IMPACTO CIENTÍFICO EDITORA

FOOD CHEMISTRY – ITS IMPACT ON HUMAN HEALTH

QUÍMICA DOS ALIMENTOS – ATUAÇÃO NA SAÚDE DO SER HUMANO

QUÍMICA DE LOS ALIMENTOS: SU IMPACTO EN LA SALUD HUMANA

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ABSTRACT

Because various foods contain nutrients and elements from the periodic table, and their ingestion can cause reactions within the human body, we will present some of these elements and chemical reactions that can be beneficial or harmful to health, including high-energy foods, while others can cause serious harm, such as detox foods. To discover how the body processes, absorbs, and utilizes nutrients and chemical elements, we can study which may be beneficial or harmful, and analyze improved nutrition to avoid excesses that could cause allergies or intolerances. Finally, we can determine what happens to our bodies when nutrients are lacking. This study included research on websites related to nutrition and the chemical composition of foods, seeking information that would complement the data for consistent publication. Food chemistry can be analyzed from various angles. One phase begins with ingestion and the breakdown of the starch molecule into maltose. During the ingestion process, the food undergoes transformations, subjecting it to chemical action by the human body. It's important to emphasize that a given process can reveal food intolerances or allergies, how the body obtains energy for consumption in various forms, and how detox foods can harm the human body.

Keywords: Química dos Alimentos. Detox. Intolerância.

RESUMO

Devido a diversos alimentos com nutrientes e elementos da tabela periódica fazerem parte de sua composição e a consequência de sua ingestão causarem reações no interior do corpo humano, serão apresentados alguns desses elementos, e reações químicas que podem ser benéficas ou prejudiciais à saúde, dentre eles um alto poder energético, já outros que podendo causas sérios danos à saúde, como os alimentos detox. Com o objetivo de descobrir como o corpo processa, absorve e utiliza os nutrientes e elementos químicos, pode-se estudar quais podem ser benéficos ou prejudiciais, e analisar uma melhor alimentação, para que não haja excesso, podendo causar alergia ou algum tipo de intolerância e por fim certificar-se do que ocorre com a ausência de nutrientes ao nosso corpo. Para a realização deste trabalho foram realizadas pesquisas em sites relacionados a nutrição, composição química dos alimentos e buscando informações onde complementasse

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dados a serem publicados de forma coerente. A química dos alimentos possui diversos ângulos a ser analisados, onde em uma das fases, se dá início com a ingestão e a quebra da molécula do amido em maltose, e no decorrer do processo de ingestão o alimento passa por transformações, onde o alimento submete-se a ação química causada pelo organismo humano. Ressaltar que em um determinado processo pode-se descobrir a intolerância ou alergia alimentar, como o corpo ganha energia para ser consumida de diversas formas, e como o alimento detox pode prejudicar o organismo humano.

Palavras-chave: Food Chemistry. Detox. Intolerance.

RESUMEN

Dado que diversos alimentos contienen nutrientes y elementos de la tabla periódica, y su ingesta puede provocar reacciones en el cuerpo humano, presentaremos algunos de estos elementos y reacciones químicas que pueden ser beneficiosos o perjudiciales para la salud, incluyendo los alimentos de alto valor energético, mientras que otros pueden causar graves daños, como los alimentos desintoxicantes. Para descubrir cómo el cuerpo procesa, absorbe y utiliza los nutrientes y elementos químicos, podemos estudiar cuáles pueden ser beneficiosos o perjudiciales y analizar una mejor nutrición para evitar excesos que podrían causar alergias o intolerancias. Finalmente, podemos determinar qué le sucede a nuestro cuerpo cuando faltan nutrientes. Este estudio incluyó la investigación en sitios web relacionados con la nutrición y la composición química de los alimentos, buscando información que complementara los datos para su publicación consistente. La química de los alimentos puede analizarse desde diversos ángulos. Una fase comienza con la ingestión y la descomposición de la molécula de almidón en maltosa. Durante el proceso de ingestión, el alimento sufre transformaciones, sometiéndolo a la acción química del cuerpo humano. Es importante destacar que un determinado proceso puede revelar intolerancias o alergias alimentarias, cómo el cuerpo obtiene energía para el consumo en diversas formas y cómo los alimentos detox pueden dañar al cuerpo humano.

Palabras clave: Química de los Alimentos. Detox. Intolerancia.

1 INTRODUCTION

The main idea of this work was to research how some ingested foods react and can cause damage to the human body, such as intolerance and allergy to certain foods.

This research presents the chemical process from ingestion to absorption of chemical compounds by the human body. During this process, we seek to study and analyze the behavior of detox foods and their consequences on the digestive process. The chemically ideal foods are shown for the best use of the energy released. With ingestion, the human body will react independently to each food. With this ingestion, the body can create a rejection in the form of allergy or intolerance.

It reveals all the possible problems and benefits that may occur based on the chemical processes of some foods, based on the fact that each food releases a certain substance that is important for each part of the body. The idea is to know how ingested food reacts and can cause damage to the human body and how food is transformed into energy.

2 FOOD - CHEMICAL PROCESSING OF FEED

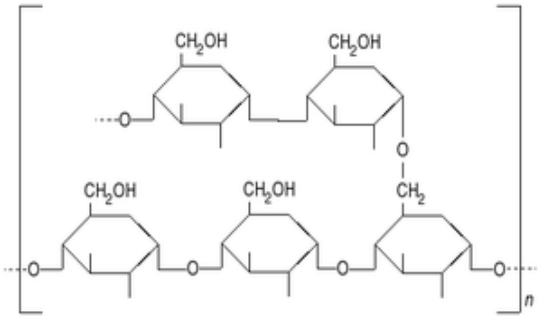
Digestion is very important in the chemical processing of food, in which food is broken down into smaller particles due to the action of enzymes present in the digestive juice, undergoing changes in its chemical composition (MAGALHÃES, 2024).

The peristaltic movements in the stomach mix the food bolus with the gastric juice, produced by the glands of the gastric mucosa. This juice contains hydrochloric acid, which maintains stomach acidity, offering favorable conditions for the work of enzymes in digestion.

The enzymes present in the mouth carry out the first breakdown process by transforming starch (fig. 1) into maltose (fig. 2), where it undergoes the action of hydrochloric acid (HCl) that makes it possible to make the stomach with an acidic pH, chemically processing and allowing chemical reactions.

Figure 1

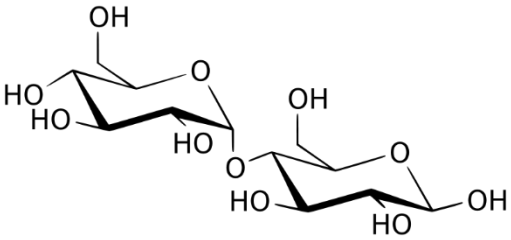
Starch Structure [$(C_6H_{10}O_5)_n$]



Source: Amido (2024).

Figure 2

Maltose (C12H22O11)



Source: **(**FILE:MALTOSE, 2025).

Foods that are composed of various chemical substances are released and absorbed by the body. In the process of separating food, each organ is responsible for the decomposition and absorption of chemical elements. Nutrients appear, which are divided into **inorganic** and **organic.**

I) **Inorganic:** the main ones are **mineral salts**.

Mineral salts are necessary for the human body that are not produced by it, therefore, being necessary for their ingestion through an adequate and balanced diet (SANTOS, 2024).

They are essential substances for living beings, being necessary in various parts of our body, such as: enzymes, hormones, bones and dentin in the teeth.

They can be classified as: **Macrominerals and Microminerals** (A NECESSITA, 2025).

Macrominerals: are those that are needed daily in amounts above 100 mg. For example:

Calcium: it is important in the body, as it is part of the formation of bones and teeth, it is also responsible for blood clotting, muscle contraction, transmits nerve impulses and balances the pH of the blood. Excess can cause kidney stones and its lack can cause osteoporosis, where it leaves the bones of the body fragile and easily breakable (SANTOS, 2024).

We find calcium in the following foods: dairy products (milk, cheese and yogurt), sardines, salmon, beans, chickpeas, kale, spinach, broccoli, Brazil nuts, almonds, peanuts.

Phosphorus: together with calcium, it is part of the composition of bones and teeth (FERREIRA, 2017). It is the second most abundant salt in our body. Its absence can cause: greater occurrence of bone problems and fractures, joint pain, feeling of numbness and/or tremors, lack of appetite, growth problems, brittle hair and nails, tachycardia, memory problems, irritability or anxiety, fatigue and tiredness, greater propensity to diseases (osteoporosis, arthrosis and arthritis) (FERREIRA, 2017).

Phosphorus can be found in: **seeds** (such as sunflower and pumpkin), foods such as almonds, Brazil nuts and cashews, walnuts, peanuts, salmon and sardines, lentils, oats, carioca beans, meats, milk and dairy products, eggs, mushrooms, cereals, among others.

Sodium: it is well known for its importance in controlling the volume regulation of body fluids, in addition to being an important conductor of nerve impulses, together with potassium, and is related to blood pressure and muscle contractions. In excess it can cause: hypertension, heart problems, kidney problems (stones), fluid retention. Sodium is not totally a villain in our body, as many think. It helps in the functioning and helps in some functions in the body, such as: ensuring a balanced pH of the blood, favoring nerve impulses and muscle contraction, improving the quality of the heart's electrical impulses, balancing the amount of water in the body and favoring the functioning of the kidneys. We find sodium in: table salt, in some vegetables, cheese and several other types of food such as: meat, fish, eggs and snacks.

Potassium: an important element necessary for the human body, where one of its functions is that of an electrolyte (allows the transmission of electric current) in nerve transmissions, muscle contraction and fluid balance in the body. In addition to participating in the balance of water in the body. Its absence in the body can cause muscle problems due to the agent that transmits electric current, as it can even affect the heartbeat, because the heart is also a muscle (SOUZA, 2025). The absorption of potassium by the body occurs in the small intestine. Potassium is excreted through sweat, urine, and feces. It is found in the following sources: black beans , mushrooms, spinach, silver bananas, apricots, tomatoes, avocados, blackberries, carrots, cow's milk, chicken eggs, green peppers.

Chlorine: an important component in the body, as it is part of the digestive process in the formation of gastric and pancreatic juices, contributing to digestive enzymes in the breakdown of food. Some benefits can be related to the participation in the acid-base balance and in the maintenance of blood pH and it cannot be forgotten that it is one of the most important minerals in the regulation of osmotic pressure, as ionized chlorine, together with sodium, maintains the aqueous balance (NUTRITION, 2025).

Its main sources: table salt, seafood, milk, meat, and eggs.

Magnesium: one of the mineral salts that is least present in the human body and has a strong importance, as one of its functions is the synthesis of vitamin D, which allows the ion exchange of the cell membrane, among other functions. Main sources: avocado, banana, grape, okra, peanuts, cabbage, sesame, fish, soybeans, cashew nuts, cow's milk, oats, brown rice, whole wheat flour and potatoes with peel (KNOW, 2025).

Sulfur: like the others, it is an important element in the body, as it participates in the formation of the blood clot, collagen, without forgetting that it is also linked to the constitution of cartilage, mucous secretions. It can be found in eggs, meats and vegetables (SAIS, 2011).

Trace minerals: one of the important mineral salts, which is not produced in the body, are **chromium**, as their consumption in the correct amount can reduce body fat, especially in the abdomen. This is possible because it helps to reduce the exaggerated desire for sweets and also controls appetite (LEITE, 2025a). Its absence can cause some symptoms, such as: insulin resistance, type 2 diabetes (usually in older people), risk of glaucoma, weight loss, brain damage, numbness and tingling, burning sensations in the feet and hands, increased risk of heart disease, high blood pressure, increased anxiety, dizziness, racing heart. It can be found in meats, whole grains, breads, brewer's yeast, nuts and spices.

Cobalt: is an element that is important for the body, as it is part of the composition of vitamin B12, the formation of red blood cells, bone marrow cells, nervous and gastrointestinal systems. Hence its importance in our body. However, its high consumption can cause thyroid gland dysfunction, dermatitis, cardiomyopathy, hepatotoxicity, and nephrotoxicity (LEITE, 2025b). Sources of Cobalt: cooked salmon, boiled oysters, egg, sardines, ham, caviar, octopus and crab.

Copper: along with other elements, it is part of the formation of hemoglobin, when bound to iron, when bound to vitamin C, it helps in the formation of collagen that will interfere with the formation of bones, cartilage, tendons and skin (LEITE, 2025b). Sources of copper: liver, fish, whole grains and meats in general.

Iodine: essential for the functioning of the thyroid gland, iodine also works on the storage of oxygen by the muscles and prevents the deposit of fat in body tissues. Iodine deficiency can cause goiter, a disease characterized by the growth of the thyroid gland, and obesity (LEITE, 2025b). Sources of iodine: **lettuce, seafood** (**fish, shellfish, seaweed, oysters, lobsters, shrimp, crab and mollusks**).

Fluoride: another mineral that acts in the formation of bones and teeth is fluoride. However, this is not its only function: it prevents the dilation of the vessels, the development of calculi in the vesicles and paralysis. The intake of the nutrient is especially important for pregnant women and children who are in the process of forming their second teeth (LEITE, 2025b).

The sources of fluoride are: asparagus**, cucumbers,** meat, fish, cereals (apples), anchovies, products prepared from free-to-ground chickens and chocolate.

Manganese: is a mineral salt that helps in the formation of bones and the reproduction system. Its deficiency can cause weight loss, transient dermatitis, nausea, vomiting. The

excess can be deposited in the liver and nervous system, causing Parkinson's-like symptoms. Source of manganese: whole grains, nuts, nuts, teas, hazelnuts, soybeans, leafy green vegetables (LEITE, 2025b).

Molybdenum: Molybdenum is an essential mineral that performs several important functions in the human body. It is a vital micronutrient found in a variety of foods. With its presence in adequate amounts in the diet, molybdenum contributes significantly to healthy metabolism and proper functioning of the body. Molybdenum is found in small amounts in a variety of foods, especially in legumes like beans, lentils, whole grains, as well as certain dark green leafy vegetables. Its presence is important for several metabolic and enzymatic processes that occur within the human body (MOLYBDENUM, 2025). The foods richest in molybdenum are: whole grains, oats, green beans, lentils, peas, soybeans, potatoes, green leafy vegetables, liver and other offal.

Selenium: is a mineral found naturally in soil that is also present in certain natural foods, and in small amounts in water. It is extremely vital for the human body, as it boosts immunity, participates in antioxidant activity that defends against radical damage and inflammation, and plays a key role in maintaining a healthy **metabolism** (PIMENTEL, 2025). Foods rich in selenium are: Brazil nuts, eggs, liver (lamb and beef), various fish, tuna, pork loin, chicken breast.

Iron: it is essential for blood formation, it acts in the transport of oxygen to the entire human body. The lack of this component in the body can develop anemia (LEITE, 2025b). Sources: a) green vegetables: **watercress, arugula, spinach, broccoli and kale**. b) whole grains: beans, oats, barley and wheat.

Zinc: is a nutrient that acts in the brain control of muscles, in the respiration of tissues, in reproduction and fertility, and in the metabolism of proteins and carbohydrates. The lack of this component in the body reduces the amount of male hormones produced, impotence, hair loss and is a risk factor for the onset of diabetes. Excess zinc in the diet is associated with problems such as nausea, vomiting, loss of appetite, abdominal cramps, in addition to interrupting the absorption of copper and iron.

Sources: raw oysters **, roasted beef, boiled beef liver, roasted pork, mozzarella cheese, sesame, almonds, peanuts, baked beans, cashews, rolled oats, nuts, and brown rice.**

II) **Organic:** proteins, with emphasis on **essential and non-essential amino acids, vitamins, carbohydrates and lipids** (SILVA, 2024).

Examples of **essential amino acids**: arginine, phenylalanine, histidine, isoleucine, leucine, lysine, meteonine, threonine, tryptophan and valine. Of the **non-essential amino**

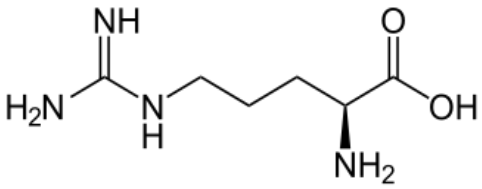
acids, the following stand out: alanine, asparagine, aspartate, cysteine, glycine, glutamate, glutamine, pyroline, serine and tyrosine.

2.1 BRIEF DESCRIPTION OF SOME ESSENTIAL AMINO ACIDS

2.1.1 Arginine, C6H14N4O2

Figure 3

Arginine



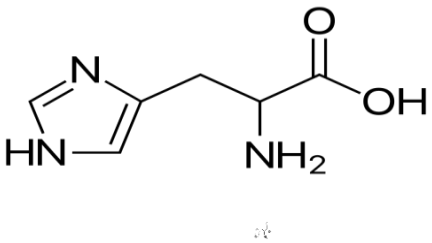
Source: **(**FILE:L-ARGININ, 2025).

Arginine is an important amino acid for the body, as it strengthens the immune system, improves healing, in addition, helps improve muscle performance and facilitate the gain of lean mass. Arginine can be found in various foods, such as chicken, fish, nuts, nuts, beans or cocoa and, therefore, can be consumed naturally through food (LEAL, 2025). Arginine (fig. 3) is important in: muscle and tissue recovery; increased performance; accelerated muscle recovery; increased physical endurance. For the intake of this amino acid, we can find it in some foods: yogurt, cheese, whole wheat bread, raisins, cashew nuts, Brazil nuts, walnuts, hazelnuts, beans, cocoa.

2.1.2 Histidine, C6H9N3O2

Figure 4

Histidine



Source: (FILE:HISTIDIN, 2025).

Histidine (fig. 4) is an amino acid produced by the human body that helps in various parts of the body, including:

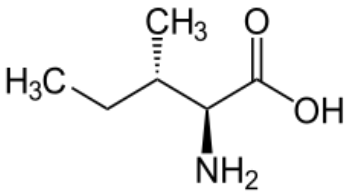
- Growth and regeneration of various tissues, including muscle.

- Maintenance of brain cells and converts into histamine, a compound involved in the body's immune responses.
- Increase gastric acid secretion.
- Improve sexual functions.
- Protect cells from damage caused by radiation and heavy metals.

2.1.3 Isoleucine, C6H13NO2

Figure 5

Isoleucine



Source: (FILE:L-ISOLEUCIN, 2025).

Isoleucine (fig. 5) is part of a group of amino acids, known as BCAAs (the acronym refers to the English term *Branched-Chain Amino Acids*, and encompasses three specific molecules: leucine, isoleucine and valine), where its main function is energy metabolism with muscle recomposition after exercise. During the digestion process, the body also breaks down isoleucine, transforming it into a molecule called acetylcoenzyme A (Acetyl CoA).

Other body functions linked to isoleucine are linked with controlling blood sugar levels, increasing hemoglobin production, blocking the elimination of vitamin B3 (niacin) by the kidney.

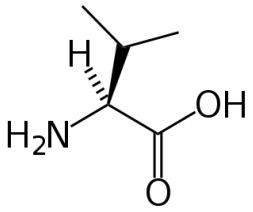
The absence of this amino acid in the body can cause tiredness and muscle fatigue, while in excess it can cause damage to the kidneys.

Isoleucine is found in the following foods: soy derivatives , meat and fish, eggs, dairy products, vegetables, beans, lentils, and chickpeas.

2.1.4 Valina C5H11NO2

Figure 6

Valine



Source: (FILE:L-VALINE, 2025).

Another amino acid in the BCAA group is valine (fig. 6) which is important for metabolism, muscle coordination, tissue repair, maintenance of nitrogen balance (old name that was used to name nitrogen). Valine is also responsible for treating diseases in the liver and gallbladder, it also reacts in the brain as a mental invigorator and calming. It works in conjunction with Isoleucine and leucine (VALINA, 2025). It can be used in the treatment for:

- Fight insomnia and stress.
- Control appetite.
- Strengthen the immune system.
- Maintain blood sugar levels.
- Improve physical endurance.

Foods with vanilla: dairy products, eggs, soy and derivatives, red meat and chicken, legumes, lentils, beans, roasted peanuts, chickpeas, vegetables and fruits.

2.2 BRIEF DESCRIPTION OF SOME NON-ESSENTIAL AMINO ACIDS

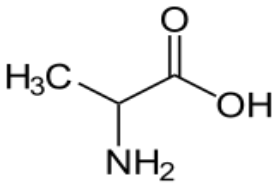
The non-essential amino acids are:

Alanine, $C_3H_7NO_2$; aspartate, $C_4H_7NO_4$; asparagine, $C_4H_8N_2O_3$; cysteine, $C_3H_7NO_2S$; glutamate, $C_5H_9NO_4$; glutamine, $C_5H_{10}N_2O_3$; glycine, $C_2H_5NO_2$; proline, $C_5H_9NO_2$; serine, $C_3H_7NO_3$; tyrosine, $C_9H_{11}NO_3$.

2.2.1 Alanine, $C_3H_7NO_2$

Figure 7

Alanine



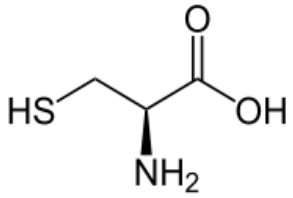
Source: Alanina (2025).

This amino acid has the function of assisting in the transfer of nitrogen (nitrogen) to the liver tissue, where it helps in the metabolism of glucose, together it protects the muscles so that toxic substances do not accumulate when released, such as muscle protein, breaks down quickly to meet energy needs, such as what happens with aerobic exercise, It strengthens the immune system, producing antibodies, prevents diabetes and together with arginine prevents muscle wasting. Foods with alanine: asparagus, potatoes, carrots, eggplants, beets, oats, cocoa, rye, barley, coconut, avocado, hazelnuts, walnuts, cashews, Brazil nuts, almonds, peanuts, corn, beans, and peas.

2.2.2 Cysteine, C3H7NO2S

Figure 8

Cysteine



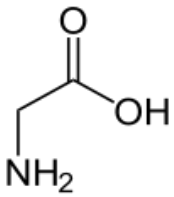
Source: Cysteine, (2025).

Cysteine works as one of the components to form a powerful antioxidant, but for it to happen it needs to act together with glutamate and glycine, which together form glutathione. Glutathione also acts in the control of vitamins C and E, together it acts in the recovery and gain of muscle mass after great physical effort. The main food sources of cysteine **are: meat, poultry, eggs, fish, dairy products, sunflower seeds, nuts, soybeans, broccoli, red and yellow peppers, onions, and garlic**.

2.2.3 Glycine, C2H5NO2

Figure 9

Glycine



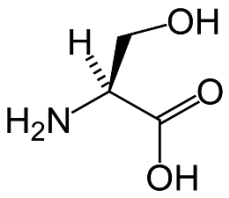
Source: Glycine (2025).

Glycine is an important cellular energy source, in addition to helping with muscle growth, brain performance, sleep control and digestion. In order to add the functions of this small amino acid, we can add the control of blood glucose concentration, which can manage the energy level, fight muscle fatigue and a great source of collagen (GLYCINE, 2025). Foods rich in glycine are: pumpkin, sweet potato, English potato, carrot, beets, eggplant, cassava, mushrooms, green peas, beans, barley, rye, milk and dairy products, hazelnuts, walnuts, cashew nuts, Brazil nuts, almonds, peanuts.

2.2.4 Serina, C3H7NO3

Figure 10

Serine



Source: Serina (2025).

Serine is important to increase defense, in addition to helping in the functioning of the nervous system, in participating in the transformation of fat, and participates in the production of other amino acids, such as glycine (LEAL, 2025). Foods rich in serine are: hazelnuts, cashews, Brazil nuts, almonds, peanuts, beans, corn, barley, rye, beets, eggplant, potatoes, mushrooms, pumpkin, red onion, garlic, milk, cheese, yogurt, meat, fish and eggs.

2.3 VITAMINS

Vitamins are essential organic compounds for our body, where we are unable to produce them and it is necessary to ingest them through foods such as fruits, vegetables and legumes, but they are also found in meat, milk, eggs and cereals. Deficiency (just below the required limit) or insufficiency (enough or absence of the vitamin in the body) can cause health problems, according to the vitamin (VITAMIN, 2024).

Vitamins can be classified into:

Water-soluble: soluble in water and with daily intake, it allows the proper functioning and production of energy necessary for day-to-day activities. They are absorbed in the intestine and taken by the circulatory system to the tissues for storage.

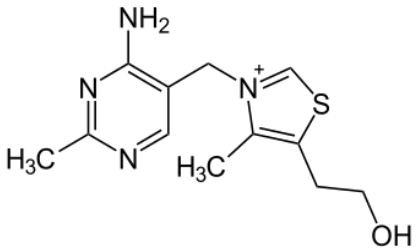
Fat-soluble: soluble in fat (lipids), and for absorption the presence of bile, pancreatic juice and fat is necessary.

Water-soluble vitamins

- **Vitamin B1 -** Thiamine, Antiberibérica, C12H17N4OS

Figure 11

Vitamin B1



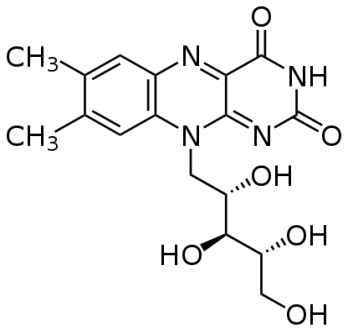
Source: Tiamina (2025).

Vitamin B1 (fig. 11) is in the process of carbohydrate metabolism, improves oxygen uptake by the brain, balances the nervous system and ensures normal growth. In addition, it allows the relief of muscle pain and menstrual cramps. Foods rich in Vitamin B1: whole wheat bread, ham, brown rice, whole grain, liver, pork, fish, vegetables, egg yolks, whole wheat pasta, beets, sausage, oranges, lemons, apples, cheese.

- **Vitamin B2 -** Riboflavin, C17H20N4O6

Figure 12

Vitamin B2



Source: Riboflavin (2025).

Among its functions is the conservation of tissues, especially the tissue of the eyeball. We can also attribute to Vitamin B2 (fig. 12) the function of aiding vision, reducing eye fatigue, also preserving nails, hair and mucous membranes. Its absence can cause ulcers in the

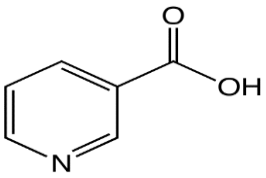
mouth and lips, a difficulty in healing wounds, dermatitis, red and irritated inflamed eyes, anemia and also muscle weakness.

Foods rich in vitamin B2: liver, almonds, parsley, soybeans, salmon.

- **Vitamin B3 –** Niacin, C6H5NO2

Figure 13

Niacin

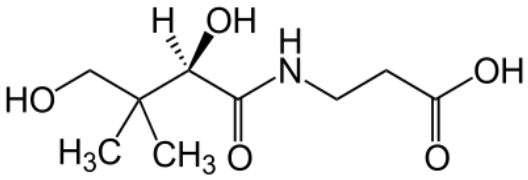


Source: Niacin (2025).

- **Vitamin B5 -** Pantothenic acid, Vitamin W, C9H17NO5

Figure 14

Vitamin B5

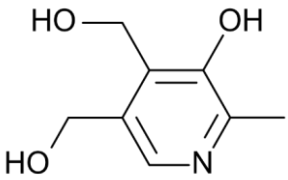


Source: Pantothenic Acid (2025).

- **Vitamin B6 -** Pyridoxine, C8H11NO3

Figure 15

Vitamin B6

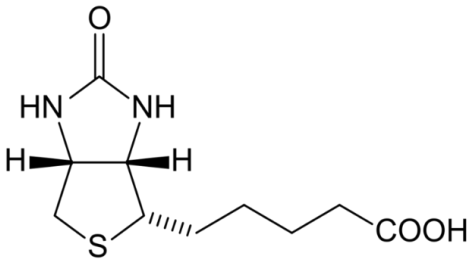


Source: Vitamin B6 (2025).

- **Vitamin B7, B8 or Vitamin H –** Biotin, C10H16N2O3S

Figure 16

Vitamin B7, B8 or Vitamin H

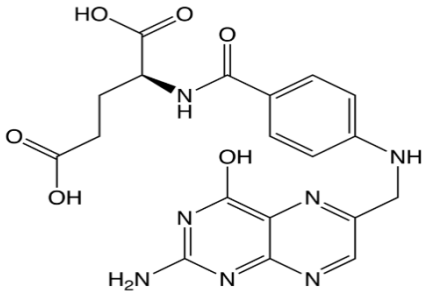


Source: Biotin (2025).

- **Vitamin B9 -** Folic acid, C19H19N7O6

Figure 17

Vitamin B9

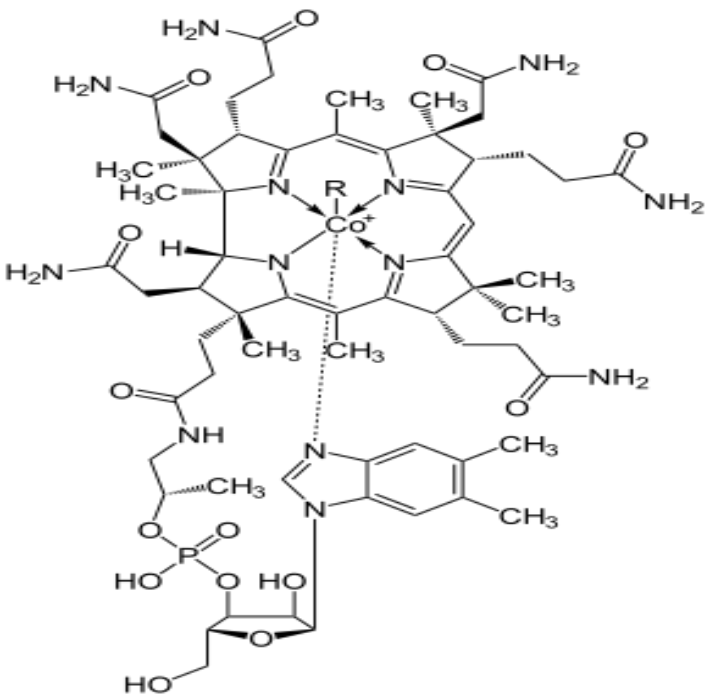


Source: Folic Acid (2025).

- **Vitamin B12 -** Cobalamin, C63H88CoN14O14P

Figure 18

Vitamin B12

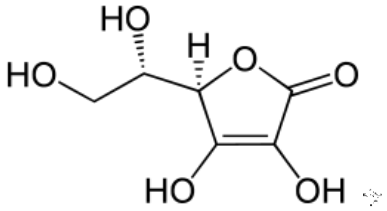


Source: Vitamin B12 (2025).

- **Vitamin C -** Ascorbic acid, C6H8O6

Figure 19

Ascorbic Acid



Source: Ascorbic Acid (2025).

Ascorbic acid or vitamin **C, has as** its main function the hydroxylation of collagen, the fibrillar protein that gives resistance to bones, teeth, tendons and blood vessel walls . In addition, it is a powerful antioxidant, being used to transform reactive oxygen species into inert forms. It has the following effects on the body in moderate doses: it favors the formation of teeth and bones, helps resist heart disease, prevents flu, muscle weakness and infections,helps the immune system and cellular respiration, stimulates the adrenal glands and protects blood vessels.

Vitamin C is important for the proper functioning of white blood cells. It is effective against infectious diseases and an important supplement in the case of cancer. A lack of this vitamin causes avitaminosis known as scurvy.

Foods rich in vitamin C are: acerola, guava, kiwi, orange, lemon, papaya, strawberry (ASCORBIC ACID, 2025).

Fat-soluble vitamins

Vitamin **A**, also called retinol, is responsible for protecting the skin and vision. It also contributes to the formation of liver enzymes and the production of sex hormones. Vitamin A is often given in dietary supplements in people with respiratory infections, eye or skin problems for its repairing properties (THE VITAMINS, 2025).

Vitamin A is found in animal foods, legumes such as carrots and spinach, butter.

Vitamin **D** is also called calciferol, and it is so named because it contributes to the absorption of calcium and phosphorus. These absorbent properties make this vitamin very necessary for children of growing age, so the milk is fortified with this vitamin. However, vitamin D is obtained automatically in the skin by exposure to sunlight.

Some foods rich in vitamin D include sardines, tuna, margarine, eggs, and high-fat cheeses.

Vitamin **E**, or tocopherol, performs functions related to the production of red blood cells and the formation of muscle tissue. It is also considered one of its main functions to produce male hormones and allow the maturation of sperm and eggs, so this vitamin is related to favoring fertility. It also has antioxidant properties, which help regenerate tissues and prevent cellular aging. Also often used for beauty treatments (AS VITAMINAS, 2025).

Some foods rich in vitamin E include sunflower, corn and soybean oil, nuts, coconut, butter, and other fatty foods.

Vitamin **K** or anti-hemorrhagic is so named because its function is to contribute to blood clotting. Vitamin K is normally present in the body. Their deficiencies are often associated with problems in the absorption of fats.

Some foods rich in vitamin K are green leafy vegetables, liver, oil, and egg yolks.

Vitamin F is not a true fat-soluble vitamin, but it is referred to as the set of essential fatty acids that must come from external foods because it is not produced by the body automatically.

They fulfill the structural functions of membranes, are responsible for oxygen transport, coagulation and nourish dermal cells. These acids are the famous Omega 3 and Omega 6, which also serve to disperse cholesterol, so that veins and arteries are not blocked (THE

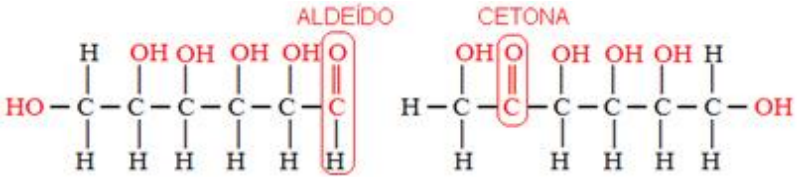
VITAMINS, 2025). Foods rich in the vitamin are: fish, fish oil, almond, avocado, soybeans, peanuts, wheat germ.

2.4 CARBOHYDRATES

Carbohydrates , also called sugars, carbohydrates, carbohydrates or carbohydrates, are compounds whose composition is made up of carbon, hydrogen and oxygen (fig. 20).

Figure 20

Aldehyde and Ketone Group



Source: Fogaça (2024).

Carbohydrate, chemically, is called a carbohydrate, whose general formula is $Cx(H2O)_y$ (BATISTA, 2025).

Carbohydrates have the main function of providing energy to our body to carry out activities of any nature. The classification of carbohydrates is made according to the amount of ketones or aldehydes present in the compound, in addition to taking into account the ability to undergo hydrolysis (FOGAÇA, 2024). The three main functions of carbohydrates are: energy supply, energy storage, and cell structuring. The lack of carbohydrates in the body causes body fat to be used as an energy source. Carbohydrate is important in the fat burning process and, without it, the process is incomplete, causing the formation of toxins that can lead, for example, to a decrease in blood pH and dehydration.

The main sources of carbohydrates for food are found mainly in vegetables, however, animal products can contain carbohydrates, such as milk that has lactose sugar, in cakes, sweets, soft drinks, ice cream, chips, beans, lentils and corn.

2.5 LIPIDS

Lipids, also called fat, are complex substances indispensable to the body, but in excess they cause serious health problems. Lipids are divided into: Carotenoids (Fig.21), Phospholipids, Glycerides and Steroids.

Carotenoids

Figure 21

Sources of carotenoids

Source: Gottschald (2021).

They are lipids with **orange pigments of plant origin, and can be found in** plants, algae and bacteria that perform photosynthesis. **They act as an antioxidant, and are important in the fight against cancer, where some of these vegetables are rich in Vitamin A (**GOTTSCHALD**, 2021).**

Phospholipids

The importance of phospholipids is also evidenced by their relationship with various pathologies. Alterations in the composition and metabolism of phospholipids are associated with cardiovascular, neurodegenerative, hepatic, inflammatory, genetic, and metabolic diseases. Studying phospholipids and their functions not only clarifies fundamental aspects of cell biology, but also opens the way for therapeutic interventions in various diseases **(PABLO, 2024).**

Glycerides

Glycerides are part of one of the four lipid groups and consist of glycerol molecules (C3H8O3) joined to one, two, or three fatty acid molecules. When glycerides are attached to three fatty acid molecules, they are known as triglycerides or triglycerides. Inside the cells we will always find fatty acid molecules united to glycerol molecules, forming glycerides, which can be found in foods such as milk, cheese, eggs, animal fats and vegetable oils **(GLYCERIDES, 2025).**

Steroids

Biologically, steroids are part of a complex group of hormones and enzymes that interact to maintain life, being present in almost all forms of life and being synthesized by the organisms themselves. When looking at steroids from a chemical point of view, they are fat-soluble compounds, derived from tetracyclic triterpenes. Steroids are part of a class of lipids

that have a common hydrocarbon structure with 17 carbon atoms linked in four cyclic structures **(FONSECA, 2025).**

Steroids are hormones produced by the adrenal cortex or gonads, and are responsible for several functions in the body, including metabolic control and sexual characteristics.

Depending on the functional groups that bind in the base structure of steroids, the molecule will have different functions in the body. These functional groups can be diverse, but the most common are alcohols, esters, ketones, aldehydes, and carboxylic acids. Among natural steroids, the most important is cholesterol and its derivatives, such as female (estradiol) and male (testosterone) sex hormones.

Foods rich in lipids are: avocado, olive oil, beef, dark chocolate, coconut, flaxseed, butter, egg, salmon,

3 GENERATION OF ENERGY FOR THE HUMAN BODY THROUGH THE CHEMICAL REACTIONS OF FOOD

With the breakdown of food to the smallest part where it is possible for the body to absorb, the transformation process begins. Energy is obtained from nutrients in food, such as glucose, protein, and carbohydrates. For a piece of bread to be transformed into energy, it is not enough that it is chewed, digested and swallowed. It has to be broken down into small molecules, which can be absorbed by the cells (PORTILHO, 2024).

During this transformation process, our body identifies in food what glucose, protein and carbohydrates are.

Among the contents absorbed by the human body, glucose is the one with the greatest power, as it is the one that generates energy for the processing of the other elements. Human beings, during the evolutionary process, are able to make better use of the glucose that comes from food, extracting the maximum energy from it.

The energy that the body produces will mainly go to the following parts of the human body:

a) **Brain,** which is responsible for the consumption of 19%, because for the realization of synapses (communication between neurons) most of the energy is needed. Because it has little glycogen in reserve, the brain can suffer severe damage when glucose is lacking, even for a brief period of time. Glucose ingested in excess can cause damage to the brain such as memory problems (PORTILHO, 2024).

b) **Muscles,** which are responsible for 18% of consumption, due to muscle contractions that require a lot of energy and intense physical activities.

c) **Heart,** which accounts for 7%, since the heart depends a lot on the immediate energy of glucose.

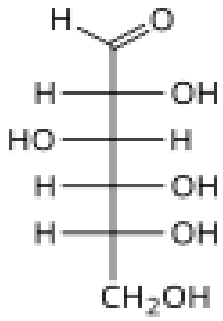
d) **Spleen and the Liver**, which together use 27%, because the liver is where glycogen is stored, which is responsible for the source of energy while we sleep.

e) **Kidneys**, which consume 10%, as most of this energy is used for urine production. The rest is used to manufacture hormones or eliminate toxins. And the 19% that exceed it is used in the rest of the body (PORTILHO, 2024).

The glucose molecule (GLUCOSE, 2024), C6H12O6, (linear structure in fig. 18), *works as fuel and is broken down into energy for the body, analogous to* a piece of bread, which is millions of times larger than a cell, whose first step is to break it into smaller and smaller portions, through chewing and digestion, until the carbohydrate is reduced to its smallest unit: glucose. In the small intestine, glucose is absorbed by the venous system, goes to the liver, peripheral tissues and finally to the cell, then it enters the cytoplasm, the aqueous portion of the cell, and undergoes its first division. One molecule of glucose gives rise to two molecules of pyruvic acid. (PORTILHO, 2024).

Figure 22

Glucose (C6H12O6)



Source: Glucose (2024).

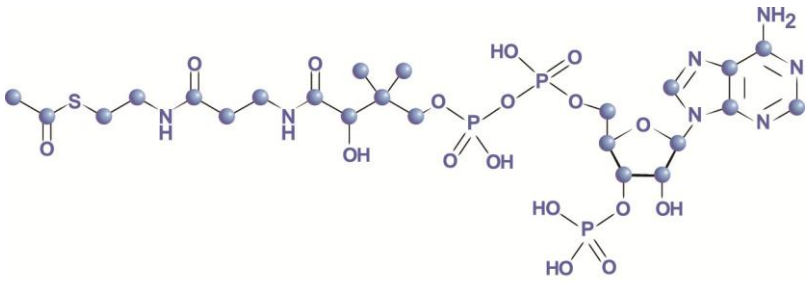
Pyruvic acids go to the mitochondria, responsible for cellular respiration. To obtain more energy, the Krebs cycle, a sequence of reactions, begins. In this phase, the acid loses hydrogens, which go to other molecules, and carbons. These bind to the oxygen available in the cell, generating CO2, which is released in the breath. At the end of the cycle, all the carbons in glucose turn into CO2.

The Krebs cycle or citric acid cycle is one of the metabolic steps of aerobic cellular respiration that occurs in the mitochondrial matrix of animal cells. Cellular respiration consists of 3 phases (CICLO, 2024):

I. Glycolysis - the process of breaking down glucose into smaller parts, with the formation of pyruvate or pyruvic acid, which will give rise to Acetyl-Co A (acetylcoenzyme A), which is

an important biochemical molecule (fig. 23) in cellular respiration, is produced in the second stage of aerobic respiration after glycolysis and plays a fundamental role in the body (RACHID, 2022).

Figure 23



Acetyl-CoA

Source: Gelambi (2021).

This organic compound acts directly on cell metabolism and has the function of producing energy for our body.

II. Krebs cycle - Acetyl-Co A is oxidized to CO2.

III. Respiratory Chain - production of most of the energy, with the transfer of electrons from hydrogens, which were removed from the substances participating in the previous stages.

The hydrogens that came out of pyruvic acid tend to bind to oxygen from respiration. When they unite at the crest of the mitochondria, hydrogen and oxygen form the molecule H_2O. Part of this water is eliminated, and another part remains inside the cell acting in chemical reactions and helping to form cytoplasm. But there are some H+ ions left, which are attracted to the inner side of the membrane, which is loaded with negative ions. To do this, they pass through a specific path, a kind of umbrella-shaped "turbine", ATP-synthase (Adenosine Triphosphate), which rotates and connects a phosphate, which is already in the cell, to an ADP (Adenosine Diphosphate), which is also there, forming ATP, which is free to participate in other reactions in our cells (PORTILHO, 2024).

One of the reactions that uses energy is muscle contraction. Two of the proteins in the muscle make the contractions: actin and myosin. Myosin binds to ATP from the mitochondria, and curves onto actin. The ATP then breaks down, releasing a phosphate and an ADP, which are free to be recharged again. Thus, actin and myosin slide over each other, performing the movement. For the two to loosen and the muscle to relax, another ATP needs to bind to myosin, turning off the two proteins (PORTILHO, 2024).

The main most energetic foods are: cereals: rice, rye, barley, oats, corn and wheat, legumes: lentils, chickpeas, beans, peas and soybeans, fruits, hazelnuts, walnuts, Brazil

nuts, almonds, peanuts, cashews, olive oil, coconut oil, avocado oil, flaxseeds, sesame and sunflower, tuna, sardines, salmon, egg; chicken, beef, turkey, milk, yogurt, cheese.

They are considered more energetic because of the amount of carbohydrates that provide greater energy content (LEAL, 2024).

4 THE INTAKE OF DETOX FOODS (DETOXIFICATION) CAN HAVE CONSEQUENCES IN THE HUMAN BODY

Due to the consumption of industrialized foods, the population is becoming intoxicated with the products added during the manufacturing process. This intoxication can cause health problems, such as obesity and internal inflammation. The main objective of doing a detox diet is to reduce or eliminate the excess toxins that accumulate in the body and accelerate the aging process. **Doing a detox diet every 3 months** is important to improve mental activity and concentration, because it also cleans the toxins accumulated in the brain. These toxins that can accumulate are present in herbicides used in agriculture, and in food dyes and sweeteners, in addition to being naturally produced in the body during stressful situations (ENTENDA, 2016).

Detox teas promise benefits such as fighting swelling and eliminating toxins accumulated in the body. These teas usually have herbs that guarantee diuretic properties, such as hibiscus, horsetail, green tea and dandelion. Green tea is thermogenic and antioxidant. Ginger can also be used, with an anti-inflammatory and digestive effect. Other herbs such as mint, boldo and cinnamon are also frequently used (RODRIGUES, 2025).

4.1 TOP DETOX FOODS

The main foods with detoxifying properties that should be consumed regularly are:

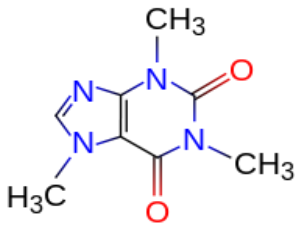
Spirulina, an antioxidant-rich seaweed; **kale**, as it is rich in anti-inflammatory substances that help the kidneys function; **probiotics**, such as natural yogurts, which improve the intestinal flora and immune system; **lemon, orange, passion fruit and pineapple citrus juices**, as they are rich in antioxidants; **water**, for helping to eliminate toxins through urine; **ginger**, for having strong antioxidant and anti-inflammatory action; **garlic**, as it contains the powerful antioxidant allicin. In addition to increasing the consumption of these foods, for the detox diet to work, the consumption of alcoholic beverages, sweets, red and processed meats, such as sausage and sausage, and fried foods must be avoided (ENTENDA, 2016).

5 FOODS THAT RELEASE CERTAIN CHEMICAL COMPONENTS THAT INDIVIDUALLY CAUSE ANXIETY, WELL-BEING AND TRANQUILITY

Food can behave in different ways in the human body, and can act as a great beneficiary or as a great villain. On the one hand, it can generate energy, but it can have side effects, such as anxiety, well-being or tranquility.

Figure 24

Caffeine (C8H10N4O2)



Source: Caffeine (2024).

Caffeine (fig. 24), acts on the central nervous system and also on basal metabolism, thus increasing the production of gastric juice. Therapeutic doses of caffeine stimulate the heart by increasing its working capacity, also producing dilation of peripheral vessels. Its stimulating action makes it a powerful antidote to respiratory depression as a result of intoxication by drugs such as morphine and barbiturates. Excessive intake can cause, in some people, negative effects such as irritability, anxiety, headache, and insomnia (CAFFEINE, 2024).

Caffeine is found in many plant species and its function in the plant organism is to act as a kind of natural pesticide. The main plants that contain the active ingredient of caffeine are: **yerba mate, coffee, tea, cocoa, guarana, guavusa and cola.** As caffeine is widely consumed by practitioners of physical activities, laboratories producing supplements have developed techniques to isolate this substance and even produce it synthetically. It is very common to find caffeine in capsules or powder, usually mixed with a solution, such as energy drinks (CAFFEINE, 2024).

Anxiety causes emotions and also reflects on the health of our body. There are treatments and therapies to control it, but food can also help control anxiety, highlighting some foods that contain essential amino acids and vitamins that act to reduce stress, fighting anxiety and increasing the levels of serotonin and tryptophan, which are responsible for well-being and relaxation and also the level of cortisol, the stress hormone (MOREIRA, 2024).

The list of foods associated with anxiety are:

a) Recommended: salmon, mushrooms, oats, leafy greens, chard, cheeses, kiwi,

bananas, brown rice, whole grains.

b) Not recommended: sugar, sweeteners, margarine, fried foods, alcohol,trans fat, coffee, soda, and crackers Stuffed.

6 UNCONTROLLED FOOD INTAKE CAN CAUSE INTOLERANCE OR ALLERGY

Some people have difficulty digesting milk and its derivatives and this is due **to lactose intolerance**, a condition caused by insufficient production of the enzyme lactase, which is responsible for breaking down milk sugar during digestion. Lactose intolerance impacts millions of people around the planet. It happens when the body has difficulty digesting the natural sugar in milk and its derivatives, causing uncomfortable symptoms, such as gas, bloating, cramps, and episodes of diarrhea (INTOLERANCE, 2025).

According to Souza (2023), there are three types of lactose intolerance:

- **Primary lactose intolerance**: This is the most common form and occurs when lactase production naturally decreases after breastfeeding, usually after age 2. It can be hereditary and become evident throughout childhood or adolescence.
- **Secondary lactose intolerance**: In this case, intolerance is a result of damage to the lining of the small intestine, usually caused by diseases or injuries, such as celiac disease, gastroenteritis, inflammatory bowel diseases, irritable bowel syndrome, or treatments such as radiation therapy can lead to a temporary reduction in lactase production, causing symptoms of lactose intolerance.
- **Congenital lactose intolerance**: it is a rare form of intolerance, which is genetically inherited and is present from birth. It is caused by a genetic predisposition that interferes with the production of lactase.

The diagnosis of lactose intolerance is usually made based on the patient's symptoms and can be confirmed through some tests and tests, such as blood tests, feces, lactose intolerance tests, in which the hydrogen expired test is one of the most used tests, which consists, after ingesting lactose, of measuring the amount of hydrogen in the exhaled air. High values indicate fermentation in the gut, a clear sign of digestive upset.

The treatment and management of lactose intolerance aims to relieve symptoms and allow the person to have a balanced diet. The main step is to reduce or eliminate the consumption of foods such as milk, cheese, and traditional yogurts. In many cases, it is possible to consume small amounts of these foods without causing symptoms, depending on the degree of the disorder. There are versions of many dairy products, which undergo an enzymatic process that breaks down the substance present in the dairy before consumption (INTOLERANCE, 2025).

There are people who are **intolerant to gluten**, which is a protein present in cereals such as wheat, rye, malt or barley, which, together with water, forms a type of gel, acting as a kind of glue, which ensures greater elasticity in foods such as bread, pasta and cookies. As it is a vegetable protein in cereals with good sources of fiber, foods with gluten can be consumed freely by people who do not have celiac disease, allergies or intolerance to this protein (ZANIN, 2023).

Gluten intolerance corresponds to an abnormal response of the immune or digestive system to gluten ingestion, resulting in a variety of symptoms and discomforts. The first step is to see a gastroenterologist for an evaluation of symptoms, who will observe the frequency, intensity and triggering factors, in addition to investigating the family history of celiac disease and other autoimmune conditions. The doctor will order tests and then recommend a gluten-exclusion diet (GIRÃO, 2025).

7 FINAL CONSIDERATIONS

The chemical food process begins when the food is placed in the mouth where the breakdown of starch begins.

Continuing the process of food digestion at the stomach level, there is a degradation of proteins by the action of pepsin, resulting in the condition of absorption in the intestine.

In the small intestine, the entire digestive process is completed, where sugars that have not been digested in the mouth, proteins that have not been digested in the gastric and triglycerides, are all digested in the small intestine, each by the action of specific enzymes.

Given the beginning of food processing, until the beginning of absorption, the food passes through the region of the stomach where it undergoes the reaction with HCl (hydrochloric acid). Some foods with the presence of starch begin to be worked in the mouth, proteins in the stomach and finally fatty foods in the intestine. Food is broken down until it reaches nutrients, vitamins, carbohydrates.

Each food, in addition to macromolecules, which are sugars, proteins and lipids, still has vitamins, and mineral salts that will also be absorbed at the level of the small intestine in its vast majority.

Food is made up of glucose, which at the end of the process, the body absorbs and gives energy to the muscles, giving conditions to exercise physical activity.

Detox foods, on the other hand, instead of improving the quality of life, as promised, can cause damage to health, as the nutrients necessary for the reconstruction of the body structure, such as muscles, bones and other parts of the body, will not be found in the

necessary amount in these foods, thus parts of our body may collapse, due to the reduction or total absence of those nutrients.

In the way that the absence of some nutrients can cause health problems , their presence can cause anxiety, well-being and tranquility. These symptoms are directly linked to what is ingested and the reaction of neurotransmitters. When there is the ingestion of certain foods, it causes a certain reaction, such as coffee that inhibits a neurotransmitter that is a natural calming, causing some agitation.

To have problems with food, it is not necessary to consume excess, because in some cases the human being is born with it or acquires it during age, and finally, caused by acquired diseases. Unlike allergy, it is where the body considers that food as an enemy and fights it as a disease.

Food intolerance is one of the serious problems for the human body of some people. The rejection of food by the body causes reactions ranging from respiratory problems to fever, among other symptoms.

Lactose, gluten, crustaceans, chocolate and foods with preservatives and dyes in general are the main causes of food intolerance.

After analysis and studies, it is concluded that the feeding process begins in the mouth with the action of saliva and during the process there is a breakdown of the structure until the moment of absorption. During this process, for each food, there are amino acids contained that are essential to the body and others that are complementary, which help in some way in the body.

In the food chain, detox foods appear, where they can cause serious damage to the body, as the consequences of ingesting certain mixtures of plants are not known, and instead of curing as it is mentioned on websites and literature, they can be similar to poison.

Regional beliefs about miracle foods can have the opposite effect.

Therefore, the ideal food for energy generation is one proven not to cause damage to health. Damage that can cause food intolerance or allergy, which also in some cases can lead to death.

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