons, our body is able to absorb at best 8% of these quantities**: this means that to cover the daily need for iron using only raw spinach you would have to eat between 4 and 17 kg per day because boiling causes it to lose a lot in the cooking water.
This example shows how it is essential to take into account **bioavailability, that is the aptitude of a nutrient to be absorbed by the intestine** and then the assimilation by the cells that must use it. Many factors can influence the bioavailability of iron. **Vitamin C increases it**, so it is good prac-

 ISBN 9788891793324

tice to season vegetables cooked with lemon or eat fruits and vegetables that contain vitamin C; the fibre makes it decrease, as well as tannins.

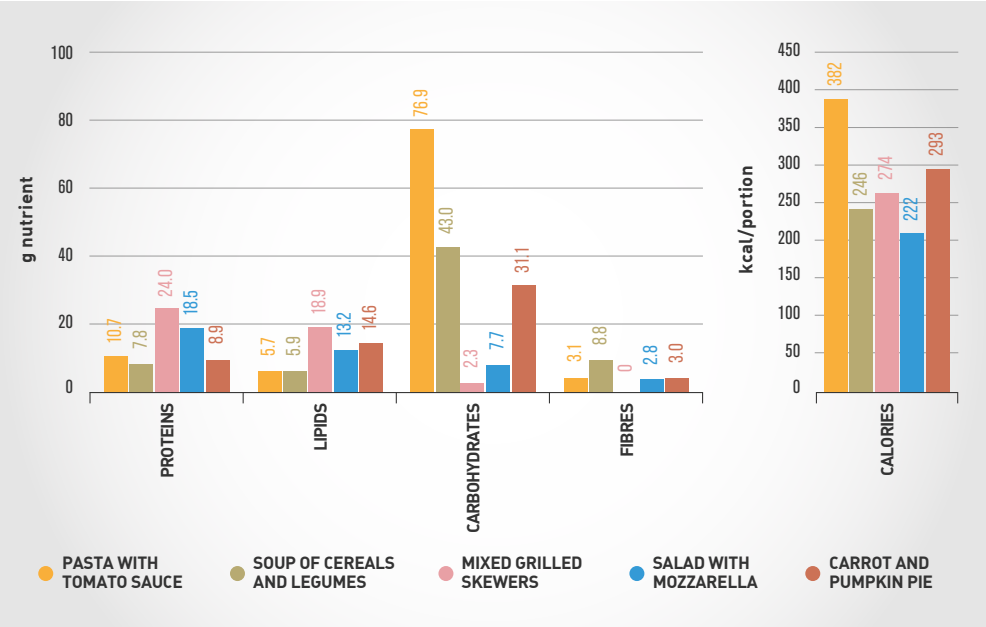
Many scientific studies have focused on the role of quantity, quality, type and timing of protein consumption and consequences of effects on health[53].

Today it is believed that a daily protein intake moderately superior to the recommendations (recommended intake for the population - 0.9 g/kg × day) for adults[54] may be useful for some people, such as the **elderly**[55] and physically active individuals[56].

Furthermore, a moderately high **protein intake in the diet** can help reduce **the risk of chronic diseases such as obesity, cardiovascular disease, type 2 diabetes, osteoporosis and sarcopenia**[57]. But it is essential that it derives from different types of foods, both of animal and vegetable origin.

In the group of foods rich in proteins, those of animal origin, in addition to providing complete proteins from the amino acid composition point of view, contribute to the daily intake of nutrients such as iron, zinc, vitamin B12, phosphorus and calcium, while proteins of plant origin contribute more to the intake of dietary fibre, vitamin E, magnesium. It is precisely these characteristics that support the advice for eating a variety of protein food sources, both for health reasons and to help meet nutritional recommendations[58-59].

 ISBN 9788891793324



The value of a varied and balanced diet is evident in the analysis of the contribution of nutrients from different foods

RECIPE	INGREDIENTS (PER PORTION)
PASTA WITH TOMATO SAUCE	Pasta 90g, Peeled tomatoes 80g, Oil 5g
CEREALS AND LEGUMES SOUP	Cereals 50g, Legumes 40g, Oil 5g
MIXED GRILLED SKEWERS	Chicken breast 40g, Pork sausage 40g, Veal rump 40g, Peppers 30g, Oil 7g, Wine 10g
SALAD WITH MOZZARELLA	Cabbage 50g, Tomatoes 50g, Mozzarella 80g, Green salad 50g
CARROT AND PUMPKIN PIE	Eggs 20g, Almond flour 25g, Sugar 25g, Carrots 15g, Pumpkin 10g, Powdered sugar 2g

By comparing the nutritive elements of some recipes, we can see how, in a balanced diet, meat provides more proteins than other foods.
(Source of the recipes: Elaborations within the working group)

 ISBN 9788891793324

3 THE NEEDS DURING THE DIFFERENT PHASES OF AN INDIVIDUAL'S LIFE

The nutrient requirement starts at the beginning of life and continues in all its phases, with variations due to age and specific needs. All nutrients are essential, but each period of life is characterised by a lesser or greater requirement of some nutrients or energy. **Meat provides useful nutrients at all stages in life**, but there are some special situations such as pregnancy and lactation, as well as during growth and exercise, where it is advisable not to deprive yourself of this food. For example, during pregnancy, breastfeeding, growth and aging the needs of certain nutrients or compounds increases such as proteins, essential fatty acids, choline, and micronutrients such as iron, zinc, calcium and vitamin B12, and you should not forfeit the best sources of these nutrients: foods of animal origin. Adults can satisfy their needs even with limited quantities of meat.

Recently a position paper[60] of the Sipps (Italian Society of Preventive and Social Paediatrics), together with the FIMP (Federation of Italian Medical Paediatricians) and the Italian Society of Perinatal Medicine has decided to clarify the adequacy of vegetarian diets and concludes that vegetarian and vegan diets that are not supplemented (with vitamin B12, DHA, iron, vitamin D, calcium and zinc) must be considered inadequate to guarantee a correct psychomotor development. Pregnant or nursing women, children and adolescent vegetarians must be periodically evaluated to verify that the supplementation is sufficient.

3.1 Pregnancy and lactation

The baby in the womb is totally dependent on the nutrients that are provided by the mother. Maternal eating habits and the nutritional status before conception, during pregnancy and lactation affect the unborn child, its growth and its health. Therefore it is important that the foods that a pregnant or nursing woman takes provide all the necessary nutrients to support the growth and development of the child, and this can only be achieved through a varied and balanced diet.

Proteins are a primary nutrient, because they guarantee the bricks necessary for the construction of the tissues of the unborn child: it goes from two cells at the time of fertilisation to about ten thousand billion in the new-born! But we must provide also the proteins necessary for the development of the placenta, for the mother's mammary and uterine tissues and for the growth in volume of the circulating blood (more haemoglobin, more proteins of the plasma), besides that of the amniotic fluid. Foods that contain proteins of high biological value are milk and derivatives, eggs, meat and fish. The same foods help to supply the body with other important nutrients during pregnancy and lactation like calcium, iron,

 ISBN 9788891793324

zinc, iodine, B vitamins, vitamin D, and some fats from the omega-6 family, such as arachidonic acid (AA).

In pregnancy and during lactation a frequent consumption of **fish is highly recommended to obtain the precious long-chain omega-3 fatty acids**, present albeit in smaller quantities even in meat, such as **docosahexaenoic acid (DHA)**. In fact, DHA is one of the main structural components of cell membranes and is essential for the formation of new tissues, **in particular for foetal development of the brain, nervous system and retina, which continue to mature during the first months of life**.
A good supply of calcium, together with phosphorus and vitamin D, is essential for foetal development and the first months of life. It is not only bones and teeth that benefit from it, but also the nervous functions, muscular contractions and blood coagulation. In pregnancy it is also necessary to pay close attention to the intake of sufficient quantities of iron and iodine. The greater iron requirement is due to the greater volume of blood: the baby's cells breathe with oxygen transported by the iron (haemoglobin) of the mother. Adequate iodine intake is essential for an optimal production of thyroxine, a thyroid hormone needed in larger quantities to control the major underlying metabolism induced by pregnancy. In addition to consuming fish regularly, it is good to replace salt with iodized salt.

During pregnancy, iron deficiency can impair brain functioning, learning and memory: children with low levels of iron have a delay of neuro-cognitive and motor development, a fact confirmed also by a recent research conducted at the paediatric hospital in Los Angeles and published in Paediatric Research[61], one of the most prestigious magazines of the sector.

All vitamins are important in pregnancy, but some even more so: **vitamin A and vitamin C, necessary for tissue growth, and B vitamins,** essential for energy transformation and protein metabolism, found in cereals, legumes and foods of animal origin. Special attention is needed for folic acid, an essential vitamin for the proper development of the foetus's spinal cord in the first 3 months after conception, to the point that during pregnancy a higher consumption is recommended. It also intervenes in the formation of red blood cells and is capable of reducing the risk of heart disease. During this phase of life, the **requirement of vitamin B12** also increases, **which goes from 2.4 µg per day to 2.6 µg in pregnancy and 2.8 µg during lactation.**

3.2 Growth and development

The nutrition of children and adolescents is based on the same principles of adult nutrition, but with different quantitative needs. The first 2 to 3 years of a child's life are fundamental for his physical and mental development, and in this context, proteins play a key role in the correct functioning of bones, muscles, blood, skin and hormones. Animal proteins, especially meat, are therefore very important foods: an 80 to 100 gram portion of most types of meat contains about 20 grams of protein, an easy way to help the child achieve its goals of protein intake. In addition to this, a correct intake of vitamin B12 is essential to all the other stages of life and if it does not feed properly it can get sick easier, or in general not develop in the right way. For

 ISBN 9788891793324

example, it is at this stage that obesity can be promoted in adulthood. In fact, today it is understood that fat cells are formed during childhood: if a child eats too much, it produces a greater number of fat cells that remain virtually unchanged in quantity when an adult[62]. Therefore, it will have a greater risk of becoming obese. Some nutritional deficiencies, **such as iron deficiency, can cause low levels of attention and concentration in the child, with consequent poor academic results**[63].

Most of the studies investigating the association between nutrition and cognitive development have focused on single micronutrients that are considered essential for the proper development of the brain: they are omega-3 fatty acids, vitamin B12, folic acid, zinc, iron and iodine[64], all nutrients supplied preferentially from food of animal origin. In children, the association between **vitamin B12 and cognitive development** was observed above all in children born to vegetarian or vegan mothers or who followed a macrobiotic diet. These diets can cause vitamin B12 deficiency because vitamin B12 is found exclusively in foods of animal origin. Studies on children with vitamin B12 deficiencies have highlighted abnormal clinical and radiological signs, including: hypotonic muscles, involuntary muscle movements, apathy, and reduced growth and demyelination of nerve cells. After treatment with vitamin B12, a rapid improvement occurs of the neurological symptoms in children with deficiencies, but in many the damage is permanent with lifelong delays in cognitive development and language[65]. The long-lasting effect of vitamin B12 deficiency is supported by the results of some studies[66] in which researchers examined the cognitive functioning of adolescents who consumed a macrobiotic diet up to the age of 6, compared to boys who followed an omnivorous diet. Those adolescents who followed a macrobiotic diet up to 6 years of age had lower levels of fluid intelligence, spatial capacity and short-term memory compared to control subjects.

Zinc deficiency appears to be a major problem worldwide, affecting 40% of the population. Some research suggests that children, adolescents, elderly and people with diabetes are at high risk of zinc deficiency[67]. Zinc is thought to be an essential nutrient for the brain, with important structural and functional roles. More specifically, zinc is a cofactor for more than

 ISBN 9788891793324

200 enzymes that regulate different metabolic activities of the body including proteins, DNA and RNA synthesis. Furthermore, zinc plays a role in neurogenesis, maturation and migration of neurons and synapse formation.
Zinc is also found in high concentrations in the synaptic vesicles of the hippocampal neurons (which are involved in the learning and memory centre). Zinc supplementation has a positive effect on the immune status of new-borns and can prevent congenital malformations[68].
One of the most common nutritional deficiencies in both developing and developed countries is **iron deficiency**. It is believed that iron is involved in different enzyme systems in the brain, including those involved in energy production, in the synthesis of dopamine receptors, in the myelination of nerve cells and in the regulation of brain growth. Furthermore, iron appears to modify developmental processes in hippocampal neurons by altering dendritic growth. Some authors have found significantly lower performances in language skills, motor skills and attention in 5-year-olds, whose levels of ferritin were lower[69]. There is a broad scientific consensus[70] that iron deficiency has a negative impact on cognitive, behavioural and motor skills and these cognitive deficits can appear at any age. The lack of iron is in fact clearly linked to cerebral alterations at the hippocampus level, mitochondria of the brain, metabolism of dopamine, a neurotransmitter, and the myelination of nerve fibres.

One of the most worrying consequences of **iron deficiency in children is behavioural alteration and cognitive performance**, for which there is a wealth of clinical, biochemical and neuropathological research that shows how iron deficiency can have a deleterious direct effect on brain learning and development, which can also occur with normal haemoglobin levels[71].
Iron supplementation improves cognitive functions and meat, especially beef, provides heme iron, a different form of iron that the body absorbs to a greater extent and is not found in plant or fortified foods. If iron deficiency occurs very early in life, the damage can be irreversible, and it may not be possible to reverse the brain damage with iron treatment[72].
Infants who are breast-fed only, at 9 months of age, get only 10 percent of the iron and zinc they need, and if during post weaning there are only cereals, fruit and vegetables they only get 30% of their needs of these important nutrients. Introducing meat instead as early as the sixth month is an effective way to provide iron and zinc in appropriate quantities[73].
Meat and other products of animal origin, such as milk, contain nutrients such as iron, zinc and calcium which is difficult to find elsewhere, or which are in a highly absorbable form and usable by the body, such as iron.
The World Health Organization recommends the intake of food of animal origin from 6 months of age, highlighting how diets based only on vegetables are not able to meet the nutritional needs of the child, unless the use of supplements or fortified products is used[74].

3.3 The nutrition of adults

During this phase of life, it is important not to increase weight too much, because overweight and obesity are connected to greater health risks. Meat, given its high nutritional density, can therefore be of help to limit calories, while ensuring an

 ISBN 9788891793324

adequate supply of nutrients. The prevalence of obesity in Italy has more than doubled in the last 25 years and numerous studies indicate that diets with higher proportions of proteins, obtainable for example with lean cuts of meat and cured meats, are effective for weight loss and maintenance. Meat, thanks to its protein contribution, can also contribute to satiety and consequently reduce the intake of food and energy. As with children and adolescents, adults are also at risk of iron, zinc and iodine deficiencies. Only an adequate diet, which includes also foods of animal origin and in particular meat, can avoid this risk.

A study[75] conducted on 127 young non-anaemic women between 18 and 35 years which wanted to evaluate the relationship between iron status and cognitive performance, highlighted the association between some haematological indicators of the iron status (haemoglobin, amplitude of blood cell distribution, saturation of the transferrin, ferritin, transferrin receptor, and total body iron) with brain function (attention, logic, memory, etc.). In practice better the iron status, better is the performance in sustained attention tasks and planning ability.

3.4 Meat for sportsmen

It is important for those who practice physical activity to follow a healthy and balanced diet, which provides calories and nutrients sufficient to meet the energy and nutritional needs and can ensure optimal performances during exercise[76]. A good nutrition in fact helps the athlete to train hard, to recover quickly and to adapt effectively to environmental conditions, with less risk of illness and injury. It is no coincidence that physical activity creates a higher energy demand, as well as macronutrients such as carbohydrates, fats and proteins.

Carbohydrates and fats are the primary fuels for exercise, while proteins are necessary for the growth and repair of body tissues: the muscles contain about 40% of the total proteins of the body. When the requirement of amino acids is not satisfied by the diet, **the muscle proteins supply the body with the necessary amino acids, but this happens even after exercise, during the phase of recovery, during which it is essential that there is an adequate supply of protein.**

Numerous studies have shown that the consumption of proteins, and in particular of the essential amino acids that constitute them, before, during, but especially immediately after the workout is capable of stimulating muscle protein synthesis. It is clear that proteins alone are not enough. But studies on the effects of protein on muscle power have identified some forms, that more than others, are able to optimise muscle protein synthesis, inhibit protein catabolism and therefore stimulate muscle growth. In fact, it is necessary to favour proteins rich in essential amino acids, such as those supplied by milk and its derivatives, eggs, fish and meat. Foods or snacks that contain high quality protein, such as meat and cured meats, fish, eggs or milk should be consumed regularly during the day. In particular, immediately after exercise, to **maximise protein synthesis, to help maintain muscles and help repair damaged tissues**.

Exercise increases the need for some vitamins and minerals. A varied diet capable of balancing energy expenditure satisfies the greater needs of athletes

 ISBN 9788891793324

for some micronutrients, but for others, present in a highly digestible form in the products of animal origin like calcium, iron, zinc and magnesium and vitamin B12, there may be a deficiency problem especially in athletes and vegetarians. Iron is a vital component of haemoglobin and myoglobin, proteins found respectively in red blood cells and muscles. **Haemoglobin and myoglobin provide oxygen to the tissues during exercise and the athletic performance of athletes**, especially aerobic sports athletes, depends strongly on the oxygen supply to the muscles so that they can work efficiently. When the state of iron becomes low, less oxygen is delivered to the muscles and sports performances are reduced. Iron deficiencies, often evident in athletes, can therefore compromise sports performances and can be avoided by the intake of highly absorbable and usable iron, such as that contained in beef.
Zinc intervenes in many very important functions such as growth, construction and repair of muscle tissue, the transformation of energy. Athletes, especially women, are at risk of deficiency of this mineral, whose best food source is represented by meat, but also by eggs and fish products.

Some B vitamins (thiamine, riboflavin, vitamin B6, niacin, pantothenic acid, biotin) are involved in the energy transformation process during exercise, while folate and vitamin B12 are necessary for the production of red blood cells, protein synthesis, tissue repair and maintenance. Although the need for these vitamins is slightly higher in athletes, it is generally covered by the increased energy intake necessary for athletes to maintain body weight.

3.5 The importance of foods of animal origin for the elderly

After 70 years of age you need less calories, because you no longer move like before and metabolism slows down. But to maintain health **the organism still requires the same amount of nutrients and even higher levels for some of them, like proteins**. Even the stomach and the intestine become less efficient. There is a decrease in gastric acid secretion, which can limit the absorption of iron and vitamin B12. With passing of years, the body reduces progressively the perception of feeling hunger and thirst; the regulation mechanisms of glucose and protein synthesis also become less efficient. Even taste fades and very tasty foods tends to be preferred, or excessive quantities of salt and seasonings are added to the food. The losing of teeth or the decrease in taste and smell always make favourite foods less attractive[77].

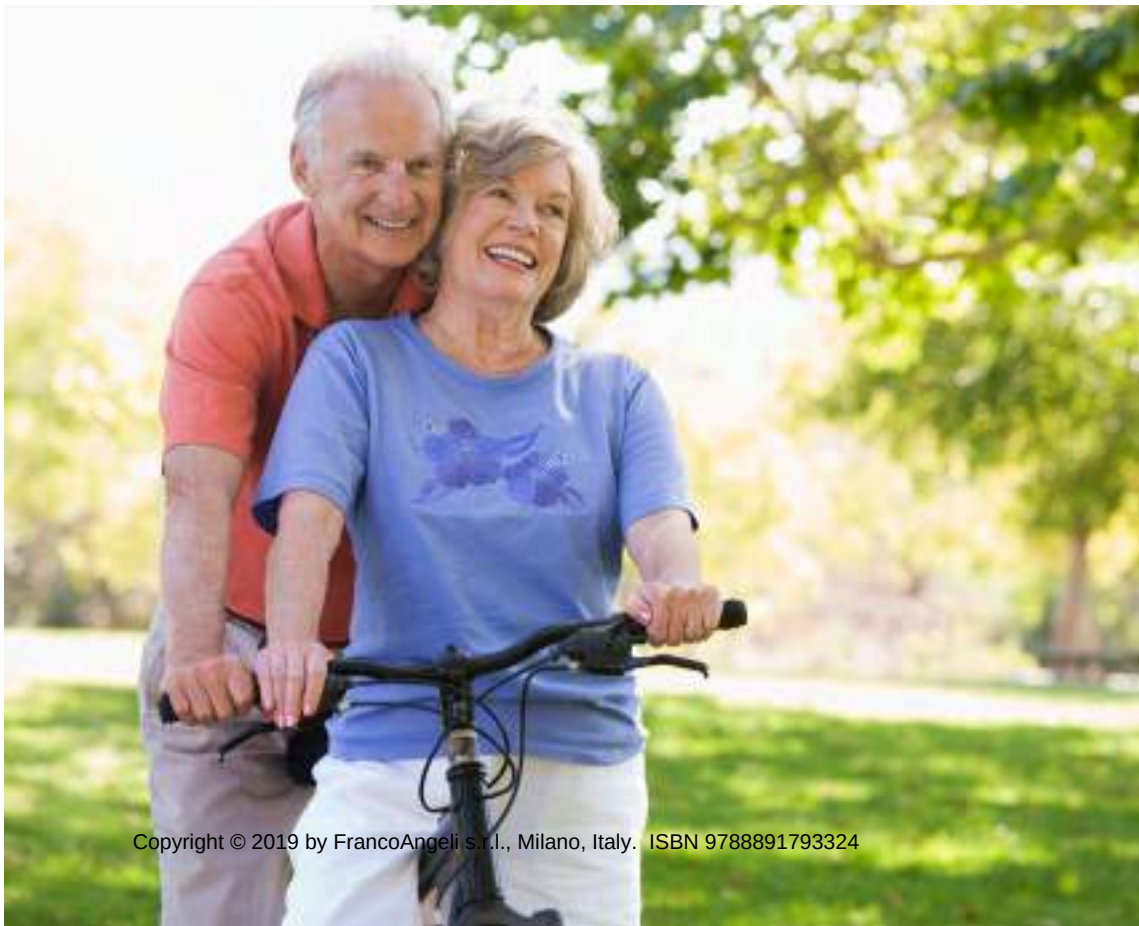
Meat and cured meats are part of a balanced diet for the elderly[78] and their consumption is recommended as it provides high biological value proteins and microelements including iron, vitamin B12, zinc and selenium. Once you reach adulthood muscle mass begins to decrease and the rate at which it is reduced accelerates after 50 years of age: **muscles represent about the 45% of body weight between 20 and 30 years, falling to only 27% of body weight at the age of 70**.
This tendency to lose muscle mass, called **sarcopenia**, is accentuated if one does not assume sufficient quantities of protein. It is therefore very important for adults to consume adequate amounts of high quality protein at every meal, in combination

with exercise[79]. It is clear that essential amino acids are fundamental for **the optimal stimulation of the synthesis of muscle proteins** and the amino acid leucine is a powerful signal of this process. Animal proteins have the highest proportion of the amino acid leucine[80].

Sarcopenia has numerous consequences in the elderly: **loss of strength** and ability to perform the activities of daily life, **loss of independence, an increased risk of falls[81], frailty, disability, poor health and lower longevity**[82]. In the PURE study, for example, which followed 140,000 adults aged between 35 and 70 in 17 countries, it was shown that greater muscle strength is associated with longevity and reduced cardiovascular risk[83].

A slightly larger amount of protein than in adulthood can be useful for the elderly, who can increase their reserve capacity and counteract the progressive loss of muscle mass, but also **to prevent the fragility of the skin and the reduction of immune functions, resulting in better recovery from disease**[84].

A vitamin B12 deficiency in the elderly is associated with decreased memory and hearing. Another nutrient at risk of deficiency in the elderly is **zinc, involved in the process of healing wounds, vision, taste and smell.** Most of the nutrients for which the needs in the elderly are increasing are found in large quantities and in easily assimilated form in foods of animal origin.



 ISBN 9788891793324

4 FOOD AND HEALTH

Dietary habits are intimately linked to different aspects of human life, such as growth, development, resistance to disease, and it is well established that they represent the most influential environmental factors in duration and quality of life.

To date, many nutritional strategies have been studied to prevent or delay the beginning of a disease, or even to optimise the therapy. But it is clear that not all individuals respond in the same way to dietary changes and part of this variability is due to individual genetic and epigenetic differences, which can in turn influence absorption, digestion, metabolism, excretion and the action of bioactive food compounds. Although dietary factors are important in many of the chronic degenerative diseases that are the main causes of illness and death in wealthy societies, it is very difficult to determine with certainty a cause-effect relationship. In fact, chronic diseases have many causes and take years to develop: eating habits can however be clearly a "risk factor".

The scientific methods for investigating chronic diseases, their causes, treatment and prevention are mostly epidemiological, a method that studies the prevalence of the frequency with which diseases occur and the conditions that favour or hinder their development, including dietary habits. These studies can focus on the subjects after the diagnosis of the disease (retrospective studies), or before the diagnosis (prospective studies). The influence of data and recommendations from developed countries on nutritional guidance **has often overshadowed the recognition of essential micronutrients and the contribution of proteins which, for example, meat contributes towards and whose legacy of key proteins and micronutrients is often underestimated**[85].

For example, in recent decades there has been an increase in the prevalence of some chronic diseases related to diet and lifestyles such as overweightness and obesity, hypertension and diabetes. While the incidence of these diseases continues to grow over the years, the general increase in food consumption that characterises the era in which we live, has partly reversed the trend, especially for some foods such as meat, whose daily intake has decreased over time.

The key to the meat question is therefore the quantity that should be consumed because, being a food with a high nutritional efficiency, in the modest quantities foreseen by the Mediterranean food model it already permits the benefiting from its precious effects without causing health risks[86]. Because if it is true that too little meat can slow down development and knowledge, excessive consumption seems to be associated with other health problems, such as vascular and neoplastic ones. Although there is a probable relationship between a excessive consumption of red meat and cancer or cardiovascular disease, the results of

 ISBN 9788891793324

the research are not entirely consistent and they differ amongst the populations, making it difficult to understand the reasons for this correlation[87].

According to scientific studies, in fact, the relationship between meat and mortality risk is more pronounced in the United States, compared to what happens in Europe or in Asia. This could be due to several factors:

- **Americans consume meat in much higher quantities than the average European and twice as much as in Italy;**
- **Europeans do not grill meat with the same frequency as Americans;**
- **The type of meat consumed by Americans comes predominantly from castrated animals, which results in a much higher fat content than the European average; furthermore, these fats are not superficial but are present in the lean part of the muscle and therefore difficult to remove;**
- **American farms allow the use of natural hormones for growth.**

The main diseases closely associated with nutrition are cardiovascular diseases, obesity, diabetes and some forms of cancer.

4.1 Cardiovascular diseases: saturated meat fats are acquitted after 40 years of accusations

Diseases that affect heart and blood vessels - cardiovascular diseases - include numerous health problems, many of which are linked to a process called arteriosclerosis, a condition that develops when a substance called plaque is deposited on the walls of the arteries. Its accumulation restricts the arteries, making the flow of blood more difficult. If a clot forms inside the arteries, blood flow can be stopped. This can cause a heart attack or stroke. **Cardio-cerebrovascular diseases are one of the most important public health problems in Italy. In 2014 there were a total of 220,200 deaths in Italy due to circulatory system diseases (96,071 in men and 124,129 in women); of these, 69,653 deaths were attributed to ischemic heart disease (35,714 in men and 33,939 in women) and 57,230 to cerebrovascular diseases (22,609 in men and 34,621 in women).**

Cardiovascular diseases are for the most part preventable through the adoption of healthy lifestyles, especially **healthy nutrition, regular physical activity and the abolition of cigarette smoking**. Meat is often considered with concern regarding **heart health, but not all scientific studies agree on this point**. A systematic review of the literature of 11 epidemiological studies published in 2015 found that a high intake of red meat is a significant risk factor for coronary artery disease (CAD) in 4 studies, but no significant association was found in 5 other studies[88].
A reasonable amount of lean beef can be included in a healthy heart diet, and can have favourable effects on the metabolic syndrome and coronary heart disease. For example, in some studies it has been observed that adults with high cholesterol, taking 100-115 g of lean beef per day, but limiting the intake of saturated fat to less than 7% of total calories, have had a significant decrease in total cholesterol and LDL cholesterol compared to subjects with a diet low in meat but with 12% of total calories from saturated fats[89]. Another meta-analysis study published in 2010[90] showed a significant increase in the risk of coronary heart disease with

 ISBN 9788891793324

the increase in consumption of processed meat: a contribution of 50 g of processed meat per day (which is more than twice that consumed in Italy) was associated with an average risk increase of 42%, while no correlation was shown with an intake of red meat (risk relative [RR] = 1.00). The EPIC study also showed a significant increase in the risk of death due to cardiovascular disease linked to the increase in consumption of processed meat (HR 1.72 [95% CI 1.29-2.30]) comparing higher and lower consumption (› 160 g per person per day compared to 10-19.9 g)[91]. There was no significant correlation with unprocessed white and red meat with regards cardiovascular death.
In summary, the indications of the WHO to prevent cardiovascular diseases are to reduce the consumption of saturated fats, in order to control the level of "bad cholesterol" in the blood: hence the suggestion to prefer lean cuts in the choice of meats. But also to pay attention to other foods: **saturated fats are also present in dairy products, in many baked goods and fried foods.** Some plant foods, such as **palm oil or coconut oil**, for example, contain **large quantities of saturated fats**. Taking into consideration the food composition tables of some products already shown in the nutrients section, it turns out that meat and cured meats are in effect among the least responsible foods for the intake of saturated fats.

In 2017, the results of the important PURE study do not support current recommendations to limit daily intake of fats to less than 30% of total energy and that of saturated fats to less than 10%, because **it is unlikely that decreasing the overall consumption of fat leads to an improvement in health, as would happen by reducing carbohydrate consumption**. Limiting total fat consumption to around 35% of energy taken daily and contemporaneously carbohydrate intake can reduce the risk of total mortality.

4.2 Tumour pathologies

Cancer is one of the main causes of morbidity and death all over the world: on average each year there are about 14 million new cases and 8.2 million cancer-related deaths. More importantly, it is expected that the number of new cancer cases will grow by almost 70% over the next two decades, up to 22 million new cases per year, making tumours the likely number one cause of mortality all over the world[92]. The five most common types of malignant cancer in men are those of the lung, prostate, colorectal, stomach, and liver tumours; on the other hand, the five most common types of neoplasms in women are breast cancer, colorectal, lung, cervical and stomach cancers.

Although dark areas remain, it is now established that the **interaction between genetics and the environment promotes carcinogenesis**. In particular, some physical carcinogens (such as **ultraviolet and ionising radiation**) and biological (**viral, bacterial or parasitic infections**) interact with behavioural and **food risk factors such as obesity**, insufficient consumption of fruit and vegetables, **lack of physical activity**, **the use of tobacco and alcohol**, to promote the transformation of a normal cell into a malignant cell. A phenomenon that can be amplified in individuals particularly predisposed genetically[93]. Amongst the various factors, **eating habits play an important role in increasing or reducing the risk of various cancers**. Although the causal relationship between

 ISBN 9788891793324

diet and cancer is complex and can hardly be unveiled due to the fact that diets are characterised by many different foods and nutrients, there is substantial evidence that certain foods may be more harmful than others[94]. Despite progress in scientific knowledge, however, areas of disinformation persist, sustained by prejudices and health simplifications, not always spread correctly by some mass media. And so foods are often classified as "**good**" and "**bad**", which disorients the consumer even more.

In fact, **no product can be considered good or bad for health, but must be evaluated by the nutrients which its contributes towards the daily diet, keeping in mind that the daily limit for each category of food in a balanced diet is not exceeded**. It must in fact always be remembered that cancer diseases are diseases extremely complex because:

- there are over 100 types of cancer for which the causes are not always known;
- people's diets contain an almost imponderable number of different components, some of them may decrease and others increase the risk of developing tumours;
- the development of a tumour takes place over a very long time making it very difficult to establish a sure and reliable relationship of cause and effect;
- many questions on diet and tumours remain unanswered, and often studies are based on tests done on animals in the laboratory without direct evidence on humans;
- recommendations for a correct diet that reduces the risk of contracting a tumour must be based on relevant scientific evidence, and not refer to a single study.

Meat is certainly one of the most controversial foods because excessive consumption, especially red and processed meat, can contribute to the risk of cancer[95].

The press release of the International Agency for Research on Cancer (IARC) issued on October 26th, 2015 and the IARC report Red Meat and Processed Meat volume 114 published in 2018[96] reported a high level of attention on the topic, as consumption of red meat and processed meat has been classified respectively as "probably carcinogenic to humans" and "carcinogenic to humans"[97-98].

IARC studies

As seen, the nutrition-cancer correlation is very difficult to study because there are many elements, real or presumed, that can favour the onset and development of tumour pathologies. In support of the recommendations of national authorities there are the studies of the International Agency for Research on Cancer (IARC) based on national studies that highlight and classify the **agents considered, undoubtedly or presumably, responsible for the onset of tumour pathologies.**
The mere presence of an agent in the classification does not immediately make it dangerous because it is necessary to understand, in addition to the level of carcinogenicity, also what are the **quantities and durations of exposure** that transform the theoretical into real risk, as well as what the real factors of risk are. Cigarette smoke is certainly carcinogenic, but those who smoke a single cigarette a day do not run a real risk of tumour development. The chemical compounds that are generated in cooking over a high flame and involve the burning of food are risky: **the**

 ISBN 9788891793324

modification of cooking habits immediately reduces the risk. In the case of processed and red meats, the most probable cancer pathology is related to colorectal which could be more likely attained by consumers of large quantities than moderate ones. The IARC studies have associated **excess consumption with an increase in the relative risk** of about 18% for transformed and 17% for red meat. It is essential, however, not to confuse **absolute risk** (for simplicity we could to say real) with relative, which **only represents the increase of the absolute risk**. IARC data tell us: people that consume larger quantities of red meat (more than 100 g per day) have a 17% increase in the risk of colon cancer compared to those who consume a small amount of meat. According to IARC, processed meat increases the risk by 18% with 50 g per day. These figures, however, represent a relative risk. In reality they mean that if 6% of people in a population are likely to develop colon cancer (60 out of 1000 people), among those who eat small amounts of meat this number is more likely to be 5.6% (56 people in 1000), and among high-volume consumers this number is expected to rise to 6.6% (66 people in 1000).

So the absolute risk between those who eat too much or too little meat is only 1%. Another very important element concerns the quantities covered by IARC research, which are 50 g of processed meat or 100 g

IARC CLASSIFICATION

Amongst all classified agents, only 6 (red meats, processed meats, coffee, alcohol, matè, salted fish Chinese style) are foods/beverages.
The others are made up of substances or molecules belonging to various groups, amongst which pollutants and by-products of industrial production stand out. All other agents are chemicals or work environments that are potentially at risk.

GROUP 1 CARCINOGENIC TO HUMANS an agent characterised by an evident level of carcinogenicity in humans. This class contains 120 substances (e.g. tobacco smoke, alcohol (from 2012), arsenic, asbestos, plutonium, atmospheric pollution, solar radiation, etc.).

GROUP 2A PROBABLY CARCINOGENIC TO HUMAN limited evidence of carcinogenicity in humans and sufficient evidence in experimental animals. The substances included in this category are 82, the only food/drink present is matè (infusion) incriminated also by the fact of being consumed very hot, a risk factor for cancer of the oesophagus and the oral cavity.

GROUP 2B POSSIBLY CARCINOGENIC TO HUMANS limited evidence of carcinogenicity in humans and less than sufficient evidence of carcinogenicity in experimental animals. A category that includes 302 substances.

GROUP 3 NOT CLASSIFIABLE AS TO ITS CARCINOGENITY TO HUMANS a category usually used for agents for whom the evidence of carcinogenicity is inadequate in humans and inadequate or limited in experimental animals. This is the most numerous category with 501 substances.

GROUP 4 PROBABLY NON CARCINOGENIC TO HUMANS absence of carcinogenicity both in humans and in experimental animals. At the moment the only substance included in this category is caprolactam, the precursor in nylon production.

 ISBN 9788891793324

of red meat per day. These consumptions are **much higher than those of typical Italian consumers** and, in general, those of the world. The **Global Burden of Diseases** Risk Factors Study 2017 (GBD 2017) provides a comprehensive assessment of risk factor exposure and attributable burden of disease (www.healthdata.org/gbd). It is proposed as a targeted health measurement system to estimate the weight of individual factors (for example Behavioral risks such as smoking or alcohol use) on the development of diseases to monitor risk exposure trends critical to health surveillance and inform policy debates on the importance of addressing risks in context. Considering data in Western Europe (Causes, All ages, Percent of total deaths), it emerges that colorectal cancer is actually one of the main causes of death in developed countries (at seventh place in 2017), but with a rather low incidence (about 3.48% of deaths in 2017). If the analysis moves onto the behavioral risks, regardless of the type of disease generated, it is interesting to observe that in Western Europe the first risk factor is smoking, followed by alcohol use.

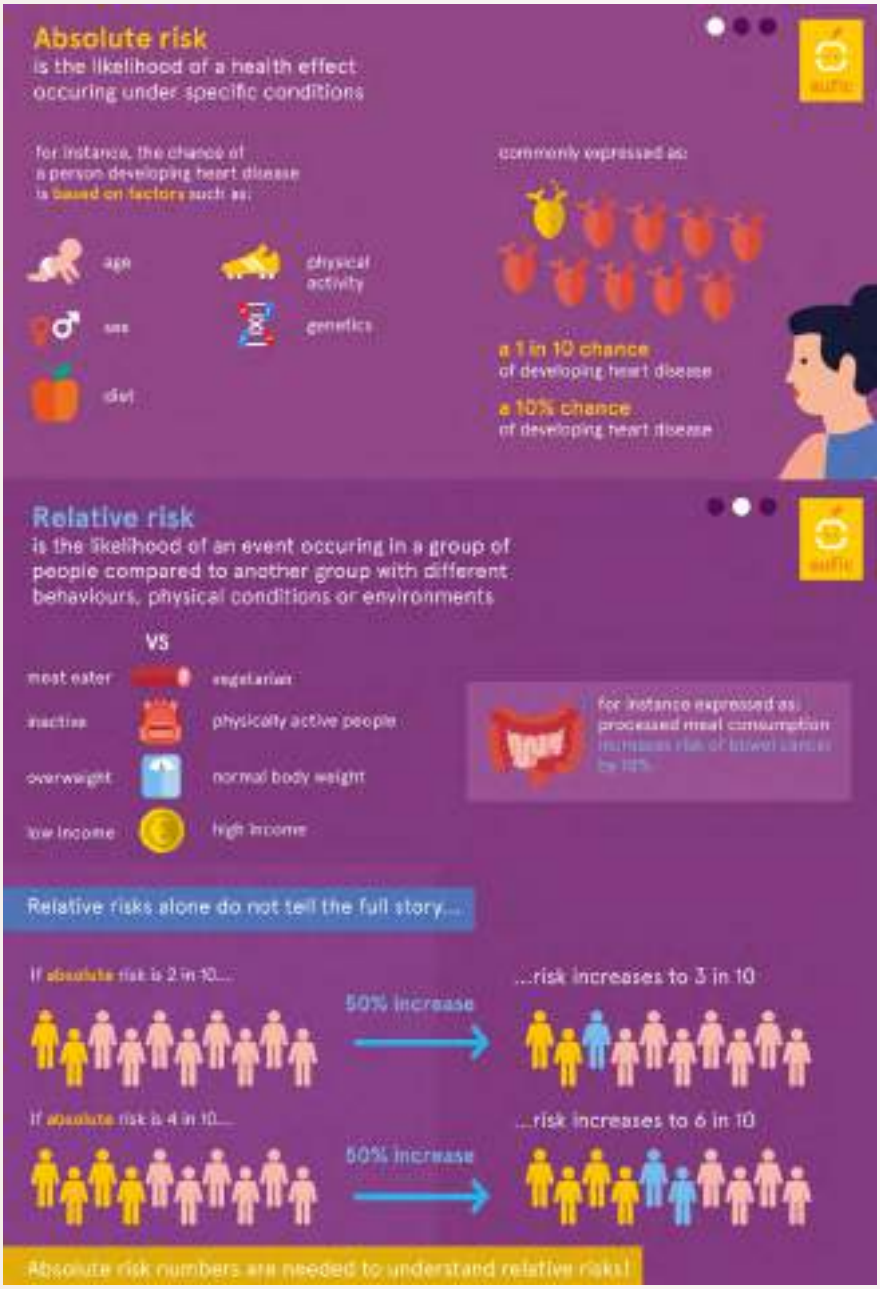
Considering dietary factors, diet low in whole grains is a huge risk factor when compared to a diet rich in red meat (41.6 versus 1.14): a further confirmation of the importance of following the indications proposed by the Mediterranean Diet.

BEHAVIORAL RISK FACTORS FOR HEALTH: NUMBER OF DEATHS EVERY 100,000 PEOPLE

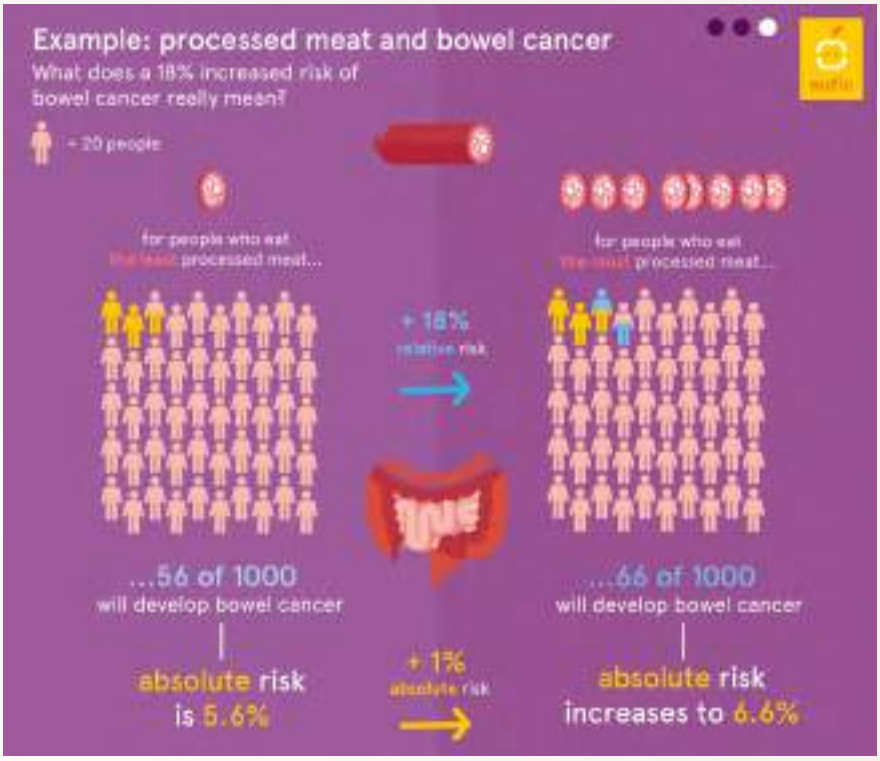
Source: GBD 2017 Institute for Health Metrics and Evaluation; extraction made in March 2019 taking into account behavioural risk factors in Western Europe

 ISBN 9788891793324

CANCER RISK
ABSOLUTE AND RELATIVE



 ISBN 9788891793324



Source: EUFIC, 2015 - How to talk about food risk? A handbook for Professionals. pp. 40-41

In the report "How to talk about food risk? A Handbook for Professionals", the EUFIC, the European information food board council (a non-profit organisation, established in 1995, which fights for scientific information on food and health), contains an interesting study on the importance of the distinction between absolute and relative risk.

***Absolute risk** is the difference between the disease rate of a risk category and that of a control group; the **relative risk**, instead, is the relationship between the illness rate of a risk category and that of a control group. Relative risks, if not reported in the context of absolute risk, may be misleading.*

*Absolute risk data, on the other hand, is necessary to understand the implications of the relative risks and how specific factors or behaviours can influence, for example, the likelihood of developing a disease or a particular health status. In other words, the absolute risk measures the clinical impact associated with exposure to a certain risk factor, the one related to the strength of the association. The infographic shows an example of treated meat consumption and the risk of bowel cancer. The **relative risk** of developing bowel cancer for those who eat less treated meat respect to those who eat more treated meat increased by 18%; when related to absolute risk, this involves a small increase, equal **to 1%**, from 5.6% to 6.6%.*

 ISBN 9788891793324

ELEMENTS OF CANCER RISK IN MEAT

According to the IARC, the risk factors of meat are due to substances that may be particular to meat (e.g. heme iron), and/or originated during processing or cooking at high temperature (e.g. NOC nitrous compounds or HAA aromatic amines). These substances in the long run, when introduced into the organism, can be co-responsible for the development of forms of tumour due to different biochemical mechanisms. An example can be that of aromatic amines (HAA), genotoxic substances potentially capable of damaging genetic information inside a cell causing mutations and inducing changes in DNA. The suggestion of limiting the consumption of red meat is therefore accompanied by that of avoiding cooking with an open flame, such as the barbecue. For completeness it is useful to observe that this phenomenon is not typical of meat, but of the method of cooking: the same dangerous compounds, even if to a lesser extent, are formed in other foods, such as for example grilled vegetables or pizza cooked in a wood oven.

NITRATES AND NITRITES + HEME IRON + COOKING

Nitrosamines: *are organic compounds containing a nitrous group, -N = O, bound to the amino nitrogen. They are obtained in very acidic conditions or at high temperatures due to the reaction of the nitrites with a secondary amine, which may be present within a protein structure. Many nitrosamines are carcinogenic, i.e. provoke genetic mutation, as demonstrated by animal studies in laboratory; their intake is linked to the development of stomach and oesophagus cancer. The problem of nitrosamines is linked to the presence of nitrate as a natural component of food, convertible into nitrite in the mouth thanks to saliva, and to the use of nitrite as a food preservative, essential to prevent the development of micro-organisms in foods such as the botulinum bacterium. Nitrite finds optimal conditions to produce nitrosamines inside the stomach or through cooking methods such as frying or roasting.*

Heme Iron*: is found in meat in the form of haemoglobin and myoglobin. The heme iron is released by these proteins due to the low pH in the stomach and the action of proteolytic enzymes in the stomach and small intestine, to be then absorbed by the mucosa and transported in the blood directly to the cells to make haemoproteins. The negative effects of very high amounts are cytotoxicity and increased formation of endogenous N-nitrous compounds (NOCs), which can increase the overall mutation rate in the DNA of the colon tissue.*

Heterocyclic amines*: form in meat and bread if they are burned, due to cooking at too high a temperature. In human populations an association between the ingestion of "burned" meat and the risk of cancer has not been identified. Probably it has a limited effect and is difficult to identify.*

COOKING AND SMOKING

Polycyclic aromatic compounds: *are formed after cooking at high temperatures and smoking. Although more than a hundred different PAHs exist, IARC (International Agency for Research on Cancer) has added to the lists those most dangerous or more responsible for serious damage to human health. Repeated exposure to certain types of PAHs has been shown to increase the onset of cancer significantly.*

 ISBN 9788891793324

Not all meats are the same

Once clarified which substances are characterised by the greatest risk factors, it is advisable to analyse in-depth relative to their presence in the various cuts of the meat.

A first analysis is about nomenclature: it must be clarified what is meant by red and processed meat. In traditional culinary terminology, meat is conventionally classified as "red" when characterised by a typical red colour, while "white" usually defines a sub-type with a lighter colour. Although the semantic debate is still open, the first type defines "red" as the meat of the majority of large mammals (cattle, pigs, sheep, goats, horses) while the "white" type identifies poultry (chicken, turkey) and rabbit.

One of these substances, **heme iron**, is characterised by a marked variability both between red and white meat and between groups of red meats.

Nitrites, another critical substance, is mainly contained in processed meats (where they play the **role of preservative**), but also in other **foods**. Fresh vegetables, for example, contain high amounts of nitrates, which can be turned into nitrites. It should be remembered that most PDO cured meats are free of these substances[99].

As for **aromatic amines (HAA)**, their presence is strictly related to cooking methods: the data published in the EPIC study observed in fact the change in the content of the main substances between fresh meat (with zero value) and cooked meat in various ways. In this context, **communication to consumers should recommend a change in meat cooking methods**, rather than a general reduction in consumption[100]. Finally, for **polycyclic aromatic hydrocarbons,** the 2004 EFSA opinion indicates that indicates that the two major contributions to **dietary exposure are cereals, products derived from cereals, and seafood** and their derivatives. For these substances it is also important to observe how **in smokers the contribution of the diet is almost zero compared to that of the smoke.**

MEAT TYPE	CUT	FE TOT	FE HEME
 BEEF	Fillet steak	2.3	2.1
	Roast beef	2.0	1.8
	Rump	1.9	1.7
 SHEEP	Sheep thigh	2.2	1.7
	Lamb thigh	0.9	0.4
 PORK	Loin	0.4	0.2
	Steak	0.5	0.3
 POULTRY	Breast convent.	0.4	0.1
	Thigh convent.	0.7	0.2
	Bio breast	0.6	0.3
	Bio thigh	1.0	0.5

Presence of Iron and Heme Iron in meats. Data in mg/100 grams. Source: Lombardi-Boccia G. et al., 2004[101] - Mele M. et al., 2015[102]

 ISBN 9788891793324

NITRITES AND NITRATES: THE HIGHEST CONCENTRATIONS ARE IN VEGETABLES					
mg/100g	NITRATES	NITRITES	mg/100g	NITRATES	NITRITES
Beetroot	329	0.60	Raw ham PDO	0	0
Celery	315	0.08	National raw ham	0	0
Radishes	258	0.48	Choice cooked ham	6	5
Spinach	247	0.38	Bacon	21	0
Lettuce	233	0.06	Frankfurter of pure pork	13	0
Beets	203	0.13	Zampone Modena PGI	0	7
			Sausages PDO	1.4	0

Presence of nitrates and nitrites in some foods. Data in mg/100 grams. From: food content of potentially carcinogenic substances[103]

THE FOOD CONTENT OF POTENTIALLY CARCINOGENIC SUBSTANCES	PHLP (ng/g)	MELQX (ng/g)	DIMELQX (ng/g)	AC (ng/g)	IQ (ng/g)	MELQ (ng/g)
Fresh beef	0	0	0	0	0	0
Beef grilled (rare)	0-1.2	0-1.1	0	0	0	0
Beef grilled (well cooked)	0-15.0	0-2.2	0-4.3	0-4.15	0	0
Beef grilled (very cooked)	5.7-33.3	1.2-5.8	0.4-1.9	0	0	0
Fried beef	0-23.2	0-8.2	0.1-1.3	0	0-2	0-1.7
Hamburger	0.2-18.4	0.2-1.8	0-0-1	0	0	0
Pork meat (fried or grilled)	0-7.8	0-3.8	0-1.1	0	0-0.7	0-0.1
Chicken meat (fried or grilled)	0-270	0-9	0-4	0-170	0	0
Bacon	0-46.2	0-23.7	0-3.4	0-0.1	0-10.5	0-1.7
Frankfurters	0-0.6	0-0.7	0-0.2	0	0-0.2	0-0.1

Data in ng/100 grams. From: food content of potentially carcinogenic substances[104]

 ISBN 9788891793324

Protective effect of a balanced diet: vitamin C, vitamin D, folic acid

The analysis of all this data, which doesn't identify in a clear way a "good" and a "bad", confirm once again that a diet should be considered as a whole and that **the correlation of causes and effects is very difficult, when referring to a single food or food substance**. Some studies have recognised the protective role[105] of calcium, milk or whole grains, often associated with a lower risk of colorectal cancer, and there is substantial evidence for the potential chemo preventive effects of **vitamin D, folic acid**, fruit and vegetables, also because of their **vitamin C** content.

FOOD	PREPARATION	TOTAL PAH (µg/kg)
Beetroot	raw	14
Cauliflower	raw	2.8
Lettuce	raw	2.6
Courgette	raw	8.9
Apple	raw	8.3
Oatmeal bread	oven	64
White bread	oven	3.2
Breakfast cereals	dried	5.7-59.5
Cereal flour	dried	8.6-38
Pizza	oven	13
Bacon	smoked	6.8
Beef	smoked	9.7
Beef	barbecue	5.7-42.1
Chicken	barbecue	0.6-60.2
Ham	smoked	2.6-9.5
Pork meat	barbecue	3.1-13.6
Salmon	smoked	86.6
Herring	smoked	55-180

Content of polycyclic aromatic hydrocarbons. Data in µg per kg.
Source: Food content of potential carcinogens, EPIC, 2004.

 ISBN 9788891793324

Suggestions

It is clear that every food, including water, every nutrient or food substance presents actual, presumed or potential risks closely related to the quantities consumed, the individual and lifestyle. Meat has high nutritional qualities and its consumption in moderate quantities is linked to proven and consolidated benefits over thousands of years. The benefits and risks associated with the consumption of red and processed meat should not cause dilemmas, if these meats are consumed in moderate quantities as part of a balanced diet[106]. On the basis of apparent consumption data currently available (FAO and Ismea), on average Italians consume 237 g per day of all types of meat (chicken, pig, bovine, ovine-caprine). **The real consumption pro capita corresponds instead to less than half, or 104 g per day of meat**, equal to 728 g per week and 38 kg per year. This consumption includes all meat, regardless of how (raw, cooked, transformed into cured meats, present in mixed food preparations, canned, etc.) and where (home, restaurants, fast food, canteens, communities, stalls, etc.) it is consumed. Considering only **the consumption of red meat (beef and pork) and cured meats (thus excluding white meat), the actual consumption stands at 69 g per day, with regard on the other hand to only beef, real consumption drops to 24.8 g per day per capita**, well below the 100 g per day as indicated by WHO/IARC as a risk threshold for cancer diseases[107]. There is, of course, considerable variability around these values and suggestions of consumption reduction are orientated especially if processed meat consumption is high. However, there remains considerable uncertainty about the risks associated with specific types of red meat (e.g. pork and beef) and processed meat and, in fact, on which meat to consider processed[108]. It is risky to give credit to information which, on the basis of a hypothesis of risk of a minimum increase in the probability of a disease (such as cancer) leads to **a specific risk of nutritional deficiencies and to the known effects that result at metabolic and cognitive level**. These considerations have an even greater value when they concern the diet of growing individuals, that in subjects of old age or with particular health conditions.

The opinion of the CNSA

The National Committee on Food Safety (CNSA) has made clarity on the IARC report about meat and cancer, sustaining that:

(...) *meat is an important source of high biological value proteins, amino acids, vitamins, minerals and metals (in particular iron and zinc) in human nutrition and, above all, in certain age groups and/or physiological states, as well as in particular health conditions;* (...)

and also,

(...) *that colorectal cancer, like all neoplasms, is the result of several factors and is triggered by the interaction between environment, lifestyle and genetics; which, in this general framework, are particularly relevant: weight excess, sedentary lifestyle, low fibre consumption, excess calories in the diet, lifestyle as a whole, including food* (...)

and it is recommended

(...) *to follow a varied diet, inspired by the Mediterranean model, avoiding excessive consumption of red meat, both fresh and processed* (...) *avoiding the excessive consumption of each food*".

(Source: www.salute.gov.it/imgs/C_17_pubblicazioni_2473_allegato.pdf)

 ISBN 9788891793324

5 IS MEAT CONSUMPTION SUSTAINABLE?

The starting point for assessing whether people's food consumption is consistent with the guidelines suggested by nutritionists is to quantify the consumption data per capita per year. Scientific literature offers a lot of information in regard, that however has a limited usefulness due to the many variables in terms of in-depth detail and the boundaries of the analysed phenomena. The following however is a proposed analysis that, although preliminary, provides some interesting information on the consumption of meat and cured meats.

5.1 How people's food consumption is estimated

In general, food consumption can be estimated using two different approaches: the calculation of **food availability** and the **detection** of real consumption.

Availability of food (apparent consumption)

The first method is to estimate a very general picture of the food resources available for human consumption in a country in a given period of time, to the point that its monitoring is normally carried out by major institutional sources (ISTAT, Eurostat, FAO...) showing the relationship between food availability in a country and the number of inhabitants accessing available resources. In the case of meat, the data is given in **equivalent carcass weight** which, including non-edible parts (tendons, bones, fat, ligaments), tends to overestimate the real consumption: in this case it is **apparent consumption**. By their nature, this information should not be used to study the relationship between food and consumer health, unless it accepts the enormous overestimation of real meat consumption.

$$\frac{(\text{production} + \text{import} + \text{initial provisions}) - (\text{non-food use} + \text{export} + \text{final provisions})}{\text{number of inhabitants of the country}}$$

Real consumption

Real consumption is estimated by surveying families or people through specific surveys of well-defined population samples. Although for simplicity in this work the two methods are assimilated, in truth the survey on families is normally conducted analysing the economic expenditure of a given period of time through interviews, while that on individuals involves just the consumption of a given food by a specific sample of people over a given period of time. These methods are used by organisations specialised in the analysis of statistical data, such as INRAN, Nielsen, Eurisko, or by scientific studies as in the case of the *European Prospective Investigation into Cancer and Nutrition* (EPIC) project. They are ideal for the acquisition of information useful for the study of the relationship between eating habits and health of people, but they have the defect of being very expensive.

 ISBN 9788891793324

	APPARENT CONSUMPTION	REAL CONSUMPTION	
	FOOD AVAILABILITY (APPARENT CONSUMPTION)	MONITORING FAMILY EXPENDITURE	INDIVIDUAL CONSUMPTION
MODE	Mathematical relationship between quantity of available food and inhabitants	Detection of expenditure (and sometimes quantity) for the purchase of food by families	Detection of individual or group consumption in 24 hours or in longer periods by diary or interviews
TARGET	Know the amount of food available in a country Compare trends and consumption amongst various countries Orient decisions on agri-food policies	Analyse food spending by various sampling of people Monitor food consumption over time	Evaluate per capita consumption of food Studying the relationship between diet and health
CRITICAL ISSUES	Does not include production for self-consumption Includes non-edible parts Difficulty in estimating quantities destined for non-food uses Includes losses in the different stages of the supply chain In calculating people, it does not take into account the balance of the flow of tourists as well as non-resident immigrants	Detects the expense and not the quantity purchased Does not estimate eating meals outside the home There is no distinction between the moment of purchase and the moment of consumption Methodological aspects related to sampling	The detection can consider weights or number of portions as well as raw or cooked weight Considers with difficulty waste in the plate Preparations with different types of ingredients (e.g. meat and vegetables) Methodological aspects related to sampling Participant reliability Cost of the method

 ISBN 9788891793324

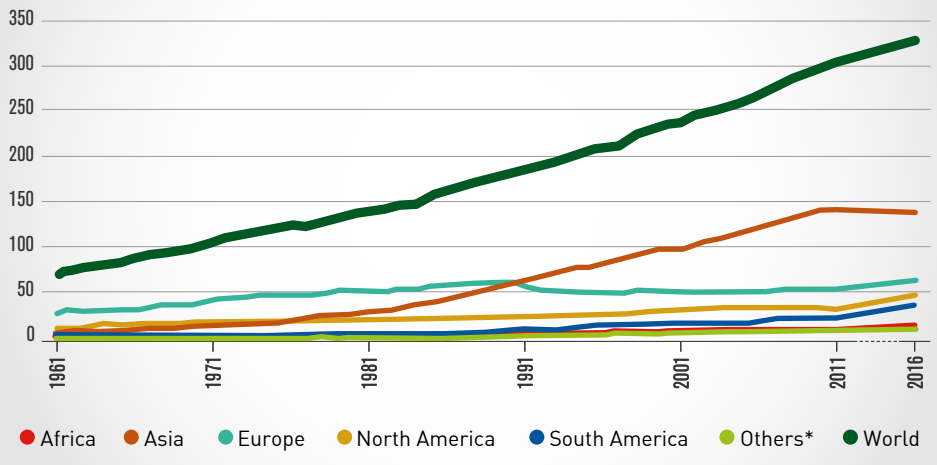
5.2 The consumption of meat in the world

In 2016, the world's theoretical meat supply reached about 330 million tons per year, of which just over 40% in the Asian continent only. Which, since the early nineties, has contributed more to the growth of the volumes. Europe and North America contribute in a more limited way, with values that measure respectively 19% and 15%. The most consumed species are pork, chicken and beef, although with different annual trends: consumption of beef has been substantially stable for over 20 years, while over the same period the consumption of poultry meat has almost doubled. Albeit with some differences between the various species, there is no doubt that the consumption of meat has undergone, over the last 30 years, a clear increase at global level, an increase referring also to the increase in the world population, from about 3 billion in 1960 to the current 7.5 billion. However, it is worthwhile focusing on the individual regions of the world to see how and where people's eating habits have changed over time. To do this, the theoretical availability data per capita in the same areas already studied are analysed. Also in this case there are substantial differences between the various regions of the world: the countries of North America, in fact, register an apparent consumption much higher than that of other continents.

Asian countries, which have become the first global consumers in terms of volume, are in fact amongst those with a

APPARENT MEAT CONSUMPTION IN THE WORLD

Millions of t/year



Source: FAOSTAT www.faostat3.fao.org/home/Ee
** Oceania and Central America*

 ISBN 9788891793324

lower per capita value, even if they have grown substantially since the end of the 1980s.

Too much meat or too much imbalance between the Countries of the world?

The analysis of world consumption data, but above all their variability from region to region, leads to the consideration that the direct correlation between meat consumption and sustainability is always very critical, without this being contextualised.

Statements such as "**eating too much meat**" or "**meat consumption is unsustainable**" should be contextualised in the light of such data, to understand if this is true at all or if it is more true in some parts of the world. Obviously this work offers only a preliminary vision of the problem, which could be explored with a more detailed analysis.

However, it seems clear enough that:

- meat consumption is increasing both due to the higher per capita consumption in some areas of the world, and (and above all) to the **increase of the global population**;
- here is a strong imbalance between regions of the world: the meat consumption per capita in North America is more than 4 times higher than the average African one;
- consumption of **beef in Europe does not show substantial increases since the end of the 1990s**.

DATA SOURCE USED

The analysis presented in this part of the document were realised taking into consideration the data published on the FAOSTAT database, available on the website www.faostat3.fao.org/home/Ee which refer to **apparent consumption**, having been processed using the *food balance sheet*.

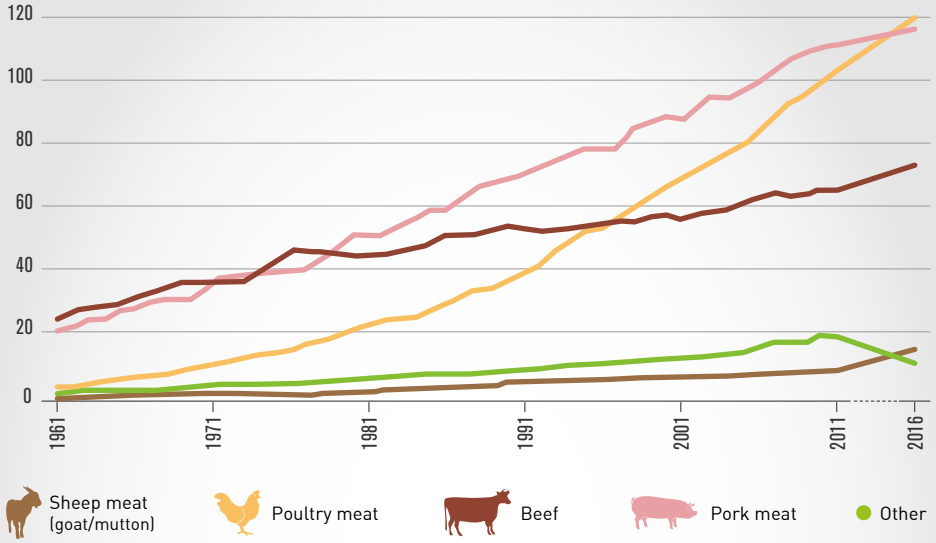
The interrogations were performed in August 2018 with the following characteristics:

- annual coverage from 1961 up to 2016;
- types of products included in the total meat item: *Bovine Meat - Meat, Other - Mutton & Goat Meat - Offals, Edible - Pork meat - Poultry Meat;*
- in the "other" regions, Oceania and Central America were included.

 ISBN 9788891793324

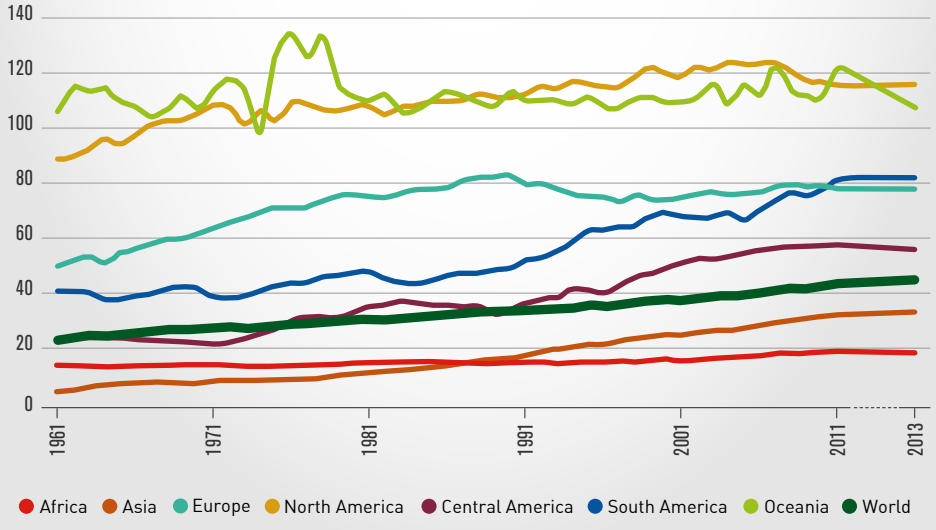
APPARENT MEAT CONSUMPTION PER SPECIES IN THE WORLD

Millions of t/year



APPARENT MEAT CONSUMPTION PER CAPITA

kg per capita per year



Source: FAOSTAT www.faostat3.fao.org/home/Ee

 ISBN 9788891793324

FOOD DIETS IN THE WORLD:
A COOP - DOXA RELEVATION

Among the projects published in the period of EXPO 2015, an interesting study was found conducted by DOXA for COOP Italy aimed at studying what could be the evolution of the food sector. From the analysis, available on the DOXA 109 website, an estimate of average food consumption in some countries has also emerged.

Even if the evaluation is to be considered preliminary because it shows the frequencies of consumption and not the quantities, it is very interesting to observe how Italy has a consumption lower than average for animal proteins, and therefore also for meat, and higher for that which concerns carbohydrates, sweets, fruit and vegetables. The main consumers of meat among the analysed countries are Russia, China and Brazil. Italy is the lowest consumer of meat after India.

The diets of the world

In Italy "**Mediterranean Diet**", high **meat** consumption in Russia, China and Brazil, mainly **protein** diet for Germany, UK and USA

Average weekly consumption in days									
4.7	Carbohydrates	5.2	3.8	3.9	3.7	4.1	5.9	5.4	5.8
4.0	Meat	3.4	3.9	3.7	3.9	4.8	4.6	2.6	4.7
1.7	Fish	1.6	1.2	1.5	1.5	1.8	2.6	2.4	1.4
3.6	Cheese and dairy products	3.0	4.4	3.3	4.0	4.0	3.6	2.9	3.9
2.6	Eggs	1.5	2.1	2.1	2.6	2.7	4.2	3.0	2.6
4.6	Fruit	5.1	4.7	4.5	4.0	4.1	4.8	4.9	4.3
4.9	Vegetables	4.9	4.4	4.8	4.5	4.6	5.8	5.5	4.7
4.0	Sweets	4.2	3.5	3.5	3.7	5.3	2.8	4.2	4.8

 ISBN 9788891793324

5.3 Consumption of meat in Italy

As for consumption in Italy, it was decided to compare the apparent consumption data, available in the FAO database already consulted, with those of real consumption.
To this end, various public sources mentioned in the bibliography were analysed. Despite being rather complex to identify a univocal data of **real or apparent consumption**, the results allow to make some general considerations. Going into detail on the data analysed, we can see that the apparent consumption value is around 232 g of meat per capita per day, while that of real consumption is about 103 grams.

This difference is also consistent with the average yield data between edible meat and animal carcasses.

DATA SOURCE USED

APPARENT CONSUMPTION

- **FAOSTAT**
  Database already described for the analysis of world consumption. The data presented is relative to 2016
- **ISMEA**
  The data is part of a historical series from 1938 to 2009 elaborated by the Milan Chamber of Commerce in 2010. In this analysis the most recent available data was taken into consideration[110].
- **GIRA**
  Data disseminated by the main statistical research institutes

REAL CONSUMPTION

- **INRAN**
  The data presented is the average of 4 scientific studies conducted by CSPO[111], EPIC[112], INRAN[113] (now CREA - Food and Nutrition)
- **GFK Eurisko**
  The basic data used in this work are those of the Ismea-Gfk-Eurisko database from periodic surveys on purchase behaviour of a sample of 8000 families. Consumption outside the home is not included. The study is cited in the ISMEA document
- **ASPA**
  Scientific study of the Association for Science and Animal Production (ASPA)

FROM APPARENT CONSUMPTION TO REAL CONSUMPTION
THE ASPA STUDY

ASPA, Association for Science and Animal Production, was founded with the aim of promoting the progress of the science and technology that affects livestock production with all the factors of sustainability concerned. Many Italian academic organisations are members of the association who, for their different skills, have the objective of carrying out scientific studies useful for the purpose[114].

One of the ASPA projects led to the finalisation of a system for the estimation of real meat consumption in Italy: thanks to the in-depth study of all the livestock production chains, the objective of the research was to ***publish conversion coefficients useful for transforming the data related to the availability of meat products (apparent consumption) in real consumption by consumers.***

In the book "Real consumption of meat and fish in Italy"[115]*, published in 2016, the results of the full study are reported, based on practical analysis and field surveys, specific surveys, interviews with operators. The great advantage of the method proposed was to arrive at the estimate of the actual consumption of meat with a precision comparable to that of a survey on individual consumption, avoiding the high costs of the latter.*

Starting from the apparent availability data and using

CONVERSION COEFFICIENTS OF THE CARCASSES OF DIFFERENT ANIMAL SPECIES IN SELLABLE MEAT

SPECIES AND CATEGORY (RED MEAT)	CONVERSION COEFFICIENT (K)
Calves	0.524
Male bullocks	0.593
Female bullocks	0.575
Cows	0.507
Piglets	0.494
Light pigs	0.528
Heavy pigs	0.492
Baby lamb	0.573
Adult lamb	0.536
Kids and goats	0.526

SPECIES AND CATEGORY (WHITE MEAT)	CONVERSION COEFFICIENT (K)
Chicken meat <2kg	0.610
Chicken meat >2kg	0.620
Turkeys	0.621
Guinea fowls	0582
Ducks	0.520
Geese	0.520
Quails	0.452
Rabbits	0.553

Source: Russo V. et al., 2016. Conversion coefficients (K) of the carcasses of the various species in consumable meat. Tab. 1, p. 49

 ISBN 9788891793324

the conversion factors resulting from the study of the working group led by prof. Vincenzo Russo, it was possible to calculate the real consumption data, estimating the edible part with respect to the carcass of the single animal species.

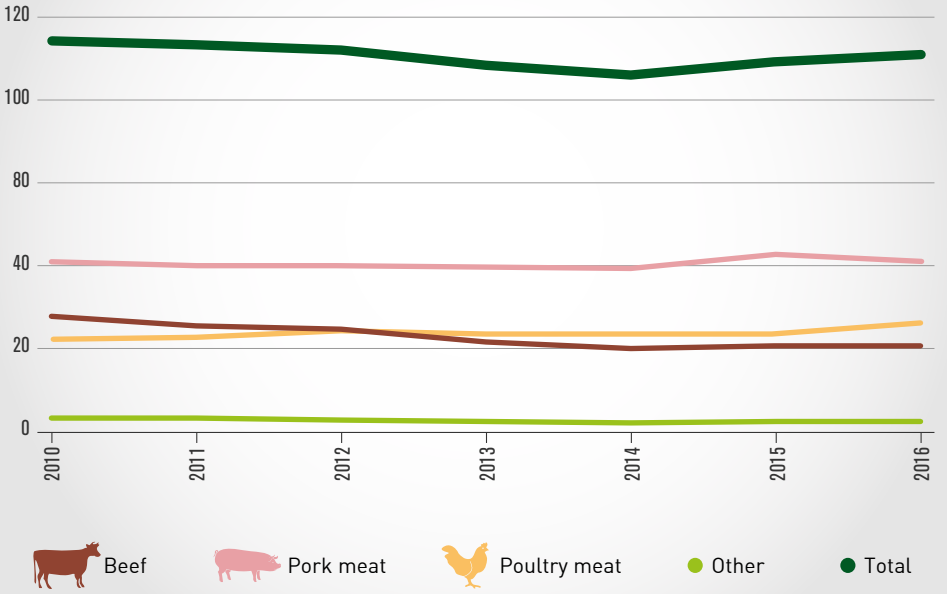
ANNUAL CONSUMPTION PRO CAPITA OF APPARENT[116] AND REAL MEAT IN ITALY					
MEAT TYPE	APPARENT CONSUMPTION	CONSUMABLE MEAT	REAL CONSUMPTION	CONSUMABLE ON APPARENT (%)	REAL CONSUMPTION ON APPARENT (%)
BOVINE					
2010	23.8	13.6	12.0	57.1	50.5
2011	22.1	12.6	11.1	56.9	50.4
2012	21.3	12.2	10.8	57.2	50.6
2013	20.2	10.9	9.6	N.C.	N.C.
2014	19.6	9.6	8.5	N.C.	N.C.
2015	17.6	10.2	9.0	57.9	51.0
AVERAGE	20.8	11.5	10.2	57.3	50.6
PORK					
2010	38.4	20.2	17.8	52.6	46.3
2011	37.3	19.8	17.4	53.1	46.7
2012	36.9	19.5	17.2	52.8	46.7
2013	36.7	19.5	17.2	53.1	46.8
2014	36.4	19.5	17.2	53.6	47.3
2015	39.0	20.7	18.3	53.1	46.9
AVERAGE	37.4	19.9	17.5	53.0	46.8
POULTRY					
2010	18.0	10.9	9.6	60.6	53.4
2011	18.6	11.6	10.2	62.3	54.8
2012	19.4	12.1	10.6	62.4	54.6
2013	18.8	11.6	10.2	61.7	54.2
2014	19.5	11.8	10.3	60.5	52.8
2015	19.9	11.7	10.3	58.7	51.7
AVERAGE	19.0	11.6	10.2	61.0	53.6

Source: Russo V. et al., 2016. Apparent consumption (ISMEA), availability of consumable meat and real consumption of beef, pork and poultry (kg per capita/year). Tab. 5-6-7, pp. 55-56

 ISBN 9788891793324

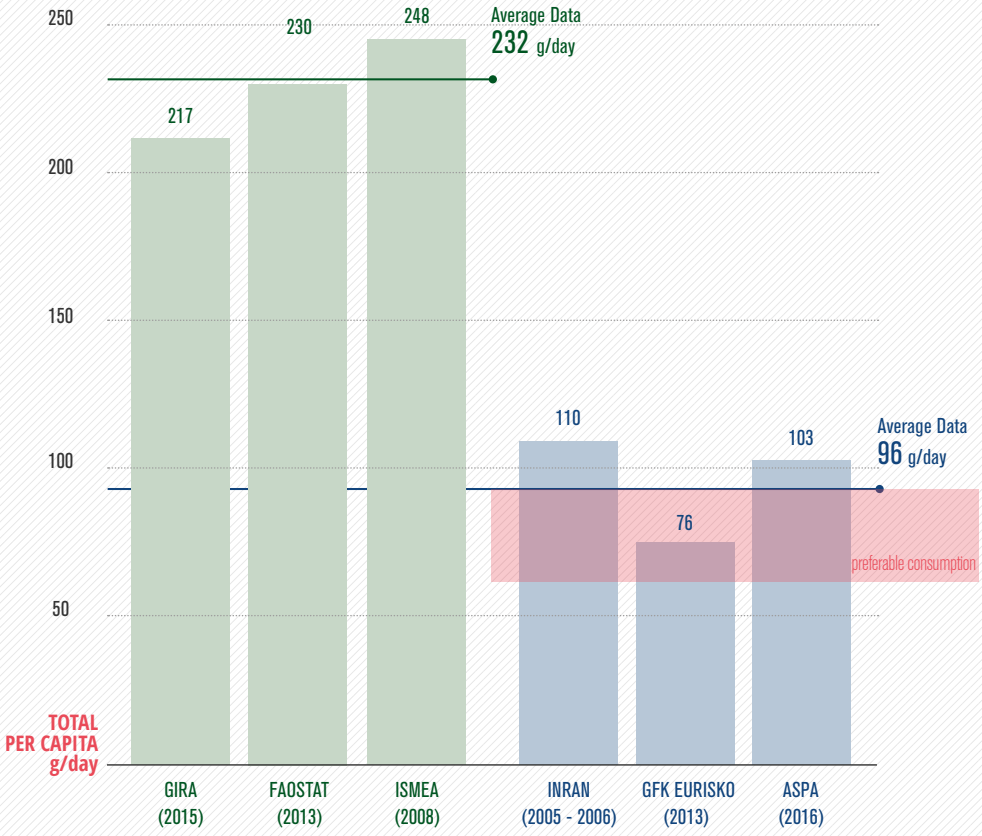
DAILY REAL CONSUMPTION PER CAPITA OF MEAT

g/day per capita



Source: Russo V. et al., 2016. Apparent and actual daily consumption (g) of total meat and the main species in the sexennial 2010-2015. Tab. 10, p. 60

CONSUMPTION OF MEAT AND CURED MEATS IN ITALY



APPARENT CONSUMPTION

Estimated from production data for macro-economic evaluations. It cannot be used for nutritional considerations.

REAL CONSUMPTION

Based on surveys involving consumers for the purpose of assessing nutritional habits.

 ISBN 9788891793324

FREQUENTLY ASKED QUESTIONS

THE MEDITERRANEAN DIET INCLUDES MEAT CONSUMPTION?

Yes. The Mediterranean Diet is very varied, and includes balanced quantities of each type of food. In general, what emerges from the Mediterranean model is a style of eating with a high consumption of vegetables, legumes, fruit and nuts, olive oil and cereals (possibly wholegrain), and a moderate consumption of fish, meat, dairy products (especially cheese and yogurt) and desserts.

Meat is also therefore part of the Mediterranean Diet. In fact, in the past, in addition to fish, game, various courtyard animals (chickens, turkeys, rabbits, geese, etc.) and pigs were consumed, the feeding of which was based on the use of agricultural by-products and human food waste. The slaughter was done directly by the owners of the animals, which, if large (pigs and cattle in particular), made it necessary the preservation of the meat in order for it to be used in subsequent periods.

This necessity has allowed us to "give rise to" numerous cured meats, which have become today a pride of our food production and appreciated all over the world.

Suffice it to say that out of ***244 Italian PDO and PGI products, 1/3 comes from breeding production and 37 are part of the meat category****, such as bresaola, ham, culatello, cured meats, mortadella, cotechino, bacon, coppa, lard etc.*

ACCORDING TO MODERN BIOMEDICAL SCIENCE THE MEDITERRANEAN DIET REPRESENTS THE BEST WAY OF EATING AND REPRESENTS A TRUE STYLE OF LIFE. WHY?

The international scientific community has accepted the role of the Mediterranean Diet in increasing life expectancy and improving general health, and has contributed to the spread of this dietary model as a central pillar of public health programs and policies in many countries, from the United States to Europe.

But the Mediterranean Diet is not just a diet, it represents a way of life. The "Mediterranean Diet Foundation" has developed a graph of the Food Pyramid, which includes information closely related to the Mediterranean cultural and social lifestyle, as well as the importance of physical exercise and conviviality.

The importance of Mediterranean ***life*** *is highlighted in the Pyramid, including factors not related to the use of particular foods. It is a global approach: not a single food, not a single behaviour, but a lifestyle that requires regular physical activity, adequate rest, conviviality and different products to be consumed following seasonality.*

WHY IS THE PRESENCE OF ANIMAL PROTEINS IMPORTANT IN A BALANCED DIET? WHAT BENEFITS DOES THE ORGANISM DERIVE FROM MEAT CONSUMPTION? HOW MUCH CONSUMPTION OF MEAT IS RECOMMENDED?

Just as the Mediterranean Diet shows, it is necessary to follow a varied and balanced diet for health and physical well-being. This "diet" should include not only fruit and vegetables, but also a moderate consumption of meat, a food capable of bringing numerous benefits to the body.

A proper consumption of meat, especially of lean cuts, can be beneficial at different stages of life. Like during growth and adolescence, when boys and girls are more in need of proteins and must avoid the risk of ***iron*** *deficiency anaemia.*

Even during pregnancy, one of the times when increased nutrient requirements are greatest, the intake of meat (in this case well cooked) is very important. Or again during the paediatric age, another period of life when there is continuous growth, the needs of proteins are very high, and these are used by the body for fabric construction. During old age, the assumption

 ISBN 9788891793324

of proteins can no longer be underestimated. An inadequate intake of protein in an elderly person, in fact, contributes to increase skin fragility, reduces the body's ability to recover and its immune functions, causing difficulty and prolonging the time for healing from illnesses. Always accompanied by abundant quantities of fruit and vegetables, the right amount of food of animal origin allows in every phase of life to increase the intake of vitamins of groups B, A and D and of mineral salts such as calcium, iron and iodine. Compared to a meat-free diet, a diet that includes lean cuts contributes to a better intake of protein, selenium, thiamine and vitamin B6, without increasing the intake of total and saturated fat.

Not only that, unlike food based on fats and carbohydrates, it ***has a high satiating effect.*** *The anti-hunger effect is due to the blocking of ghrelin, the hormone that stimulates hunger, caused by the digestion of proteins.*

WHAT ARE THE HEALTH BENEFITS OF THE MEDITERRANEAN FOOD MODEL?

It reduces the risk of metabolic syndrome and chronic diseases, as well as cardiovascular risks.

Scientists have compared the risk of developing heart disease and other diseases in populations that have and have not adopted the Mediterranean Diet. The latter is linked to:

• increase in longevity, i.e. a reduced possibility of death at any age, mainly because of the reduced chances of developing, having a recurrence or dying of heart disease or due to cancer. The results were confirmed in the populations of the United States and United Kingdom, with a 20% reduction in the risk of death at all ages: reduced risk of developing diabetes 2, hypertension or increased blood cholesterol, each of which is associated with heart and vascular disease;

• reduction of the possibility of becoming obese: the Mediterranean Diet has formed the basis for a balanced weight reduction; reduction of the risk of developing Parkinson's disease and Alzheimer's disease.

IS EATING MEAT DANGEROUS FOR HUMAN HEALTH?

A moderate consumption of animal proteins is indeed not dangerous for human health. In contrast, excessive consumption of red meat, exceeding 500 g per week, is associated with an increased risk of developing diabetes, cardiovascular disease and cancer. According to studies by the Italian Association for Cancer Research, "no pathology is caused solely by the consumption of meat, and there is no direct and absolute cause and effect relationship between consumption of animal proteins and the development of a given disease. [...]

There are no studies to suggest a convincing relationship between the risk of disease and a low consumption of animal proteins; indeed, in some cases a limited intake of animal proteins has beneficial effects, because it provides important micronutrients". The value of 500 grams is however higher than what is suggested in the nutritional claims related to the Mediterranean diet.

IF THERE IS NO DANGER FOR HEALTH, WHY HAS IARC (INTERNATIONAL AGENCY FOR CANCER RESEARCH, THE RESEARCH AGENCY OF THE WORLD HEALTH ORGANISATION) CLASSIFIED RED AND TRANSFORMED MEATS RESPECTIVELY AS PROBABLY CARCINOGENIC AND CARCINOGENIC FOR MANKIND?

The IARC in 2015 anticipated the decision to include processed meat in Group 1 (carcinogenic) and red meat in Group 2A (probably carcinogenic), based on many scientific studies, the results of which have been known for some time.

"In the studies examined, consumption of processed meats was associated with a small increase in cancer risk. In these studies, the risk generally increases with the amount of meat consumed.

Analysis of data from 10 studies estimates that each 50g portion of processed meat, consumed every day, increases the risk of colorectal cancer by about 18%. The risk of cancer related to ***consumption of red meat is more difficult to estimate****, because the proof*

 ISBN 9788891793324

that red meat causes cancer is not so strong. However, if the association between red meat and colon-rectal cancer has been shown to be causal, data from the same studies suggest that the risk of ***colorectal cancer could increase by 1% in absolute terms (18% in relative terms) for each portion of 100 g of red meat eaten every day****" (source: Q & A IARC site).*
As we can see, IARC refers to elevated daily portions, very far from real consumption.

WHAT IS IN RED AND PROCESSED MEAT THAT INCREASES THE RISK?

According to IARC studies, the risk factors of meat are due to substances that may be proper to meat (e.g. heme iron), or ***substances originating during processing or cooking at high temperature*** *(e.g. nitrous compounds or aromatic amines). The suggestion to limit the consumption of red meat is therefore accompanied by that of avoiding cooking with an open flame, such as the barbecue, and* ***adding food containing vitamin C, which not only facilitates the absorption of free iron present in red meat, but almost completely neutralises the risks related to potentially harmful substances****.*
The presence of nitrous compounds or aromatic amines is considered responsible for the activation of carcinogenic mechanisms when the consumption of meat and cured meats is very high: for red meat we speak of over 100 g per day, while for processed meat of 50 g day, values very distant from actual Italian consumption. For completeness it is beneficial to observe that this phenomenon is not typical of meat, but of the cooking method: the same caution should in fact be used for other foods, such as grilled vegetables or pizza cooked in a wood oven.

CAN THE ADDITION OF NITRATES AND NITRITES IN CURED MEATS BE AVOIDED?

Nitrates and nitrites are used, in the quantities authorised by health authorities, to prevent the development of Clostridium botulin spores, which in turn produce a very dangerous, even fatal, toxin for humans. In reality it is important to remember how these substances are used when only strictly necessary: in products with long seasoning, typical of Italian gastronomic tradition, they are not present because it was discovered that the same conservation process is sufficient to eliminate all risk and to preserve the meat's colour. In some products, such as PDO hams, the use of these substances is even prohibited. For the products in which they are used, the nutritional analyses of 2011, compared to those of 1993, showed decreases between 50% and 90% of nitrates (present however in a few parts per million).

CAN THE METHODS OF COOKING MEAT CHANGE THE RISK?

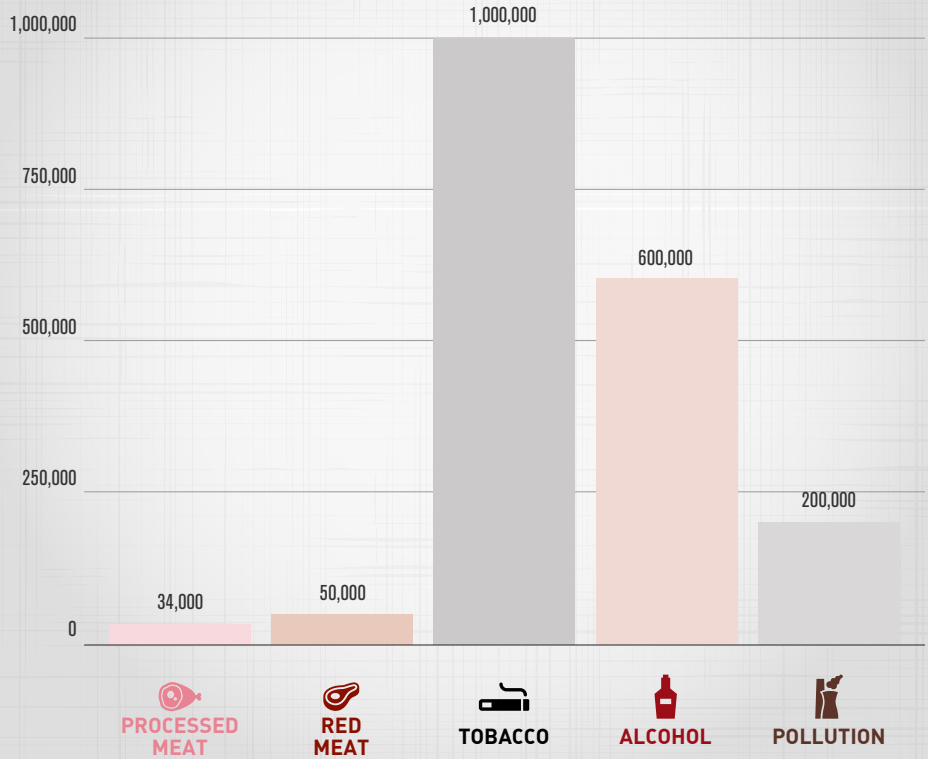
High temperature cooking methods can generate compounds that could contribute to the carcinogenic risk, but their role is not yet fully understood. In particular, cooking at high temperatures or with food in direct contact with a flame or hot surfaces, such as barbecues or frying, produces different types of carcinogenic chemicals, such as polycyclic aromatic hydrocarbons and heterocyclic aromatic amines. However, it should be noted that this phenomenon is independent from the type of food and also concerns the carbonisation of other foods such as fish, vegetables, pizza, etc.

SINCE TOBACCO SMOKE, ASBESTOS AND ALCOHOL ARE CLASSIFIED AS CANCEROGENES FOR HUMANS, DOES IT MEAN THAT PROCESSED MEAT IS CARCINOGENIC AS WELL?

No. Even if they are in the same category as tobacco smoke or asbestos because of cancer, this does not mean they are all equally dangerous. The IARC classifications describes the strength of an agent's scientific evidence to be a cause of cancer, rather than assessing its level of risk. In other words, it is important to know not only in what list a certain substance is, but what are the dosages and durations of exposure beyond which the risk becomes real and not just theoretical.
As the IARC explains, "according to most recent estimates of the Global Burden of Disease Project, an independent academic research organisation, about 34,000 cancer

deaths each year worldwide are attributable to diets rich in processed meats. Eating red meat has not yet been defined as a cause of cancer. However, if the association reports were proven to be causal, the Global Burden of Disease Project estimated that diets rich in red meat could be responsible for 50,000 cancer deaths worldwide each year. These numbers contrast with about 1 million cancer deaths due to tobacco smoking worldwide each year, 600,000 per year due to consumption of alcohol and more than 200,000 per year due to pollution" (Source: Q & A IARC site).

CANCER DEATHS PER YEAR AND EXPOSURE TO THE SUBSTANCE



Source: Global Burden of disease project (cited by the WHO)

 ISBN 9788891793324