كُلُوا وَاشْرَبُوا وَلَا تُسْرِفُوا

DIET AND NUTRITION

In Holistic System of Medicine

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A Complete Guidebook to become a Nutritionist

“Then let the man pay attention to his food.”. (‘Abasa: 24).

Human’s need for eating and food intake is his most important daily necessity, which accompanies him from birth to death, and even the prophets and divine authorities are no exception. God has given food to human for his health, life, and ability to perform his duties.

Healthy Nutrition is taken into consideration in the Islamic religion from many other viewpoints too. One of the medical miracles of the Holy Qur’an that plays an important role in the mental and physical health of the community is the blame for extremism in eating and drinking. Having regular and healthy balanced nutrition not only contributes to live a long and healthy life, but also affects mental health. It also promotes maturity and intellectual growth.

Imam Sadeq (AS) also says: “Eating less is commendable in every situation and among all tribes, for it has an intrinsic beneŸit and it is beneŸicial to physical appearance as well”

As we know, many diseases and illnesses can be prevented by keeping an eye on healthy nutrition.

Imam Sadeq (AS) said to the Hindu physician: “I carry a better stuff than yours ... I use what the Prophet (PBUH) has said, and I know that the stomach is the home of every pain and avoidance is the only cure”.

Food is that which nourishes the body. Food may also be defined as anything eaten or drunk, which meets the needs for energy, building, regulation and protection of the body. In short, food is the raw material from which our bodies are made. Intake of the right kinds and amounts of food can ensure good nutrition and health, which may be evident in our appearance, efficiency and emotional well-being

Nutrition has been defined as food at work in the body. Nutrition includes everything that happens to food from the time it is eaten until it is used for various functions in the body. **Nutrients** are components of food that are needed by the body in adequate amounts in order to grow, reproduce and lead a normal, healthy life. Nutrients include water, proteins, fats, carbohydrates, minerals and vitamins. There are several nutrients in each of the groups: proteins, fats, carbohydrates, minerals and vitamins; hence the plural form of these words has been used. Thus there are over 40 essential nutrients supplied by food, which are used to produce literally thousands of substances necessary for life and physical fitness. The study of the science of nutrition deals with what nutrients we need, how much we need, why we need these and where we can get them. Nutrition is the result of the kinds of foods supplied to the body and how the body uses the food supplied.

Adequate, optimum and good nutrition are expressions used to indicate that the supply of the essential nutrients is correct in amount and proportion. It also implies that the

utilisation of such nutrients in the body is such that the highest level of physical and mental health is maintained throughout the life-cycle.

Nutritional status is the state of our body as a result of the foods consumed and their use by the body. Nutritional status can be good, fair or poor.

The characteristics of **good nutritional status** are an alert, good natured personality, a well developed body, with normal weight for height, well developed and firm muscles, healthy skin, reddish pink colour of eyelids and membranes of mouth, good layer of subcutaneous fat, clear eyes, smooth and glossy hair, good appetite and excellent general health. General good health is evident by stamina for work, regular meal times, sound regular sleep, normal elimination and resistance to disease.

Poor nutritional status is evidenced by a listless, apathetic or irritable personality, undersized poorly developed body, abnormal body weight (too thin or fat and flabby body), muscles small and flabby, pale or sallow skin, too little or too much subcutaneous fat, dull or reddened eyes, lustreless and rough hair, poor appetite, lack of vigour and endurance for work and susceptibility to infections. Poor nutritional status may be the result of poor food selection, irregularity in schedule of meals, work, sleep and elimination.

The WHO (World Health Organization) has defined health as the 'state of complete physical, mental and social well-being and not merely the absence of disease or infirmity'.

Malnutrition means an undesirable kind of nutrition leading to ill-health. It results from a lack, excess or imbalance of nutrients in the diet. It includes undernutrition and overnutrition. Undernutrition is a state of an insufficient supply of essential nutrients.

Malnutrition can be primarily be due to insufficient supply of one or more essential nutrients; or it can be secondary, which means it results from an error in metabolism, interaction between nutrients or nutrients and drugs used in treatment.

Overnutrition refers to an excessive intake of one or more nutrients, which creates a stress in the bodily function. Diet refers to whatever you eat and drink each day. Thus it includes the normal diet you consume and the diet people consume in groups (hostel diet). Diet may also be modified and used for ill persons as part of their therapy (therapeutic diets).

Nutritional care is the use of nutritional knowledge in planning meals and the preparation of these meals in an acceptable and attractive manner to feed people. It involves assessment of the exiting meal patterns and improving these in an acceptable manner. While the nutritional plan may be general for a group of people, the actual execution is individualized to suit the person's needs and background. Thus one has to use a lot of ingenuity to succeed in making nutritional care effective in practical terms. Health the word health refers to the condition of the body, good health not only implies freedom from disease, but physical, mental and emotional fitness as well.

Functions of Food

Physiological functions of food

The first function of the body is to provide energy. The body needs energy to sustain the involuntary processes essential for continuance of life, to carry out professional, household and recreational activities, to convert food ingested into usable nutrients in the body, to grow and to keep warm. The energy needed is supplied by the oxidation of the foods consumed.

The foods we eat become a part of us. Thus one of the most important functions of food is building the body. A newborn baby weighing 2.7-3.2 kg can grow to its potential adult size of 50–60 kg if the right kinds and amounts of food are eaten from birth to adulthood. The food eaten each day helps to maintain the structure of the adult body, and to replace worn out cells of the body.

The **third function of food** is to regulate activities of the body. It includes regulation of such varied activities as:

- Beating of the heart
- Maintenance of the body temperature
- Muscle contraction
- Control of water balance
- Clotting of blood
- Removal of waste products from the body.

The **fourth function** of food is to improve our body's resistance to disease.

The Psychological Functions of Food

In addition to satisfying physical and social needs, food must satisfy certain emotional needs. These includes a sense of security, love and attention. Thus familiar foods make us feel secure. Anticipating needs and fulfilling these are expressions of love and attention. These sentiments are the basis of the normal attachment to the mother's cooking. Sharing of food is a token of friendship and acceptance. In a friendly gathering we try unfamiliar foods and thus enlarge our food experiences. It must be noted that even a nutritionally balanced meal may not be satisfying to the individual, if the foods included are unfamiliar or distasteful to him/her. With time and repeated experience, strange foods become familiar and new tastes are formed. These aspects are important in food acceptance and must be considered in planning meals, which are not only nutritionally adequate, but also enjoyable for the group for whom they are intended. Functions of Nutrients The foods which we use daily include rice, wheat, dal, vegetables, fruits, milk, eggs, fish, meat, sugar, butter, oils, etc. These different foods are made up of a number of chemical components called nutrients. These are classified according to their chemical composition. Each nutrient class has its own function, but the various nutrients must act in unison for effective action. The nutrients found in foods are — carbohydrates, proteins, fats, minerals, vitamins and

water. Fibre is also an essential component of our diet. The functions of nutrients are given below.

Carbohydrates: Starch found in cereals and sugar in sugarcane and fruits are examples of carbohydrates in foods. The chief function of carbohydrates is to provide energy needed by our body. Those not used immediately for this purpose are stored as glycogen or converted to fat and stored, to be mobilised for energy supply when needed.

Fats: Oils found in seeds, butter from milk, and lard from meat, are examples of fats found in foods. Fats are concentrated sources of energy, carriers of fat soluble vitamins and a source of essential fatty acids. If excess fats are taken in the diet, these are stored as fat reserves in the body. Energy taken in excess of body needs, is stored as fat in the body.

Proteins: Casein from milk, albumin in egg, globulins in legumes and gluten in wheat, are examples of proteins occurring in foods. The main function of protein is the building of new tissues and maintaining and repair of those already built. Synthesis of regulatory and protective substances such as enzymes, hormones and antibodies is also a function of food proteins. About 10 per cent of the total energy is supplied by proteins in the diet. Protein, when taken in excess of the body's need, is converted to carbohydrates and fats and is stored in the body.

Minerals: The minerals calcium, phosphorus, iron, iodine, sodium, potassium and others are found in various foods in combination with organic and inorganic compounds. Minerals are necessary for body-building, for building of bones, teeth and structural parts of soft tissues. They also play a role in regulation of processes in the body, e.g., muscle contraction, clotting of blood, nerve stimuli, etc.

Vitamins: Fat-soluble vitamins A, D, E and K and also water-soluble vitamins C and B group are found in foods. These are needed for growth, normal function of the body and normal body processes.

Water: We get water in foods we eat and a major part from the water we drink as such and as beverages. Water is an essential part of our body structure and it accounts for about 60 per cent of our body weight. Water is essential for the utilisation of food material in the body and also for elimination of food waste. It is a regulator of body processes such as maintenance of body temperature.

- **WATER IS NOT A HUMOR** Water is an essential part of biological systems, and Unani medicine considers the state of hydration as an integral part of the four temperaments. However, the watery fraction of the blood and other substances is not a humor because it does not nourish but is necessary to soften the food and facilitate its absorption. Water assists in taking out waste in urine. An excess of water thins the humors and may cause some health problems like nosebleed and loose bowels. Loss of the water fraction from a humor causes its precipitation or combustion, according to Avicenna's terminology .

All individuals need the same nutrients for the same body function. The only variation is in the amounts of each nutrient required according to age, size, activity, etc. For example, all persons need energy for work, but a man, who carries loads may need more energy than a man, who works in an office at a desk job.

OUR BODY is synthesised from the food we eat. It is made of a complex structure of cells, tissues and organs. How does this change from food to our body structure occur? All the changes that occur in the food from the time we eat it, to its use in the body and discarding of the waste matter are known as metabolism. One can describe metabolism of each nutrient separately to ensure ease of understanding. But actually it occurs in a correlated systematic manner. Basic concepts of biology and chemistry need to be understood in the study of nutrition. Let us review these.

Concepts in Biology: The study of nutrition begins with the cell, the basic unit of our body. All the nutrition processes, which we refer to as metabolism, take place in the cell.

Metabolism includes both anabolism and catabolism.

Anabolism involves synthesis of compounds needed for use in the body. Breakdown of complex substances to simpler ones is known as catabolism. Thus cells are able to take up nutrients, synthesise substances they need and eliminate wastes. The energy release and its utilisation occurs in the cell. There are many kinds of cells in the body, each type specialised in carrying out certain functions required by the body.

Cells are grouped together to form a tissue. Muscle, nerve, epithelial and connective tissue are examples of various tissues.

Two or more tissues are combined to form an organ, which carries out a specific function. Heart, lungs and kidneys are examples of organs. Now we will discuss Cells, Tissues, and Organs (Digestive only) in details

Cells

Cells are made up of several parts. Each part has an appropriate structure and a specific function. Two main parts of the cell are the nucleus and the protoplasm, which surrounds the nucleus and is called cytoplasm.

The nucleus controls the functions of the cell; the metabolic activities of the cell are carried out by the cytoplasm. The deoxyribonucleic acid (DNA) in the cell nucleus contains the pattern for each of the different proteins in the body. The ribonucleic acid (RNA) directs the actual protein synthesis in the ribosomes, using the information stored in the DNA. This process, which is directed and controlled by DNA, is the key to nutrition. All the components, which form nutrients, come from food. Our genes determine the nutrients that can be synthesised in the body and those which need to be provided preformed in the food. The small channels in the cytoplasm, called endoplasmic reticulum, transport nutrients and their metabolites throughout the

cytoplasm. The enzymes, which function in metabolism, are found in the membranes surrounding the channels. The mitochondria and lysosomes are also present in the cytoplasm. Mitochondria release the energy provided by the carbohydrates, fats and proteins and transfer it to an energy acceptor (ATP). The ATP transfers the energy as needed wherever work is being done. Therefore the mitochondria are known as the 'power plants' of the cell. Lysosomes contain enzymes, which function in the breakdown of proteins and other compounds. Lysosomes help to digest foreign matter that may have entered the cell and thus protect the body from their harmful effects.

Tissues

Epithelium Introduction and Key Concepts for Epithelium

Epithelium covers nearly all body surfaces. The basic functions of epithelial tissue are

- protection of the body from abrasion and injury (e.g., skin and esophagus);
- absorption of material from a lumen (e.g., tubules in kidney, small and large intestines);
- transportation of material along a surface (e.g., cilia-mediated transport in the trachea);
- secretion of mucus, hormones, and proteins (e.g., glands);
- gas exchange (e.g., alveoli in the lung); and
- lubrication between two surfaces (e.g., mesothelium of pleural cavity).

Epithelium is an avascular tissue, which lacks a direct blood supply. Nutrients are delivered by diffusion from blood vessels in the neighboring connective tissue. Most epithelial tissues are renewed continuously.

Glands

Introduction and Key Concepts for Glands

Glands are composed of epithelial tissue and can be classified as endocrine and exocrine according to how the secretory product leaves the gland.

Endocrine glands release their products into interstitial fluid or directly into the bloodstream.

Exocrine glands secrete their products either through ducts into the lumen of an organ or directly onto the body surfaces.

Connective Tissue

Introduction and Key Concepts for Connective Tissue

Connective tissue provides structural support for the body by binding cells and tissues together to form organs. It also provides metabolic support by creating a hydrophilic environment that mediates the exchange of substances between the blood and tissue. Connective tissue is of mesodermal origin and consists of a mixture of cells, fibers,

and ground substance. The hydrophilic ground substance occupies the spaces around cells and fibers. Fibers (collagen, elastic, and reticular) and the ground substances constitute the extracellular matrix of connective tissue. The classification and function of connective tissue are based on the differences in the composition and amounts of cells, fibers, and ground substance.

Connective Tissue Cells

A variety of cells are found in connective tissue, which differ according to their origin and function. Some cells differentiate from mesenchymal cells, such as adipocytes and fibroblasts; these cells are formed and reside in the connective tissue and are called **fixed cells**. Other cells, which arise from hematopoietic stem cells, differentiate in the bone marrow and migrate from the blood circulation into connective tissue where they perform their functions; these mast cells, macrophages, plasma cells, and leukocytes are called **wandering cells**. Cells found in connective tissue proper include fibroblasts, macrophages, mast cells, plasma cells, and leukocytes. Some cells, such as fibroblasts, are responsible for synthesis and maintenance of the extracellular material. Other cells, such as macrophages, plasma cells, and leukocytes, have defense and immune functions.

Muscular Tissues

Introduction and Key Concepts for Muscle

The contraction of **muscle tissue** is the only way in which we can interact with our surroundings and is essential to maintaining life itself. There are three general types of muscles: **skeletal, cardiac, and smooth**.

- The voluntary contraction of skeletal muscle allows us to move our limbs, fingers, and toes; to turn our head and move our eyes; and to talk. Its name comes from the fact that most skeletal muscle attaches to bones of the skeleton and functions to move the skeleton. However, exceptions include the extraocular muscles, the tongue, and a few others.
- The continuous, rhythmic contraction of cardiac muscle pumps blood through our bodies, without ceasing, for our whole lifetime. Cardiac muscle contraction is involuntary, in contrast to that of skeletal muscle, although its frequency of contraction is modulated by the autonomic nervous system and by hormones and neurotransmitters in the blood.
- Smooth muscle is the most diverse type of muscle. It occurs in different subtypes in different organs and is essential for many involuntary physiological functions, which include regulating blood flow and blood pressure, aiding in the digestion of food, moving food through the digestive system, regulating air flow during respiration, controlling the diameter of the pupil in the eye, expelling the baby during childbirth, and others.

Nervous Tissue

Introduction and Key Concepts for the Nervous System

It is difficult to consider the tissue of the nervous system separately from the nervous system itself. In most organ systems, the purpose of the tissue is to filter, secrete, or transfer gases or digest and absorb nutrients. The histological structure of one small region of the liver or kidney or small intestine is very much like the structure of any other region of that organ, and the function of one portion of the organ is very much like the function of any other portion. By contrast, the purpose of the nervous system is to carry sensory information from the sensory organs to the brain; to process that sensory information in the brain to produce perceptions, memories, decisions, and plans; and to carry motor information from the brain to the skeletal muscles in order to exert an influence on the individual's surroundings. In truth, all we know of the world that surrounds us is carried as electrical impulses over our sensory nerves; the only way we have of interacting with that world is via electrical impulses carried by motor nerves from our brains to our muscles.

THE DIGESTIVE SYSTEM: MECHANISM FOR NOURISHING THE BODY

Ingestion of foods and beverages provides the body with at least one, if not more, of the nutrients needed to nourish the body. The body needs six classes of nutrients: carbohydrate, lipid, protein, vitamins, minerals, and water. For the body to use the carbohydrate, lipid, protein, and some vitamins and minerals found in foods, the food must first be digested—in other words, the food first must be broken down mechanically and chemically. This process of digestion occurs in the digestive tract and, once complete, yields nutrients ready for absorption and use by the body.

THE STRUCTURES OF THE DIGESTIVE TRACT AND THE DIGESTIVE AND ABSORPTIVE PROCESSES

The digestive tract, approximately **16 feet in length**, includes organs that comprise the gastrointestinal (GI) tract (also called the alimentary canal or gut) as well as three accessory organs. The main structures of the digestive tract include the oral cavity, esophagus, and stomach (collectively referred to as the upper digestive tract), and the small and large intestines (called the lower digestive tract). The accessory organs include the pancreas, liver, and gallbladder. The accessory organs provide or store secretions that ultimately are delivered to the lumen (interior passageway) of the digestive tract and aid in the digestive and absorptive processes. The four main tunics, or layers, of the gastrointestinal tract are :

- The mucosa
- The submucosa
- The muscularis externa
- The serosa.

This first layer, the **mucosa**, is the innermost layer, and is made of three sublayers: **the mucosal membrane, the lamina propria, and the muscularis mucosa**. The mucosa acts as a membrane, consists of epithelial cells that line the lumen of the gastrointestinal tract, and is the inner surface layer that is in contact with the food (and its nutrients) that we eat. In the small intestine, this layer is arranged differently than in other sections of the digestive tract. Both exocrine and endocrine cells are found among the epithelial cells of the mucosa. The exocrine cells secrete a variety of enzymes and juices into the lumen of the gastrointestinal tract, and the endocrine (also called enteroendocrine) cells secrete various hormones into the blood. The lamina propria, another sublayer, lies adjacent to the epithelium and consists of primarily connective tissue and lymphoid tissue. This lymphoid tissue contains a number of cells, especially macrophages and lymphocytes, which provide protection against microorganisms. The third sublayer of the mucosa, the muscularis mucosa, is made up of a thin layer of smooth muscle.

Next to the mucosa is The submucosa, the second tunic or layer, is made up of connective tissue, blood and lymphatic vessels, more lymphoid tissue, and a network of nerves called the submucosal plexus, or plexus of Meissner. This plexus (plexus means network) controls, in part, gastrointestinal secretions and local blood flow. The lymphoid tissue in the submucosa is similar to that found in the mucosa and protects the body against ingested foreign substances. The submucosa connects the first mucosal layer of the gastrointestinal tract to the muscularis externa, or third layer of the gastrointestinal tract.

The **muscularis externa** contains inner circular and outer longitudinal smooth muscles that surround (lie on top of) the submucosa and facilitate motility. This layer also includes the myenteric plexus, or plexus of Auerbach, which lies between the circular and the longitudinal muscles. This plexus controls the frequency and strength of contractions of the muscularis to regulate gastrointestinal motility.

The outermost layer, the **serosa (sometimes called the adventitia)** consists of relatively flat mesothelial cells that produce small amounts of lubricating fluids. For many areas of the digestive tract, this layer is continuous with the peritoneum. The peritoneum is a membrane with two layers within the abdominal cavity. In the abdominal cavity, the visceral peritoneum surrounds the stomach and intestine, and the parietal peritoneum lines the pelvic cavity walls. These membranes are somewhat permeable and highly vascularized. Between the two membranes is the peritoneal cavity. The selective permeability and the rich blood supply of peritoneal membranes allow the peritoneal cavity to be used in dialysis, an ultrafiltration process used to treat kidney failure.

Immune system protection is located throughout the gastrointestinal tract (and called gut-associated lymphoid tissue or GALT), especially the mucosa and submucosa layers of the small intestine (and sometimes called mucosa-associated lymphoid tissue or MALT).

Atrophy of these mucosa and submucosa layers can result in bacterial translocation from the intestine into the blood, leading to sepsis (infection). Within these layers of the digestive tract, immunoprotection is provided by leukocytes, especially T- and B-lymphocytes; plasma cells; natural killer (NK) cells; macrophages; microfold (M) cells; and dendritic cells, among others. Many of these cells are found in Peyer's patches, which are aggregates of lymphoid tissue, usually present in a single layer, in the mucosa and submucosa. The plasma cells produce secretory IgA, which binds antigens ingested with foods, inhibits the growth of pathogenic bacteria, and inhibits bacterial translocation. Tissue macrophages secrete cytokines, which exhibit a variety of immunoprotective effects to defend against foreign substances. The M-cells are antigen-presenting cells; these M-cells pass or transport foreign antigens to the Peyer's patches or lymphocytes, which in turn mount an immune response. After processing the foreign antigens, some of these lymphocytes are released from the Peyer's patches and enter circulation to augment the immune response. Dendritic cells, a type of macrophage, also are found in the gastrointestinal tract. Dendritic cells destroy foreign substances and then serve as antigen-presenting cells to stimulate lymphocyte activity and proliferation. The processing and presentation of antigens by antigen presenting cells further triggers recognition of antigens by other parts of the immune system as "safe" or "harmful." The digestive process begins in the oral cavity and proceeds sequentially through the esophagus, stomach, small intestine, and finally into the colon (large intestine).

Use of Food in the Body The use of food in the body involves three processes — digestion, absorption and utilisation of nutrients in the body.

Digestion is the process, which releases many nutrients in the forms the body can use, by breaking up food in the intestinal tract.

Absorption is the process which carries these nutrients into the circulation system and delivers them to the cell.

Utilisation.

Cell is the functional unit of life. Hence a large number of the chemical reactions in the cell utilise the nutrients absorbed to produce materials needed for our existence.

Mechanical processes involved in digestion include chewing of food, swallowing of food, churning action in the stomach and rhythmic contraction of the intestinal tract. Chewing of food reduces the food particles in size, mixes these with saliva and dilutes it with water, so that it is easy to swallow. The food swallowed is mixed with enzymes and acid by the churning action in the stomach. Further the rhythmic contraction of the intestine, help to break the food into small particles and move the food mass forward through the digestive tract

Functions of Each Nutrient

Carbohydrates have many important functions in the body:

- The primary function of carbohydrates in the body is to supply energy. Each gramme of carbohydrate, as starch or sugar, provides 4 kcal/g. Carbohydrates are a source of readily available energy, which is needed for physical activities as also the work of the body cells. The brain and the central nervous system are dependent on the constant supply of glucose from the blood to meet their energy needs.
- Carbohydrates act also as reserve fuel supply in the form of glycogen, stored in muscles and liver. The total amount of glycogen in the body is over 300g. But it must be maintained by regular intake of carbohydrates at frequent intervals, so that the breakdown of fat and protein tissue is prevented.
- Carbohydrates serve other special functions in the body. Carbohydrates provide chemical framework, which combine with the nitrogen to synthesise non-essential amino acids in the body.
- Carbohydrates and their derivatives work as precursors of important metabolic compounds. These include nucleic acids, the matrix of connective tissue and galactosides of nerve tissue.
- Lactose, the milk sugar, provides galactose needed for brain development. It aids absorption of calcium and phosphorus, thus helping bone growth and maintenance.
- Lactose forms lactic acid in the intestinal track due to the action of the bacteria (lactobacilli) present there. These lactobacilli synthesise some of the B-complex vitamins. It aids, bacteria (lactobacilli) present to suppress the activities of putrefactive bacteria and protects us from their undesirable effects.
- Carbohydrates are an important part of some compounds, which increase our resistance to infection (immunopolysaccharides). Ribose, a five carbon sugar, is an essential part of DNA and RNA. Carbohydrates are a part of important compounds, which are components of nervous tissue (galactolipid), heart valve, cartilage, bone and skin (chondroitin sulfate).
- Carbohydrates are needed for ensuring complete normal metabolism of fats, thus preventing acidosis.
- Carbohydrates are needed to prevent dehydration. A low carbohydrate diet causes loss of water from tissues as also electrolytes (especially sodium and potassium) in the urine and can lead to involuntary dehydration.
- A minimum of 100g carbohydrates are needed in the diet to ensure the efficient oxidation of fats. Most diets supply more than this amount. If the carbohydrate foods are consumed in excess of the body's need, the excess is converted into fat and is stored as reserve. No daily allowance has been fixed for carbohydrates. As it is the cheapest source of food energy, it supplies up to 80 percent of the calories . If the proteins supply about 10 per cent of the calories, fat 20 per cent, then carbohydrates must supply the remaining 70 per cent calories.

Functions of Dietary Fibers:

- The human body does not have enzymes capable of breaking down cellulose, hemicellulose and pectins and so fibre is not digested in the body. However, in view of their ability to absorb water, these indigestible substances serve a useful purpose in helping with the elimination of intestinal wastes. They stimulate the peristalitic (rhythmic) movements of the gastrointestinal tract by adding bulk to the intestinal contents.
- The insoluble fibre needs chewing and may improve mastication of food.
- Dietary fibre absorbs water, swells and thus increases surface area of the mass. Thus there is increased contact between the food mass and enzymes and hence digestion improves. There is also a feeling of fullness. The spongelike swollen mass of fibre ensures smooth elimination of faeces. It helps smooth movement of food waste through the digestive tract and the soft, bulky stools are comfortably eliminated.
- Fibre reduces transit time and binds some minerals such as calcium, iron, zinc, etc.
- Soluble fibre binds bile acids and cholesterol and helps carry these out of the body.
- There is no recommended dietary allowance for fibre. However, nutrition researchers and dieticians suggest that fibre intake be increased to 25 grammes or more per day.

Fat is a major nutrient and it has several functions.

Oils and fats are concentrated sources of energy. Each, gramme supplies 9 calories. Besides providing energy, oils and fats have several functions in the body. Food fats are a source of two groups of essential nutrients — essential fatty acids (EFA) and fat soluble vitamins A, D, E & K and their precursors.

- Food fats also aid the transport and absorption of fat-soluble vitamins.
- Cholesterol is an essential lipid synthesised in the liver.
- Some important hormones and bile acids are formed from cholesterol.
- Fat forms the fatty centre of cell walls, helping to carry nutrient materials across cell membranes. Fats are used to synthesise phospholipids, which are found in all cells. Fat stored in various parts of the body is known as adipose tissue.
- The vital organs in the body are supported and protected by a web-like padding of this tissue. Fats act as a cushion for certain vital organs.
- Nerve fibres are protected by the fat covering and it aids relay of nerve impulses.
- Since fat is a poor conductor of heat, a layer of fat beneath the skin helps to conserve body heat and regulate body temperature.
- The flavour, palatibility and satiety value of foods is increased by fats.

- The slower rate of digestion of fat as compared to carbohydrates results in a feeling of satisfaction. Fats may have other functions, which are not as yet clear.

Essential Fatty Acids (EFAs) Linoleic acid (omega-6 PUFA) and linolenic acid (omega-3 PUFA) are called essential fatty acids because

- these are not synthesised in the human body
- these are required for important functions in the body
- these are available only through diet.

The EFAs have several important functions.

- They are essential for growth in the young and maintenance of normal healthy skin.
- Their other functions are as components of membranes to ensure their permeability to water and other small molecules.
- They are precursors of eicosanoids, a group of important metabolites which regulate vascular function, one of these are prostaglandins.
- The omega-3 fatty acids, DHA (decosa hexenoic acid) and EPA (eicosa pentenoic acid) have an important role in fetal brain and eye development. These acids also protect against rheumatoid arthritis and cardiovascular diseases.
- EFAs are used to synthesise certain prostaglandins. Prostaglandins prolong bleeding time, reduce the thickness and stickiness of platelets, lower levels of triglycerides and very low density lipoproteins (VLDL) in the blood. Thus artery blockage is reduced. Prostaglandins also reduce inflammation and thus reduce pain in certain ailments (e.g., in rheumatoid arthritis)

The fat requirement is based on two factors, namely to meet energy and the essential fatty acids needs. About 10 per cent of the total energy need is met by invisible fat in the diet. A minimum of 5 per cent of total energy needs to be provided as visible fat in the diet. This works out to about, 12 g of fat per day. A higher, level of intake of 20 g/day is desirable to provide energy density and palatability for normal adults. It is desirable that an upper limit of 20 g/day of fat intake for adults and 25 g/day for young children be followed, in view of the possible complications resulting from excessive intake of fat. However, in order to meet the essential fatty acid needs, the diet should contain at least 10 g of vegetable oil, which is a good source of linoleic acid.

Functions of Proteins

Body-Building or Building of New Tissues:

Protein is an essential part of every cell. We cannot synthesise (form) protein from simple nitrogen compounds as plants do. Therefore amino acids must be supplied in

the diet for building new tissues. Proteins provide the amino acids needed for the formation of new cells. They also provide the material from which nucleic acids are formed, e.g., DNA and RNA, which carry the genetic code. The amount needed at various stages of life varies with the rate of growth. Infants need more proteins per unit of body weight than adolescents, because the rate of growth is the highest during infancy. More protein is needed in the last part of pregnancy as compared to the first part. There may be a need to supply extra protein, to rebuild tissues after their loss or destruction. The loss may occur in any one of the following ways;

I. Donation of blood
II. Excessive menstruation
III. Haemorrhage after an accident
IV. Destruction of tissues due to burns, in wasting diseases such as TB (tuberculosis0, rheumatic fever, etc.

Maintenance of tissues:

The need for protein to maintain and repair the old tissues continues throughout life. Proteins in the body tissues are not static; they are constantly being broken down and replaced by new protein synthesised from amino acids from dietary and tissue sources. For example, the lining of the intestinal tract is renewed almost everyday and a half; the protein in the liver and blood plasma is broken down and remade every six days, blood cells have a life span of 120 days and adequate replacement must be supplied to avoid anaemia. In fact, all body proteins are constantly being degraded and synthesised at varying rates. Thus there is a continuous need for protein to provide for the maintenance of tissues already built.

Regulatory Functions: Haemoglobin, a protein and iron complex, ensures the smooth running of respiratory cycle by being the vital oxygen carrier in the red blood cells. Proteins in fluids such as blood help to regulate body processes. Plasma proteins contribute to osmotic pressure and thus exert an important influence on the exchange of water between tissue cells and the surrounding fluids and on the water balance of the body as a whole.

The amphoteric nature of proteins is useful in maintaining acid-base balance of blood and tissues. Their amphoteric nature further makes them ideal carriers of nutrients across cell membranes. The blood proteins (haemoglobin and oxyhaemoglobin) combine with the carbon dioxide formed in cellular metabolism and excrete it in the expired air. The metabolic products which are acidic or basic combine with protein and are carried through the system without affecting the tissue pH excessively.

Proteins as Precursors of Enzymes, Hormones and Antibodies:

A small amount of protein (or of amino acids) is needed for synthesising enzymes, hormones and antibodies. All enzymes are proteins and are essential catalysts in digestion and metabolic processes in the tissues. Hormones, secreted by various

glands are proteins in nature. Hormones regulate and co-ordinate body processes and activities. Hormones are chemical messengers, synthesised in the body. They are responsible for regulating all the activities of the body. Examples of hormones are insulin, thyroxine, growth hormones, steroid hormones, etc.

Proteins form antibodies and special white blood cells defend the body against infection and disease and thus participate in the body's immune system.

Transport of Nutrients:

Due to their amphoteric nature, proteins are ideal carriers of nutrients across cell membranes. Proteins as lipoproteins transport triglycerides, cholesterol, phospholipids and fat soluble vitamins across the cell wall. Specific protein carriers ensure transport of many vitamins and minerals. Albumin carries free fatty acids, bilirubin as also many drugs.

Special Functions of Amino Acids:

Almost all amino acids have some unique functions in the body. A few of these are listed here. **Tryptophan** serves as a precursor for the B-vitamin niacin and serotonin, a neuro-transmitter**. Glycine**, a simple ubiquitous amino acid is used in synthesis of porphyrin nucleus of haemoglobin. It is also a constituent of one of the bile acids. It combines with many toxic substances to form harmless products, which are excreted. **Glycine, methionine and arginine** synthesise **creatinine**, which with phosphate forms creatine phosphate, an important, form of high energy compound in the cell. **Histidine** is used in the synthesis of histamine used as a vasodilator in the circulatory system. **Glutamic acid** is a precursor of a neuro-transmitter. **Phenylalanine** is a precursor of tyrosine and together they lead to the formation of thyroxine and epinephrine. T**yrosine** is also the precursor of skin and hair pigment. **Methionine**, the sulphur-containing amino acid, is the principal donor of methyl groups in the synthesis of choline and other important compounds.

Milk Formation :

Mother's milk is the first food for a young of any mammal. Human milk contains about 1.2 per cent protein. The milk proteins are synthesised in the mammary gland from the available dietary and tissue proteins. A nursing mother needs to take extra protein in her diet to meet the demands of protein for milk formation.

Energy Supply:

A small part of the body's need for energy (about 6 to 12 per cent) is supplied by products of protein metabolism. Each gramme of food protein yields four calories to the body.

Vitamins

It was thought that a diet containing proteins, carbohydrates, fats, minerals and water was adequate to maintain life, until the beginning of last century. But research conducted in the early part of the last century proved that some vital factor was missing from the diet. This vital factor was given the name vitamin. Later it was found that there was more than one factor involved.

Now we know that vitamins are one of the six classes of nutrients supplied by food. They are required for normal growth and maintenance of all animal life. Vitamins are important for their regulatory and protective functions. Unlike most other nutrients they are required in very small amounts. But it is necessary to provide these in the diet because many of them cannot be manufactured by the body. The lack of vitamins results in definite deficiency disorders, which are specific for each particular vitamin. Vitamins have captured public interest in the last sixty years. This may be because they have been synthesised and marketed by a large pharmaceutical industry. Their efforts have been supported by medical practitioners and health conscious public.

Some people have often been misled into thinking 'if little is good, more may be better'. Surely vitamins are essential nutrients. We need to understand what they do, how much we need them and where we can get them. Can we get enough of these in foods or do we need pills to meet our needs of some vitamins? Most important, can mega-doses of vitamins hurt us? We need sound answers to these questions.

Definition

A substance can be classified as a vitamin if it satisfies the two criteria:

- ✓ It must be a vital, organic dietary substance, which is neither a carbohydrate, fat, protein, or mineral and is necessary in only very small amounts to perform a specific metabolic function or to prevent an associated deficiency disease, and
- ✓ It cannot be manufactured by the body, and, therefore, must be supplied by the diet.

Nature of Vitamins

Vitamins are organic substances, which occur in small amounts in foods. They are necessary for life and growth. Chemical structure of each vitamin is specific; some like vitamin C have a simple structure, while others such as vitamin D have a complex structure. Vitamins do not provide calories, but are essential in the metabolic reactions, which release energy from carbohydrates, fats and proteins. Vitamins are essential co-factors in hundreds of metabolic reactions in the body. They may act singly or in coordination with each other. Each vitamin has specific functions and so one vitamin cannot substitute for another in the body. Vitamins may occur in preformed or its active form in the food, or as a precursor compound which can be changed into active form in the body. Vitamins are conveniently classified into two groups on the basis of their solubility into **fat soluble and water-soluble vitamins**.

Fat-soluble vitamins include A, D, E and K. Water-soluble vitamins include the B-group and vitamin C.

Fat-Soluble Vitamins

Fat-soluble vitamins can only be absorbed in the presence of fat. Therefore, the presence of some fat in the diet is essential for their absorption. Fat-soluble vitamins can be stored in the body and hence occasional intake of very high sources may help the body tide over periods of low intake. The requirement for fat-soluble vitamins may be met by intake of a precursor or the vitamin itself. Not much of fat soluble vitamins are lost in normal cooking procedures.

Vitamin A

This was the first fat-soluble vitamin to be discovered. It has a number of important functions in the body. Vitamin A is found only in animal foods, mainly as retinol. Plants provide a source of vitamin A for animals in the form of orange-yellow pigments called the **carotenoids**. The chief source in human nutrition is **beta-carotene**, which the body converts to vitamin A in the intestinal mucosa during absorption. The conversion is partial and varies from 25 to 50 percent.

Functions

It is necessary for **normal growth and development**. If the intake of vitamin A is not sufficient for normal growth, the bones will stop growing, before the soft tissues are affected. This may result in overcrowding of the brain and nervous system, cranial pressure and consequent brain and nerve injury. In some instances the pressure on the optic nerve may result in blindness. Vitamin A deficiency may sometimes cause degeneration of nervous tissue without causing bone malformation.

Function in Vision: Vitamin A occurs in the retina of the eye and is required in the process of vision to adjust to light of varying intensity (dark adaptation). It occurs in the light receptor cells in the retina in combination with protein. This substance is known as visual purple (rhodopsin). It is bleached in the presence of light, which enables a person to see. Some vitamin A is used up in the process. If more vitamin A is not available, ability to adjust to changes in intensity of light is impaired. Night blindness occurs in severe vitamin A deficiency; it indicates the inability of a person to see at night, when the amount of light is far too little to permit adequate vision.

Health of Epithelial Tissues: These tissues cover the outer surface of the body, line the major cavities and all the tubular systems in the body. These are specialised tissues, of which the outer covering is resistant; protective epidermis and the internal tissue is a secretory mucous membrane. Inadequate supplies of vitamin A results in suppression of the normal secretions and produces a keratinised (dry, horny) type of epithelium. The skin may become excessively dry and mucous membrane may fail to secrete normally and hence be prone to bacterial invasion. In vitamin A deficiency keratin-producing cells replace mucus-secreting cells in many epithelial tissues of the

body. This is the basis of the pathological process termed **xerosis** that leads to the drying of the conjunctiva and cornea of the eye. The process can be reversed by vitamin A. It has become clear recently that vitamin A mainly in the form of retinoic acid plays a key hormone-like role in cell differentiation throughout the tissue and organs of the body. Hence the formation of retinoic acid must be regulated precisely.

Immune Response: Many of the epithelial tissues are important barriers to infection. Vitamin A deficiency impairs this function in a non-specific way. In addition, vitamin A in a more specific way helps to maintain the lymphocyte pool. Vitamin A also functions in T-cell-mediated responses. Some aspects of the immune response, such as immunoglobulin production, are now known to be affected by retinoids.

Haemopoesis: Vitamin A deficiency in man and experimental animals is consistently associated with an iron deficiency type of anaemia. In these conditions, vitamin A is required in addition to iron for a full response.

Growth: Retinoic acid is known to play its hormone-like function in control of growth and development of tissues in the musculo-skeletal system, just as it does elsewhere.

Other Functions

Energy Balance: It has been recently shown that an enzyme in mitochondria, which controls the local production of energy as heat is under the transcriptional regulation of retinoic acid.

Central Nervous System: Retinoic acid plays a major role in the development of the foetal central nervous system.

Gap Junctional Communication: Gap junctions are narrow, hydrophilic pores connecting the cytosol of two adjacent cells. The gap junctions are reported to be involved in regulation of morphogenesis, cell differentiation, secretion of hormones and growth. Retinoic acid and its analogues act as ligands of nuclear receptors.

Activity of Carotenoids: Carotenoids carry out several important functions in animals and plants. Some carotenoids are only precursors of vitamin A and its derivatives. They act as accessory pigments in energy transfer in photosynthesis. Carotenoids have a photoprotective role in man and bacteria. They are also involved in phototropism in simple and higher plant forms and in plant growth regulation. Carotenoids act in the trapping or tying up of single oxygen. They are used as colouration of food for mankind.

Human Requirements

Recommended Dietary Allowances of Vitamin A (mcg/day)

* ASG**	Retinol	Beta-carotene

Infants (6–12 months)	350	1400
1–6 years	400	1600
7–12 years	600	2400
13–18 years	600	2400
Adult Man and Woman	600	2400
Pregnant Woman	600	2400
Lactating Woman	950	3800

Overdosage

An overdosage of vitamin A may cause serious injury to health. Self-administration of highly potent concentrates is likely to cause a serious condition from which recovery is slow. Some of the symptoms of overdosage are irritability, headache, nausea and vomiting. Symptoms subside gradually on stoppage of intake of vitamin A.

Vitamin D

Pure vitamin D was isolated in crystalline form in 1930 and was called calciferol. Vitamin D is now considered a pro-hormone than a vitamin. Vitamin D is sometimes called the 'sunshine vitamin' because the body is able to convert a precursor 7-dehydrocholesterol, a sterol present in the skin, to vitamin D in the presence of sunlight. It can be synthesised in the body in adequate amounts by simple exposure to sunlight even for five minutes per day. Vitamin D activity is shown by a group of chemical substances called sterols, which are wax like substances. These compounds are insoluble in water, but are soluble in fats. They are stable to heat, acids, alkalies and oxidation.

Functions

Vitamin D performs several important functions in the body. These include:

- **Absorption of calcium and phosphorus:** calcitriol, a hormone, is an activated form of vitamin D. It acts with two other hormones (the parathyroid hormone and the thyroid hormone calcitonin) and stimulates the absorption of calcium and phosphorus in the small intestine. Without the presence of vitamin D formation of strong and rigid bones is not possible.
- **Bone mineralisation:** The bone tissue formation from calcium and phosphorus and other materials is regulated by calcitriol. It regulates the rate of deposit and resorption of these mainerals in bone. This balancing process helps to build and

maintain bone tissue. Vitamin D hormone can be used to treat rickets in children and osteoporosis (bone loss) in older women.

Recommended Dietary Allowance

It is difficult to set requirements for this nutrient due to its unique hormonelike nature, its synthesis in the skin by sun's irradiation of the 7-dehydrocholesterol there and its limited food sources. As the extent of synthesis of this vitamin and dietary intake is not easy to determine, exact data on vitamin D requirement is not available. Only a range of values is usually given. About 5 mcg or 200 International Units are stated to be the daily requirement of a child. The requirements for adults may be less but are not known with any degree of certainty. However, during pregnancy, adequate supply of vitamin D is essential for the healthy development of the foetus. As already said, exposure to sunlight results in the conversion of a compound present in the skin to vitamin D. Thus a specific recommendation of a daily supplement of 10 mcg or 400 IU per day is made for only people who work at night, those whose habits or style of dress shield them from sunlight and for invalids who stay indoors.

Overdosage

Intake of excessive amounts of vitamin D is toxic to the body and causes irritability, nausea, vomitting and constipation. Even a dose of 1000 International Units (25 mcg), when administered over long periods of time, has been found to cause toxic side effects in children.

Vitamine E

Vitamin E or alpha-tocopherol is a fat-soluble vitamin. No definite proof of vitamin E deficiency in human beings has been established.

Functions

The main function of vitamin E, tocopherol, is its ability to prevent tissue breakdown, by virtue of its antioxidant nature. Vitamin E acts as nature's most powerful fat-soluble antioxidant. In the lipid membranes of body tissues, the polyunsaturated fatty acids present are easy targets for oxygen to break down. Vitamin E protects the cell membrane fatty acids from damage by interrupting this oxidation process. It is believed to prevent the oxidation of vitamin A and carotene in the digestive tract and to regulate the rate of oxidation of foods inside the body.

Selenium is a trace mineral that works as a partner with vitamin E as an anti-oxidant.

Vitamin E requirement is linked to that of essential fatty acids (linoleic and linolenic acids). The requirement of vitamin E suggesed is 0.8 mg/g of essential fatty acids.

Vitamin K

Phylloquinone is the major form of vitamin K found in plants. It is also the form found in our dietary.

The basic function of vitamin K is in the blood-clotting process. It is essential for the formation of prothrombin by the liver. Prothrombin is a normal constituent of the blood and helps clotting of blood on contact with air.

The normal formation of vitamin in the intestinal tract is disturbed by the use of sulfa drugs. Patients, who are treated with antibiotics, after surgery, are likely to suffer from vitamin K deficiency, due to killing of intestinal bacteria, which synthesise the vitamin. Thus there may be blood loss due to non-clotting and poor wound healing.

Water Soluble Vitamins

Consist of a large number of substances. These include ascorbic acid and the B-complex vitamins. The water-soluble vitamins are absorbed quickly in the body and the amounts not utilised are excreted in the urine. Adequate amounts should, therefore, be supplied in the daily diet. Some of the water-soluble vitamins are partly lost in cooking procedures. This factor has to be kept in mind while meeting their requirements.

Vitamin B-Complex

A number of substances have been identified and grouped together under this heading. It must be noted that each of the B vitamins is a separate vitamin in name, structure and function. Six members of this group, namely, **thiamin, riboflavin, niacin, pyridoxine, folic acid and vitamin B12** are included in the RDA, because definite requirements of these vitamins have been established through research. A diet, which provides adequate amount of these six vitamins, also, carries enough of the other members of this group. All these vitamins are essential for human nutrition.

Thiamin

Thiamin (also known as vitamin B1 and aneurin) was first isolated in 1926 from rice polishings by Jansen and Donath. They isolated 100 mg of crystals from 100 kg of rice polishings. Subsequently, it was synthesised in 1936 by R.R. Williams and is now available in the market in the form of thiamin hydrochloride. The name thiamin is derived from its chemical ringlike structure. Thiamin consists of substituted pyrimidine and thiazole rings linked by a methylene bridge. It exists mainly in various inter-convertible phosphorylated forms, chiefly thiamin pyrophosphate (TPP). It is very soluble in water and is readily broken down by heat in neutral or alkaline solutions.

Functions:

The basic function of thiamin as a coenzyme is related to release of energy from glucose and its storage as fat, thus it makes energy available for normal growth and function of the body. Thiamin pyrophosphate, the coenzyme form of thiamin, is necessary for catalysing the oxidation of carbohydrates in the body. This reaction releases energy in the system.

Thiamin is needed to maintain normal function of three systems in the body, **gastrointestinal, nervous and cardiovascular system**.

Gastrointestinal System: Thiamin helps to produce energy needed for the cells of smooth muscles and secretory glands. In its lack, there is lack of muscle tone and deficient gastric secretions; as a result there is poor appetite, indigestion, constipation and poor stomach function.

Nervous System: The central nervous system needs glucose as energy source for its function. When there is a lack of thiamin, the energy is not released and nerves are unable to work, with loss of response and alertness. The result is apathy, fatigue and irritability. If the deficit continues, nerve tissues may be damaged causing pain and finally paralysis.

Cardiovascular System: If energy supply is not continuous, due to lack of thiamin, the heart muscle weakens and may lead to heart failure. The blood vessel walls become weak, the vessels may dilate and fluid may accumulate in the lower part of legs. Thus insufficient thiamin supply affects the body systems adversely and body function is disturbed.

As thiamin is directly involved in energy and carbohydrate metabolism, the thiamin requirement is expressed in terms of energy intake. Hence the recommended thiamin allowance is 0.5 mg per 1000 calories for all age groups.

Riboflavin

Riboflavin, a more heat-stable factor, was discovered after thiamin. It was isolated from yeast by Warburg and Christian. Kuhn and coworkers synthesised it in 1935. It was formerly known as vitamin B2 or vitamin G. The name riboflavin is derived from its chemical structure. It is a yellow-green (Latin word ‘flavus’ means yellow) fluorescent pigment containing the sugar ‘ribose’, hence the name riboflavin. It is less soluble in water than thiamin and more stable to heat, especially in acid solutions. When in solution, riboflavin is destroyed on exposure to sunlight. For example, prolonged exposure of milk to direct sunlight may decrease the riboflavin content of milk considerably.

Functions: The primary form of riboflavin is as an integral part of the coenzymes flavin mononucleotide (FMN) and flavin-adenine dinucleotide (FAD). Riboflavin functions as a vital part of coenzymes in both energy production and tissue protein building. It is thus essential for tissue health and growth of all animal and plant life (including microorganisms). It plays an important role in maintaining the integrity of mucocutaneous structures.

Riboflavin requirement is related to total energy requirements. For practical purposes the general RDA standard is based on **0.60 mg of riboflavin per 1000 kcal** for all ages. Thus the recommended allowance varies from 0.7mg for an infant to 1.7

mg for an adolescent. The need for riboflavin increases during pregnancy and lactation and also with increased activity and caloric intake.

Niacin

Goldberger in 1915 observed the existence of a pellagra-preventing factor, which he related to B vitamins. He found that the same factor cured black tongue in dogs. In 1937 Elvehjem and coworkers discovered that nicotinic acid was effective in curing black tongue in dogs. Smith and others found that nicotinic acid cured pellagra in humans. Thus a known substance (nicotinic acid) was identified as a vitamin. Cowgill suggested that the term 'niacin' be used for nicotinic acid to avoid association with the nicotine of tobacco. Niacin, the term which includes both nicotinic acid and nicotinamide, is another vitamin of the B-complex group. The amide is very soluble in water and is the one preferred therapeutically because it has no side reactions. Both products are stable and are not affected by heat, acid or alkali.

Functions: Niacin functions in the body as a component of two important co-enzymes NAD and NADP. The full name is nicotinamide adenine dinucleotide and its phosphate derivative respectively. These coenzymes are involved in tissue respiration and synthesis and the breakdown of glucose to produce energy. Niacin works in close association with riboflavin and thiamin in the cell metabolism system that produces energy. It is necessary for growth.

Requirements: All the factors, which affect energy needs, influence niacin requirement. Since one of the amino acids, tryptophan has been shown to be a precursor of niacin in the body, the total niacin requirement is stated in terms of 'niacin equivalents' to account for both sources. About 60 mg of tryptophan can give rise to one mg of niacin.

Since niacin is involved in the utilisation of carbohydrates, the requirement of niacin is related to the total calories in the diet. The figure recommended is **6.6 mg per 1000 calories**. The total niacin equivalent required daily on the basis of calorie requirement could range from 8 mg to 26 mg depending on the age and occupation of the individual.

Pyridoxine

Three naturally occurring pyridine derivatives (pyridoxine, pyridoxal and pyridoxamine) are known as vitamin B6.

Functions:

Vitamin B6 is a co-factor for several enzymes connected with the metabolism of amino acids. It is also believed to have a role in the formation of antibodies.

Requirements: There is some evidence that the pyridoxine requirements may be related to protein intake. The average requirement for adults would appear to be about

1.5 mg per day. **The suggested daily intake varies from 0.4 mg for infants to 2.0 mg for adults and 2.5 mg for expectant and nursing mothers.**

		Pyridoxine mg	*Folate* µg	*Vitamin* B_{12} µg	Ascorbic *acid mg*
Adult man and woman		2.0	100	1	40
Pregnant woman		2.5	400	1	40
Lactating woman		2.5	150	1.5	80
Infant:	0–6 months	0.3	25	0.2	25
	6–12 months	0.4			
Preschool children	1–3 years	0.9	40	0.2 to 1.0	40
	4–6 years		50		
School children	7–9 years	1.6	60		
	10–12 years		70		
Adolescents	13–15 years	2.0	100		
	16–18 years		100		

Folic Acid

Folic acid and related compounds, which is one of the B vitamins, was discovered in 1941, as a growth factor for bacteria. It was found to be essential for all vertebrates including man. Its name was derived from the Latin word folium, which means leaf, because it was first isolated from spinach leaves and is widely distributed in green, leafy plants. Folic acid is pteroyl-mono-glutamic acid. It is quite soluble in slightly alkaline or acid solution; but is reasonably stable in neutral or alkaline solutions, especially in the absence of air.

Functions:

The primary function of folic acid is related to the transfer of single carbon in the synthesis of a number of metabolites in the body. It is also involved in the synthesis of nucleic acid along with vitamin B12. Folic acid undergoes a series of metabolic conversions to its various coenzyme forms after it is absorbed.

Vitamin B12

Vitamin B12 or cyanocobalamin was the last member of the B vitamins discovered in 1948. It contains cobalt and phosphorus and is red in colour. It is found only in animal foods and higher plants are unable to synthesise it. Cyanocobalamin is considered the most potent vitamin and is one of the last true vitamins that has been classified. It was discovered through studies of pernicious anaemia, a condition that begins with a megaloblastic anaemia and leads to an irreversible degeneration of the central nervous system. It was found that the condition could be reversed by feeding afflicted patients large amounts of raw liver. The active material in the liver was found to be vitamin B12, which is present only in very small amount. Cyanocobalamin contains a tetrapyrrole ring system, which is chemically very similar to the porphyrin ring system of the haeme compounds.

Functions:

It promotes normal growth and development. It helps with certain types of nerve damage, and treats pernicious anaemia. It is an essential component of several coenzymes, which are needed in the synthesis of nucleic acids. Its metabolism and use in the body is closely related to folic acid. It is essential for the normal functioning of all cells, especially those of bone marrow, the nervous system and the gastrointestinal tract.

Ascorbic Acid (Vitamin C)

Ascorbic acid (vitamin C) was isolated and its chemical structure elucidated in 1932 by C.G. King. Its lack in human diet has long been known to cause a disease called scurvy. In olden days, sailors to whom fresh fruits and vegetables were not available for many days during long voyages at sea developed this disease. It is reported that 100 out of the 180 men who sailed with Vasco da Gama, died of scurvy before they reached India in 1498. Ascorbic acid closely resembles glucose in structure. The vitamin is a white, crystalline, odourless compound readily soluble in water. It is a strong reducing agent. It is comparatively stable in an acid medium but is destroyed by the action of heat, oxygen and catalysts such as copper. It is now made synthetically and the synthetic product is relatively inexpensive.

Functions:

Ascorbic acid performs a number of important functions in the body. It is a part of the cementing material which hold the body cells firmly in place. Thus it plays an important role to build and maintain strong tissues in general, especially connective tissues (bone, cartilage, dentin, collagen, etc). Blood vessel tissue depends on vitamin C to form strong capillary walls. Vitamin C is an important partner of protein for tissue synthesis. Naturally it is needed in growth stages of life. High concentrations of vitamin C are found in metabolically active tissues in the body, indicating its importance in their function. These include brain, liver, kidney, pancreas, adrenal glands, thymus and spleen. It helps the body to build resistance to infection. It helps in the absorption of calcium and ensures the health of bones. By aiding absorption of iron, it makes it available for haemoglobin synthesis. It is needed in wound healing, infections and fever to help recovery. Being a strong reducing agent, it helps to tie up free radicals and thus protects the body from their deleterious effects.

Recommended Dietary Allowance: Ascorbic acid cannot be stored in the body. The requirement has to be supplied daily. Even if excess is ingested, it is excreted in the urine. The recommended daily allowance increases with age from 20 to 40 mg for children and is 40 mg per day for adult. An intake of 80 mg per day is recommended for a nursing mother. The amount recommended is liberal, as ascorbic acid is a very labile nutrient.

Major and Trace Minerals

Introduction

The importance of minerals in our well-being is emphasised by the fact that iron deficiency anemia is one of the five major health problems in Pakistan. The increase in the number of fractures in the elderly as also the incidence of high blood pressure are also pointers that focus one's attention on minerals, calcium and sodium. A liberal intake of calcium, with increased mobility and exposure to sunlight is known to improve the strength of bones and thus reduce their fragility. A reduction in sodium intake can be one of the helpful factors in reducing hypertension. Though advertisements for dietary supplements may lead you to believe that these may be the answer to the problem, it is not so. The key is to select foods to meet the body's mineral needs and to season foods moderately to avoid excess intake of salt.

Nature and Composition As you may know from your elementary chemistry course, minerals are inorganic substances. So far we have studied nutrients, (carbohydrates, fats, proteins and vitamins), which are organic compounds. Minerals are present in all body tissues and fluids. In bones and teeth the minerals calcium and phosphorus are deposited in protein material. Iron is found in blood as a part of the red pigment, haemoglobin. Minerals occur in foods as salts and also in combination with organic substances.

Minerals have two distinct characteristics

- ✓ Mineral elements do not provide energy.
- ✓ Mineral elements are not destroyed during food preparation.

The mineral elements found in the body form only 4 to 6 per cent of the weight of our adult body. This means that about 2 to 3 kg of our body weight consists of minerals. Of this 90 per cent is accounted for by seven minerals (calcium, phosphorus, potassium, sulphur, sodium, chloride and magnesium). The other minerals are known as trace elements, as these add together to about 10 per cent of the total mineral content of the body.

The largest concentration of minerals is found in the bones and teeth. Minerals are also found in soft tissues such as nerves and muscles and in blood and other body fluids.

General Functions of Minerals

Some minerals play an important role in the regulation of body functions. These are:

- ❖ Maintenance of acid-base balance.
- ❖ Control of water balance.
- ❖ Contraction of muscles.
- ❖ Normal response of nerves to physiological stimulation.
- ❖ Clotting of blood.

Minerals do not act singly in their function and regulation of body processes, but work with the help of other minerals and organic compounds. A certain concentration of each element must be present for efficient functioning of the body.

Mineral	*Approximate amount in adult body*	
	60 kg	*50 kg*
Major Mineral Elements		
Calcium	1030 g	855 g
Phosphorus	645 g	535 g
Potassium	210 g	175 g
Sulfur	150 g	125 g
Sodium	90 g	75 g
Chlorine	90 g	75 g
Magnesium	26 g	21 g
Trace Elements		
Iron	3.4 g	2.9 g
Molybdenum	2.6 g	2.1 g
Zinc	1.7 g	1.4 g
Selenium	1.7 g	1.4 g
Fluorine	0.9 g	0.75 g
Copper	130 mg	110 mg
Manganese	130 mg	110 mg
Iodine	26 mg	21 mg
Cobalt	4 mg	3.6 mg
Chromium	4 mg	3.6 mg

Absorption of mineral elements is favoured by

- Body requirement: If the body needs are high, as in pregnancy and growth stage of children, there is higher absorption of calcium and iron (up to 60 per cent) from the diet.
- Stomach acidity: Absorption of several minerals, for example, calcium and iron is improved by the presence of acid conditions. Thus absorption of calcium in the intestinal tract is enhanced by lactose, which is hydrolysed to lactic acid. The absorption of calcium, iron and zinc is improved by ascorbic acid.
- Form in which the mineral is present in the food: Haeme iron in animal foods is more easily absorbed in the body than iron compounds present in plant foods.

Absorption of mineral elements is reduced by

- Dietary components, which combine with mineral elements to form insoluble complexes, reduce their absorption. These components include oxalic acid, phytic acid, excess fibre and others. Minerals are also bound by some medications.
- The absorption of some minerals is adversely affected by an excessive intake of other minerals. Such a situation arises when supplements of minerals are taken. For example, intake of iron supplements hinders the absorption of zinc, while zinc supplements reduce the absorption of copper.
- Increased mobility of intestinal track due to diarrhoea, intake of laxatives, etc., reduces the time of absorption and hence the amount absorbed.
- Parasites present in the intestinal tract also interfere with the absorption of minerals. Iron deficiency anaemia in children is attributed to this factor.

Toxicity

The possibility of toxicity due to excessive intake of mineral elements from normal natural foods is very remote. Excessive intaker, which can be toxic, is possible only when

- ❖ Iron pills or other nutritional supplements are taken in excess
- ❖ errors are made in substituting supplements
- ❖ Exposures to toxic levels of chemicals occur in an industrial plant
- ❖ Children consume excessive number of iron pills accidentally

Even common salt used in the kitchen can be toxic, if fed by mistake in excess to infants.

Major Minerals

Calcium

Body Composition and Functions:

Bones and teeth contain about 99 per cent of calcium in the body, in combination with phosphorus, protein and other minerals. These give the skeleton structure and rigidity. In the long bones, the calcium and phosphorus is stored mainly in the ends (trabeculae), from where it can be easily taken to maintain blood calcium levels.

The remaining 1 per cent of calcium is present in the soft tissue and blood and is responsible for many regulatory functions. These functions, which it carries out along with other minerals, are:

- ➢ It is involved in normal muscle contraction, which includes heartbeat. • Control of the transmission of nerve impulses.
- ➢ Maintenance of permeability of cell membranes to permit movement of material in and out of the cells.
- ➢ Help normal clotting of blood.
- ➢ Activate action of enzymes, e.g., pancreatic lipase as a cofactor.
- ➢ Ensure the absorption of vitamin B12.

Group		*Calcium*	*Phosphorus*
Adult Men		400	400
Adult Women		400	400
Pregnancy and lactation		1000	1000
Infants		500	750
Children	1–9 years	400	400
	10–15 years	600	600
	16–18 years	500	500

Phosphorus

Body Composition and Functions:

Bones and teeth contain 85 per cent of the phosphorus in the body. The remaining 15 per cent is found in various compounds, which contribute to body function and regulation.

Thus functions of phosphorus are:

- Body building as an important component of bones and teeth.
- Fat absorption and transport with aid of coenzyme A and ATP.
- As a part of DNA (deoxyribonucleic acid) and RNA (ribonucleic acid), which are essential for genetic coding and protein synthesis.
- As a part of ATP (adenosine triphosphate) and ADP (adenosine diphosphate), which are essential for energy metabolism in the body.
- As a component of enzymes needed in carbohydrate, fat and protein metabolism.
- As a part of buffer salts, which maintain acid-base balance in the body.

Magnesium

Body composition and functions:

Bones and teeth contain 60 per cent of the magnesium in the body. Besides body building, magnesium has three other important regulatory functions. Along with other minerals, it regulates muscle contraction, regulation of the transmission of nerve stimuli and activates the function of many enzymes involved in metabolism. Like calcium, magnesium is absorbed in an acid medium in the gastrointestinal tract. in fact, they compete for carrier sites in this process. It is important not to have an excess intake of these elements to avoid competition in absorption.

RDA: The Recommended Dietary Allowance (RDA) for adults 19-51+ years is 400-420 mg daily for men and 310-320 mg for women. Pregnancy requires about 350-360 mg daily and lactation, 310-320 mg.

Trace Elements

Iron

Functions:

Though the amount of iron in the body is only about two to three grammes, its presence is very important. Iron combines with protein for the development of haemoglobin, the red pigment of the blood. The main function of iron in **haeme** is to carry oxygen from the lungs to the cells and to carry back some of the carbon dioxide formed, to the lungs for exhalation. Iron is also an essential constituent of many tissues (muscles) and of the catalysts which regulate oxidation-reduction reactions in the body. Iron is stored in the liver, spleen and bone marrow in the form of the protein **ferritin**. Men have higher stores of ferritin than women.

Utilisation of Iron:

Iron needs of the body are met by

- Use of iron released from red blood corpuscles (RBCs) over and over again.
- Absorption of iron from the diet.
- Use of the stores of ferritin.

Absorption of iron from food takes place mostly in the duodenum and the small intestine. Only 3 to 10 per cent of iron is absorbed by a well nourished adult. Higher percentage is absorbed in growth stages and by anaemic persons when need of the body is high. If the body has an immediate need for iron, it passes directly from the intestine into the blood stream. If the supply of iron is more than what the body needs, it is stored in the mucosa of the intestinal cells as ferritin. Ferritin is made up of a protein and an iron containing compound. Diet directly supplies only about one mg of iron as compared to the reutilisation of iron from the breakdown products of hemoglobin which supplies 25 mg. Since most of the iron produced from the breakdown of iron compounds in the body is reutilised, iron is known as one way element.

Particulars	*Iron mg/day*	*Particulars*	*Iron mg/day*
Man (60 kg)	28	*Children*	
Woman (50 kg)	30	Boys 10–12 years	34
Pregnant woman	38	Boys 13–15 years	41
Lactation	30	Boys 16–18	50
Children			
1–3 years	12	Girls 10–12 years	19
4–6 years	18	Girls 13–15 years	28
7–9 years	26	Girls 16–18 years	30

Iron Overload

When too much iron is absorbded, large amounts are deposited in the liver, lungs, pancreas and other tissues. **Hemochromatosis** is a genetic defect, in which there is excessive absorption of iron resulting in organ damage and skin pigmentation. It may further lead to the cirrhosis of the liver. Excessive iron storage, without tissue damage, results in **hemosiderosis**—iron storage minus tissue damage. It occurs when iron supplements are given for long periods even after it is not needed. Abnormal breakdown of red blood corpuscles (RBCs) can also be the cause of hemosiderosis.

Iodine

A small amount of iodine is required to keep our body healthy. There are about 25 to 30 mg iodine in the body. Of this about 33 per cent iodine is present in the thyroid gland. But iodine in minute traces is found in all cells of the body. Two hormones produced by the thyroid gland, viz., triiodothyroxine (T3) and thyroxine (T4) contain

iodine. These hormones monitor the rate of energy metabolism in the body and thus are essential for growth and development.

Other Trace Elements

Besides iron and iodine, a number of other trace elements are required by the human species. These are **copper, zinc, selenium, cobalt, fluorine, molybdenum and manganese**. Their functions are given below.

Copper is associated with iron in energy production.

Zinc is an essential part of cell enzyme systems. It combines with insulin to form a storage form of the hormone. It is important in the immune systems as part of white blood cells.

Selenium functions as an essential part of an antioxidant enzyme that protects cells and their membranes against oxidative damage and hence against cancer. In this way it spares vitamin E. It is also credited as a protective agent against mercury poisoning in animals. Reduced blood selenium values have been reported in children suffering from protein-calorie malnutrition.

Cobalt: The only known function of cobalt is its association with RBC formation as part of vitamin B12.

Fluorine is necessary for resistance to dental caries. It may have a function in prevention of the bone destruction associated with ageing.

Molybdenum functions as a catalyst component in several cell enzyme systems.

Manganese: Like other trace elements it functions as an essential part of cell enzymes.

Acid-base Balance pH:

The concentration of hydrogen ions in a solution is referred to by the symbol pH. It is the measure of acidity or alkalinity of the solution. Neutral pH, which is the pH of water, is 7.0. The pH below 7.0 denotes acidity which increases with decrease in the pH. The alkalinity on the other hand, increases with increase in the pH. The pH of body fluids is maintained in the narrow range between 7.35 and 7.45, which is slightly alkaline. The maintenance of pH in this narrow range is known as acid-base balance.

Reactions of Foods: The foods which contain sizeable amounts of sulphur, chloride and phosphorus, metabolise to form anions in excess of cations. Such foods are potentially **acid producing foods**. Acid producing foods include cheese, legumes, cereal foods, coconut, eggs and flesh foods. The foods which produce excess cations on metabolism are termed **alkali producing foods**. These foods contain excess cations such as calcium, sodium, potassium and magnesium. Fruits, vegetables, milk, groundnuts, etc., are **alkali producing foods**.

It is important to note that the sour tasting fruits (citrus and other fruits) are alkali producing foods. So the taste of the food is not related to its metabolic reaction.

The third group of foods which are low in mineral elements are termed **neutral foods**. These include sugar, starch, tapioca, oils, butter and other cooking fats.

Regulation of Acid-base Balance: Mineral elements act as buffer salts, which prevent change in the pH. In the body the carbonate and the sodium phosphate buffer systems are important in pH regulation. Proteins, which hydrolyse to form amino acids, containing an alkaline (NH2) an acidic (COOH) group, are also good buffers. Carbonic acid is the main acid produced in metabolism, which is exhaled by the lungs as carbon dioxide and water vapour. Breathing rapidly and deeply helps us to bring down the increased carbon dioxide content of the blood. This is the basis of for the recommendations for exercises, which make us breathe rapidly and cleanse the blood. Yoga, which teaches us to breathe deeply, ensures that oxygen reaches all the cells. Thus it helps the process of oxidation, which releases the carbon dioxide to be exhaled. The kidneys are able to excrete very acidic urine, when excess acid is produced in the body, thus preventing changes in blood pH. The kidneys act as the last regulators of acid-base balance. **Disturbances in Acid-base Balance:** If the pH of body fluids drops below pH 7.3, it is called **acidosis.** When diabetes is not controlled, the patients suffer from acidosis and excrete large amounts of ketones. In severe starvation, the body fat reserves are metabolised in the absence of carbohydrate and acidosis occurs. In renal failure, acidosis occurs, as the kidneys are not able to get rid of excess acid. If the pH increases above 7.5., it is called **alkalosis**. Any condition which leads to loss of stomach acid, results in alkalosis. Severe vomiting is one such condition. Another is excessive intake of antacids such as sodium bicarbonate. Third is loss of hydrogen ions due to renal malfunction. Any change in pH needs immediate action to avoid disturbance in the metabolism and restore normalcy.

THE HUMORS

The humors (akhlat,), as Avicenna defines them, are the soluble substances produced from food and drink by the various digestive processes in the mouth, stomach, intestines, blood, and organs. Avicenna follows the traditional Unani classification of humors that includes four major types of humors (blood, phlegm, yellow bile, and black bile). These four humors correspond to the major classes of the biological molecules that we know today:

- Normal proteins fall under blood humor.
- Unassimilated and incompletely digested proteins fall under phlegm humor.
- Fats and lipids fall under yellow bile humor.
- Other classes, such as organic acids, nucleic acids, and metabolic byproducts fit within black bile humor.

- Normal humors may change in their quality and quantity and become abnormal humors. Take for example the lowdensity lipoprotein (LDL), which currently

has a bad reputation due to its statistical association with coronary artery disease and the supposed formation of atherosclerosis in arteries. In the context of Unani, LDL is a blood humor, a protein that solubilizes fatty acids and carries the cholesterol molecules across the arterial wall, a normal and beneficial process; however, for unknown reasons LDL polymerizes and precipitates on the inner arterial wall, forming plaques that obstruct the blood flow, leading to cardiovascular disease and death. The polymerization of LDL transforms it from a beneficial blood humor to an abnormal phlegm humor that requires maturation to correct the abnormality.

- The humoral imbalance in quality and quantity is the trigger for increasing the susceptibility to illness, or it could be indicative of an existing illness. Critics of the humoral theory argue that the humors are undefined and that no one has demonstrated their presence in the body; others think that humors must be constituents of the blood itself. Unfortunately, such erroneous conceptions dominate the public discourse and have made their way into the print media, becoming the prevailing contemporary viewpoint on humors. Sadly, these opinions are also prevalent even among those who are open-minded about the use of traditional medicine. Those who claim such misconceptions have not read the original texts on humors, such as that of Avicenna, or if they have, they have not understood them. There are thousands of unknown compounds in the human body that have not yet been identified, and their abnormal qualitative and quantitative changes that contribute to disease have not yet been explored. Therefore, we are still faced with the same dilemma (albeit to a lesser degree, since we have now some blood parameters to work with) that the physicians of the eleventh century had to deal with; that is, how to spot the early signs of illness, diagnose, and treat when the exact chemical composition is unknown. Now that we know the general chemical classes of the humors, the question becomes, Would a humoral explanation in conjunction with modern blood and serum indicators give us a better preventive and diagnostic advantage? The readers should try to answer this question for themselves.
- **RAW HUMORS AND THEIR MATURATION** Throughout the Canon, there are many references to raw, unripe, and immature humors. Explaining this concept is important to understanding the disease mechanism according to Unani medicine because susceptibility to illness and disease development is tied to the accumulation of raw humor in the body (see the example on LDLs). Raw humor is a quality issue that has to be dealt with; the quality of the humor, or a metabolite in our modern biology, is an important factor in health preservation, a fact that is rarely given attention when merely measuring the quantity of a biomolecule. In a Western-type clinical environment, the physician or nurse may not be aware of this issue since all blood indicators they deal with are quantitative and only measured in the blood, the assessment and treatment is based on whether the test results show above or below the normal range. According to Avicenna, in many instances the raw humor may be higher

in concentration within the organ, and not within the vessels, and its effect is local rather than systemic. Ironically, the difference in measuring levels in blood versus organs is well known in the practice of toxicology and forensic pathology—so that modern medicine applies these distinctions to understanding what killed someone, but unfortunately does not use this understanding to help care for the health of living patients! In Unani medicine, many of the treatments by diet, drugs, or manual procedures target the raw humor to loosen and mature it, which will lead to its conversion to a normal humor or get it ready for evacuation. Maturation of a raw humor is a process that involves digestion of undigested material of the humor or the breakdown of its abnormal aggregation and viscosity. The same process is applied to the waste byproducts in the body to dislodge them and get them out of the body.

The Definition of Humor and Its Types

The humor is a moist, runny substance that originates from food first; it encompasses a beneficial type that becomes an essential component of the body either by itself or in combination with others. The transformed food resembles the humor in its independent form or when in combination. Overall, the newly transformed humor replaces the decomposed portion, and it also comprises waste products and a bad portion, which rarely becomes a good humor and should be sent out of the body. We state that the body's fluids are primary and secondary.

The **primary ones** are the four humors that we mention, and the **secondary humors** are the waste humors and non waste tissue humors.

We will mention the waste humors.

The non waste tissue humors are transformed from their essential states and infiltrate the organs but have not become part of the single organs by complete transformation. These are of four types:

- The liquid in the tiny blood vessels that are adjacent to the proper organs that supply them.
- The liquid that keeps the organs moisturized (similar to dew), and this humor could turn into a nutritional source when supply is scarce and replenish the organ's moisture when lost due to violent movement or other effects.
- A close-to-maturity humor that is similar to that of the organ in temperament and composition but not in complete texture.
- The humor in the original organs that exists since inception, originating in the zygote, which originates from humors and keeps the parts of the organs in contact [milieu interieur is the extracellular fluid].

We state, also, that the beneficial and waste humoral fluids are restricted to four types: **blood, phlegm, yellow bile, and black bile.**

Blood (dam,), hot in nature and moist, is of two kinds: normal and abnormal. The normal blood is red colored, without a stench, and very sweet. Abnormal blood divides into two types:

- Changed from good blood humor without any admixing with other material but due to dystemperament such as development of cold or hot temperaments;
- Mixed with a bad humor that arises in two ways: (a) the bad humor is external, mixes with it, and corrupts it; or (b) the bad humor originates within it by putrefaction and transforms that layer to bitter yellow bile and dense, bitter black bile, and one or both remain in it. This latter type varies depending on the material with which it mixes, and its types are like those types of phlegm, black bile, or yellow bile, and watery; it becomes sometimes turbid, light, dark black, or white, and other times changes its smell and taste to bitter, salty, or acidic.

Phlegm (balgham,) also is normal and abnormal. The normal type could turn into blood at some time because phlegm is an immature blood (a type of sweet phlegm); it is not very cold in comparison with the whole body, but cold in comparison with the blood and yellow bile.

Some of the sweet phlegm is abnormal: this is the tasteless phlegm that we shall mention if it gets mixed with normal blood as experienced in colds (inflammations) and menstruation. However, Galen stated that nature has not prepared a reservoir for the normal sweet phlegm like the two bitter humors [yellow and black biles] because phlegm is very similar to blood, all organs need it, and that is why it flows like the blood. And, we state that this occurs for two purposes: one is necessity and the other is beneficial.

There are two reasons for the necessity; **the first**, to be close to the organs; when supplies to the organs from stomach and liver are scarce, it becomes blood. For such unusual circumstances, the organs' faculties use its innate heat to mature it, digest it, and use it as a nutrient. The innate heat ripens, digests, and turns it into blood, however, abnormal heat corrupts and ruins it. This process is not necessary for the two bitter humors since they are not similar to the phlegm in that the innate heat transforms it into blood, but they are similar to it in that the abnormal heat turns them into putrefaction. **The second reason**, for necessity, is that it mixes with blood to prepare it for nurturing the organs with phlegmatic temperament that require a certain amount of phlegm in their blood supply, such as the brain. This is also shared with the two bitter humors. The benefit comes from the wetting of joints and organs with excessive movement, so that they do not dry out because of the movement and friction. This is a benefit of extreme importance.

Abnormal phlegm [numbered 1–8] comprises the waste phlegm, such as

I. **The mucoidal** (al-mukhatee,), which has a heterogeneous texture to the touch;
II. **The raw (al-kham,),** which is homogenous to the touch;
III. **The watery (alma'ee,),** which is light;

IV. **The gypsoid** (al-jissee,), which is very dense and separates and precipitates into a layer in the joints and exits; it is the thickest of all; and

V. **Salty (al-maleeh,),** which is the hottest, hardest, and driest of the phlegm types. The cause of all saltiness that takes place is the balanced mixing of watery moisture, of little or no taste, with burned earthy parts of dry temperament and bitter taste; its excess increases bitterness. From this, salts are generated and water becomes salty. Salt can be made from ash, alkali, and lime, as well as other sources, by cooking them in water, filtering, and then boiling and reducing the water until crystallization occurs, or leaving it alone to dry and crystallize. Yellow phlegm develops by balanced mixing of light phlegm that is tasteless, or with little and weak taste, with burned bitter dry humor that turns it salty and hot. The respected physician Galen stated that this phlegm adds saltiness due to its putrefaction or admixing with watery humor; and we say that putrefaction makes it salty due to the burning effect followed by the mixing of ashiness (al-ramadyeh,) with its moisture; watery phlegm does not by itself cause saltiness without the second reason [mixing of ashiness]. There is also

VI. **Acidic phlegm**. Sweet phlegm is of two kinds: (a) sweet by nature, and (b) sweet from mixing with strange matter. So is the acidic phlegm, it can be of two kinds: one due to mixing with strange abnormal substances such as the acidic black bile (we will mention it later), and the other reason is from within, such as what happens to sweet phlegm (or on its way to be sweet) and other sweet humors of boiling, then acidity.

VII. **Acrid (aafss,)** due to mixing with acrid black bile or because of extreme cooling that converts its taste to acridity by increasing the rigidity of its water and its tendency to dryness, therefore, it did not mature because of the heat weakness and instead turned acidic.

VIII. **Glassy (zujajee,),** thick and resembles the melted glass in its density. It can be acidic or insipid (tasteless). The dense insipid resembles the raw or can be converted to the raw; and this type of phlegm is watery and cold in the beginning, so it does not become corrupt or mix with others but stays confined until thickened and colder.

Therefore, the types of abnormal phlegm according to **taste** are four: salty, acidic, acrid, and insipid (tasteless) (musseekh,); and also four according to **density**: watery, glassy, mucoidal, and gypsoid. Also, the raw is counted as mucoidal.

Yellow bile (al-safra,) also is normal and abnormal; the normal is the blood foam, which is bright red in color, lightweight, and hot in temperament. The warmer it is, the more red in color. When generated in the liver, one part of it goes with the blood and the other to the gallbladder. The portion that goes with the blood meets a necessity and confers a benefit. The necessity is supplying the organs that require yellow bile for their temperaments with a normal portion of yellow bile, and the right proportion as in the lung. The benefit is to ameliorate the blood and facilitate its entry into very small

vessels. The filtered portion that goes into the gallbladder is necessary for the elimination of wastes and benefits the gallbladder by supplying it with nutrients. The benefit is also in that it rinses the intestines of the residues and viscous phlegm, and it stimulates the large intestine and sphincter to encourage excretion. Therefore, sometimes colic develops when the (biliary) tract from the gallbladder to the (small) intestine gets blocked.

The abnormal yellow bile occurs due to admixing with strange abnormal substances or by deviation from normal due to intrinsic abnormal change.

- Of the first type, the most well known is the one that mixes with phlegm, and it is generated in the liver most of the time and termed bitter yellow bile if it mixes with light phlegm or bitter yolk if it mixes with thick phlegm,
- There is the less known type that mixes with black bile, which is called burned yellow bile. The latter may happen in two ways:
- First, when the yellow bile burns by itself and produces ashiness that makes it difficult to distinguish between its good part and its ashy part, and if the ashiness becomes trapped then it is bad;
- Second, when the black bile arrives from a different location and mixes with it, which is better than the previous one. The color of the latter is reddishyellow, not bright or radiant, but similar to blood, and its color could change. The abnormal type that is caused by intrinsic deviation from normal is generated mostly in the liver, but is overproduced by the stomach. The one from the liver is of one type that is light and, if it burns, produces black bile. The one from the stomach is of two kinds: **leek green (kerathee,) and verdigris (zenjaree,).** The green is produced by the burning of yolky, yellow bile when the blackness mixes with yellow and produces green color. The verdigris is generated from the green yellow bile by excessive burning that displaces all of its moisture, and its color tends to be whitish. Heat initially produces blackness in a moist body, and then blackness starts to disappear with the dissipation of moisture, and eventually bleaches it into white. Observe what takes place in a piece of (burning) wood; it first turns into charcoal because the heat turns the moist object black and a dried object white. Coldness turns a moist object white, and a dry one black. My description of the green and verdigris yellow biles is a hypothesis. The green is the hottest, worst, and most fatal type of the yellow biles.

Black bile (es-sawda,) is also normal and abnormal. In a fine blood, the normal black bile is sedimentary (rusubee,), residual , and causes its turbidity , and tastes between sweet and acrid. If it is generated in the liver it gets distributed to the blood and spleen. The part that mixes with the blood fulfills a necessity and confers a benefit. It is necessary in the blood supply to the organs, such as bones, that their temperament comprises a black bile. The benefit comes from its effect on the blood, where it strengthens, thickens, and prevents its disintegration. The part that goes to the spleen

is a fraction that the blood gives away for a necessity and a benefit. The necessity is a cleansing of the whole body from drugs and nourishment of the spleen. As for the benefit, it occurs when the black bile breaks down at the stomach mouth; it binds, thickens, and strengthens it. Black bile also stimulates with acidity the stomach mouth and gives the feeling of hunger and appetite. Also note that the yellow bile effusing to the gallbladder is unwanted by the blood, and the yellow bile effusing out of the gallbladder is an excess. The same applies to the black bile effusing to the spleen; it is the excess in the blood, and what is released from the spleen is from the excess there. The latter yellow bile [coming out of the gallbladder] stimulates excretion from below while the latter black bile [at the stomach mouth] stimulates food intake from above.

The abnormal black bile differs from the normal one in that it is not sedimentary, but similar to the ashiness of charring. A substance of earthy temperament shows its earthiness in two ways:

(1) By precipitating, and an example of this is black bile, or

(2) By charring, where the light part disintegrates and leaves the thick part in the blood and humors; an example of this is the waste black bile that is called the bitter black bile.

Precipitation is a blood characteristic, whereas phlegm is viscous [dissolving well] and does not cause any sediment [precipitation], and yellow bile is light, constantly in motion, lacks earthy temperament, and also does not separate from the blood in appreciable quantities. That which separates, putrefies, or is excreted loses its light [useful] fraction and its thick [waste] part becomes charred black bile and is not sedimentary. Waste black bile may be the ash and charring of yellow bile, which is bitter. The difference between this and burned yellow bile is that the latter has this waste black bile mixed with it, and it also exists by itself. Waste black bile has lost its good fraction; some is the ash of phlegm charring. If the phlegm is very light and watery it gives salty ash, otherwise it tends to be acidic or acrid. Some waste black bile is the product of blood charring, and this tends to be salty to sweet.

Black bile may give rise to abnormal types; the light black bile produces very acidic ash like vinegar boiling at the surface of the earth with acidic fumes that repel flies and alike. The thick black bile produces less acidic ash with some acridity and bitterness.

There are three types of bad black bile:

The charred yellow bile that lost its good fraction, and the other two types that follow [i.e., phlegmatic and blood black biles]. The phlegmatic black bile is slow in its harming effect and less dreadful. The burned four humors may be listed according to their vileness: black bile is the worst in form and effect, and yellow bile is the most susceptible to corruption but the easiest to treat. The other two are worse, depending on their acidity—the more acidic the worse—but they accept the treatment the earliest

it is applied. The third is less reactive with earthy substances, less attached to organs, and slow to become fatal, but more difficult to disintegrate and mature, as well as to accept the treatment. These are the natural humors and the waste ones. Galen said, “It is incorrect what some state that the only normal humor is the blood and the other humors are useless waste”; this because if blood were the only humor that nourishes the organs, then all the organs would be similar in temperament and texture. And since bone is harder than flesh, then its blood is mixed with black bile, and since the brain is softer, then its blood is mixed with soft phlegm. The blood itself is mixed with the other humors and separates from them when placed in a container, according to touch, into a fraction that is a foam, which is the yellow bile, a fraction that resembles egg white, which is the phlegm, and turbid sediment that is the black bile. There is also a watery fraction that is waste and is released in urine; however, the watery part is not a humor because it does not nourish but is necessary to soften the food and infiltrate it. The humor originates from the nourishing food and drink, and by nourishment we mean that, by its power, it is similar to the body, which is the human body, that is, of mixed temperament, and not simple. Water is simple. It is not true what some people think that the strength of the body is due to excess of the blood, and its weakness due to its scarcity, but if the weakness is caused by it then fixing it will fix the weakness. Some people think that if the ratio of the humors to one another is maintained as the human body requires, then health is preserved, but this is not the case. Every humor should have its own constant quantity, not in comparison with other humors, and at the same time, a fixed ratio to the other humors. There are other issues about the humors, but their discussion is not suitable for physicians because it is not their specialty and should be left to the scientists; therefore, I kept it out.

How Humors Are Generated

Note that the food is digested by **mastication** because the surface of the mouth is connected with the surface of the stomach as if the two are one, and it has a **digestive capability**; it changes the state of the masticated food via the **innate heat** of the saliva. For this reason, masticated wheat by itself has an effect on the maturation of pimples and boils that is different from its water-soaked grains, or from cooked flour. Others have stated that the evidence that masticated food undergoes a little digestion is that it loses its original taste and odor. Then when it enters the stomach it gets fully digested not only by the heat of the stomach, but by the additional heat that comes from the liver on the right side, and from the left side by the heat that is generated in the vasculature of the spleen, as well as by the heat dissipating from the frontal (abdominal) fat layer because of its capability to generate heat and its fatty supply to the stomach. As from the top, the heart heats the middle of the diaphragm. If the food gets digested it becomes (in many animals), together with the drink it mixes with, **into chyle** [from Greek chylos, juice], **which is a whitish thick substance that resembles dissolved, dried yogurt paste and has the texture and color of barley water**. After that, its good portion seeps from the stomach and the intestine through a network of veins that is connected with all of the intestines called **mesentery**. Through the

mesentery it gets to the portal vein and gets distributed throughout the liver in a network with small, hairy branches that meet the openings of the roots of the vein leaving the liver at the **kyphosis [hump]. Water**, in excess of that needed by the body, assists in the movement of the chyle through the vessels, and it gets distributed through the whole liver and acts on it intensely and fast. When this takes place, the **chyle is cooked**, and like all cooking there is a **foam** and there is a **sediment,** and there may be some burning when cooking is prolonged or rawness [uncooked] when shortened. The **foam is the yellow bile**, the **sediment is the black bile**, and both are normal**. The light portion of the burned substance is waste yellow bile, and the thick portion is bad black bile. The raw, uncooked portion is the phlegm. The remaining mature substance is the blood,** which after passing through the liver is lighter than it should be due to the excessive water that was needed initially. When the blood leaves the liver, waste water separates from it, and this waste water goes through a vein to the kidneys, carrying with it some blood that is sufficient by quality and quantity to nourish the kidneys with fat and blood, and the rest goes to the urinary bladder and ureter. The rest of the good blood in the liver goes through the vein at the hump of the liver, then the branching veins, the creeks, the canals of the branching veins, the feeders of the canals, and then the fibrous hairy veins; it percolates from their mouths into the organs. **Blood humor** is actively produced by moderate heat, and it is made from moderate food and good drinks, and its formative cause is good maturity, and its purpose is to nourish the body. **Normal yellow bile**, which is the blood foam, is generated by moderate heat, but the burned one is due to excessive burning heat, especially in the liver, and both types come from slightly hot and sweet, fatty food. Its formative cause is overcooking, and its purpose is necessity and benefit, as we mentioned before. **The phlegm is generated by undercooking** [i.e., insufficient digestion], from heavy, moist, viscous, and cold foods. Its purpose, as mentioned earlier, is necessity and benefit. **Normal black bile is produced by moderate heat**, and burned black bile by heat that surpasses moderate from very heavy, dry foods, especially the hot ones. Its formative cause is the sediment that resists movement or decomposition, and its purpose is the mentioned necessity and benefit. Black bile increases due to heat of the liver [overdrive or incomplete breakdown of toxins], the weakness of the spleen, excessive freezing cold, permanent congestion, or lasting chronic diseases that brought the humors to ash. If black bile increases, it settles between the stomach and the liver and reduces the generation of blood and other good humors and thus decreases blood. You need to know that **heat and cold** are two causes, in addition to other causes, that generate the humors; however, moderate heat generates the blood humor, excessive generates yellow bile, very excessive produces black bile by charring, coldness produces phlegm, and the very cold produces black bile by freezing.

However, you should take into consideration the active faculties, along with reactive faculties, and must not think that every temperament produces the biles that resemble it, and accidentally the opposite. If it is not exact, the temperament could excessively

produce the opposite; the cold dry temperament produces the abnormal strange humidity due to weak digestion, and such a human being is usually thin with loose joints and fearful, their body cold and oily with narrow surface vessels. Older people are cold and dry with similar abnormal moisture. In circulation, blood and the other humors undergo a third digestion. A fourth one takes place when the humors enter the tissues.

The waste of the primary digestion of the stomach is excreted through the intestines. Most of the waste from the secondary digestion in the liver goes out in the urine, and a small fraction goes to the gallbladder and spleen. The waste of the third and fourth digestions is removed by unfelt decomposition, by sweating, by felt secretions of the nose and ear wax, by unfelt secretion like that of skin pores, or unusual discharges via boils and abscesses, as well as extra growth of hair and nails.

Know that a person with thin humors gets weakened by their reduction and suffers weakness from the wide pores because decomposition is followed by weakness and thin humors are easier to decompose and eliminate. Elimination of thin humors weakens the vital force, thus further increasing their decomposition. Know that, as there are reasons for the generation of humors, there are reasons for their movement. **Movement and hot things induce the movement and strength of the blood and yellow bile and may move the black bile. However, rest strengthens phlegm and types of black bile.** Mental activity moves humors, such as looking at a red object induces the movement of blood; this is the reason that a person with a nosebleed is told not to look at bright red objects.

This is what we say about humors and their generation, and those who are in disagreement in the correctness of this should discuss it with philosophers [scientists] and not physicians.

Implications of the Humoral Theory on Diet and Food Preparation

The concept of humors, as outlined in the writings of Avicenna, extends beyond the body and enters into our diet and food sources and, importantly, methods of food preparation. Avicenna established the humors as the connection between the food we ingest and its effects on our body by defining them as the substances into which food is converted in the body. This is not surprising given that the vast majority of what we eat ends up as the building blocks of our body's tissues, drives our metabolism, provides energy, generates the waste we must excrete, and ultimately helps determine our state of health (or illness). An important point that should be reemphasized is that the humors are not the whole constituents of the blood fluids or solids, but rather the nutritional fraction of them that is available to the tissues for sustenance and growth. As such, the humors are important for the well-being of the individual, and their imbalance according to Unani medicine may have pathological effects that are signs of abnormal states of health.

Avicenna defined body humors as the materials into which the food we ingest is transformed (i.e., their source is the food we eat), and this has implications for the food we select and its methods of preparation. He further explained how the digestive processes are similar to the cooking process, which transforms the food into substances ready to be converted into humors.

The food is digested through the first digestion in the stomach and intestine, the second digestion in the liver, the third digestion in the blood, and the fourth in the tissues to produce the humors.

It is unmistakably clear that Avicenna thought that the body's digestive processes for food are similar to the effect of cooking, with the end product of both being the humors. Simply put, both processes break down food into its basic components, the humors. If conditions are within the optimal range, they produce the normal humors; otherwise, they give out abnormal humors depending on the severity of deviation from the normal range of "cooking." Traditional Old World cooking within many cultures emphasizes well-prepared food that should be soft and easy to digest. It is usually a process where the end product does not resemble the raw starting materials in color, taste, or texture, and where the fusion of oils, spices, and other condiments presents tasty, healthful, and sustaining dishes. Probably, no microwave cooking can produce the same results! Within the humoral context, it is obvious that healthy living requires a proper method of food preparation and cooking; it also points out what to eat and what to reject. One should favor well-cooked food whose components have been cooked through, turned into light texture, and contain a minimal amount of burn (no black sediment), and reject food (or at least minimize its consumption) that is lightly cooked, dense, or overcooked with black sediment. Differences in cooking styles mean that the same food may have different effects and results within the body; two people may eat the same food prepared in two different ways, and each may experience different effects and benefits from it. Avicenna tells us that well-cooked food has more "blood humor" in it (the most beneficial type of humor) than the halfway cooked, which will have more "phlegm humor" that requires more of the body's energy and resources to digest later before it is converted to a fully useful form—usually the blood humor. Also, burned food contains the harmful types of the yellow and black humors. The latter statement may explain the harmful effect of burning foods produced by barbecuing and grilling, as well as severe microwaving. The quality and quantity of humors are determined by several factors: the quality and types of food we start with, the cooking process that transforms the food into digestible and available substances, the quality of stomach digestion, and the processing or digestion in the blood and tissues. However, let us not forget that the body's humors may change into their abnormal types by the exposure of the body to environmental factors such as coldness or toxins.

THE INNATE HEAT

The innate heat (harārā ghareziya,) is also referred to as vital heat, natural heat, or calidum innatum, in Latin. The term describes the heat produced within the body by the respiration within the mitochondria, which should be within a normal population range for each individual. Heat is one of two factors to which Avicenna attributes the existence of life; he states, "Life is sustained by heat, and grows by moisture." He attributes health preservation to the maintenance of the normal level of innate heat, senescence to its weakness, and death to its extinction. Innate heat of the body and its organs is also described as a temperament on a scale between hot and cold in comparison with the individual's population of origin. The relationship between the innate heat and drug treatment is reiterated in several places within this book. Avicenna explains the interaction between the medication and the body in terms of the effect of the drug on the innate heat; he states that for a drug to work "its effect within the human body [should] produce warmth or coldness unlike those of the human body"). In addition to innate heat, there is sometimes the "abnormal heat" (harārā ghareba,) that is generated due to toxins, hypoxia, or weakness of the innate heat, and results in putrefaction. The abnormal heat is a state where the innate heat is not strong enough to carry out the normal functions to their completion.

According to Avicenna the innate heat ripens, digests, and turns nutrients into normal humors, while abnormal heat corrupts and ruins them. Putrefaction changes the food and nutrients temperament (moisture and heat) without converting them to normal humors (i.e., prevents them from normal assimilation). Thus, it further encourages the formation of anaerobic environments and incomplete digestion and maturation of nutrients. According to Avicenna, "If the innate heat is strong it will enable nature to mediate its action on moistures by maturation, digestion, and preservation of health, therefore, the moistures act in the proper functions and do not follow the influence of abnormal heat, thus produce no putrefaction."

Diagnosis

Signs Indicating Dominance of a Humor over a Humor

Signs of blood humor dominance are similar to those of the fullness of vessels; therefore, they may induce heaviness in the body, especially in the base of the eyes, head, and temples, accompanied with stretching, yawning, drowsiness, persistent sleepiness, fogginess of senses, slowness of thinking, fatigue without carrying out action, unusual sweetness in the mouth, tongue redness, pustules that may appear in the body, mouth sores, and bleeding in the soft areas, like nostrils, anus, and gums. Domination of blood humor is indicated by temperament, previous treatment, country, age, family, time since venesection, signs in dreams, like red objects, excessive bleeding, blood thickness, and the like.

Signs of phlegm dominance are increased whiteness in color, flabbiness, soft and cold skin, excessive sticky saliva, reduced thirst unless phlegm is salty, especially in old age, weak digestion, sour belching, whiteness of urine, excessive sleep, laziness,

laxity of nerves, dullness, and slow irregular soft pulse, in addition to age, habits, previous treatment, occupation, country, and dreams that feature water, rivers, snow, rain, and thundering hailstorms.

Signs of yellow bile dominance are yellowness of skin and eye color, bitter mouth, rough dry tongue, dry nostrils, enjoyment of cool breezes, excessive thirst, rapid breathing, weak appetite, nausea, yellow and green bilious vomiting, burning (irritating) diarrhea, horripilation like needle pricks, in addition to previous treatment, age, temperament, habits, country, time [of the year], occupation, as well as dreams featuring fires, yellow flags and seeing objects that are not yellow with a yellow tint, inflammations, hot baths, sun, and the like.

Signs of black bile dominance are dryness and murkiness of color, blackness and thickness of blood, suspicious thoughts and thinking, burning in the cardiac orifice, false appetite, turbid thick urine of black and red color, skin black and hairy (rarely black bile accumulates in white short bodies), and frequent occurrence of vitiligo nigra, terrible sores, and spleen problems. Other signs include age, temperament, habits, country, occupation, time [of the year], previous treatment, and dreams featuring darkness, deep pits, black objects, and fears.

Estimation of Energy Requirements

Basal energy expenditure — (BEE) can be estimated from the Harris Benedict equation (1919).

For men : BEE = 66 + (13.7 × W) + (5 × H) – (6.8 × A)

For women : BEE = 655 + (9.6 × W) + (1.7 × H) – (4.7 × A)

W = Actual weight in kilograms H = Height in centimeters A = Age in years. Total energy expenditure is estimated by multiplying BEE by the appropriate activity/stress factor as listed below. Maintenance : Bed rest : 1.2 × BEE

Ambulatory : 1.3 × BEE

Anabolic : 1.5 × BEE

Stress and Starvation : 1.2 × BEE × Percent change in metabolic activity

Body Mass Index

BMI may be used as an estimate of body fatness. When triceps fat fold measurements are not available, the following equation is used to calculate BMI.

Weight W÷ Height H

Where W = Weight in kilograms H = Height in meters squared.

A women with a BMI over 27.3 or a man with BMI over 27.8 are at risk for health complications of obesity.

Physical Signs in Nutrient Deficiency and the Possible Mechanism of their Formation

Deficiency	Physical Signs	Mechanism for Signs

Calories (Marasmus)	Sunken temples, prominence of bone structure, loss of muscle strength, sunken eyes.	Loss of muscle mass. Subcutaneous and retro-orbital (= behind the eye) fat.
Protein (kwashiorkar)	Hair dull and dry, easily pluckable dry, thin, scaly skin (flaky paint dermatosis); loss of muscle mass; poor wound healing.	Inadequate protein for new tissue growth
	Edema	Inadequate plasma protein levels; inappropriate growth hormone and corticosteriod secretion; increased capillary permeability.
	Parotid enlargement	Inappropriate growth hormone and corticosteriod secretion.
	Enlarged liver and spleen	Poor liver protein production, transport, and release.
	Apathy or irritability	Inadequate fuel supply to the brain; amino acid and electrolyte imbalance.
Essential fatty acids	Scaly skin lesions; rough, dry skin; poor wound healing	Inadequate essential fatty acid supply for membrane, prostaglandin and leukotriene formation leading to poor skin growth and repair.
Vitamin A	Dry skin; xerophthalmia (= dry eyes); Bitot's spots (= piling up of epithelium near cornea); keratomalacia (= softening of the cornea); follicular hyperkeratosis (= sand paper skin).	Abnormal growth of epithelial cells with conversion from columnar to undifferentiated squamous (= flat) cells, and failure to develop receptors for epidermal growth factor.
	Night-blindness	Failure to form rhodopsin.
Folate	Atrophy of tongue papillae (tongue appears to be shiny and red).	Decreased rate of tissue renewal due to poor formation of DNA.

Vitamin B12	Atrophy of tongue papillae.	Decreased rate of tissue renewal due to poor formation of DNA.
	Loss of sensation in hands and feet.	Decreased ability of nervous tissue to form neurotransmitters (e.g., epinephrine).
Thiamin	Beri-beri: Heart enlargement and failure; neurological changes (sensory loss, loss of reflexes, burning sensations in hands and feet); muscle tenderness and loss of muscle strength; Wernick-Korsakoff syndrome.	Defective delivery of energy to tissues due to defective carbohydrate metabolism (failure to metabolize pyruvate).
Biotin	Scaly skin lesions; rough dry skin.	Poor metabolism of essential fatty acids: poor metabolism of phenylalanine.
Riboflavin	Abnormalities of the skin where the skin and mucous membrane meet: redness and fissuring of the corners of the eyelids, the mouth, the vulva and the anus, scalling around the nostrils and scrotum; deep red beefy tongue.	Abnormal oxidation — reduction function leading to poor tissue repair at sites of mechanical and chemical stress sites of constant new tissue generation.
Niacin	Pellagra (redness and scaling where the sun damages the skin); weakness, anorexia diarrhoea, mental changes (confusion and depression); scarlet raw tongue.	Inability to repair damaged tissue, especially DNA repair. Note that the metabolic abnormalities in niacin deficiency have been difficult to define.
Pyridoxine	Redness and fissuring around eyes; pellagralike picture.	
	Depression	Impairment of intermediate metabolism; the function of other vitamins (niacin, is dependent on pyridoxine) affected. Failure to decarboxylate glutamic acid; failure to transaminate amino acids.
Vitamin C	Scurvy: Bleeding in skin (= petechiae) and gums; bone pain due to bleeding under the periostem; swelling at the ends of bones, giving (among other signs) a ‘rosary’ consisting of swellings at the points where the bony parts of the ribs join the cartilage.	Impaired collagen formation with difficulty in regenerating blood vessel walls (note that in daily life we are constantly having microtears in blood vessel walls that are constantly and rapidly repaired.
Vitamin D	Bone softening, swelling at the growing ends of long bones, rachitic rosary, Harrison’s grove (where the diaphragm is attached to the ribs and draws, the softened ribs inwards), softening and bulging of the bones of the skull, and in an infant failure to close the fontanelles; knock knees and bowed legs.	Failure to absorb calcium and to form well structured new bone.

Vitamin E	Neurological changes consistent with a loss of spinal cord function; ceriod (wax-like) pigment deposition in smooth muscle destruction.	Failure of antioxidant function.
Vitamin K	Bleeding	Failure to form clotting factors.
Copper	Pallor	Anaemia due to failure to form haemoglobin.
	Skeletal deformities	Poor bone formation due to poor bone mineralization.
	Hair with abnormal pigmentation.	Poor formation of extracellular tissue matrix.
Iron	Blue sclerae (= whites of the eyes), pallor especially of the conjuctivae.	Failure to form haemoglobin.
	Koilonychiae (= spoon nails)	Failure to form proper keratin.
Zinc	Infections of the skin and mucous membranes; diarrohea	Depressed cell mediated immunity.
	Hypogonadism	Lack of active enzyme for testosterone formation.
	Growth failure: alopecia (= hair loss)	Failure of active enzyme formation for new tissue growth.
	Anorexia, hypogeusia (= loss of taste)	Inability to form active taste buds.
	Pallor	Iron-deficiency type anaemia, due to lack of formation of porphyrins.
	Night-blindness	Poor conversion of vitamin A to active forms.
Selenium	Cardiomyopathy (= disease of the heart muscle).	Failure to maintain intracellular redox potential in tissue with high oxidative phosphorylation rates
Molybdenum	Tachycardia (= rapid heart rate), tachypenea (= rapid breathing rate), neurological disturbances.	Sulfur amino acid intolerance, due to lack of active sulfite oxidase.
	Lethargy; dry skin with abnormal doughy consistency; sparse hair with coarse texture; slowness of thinking.	Lack of thyroid hormone.
Iodine	Enlargement of the thyroid gland.	Excess accumulation of non-iodinated thyroid hormone precursor and excess stimulus for thyroid hormone to the pituitary, so excess thyroid stimulating hormone is released.

Concept of diet in unani medicine

According to Unani physicians it is believed that diet/food provides strength to the body and to the morbid matters both. The wrong selection and misappropriation of diet may hamper the tabiyat (physic) which is known to increase the severity of diseases. Complete restriction from diet or partially reduction is generally advised in acute diseases whereas only partial reduction is recommended in chronic diseases so that the faculties of the body may be restored.

Tark-e-Ghiza (Stop diet):

When the tabiyat (physic) is strong, such patients are advised to stop the diet completely; which helps in evacuation of morbid matter from the body.

Taqleel-e-Ghiza (Reduced diet intake):

The amount of food is reduced quantitatively as well as qualitatively with an aim to restore quwa (faculties of the body), which helps tabiyat (physic) to work solely in one direction and participate in eradication of disease from the body. Half boiled egg may be advised if quwa (faculty) of the body is weak. On the other hand, watermelon and muskmelon can be advised if quwa (faculty) of the body is strong.

The diet can be reduced as per the following details:

Reduction in kammiyat (quantity) of the diet:

The quantity of diet is reduced but the nutritional value does not get affected. This type of diet is advised when digestion of the patient is weak but needs to provide strength to the faculties of the body e.g. egg.

Reduction in kaifiyat (quality) of the diet:

The quantity of diet in terms of nutritional value is reduced. This type of diet is advised when the patient has desire of food but simultaneously the vascular system of the body is hampered with morbid matters. In this situation, the production of humours is decreased which provides favourable medium for concoctive action of morbid matters e.g. vegetables and fruits.

Reduction in kammiyat (quantity) and kaifiyat (quality) of the diet:

The diet in terms of quantity and quality both, is reduced particularly when faculties of the body are not markedly disturbed.

Dietary terms used in Unani medicine

Terms	Description
Ghiza-e-Lateef (Light and soft diet)	The foods which are easily digested and reduce the viscosity of khilt (humour) inside body. e.g. Aab-e-anar (pomegranate juice), Aab-e-mosambi (orange-navel juice), Aab-e-naranji (orange juice), Ma-al-shaeer (barley water), tea, coffee, wine, etc.
Ghiza-e-Lateef Kasser-utTaghzia (Attenuated highly nutritious diet)	The foods which are easily digested and rich in calories such as Ma-allahem (meat distillate) and Zardi baiz-e-murg neem birasht (yolk of half boiled egg).
Ghiza-e-Lateef Qaleel-utTaghzia (Attenuated less nutritious diet)	The foods which are digested easily and having low calories such as fruits.
Ghiza-e-Lateef Kasser-utTaghzia jayyad al-Kaimus (Attenuated, highly nutritious and good chyme forming diet)	The foods which are digested easily, having high calories and produce good chyme such as meat distillate, yolk of half boiled egg etc.

Ghiza-e-Lateef Kasser-utTaghzia raddi al-Kaimus (Attenuated, highly nutritious and bad chyme forming diet)	The foods which are digested easily, having high calories and produce bad chyme such as liver and lung.
Ghiza-e-Lateef Qaleel-utTaghzia jayyad al-Kaimus (Attenuated, less nutritious and good chyme forming diet)	The foods which are digested easily, having low calories and produce good chyme such as fruit juices and fruits.
Ghiza-e-Lateef Qaleel-utTaghzia raddi al-Kaimus (Attenuated, less nutritious and bad chyme forming diet)	The foods which are digested easily, provide less energy and produce bad chime e.g. radish, mustard, lettuce, etc.
Ghiza-e-Kaseef (Heavy diet)	The foods which are not digested easily, form ghaleez khilt (viscous humour) which produces sudda (obstruction) in organs.
Ghiza-e-Kaseef Kasser-utTaghzia (Heavy and highly nutritious diet)	The foods which are not digested easily and having high calories such as beef
Ghiza-e-Kaseef Qalil-ulTaghzia (Heavy and less nutritious diet)	The foods which are not digested easily and having high calories such as dry beef.
Ghiza-e-Kaseef Kasser-utTaghzia jayyad al-Kaimus (Heavy, highly nutritious and good chyme forming diet)	Heavy and highly nutritious foods which produce good chmye e.g. fully boiled egg, meat of young sheep, etc.
Ghiza-e-Kaseef Kasser-utTaghzia raddi al-Kaimus (Heavy, highly nutritious and bad chyme forming diet)	The foods which are not digested easily and always produce bad chmye e.g. duck meat and horse meat.
Ghiza-e-Kaseef Qaleel-ulTaghzia jayyad al-Kaimus (Heavy, less nutritious and good chyme forming diet)	Less nutritious foods which produce good chmye e.g. meat of young beef.
Ghiza-e-Kaseef Qaleel-ulTaghzia raddi al-Kaimus (Heavy, less nutritious and bad chyme forming diet)	Less nutritious and heavy foods which are not digested easily and produce bad chmye e.g. dry beef meat.
Ghiza-e-Motadil (Moderate diet)	Foods that produce khilt (humour) of moderate viscosity which is not harmful to the human body e.g. Khichdi, cow's milk, etc.
Aghzia Barida/Aghziya Mubarrida	The food of cold temperament having ability to produce the humours which induce coldness in the body e.g. Khas (Andropogan muricatus Retz.), Kasni (Cichorium intybus Linn.), etc.
Aghziya Hamiza	Sour foods e.g. lemon, sour pomegranate, sour apple, orange, vinegar, curd, etc. They change the thick waste products of stomach into smaller particles.
Aghziya Harra	The foods of hot temperament having ability to produce the humours which induce heat in the body e.g. onion, garlic, etc.
Aghziya Hirrifa	Spicy (pungent) foods that may produce heat in the body e.g. pepper.
Aghziya Lazija	The foods which increase the viscosity of humours e.g. Khurfa, Till, etc.
Aghziya Mahmuda	Foods that produce good humours
Aghziya Maliha	Salty foods.
Aghziya Mubakhkhira	The food liable to produce flatus and vapours e.g. cabbage, pea, brinjal, cauliflower, beans, turnip, etc.
Aghziya Mughalliz-e-Dam	Foods producing Dam (Sanguine) of thick consistency.

Aghziya Mugharriya	Glutinous foods.
Aghziya Mujaffifa	Foods causing desiccation of body fluid e. g. roasted gram
Aghziya Muraqqiq-e-Dam	Foods that cause thinning of Dam (Sanguine)
Aghziya Murattiba / Aghziya Rataba	Foods of wet /moist temperament having ability to produce the humours which give rise to wetness in the body e.g. milk, kadu, (Cucurbita maxima Duchesne.) cucumber, watermelon, clarified butter, almond oil, etc
Aghziya Musakhkhina	Foods producing heat in the body e.g. spices.
Aghziya Musammina	The foods which help to put on body weight e.g. dry fruits, milk and products, etc.
Aghziya Mutaaffina	Putrefied food stuffs
Aghziya Muwallid-e Balgham	The foods which produce excessive quantity of phlegm in the body e.g. sheep milk, beet root, cucumber, etc.
Aghziya Muwallid-e-Dam	The foods which produce an excessive quantity of sanguine in the body e.g. grapes, pomegranate, egg yolk, fried meat, boiled meat, milk, dairy products, gram, etc.
Aghziya Muwallid-e-Safra	The foods which produce an excessive quantity of yellow bile in the body e.g. cheese.
Aghziya Muwallid-eSawda	The foods which produce an excessive quantity of black bile in the body e.g. buffalo meat, cabbage, brinjal, etc
Aghziya Nashifa	Foods that have the property of absorbing the moisture of the body.
Aghziya Radiyya	Foods that produce bad quality of humours.
Aghziya Saliha	The foods which produce good quality of humours.
Aghziya Saqila	The foods which are difficult to digest.
Aghziya Yabisa	The foods of dry temperament which produce dryness in the body e.g. meat, lentil, etc.

Specific diets and their uses

According to Unani system of medicine, many modified diets, separately or as an adjuvant with pharmacotherapy, are also used for the treatment of various diseases. These diets have been mentioned in several Unani pharmacopoeia.

- ✓ Ma-al-shaeer (Barley water): Barley is soaked in water for four hours, and boiled (in twenty times water) till the colour of water becomes reddish. According to Buqrat (Hippocrates) barley water is most appropriate diet in diseases of hot temperament according to him it eliminates the morbid matter, cleans the system, easily absorbable, palatable, moderate, quenches thirst and easy digestible. It is also useful in acute conditions, cool and moist in nature, moderate, cleanses the system and produces good chyme.
- ✓ Jubn (Milk): Itis moderate in temperament with little influence of cold and moist. It possesses three major qualities viz it is light, excess water content helps to eliminate morbid matter, maintains body heat, nourishes and energizes body increases body weight. Milk is useful in those conditions which produce dryness in the body.

- ✓ Ma-al-jubn (Milk water): This is prepared by boiling sheep/ goat's milk with equal quantity of water with adding some sour juice like grape or lemon juice to curdle the milk. Then it is filtered through a thick cloth and hanged for some time. Finally water is collected, boiled, filtered, cooled and mixed with sikanjabeen. It works as purgative and used in bilious condition like jaundice. It is dilute and light, easily absorbable and digestible. Its oily contents keep the organs soft that prevents irritation.
- ✓ Ma-al-lahm (Meat distillate): It is prepared by process of distillation. This is rich in calories and easy digested. It is used in malnourished and weak patients.
- ✓ Ma-al-raib (Butter milk): It is cold and moist in temperament, easy absorbed, cool and quenches thirst.
- ✓ Ma-al-asl (Honey water): Honey is boiled with water or herbal decoction. It is useful in fever, irritation, thirst and in dry cough.
- ✓ Ma-al-usool: Certain roots like beekhbadyan, kasni, karafs, etc. are crushed and boiled.
- ✓ Ma-al-fawakeh (fruit juices).
- ✓ Ma-al-buqool: It is extracted juice of crushed, pounded and vegetables.
- ✓ Paneer maaya: Itis sort of milk collected after the birth. It is boiled and when cooled it solidifies mostly prepared from milk of camel, cow and sheep. It is nutritious, strengthens heart, brain and useful in diarrhoea.
- ✓ Jullab: It is prepared by boiling honey/sugar syrup and rose water. It is used as strong purgative.
- ✓ Sikanjabeen (Oxymel): It is prepared by boiling 1 part vinegar and 2 parts honey. It is useful in purging out thickchime. It is a soothing medicine, removes yellow bile, acts as emetic when used with hot water and anti emetic if used with cold water.
- ✓ Aabkama (Mar/sirkahindi/Kaanji): Itis prepared by fermentation of mustard, salt, zeera, ajwain or wheat roti, vinegar, salt, mint, ginger, pepper, etc.
- ✓ Asfeedaj. It is mutton soup prepared without spices and mostly used in winter season. It is nutritious and energetic.
- ✓ Sikbaj. It is prepared with meat and vinegar. It is cool in temperament, anti-bilious and used in inflammation of liver.
- ✓ Khamar (Sharab): It is obtained by fermenting starchy substances. It is cardiac, brain stimulant and tonic if used in less quantity but becomes dangerous and toxic when used in large quantity.
- ✓ Murabba: Seasonal fruits are preserved by boiling in sugar syrup or honey so that they can be used later. Use of Murabba amla, halela, bihi, adrak, Aam, Seb, etc, strengthens stomach and acts as anti bilious.
- ✓ Gulqand: Rose petals are preserved in sugar syrup or honey to form a jam. It is anti-pyretic, moderate laxative, hepatic and cardiac tonic and acts as purgative when used in large quantity.
- ✓ Halwa: Maida, Sooji, honey, clarified butter and dry fruits, are mixed in herbs like aloe vera, carrot, onion and prepared as halwa. It is rich in calories, nutritious and energetic preparation.
- ✓ Hareesa: A sort of diet prepared by boiling meat and wheat It is pounded into paste and spices are added for flavour.

- ✓ Hasarmiya: A diet prepared with grape juice, lauki, palak and cucumber. It is useful in diseases of hot climate and hot temperament and also used as ant bilious.
- ✓ Zeerbaaj: Type of soup which is prepared with vinegar, dry fruits, saffron, and spices. It is useful in the diseases of stomach and liver.
- ✓ Mazeera. A diet which is prepared with curdled milk. It is cool and viscous and useful in hottemperament.
- ✓ Masleeya: This is curd and rice used same as mazeera.
- ✓ Falooda: A nutritious diet which is prepared with starch, milk or water. It sets when cooled and can be cutinto pieces. It is coolant and nutritious.
- ✓ Alqabees: A sort of halwa which is prepared with milk cream, maida and dates similar to falooda.
- ✓ Firni: It is prepared with broken rice, sugar and milk. It is nutritious diet.
- ✓ Maibah: It is prepared with quince fruit juice, grape wine, honey, powder of dried ginger, cardamom, cinnamon and saffron is added. It strengthens the stomach and useful in diarrhoea, indigestion nausea and vomiting.
- ✓ Fateer: It is special type of Rotis which is prepared with fermented or unfermented dough. It strengthens the body.
- ✓ Qashkar: It is kind of Roti which is prepared without removing husk. It is nutritious.
- ✓ Hareera: It is prepared with heating of Maida, clarified butter, milk, sugar and dry fruits. It is easily digested coolant, nutritious and used in acute conditions.

Diet Charts

People with phlegmatic temperament should take hot and dry foods.
People with sanguine temperament should take cold and dry foods.
Choleric temperament should take cold and moist foods.
Melancholic temperament people should take hot and moist.

Cold and moist temperament food

Herbal tea;

Cleansing tea
Ingredients; 1 tsp – 1 tbls fennel seeds
Method; Soak in one cup of hot boiled water and cover for an Hour.
Strain and drink (in winter, drink it warm)
Almond tea
Ingredients; 11 almonds
2 tsp poppy seeds
2 cardamom pods
100ml water
100ml milk
Method; Soak almonds, poppy seeds and cardamom in water for 6-7 hours.Liquidise with milk (boiled and cooled).Add two tsp sugar .Strain and drink half an hour before going to bed.

Special recipe;

Popular pumpkin
Ingredients; 500g pumpkin, peeled, sliced and roughly diced
¼ tsp salt
2 tbls brown sugar
whole cardamom (elachi)
cinnamon sticks
Pinch of ground nutmeg
Pinch of ground cinnamon
1 tbls butter
Method; Season pumpkin with salt, sugar, nutmeg and ground
Cinnamon. Heat butter in a saucepan,add pumpkin, cinnamon sticks and cardamom. Steam on medium heat until the pumpkin is tender but still retains its shape. Add a little water if necessary to prevent the pumpkin from burning.Mash or serve in chunks.

Cold and dry temperament food

Herbal tea

Cough tea
Ingrediants; 1 tsp basil leaves
½ stick cinnamon
1 tsp raisins/sultanas
Method; Boil all of the above in two cups of wate.
Boil away one cup of the mixture.
Strain the remaining cup and drink warm.

Lemon cider tea
Ingrediants; ½ tsp lemon juice
½ tsp apple cider vinegar
2 tsp honey
Method; Boil one cup of water
Add the above ingredients and drink warm
Advantages; An apple cider, lemon, and honey detox drink is a great way to promote overall wellness and support your body's natural detoxification process.

Digestive tea
Ingredients; 3 plums
10 grams tamarind
Method; Soak ingredients in two cups of boiled water for 1 hour
Mash the pulp until it mixes completely
Remove the seeds
Drink with a pinch of salt

Special recipe;

Cauliflower sabzi
Ingredients; 1 tbls oil
1-2 tomatoes, grated salt to tast
2 tsp white pepper
1 cauliflower, broken into florets

125ml water
2 green peppers, sliced
2 tbls fresh coriander, choped

Method; Heat oil and add tomatoes, salt and peppe. Simmer until tomatoes have reduced to a paste. Add the cauliflower and water. Cook on low heat until the cauliflower is tender but not wilted.Add green peppers and increase the heat. Sauté quickly until peppers are just done.Add the coriander. Serve alone, as a side dish or with roti or bread.

Hot and moist temperament food

Herbal tea

Digestive tea

Ingredients ; 7 mint leaves
2 black pepper corns
Small piece of fresh ginger
2 crushed cardamom pods
Methods; Boil above ingredients in 3 cups of water until only 1 cup remains
Strain and mix with brown sugar/honey
Drink warm

Special recipe;

Chicken with tarragon & vegetables

Ingredients;1 medium chicken, cut into serving pieces
1 tsp salt
1 ½ tsp mustard sauce
2 tbls lemon juice
½ tsp finely ground black pepper
4 cloves garlic, finely sliced
1 ½ tsp finely crushed green chillies
½ tsp tarragon, dried and crushed
10-12 baby carrots
10-12 baby potatoes, peeled
150g fresh green peas, deveined
½ cup water
½ tbls flour
1 tbls olive oil

Method; Marinate chicken in salt, mustard sauce, lemon juice, black pepper, tarragon and chillies for 30 minutes.While chicken is marinating, steam potatoes, carrots and peas with a pinch of salt.After marinating, melt olive oil and garlic and add chicken, cook until almost done.Add vegetables and flour mixed with water to the chicken and simmer slowly until sauce thickens and chicken is tender. Garnish with herb of choice and serve.

Hot and dry temperament food

Herbal tea

Chest tea
Ingredients ;25 grams cinnamon
25 grams cloves
25 grams celery seed (ajmo)
50 grams fenugreek seeds (methi)
Method;
Crush all ingredients into a powder .
Add ½ tsp of the powder to 2 cups of water and boil until 1 cup remains.
Strain and mix with lemon juice or honey (to taste).
Drink warm.

Clove and cinnamon tea
Ingredient; 7 clove
1gm cinamomum
As a taste lemon, salt, sugar
Dosage; One to 2 cup
Advantages; The combined flavors of cinnamon and clove can create a soothing, calming beverage that may help ease stress, improve relaxation, and enhance sleep quality. This tea also helps provide antioxidant protection and supports improved brain health.

AjwainPudinaKehwa
Dosage; One cup
Advantages; it is useful in constipation, gas, acidity, bloating, vomiting, colic. Mint Ajwain Extract is Delicious and Deep Digestive. With its use, it destroys the disorders like sour belching, nausea, vomiting, heartburn, acidosis etc.
Cinnamomumtamala extract
Dosage; One gram in one cup
Advantages; Help regulate blood sugar levels, reduce inflammation, improve digestion, and boost the immune system. It can also help reduce cholesterol levels, improve circulation, and reduce the risk of heart disease.

Special recipe

Green masala
Ingredients; 1 kg fresh green chillies
2 whole garlic
2-3 tbls oil
2 tsp salt
Method; Grind the chillies and garlic together until fine.Add oil and salt, mixing well. Spoon into suitable containers and freeze.

Cooling Food

Chart 1

Morning; Sagudana pudding, Custard, Ispaghoul, Egg (Albumen),Raw lassi, Milk soda, Fresh porridge, Barley, Boiled rice, Milk

Evening; Meat (Rabbit), Turnip, Beetroot, Rice, Barley, Zucchini, Apple gourd, Pumpkin, Dal mash, Lady finger, Edible, Mushroom, Maghaz

Evening; Same as Afternoon

Fruit; Melon, Sweet Potato, Coconut, Srdaa, Pomegranate, Guava, Prune, Sweet lime,

Salad; Cucumber, Beetroot

Beverages; Raw lassi, Coconut, Sharbat Sandal, Sharbat bazori

Spices; Green cardamom pods, Kishneez

Chart 2

Morning; Muraba Amla, Safeed chanay , Muraba karonda, Bread, Siri paye bary, Yogurt, lassi

Afternoon; Fish, Chicken, large meat, Beans, Peas, Red beans, eggplant, Cabbage, Peanuts, curd, Potatoes, Fruit Salad, Bread, Millet bread, bajra roti, jawar roti.

Night; Same as Afternoon

Fruit; Jaman, Falsa, Green Apple, Orange, Peach, Lokat, Pineapple, AlochaTarsh Pomegranate, Singhara, Red Sweet Potato, Amlok, Pomegranate pods, Coconut, Peanut.

Salad; Lemon

Beverage; Lemon Water, Falsa Drink, Imli + Alo Bukhara Infusion, vinegar, Herbal tea ,Ice, Sour lassi, Bakery items..

Spices; Anardana, Imli,Amla Lemon, Poppy Orange

Heating food

Chart 1

Morning; Broiler Egg Fry, Omelet, Boiled Egg, Roasted Gram, Nimko, Lassi, Besan Halwa, kahwa (Clove + Cinnamon + Jawtri)

Afternoon; Camel, Beef, Ojhri, Daal Masoor, Gram flour, Spinach, Bread, Qima, Methi saag, Fenugreek, Curry, kabab, shami kebab, chohangan, capsicum, bitter gourd, mango pickle.

Night: Same as Afternoon

Fruit; Grape, lokat,chohare, Japanese fruit, Sour mango, Dates dried, Nuts.

Salad; Tomato, Onion, Green Pepper, Capsicum.

Spices; Badian Khatai, Cinnamon, Clove, javatri

Chart 2

Morning; Nuts, Walnuts, Sweet eggs, Dried apricots, eggs, Omelet, Mango jam, Dates, khwa (celery + mint + Kachor + Tazepat + Honey), Suji Halwa, Almond, Egg yolk

Afternoon; Goat meat, Saag taramera, Batho, Mathery, Desi chicken, kaleji, Moringa pickle, Garlic, Red pepper

Night; Same as Afternoon

Fruit; Dates, Dried apricots

Salad; Green mint salad

Chutney; (green mint leaves + Garlic + salt) fried in desi ghee.

Spices; Green peppers, Garlic, Zira, Safeed, Methray

Chart 3

Morning; Duck egg, Halwa Badaam, Halwa Adrak, Oatmeal, wheat, Magaz Badam, Semolina cooked in ghee, Murabba ginger, Radish Paratha with red pepper, Milk with honey, Adrak khwa, Goat and Camel milk

Afternoon; Goat, Lamb, Tetar, Bater, Kobutar, Apple gourd, Saagmako, Carrot by adding Mutton..

Night; Same as Afternoon

Fruits; Fresh sweet grapes, Sweet Melon, Sweet Mango.

Beverages: Fennel + Ginger + Honey, Mulberry Syrup, Milk Cow, Goat Milk, Camel Milk, Mango Shake, Almond Oil, Ghee Milk, Sharbat Buzuri haar

Spices: Black pepper, Salt, Turmeric, Ginger.

Chart 4

Morning; Pumpkin halwa, Carrot jam, Halwa carrot, Magzyat Harira, Sawyian, Barfi, Butter, Sweet rice, Malai, Khawa (fennel + small cardamom + white cumi), 4 Magaz

Afternoon; Pumpkin, Radish, Yellow Turnip, Apple Gourd, Black Zucchini, Carrot, Beetroot, Khichdi, Peanut, Rice

Night; Same as Afternoon

Fruits: Banana, Pear, Garma, Melon, Sugarcane, Mosambi

Salad; Carrot

Drinks;Sugarcane Juice , Buzuri Moatadal ,Banana milkshake, Water and Honey, Sheep Milk.

Spices; Condiments of white cumin, Cardamom, fennel

Nutritional Values of Various Foods

Barley Porridge

The nutritional content of Fresh Barley Porridge prepared with 20 grams of barley, 200 grams of cow milk, and 40 grams of white sugar can be estimated as follows:

Calories: Approximately 250-300 calories.
Proteins:Around 7-8 grams, mainly from barley and cow milk.
Carbohydrates: Approximately 45-50 grams, coming from barley, lactose in cow milk, and added sugar.
Fats:Approximately 4-6 grams, mostly from cow milk.
Dietary Fibers:Around 3-4 grams, primarily from barley.
Sugar:About 40 grams

here's an approximate breakdown for the micronutrients in Fresh Barley Porridge prepared with 20 grams of barley, 200 grams of cow milk, and 40 grams of white sugar:

Calcium:Around 200-250 milligrams
Vitamin D:Variable and depends on fortification; can range from 1 to 2 micrograms.
Vitamin B12: Approximately 1 microgram
Riboflavin (Vitamin B2):Around 0.3 milligrams
Phosphorus: Approximately 250 milligrams
Potassium:Roughly 400-450 milligrams

Boiled Rice and Sweet Boiled Milk

The nutritional content of Boiled Rice with Cow Milk and White Sugar, considering 100 grams of boiled rice, 20 grams of cow milk, and 10 grams of white sugar, can be estimated as follows:
Calories: Approximately 230-250 calories.
Proteins:Around 4-5 grams, mainly from rice and cow milk.
Carbohydrates: Approximately 50-55 grams, primarily from rice and added sugar.
Fats:Approximately 1-2 grams, mostly from cow milk.
Calcium:Around 60-70 milligrams (mainly from cow milk).
Sugar:About 10 grams, contributing to the overall carbohydrate content.

Micronutrients:
Calcium:Around 50-70 milligrams (mainly from cow milk).
Vitamin D: Variable and depends on fortification; can range from 0 to 1 microgram.
Vitamin B12: Approximately 0.2 micrograms (mainly from cow milk).
Riboflavin (Vitamin B2):Around 0.05 milligrams (mainly from cow milk).
Phosphorus: Approximately 70-80 milligrams (mainly from rice and cow milk).
Potassium:Roughly 70-100 milligrams (mainly from rice).

Sangtra

"Sangtra" typically refers to "Santra" or "Santara," which are Hindi terms for oranges. Oranges are rich in vitamin C and offer various health benefits. Here are approximate nutrient values per 100 grams of raw oranges:
Calories: Around 43 kcal
Water: Approximately 87 grams
Carbohydrates: About 8.3 grams
  Sugars: 8.2 grams
Proteins: Around 1.0 gram
Fats:About 0.2 grams
  Saturated fat: 0.02 grams
  Monounsaturated fat: 0.02 grams
  Polyunsaturated fat: 0.03 grams
Dietary Fiber: Roughly 2.1 grams
Cholesterol: 0 mg

Micronutrients:
  Vitamin C: 53.2 mg
  Vitamin A: 34 IU
  Potassium: 181 mg
  Calcium: 43 mg
  Iron: 0.1 mg
  Magnesium: 10 mg

Kinu
Kinu, also known as Nagpur orange or mandarin orange, is a sweet citrus fruit. Here are approximate nutrient values per 100 grams of raw Kinu:
Calories: Around 43 kcal
Water: Approximately 87 grams
Carbohydrates: About 8.2 grams
 Sugars: 8.2 grams
Proteins: Around 0.7 grams
Fats: About 0.2 grams
  Saturated fat: 0.03 grams
  Monounsaturated fat: 0.02 grams
  Polyunsaturated fat: 0.03 grams
Dietary Fiber: Roughly 1.8 grams
Cholesterol: 0 mg
Micronutrients:
  Vitamin C: 43.7 mg
  Vitamin A: 34 IU
  Potassium: 166 mg
  Calcium* 43 mg
  Iron: 0.1 mg
  Magnesium: 10 mg

Jujube Fruit

Jujube fruit, also known as "Ber" or "Chinese date," is a sweet and nutritious fruit. Here are approximate nutrient values per 100 grams of raw jujube fruit:
Calories:Around 79 kcal
Water: Approximately 78 grams
Carbohydrates: About 20.2 grams
  Sugars: 14.0 grams
Proteins: Around 1.2 grams
Fats:About 0.2 grams
  Saturated fat: 0.03 grams
 Monounsaturated fat: 0.04 grams
  Polyunsaturated fat: 0.04 grams
Dietary Fiber: Roughly 4.0 grams
Cholesterol: 0 mg

Micronutrients:
  Vitamin C: 69.0 mg
  Vitamin A: 40 IU
  Potassium: 250 mg
  Calcium: 21 mg
  Iron: 0.5 mg
  Magnesium: 10 mg

Lychees
Lychees are sweet and aromatic tropical fruits. approximate nutrient values per 100 grams of raw lychees:
Calories: Around 66 kcal
Water: Approximately 81 grams
Carbohydrates: About 16.5 grams
 Sugars: 9.2 grams
Proteins: Around 0.8 grams
Fats: About 0.4 grams
  Saturated fat: 0.1 grams
  Monounsaturated fat: 0.1 grams
  Polyunsaturated fat: 0.2 grams
Dietary Fiber: Roughly 1.3 grams
Cholesterol: 0 mg

Micronutrients:
  Vitamin C: 136 mg
  Vitamin B6: 0.1 mg
  Niacin (B3): 0.6 mg
  Riboflavin (B2): 0.1 mg
  Potassium: 171 mg
  Copper: 0.1 mg
  Phosphorus: 31 mg

Raspberry
Raspberries are delicious berries with notable nutritional benefits. Here are approximate nutrient values per 100 grams of raw raspberries:
Calories: Around 52 kcal
Water: Approximately 86 grams
Carbohydrates: About 11.9 grams
  Sugars: 4.4 grams
Proteins: Around 1.2 grams
Fats: About 0.7 grams
  Saturated fat: 0.0 grams
  Monounsaturated fat:0.1 grams
 Polyunsaturated fat: 0.4 grams
Dietary Fiber: Roughly 6.5 grams
Cholesterol: 0 mg
Micronutrients:
  Vitamin C: 26.2 mg
  Vitamin K: 7.8 mcg
  Folate: 21 mcg
  Potassium: 151 mg
  Magnesium: 22 mg
  Manganese: 0.7 mg

Raspberries are also rich in antioxidants, particularly anthocyanins.

Louqats
Loquats are small, sweet, and tangy fruits. Here are approximate nutrient values per 100 grams of raw loquats:

Calories: Around 47 kcal
Water: Approximately 86 grams
Carbohydrates: About 12.1 grams
 Sugars: 8.1 grams
Proteins: Around 0.5 grams
Fats: About 0.2 grams
  Saturated fat:0.0 grams
  Monounsaturated fat: 0.0 grams
  Polyunsaturated fat: 0.1 grams
Dietary Fiber: Roughly 1.7 grams
Cholesterol: 0 mg

Micronutrients:
  Vitamin A: 1527 IU
  Vitamin C: 1.0 mg
  Vitamin B6: 0.1 mg
  Niacin (B3): 0.2 mg
  Folate: 14 mcg

Potassium: 266 mg
Copper: 0.1 mg

Pineaple
Pineapple is a tropical fruit with a sweet and tangy flavor. approximate nutrient values per 100 grams of raw pineapple:

Calories: Around 50 kcal
Water: Approximately 86 grams
Carbohydrates: About 13.1 grams
Sugars: 9.9 grams
Proteins: Around 0.5 grams
Fats: About 0.1 grams
Saturated fat: 0.0 grams
Monounsaturated fat: 0.0 grams
Polyunsaturated fat: 0.0 grams
Dietary Fibers: Roughly 1.4 grams
Cholesterol: 0 mg

Micronutrients:
Vitamin C: 47.8 mg
Vitamin A: 3 IU
Thiamine (B1): 0.1 mg
Riboflavin (B2): 0.0 mg
Niacin (B3): 0.1 mg
Folate: 1 mcg
Potassium: 109 mg
Manganese: 0.9 mg

Plums
Plums are delicious and juicy stone fruits. approximate nutrient values per 100 grams of raw plums:

Calories: Around 46 kcal
Water: Approximately 87 grams
Carbohydrates: About 11.4 grams
Sugars: 9.9 grams
Proteins: Around 0.7 grams
Fats: About 0.3 grams
Saturated fat: 0.0 grams
Monounsaturated fat: 0.1 grams
Polyunsaturated fat: 0.1 grams
Dietary Fiber: Roughly 1.4 grams
Cholesterol: 0 mg

Micronutrients:

Vitamin C: 9.5 mg
Vitamin A: 345 IU
Vitamin K: 6.4 mcg
Potassium: 157 mg
Phosphorus: 16 mg
Magnesium: 7 mg

Pomegranate

"Pomegranate" is generally known for its sweet and tart taste. If you are referring to a variety that is specifically labeled as "sour pomegranate," it's not a widely recognized term in common use. Pomegranates typically have a sweet and slightly tart flavor. approximate nutrient values per 100 grams of raw pomegranate arils (seeds):

Calories: Around 83 kcal
Water: Approximately 79 grams
Carbohydrates: About 18.7 grams
Sugars: 9.2 grams
Proteins: Around 1.7 grams
Fats: About 1.2 grams
Saturated fat: 0.1 grams
Monounsaturated fat: 0.1 grams
Polyunsaturated fat: 0.1 grams
Dietary Fiber: Roughly 4.0 grams
Cholesterol: 0 mg
Micronutrients:
Vitamin C: 10.2 mg
Vitamin K: 16.4 mcg
Folate: 38 mcg
Potassium: 236 mg
Phosphorus: 10 mg
Magnesium: 12 mg

Water Chestnut

Water chestnuts are aquatic tuber vegetables commonly used in various cuisines. Here are approximate nutrient values per 100 grams of raw water chestnuts:
Calories:Around 97 kcal
Water: Approximately 74 grams
Carbohydrates: About 23.9 grams
Dietary Fiber: 3 grams
Sugars 4.5 grams
Proteins: Around 1.4 grams
Fats: About 0.1 grams
Saturated fat: 0.0 grams
Monounsaturated fat: 0.0 grams
Polyunsaturated fat: 0.0 grams
Cholesterol: 0 mg

Micronutrients:
- Vitamin C: 2 mg
- Potassium: 584 mg
- Magnesium: 25 mg
- Phosphorus: 62 mg
- Iron: 0.6 mg