Nutrition, Health and Sport

Nutrition, Health and Sport

By

Agron Rexhepi

Cambridge Scholars Publishing

Nutrition, Health and Sport

By Agron Rexhepi

This book first published 2022

Cambridge Scholars Publishing

Lady Stephenson Library, Newcastle upon Tyne, NE6 2PA, UK

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

ISBN (10): 1-5275-8558-1
ISBN (13): 978-1-5275-8558-4

Writing a book is hard work and an immense responsibility, yet a very noble endeavour. It has been more challenging than I thought and more rewarding than I could have ever imagined.

With this work, I have tried to push the boundaries of science in the field of nutrition.

I dedicate this book to my father Muharrem (Ruhan, Azize) Rexhepi (1912-1982), who taught me to be an independent and determined person, and my mother, Maliqe (Musli, ZyhrijeMakolli) Rexhepi (1930-2011), for educating and raising me to believe that everything is possible.

"… Eat and drink, but be not excessive ..."

"The worst vessel to fill is the stomach due to the innumerable fatal illnesses caused by satiation that appear sooner or later, whether internally or externally. If one must fill his stomach, then he should let his food fill it one third only, his drink another third, and leave the remaining third for his breath, so that he would not suffer constriction, harm and laziness."

CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

ACKNOWLEDGEMENTS

I thank my whole family for their patience and continued support.

Sincere thanks to my friend Prof. Dr Behlul Brestovci, who has encouraged me, supported me, and with his constant suggestions, helped me throughout the time spent working on this book. He stood by me through both difficulties and successes – this is a real friend.

My thanks to everyone on the Cambridge Scholars Publishing team who helped me greatly. I must also give special thanks to my Senior Commissioning Editor, Rebecca Gladders, for her constant professional assistance throughout this time.

Above all, the exclusive praise and thanks are due to God Almighty, the All-Knowing, the All-Merciful; nothing can be done without His will and help.

ABBREVIATIONS

ATP – adenosine triphosphate;
BH – body height;
BW – body weight;
BMI – body mass index;
CP – creatine phosphate;
DEN – Daily Energy Needs;
Ei – input energy;
Eo – output energy;
GI – Glycaemic index;
HCL – Hydrochloric acid;
HR – heart rate;
IBW – ideal body weight;
IOC – International Olympic Committee;
kAF – coefficient of physical activities based on Harris-Benedict equation;
Kcal – kilocalorie;
Kj – kilojoule;
LB – pound;
LCI – Lorenz's constitutional index;
Max HR – maximal hart rate;
BM – basal metabolism;
NaCl – natrium chloride;
NH3 – ammonium;
PH – potentiometric hydrogen ion concentration (indicates the alkaline or acidic level in the body);
RQ – respiratory coefficient;
VO_2max – maximal oxygen uptake or maximal aerobic capacity;
WADA – World Antidoping Agency;

CHAPTER ONE

INTRODUCTION TO NUTRITION

1.1 Introduction

Achieving and maintaining good health is a common goal for all categories of the population. This is especially true for athletes and their greater demands for endurance and energy. Among the many factors that participate in realising this goal are: leading a physically active life, good nutrition, and regular hydration. These factors help maintain the balance between output energy (the energy that our body expends while resting, working or eating) and input energy (calories that we take in through food). So, to have a healthy life, the amount of incoming energy must be sufficient for the organism's needs. Disrupting this balance, in terms of excessive output energy (Eo > Ei), will reduce the functional ability of athletes, increase the possibility of injury during training sessions or sports competitions, as well as increase their morbidity (via decreased immunity). Disrupting the balance between the two energies mentioned above, in favour of input energy (Eo < Ei), will cause an increase in body weight.[1]

Nutrition is an essential bio-physiological process for living organisms that provides their cells with the materials necessary to support life. In other words, the science of nutrition studies the process of nutrition, with respect to the importance of food for normal growth and daily activities. The basic characteristics of living beings are: its cell structure and chemical composition, exchange of substances and energy, body movements, multiplication, growth, development, reaction to various stimuli (adaptation, transformation), etc.

The human body contains different complex chemical compounds such as water, carbohydrates, amino acids, fatty acids, and nucleic acids. These compounds are composed of chemical elements such as nitrogen, oxygen, carbon, hydrogen, phosphorus, calcium, iron, zinc, magnesium, manganese and other components. All these components in the body can be found in different forms and combinations (hormones, enzymes, vitamins, phospholipids, and minerals). Food is one of the most influential external

factors in maintaining the bio-psycho-social homeostasis of the human body. Living creatures, throughout their life, consume nutrients from the external environment, which they change and then release back into the external environment. The organism is able to convert simple organic compounds into complex organic compounds and vice versa.[2]

The science of nutrition is a relatively new field, which investigates the body's metabolic and physiological responses to various diets. The close connection between this science and success in sports activities means nutrition is ranked among the most influential sciences in the life of athletes. At the same time, nowhere have more mistakes been made than when it comes to athlete nutrition, and unfortunately, similar mistakes continue to be made in other areas. Optimal nutrition and physical activity are both crucial factors among many other factors that determine bio-psycho-social wellbeing. Regular physical activities, in addition to the positive impact they have on the athlete's psycho-physical condition, also have a positive impact on their nutritional status. However, increasing the level of an athlete's daily physical activity requires an increase in his or her daily energy needs, increasing the need to consume large amounts of food during the day.[3] Food can be considered to be both fun and fuel, with the pleasures and social aspects of eating. The good taste of favourite and familiar foods, travel, food availability, and tight budgets are all factors that influence food choices and when food is consumed.

The diet means the specific composition of the various foods that an organism eats, the amount and composition of which is determined based on nutritional scientific research done in advance for specific individuals or groups under different living conditions. Many common health problems can be prevented or alleviated with a well-balanced, healthy diet, and advanced functional abilities can also be improved. In contrast, an imbalanced diet can harm the health and the functional skills of athletes. There are many types of diets, correct and incorrect, so we should always choose those diets whose results have been proven by scientific work or practical experience. Overall, diets vary significantly depending on the subject's location and climate. For instance, the Mediterranean diet tends to be mostly plant-based, while diets at higher latitudes include more animal products.

Nutrients are essential substances for life (for growth and development of the body and the realization of vital biochemical and physiological processes); these substances are received in different forms from our environment. Consumed nutrients can be divided into two broad classifications:

- Macronutrients (carbohydrates, proteins, fats and water) are needed in relatively large quantities:
    - Carbohydrates are the primary source of energy (1g = 4 kcal);
    - Proteins are primarily essential to the growth and repair of muscle and other body tissues, as well as the source of energy (1g = 4kcal);
    - Fats (lipids) are also a source of energy (1g = 9kcal) and are essential in the absorption of fat-soluble vitamins;
    - Water, although it does not contain any carbon, because it is used in large quantities by organisms and is essential for their biochemical processes, it can also be considered a macronutrient.
- Micronutrients are needed in relatively small amounts:
    - Vitamins play essential roles in many chemical processes in the body;
    - Minerals are naturally occurring inorganic substances;

All these nutrients are essential for the normal function of the human organism, and if even one of them is missing in our diet, our bodies will be disadvantaged. For a nutrient to be essential to human nutrition, it must meet two criteria:

- Elimination of a nutrient from the diet should lead to a nutritional deficiency and health decline (deterioration), and
- Returning that nutrient to the diet will remove the nutritional deficiency and improve health (the individual's condition will become normal).

Nutrients have multiple functions, some of which are vital for the human body. Nutrients provide energy, build the body, protect the body and participate in metabolic processes. Based on their functions, nutrients can be divided into three groups:

1. Energy supply:
    a. Carbohydrates;
    b. Proteins;
    c. Fats (fats and oils).
2. Growth and development:
    a. Proteins;
    b. Lipids;
    c. Vitamins;
    d. Minerals;
    e. Water.

3. Regulation of body functions:
    a. Proteins;
    b. Lipids;
    c. Vitamins;
    d. Minerals;
    e. Water.

A food guide pyramid is a tool that, graphically, helps people understands how to eat healthily and how to plan a balanced healthy diet. A good healthy dietary composition provides us with the nutrients our body needs and decreases the risk of cardio respiratory and metabolic diseases. The authentic food guide pyramid was derived in the U.S.A. in 1992; at the time, this pyramid was adopted in many countries according to their culture and national dietary models and demographic. This "pyramid" consists of grouping foods a long with the amounts of each food group that should be consumed each day (six coloured stripes that represent: grains, vegetables, fruits, dairy, meat, as well as fats and oils).

The dispersion of foods from the base to the peak of the food guide pyramid is as below:

- Bread, grain, cereal and pasta;
- Vegetables and fruits;
- Dairy and proteins;
- Fats, oils & sweets.

All rules pertaining to the food guide pyramid are based on dietary guidelines and nutritional recommendations. The advised daily amounts of these foods for each group vary depending on the level of physical activity, body size, age and gender. In other words, this pyramid is a general guide that lets us choose a healthy diet for ourselves.

According to the food guide pyramid and nutritionists' advice, today's sportspeople and non-sportspeople alike should eat foods from all foods groups, but in different quantities. The purpose of a "varied diet" is to eat various healthy foods in order to gain normal body weight, lose excess body weight, or retain current body weight. A food diversity score helps us calculate the variety of the foods we eat during a given period. Everyone can achieve a varied diet if they eat a mixture of foods across the range of food groups and from within each food group. Nutritionists prefer, especially for sportspeople, to eat plenty of fruits, vegetables, low-fat milk products, fish, lean meat, grains, and legumes. They should limit foods, high in salt, cholesterol, and saturated fat.

Metabolism is defined as different chemical reactions that occur in a living organism, that provide the energy needed to develop the organism's vital functions, in short, to maintain life. These chemical reactions or

processes convert the fuel from food into the energy required to do everything from moving, thinking, growing, reproducing, and other functions. Metabolism is usually divided into two categories:

- **Anabolism,** pertaining to building and storing; and
- **Catabolism**, the processes that produce the energy required for all activities in the cells.

Based on the level of intensity and duration of exercise, there are three main methods for converting nutrients to energy (ATP) for use in exercise: the phosphagen (immediate) pathway, the anaerobic (glycolytic) pathway, and the aerobic pathway. During high-intensity dynamic exercise (e.g. sprinting, track cycling, or interval training), the breakdown of ATP (adenosine triphosphate), CP (creatine phosphate) and glycogen-lactic acid degradation in the muscle, are the major sources of energy. The number of food calories (the amount of energy provided) that one needs varies according to age, height, weight, gender, and activity level. For those whose calorie intake is higher than that expended through regular daily activity or exercise, they are more likely to be overweight.

Body Mass Index (BMI) is a statistical , which can only be measured indirectly. BMI evaluates the body mass by showing the proportion between the bodyweight (as a three-dimensional anthropometric variable) and the body height squared (as a one-dimensional anthropometric variable): BMI=BW/BH2 (kg/m2). This anthropometric index is a handy indicator of healthy body weight according to the body height of a person. The values of BMI that show normal weight for men are between 20.1 and 25, whereas for women, they are between 18.7 and 23.8. Higher values of BMI indicate a possibility of being overweight, while lower values indicate being underweight. There are still soanthropometric variable RNI me problems in using BMI to determine if a person is overweight. While some people with very developed muscle tissue could have a BMI above the normal range, others are genetically predisposed to having a higher BMI or have a different body fat distribution. So, for these categories of people as well as some others, different BMI criteria are needed.

Reference Nutrient Intake (RNI) is a table of guidelines containing recommended intake amounts for each vitamin and mineral according to age, gender and physical condition. The RNI value should be sufficient, or greater than the individual needs, to prevent deficiencies for 97.5% of people. RNI is used as the basis for nutritional requirements in planning diets and menus for institutions and specific population groups. The RNI value can vary from country to country. Because it is usually higher than people's needs, dieticians and nutritionists prefer not to use it during the planning of an individual's diet. Furthermore, the fact that according to

RNI, people take higher amounts of the nutrients than they require in reality, they risk creating an imbalance between input energy and output (expended) energy (Ei > Eo = overweight).

Free radicals are atoms/molecules with an odd number of electrons and "extra energy" that make them unstable and highly reactive. Free radicals can be produced constantly in our bodies due to normal metabolic processes or introduced from the environment. They occur continuously in the cells as a consequence of both enzymatic and non-enzymatic reactions. Free radicals create a destructive process in our cells that can make the molecules within unstable. These atoms/molecules affect different health conditions, including the ageing process, many cancers, cardiovascular diseases, and muscle soreness (after exercise).

Antioxidants are vitamins, minerals, or enzymes in our blood, which disarm free radicals by neutralising their harmful effects on the cell (anti-oxidative effect). Antioxidants block the process of oxidation by donating one electron to free radicals in order to neutralise (disarm) them. Antioxidants are believed to be very important in preventing the expansion of chronic cardiovascular diseases (atherosclerosis), cancer, Alzheimer's disease, rheumatoid arthritis, and cataracts. According to some studies, athletes' use of dietary supplements high in antioxidants induced lower increases in blood lactate concentration after a maximal exercise test. Antioxidants could also improve the efficiency by which aerobic energy is obtained. In the process of neutralising free radicals, antioxidants themselves become oxidised, and so our body constantly needs to be supplied with antioxidants. Non-athletes can replenish their requirement for antioxidants by eating varied diets rich in antioxidants according to their RDA (Recommended Dietary Allowance). With athletes, it is different because their needs for antioxidants are higher than for non-athletes, so in addition to eating varied natural food, they might take a daily antioxidant supplement.

Sports Nutrition, as a branch of nutrition, aims to practically apply all theoretical nutritional knowledge to compile an adequate daily nutrition plan for those involved in sports. This should sufficiently provide fuel for physical activity, the process of repair and recuperation after physical activities, and optimize athletic performance during competitive events, while also promoting overall health and wellness. Certainly, Sports Nutrition, with its theoretical knowledge and practical application, facilitates and fulfils the work of Sports Medicine and Sports Science. As with other areas in Sports Science, Sports Nutrition is in the process of constant change and evolution. In this way, the recommendations given to athletes today are different from those given even just a few years ago.

Sports nutrition provides athletes with a balanced method for eating healthy and satisfying foods and maintaining proper hydration, while increasing their psychophysical performance. This method will differ depending on the respective phase of active sports life that the athlete is currently in (workout/preparation phase, competitive phase, or transition/rest/recovery phase).

What the athlete eats before an athletic competition (or a basic training workout) can significantly affect the athlete's performance and recovery. Whether the athlete's body uses fats or carbohydrates as the primary fuel source depends on exercise intensity and duration. Although the basics of sports nutrition are similar for all athletes, there are substantial differences between athletes engaged in different sports (e.g. dietary needs of endurance sports athletes differ from the dietary requirements of athletes taking part in strength/power sports). The optimal composition of an athlete's diet depends on the type of sport (intensity, frequency, and duration of training) and whether they need to manipulate their body weight or body composition. Athletes need to individualize dietary advice based on scientific principles and incorporate it into their daily routine. As for sports nutrition for vegetarian athletes, they must take extra care to avoid deficiencies of iron, zinc and B12, which can damage the athletes' health and negatively impact their sports performance.

During the training period, healthy and appropriate nutrition allows the athlete to stay healthy, maintain physique, avoid injury, and adapt better and faster to the training process.

Some of the main goals of sports nutrition can be:

- Preparing athletes for training;
- Maintaining the level of performance achieved;
- Speeding up recovery after training in some sports;
- Maintaining body shape from an aesthetic point of view (e.g. bodybuilding);
- Maintaining body weight in sports where categorization is required.

Research to date has shown that regular and healthy eating (well-balanced nutrition), both in terms of quantity and quality, can significantly affect athletes' health and improve their sports performance. In this regard, we will mention the proposals of the well-known American nutritionist, Dr Jonny Bowden[59]. Among his suggestions for maintaining health and reducing medical check-ups, he proposes the following:

- Avoid saturated fats in the list of foods consumed;
- Do not smoke;

- Increase or ensure regular physical activity (isometric and isotonic);
- Reduce sugar consumption;
- Eat fish at least twice a week;
- Consume many fruits and vegetables (e.g. up to 9 times a day);
- For the preventative benefits of vitamin D, sunbathing is encouraged;
- Build good family relationships and cultivate a positive spirit.

Consistent healthy nutrition in athletes can improve their endurance (aerobic skills) by up to 40%, improve force intensity up to 25%, significantly shorten recovery time, reduce the possibility of injury, and prolong their sports career. Meanwhile, an irregular and unhealthy diet significantly affects the decline of athletes' physical abilities, increases recovery time, increases the possibility of bodily injuries, and shortens their active sports life. It is still possible for an athlete who does not eat healthily and regularly to continue his sports activity, score good results, and even become a champion (there are many such cases). However, these results would be short-lived compared to the athlete who eats healthy and regularly. However, it is more than certain that only regular and healthy food (in terms of quantity, quality, and timing of meals) cannot replace a lack of natural skills (endogenous factor), lack of proper engagement during training processes or technical-tactical inability (exogenous factor).[4,5]

1.2 The history of sports nutrition

Human nutrition has gone through different historical periods. It is thought that during earlier time periods, the human diet mainly consisted of plants, then later on, also consuming various animals and fish. Not wanting to rely only on an irregular food supply, humans began to cultivate various plants and animals. As the number of people increased, humans began to engage in the provision of food across seasons - thus beginning the period of food production in its industrial form.

Lack of food for humankind has always been a problem that has preoccupied man during different periods of development. Today, in many countries with low economic development, various diseases caused by malnutrition occur due to lack of food. On the other hand, in developed countries, where food is in abundance (surplus), there are also nutritional disorders characterised by being overweight (obesity) and excessive fat tissue accumulation. Diseases like arteriosclerosis, with all its complications, diabetes, heart diseases and coronary artery diseases, are also affected by

how we eat. So, while in some cases increasing the amount of food improves health conditions, in others, reducing the amount of food improves health conditions.

Ancient Greek and Roman physicians, philosophers and writers (Socrates, Cicero, Hippocrates, Galen, etc) have left writings on the occurrence and impact of hunger and food on the cure of various diseases. According to Hippocrates, there can be serious health consequences if a person remains on a diet for more than seven days. Also, according to Hippocrates, to lose excess body weight, one should take food only once a day and walk as much as possible. Socrates, for weight loss, prescribes dancing to exhaustion. Galen, meanwhile, has proposed starvation treatment as a form of cure.

Until the sixteenth century, the development of the science of nutrition was unknown. In the 16th century, the Italian physician Sanctorius (1561-1636) conducted an experiment in which he compared changes in body weight with the amount of food consumed, but without giving any concrete explanations.

In the eighteenth century, the modern development of physiology and biochemistry began, which, in addition to the development of sports, helped develop the science of nutrition. The Italian scientist, Spallanzani, has devoted his research to the digestion of food in the stomach and the role of gastric juice.

The English scientist Joseph Priestley and the French scientist Antoine Lavoisier, with their experiments, proved that the food taken into the body is burned, and the man who works harder also needs more food. The French scientist, Antoine Lavoisier, is also known as the 'Father of Nutrition'. The famous French doctor, François Magendie, divided food into the nitrogen-containing group (proteins) and the nitrogen-free group and confirmed that nitrogen-containing food is a necessity for life. The German philosopher Carl Voit experimentally proved the importance of proteins in building and regenerating tissues.

It is interesting to note how sports nutrition science and practice has evolved over the past decades and centuries. Awareness of the history of sports nutrition is important because it can help understand current practice in this science. Listed below are some examples of historical knowledge and writings, dating back to ancient times, regarding the influence of food on human health:

- 6th Century BCE–Milo, a Crotan (now Calabria) wrestler, won 32 wrestling competitions (Olympic, Pythian, Isthmian, and Nemean Games). According to legend, he consumed 20 pounds of meat, 20 pounds of bread, and 8 quarts of wine per day.[6]

- 1809 – Considered to be the most famous pedestrian, Captain Barclay Allardice walked 1000 miles in 1000 hours. His dietary recommendations were: "Animal diet is alone prescribed, and beef and mutton are preferred. Vegetables are never given as they are watery and of difficult digestion. Fish must be avoided. Salt, spices and all kind of seasonings, except vinegar, are prohibited. It is an established rule to avoid liquids as much as possible".
- 1860–Australian sprinter Tom Cusack ate a bowl of soup, stewed mutton, eggs, toast and drank 3 cups of tea before racing.
- 1911–Physiologist Nathan Zuntz reported that fat and carbohydrates are used as fuel by exercising muscles.
- 1923-24–Researchers at the Boston marathon found that some runners finished the race with blood glycogen levels considered hypoglycaemic. The following year they reported that feeding candy to runners during the marathon improved their blood glucose levels and performance.
- 1928–It was reported that the contribution of carbohydrates to energy metabolism was proportional to the exercise intensity.
- 1953–According to the International Amateur Athletic Federation (IAAF) Guidelines for Distance Events, aid stations were allowed in the distance running events only after 15km, and water was permitted.
- 1969–Ron Hill first used the carbohydrate loading diet at the European Championship marathon in Athens. He won the race in 2:16:48.
- 1970's–Sports nutrition experts asserted that athletes' protein needs are not different from sedentary people.
- 1975–The ACSM (American College of Sports Medicine) published a position stand on thermal injuries during running, and promoted water as the ideal fluid for ingestion during endurance events. They warned against the consumption of carbohydrate solutions in concentrations greater than 2.5%.
- 1979–It was reported that caffeine ingestion before endurance exercise could increase time to exhaustion, and marathon runners started drinking black coffee before events.
- 1980's–Several studies demonstrated that carbohydrate ingestion during athletic events longer than 90 minutes improved performance. It was also reported that gastric emptying and fluid balance did not appear to be compromised with solutions under 8%.

- 1988–Professor Noakes warned of the potentially fatal risks of hyponatremia.
- 1990's–Sports drinks and other products like gels and bars were introduced and hailed as "a huge success in sports achievements".
- 1990–Professor Lemon reported that the protein needs of endurance and strength-training athletes are 50-100% higher than those of sedentary individuals.
- 1992–Professor Coyle demonstrated that dehydration, even at mild levels, impairs work output and causes an increased perception of effort when exercising in conditions of heat.
- 1996–An American supplement company declared a profit of 195 million dollars from the previous year's sales of Creatine.
- 1996–The ACSM published a position stand recommending the ingestion of carbohydrates at a rate of 30-60g/hour during events longer than one hour.
- 1998–Studies reported that high-intensity exercise performance of around 60 minutes could be improved by consuming carbohydrates during the event.
- 1999–Several athletes from different countries tested positive for the banned steroid Nandrolone.
- According to new guidelines, proteins and fats should be limited in the food ratio, while the amount of carbohydrates should be increased. Successful replenishment of carbohydrate stores cannot be done without prior rehydration of the body.[7,8,9,10]

Thoughts, suggestions and experiences related to nutrition like these, although some more correct than others, have all influenced the development of nutrition. The biggest mistake made in athlete nutrition has been relying on the nutritional needs of the average non-athlete. Previously, it was thought that athlete’s need for protein, carbohydrates and fats did not differ from non-athletes. Athletes' protein needs are also much smaller than previously thought. Meanwhile, the need for complex (slowly absorbed) carbohydrates is much greater, while the need for simple (rapidly absorbed) carbohydrates is minimal.

Three decades ago, it was thought that since sweating results in the loss of many minerals, athletes (especially those who compete in high outdoor temperatures) should not consume more than one litre of water per day. Today, this former commonly accepted concept and proposal, is now rejected as inaccurate, and even more so, as being harmful to health. The consequences of this misconception have been: poor sports results, premature termination of sports careers, damage to health, and numerous cases of death on sports fields.

According to the above-written ideas on nutrition developed over the centuries, we can conclude that sports nutrition practices have evolved significantly through the years, especially in the last two decades where we have witnessed a change in many beliefs regarding sports nutrition. An experimental approach to the field of human muscle energy metabolism had its start in the latter part of the 19th century.

1.3 The human digestive system

To supply the body with nutrients, consumed food enters the human digestive system and is subjected to various physical and chemical processes. This system also excretes unnecessary waste from the body. The gastrointestinal system secretes several hormones, such as gastrin, secretin, cholecystokinin, ghrelin and leptin, which act to regulate the digestion of nutrients.

The gastrointestinal system of an adult is approximately 5 meters long (when the muscles are toned), while in the dead (when the muscles lose tone) it reaches 9 meters.

The human digestive system consists of the following organs:

- Mouth, containing:
    - Teeth, which chew (grind) food;
    - Tongue, which tastes and mixes food in the mouth;
    - Saliva contains water and enzymes secreted by the salivary glands (parotid, sublingual and submaxillary). Saliva keeps the mouth moist and serves as a buffer for neutralizing acidic foods, as well as having antibacterial action;
- The pharynx is a passageway from the mouth that passes into the trachea and oesophagus. When food is digested, the epiglottis closes the passage to the trachea, while the uvula closes the passage to the nose, allowing food to pass freely into the oesophagus;
- The oesophagus is a muscular tube, approximately 22-30 cm long, which connects the pharynx with the stomach. The rhythmic contraction of its musculature enables food to go from the pharynx to the stomach. Inside the oesophagus, mucus is secreted that wets the swallowed food and makes it easier for it to pass to the stomach. The distal part of the oesophagus ends in a ring-shaped muscle mass that plays the role of a sphincter, effectively preventing food in the stomach from moving back to the oesophagus;

- The stomach is a J-shaped elastic muscular organ that connects the oesophagus to the intestines. It begins at the cardiac sphincter and ends with the pyloric sphincter. This organ can expand to hold about 2 litres of food. The stomach contains highly concentrated hydrochloric acid (HCL) with a pH between 1.5 and 3. HCL kills bacteria that enter the body from the outside and also breaks down proteins. The stomach wall secretes mucus, which coils and protect its wall from the action of HCL and pepsin;
- Duodenum (duodenum);
- Ileum (small intestine);
- Ileum (small intestine);
- The colon (large intestine), with its different parts (ascending, transverse, descending part, sigmoideum and rectum), extends from the cecum to the anal canal.

Food digestion means the process of breaking down nutrients into smaller molecules for easier absorption by the digestive tract (e.g. the breakdown of proteins into amino acids, carbohydrates into glucose, or fats into fatty acids and triglycerides). Nutrient degradation takes place via the mechanical and enzymatic activity of the gastrointestinal tract. The body then breaks down these nutrients, absorbs them, and uses them to build, nourish cells, and supply energy.

The human body is "inhabited" by trillions of different types of microorganisms, which constantly enter from the external environment. These organisms coexist in different parts of the body (skin, eyes, respiratory system, digestive system, urinary system) in a pre-determined order and harmony determined by our Creator. Coexistence and symbiotic relationships between microorganisms and the human body have led to the construction of an ecosystem of macro and micro life, the disruption of which would make human existence impossible.[11]

By symbiosis, we mean the (more or less) close relationship between organisms of different species, which are called symbionts. In 1873 the German botanist Heinrich Anton De Bary used the term "symbiosis" for the first time, to describe the relationship between different types of organisms, essentially the coexistence of organisms with different names.

Under the mutual relationship realized by coexisting organisms, we can distinguish several types of symbiosis:

- Parasitism, when coexistence between symbionts (organisms) is to the detriment of one of organisms;
- Mutualism, when coexistence is useful and necessary for both symbionts (organisms) involved;

- Commensalism, when only one symbiont (organism) benefits.

The other classification of symbiosis can be based on localization of the symbionts:

- Ectosymbiosis, when symbionts live on the outside of the body: skin, eyes, mouth, nose, respiratory tract and digestive tract;
- Endosymbiosis, when symbionts live in the intracellular spaces of the "host" organism.

The largest number of symbiont microorganisms live in the human digestive system, which itself is also a symbiont organism. Within an adult human's intestines reside almost 2 kg of bacteria, consisting of over 400 different species (99% of which are anaerobic). These are found in the lumen and intestinal mucosa, and under normal conditions never penetrate the intestinal wall (which can cause peritonitis and abscesses). These bacteria make up the normal gut bacterial flora, which can be divided into:

- The essential (normal) bacterial flora, consisting of the numerically and functionally dominant types of microorganisms found in healthy human intestines (bifidobacteria, Lactobacteria, Propionobacteria, physiological strains of Escherichia coli, Peptococcus and Enterococcus Peptococcus);
- The opportunistic flora, consisting of microbes that, under certain conditions, can cause major health problems. Science knows of over 500 species of these bacteria that can be found in the human gut, but this number is still limited in a healthy body. The most common types of these bacteria are Bacterioids, Peptococci, Staphylococci, Streptococci, Clostridia, Enterobacteriaceae (Proteus, Klebsiella, Citrobacter), Fusobacteriaceae, and many others;
- The transitional flora, comprising of bacteria that humans swallow daily through food or water.

The digestive system is the gateway for many pests of the human body (microorganisms, chemicals, toxins) that enter the body in various forms (via food and fluids). In a healthy organism, the intestines are protected by essential bacterial flora, and as long as this flora is undamaged, both the opportunistic flora and the transitional flora cannot harm human health.

The essential intestinal flora prevents infection by inhibiting the action of pathogenic bacteria. The oral use of antibiotics can destroy the essential intestinal flora, and thus, disrupt the relationship between the essential, opportunistic and transitional bacterial flora. Such a breakdown in the relationship between the three types of intestinal bacteria may favour an increase in the number of pathogenic exogenous and endogenous bacteria, which causes infection in the organism.[12, 13]