Nutrition and Food

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By

Luis E. Voyer

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ABBREVIATIONS

AA	arachidonic acid
ADP	adenosine diphosphate
AGEs	advanced glycation end products
AMP	adenosine monophosphate
ATPa	denosine triphosphate
CRP	C-reactive protein
DHA	docosahexanoic acid
EPA	eicosapentaenoic acid
GI	glycemic index
GL	glycemic load
GSH	reduced glutathione
GSSG	oxidized glutathione
HbA_{1c}	glycated haemoglobin
HDL	high-density lipid
HFCS	high fructose corn syrup
HOMA	homeostasis model assessment index
Ig	immunoglobulin
IL 6	Interleukin 6
LDL	low-density lipid
MTHFR	metyltetrahydrofolate reductase
NCEP	National Cholesterol Education Program
NAD	nicotinamide adenine dinucleotide
NADP	nicotinamide adenine dinucleotide phosphate
NAE	net acid excretion
NSAIDs	non-steroid anti-inflammatory drugs
TNFα	tumour necrosis factor-alpha

CHAPTER 1

MEALS FROM A NEW POINT OF VIEW

The role of food in the growth, development and repair of organs and tissues, and therefore in the preservation of health is already known, which in turn implies the prevention of diseases.

With the current knowledge of physiology, cellular structure and molecular biology, food today must be seen from a new dimension. It plays a fundamental role in the treatment of numerous diseases, adjunctive treatment not only with pharmacology, surgery and radiotherapy but also in the field of psychiatry, kinesiology, oncology and infectiology. All of this corrects underlying metabolic disorders that cause diseases, such as those derived from weight gain and obesity, allowing sustainable cures over time, avoiding recurrences or even from cancer and infections by correcting oxidative stress, chronic inflammation and modulating immunology. Apoptosis, the programmed cell death beginning at the development of the embryo, during life, allows the reuse of materials from aged cells and slows tumour development. Apoptosis partially depends on the intrinsic pathway of the mitochondria by increasing the permeability of their outer membrane, which releases cytochrome to the cytoplasm that activates apoptosis-activating proteins.

To maintain the functional integrity of the mitochondria so important for health, an alkaline diet is necessary. An acidic diet, which is most common, impairs mitochondrial function.

Currently, being overweight or obese, with its consequent diseases (mainly diabetes, hypertension and cardiovascular disease), is already an endemic and global problem in developed or developing countries, to which we must add cancer, osteoporosis and neurodegenerative diseases. This implies that a significant deterioration in the quality of life, a high social cost and the risk of a decrease in life expectancy is already evident. This has given rise to a certain boom in the so-called alternative ‘medicines,’ many outside the progress of science.

On the other hand, in 1989 in Japan, the concept of functional foods was proposed, a little elastic and somewhat debatable, which will be developed later.

It is important to implant the concept of the therapeutic power of food in the minds of the general population, to encourage it to see food from a new dimension as a means of treating diseases along with pharmacology, surgery and radiotherapy.

Ages of the human being, 1st, 2nd and 3rd

The **1st is childhood**, which paediatrics deals with.

Early childhood is defined as up to two years with breastfeeding as a priority, and second childhood is defined as over two years old, in which extra familial socialization with institutions begins.

Puberty and *a*dolescence are distinguished as being between 12 and 18 years of age. Adolescence is a critical period where the characteristics of childhood are lost and all the faculties of adults have not yet been acquired. Care must be taken with sexual development and consolidation or definition of gender. There is a greater vulnerability to accidents, drug addiction and social-work integration. With specialized assistance, adolescent medicine avoids risks and allows one to enter healthy adulthood where ethical development could be completed.

The **2nd is adulthood** dealt with by a doctor at a general medical practice.

The **3rd is old age** which geriatricians deal with. But the geriatrician especially faces age-related pathologies.

Just as adolescence is the final period of childhood with its own characteristics, of the transition to adulthood, there is a transition period from 60 years to the beginning of old age, which we could properly call *senescence.*

In this period of life, you may not have the capacity for any great exertions. There is a decrease in the body's ability to overcome very adverse situations and organic resilience, a greater vulnerability that must be compensated with prudence, a decrease in sexual potency and also less social integration due to, for example, retirement from work.

Specialized assistance in this period of life allows for the preservation of functions preventing cognitive deterioration in order to reach old age in good health and a state of bio-psycho-social well-being. Here it is essential to optimize nutrition, along with physical activity, mental work, normal sleep and preservation of a social openness that allows normal emotional exchanges.

Fermented foods are important in nutrition and even more than for younger age groups for microbiota and microbiome preservation. In addition, an alkaline diet is necessary to avoid subclinical acidosis with its consequent diseases, and bioactive phytochemicals that are beneficial to health, along with anti-oxidants, anti-inflammatory and anti-cancer compounds with preventive and co-adjuvant action in therapy for cardiovascular and neurodegenerative diseases, which are bio available through the adequate consumption of vegetables and fruit and the medicinal use of condiments.

An apple a day keeps the doctor away.

Photo 1-1: Apple

This anonymous saying does not refer precisely to the first apple Adam ate in Eden, the cause of so many later misfortunes! It is more that an apple, a symbol for all fruit and vegetables and natural foods that, together with meat and various spices, should be the basis of our usual diet; food that nature provides for us, and as far as possible, in its natural state.

A baked apple is no longer in its natural state, but its colour, aroma and flavour make it especially appetizing, and we can enjoy it occasionally but should never be a frequent part of our diet. Due to the high temperature

during baking, it loses some of its vitamins and generates glycation products, also called glycotoxins, with undesirable health effects.

The aforementioned saying, to be more precise, should say: an apple a day *in its natural state*, keeps the doctor away. And the natural state is also like Adam ate it, without peeling it. In addition to the basic nutritional compounds, mainly glucides (misnamed carbohydrates) it contains chemical compounds with a small molecular weight called phytochemicals, which are typical of the plant kingdom, with important beneficial actions for health and flavonoids such as quercetin with anti-cancer and anti-allergic actions. These compounds are especially in the skin of the apple and are inactivated by heat.

In the anonymous saying above, "keeps the doctor away" is a fallacy because it considers the doctor as the one who only cures the disease, but the doctor must also prevent the disease. Health preservation and disease prevention should make the doctor a great health educator, seeking to change disease behaviours for health behaviours, among which is eating behaviour, and the way to achieve this is through education.

As far as food education is concerned, there is another saying, less well known:

"If man made it, don't eat it". But this should not be taken in an absolute sense. This saying is not anonymous but belongs to Jack LaLanne, a fitness expert and pioneer in health and an innovator in diet and nutrition.[1,2]

The content of this saying is in line with the previous one, about natural foods for normal meals without excluding foods from regional cuisines of different cultures for family or social events, such as a birthday cake, Christmas sweet bread, weekend ravioli or a pizza with friends, as part of an occasional meal but not as part of our everyday meals.

Among glucides are those not digested by gastrointestinal juices; fibres that in the intestine act as prebiotics favouring the development of intestinal bacterial flora.

Fibre fermentation bacteria produce saturated lipid acids, including butyric acid, which is not provided by food and is the main nutrient of enterocytes, the cells of the intestinal epithelium. In this way, a healthy intestine optimally fulfils its dual function: absorption of nutrients and acting as a barrier to toxins and pathogenic bacteria that cause disease.

This has resulted in a medical article, which paraphrases the aforementioned saying "*An apple a day, keeps the doctor away*", that was entitled: "An apple a day, keeps microbes away?" because a normal microbiota protects against microbes that can cause disease.

What should we eat? What is the healthiest *diet?*[3]

This is one of the topics that have been very relevant for several years; first because of the health risks of various diets for losing weight, some so absurd that they do not deserve consideration, and especially because of the awareness that for many chronic diseases such as diabetes, cardiovascular disease, neurodegenerative diseases and cancer, diet plays an important role in their prevention and control.

To end with paradigmatic axioms on food, we must remember the statement from the father of medicine (in Greco-Roman culture) Hippocrates, 400 years before Christ: *"Medicate yourself with food; do not feed yourself with medicines,"* a statement of special importance today.

Undoubtedly, numerous diseases require drugs, such as antibiotics for mainly bacterial or some viral infections, hormones for some glandular deficiencies such as insulin in type 1diabetes or corticosteroids for certain kidney diseases and highly inflammatory conditions. Abuse and self-medication, for example with antibiotics, antacids, digestives, analgesics, anxiolytics and other symptomatic medications are also undoubted. Medicating with food refers to the fact that a good diet prevents many diseases, as it improves defences by strengthening the immune system, favours digestion avoiding acidity and gastrointestinal disorders such as diarrhoea, constipation, intestinal polyps, decreases the risk of colorectal cancer and other organs and influences the emotional state. The intestine is well considered the second brain due to its extensive neural network interconnected with the central nervous system.

'Do not feed yourself with drugs' is also currently widely valid. Consumption of not just complementary drugs but also the aptly named nutritional supplements, poly-vitamins, minerals, synthetic fibre, protein powder such as bovine whey albumin, energizers and creatine, for muscle development.

Processed, and especially ultra-processed foods, also have multiple unnecessary additives for health, used for the conservation and greater acceptance in the market but have doubtful effects on health if they are part of our usual meals.

Consumption of ultra-processed foods such as sweets, biscuits, cakes and sweetened beverages, as a food base for adults over 60, increases the risk of chronic metabolic diseases, cancer and mortality.[4]

The overwhelming technology and industry developments achieved today make a careful evaluation necessary, within an ethical framework, of the advances that we must incorporate to achieve health and well-being in line with ecological environment preservation, but when in doubt, apply the precautionary principle; abstain and look for valid alternatives with more benefits and fewer risks.

There is a need for a greater intercommunication link between the food and the health industries, subordinating economic interests to an ethical framework for the good of our health.

Wendel Berry, an American writer, farmer and advocate of organic farming states: *"*People are fed by the food industry, which does not pay attention to health and they are treated by the health industry which does not pay attention to food."[5] It is universally recognized that food is a fundamental factor for health, preventing its deterioration. Consequently, food is an important factor that intervenes in longevity and even more importantly, in the quality of our lives.

With the current knowledge of physiology, cell structure, molecular biology, genetics and epigenetics, we can avoid situations that cause numerous diseases due to cellular damage that we now refer to, which will be dealt with extensor in respective chapters.

Situations that cause numerous diseases

Oxidative stress

Inflammatory chronicity

Mild and persistent acid-base imbalance

Depletion of mitochondrial metabolism by xenobiotics and acidosis

Oxidative stress

For growth, repair and specific organic functions, the energy for chemical reactions that make up the metabolism is of vital importance.

The availability of energy comes from oxidation><reduction, a metabolic process called redox, between atoms of reactive substances. Oxidation means the loss of one or more electrons, which generates so-called free radicals. Free radicals, oxidized atoms, are very reactive, seeking in fractions of a second to recover the lost electrons, which is called reduction. These electrons, not being free, are taken from other atoms, which in turn oxidize.

Oxidized atoms acted as *oxidants*.

The greatest production of energy in our cells is carried out in the mitochondria, where there are electron transport chains, the energy being stored in adenosine triphosphate (ATP) molecules.

In cells, there are *antioxidant* substances, the main one being glutathione, which gives up electrons preventing oxidation in other substances. *Glutathione* can reduce itself using the enzyme glutathione reductase.

The predominance of oxidation over reduction, surpassing the capacity of cellular antioxidants such as glutathione and other compounds, if it is mild, is good for the immune system and to kill pathogens, but if it is intense, it configures *oxidative stress.* Oxidative stress is an important factor in cellular damage participating in the pathogenesis of more than 100 diseases such as atherosclerosis, neurodegenerative diseases (Parkinson's, Alzheimer`s, Huntington's), metabolic diseases and even ageing and cell death. Situations such as infectious diseases, cancer, smoking or extreme physical exercise favour oxidative stress. Oxidative stress causes organic damage; it can be compared to oxidative damage in metals that undergo corrosion. To avoid oxidative stress, have a measured life with healthy behaviours and habits and among these, the regular intake of exogenous antioxidants, mainly flavonoid and non-flavonoid polyphenols and other phytochemicals abundant in fruit, vegetables and infusions with natural products are very beneficial for health.

Inflammatory chronicity

Inflammation is a defensive, normal and controlled reaction of the body to harmful agents—physical such as trauma, chemicals such as acids or biological such as infections by bacteria, viruses, fungi or parasites, subject to intensity, time and place. Problems arise when the inflammatory process is in a generalized and permanent state, causing or aggravating numerous diseases, such as obesity, diabetes, cardiovascular disease,

arthritis and even cancer, which require adjuvant anti-inflammatory medication. Modulation of the potential capacity of an inflammatory process depends to a great extent on the diet, mainly as regards the quality of the lipids, since there are pro-inflammatory and anti-inflammatory ones. The constituent acids of lipids, generally called *fatty acids*, are preferably referred to as *lipid acids.* Lipid acids are from sea or land animal and vegetable origin and are pro-inflammatory or anti-inflammatory, with variable bioavailability according to absorption and metabolization, and they are more or less stable according to susceptibility to oxidation, depending on the presence or not of antioxidants. A balance is necessary, as it is risky to almost nullify the capacity for inflammatory reaction, an excessive and persistent inflammatory state is the conditioning and aggravating factor in many diseases. Choosing the best quality lipids that we incorporate into our usual diet to optimize it will have invaluable benefits for health.

Mild and persistent acid-base imbalance

The acid-base state of our internal environment, considered as the organic liquids that surround our cells, is alkaline, with a pH of 7.4 with very narrow variations, between 7.35 and 7.45. These values are maintained by the buffering effect of bicarbonate, the alkaline reserves of the bones, the capacity for acid elimination in the urine and the respiratory elimination of carbon dioxide. In this aspect of the regulation of the internal environment, maintaining normal values of pH, bicarbonate and carbon dioxide, food is also of paramount importance, which is often not taken into account and consequently generally neglected, with far-reaching consequences over the years. According to the quality of our food, we distinguish a diet being acidic or alkaline by the number of acid residues that these foods leave when metabolized. In the industrialized countries of the Western world, 50% of the acid load of the organism comes from the food, however, normal values of pH, bicarbonate and carbon dioxide are maintained at the expense of a permanent consumption of plasma bicarbonate which is replaced by calcium carbonate from the bones, but calcium is lost by the kidney. Together with this, there is a permanent state of urinary acidification and ammonia production by the kidney to eliminate hydrogen ions using glutamine from the muscle mass. This leads over the years to an increased risk of bone demineralization, loss of muscle mass and kidney failure.

To improve our diet with an important intake of alkaline foods, reducing at the same time the acid contributions, means to preserve the state of health over the years as explained in the respective topics (Chapter 7).

The depletion of mitochondrial metabolism by xenobiotics

With the great development of industries, mainly chemical and pharmaceutical, the environmental pollution of air, land and sea and the availability of cosmetic and medicinal products create a great potential for exposure to non-biological products, that is *xenobiotics*, such as mercury, bisphenols, phthalates, dioxins, herbicides, pesticides, synthetic sweeteners (some of which have petroleum derivatives), analgesics, anxiolytics and synthetic antibiotics, which can interfere with vital structures and functions and especially to the microbiota and structure and function of mitochondria.

Reducing the consumption of ultra-processed foods to a minimum, avoiding the abuse of antibiotics and self-medication preserves a normal metabolism, thus avoiding serious diseases. On the other hand, optimal meals, together with a healthy lifestyle, are the basis for changing a disease behaviour into a health behaviour through which, in addition, gene transcription is modulated by epigenetic factors and improves the immune status.

Health and disease behaviours

With reference to health and disease behaviours, they are shown on the graph with a fork, feet and fingers.

Photo 1-2: Factors that make up health or disease behaviours

The fork refers to food, the feet are a symbol of activity and the fingers as a symbol of habits, referring to one of the most harmful, the habit of

smoking. To this must be added the environment, or the ecosystem where we live, which must be preserved. Changing some habits is difficult. Since it is difficult to quit smoking, is also difficult to change your diet. We eat according to whether 'I like it' or 'I don't like it'. But you are not born with tastes, they are acquired, the only taste you are born knowing is breast milk. Educate your body. The body listens: thoughts are the seeds of action, be aware of what you say to yourself.

The body listens and believes what you say, so take care of what you say, eliminate self-sabotage, don't say "I can't"; say "I want it", "I can't do it, but I'm going to achieve it". Defend your goals, and write them down, with a figure in your mind.

All hypnosis is self-hypnosis.

The body listens.

Microbiota and microbiome

We live with the microbiota, a set of microorganisms, mainly bacteria (70%) and fungi, mostly from our intestinal flora, in a number 10 times greater than the number of our cells, which is 30 billion. Microbiota is largely derived from food that germinates on the ground, but begins at the moment of natural birth, (not by caesarean) and continues with intimate contact through breast milk.

Herbicides and pesticides, which do not attack crops, (and even less, transgenic crops), sterilize the soils affect the nutritional value of food and compromise our microbiota.

The fibre in food is one of the main factors that favour the development of the microbiota, therefore called prebiotics, to which are added microorganisms by fermented foods, thereafter called probiotics.

Metabolic products and genes, which are nucleic acids from the microbiota and food, constitute the microbiome, which interacts with the genes of our genome.

Mitochondria

We are the evolutionary result of interactions with the environment. Mitochondria, the largest organelles in our cells (Fig. 1-1) are the

metabolic centres for 90 to 95% of energy production. According to a solid evolutionary theory, mitochondria are aerobic bacteria, that is, with an oxygen-dependent metabolism incorporated into the cell structure approximately one billion years ago. Our state of health depends largely on the balance in this symbiotic coexistence, and its imbalance implies an important role in the origin and mechanism, etiopathogeneses of numerous diseases, such as cardiovascular, neurological, neurodegenerative, metabolic, early ageing, cancer and others.[6.7]

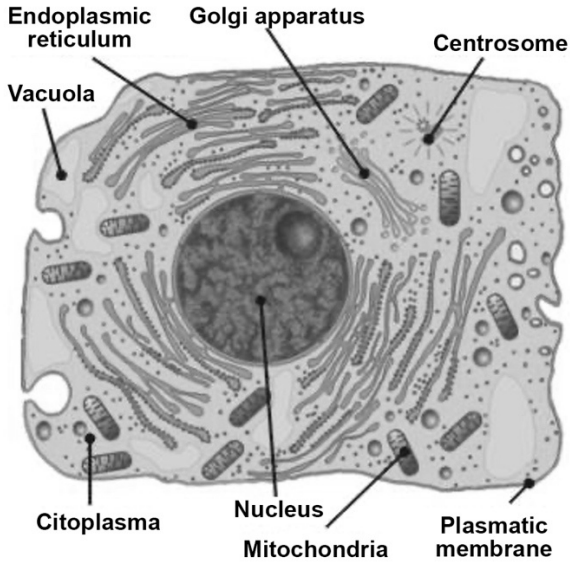

Fig. 1-1: A cell with the nucleus and organelles

Mitochondria, like the bacteria of the microbiota, have a prokaryotic cell structure, do not have a nucleus and nucleic acids are in the cytoplasm, and their metabolism is aerobic. Both are exposed to damage in their integrity and function due to the action of non-biological compounds, therefore called xenobiotics, such as antibiotics, analgesics, or non-steroid anti-inflammatory drugs (NSAIDs).

Genetics

Our genetic inheritance is encoded mainly in the DNA of the nucleus of the cell, the nuclear DNA, of paternal and maternal transmission through

the sperm and the ovule, but there is also DNA in the mitochondria from an exclusively maternal transmission. Mitochondrial DNA is transmitted exclusively by the mother, since in fertilization only the head of the sperm with the nuclear DNA enters the maternal cell, leaving the tail and neck of the sperm, where the mitochondria are, outside the egg.

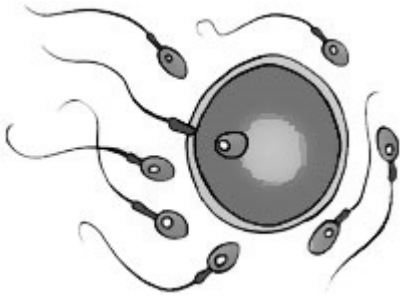

Fig. 1-2: Fecundation

Mitochondrial DNA represents only 0.1% of the total genetic material in our cells, but alterations in this genetic material constitute a causal or leading factor, by various mechanisms, of various diseases.

Unlike nuclear DNA, which is only 90% genetically encoded, all mitochondrial DNA is genetically encoded. In addition, nuclear DNA is provided with histones and proteins that in addition to intervening in gene expression have a structural packaging protection function against eventual damage. Mitochondrial DNA does not have histones and is, therefore, more easily exposed to damage by various factors in addition to xenobiotics, for instance, damage from oxidative stress. From DNA, genetic codes are transmitted by transcripts into the RNA messenger throughout the cell for expression in protein synthesis. A large part of our genome is not coding, and its function was unknown; today we know that to a large extent they activate or deactivate genetic codes in interaction with components of the microbiome.

Epigenetics

Activating or inhibiting factors for expression and development act on the vast majority of the conditions of genetic inheritance. All these factors that act over genetics constitute what is called epigenetics. Epigenetic factors come from the microbiome and the ecological and socio-cultural

environment. Even though that has not yet been understood in all its significance, it deserves to be highlighted that the tremendous complexity of neural networks of our brain means that emotions and thoughts, without yet fully understanding their mechanisms, can also act as epigenetic factors beyond the conditioning of habits and behaviours. It is interesting to analyze what happens with the overweight and the obese and the consequent metabolic syndrome, where there are families in which parents and children suffer from it. Genetic conditioning may exist, but for no more than 10% and it manifests itself only with an eating behaviour that favours it, as it exists at high risk in an obesogenic environment.

In other pathologies such as hypercholesterolemia, arterial hypertension, cardiovascular disease, breast or prostate cancer, a hereditary predisposition due to genetic conditioning may also exist, but it is not an obligatory determinant if there are no triggering factors, such as lifestyle and cultural habits, and, of utmost importance, food.

We are in the post-genomic era after the achievements of the human genome project. Today we know that we have around 25,000 genes, instead of the presumed 100,000, to encode approximately 200,000 proteins (proteome**)**. The idea of 1 gene, 1 protein and 1 cellular behaviour is no longer valid. A gene has pleiotropic expression and it can be expressed in numerous proteins. Proteins, after their gene translation, are modified by union with other molecules such as sugars, and by glycosylation; also with lipids, phosphate or acids, which modifies their biological activity by modulating their function.

The microbiota and the microbiome, which act very early, as environmental and cultural factors that can act on stability and gene translation, constitute epigenetics factors.[8,9]

Genes are not the only ones responsible for what happens to us, but everything that acts over them, and we are partly responsible for the factors to which we expose our genes. Most of our normal or pathological characteristics are of multifactorial origin, that is, polygenic. Polygenic is understood as not many genes but many determining factors, genetics and epigenetics. Among epigenetics factors, the relevance of nutrition has led to what is called nutrigenomics**.**

Social inheritance

> "It is not true that all inheritance is measured by nuclear DNA. A well-documented example is cultural evolution."[10]

In addition to the genetic inheritance encoded in DNA, we have social inheritance, that is, culture, encoded in society and that reaches each child in the first place through the family, which is like the RNA messenger in genetic inheritance. Eating behaviour is part of social inheritance, and education acts on that basis. The mother has a special intervention not only in genetic inheritance, in which she contributes in addition to nuclear DNA with mitochondrial DNA but also in social inheritance due to the special relationship with the child in the first two years of life, mainly due to the intimate implicit contact from the practice of breastfeeding.[11,12]

CHAPTER 2

EATING BEHAVIOURS

Breastfeeding

The period of *breastfeeding* is of fundamental importance for the health of the child and the entire future of its growth and development, with repercussions even into adult life. The insurmountable benefits of breastfeeding lie not only in the quality of the milk specific to the species but also in other factors that are still only partially known today.[13,14]

With breastfeeding, there are benefits for the growth and development of the child due to factors beyond the purely organic ones, due to the close mother-child bond that it creates, with repercussions not yet fully understood of its transcendent significance.

There is a culture of breastfeeding for which paediatricians, childcare providers, pediatric hospitals, and general hospitals (recognized as 'baby-friendly hospitals'), which national and international medical societies such as the WHO and UNICEF are working towards. For more than 40 years there have been attempts to eradicate the culture of artificial lactation that we still occasionally see, with girls play-acting with their dolls like a mother giving a baby a bottle.

It is striking that just as you see children playing the role of doctors and patients, you do not see girls imitate their mothers by putting a doll on their chests.

Could it be that somehow a message of misplaced modesty is transmitted to them about it?

Photo 2-1: Playing at breastfeeding the baby
Source: Perrando Hospital. Resistencia, Chaco. Argentina.

Optimal nutrition should begin with breastfeeding and be supplemented from the sixth month with the gradual introduction of various nutrients until reaching a varied adult diet. In many industrialized countries only 60% of infants receive exclusive breastfeeding up to two months of age, and between 30 and 40% up to 6 months. The WHO has set a goal of reaching 50% by 2025. After six months, together with complementary meals, efforts should be made to maintain breastfeeding for up to two years of age. Breastfeeding does not need to be replaced by substitutes in no more than 4% of cases. In the few cases of contraindication to breastfeeding, the provision of human milk from banks should be sought first.

Human milk banks

The WHO accredited human milk banks as one of the best health strategies for reducing infant mortality and protecting breastfeeding. The Human Milk Banking Association of North America, the European Milk Bank Association and the Ibero-American Network of Human Milk Banks have been organized. These centres work with selected donor mothers with various collection points. The milk is analysed, pasteurized and