19FTO302 - FOOD NUTRITION

UNIT I -INTRODUCTION TO NUTRITION SCIENCE

TOPIC 1

Definition of the term - Food, Nutrition, Nutrients, Dietetics, Balance Diet, Health, Energy, Adequate Nutrition, Optimal Nutrition, Malnutrition, Under Nutrition, Over Nutrition, Phytochemicals, Prebiotics, Probiotics.

FOOD:

Food, substance consisting essentially of protein, carbohydrate, fat, and other nutrients used in the body of an organism to sustain growth and vital processes and to furnish energy. The absorption and utilization of food by the body is fundamental to nutrition and is facilitated by digestion. Plants, which convert solar energy to food by photosynthesis, are the primary food source. Animals that feed on plants often serve as sources of food for other animals. To learn more about the sequence of transfers of matter and energy in the form of food from organism to organism, *see* food chain.

Hunting and gathering, horticulture, pastoralism, and the development of agriculture are the primary means by which humans have adapted to their environments to feed themselves. Food has long served as a carrier of culture in human societies and has been a driving force for globalization. This was especially the case during the early phases of European trade and colonial expansion, when foods such as the hot red pepper, corn (maize), and sweet potatoes spread throughout Europe to Africa and Asia.

Food is treated in a number of articles. For a description of the processes of absorption and utilization of food, *see* nutrition; nutrition, human; digestion; and digestive system, human. For information on the methods used to prepare raw foods for cooking, consumption, or storage, *see* food preservation.

NUTRITION

Nutrition, the assimilation by living organisms of food materials that enable them to grow, maintain themselves, and reproduce.

Food serves multiple functions in most living organisms. For example, it provides materials that are metabolized to supply the energy required for the absorption and translocation of nutrients, for the synthesis of cell materials, for movement and locomotion, for excretion of waste products, and for all other activities of the organism. Food also provides materials from which all the structural and catalytic components of the living cell can be assembled. Living

organisms differ in the particular substances that they require as food, in the manner in which they synthesize food substances or obtain them from the surrounding environment, and in the functions that these substances carry out in their cells. Nevertheless, general patterns can be discerned in the nutritional process throughout the living world and in the types of nutrients that are required to sustain life. These patterns are the subject of this article. For a full discussion of the nutritional requirements of humans in particular, *see* the article nutrition, human.

Nutritional patterns in the living world

Living organisms can be categorized by the way in which the functions of food are carried out in their bodies. Thus, organisms such as green plants and some bacteria that need only inorganic compounds for growth can be called autotrophic organisms; and organisms, including all animals, fungi, and most bacteria, that require both inorganic and organic compounds for growth are called heterotrophic. Other classifications have been used to include various other nutritional patterns. In one scheme, organisms are classified according to the energy source they utilize. Phototrophic, or photosynthetic, organisms trap light energy and convert it to chemical energy, whereas chemoautotrophic, or chemosynthetic, organisms utilize inorganic or organic compounds to supply their energy requirements. If the electron-donor materials utilized to form reduced coenzymes consist of inorganic compounds, the organism is said to be lithotrophic; if organic, the organism is organotrophic.

NUTRIENTS

"Nutrients are the compounds in food that provide us with energy that facilitates repair and growth and helps to carry out different life processes."

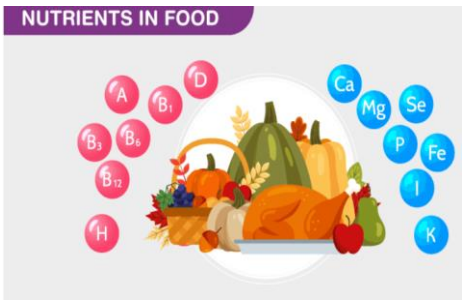
Not all nutrients provide energy but are necessary for some form or the other. These nutrients are divided into two categories:

- Macronutrients, which are required by the body in large amounts.
- Micronutrients, which are required by the body in small amounts.

Macronutrients provide energy to a living being for the function of the metabolic system. They provide massive energy has it is converted used to obtain energy. Macronutrients include fats, proteins, and carbohydrates.Micronutrient provides essential components for metabolism to be carried out. They also build and repair damaged tissues in order to control the body process. Micronutrients include calcium, iron, vitamins, iron, minerals and vitamin C.

Important Nutrients in Food

There are several nutrients that cannot be synthesized by the body and have to be taken externally through food. These are vital for the proper functioning of the body. The important nutrients and their functions include are mentioned below:



Carbohydrates

It is one of the main sources of energy for human beings. It comprises of three types of carbohydrates and they include fibre, sugar, and starch. They are usually low calories and thus help in maintaining a healthy diet.

Calcium

It is a mineral that is vital for building strong bones and teeth. In very fewer quantities it is also needed to our nerves, muscles work and heart. Sources of calcium include pudding, milk, yoghurt, tofu, canned fish, and fresh leafy green vegetables. Lack of calcium leads to a disease called Osteoporosis.

Cholesterol

It is essential for the brain, nerves, and development of cells. It plays an important role in the forming of enzymes and hormones. Foods include cheese, milk, chicken, beef, and fish.

Fats

It is one of the most important sources of calories. One gram of fat consists of 9 calories. It is almost twice of calories that we get from carbohydrates and proteins. Fat is usually found in foods that we use in cooking, as spreads on bread and it also found in snacks, pastries.

Iron

It is a constituent of our red blood cells. Its function is to carry oxygen from our lungs to organs, muscles, and cells. Food sources include spinach, soybeans and other leafy vegetables.

Protein

They are made of amino acids. We can obtain protein in foods such as nuts, lentils, beef, rice, chicken, beef etc.

Sodium

Foods like milk and fresh vegetables contain sodium. Lack of sodium might lead to high blood pressure.

DIETETICS

An academic program that prepares students to use advanced knowledge about food and nutrition to help prevent and treat disease and maintain and promote health. It is...

- People-oriented and science-focused
- Evidence-based
- The first step toward a professional credential

BALANCED DIET:

A balanced diet is one which provides all the nutrients in required amounts and proper proportions. It can easily be achieved through a blend of the four basic food groups. The

quantities of foods needed to meet the nutrient requirements vary with age, gender, physiological status and physical activity. A balanced diet should provide around 50-60% of total calories from carbohydrates, preferably from complex carbohydrates, about 10-15% from proteins and 20-30% from both visible and invisible fat.
In addition, a balanced diet should provide other non-nutrients such as dietary fibre, antioxidants and phytochemicals which bestow positive health benefits. Antioxidants such as vitamins C and E, beta-carotene, riboflavin and selenium protect the human body from free radical damage. Other phytochemicals such as polyphenols, flavones, etc., also afford protection against oxidant damage. Spices like turmeric, ginger, garlic, cumin and cloves are rich in antioxidants.

What are nutrient requirements and recommended dietary allowances (RDA)?

Requirements are the quantities of nutrients that healthy individuals must obtain from food to meet their physiological needs. The recommended dietary allowances (RDAs) are estimates of nutrients to be consumed daily to ensure the requirements of all individuals in a given population. The recommended level depends upon the bioavailability of nutrients from a given diet. The term bioavailability indicates what is absorbed and utilized by the body. In addition, RDA includes a margin of safety, to cover variation between individuals, dietary traditions and practices. The RDAs are suggested for physiological groups such as infants, pre-schoolers, children, adolescents, pregnant women, lactating mothers, and adult men and women, taking into account their physical activity. In fact, RDAs are suggested averages/day. However, in practice, fluctuations in intake may occur depending on the food availability and demands of the body. But, the average requirements need to be satisfied over a period of time.
Our diet must provide adequate calories, proteins and micronutrients to achieve maximum growth potential. Therefore, it is important to have appropriate diet during different stages of one's life . There may be situations where adequate amounts of nutrients may not be available through diet alone. In such high risk situations where specific nutrients are lacking, foods fortified with the limiting

HEALTH:

Health, in humans, the extent of an individual's continuing physical, emotional, mental, and social ability to cope with his or her environment.

This definition is just one of many that are possible. What constitutes "good" health in particular can vary widely. The rather fragile individual who stays "well" within the ordinary environment of his or her existence may succumb to a heart attack from heavy shovelling after a snowstorm; or a sea-level dweller may move to a new home in the mountains, where the atmosphere has a lower content of oxygen, and suffer from shortness of breath and anemia until his or her red blood cell count adjusts itself to the altitude. Thus, even by this definition, the conception of good health must involve some allowance for change in the environment.

Bad health can be defined as the presence of disease, good health as its absence—particularly the absence of continuing disease, because the person afflicted with a sudden attack of seasickness, for example, may not be thought of as having lost good health as a result of such a mishap.

Actually, there is a wide variable area between health and disease. Only a few examples are necessary to illustrate the point: (1) It is physiologically normal for an individual to have a high blood sugar content 15 to 20 minutes after eating a meal. If, however, the sugar content remains elevated two hours later, this condition is abnormal and may be indicative of disease. (2) A "healthy" individual may have developed an allergy, perhaps during early childhood, to a single specific substance. If the person never again comes in contact with the antigen that causes the allergy, all other factors remaining normal, he or she will remain in that state of health. However, should the individual come in contact with that allergen again, even 20 or 30 years later, he or she may suffer anything from a mild allergic reaction—a simple rash—to severe anaphylactic shock, coma, or even death, depending upon the circumstances. Thus it can be seen that, unlike disease, which is frequently recognizable, tangible, and rather easily defined, health is a somewhat nebulous condition and somewhat difficult to define.

Moreover, *physical condition* and *health* are not synonymous terms. A seven-foot-tall basketball player may be in excellent physical condition (although outside the range of normality for height) but may or may not be in good health—depending, for example, on whether the individual has fallen victim to an attack of influenza.

There are further problems in settling upon a definition of human health. A person may be physically strong, resistant to infection, and able to cope with physical hardship and other features of his or her physical environment and still be considered unhealthy if his or her mental state, as measured by behaviour, is deemed unsound. Mental health can itself be defined variously. Some say that a person is mentally healthy if he or she is able to function reasonably well and is emotionally and behaviorally stable. Others define it as the absence of mental disorder.

In the face of confusion about definitions of health, it is most useful, perhaps, to define health, good or bad, in terms that can be measured and interpreted with respect to the ability of the individual at the time of measurement to function in a normal manner, with respect to the likelihood of imminent disease. These measurements can be found in tables of "reference values" printed in textbooks of clinical medicine, diagnosis, and other references of this type. When an individual is given a health examination, the examination is likely to include a series of tests. Some of these tests are more descriptive than quantitative and can indicate the presence of disease in a seemingly healthy person. Such tests include the electrocardiogram to detect some kinds of heart disease; the electromyogram for primary muscle disorders; liver and gall bladder function tests; and X-ray techniques for determining disease or malfunction of internal organs.

Other tests give numerical results (or results that can be assigned numerical values—such as photometric colour determinations) that can be interpreted by the examiner. These are physical and chemical tests, including blood, urine, and cerebrospinal-fluid analyses. The results of the tests are compared with the reference values, and the physician receives clues as to the health of the patient and, if the values are abnormal, for the methods of improving the patient's health.

A major difficulty in the interpretation of test results is that of biological variability. Almost without exception, reference values for variables are means or adjusted means of large group measurements. For these values to have significance, they must be considered as lying somewhere near the centre point of a 95 percent range—i.e., the so-called ordinary range or, with reservations, the range from normal to the upper and lower borderline limits. Thus, the 2.5 percent below the lower limit and the 2.5 percent above the upper limit of the 95 percent

range are considered areas of abnormality or, perhaps, illness. Some areas have wide 95 percent ranges—blood pressure, for example, may vary considerably throughout the day (e.g., during exercise, fright, or anger) and remain within its range of normality. Other values have ranges so narrow that they are called physiological constants. An individual's body temperature, for example, rarely varies (when taken at the same anatomical site) by more than a degree (from time of rising until bedtime) without being indicative of infection or other illness.

ENERGY:

Energy, in physics, the capacity for doing work. It may exist in potential, kinetic, thermal, electrical, chemical, nuclear, or other various forms. There are, moreover, heat and work—i.e., energy in the process of transfer from one body to another. After it has been transferred, energy is always designated according to its nature. Hence, heat transferred may become thermal energy, while work done may manifest itself in the form of mechanical energy.

All forms of energy are associated with motion. For example, any given body has kinetic energy if it is in motion. A tensioned device such as a bow or spring, though at rest, has the potential for creating motion; it contains potential energy because of its configuration. Similarly, nuclear energy is potential energy because it results from the configuration of subatomic particles in the nucleus of an atom.

Energy can be neither created nor destroyed but only changed from one form to another. This principle is known as the conservation of energy or the first law of thermodynamics. For example, when a box slides down a hill, the potential energy that the box has from being located high up on the slope is converted to kinetic energy, energy of motion. As the box slows to a stop through friction, the kinetic energy from the box's motion is converted to thermal energy that heats the box and the slope.

Energy can be converted from one form to another in various other ways. Usable mechanical or electrical energy is, for instance, produced by many kinds of devices, including fuel-burning heat engines, generators, batteries, fuel cells, and magnetohydrodynamic systems.

In the International System of Units (SI), energy is measured in joules. One joule is equal to the work done by a one-newton force acting over a one-metre distance.

Energy is treated in a number of articles. For the development of the concept of energy and the principle of energy conservation, *see* principles of physical science; mechanics; thermodynamics; and conservation of energy. For the major sources of energy and the mechanisms by which the transition of energy from one form to another occurs, *see* coal; solar energy; wind power; nuclear fission; oil shale; petroleum; electromagnetism; and energy conversion.

ADEQUATE NUTRITION:

To maintain an active and healthy lifestyle, one needs to consume a diet in adequate quantity to meet our body's nutritional and energy requirements. Scientific research has said that for healthy growth and development of an individual, it is necessary to take an adequate amount

of at least 50 nutrients. When any of these nutrients are inadequately taken, an individual's growth and development are impaired, leading to health issues. A healthy diet reduces the risk of cancer, diabetes, heart disease, and stroke. Increased production of packaged and processed foods has changed many people's lifestyles and dietary patterns.

What Is an Adequate Diet?

An adequate diet is a diet that should meet all the nutritional and energy requirements that a person needs, and it can be of any form, such as carbohydrates, proteins, fats, etc.

The adequate level of needs is different for infants, children, girls, boys, men, and women, as per recommended dietary allowances.

OPTIMAL NUTRITION

Optimal nutrition refers to the intake of a well-balanced and nutrient-dense diet that meets the individual's specific nutritional needs. It is the cornerstone of a healthy lifestyle and plays a crucial role in the prevention of chronic diseases, maintenance of a healthy weight, and overall well-being. Optimal nutrition is not just about eating a sufficient amount of calories; it focuses on consuming the right nutrients in the right proportions to support the body's functions and promote optimal health.

To achieve optimal nutrition, it is essential to understand the concept of macronutrients and micronutrients. Macronutrients include carbohydrates, proteins, and fats, which provide energy to the body. These nutrients should be consumed in appropriate amounts to meet the body's energy requirements. Micronutrients, on the other hand, include vitamins and minerals that are necessary for various physiological processes in the body. These nutrients are required in smaller amounts but are equally important for overall health.

Key Components of Optimal Nutrition

Balanced Diet: A balanced diet is the foundation of optimal nutrition. It involves consuming a variety of foods from different food groups in the right proportions. A balanced diet should include whole grains, fruits, vegetables, lean proteins, healthy fats, and low-fat dairy products. This ensures that the body receives a wide range of essential nutrients.

Macronutrient Distribution: The distribution of macronutrients in the diet is crucial for optimal nutrition. The recommended distribution is approximately 45-65% of calories from carbohydrates, 20-35% from fats, and 10-35% from proteins. This ensures an adequate intake of energy, essential fatty acids, and amino acids.

Micronutrient Adequacy: A diet that is rich in vitamins and minerals is essential for optimal nutrition. Including a variety of colorful fruits and vegetables, whole grains, and lean proteins can help ensure an adequate intake of essential micronutrients. Additionally, fortified foods and supplements can be used to fill any nutrient gaps.

Malnutrition

Malnutrition, physical condition resulting either from a faulty or inadequate diet (i.e., a diet that does not supply normal quantities of all nutrients) or from a physical inability to absorb or metabolize nutrients.

Acquired causes

Malnutrition may be the result of several conditions. First, sufficient and proper food may not be available, because of inadequate agricultural processes, imperfect distribution of food, or certain social problems such as poverty or alcoholism. In these instances, the cause of malnutrition is most often found to be a diet quantitatively inadequate in calories or protein.

Malnutrition may also result when certain foods containing one or more of the essential vitamins or minerals are not included in the diet. This commonly leads to specific nutritional deficiency diseases. Aging, sickness, and other factors that contribute to poor appetite can result in inadequate food consumption. Likewise, poor eating habits and food preferences may lead to malnutrition through the habitual consumption of certain foods to the exclusion of others or of large quantities of nonnutritious foods. In certain parts of Africa, for example, the practice of weaning breast-fed infants to a diet consisting chiefly of one kind of starchy food, such as cassava, may lead to protein deficiency (*see* kwashiorkor). In parts of East Asia, a restricted selection of foods and a preference for white polished rice as a dietary staple has led to the prevalence of a deficiency of thiamin (vitamin B_1), which is found mainly in the germ and bran of grain (*see* beriberi). Multiple deficiencies are more likely to occur than single deficiencies, though the manifestations of one type usually predominate.

Role of metabolic defects

Malnutrition can also arise from acquired or inherited metabolic defects, notably those involving the digestive tract, liver, kidney, and red blood cells. These defects cause malnutrition by preventing the proper digestion, absorption, and metabolism of foodstuffs by organs and tissues.

Symptoms and treatment

Symptoms of malnutrition typically are self-apparent, with affected individuals commonly exhibiting weight loss, fatigue, and muscle weakness. Decreased immune function, dry skin, tooth decay, osteoporosis, dizziness, and mental disturbances (e.g., inability to concentrate) may also be present. Children who experience malnutrition over a prolonged period tend to be chronically underweight and may not develop normally, resulting in long-term consequences such as short stature.

Treatment for malnutrition depends on the cause. Food or meal delivery services may be used to ensure access to food, particularly in the case of elderly individuals. Persons who are severely affected may require hospitalization and use of a feeding tube. In many cases, however, simple dietary adjustments can readily reverse most harmful effects of malnutrition. Dietary supplements, such as vitamins and minerals, may be taken to aid recovery. Pastes or meals made from a specific combination of foods, with ingredients such as chickpeas, peanuts, bananas, and healthy oils, can greatly benefit the rehabilitation of normal gut microbial populations. Research in malnourished children has shown that such combinations of nutrients and accompanying improvements in the gut microbiome not only promote weight gain but also help restore overall metabolic function, which can impact bone growth, immunity, and other factors.

UNDER NUTRITION:

Undernutrition is usually thought of as a deficiency primarily of calories (that is, overall food consumption) or of protein. Deficiencies of vitamins and deficiencies of minerals are usually considered separate disorders. However, when calories are deficient, vitamins and

minerals are likely to be also. Undernutrition, which is often used interchangeably with malnutrition, is actually a type of malnutrition.
Protein-energy undernutrition (also called protein-energy malnutrition) is a severe deficiency of protein and calories that results when people do not consume enough protein and calories for a long time.

In countries with high rates of food insecurity, protein-energy undernutrition often occurs in children. It contributes to death in more than half of children who die (for example, by increasing the risk of developing life-threatening infections and, if infections develop, by increasing their severity). However, this disorder can affect anyone, regardless of age, if food supplies are inadequate.

Worldwide, the most important preventive strategy is to reduce poverty and to improve nutritional education and public health measures.

Protein-energy undernutrition has three main forms:

- Marasmus
- Kwashiorkor
- Marasmic kwashiorkor

Marasmus

Marasmus is a severe deficiency of calories and protein. It tends to develop in infants and very young children. It typically results in weight loss, loss of muscle and fat, and dehydration. Breastfeeding usually protects against marasmus.

Kwashiorkor

Kwashiorkor is a severe deficiency more of protein than of calories. Kwashiorkor is less common than marasmus. The term is derived from an African word meaning “first child–second child” because a first-born child often develops kwashiorkor when the second child is born and replaces the first-born child at the mother’s breast. Because children tend to develop kwashiorkor after they are weaned, they are usually older than those who have marasmus.

Kwashiorkor tends to be confined to certain areas of the world where staple foods and foods used to wean babies are deficient in protein even though they provide enough calories as carbohydrates. Examples of such foods are yams, cassava, rice, sweet potatoes, and green bananas. However, anyone can develop kwashiorkor if their diet consists mainly of carbohydrates. People with kwashiorkor retain fluid, making them appear puffy and swollen. If kwashiorkor is severe, the abdomen may protrude.

Marasmic kwashiorkor

Marasmic kwashiorkor occurs when a child with kwashiorkor does not consume enough calories. People with this disorder retain fluid, and their muscle and fat tissue waste away.

Starvation

Starvation is the most extreme form of protein-energy undernutrition. It results from a total lack of nutrients for a long time. It usually occurs because food is unavailable (for example, during a famine), but it occasionally occurs when food is available (for example, when people fast or have anorexia nervosa).

OVER NUTRITION:

Overnutrition happens when you take in more of a nutrient (or nutrients) than you need every day. While many people think malnutrition means a lack of nutrients, overconsumption is also considered malnutrition because it has negative health consequences.

Energy Overnutrition

Consuming too many calories (or energy) will cause you to gain weight over time unless you increase your physical activity. It doesn't matter if those extra calories come from macronutrients (fat, carbohydrates, or protein), because the body takes whatever it doesn't need and store it as fat.

Energy overnutrition is common in developed countries. Sometimes, people with this type of overnutrition may also experience micronutrient undernutrition if the foods they eat are high in calories but low in micronutrients.

Micronutrient Overnutrition

Micronutrient overnutrition occurs when you consume too much of a certain nutrient. It's possible to get too much of most vitamins or minerals. Usually, this happens when you take megadoses of dietary supplements. Getting too much of any micronutrient from food is rare.

Micronutrient overnutrition can cause acute poisoning, such as taking too many iron pills at once. It can also be chronic if you take large doses of a particular vitamin (such as vitamin B6) over several weeks or months.

PHYTOCHEMICALS:

Phytochemicals are non-nutrient bioactive components that are primarily responsible for scavenging toxic radicals after oxidative stress by generating antioxidants, the main cause of most chronic diseases. Fruit phytochemicals displayed high antioxidant capacities linked to lower incidence of degenerative diseases and lower mortality average in humans.

Among the phytochemicals mentioned as potentially providing health benefits are polyphenols, flavonoids, isoflavonoids, anthocyanidins, phytoestrogens, terpenoids, carotenoids, limonoids, phytosterols, glucosinolates, and fibers.

Phytochemicals have great antioxidant potential and are of great interest due to their beneficial effects on health of human beings, and they give immense health benefits to the consumers. Epidemiological and animal trials suggest that the regular consumption of fruits, and vegetables, and whole grains reduces the risk of various diseases linked with oxidative damage . The natural antioxidants are classified into two categories namely in vitro and in vivo antioxidants. Free radical scavengers act as hydrogen donors, electron donor, peroxide decomposer, singlet oxygen quencher, enzyme inhibitor, synergist, and metal-chelating agents.

PREBIOTICS:

The concept of prebiotics was initially suggested by Glenn Gibson and Marcel Roberfroid in 1995. Prebiotic was defined as "a non-digestible food element that promotes host health by selectively encouraging the growth and/or activity of one or a restricted number of beneficial bacteria in the colon."

There are numerous varieties of prebiotics. The majority of them are a subset of carbohydrate groups and are largely oligosaccharide carbohydrates (OSCs) (OSCs).

1. Fructans

This category includes inulin, fructo-oligosaccharides, and oligofructose. Their structure consists of a linear fructose chainwith β(2→1) linkage.Typically, they have terminal glucose units connected by β(2→1) linkage.Inulin has a DP of up to 60 whereas FOS has a DP of less than 10.

2. Galacto-Oligosaccharides

Galacto-oligosaccharides (GOS), the outcome of lactose extension, are divided into two subgroups: I GOS with extragalactose at C3, C4, or C6; and GOS produced from lactose via enzymatic trans-glycosylation.This reaction produces mostly a mixture of tri- to pentasaccharides including galactose in β(1→6), β(1→3), and β(1→4)links.This form of GOS is also known as TOS or trans-galacto-oligosaccharides. GOSs can considerably boost Bifidobacteria and Lactobacilli. Infant Bifidobacteria have demonstrated strong GOS incorporation. GOS also stimulates Enterobacteria, Bacteroidetes, and Firmicutes, but to a lesser amount than Bifidobacteria.

3. Starch and Glucose-Derived Oligosaccharides

There is a type of starch called as resistant starch that is resistant to digestion in the upper digestive tract (RS).It has been claimed that RS should be categorised as a prebiotic because it produces a high level of butyrate. DiverseFirmicutes groupings have the highest incorporation of RS.In vitro research indicated that Ruminococcus bromii, Bifidobacterium adolescentis, Eubacterium rectale, and Bacteroidesthetaiotaomicrobe were also capable of degrading RS.In the mixed bacterial and faecal incubations, however, RS decomposition is impossible without R. bromii.Polydextrose is a glucose-derived oligosaccharide. It is composed of glucan with many branches and glycosidic bonds.Some data suggests that it can activate Bifidobacteria, however this has not yet been verified.

4. Other Oligosaccharides

Some oligosaccharides are derived from pectin, a polysaccharide. This oligosaccharide is referred to as pectic oligosaccharide (POS). They are based on the elongation of galacturonic acid or rhamnose (rhamnogalacturonan I). The carboxyl groups can be methyl esterified, and the structure can be acetylated at C2 or C3.The side chains are connected to various sugars (such as arabinose, galactose, and xylose) or ferulic acid. Their topologies differ considerably based on the origins of POSs.

PROBIOTICS:

Probiotic, any of various live microorganisms, typically bacteria or yeast, that are ingested or otherwise administered as a means of potentially aiding the prevention and treatment of certain health conditions, primarily gastrointestinal disorders. The notion that the ingestion of certain microorganisms can benefit digestion as well as immune function emerged in the early 20th century, with the work of Russian-born zoologist and microbiologist Élie Metchnikoff. Interest in probiotics surged in the early 21st century, when more became known about the human microbiome.

Some of the most commonly used probiotics are lactic-acid bacteria, namely strains of *Lactobacillus* and *Streptococcus*, which are normal components of the human microbiome and have been used for centuries in the production of yogurt, cheese, and some pickled foods. Other types of probiotics include certain strains of *Bifidobacterium* bacteria and the yeast *Saccharomyces boulardii*. Often, the various probiotic microorganisms, in addition to occurring naturally in certain foods, are sold over the counter as capsules, powders, liquids, or chewable tablets.

Probiotics have been studied for the prevention and treatment of a variety of gastrointestinal conditions, including Crohn disease, ulcerative colitis, and pouchitis (inflammation of a surgically created rectum in patients who have had their large intestine and rectum removed). In general, these studies indicate that, for most people who are at risk of or who are affected by these conditions, probiotics have little or no detectable benefit. The most-convincing evidence for their effectiveness comes from studies of diarrheal diseases, particularly in children. For example, the use of *S. boulardii* has been associated with a reduction in the frequency of diarrheal episodes in children with acute diarrhea. Likewise, certain strains of probiotics, such as *L. rhamnosus* GG, may have modest effects in reducing the duration of infectious diarrhea. *L. rhamnosus* GG and *S. boulardii* may be effective in preventing antibiotic-associated diarrhea in children and adults.

Although generally considered to be safe, probiotics have been associated with severe bacteremia (bacterial infection of the blood) and fungemia (fungal infection of the blood) in patients whose immune systems are compromised. Probiotic-associated bacteremia has been reported in individuals with severe ulcerative colitis. In preterm infants, probiotics have proven beneficial, reducing the likelihood of necrotizing enterocolitis, but cases of probiotic-associated sepsis have been documented. In addition, although microorganisms are incorporated into commercial products that are marketed and sold as health-promoting probiotics, direct evidence is lacking for the ability of many such over-the-counter probiotics to promote well-being in otherwise healthy individuals.