HAND BOOK
on
Developing Healthy food habits for better nutrition and food safety

Campaign on

SUPOSHAN

Strategy for Undertaking Participatory Outreach by Students for Health and Nutrition Through

Cultural Leadership Center (CLC)

Promoted by :

Samskruti Foundation

Sponsored by :

MIDHANI Mishra Dhatu Nigam Limited

Prepared by

Dr Vasanthi Siruguri

Independent Consultant on Food Safety
Former Senior Scientist at the ICMR-National Institute of Nutrition, Hyderabad


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State Level Work Shop - 2023
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Contents

Introduction and overview

The importance of a balanced diet to good health and nutrition has been documented in India more than 5000 years ago. Description about food habits, nutrition and importance to health that are very relevant to the current concepts of nutrition and balanced diet can be observed in Shrimad Bhagavad Gita scriptures as well as Charaka Samhita. However, with changing lifestyle traditional dietary patterns have been undergoing a major change with profound impact on health. The concept of what constitutes a healthy diet has been continuously evolving as newer understanding/knowledge of the roles that various foods, nutrients and the food constituents in the promotion of health and prevention of non-communicable diseases such as obesity and cardiovascular diseases. Changing lifestyle has made profound impact on dietary choices such that consumption of foods important for contribution of micronutrients and other essential compounds is decreasing and foods promoting non-communicable diseases and other health issues are increasingly being consumed. In addition, emerging concerns on food safety are further posing challenges to maintenance of nutrition and good health. Children are becoming the most vulnerable targets for these lifestyle changes and disease risk. Thus, under the scenario of the fast growing market of processed foods paralleled with life style demands there is an urgent need to create public awareness and educate young children about the importance of a balanced diet and food safety for good health and nutrition.

The present article aims to bring out the importance of healthy balanced diet through dietary diversity such that foods rich in nutrients essential for maintenance of a healthy body at all stages of life. The need for balancing intake of energy dense foods and increasing intake of fruits and vegetables while minimizing intake of saturated or trans fats and sugar and salt are important dietary changes recommended by nutrition authorities namely the ICMR-National Institute of Nutrition in Hyderabad. Food guides have been published by the NIN that facilitate in choosing foods to make a diversified diet that provides all the essential nutrients particularly the micronutrients. The contents of the article may find useful application as education material particularly for women and children.

The present article is divided into 9 chapters beginning with a brief account of ancient Indian practices relevant to nutrition and food safety that include relevant texts from Shrimad Bhagavad Gita. Following this, the article presents the current concepts in health and nutrition and food safety with an overview of basic principles of nutrition and importance of a balanced diet in maintaining good health and nutrition; the role of fruits and vegetables in the diet as major sources of micronutrients and dietary fiber; the intake of processed foods rich in calorie density, sugar and salt and their impact on the risk of developing non-communicable diseases; and the important role of food safety, quality and hygiene in ensuring healthy and nutritious diet.

Chapter 1.0

Ancient Indian practices relevant to nutrition and food safety

There existed profound connection between the food, culture and ancient traditions of every region in India. Food attained an important position in the diet and seen as the source of nourishment for the physique, mind, and spirit.

अन्नम ब्रह्म रसं विष्णुं भोक्ता देवो जनार्दनम् एवम् ध्यातव तथा ज्ञत्व अन्न दोषो न लिप्यते।

Food is Brahma, the essence in it is Vishnu, and the one who consumes (enjoys) it is Maheshwara the Lord Himself.

"Sarve bhavantu sukhinah, sarve santu niramayah" -May all be happy, may all be healthy (Sanskrit shloka)

The following shloka indicates the importance of health and nutrition begins in the mothers womb.

आयुः कर्म च वित्तं च विद्या निधनमेव च । पञ्चैतानि हि सृज्यन्ते गर्भस्थस्यैव देहिनः ॥

Chanakya Neeti - Chapter 4 - Shlok 1
aayuh karma ca vittam ca vidyaa nidhanameva ca|
pañcaitaani hi srjyante garbhasthasyaiva dehinah||

Five components - life-span, type of work, wealth, learning and the time of one's death are determined while one is in the womb.

1.1 Relevance of our ancient scriptures to the current concepts of health, nutrition and food safety

Dietary practices including food preparation and consumption in India date back 5000 years ago. The concept of balanced diet and nutrition as well as healthy food habits was scripted in Srimad Bhagwad Gita Chapter 6. The 17th verse of the 6th chapter from the Bhagavad Gita preaches the importance of healthy eating habits and a balanced lifestyle. The verses in this Chapter explain the importance of eating for sgtrength and vitality: "we should not eat just to gratify our tongues; rather, we should eat to have strength and vitality". This is a very important factor in maintaining health. And the foods that give the most vitality are those which may be eaten in natural form, such as fruits and vegetables prepared in salads or lightly steamed"

(a) Srimad Bhagwad Gita Concept of moderation in food intake and activity

In Shloka 16 of Chapter 6 Srimad Bhagavad Gita, Sri Krishna explains to Arjuna about the disadvantages of excessive eating and sleeping is stated as follows:

नात्यश्नतस्तु योगोऽस्ति न चैकान्तमनश्नत: |
न चाति स्वप्नशीलस्य जाग्रतो नैव चार्जुन | | 16| |

naatyashnatastu yogosti na
chaikaantamanashnataha |

na chaati svapnasheelasya jaagrito naiva chaarjuna | | 16 | |

Meaning of the above shloka:
Eating too much food or starving, and sleeping too much or remaining awake all the time is not health friendly. Such people cannot concentrate or do sadhana. Yogaasans, Praanayaam, and the science of proper diet are an essential part of Vedic knowledge.

In shloka 17. Sri Krishna talks to Arjuna about importance of moderation as follows: 'those who are temperate in eating and recreation, balanced in work, and regulated in sleep, can mitigate all sorrows by practicing Yog'.

yuktaahaara-vihaarasya yukta-cheshtasya karmasu
yukta-svapnaavabodhasya yogo bhavati duhkha-haa

which means,
"the one, whose diet and movements are balanced, whose actions are proper., whose hours of sleeping and waking up are regular, and who follows the path of meditation, is the destroyer of pain or unhappiness."

Yukta-moderate;

Aahaaraa-eating;

Vihaarasya-recreation;

Yukta cheshtsya karmasu-balanced in work;

Yukta-regulated;

Svapna-avabodhasya-sleep and wakefulness;

Yogah-Yog;

Bhavati-becomes;

Duhkha-haa-the slayer of sorrows

If we relate this to our daily diet, exercise, activity, sleep the above shloka explains the importance of moderation in diet, physical activity as well as amount of exertion (physical or mental) in a job/professional activity, in the amount of sleep and wakefulness. The description of the above shloka is as follows:

Yuktaahaara: moderate diet, one should neither feast nor fast

Yuktavihaarasya: moderate physical activity

yukta-cheshtasya karmasu: moderate stress especially while working

yukta-svapnaavabodhasya: moderate sleep, moderate wakefulness

(b) Srimad Bhagwad Gita Concept of healthy eating habits

The Bhagwad Gita also explains about healthy food/eating habits/ how to eat: "while eating, one should concentrate only on eating as the food is served to one's consciousness" (9.27). Lord Krishna says that even eating leaves, fruits, and water suffice to keep us healthy".

yat karoshi yad ashnaasi yaj juhoshi dadaasi yat

yat tapasyasi kaunteya tat kurushva mad-arpanam

The above shlokas are very relevant to the current concept of malnutrition and food habits that lead to good nutrition: undernutrition due to starving and not consuming essential nutrients through food, and over nutrition such as obesity due to excessive intake of food and lack of essential nutrients and limited physical activity. Eating p

lenty of vegetables and fruits is important to obtain various micronutrients in our diet.

(c) Srimad Bhagwad Gita Concept of eating diet with coarse and soft ingredients

Bhagavad Gita: Chapter 17, Verse 7

आहारस्त्वपि सर्वस्य त्रिविधो भवति प्रिय: |
यज्ञस्तपस्तथा दानं तेषां भेदमिमं शृणु | | 7| |

aahaaras tv api sarvasya tri-vidho bhavati priyah
yajnas tapas tathaa daanam teshaam bhedam imam srinu

aahaarah—food; tu—indeed; api—even; sarvasya—of all; tri-vidhah—of three kinds; bhavati—is; priyah—dear; yajnah—sacrifice; tapah—austerity; tathaa—and; daanam—charity; teshaam—of them; bhedam—distinctions; imam—this; srinu—hear

The food people eat influences their nature and vice versa. The Chhaandogya Upanishad explains that the coarsest part of the food we eat passes out as feces; the subtler part becomes flesh; and the subtlest part becomes the mind (6.5.1). Again, it states: aahaara shuddhau sattva shuddhih (7.26.2) [v1] "By eating pure food, the mind becomes pure."

Relevance of above shloka to importance of fiber in the diet and inclusion of fruits and vegetables: The above shloka explains that coarsest part of food passes out as faeces that is akin to eating good amount of fiber/coarse cereals/whole grain pulses in the diet, the subtlest part becomes the mind that is akin to intake of micronutrients through vegetables and fruits which play important part in normal growth and development, maintenance of energy level, mental clarity and overall capacity.

(d) Srimad Bhagwad Gita Concept of eating diet that promote life span and which are juicy and succulent

Bhagavad Gita: Chapter 17, Verse 8

आयु:सत्त्वबलारोग्यसुखप्रीतिविवर्धना: |
रस्या: स्निग्धा: स्थिरा हृद्या आहारा: सात्त्विकप्रिया: | |8| |

aayuh-sattva-balaarogya-sukha-priti-vivardhanaah
rasyaah snigdhaah sthiraa hridyaa aahaaraah saattvika-priyaah

aayuh sattva—which promote longevity; bala—strength; aarogya—health; sukha happiness; priti—satisfaction; vivardhanaah—increase; rasyaah—juicy; snigdhaah—succulent; sthiraah—nourishing; hridyaah—pleasing to the heart; aahaaraah—food; saattvika-priyaah—dear to those in the mode of goodness

BG 17.8: Persons in the mode of goodness prefer foods that promote life span, and increase virtue, strength, health, happiness, and satisfaction. Such foods are juicy, succulent, nourishing, and naturally tasteful.

In the above verse, these foods are described with the words aayuh sattva, meaning "which promote longevity." They bestow good health, virtue, happiness, and satisfaction. Such foods are juicy, naturally tasteful, mild, and beneficial. These include grains, pulses, beans, fruits, vegetables, milk, and other vegetarian foods.

Relevance of the above shloka to intake of fruits and vegetables in the diet: Fruits are juicy and succulent. So also certain vegetables and milk. These foods are rich in micronutrients, protein and fiber which are essential nutrients for maintenance of good health and longevity.

According to Shrimad Bhagavad Gita, food does play a central role in being a rich source of energy for our physical body, and it also impacts the mind. The kind of food we eat affects the three qualities, i.e. Sattva, Rajas and Tamas. In turn, these qualities influence the digestive system, our balanced state of mind, and holistic health.

- Ancient text Shri Bhagavad Gita lucidly states that freshly cooked meals with sattvic ingredients are easy to digest, aromatic, juicy and sweet to taste. Such meals promote strength, health, longevity, cheerfulness and happiness.
- Foods that are salty, oily, pungent, sour and spicy are rajasic foods. Such foods cause anger, excitement, pain, and grief.
- Foods that are stale, rotten, half-cooked, leftover, and re-heated are tamasic foods. Such foods promote slothfulness, laziness and lethargy.

1.2 Importance of cleanliness to ensure food safety as explained in the Gita

Our scriptures clearly mention three types of purities we need to understand when it comes to cooking and food.

(a) **Patra Shudhi** (pure vessels)- The vessels used for cooking have to be clean and pure.

(b) **Pak Shudhi** (the process of cooking)- The individual who cooks the food and serves must be clean in appearance and clean in terms of moral conduct, habits, and character. He/she must prepare food with a sattvic mind.

(c) **Padartha Shudhi** (pure food ingredients)- The ingredients used during cooking have to be pure, of good quality and sattvic in nature.

1.3 Ancient Food preparation practices that are relevant to the current concepts of healthy food-some examples

(a) Importance of fermentation in enhancing nutrition and digestibility of food: The practice of converting milk to curd, fermentation of cereal and pulse combination in the preparation of idly/dosa and other fermented products.

(b) Importance of heating foods to enhance shelf-life and safety of food. Example heating even pasteurized milk to boiling temperature.

Chapter 2.0

Current concepts in health and nutrition and food safety

2.1 Understanding Basic nutrition

Understanding basic nutrition is important to protect against malnutrition in all its forms and prevent non-communicable diseases. Nutrition is critical to health and development of any living being. Food consumption, which largely depends on its production and distribution, determines the health and nutritional status of the population. Nutrition is required for all processes of growth, maintenance and repair of the human body. Nutrition is an important determinant of the health status of the population. Good nutrition is related to improved infant, child and maternal health, stronger immune systems, safer pregnancy and childbirth, lower risk of non-communicable diseases (such as diabetes and cardiovascular disease), and longevity.The importance of optimal nutrition begins at pre-conception, and continues during pregnancy, at birth, through childhood and adolescence. The most critical time for good nutrition is during the 1,000-day period from pregnancy until 24 months of child's life.

The components of food that provide nutrition are called nutrients. Nutrients are broadly classified as macro and micronutrients. Macronutrients are nutrients that provide calories or energy and are required in large amounts to maintain body functions and carry out the activities of daily life. These consist of carbohydrate, protein and fat that provide energy. Micronutrients are vitamins and minerals needed by the body in very small amounts. The impact of micronutrients on the human health are critical for normal growth and development and deficiency in any of them can cause severe and even life-threatening conditions.

The common nutritional problems of public health importance in India are low birth weight, protein energy malnutrition in children, and chronic energy deficiency in adults, micronutrient malnutrition and diet-related non-communicable diseases. Malnutrition, in every form, presents significant threats to human health. Malnutrition includes undernutrition (wasting, stunting, and underweight), inadequate vitamins or minerals leading to micronutrient deficiencies, and overweight, obesity, and resulting diet-related non-communicable diseases such as heart disease, stroke, diabetes and some cancers. Undernutrition and anaemia continue to threaten large segments of our population. One third of the global burden of undernutrition is represented by India. Ensuring availability, accessibility and consumption of adequate amounts of foods is the focus of various strategies to prevent the problem of malnutrition.

The Dietary goals for achieving good nutrition are outlined as follows:

(a) Achieve adequate intake of required nutrients and prevention of nutrition deficiency diseases.

(b) Prevent chronic diet-related disorders.

(c) Maintain positive health and optimal performance by maintaining ideal body weight.

(d) Ensure adequate nutrition in pregnant women and lactating mothers.

(e) Strive towards achievement of good health and nutrition of infants, children and adolescents through improvement in birth weights and growth to achieve their full genetic potential.

(f) Maintenance of the health of the elderly and increasing longevity.

2.2 Macronutrients and their importance in the diet

Macronutrients are essential nutrients that are needed in large amounts to provide the body with energy, help prevent disease, and allow the body to function correctly. There are three main types of macronutrients: proteins, fats, and carbohydrates. Most of the body's energy and calories come from macronutrients. The amount of each macronutrient a person requires varies with weight, age, and preexisting health conditions. Combination of these macronutrients in our diet help to maintain longevity and health.

(a) Carbohydrates

Carbohydrates are major sources of easily available energy in our diet comprising more than 60-78% of total energy intake and provide 4 Kcal/g food. The major dietary sources of carbohydrates are sugars, cereals and millets, roots and tubers, pulses and legumes and to a limited extent from vegetables, fruits and diary. Added sugars in the diet are sugar sweetened carbonated beverages, fruit juices and concentrates, sweets and desserts, cakes, biscuits, chocolates and candy and beverages such as tea and coffee. There are two types of carbohydrates namely complex and simple carbohydrates. Complex carbohydrates or polysaccharides are found in most whole, unprocessed foods like whole grains, cereals, millets, pulses and root vegetables and glycogen in animal foods. Simple carbohydrates such as glucose and fructose are found in fruits, vegetables and honey, sucrose in sugar, highly processed foods, fruits, and sugary snacks and lactose in milk. These are easily digested in the small intestine. Cellulose or dietary fibre in vegetables and whole grains, and gums and pectins are a group of complex carbohydrates that are resistant to digestion in the human digestive tract. Diets rich in complex carbohydrates are healthier than low-fibre diets based on refined and processed foods. It is recommended that 55% of total dietary calories are derived from carbohydrates present in plant foods such as cereals, millets and pulses.

(b) Proteins

Protein helps build and repair muscle, tissues and organs, as well as aid in hormone regulation. Proteins are primary structural and functional components of every living cell with half in the form of muscle, and rest distributed in bone, cartilage and skin. Like carbohydrates proteins provide energy up to 4Kcal/g.

Proteins are made of amino acids that are essential to life. A total of 20 amino acids are required by the human body. Some of these amino acids are synthesized in the body and are termed as non- essential amino acids. Whereas 9 amino acids termed as essential have to be obtained from the proteins in the diet. Proteins sourced from the diet should supply these essential amino acids in proper proportions and adequate quantities to synthesize tissue proteins in the body.

The amount of protein required varies with sex, age, and physical activity levels as well as physiological status and stress. More proteins are required by growing infants and children, pregnant women and individuals during infections and illness or stress. Animal foods like milk, meat, fish and eggs and plant foods such as pulses and legumes are rich sources of proteins. Proteins present in animal foods are of high quality based on the presence of all essential amino acids. In contrast plant proteins have low content of these amino acids. Through careful combination of cereals and pulses the quality of plant proteins in the diet can be greatly enhanced.

(c) Fats

Cooking oils (liquid) and solid fats together are referred to as fats. Presence of fats in the diet helps to improve texture, flavor, and taste. Dietary fats provide energy and essential fatty acids, and important for absorption for fat soluble vitamins A, D, E and K and carotenes.

Fats are a concentrated source of energy providing 9 Kcal/g, and are made up of fatty acids in different proportions. Dietary fats are derived from two sources viz. the invisible fat present in plant and animal foods; and the visible or added fats and oils (cooking oil). The quality of fats in the diet is determined by the type of fatty acids present in them. Fatty acids are broadly grouped as saturated (SFA), monounsaturated (MUFA) and polyunsaturated (PUFA). Saturated fatty acids are fats from coconut oil, vanaspati, animal fats (ghee and butter) and animal foods like milk, milk products and meat. Monounsaturated fatty acids are present in palm, groundnut, cottonseed, sesame and olive oils. Polyunsaturated fatty acids chiefly Linoleic (n-6) and -linolenic (n-3) acids are present only in plant foods such as Safflower, Sunflower, Cottonseed, Groundnut, Rice bran, Sesame and palmolein oils and Rapeseed, Mustard and Soyabean oils.

It is necessary to have adequate and good quality fat in the diet with sufficient polyunsaturated fatty acids in proper proportions for meeting the requirements of essential fatty acids. In case of infants and young children their diets should have adequate amounts of fat since their energy needs are higher than that of adults. On the other hand intake of fats need to be restricted in adults especially saturated fats as it may lead to various non-communicable diseases such as obesity, and cardiovascular diseases.

Key points on macronutrients

- Macronutrients are important sources of energy
- Fat, protein and carbohydrate provide energy and essential components for maintenance of body functions.
- Fats/oils have high energy value provide essential fatty acids, precursors of biologically-active compounds and promote absorption of fat-soluble vitamins and induce satiety. Excessive fat in the diet increases the risk of obesity, heart disease, stroke and cancer.
- Carbohydrates are the primary source of energy in the diet and are found in the greatest abundance in grains, fruits, legumes, and vegetables. Diets rich in complex carbohydrates are healthier than low-fibre diets based on refined and processed foods.
- Proteins are primary structural and functional components of every living cell. Dietary proteins provide energy and essential amino acids that need to be taken in proper proportions and adequate quantities to synthesize tissue proteins in the body.

2.3 Importance of micronutrients in the diet

Micronutrients are vitamins and minerals needed by the body in very small amounts. They are essential for maintaining the function of macronutrients. They are important for maintaining optimal health, and in prevention or treatment of disease. Hence these need to be consumed adequately in the diet.

Micronutrients perform a range of functions, including enabling the body to produce enzymes, hormones and other substances needed for normal growth and development. Micronutrient deficiencies can cause visible and dangerous health conditions and can also lead to reductions in energy level, mental clarity and overall capacity. This in turn can lead to reduced educational outcomes, reduced work productivity and increased risk from other diseases and health conditions.

Micronutrients important in the diet are:

(a) Vitamins:

- Fat soluble vitamins: Require fat for absorption. Vitamin A (in animal foods), Beta-Carotene (pre-cursor of Vitamin A, present in plant foods), Vitamin D, Vitamin E and Vitamin K.
- Water soluble vitamins: Soluble in water. Vitamin C (ascorbic acid) and the vitamin B complex: thiamin (B1), riboflavin (B2), niacin (B3), pantothenic acid (B5), Vitamin B6, biotin (B7), folic acid (B9), Vitamin B12

(b) Minerals:

- Macro minerals: Present in large quantities in the body and hence their requirement is also more. Macro minerals comprise calcium, phosphorus, magnesium, sodium, potassium, and chloride. These minerals are involved in the maintenance of water and electrolyte balance. Sodium, potassium and chloride are also called as electrolytes.
- Micro or Trace minerals: iron, iodine, zinc, copper, manganese, cobalt, fluoride, molybdenum and selenium.

(a) Vitamins

Vitamins have varied functions in the body. Two main classes of vitamins based on their solubility in water and fat are as follows:

Water soluble vitamins

All B vitamins, also known as B-complex vitamins help the body to convert food (carbohydrates) into fuel (glucose), which is used to produce energy. These B vitamins, often referred to as B-complex vitamins, also help the body metabolize fats and protein. B complex vitamins are necessary for a healthy liver, skin, hair, and eyes. They also help the nervous system function properly.

Thiamine

Thiamin (or thiamine) is a water-soluble B vitamin. Thiamin is naturally present in some foods, added to some food products, and available as a dietary supplement. It plays a critical role in energy metabolism and, therefore, in the growth, development, and function of cells. It occurs in three forms: thiamine monophosphate, thiamine pyrophosphate and free thiamine. Thiamin pyrophosphate (TPP), the active form of thiamin, is involved in several enzyme functions associated with the metabolism of carbohydrates, branched-chain amino acids, and fatty acids. Thiamine is important for carbohydrate and lipid metabolism. It helps to convert nutrients into energy. Dietary sources of thiamine include whole grain cereals, nuts and oilseeds, legumes, green leafy vegetables (spinach, fenugreek and gogu leaves), beans, capsicum, peas, apricot, custard apple, green chillies, garlic, spices and condiments, organ meats, pork, liver, eggs, milk and milk products; rice and wheat bran, wheat germ. Thiamine losses occur during milling and polishing of grains, cooking and preservation of foods, and processes such as baking and pasteurization of milk and ultra violet irradiation.

Inadequate intake is the major cause of thiamine deficiency in India. Thiamine deficiency leads to Beri beri which is a disease that affects multiple organ systems, including the central and peripheral nervous systems. Thiamine deficiency is common in low-income populations whose diets are high in carbohydrate and low in thiamine (e.g., milled or polished rice). Breast-fed infants whose mothers are thiamine deficient are vulnerable to developing infantile beriberi.

Riboflavin

Riboflavin is a water-soluble B vitamin, also known as vitamin B2. Riboflavin is primarily found as an integral component of the coenzymes called flavoproteins that are important for production of energy for the body, cellular antioxidant function, and in numerous metabolic pathways. It is also required for the metabolism of other vitamins such as vitamin B6, niacin and vitamin K. Riboflavin also functions as an antioxidant and protects the body from free radicals that can damage cells and DNA. Riboflavin is widely distributed in plant and animal foods. It is synthesized mainly in the green leaves and growing tips of plants. It is present in the free form in milk and in other foods combined with proteins. Rich dietary sources of riboflavin include milk, liver, kidney, heart, eggs, green leafy vegetables, legumes, mushrooms and almonds. Major amounts are found in germ and bran of cereal grains. Inadequate intake of riboflavin results in its deficiency characterized by conditions called angular stomatitis, glossitis, chelosis (cracks or sores on the outsides of the lips and at the corners of the mout) and corneal vascularization.

Niacin

Like other water soluble vitamins niacin is a part of various coenzymes that are involved in metabolic processes including energy producing reactions called redox reactions involving the degradation (catabolism) of carbohydrates, fats, proteins, and alcohol, tissue respiration, fatty acid metabolism and synthesis of macromolecules. Living organisms derive most of their energy from redox reactions, which are processes involving the transfer of electrons. Niacin can be synthesized from the essential amino acid tryptophan as its metabolic end product. Thus in considering dietary adequacy of niacin contribution of both niacin and tryptophan is taken into account. Foods of both plant and animal origin contain niacin. Meat products, peanuts, wheat germ, and dried legumes are good sources of niacin.

Deficiency of niacin leads to a condition called pellagra. The most common symptoms of niacin deficiency involve the skin, the digestive system, and the nervous system. The symptoms of pellagra are commonly referred to as the three "Ds": sun-sensitive dermatitis, diarrhea, and dementia. Symptoms related to the digestive system include inflammation of the mouth and tongue ("bright red tongue"), vomiting, constipation, abdominal pain, and ultimately, diarrhea.

Pyridoxine/vitamin B6

Vitamin B6 includes 3 forms namely pyridoxine, pyridoxal and pyridoxamine. Vitamin B6 is involved in various enzymatic reactions as part of enzymes for metabolism of proteins and fats. The coenzyme form of the vitamin namely pyridoxal phosphate is required for metabolism of amino acids along with folic acid Vitamin B12 and riboflavin and conversion of tryptophan to niacin. Dietary sources of vitamin B6 include nuts and seeds, meat and poultry. Milk and milk products, beetroot, potato, carrots and cherries, musk melon and custard apple also contain vitamin B6. Pyridoxine and pyridoxine phosphate are the predominant forms of vitamin B6 in plant food sources and pyridoxal and pyridoxal phosphate in animal foods. Vitamin B6 deficiency co-precipitates with deficiencies of other B vitamins.

Folic acid

Folic acid/folate is a haemopoietic vitamin required for the multiplication and maturation of red blood cells. Its deficiency results in megaloblastic anemia commonly seen in children and pregnant women. Folic acid intake during pregnancy protects the foetus from developing certain congenital defects. It also promotes the birth weight of infants. Along with vitamin B12 folate is required for synthesis of nucleic acids. Synthetic form of folate is folic acid that is used in supplements and fortified foods. Dietary rich sources of folate include animal foods such as fish and meat, and plant foods such as pulses and legumes, green leafy and other vegetables and cereals. Deficiency of folic acid along with vitamin B12 are associated with elevated blood homocysteine levels which is a major risk factor for cardiovascular diseases.

Vitamin B12/cyanocobalamine

Like folic acid vitamin B12 is involved in maturation of red blood cells and deficiency will result in perinicious anemia, weakness, fatigue, loss of appetite, constipation and weight loss. Vitamin B12 is also required for proper functioning of central nervous system and metabolism of folic acid and DNA synthesis. Major dietary sources of vitamin B12 are animal foods such as milk and other dairy products, meat, fish and poultry.

Vitamin C/Ascorbic acid

Vitamin C, also known as L-ascorbic acid, is a water-soluble vitamin and required for healthy bones and teeth. Unlike most mammals and other animals, humans do not have the ability to synthesize vitamin C and must obtain it from the diet. Vitamin C is an antioxidant and enzyme cofactor and also important in immune functions. It increases the bioavailability of iron from foods by enhancing intestinal absorption of non-heme iron especially from plant sources. Dietary sources of vitamin C include fresh amla, citrus fruits, guava, banana, tomatoes, berries, and green vegetables. Ascorbic acid is sensitive to heat, light and oxygen. It is for this reason that when vegetables become dry and stale or cut and exposed to air most of the vitamin C originally present in destroyed.

Vitamin C deficiency is characterised by weakness, bleeding gums and defective bone growth. Severe vitamin C deficiency leads to a condition called scurvy. Symptoms of scurvy include subcutaneous bleeding, poor wound closure, and bruising easily, hair and tooth loss, and joint pain and swelling.

Pantothenic acid and Biotin

Pantothenic acid and biotin are water soluble vitamins and components of coenzyme A which is essential for many life sustaining biochemical reactions in the body. Meat products fish, mushrooms and milk products are dietary sources of these vitamins.

Fat soluble vitamins

Vitamin A

Vitamin A is an essential nutrient in the diet and is necessary for clear vision in dim light, and for maintaining the integrity of epithelial tissues.. It is involved in regulating the growth and specialization of various cells in the human body. Vitamin A has important roles in embryonic development, organ formation during fetal development, normal immune functions. Vitamin A also has a role in maintaining resistance of the body to common infections. The three active forms of vitamin A in the body are retinol, retinal, and retinoic acid. Preformed Vitamin A consists of retinol and retinyl esters and is present in meat,

eggs and milk. Various precursors of Vitamin A are present in plant sources such as beta carotene, alpha carotene, and beta cryptoxanthin are present in vegetables and fruits. Beta carotene is the most important provitamin A and widely found in green, orange and yellow vegetables and fruits. Milk and oil are fortified with vitamin A. These provitamin A carotenoids can be converted by the body into retinol. Fortified foods, health beverages and supplements contain preformed vitamin A. The eye for its visual function and skin are the two most important tissues that have high demands for retinol for their normal function.

Vitamin A deficiency is a major cause of preventable blindness in the world. It is most prevalent among children and women of childbearing age. Vitamin A deficiency is associated with an increased susceptibility to infections, as well as to thyroid and skin disorders. Vitamin A deficiency usually results from inadequate intakes of vitamin A from animal products (as preformed vitamin A) and fruit and vegetables (as provitamin A carotenoids).

Xeropthalmia is an important vitamin A deficiency condition that leads to nutritional blindness among young children and is a major public health problem in India. This condition includes structural changes affecting conjunctiva, cornea, and retina and also retinal rod and cone functions. In vitamin A deficiency, the white of the eye (conjunctiva) loses its luster and becomes dry. In severe vitamin A deficiency, the black area of the eye (cornea) gets necrosed, leading to irreversible blindness in young children. The various symptoms that sequentially lead to xeropthalmia are as follows:

- Night blindness: inability to see in dim light
- Conjunctival xerosis: dry patches in conjunctiva
- Bitot spots:patches in the cornea
- Corneal xerosis: dryness of cornea
- Keratomalacia:Irreversible blindness
- Corneal scar
- Xeropthalmia

Vitamin D

Vitamin D is essential for the efficient utilization and regulation of calcium and phosphorus by the body. In this it helps builds strong bones by helping the body absorb calcium and helps protect older adults from osteoporosis. Vitamin D is important for normal bone development and maintenance. Severe vitamin D deficiency causes rickets in children and osteomalacia in adults. Vitamin D is also required immune, endocrine, and cardiovascular system functions.

Vitamin D can be synthesized in the skin upon exposure to sunlight but this varies based on geography, skin color, air pollution, and other factors. Vitamin D is obtained in two forms from plant sources: Vitamin D2/ergocalciferol from plants, mushrooms and yeast. Vitamin D3/cholecalciferol from animal foods like fish and eggs.

Vitamin E has antioxidant properties that are essential for maintaining essential fatty acid content of the diet. Vegetable oils and invisible fat in cereals and nuts and vegetables are sources of Vitamin E/alpha tocopherol in the Indian diet.

Vitamin K has a role in blood clotting.

Minerals

Calcium

Calcium is a major element in the body. Calcium is important for formation and metabolism of bone. More than 99% of calcium is found in bones and teeth. Vascular contraction, vasodilatation, muscle function, nerve transmission, hormone secretion. Calcium and phosphorus requirements are closely linked. Milk is the richest source of calcium. Other sources include cereals, millets such as ragi and green leafy vegetables.

Magnesium

Magnesium is an important mineral closely associated in the formation of the skeletal system like calcium. About 60-70% of magnesium occurs in the bone, 25-30% in muscle, 6-8% in soft tissues, and 1% in extracellular fluid. It is also important in maintaining electrical potential in nerves and muscle membranes and deficiency leads to neuromuscular dysfunction. Cereals and legumes and animal products are dietary sources of magnesium.

Sodium and potassium

Sodium is one of the important electrolytes that is necessary for maintenance of plasma volume, acid base balance, transmission of nerve impulses, and normal cell function. Kidney is the main organ responsible for maintaining sodium balance. The main source of sodium in the diet is common salt that provides 90% of the salt in the diet. Sodium in the diet comes from domestic cooking and processed foods such as bakery products, pickles, nuts etc. Potassium like sodium is important for maintaining electrolyte balance and normal cell function. About 80% of total potassium in the body is present in skeletal muscles. Dietary sources of potassium include cereals, dried foods, fruit juices, and vegetables. Vegetables such as avocado, broccoli, carrots, peas, lentils, tomatoes, potatoes and sweet potatoes, and Fruits such as apricots, banana, citrus fruits, milk, dairy products, nuts, meat and fish are good sources of potassium. Coconut water contains 1400mg of potassium per litre. The function of sodium and potassium is interlinked. Potassium helps in mitigating effects of blood pressure due to elevated sodium in the body. A diet rich in processed foods and low in fruits and vegetables is often lacking in potassium content.

Iron

Iron is an essential micronutrient necessary for the formation of haemoglobin, the red pigment present in the red cells of blood. Haemoglobin plays an important role in the transport of oxygen. Reduction in haemoglobin in blood leads to anaemia, a condition characterised by paleness and easy fatigue and increased susceptibility to infections. Iron is also an important part of iron-containing enzymes and involved in electron transfer and oxidation-reductions. Most of the iron in the body is reutilized and some iron is stored in the liver and spleen. The amount of iron absorbed from the daily diet depends on the bioavailability of iron present in the food.

Availability of iron from most Indian diets is very small and is in the range of 1-3mg depending upon sex and physiological status. Dietary iron occurs in two forms namely heme and non-heme iron. Heme iron sources are meat, poultry, and fish, whereas nonheme iron is obtained from cereals, pulses, legumes, fruits, and vegetables.Rich sources of iron are cereals, millets such as bajra and ragi, pulses, and green leafy vegetables. Various dietary factors such as ascorbic and citric acid facilitate iron absorption from the vegetarian diet while phytic acid and polyphenols inhibit its uptake.

Iron is available in plenty in green leafy vegetables. But the absorption of iron is limited. Vitamin C rich foods must be consumed daily to improve iron absorption.The high risk for iron deficiency are found in those parts of a population that have inadequate access to foods rich in absorbable iron during stages of high iron demand especially infants and young children, adolescent boys and girls, women of reproductive age, and pregnant women. The increased iron demand in infants and adolescents is the result of rapid growth. For women of reproductive age excessive blood loss during menstruation is the chief reason for adequate iron intake. During pregnancy, there is a significant increase in iron requirement due to the rapid growth of the placenta and the fetus and the expansion of the globular mass.

Dietary iron deficiency leads to anaemia which is a serious public health problem in India. The primary causes of iron deficiency include low intake of bioavailable iron, increased iron requirements as a result of rapid growth, pregnancy, menstruation, and excess blood loss caused by pathologic infections, such as hook worm and impaired absorption of iron. In anemia the number of RBCs in the blood is low, or the blood cells have less than the normal amount of hemoglobin. Iron deficiency is seen to coexist with other causes of anaemia such as vitamin B12 deficiency. Iron deficiency anemia can be associated with functional impairments affecting cognitive development, immunity mechanisms, and work capacity. During pregnancy, iron deficiency leads to variety of adverse outcomes for both mother and infant, such as increased risk of sepsis, maternal mortality, perinatal mortality, and low birth weight. The frequency of iron deficiency rises in female adolescents because menstrual iron losses are superimposed with needs for rapid growth.

Zinc

Zinc is an essential micronutrient that is needed for enhancing physical growth and decrease morbidity and mortality among children. Zinc also plays a central role in the immune system. Zinc supplements are essential during diarrheal infection and severe malnutrition. Zinc is present in all tissues with highest levels in muscle, bone and liver. Abundant dietary sources of zinc are animal products. Whole grain cereals , pulses and legumes are plant sources. The presence of phytic acid in whole grain cereals can bind to zinc and make it unavailable to the body. Absorption of Zinc from diet high in animal protein is higher than that from plant protein.

Selenium

Selenium is an important antioxidant in the body and protects against oxidative stress. Selenium is present in two forms in foods namely selenomethionine in plant sources and selenocysteine in animal foods. Dietary Selenium in adequate quantities is important for prevention of diseases such as cancer, cardiovascular diseases, cognitive decline and thyroid diseases.

Iodine

Iodine is essential for synthesis of thyroid hormone for optimal physical growth, metabolism and development of humans. About 70-80% of iodine in the body is concentrated in the thyroid gland. Iodine deficiency leads to enlargement of thyroid gland and a condition known as endemic goitre occurs. Its deficiency also leads to still births, abortions, low birth weight, cretinism, psychomotor defects, impaired coordination, mental retardation and hypothyroidism. Thus, Iodine is required during pregnancy and infancy for the infant's healthy growth and cognitive development.

Iodine deficiency disorders are the most common micronutrient disorders in India. Iodine content in most foods and beverages is low. Iodine is not present naturally in foods unlike other micronutrients but present in the soil. Hence foods take up iodine from the soil. Populations subsisting on foods grown in iodine deficient soils frequently have iodine deficiency which is prevalent in the State of Jammu and Kashmir, Punjab, Haryana, Uttar Pradesh and Himachal Pradesh. Fortifying salt with iodine is a successful intervention. The Government of India launched the programme of Universal Salt Iodization with the objective of iodizing entire edible salt in the country. About 90% of iodine is met through food and remaining through drinking water. Iodized salt is the largest contributor of iodine in Indian dietaries.

Key points on micronutrients

- Micronutrients needed in small amounts that are critical for a range of functions
- Water soluble B-complex vitamins are the most important for production of energy in the body from macronutrients. Whole grain cereals, nuts and oilseeds, legumes, green leafy vegetables, meat, poultry and fish, milk and milk products are major dietary sources.
- Vitamin A and its pre-cursor beta carotene are important for normal vision, the immune system, reproduction, and growth and development. Plant sources contain beta carotene which is converted to vitamin A in the body. Green, orange and yellow vegetables and fruits important dietary sources of beta carotene. Milk, oil and butter are fortified with vitamin A. Deficiency of vitamin A leads to night blindness in children.
- Vitamin D is important for absorption of calcium and phosphorus; normal bone development and maintenance.
- Iron, calcium, iodine are important minerals that have to be obtained through the diet.
- Iron along with folic acid and vitamin B12 is important for hemoglobin synthesis, multiplication and maturation of red blood cells and prevention of anemia in women of reproductive age and children, prevent maternal mortality, low birth weight in infants, susceptibility to infection in children and impairment in learning abilities. Dietary sources include plant foods like green leafy vegetables, legumes and dry fruits and animal products such as meat, fish and poultry products. Iron bio-availability in plant foods enhanced by intake of vitamin C rich foods.

- Calcium is needed for growth and bone development in children and preventing osteoporosis in women. Milk, curds and nuts and millets like ragi are rich sources of calcium.
- Iodine is required during pregnancy and infancy for the infant's healthy growth and cognitive development. Iodized salt is the largest contributor of iodine in Indian dietaries.


Brown flax seeds


Sunflower seeds


Peanuts


Poppy seeds


Pistachios


Almonds


Sesame seeds


Walnuts


Hazelnuts


Pine nuts


Wheat germ


Ground flax seeds


Golden flax seeds


Brazil nut


Cashew nuts


Pumpkin seeds

Chapter 3.0

Nutritionally adequate, Healthy and Balanced diet

Wholesome food in adequate quantities is important at all stages of life and for satisfactory growth during infancy, childhood and adolescence. Nutrients that we obtain through food have vital effects on physical growth and development, maintenance of normal body function, physical activity and health. Our diet must provide all essential nutrients in the required amounts.

3.1 Food groups:

Foods are conventionally grouped as:

i. Cereals, millets and pulses
ii. Vegetables and fruits
iii. Milk and milk products, egg, meat and fish
iv. Oils & fats and nuts & oilseeds

These food groups can be further classified based on their function in maintaining a healthy body (Table 1). Accordingly food groups can be illustrated that provide energy such as cereals, millets, oils, nuts and sugar, proteins or body building nutrients such as milk, pulses, eggs, meat, fish and protective foods such as vegetables and fruits that provide essential vitamins and minerals. There is no single food or food group that can provide all the essential nutrients required by the body. Thus, a combination of different kinds of foods is essential in the diet.

Table 1. Classification of foods based on function

Function	Food	Nutrients Provided	
		Major	Other
Energy yielding	Whole grain cereals, millets	Carbohydrates & fats	Protein, fibre, minerals, calcium, iron & B-complex vitamins
	Vegetable oils, ghee, butter		Fat soluble vitamins, essential fatty acids
	Nuts and oilseeds		Proteins, vitamins, minerals
	Sugars		Nil
Body building	Pulses, nuts and oilseeds	Proteins	B-complex vitamins, invisible fat, fibre
	Milk and Milk products		Calcium, vitamin A, riboflavin, vitamin B12
	Meat, fish, poultry		B-complex vitamins, iron, iodine, fat
Protective	Green leafy vegetables	Vitamins and Minerals	Antioxidants, fibre and other carotenoids
	Other vegetables and fruits		Fibre, sugar and antioxidants
	Eggs, milk and milk products and flesh foods		Protein and fat

3.2 Balanced diet for maintenance of health and nutrition

Eating a balanced diet is important part for the maintenance of good health. A diet in which various foods are combined in suitable proportions to carry out the three basic functions of energy yielding, body building and protection forms a balanced diet. A balanced diet can be simply defined as one that provides the required nutrients in appropriate amounts and proportions. A balanced diet should provide around 50-60% of total calories from carbohydrates, preferably from complex carbohydrates, about 10-15% from proteins and 20-30% from both visible (added fats and oils) and invisible (present in plant and animal foods) fat. Presence of various non-nutrients are also important in a balanced diet. These are dietary fibre, antioxidants and phytochemicals vitamins C and E, beta-carotene, riboflavin and selenium and polyphenols, flavones that protect the human body from free radical damage.

Requirements of essential nutrients vary with age, gender, physiological status and physical activity. When dietary intakes are lower or higher than the body requirements undernutrition (deficiency diseases) or overnutrition (diseases of affluence) may result. Infancy, childhood, adolescence, pregnancy and lactation are considered as significant periods of life demand adequate intake of nutritious food. On the other hand eating too less or too much at any age can lead to harmful consequences. Thus, an adequate diet, providing all nutrients, is needed throughout our lives. Consumption of a diet made from diverse food sources can help in achieving a balanced diet. Selecting and combining foods from different food groups such as cereals, millets, fruits, vegetables, dairy, etc. is a useful way of getting a balanced diet. A variety of foods, which are available and are within the reach of the common man, can be selected to formulate nutritionally adequate balanced diet.

Key points for maintaining a balanced diet

- Nutrition is a basic necessity to sustain life. Wise choice from variety of foods leads to a nutritionally adequate diet
- All the required nutrients in adequate amounts for the body can be provided through selecting diverse foods from several food groups.
- Cereals, millets and pulses are major sources of most nutrients especially for vegetarians. Inclusion of eggs, flesh foods and fish enhances the quality of diet.
- Milk, an excellent source of good quality proteins and calcium and an absolute essential in the diet of infants, children and women.
- Oils and nuts are energy/calorie dense foods, useful for increasing the energy density and quality of food.
- Vegetables and fruits provide micronutrients, protective substances such as vitamins/ minerals/ phytonutrients.

3.3 Importance of fruits and vegetables in the diet

Diets high in fruits and vegetables are widely recommended for their health-promoting properties. Fresh Vegetables and fruits are rich sources of micronutrients and macronutrients. Vegetables and fruits are high in dietary fibre as well as vitamins and minerals. Green leafy vegetables, carrots, tomatoes, sweet potatoes, papaya, mango are good sources of iron and calcium, vitamin C, folic acid, B complex vitamins and carotenoids. Various bioactive plant compounds especially with antioxidant properties such as polyphenols or beta-carotene are present in various fruits and vegetables. Vegetables and fruits can be used to increase or decrease calories in our diet. Some vegetables and fruits provide very low calories whereas some others such as potato, sweet potato, tapioca and yam as well as fruits like banana are rich in starch which provides energy in good amount. Sufficient intake of fruits and vegetables has been associated with a reduced risk of chronic diseases.

The recommended level of fruit and vegetable intake in the diet is 400g/day.

Key points for intake of fruits and vegetables

- Normal diet, to be wholesome and tasty, should include fresh vegetables and fruits, which are store houses of micronutrients important for preventing chronic diseases such as cardiovascular diseases, cataract and cancer.
- Eat as much vegetables and fruits as possible daily in all your meals in various forms (curry, soups, mixed with curd, added to pulse preparations and rice). Include raw and fresh vegetables as salads after proper cleaning.
- Include a variety of vegetables such as green leafy vegetables, carrots, papaya, mangoes to provide beta carotene and other micronutrients, add colour to your plate and enhance satiety value.
- Fruits and vegetables also provide phytonutrients and fibre which are of vital health significance.
- Fresh fruits are nutritionally superior to fruit juices.
- Explore growing kitchen garden at home.

3.4 Food guides as tools to achieve a balanced diet

As different foods have different nutritional values, it is not possible to obtain all the nutrients we need from a single food. Thus food guides help in choosing foods from a variety of sources in amounts and proportions that make up a balanced diet.

The Food Pyramid

The food pyramid indicates that we have to eat a variety of foods among all food groups as well as within each group in order to get different nutrients to fulfil a balanced diet (Figure 1). The Food Pyramid organizes food in four different sections according to their importance as well as the proportion in which they have to be consumed in the diet. The food pyramid suggests that more foods from the bottom of a pyramid need to be consumed more while fewer/limited foods need to be consumed from the top of the pyramid as follows:

First section: Foods that need to be consumed adequately. The lowest and first section in the pyramid represents the most important foods to be included in the diet that need to be consumed adequately as they contain the most nutrients (cereals, millets, pulses, dairy such as milk).

Second section: Foods that need to be consumed liberally. Contain vegetables and fruits which provide protective substances such as vitamins/minerals/ phytonutrients. One must consume seasonally available and different colored fresh fruits and vegetables.

Third section: Foods that need to be consumed moderately. Oils and nuts are calorie-dense, and are useful for increasing the energy density and quality of food. Meat and meat products provide good quality protein and iron.

Fourth section: Foods that need to be consumed sparingly and includes high fat salt and sugar containing foods such as burger, french fries, ice-cream, colas, chocolates.

Key points for ensuring dietary diversity

- Having dietary diversity is important to obtain all the essential nutrients through the diet.
- Always select a variety of foods, consume in amounts appropriate for age, gender, physiological status and physical activity.
- A combination of whole grains, pulses and greens helps in achieving essential nutrients.
- Include jaggery or sugar and cooking oils to bridge the calorie or energy gap.
- Give preference to fresh, locally available vegetables and fruits.
- Include in the diets, foods of animal origin such as milk, eggs and meat, particularly for pregnant and lactating women and children.
- Low-fat, protein-rich foods such as lean meat, fish, pulses and low-fat milk are often ideal for maintaining good health and nutrition in adults.
- Develop healthy eating habits and exercise regularly and move as much as you can to avoid sedentary lifestyle.

The food pyramid

Source: Dietary Guidelines for Indians-A Manual. ICMR-National Institute of Nutrition 2010

My Plate for the day

My Plate is another nutrition guide that helps in preparing a balanced diet through selection of variety of foods from various food groups (Figure 2). It primarily focuses on the addition of fruits and vegetables, into a diet due to the nutritional benefits associated with these food groups. Designed by the ICMR-National Institute of Nutrition, My Plate provides proportions of foods to be consumed that supplies 2000 Kcal per day in the Indian diet while ensuring adequate amounts of macro and micronutrients (vitamins & minerals), bioactive compounds, functional foods, antioxidants etc. My Plate suggests choosing from a mix of different colors of fruits and vegetables in order to maximize the intake of vitamins and minerals. Thus, the recommendation of My Plate is based on sourcing of macronutrients and micronutrients from minimum of 8 food groups per day with vegetables, fruits, green leafy vegetables forming essentially half the plate of the recommended foods per day. The other major portion is occupied by cereals and millets, followed by pulses and milk/curd. The amount of pulses and milk in the menu provides good quality protein and supply of all essential amino acids. Milk and milk products represented in a glass as a part of the model plate help to achieve the required protein, calcium, and are the sole source of Vitamin B12 in a vegetarian diet.

Using the proportions given in My Plate for the Day provides calories or energy typically 13.5% from protein, 29 % from fat and 56% from carbohydrates (Table 3). These levels are required to meet the 2000 calories need in a day.

The cost of the 'My plate for the day' has been estimated based on commonly consumed foods. The cost of non-vegetarian menu works out to approximately Rs.78 and vegetarian menu is Rs.66 per person per day.

Table 2. Quantity of various foods to be consumed as per My Plate guide

Foods/food group	Quantity Raw weight (g/day)	Protein (g/day)	Fat (g/day)	Carbohydrate (g/day)	Total Energy (Kcal/day)	% of total Energy
Cereals	250	25	5	172	843	42
Pulses	85	20	3	42	274	14
Milk/curd	300	10	13	16	216	11
Vegetables and green leafy vegetables	400	10	2	28	174	9
Fruits	100	1	1	11	56	3
Nuts and seeds	35	6	15	6	181	9
Fats and oils	27	-	27	-	243	12
% of Energy		15	30	55		

Source: My Plate for the Day Promotes Health Prevents Hidden Hunger and Protects from Diseases. ICMR-National Institute of Nutrition 2018

Key points in My Plate for the day

- My Plate is a simple guide for planning a balanced diet
- Proportions of food groups provided in My Plate aim at preventing macronutrient & micronutrient malnutrition, provide bioactive compounds, functional foods, antioxidants etc.
- Adequacy of micronutrients provided in the model plate may not be fulfilled by using supplements.
- Regular consumption of foods in proportions as per the model plate can help to,
  - Improve immunity and resistance to infections
  - Maintain good microbial flora/beneficial bacteria in the intestine
  - Prevent Diabetes Mellitus, Cardiovascular Diseases (CVDs) such as heart attack, stroke and many other diseases
  - Maintain appropriate alkalinity and thereby reduces inflammation and decreases chances of kidney stone formation
  - Prevent insulin resistance and maintains appropriate insulin sensitivity and glycaemic index
  - Ensures adequate intake of fibre and therefore prevents constipation
  - Prevents adverse effects of environmental pollution and toxins such as heavy metals and pesticides by working as a detoxifying diet.

Figure 2. A healthy food plate- My plate

Source: My Plate for the Day Promotes Health Prevents Hidden Hunger and Protects from Diseases. ICMR-National Institute of Nutrition 2018

Chapter 4.0

Use of processed foods and impact on nutrition

Food processing comprises the activities involved during the transformation of raw materials from plant or animal to a final product that is suitable for human consumption. Almost all food is processed in some way before it is eaten. Simply cooking or combining a food with other foodstuffs to create a recipe is also considered a form of food processing. Traditionally, in India, the main purpose of food processing to enhance the long-time storage and transport of foods, using techniques such as sun drying, preserving with salt, fermentation, pickling. Traditional wisdom about processing of food, its preservation techniques, and their therapeutic effects have been established for many generations in India. Many traditional Indian grain products contain higher amounts of resistant starches because of higher proportions of whole grain ingredients and less intensive processing. Milk processing involved boiling, fermentation to obtain curd and buttermilk and butter and paneer.

As the awareness of microbial spoilage in foods increased over time and with the development of advanced food processing technology tools processed foods sector also advanced. For example, the effective reduction in spoilage and pathogenic microorganisms achieved with processing techniques such as pasteurization and other heat treatment technologies has led to safer processed foods. With demand for practical, tasty, attractive, accessible, and affordable foods such as convenience/instant foods, more advanced processing techniques were developed to produce a variety of processed foods.

4.1 Definition and types of processed foods

Processed foods refer to any food that's changed from its natural state. The nature, extent and purpose of the processes used to make them describes 4 types of processed foods:

Minimally processed foods/unprocessed foods: fresh fruits, vegetables, whole grains, nuts, curd/yoghurt, tea, coffee and milk resulting from processes such as cleaning and removing inedible or unwanted parts, grinding, refrigeration, pasteurization, fermentation, freezing, and vacuum-packaging. The purpose of these processes is to facilitate preserving the food for some time so that it does not deteriorate and is safe to consume.

Processes used for ingredients used in cooking: Consist of removal of inedible or unwanted parts, drying, powdering, squeezing, crushing, grinding, boiling, roasting, and pasteurization, chilling, freezing, vacuum packaging, non-alcoholic fermentation. Foods under this group are normally used as ingredients while preparing the foods and include ground spices, oils from nuts and other oilseeds. The main purpose is extend the life of unprocessed foods, enabling their storage for longer use, or to make them edible, and, often, to make their preparation easier or more diverse.

Processed foods: Products made by adding salt, oil, fat, sugar or other ingredients to minimally processed foods, using preservation methods such as canning and bottling, and, non-alcoholic fermentation. Contain additives that prolong product duration, protect original properties, or prevent proliferation of microorganisms.

Ultra-processed foods: Foods that are subjected to technological modifications either for preservation or for converting into ready-to-use/eat foods. Made by a series of industrial processes using sophisticated equipment and technology. Processes include chemical modifications of foods, extrusion, moulding and pre-frying. These foods have added salt, sugar, and fat and high fructose corn syrup, hydrogenated or interesterified oils, and protein isolates. Also contain various food additives such as artificial colors and flavors, preservatives, thickeners, emulsifiers, and artificial sweeteners that promote shelf stability, preserve and enhance texture, and increase palatability. Many ready-to-eat products or pre-prepared ready-to-heat products such as carbonated soft drinks; sweet or savoury packaged snacks; chocolate, candies (confectionery); ice-cream; packaged breads and buns; margarines and other spreads; bakery items such as cookies (biscuits), cakes, and

cake mixes; powdered and packaged instant soups, noodles and desserts. Infant formulas, follow-on milks, other baby products; 'health' and 'slimming' products. Most of these foods are low in essential nutrients such as dietary fiber and other nutrients.

4.2 Need for processed foods

The demand for processed, ready-to-cook/eat and convenience foods due to changes in lifestyle foods has increased tremendously in recent years. Consumers are increasingly looking for processed foods, mainly because they are practical, tasty, attractive, accessible, and affordable. Food processing techniques have become a necessity particularly in ensuring safety of foods. These techniques help to lower the risk of foodborne pathogens or spoilage microorganisms by controlling microbial growth or inactivating microorganisms in highly perishable foods like milk and meat products, fresh fruits and vegetables. Food processing increases the seasonal availability of foods and enables easy transportation and distribution over long distances. Certain processing techniques aim to retain nutrients such as the quick freezing of fruits and vegetables after harvesting. Fortification of foods with specific nutrients such as iodization of salt, addition of micronutrients to milk and wheat flouyr during processing aimed to prevent deficiencies and their related health problems in the population.

4.3 Health and nutritional aspects of processed foods

Are processed foods healthy? Can we derive our nutritional needs from processed foods?

Both fresh and processed foods make up vital parts of the food supply. Processed food contributes to both food security (ensuring that sufficient food is available) and nutrition security (ensuring that food quality meets human nutrient needs). Processed foods are generally consumed either as part of a meal, or as a snack item. Their contribution in terms of essential nutrients depends on the type of processing and fortification, the frequency of use, and the quantity consumed.

Recent decades are witnessing increased replacement of minimally processed foods and culinary home preparations with more ready-to-eat/cook products. These lifestyle and dietary pattern changes are leading to increase in prevalence of chronic diseases such as obesity, overweight, cardiovascular disease, cancer, diabetes, metabolic syndrome, and other non-communicable diseases. frequency of consumption of processed and ultra-processed foods high caloric density together with high levels of sugar, saturated fats, sodium, and deficient levels of vitamins and minerals. In India prevalence of obesity among children under 5 years old increased in 20 out of 22 states. Overweight and obesity have also risen among adult population. Increased consumption of ultra-processed foods is being attributed to this increase. Consumption of processed foods may not only affect intake of nutrients, but in addition, increase the risk of exposure to various chemical additives.

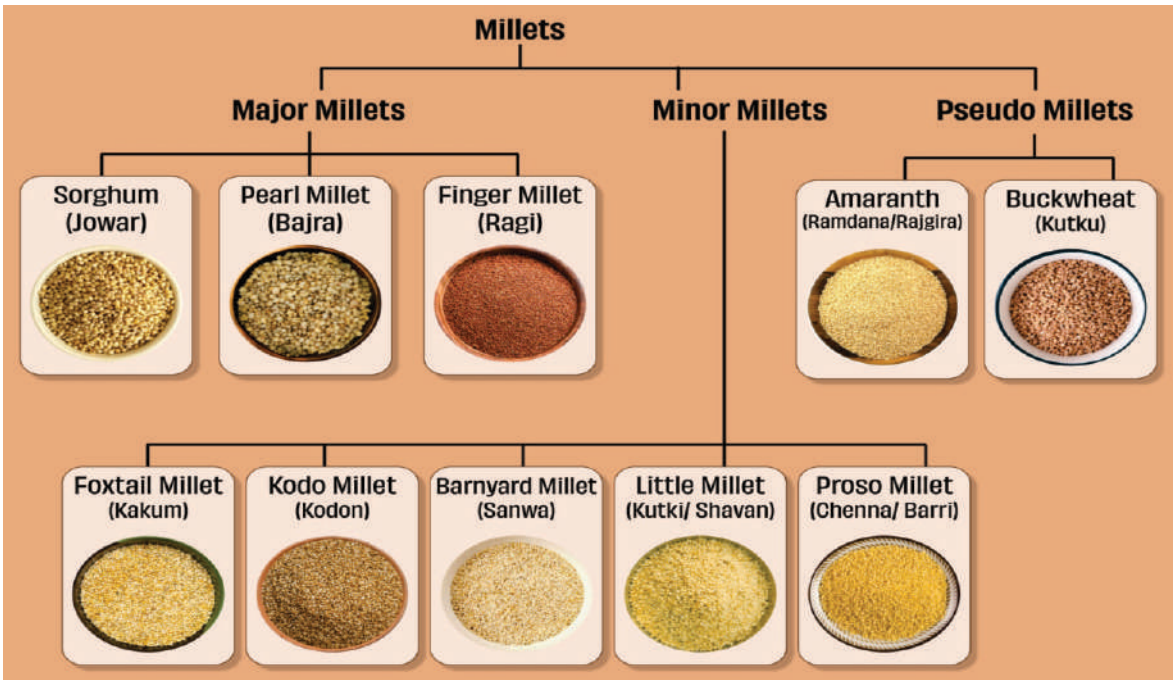
The processes and the ingredients used in the manufacture of ultra-processed foods make them highly convenient (ready-to-consume, almost imperishable) and highly attractive (hyperpalatable) for consumers, and highly profitable (low cost ingredients, long shelf-life) for their manufacturers. These processes also make ultra-processed foods typically nutritionally unbalanced and liable to be over-consumed. Thus consumption of these foods frequently referred to as “junk foods” need to be restricted.

4.4 How to identify ultra- processed foods?

The simplest way to identify if a food product is ukltra processed is to check the label and see for ingredients. These contain food substances generally not used in home kitchens, namely, hydrolysed proteins, soya protein isolate, gluten, casein, whey protein, fructose, high-fructose corn syrup, 'fruit juice concentrate', invert sugar, maltodextrin, dextrose, lactose, soluble or insoluble fibre, hydrogenated or interesterified oil. Various additives are include such as flavours, flavour enhancers, colours, emulsifiers, emulsifying salts, artificial sweeteners, thickeners, and anti-foaming, bulking, carbonating, foaming, gelling and glazing agents.

Key points for intake of processed foods

- Eat processed foods in moderation
- Reduce intake of ultra- processed foods high in non-communicable disease promoting nutrients- energy dense food products, fast foods, convenience foods, soft drinks, sugary drinks, various refined starchy foods, foods with trans fat, free sugars, high sodium/salt, processed meat
- Choose processed foods with non-communicable disease protective nutrients.
- Prefer traditional home prepared foods that are more micronutrient and fibre dense.
- Always read food labels (given on containers) for content of nutrients, shelf-life and food additives present.



Chapter 5.0

Importance of Food safety, quality and hygiene for ensuring healthy and nutritious diet

Food is the basic necessity for human health and nutrition. Thus, safe and nutritious food is vital for sustaining life and good health. Thus, it is important to ensure that all people at all times have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences. Food safety refers to handling, preparation, and storage of food in ways that prevent foodborne illness. This includes ensuring all the processes involved in making the food from production to consumption are exposed to minimum contamination from microbial, chemical and physical spoilage. The basic principle of food safety is to encompass actions aimed at ensuring that all food is as safe as possible in order to prevent health hazards. This includes ensuring all the processes involved in making the food from production to consumption are exposed to minimum contamination from microbial, chemical and physical spoilage.

5.1 Food safety and food borne diseases

A safe food can be defined as food which does not cause any illness on consumption. Ingestion of unsafe food results in acute or chronic health hazards. It may be injurious to the health of the consumer. Common symptoms of food poisoning include stomach upset, pain, vomiting and diarrhea. Sometimes such symptoms are treatable through medication or demand hospitalization in severe cases. Such symptoms that occur through consumption of contaminated food are referred to as Foodborne diseases. Food poisoning and food borne illnesses in India occur mostly due to microbial contamination of meat and meat products, poultry, eggs, milk and milk products, sweetmeats and rice preparations. Food handlers are major contributing factor in the causation of foodborne diseases. Poor, the underprivileged and the undernourished bear the brunt of the deleterious effects of food contamination. III health and undernutrition represent twin burdens of lack of adequacy and nutritive quality and presence of food contamination.

Food safety can be evaluated based on the origin, composition, method of production, and food control measures and regulations in place. The key questions for such evaluation include:

Where food comes from?	Example: Production to consumption, farmer, retailer, household
What it contains?	Example: Natural chemicals, artificial substances added during harvest, production, processing and preparation, environmental chemicals, pesticide residues
How the animals were raised or the vegetables grown?	Example: Production technologies/methods
How our government decides which foods are safe for us to eat?	Example: Food control measures/ regulations

Food safety, food quality and food hygiene are interlinked. While food safety is concerned with hazards that make food injurious to health, food quality refers to attributes that impact product value to consumer such as spoilage, contamination, adulteration, discolouration, off odours, etc (negative attributes) or origin , colour, flavour, texture (positive attributes. Food safety, quality and hygiene together evolve a robust strategy to ensure food safety through 5 key activities as described by the World Health Organization (WHO) as described below.

5.2 Five keys to safer food

i. Keep Clean

Dangerous disease causing microorganisms present in soil, water, animals and people. These get transferred to hands, cloths, utensils

- Wash your hands before handling food and often during food preparation
- Wash your hands after going to the toilet
- Wash and sanitize all surfaces and equipment used for food preparation
- Protect kitchen areas and food from insects, pests and other animals

ii Separate raw and cooked foods

Raw foods especially meat, poultry, and seafood and their juices contain dangerous microorganisms which may be transferred to other foods during food preparation and storage

- Separate raw foods namely fresh vegetables, fruits from meat products and milk and milk products.
- Use separate equipment and utensils such as knives and cutting boards for handling raw foods
- Store food in closed/airtight containers to avoid contact between raw and prepared foods

iii. Wash raw material and Cook food thoroughly

Proper cooking kills almost all dangerous microorganisms. Cooking to 70°C temp is generally safe for consumption.

- Wash vegetables, fruits, animal products thoroughly with clean and potable water
- Cook foods such as vegetables and animal foods thoroughly.
- Always ensure that foods such as milk and preparations such as soups, sauces, stews are heated to 70°C or boiled.
- Reheat cooked food thoroughly

iv. Keep food at safe temperatures

Microorganisms multiply very quickly at room temp. Holding at <5°C or above 60°C slows down growth of microorganisms

- Do not leave cooked food at room temperature for more than 2 hours Refrigerate promptly all cooked and perishable food (preferably below 5°C) Keep cooked food piping hot (more than 60°C) prior to serving
- Do not store food too long even in the refrigerator
- Do not thaw frozen food at room temperature

v. Use safe water and raw materials

Raw materials including water and ice may be contaminated with dangerous microorganisms and chemicals. Toxic chemicals may be found in damaged and mouldy foods. Care in selection of raw materials and simple measures such as washing and peeling may reduce risk

- Always use safe potable water for cooking and drinking purposes.
- Select fresh and wholesome foods
- Choose foods processed for safety, such as pasteurized milk
- Wash fruits and vegetables, especially if eaten raw
- Do not use food beyond its expiry date especially perishable packed foods such as bread, cheese.

5.3 How does food become contaminated and unsafe for consumption?

Various hazardous agents have the potential to enter the food supply at any point from production to consumption. These hazards may be originating from microbial, fungal, parasitic, chemical or physical contamination of food. Food borne microbial pathogens, naturally occurring toxicants, mycotoxins, heavy metals, pesticide residues, veterinary drug residues, and adulterants make food unsafe causing food borne illnesses and diseases to a large extent in India. Often various bacteria and their products are responsible for food spoilage. Inappropriate agricultural practices, poor hygiene at any point in the food chain, lack of food safety awareness during processing and preparation of the food, incorrect use of chemical materials, use of contaminated raw materials, food and water and

inappropriate storage leading to insect and rodent attack are major causes of food hazards as well as food losses. Consumption of animals foods derived from animals affected with pathogenic/infective bacteria and viruses can also cause food borne illnesses in consumers. Introduction of supplementary foods/weaning foods with high levels of microbial contamination and adulteration cause maximum diarrheal episodes. In India, uncertain climatic conditions, diverse food habits, poverty, inadequate basic hygienic and sanitary facilities, inadequate storage facilities and low public awareness of food safety are often recognized as major causes of food contamination and food borne disease outbreaks.

5.4 What are the common and new food hazards?

- Microbiological contamination with pathogenic bacteria/viruses
- Chemical contamination with plant toxins, fungal toxins
- Environmental contaminants such as heavy metals from industrial processes
- Contaminants from Agriculture production: Pesticide and veterinary drug residues
- Food hazards brought in from food Industry: food additives/food colours/adulterants
- Food hazards from public catering
- Newer hazards: Spread of infectious microbes from Animal foods

5.5 Raw perishable foods - most vulnerable to microbial contamination

Raw foods particularly those derived from animals such as meat and other products are a major source of pathogenic bacteria and viruses. Thus chances of cross contamination are very high especially when these foods are stored together with other fresh foods such as fruits and vegetables or cooked foods. Thus, it is important to store raw animal food products and vegetables and fruits and other perishables separately. All perishable foods should be stored under refrigeration, preferably at a temperature of 10C or less, which retards multiplication of microorganisms.

5.6 Adulteration-The most persisting problem in India

Making food appear better than what they actually are, adding inferior quality products, wholly or partly abstracting constituents of the food are considered as adulteration. Adulteration is considered as a public health menace in India. Usually these malpractices are resorted to for monetary gains. The food groups commonly adulterated are milk and milk products, cereal and cereal products, edible oils, pulse and pulse products, spices, beverages like coffee and tea, sweets, hard boiled confectionery and ice cream. Adulterants are of two types: intentional and incidental. Intentional adulterants are those substances that are added as a deliberate act on the part of the adulterer with the intention to increase the margin of profit. Some of these adulterants could cause harmful effects on the body. The different types of adulterants commonly found in India are shown below.

Table 3. Different types of food adulterants commonly found in India

Coal tar dyes: Orange, sudan, metanil yellow, auramine, melachite green, rhodamine B.

Cheaper oils: Castor oil, soyabean oil, sesame oil, rapeseed oil, palmolein, mineral oil, terpentine.

Cheaper agriculture produce: Wheat starch, maize starch, jowar starch, rice starch, arrow root starch, amaranth seeds, date seeds.

Chemicals: Saccharin, sodium bicarbonate, sodium carbonate, acetic acid, ammonium sulphate, copper sulphate, urea, dulcin, brominated vegetable oil, monosodium sterate, ammonia, calcium oxide, ultramarine blue, sulphur dioxide, anticaking agent, benzoic acid, diazepam, ammonium chloride, chloral hydrate, Triorthocresyl phosphate.

Extraneous matter: Wooden pieces, chalk, cashew husk, yeram, husk, silver oak leaf, fenugreek, sand, cellulose, colophony, resin, tamarind husk, coffee husk, grass seeds, saw dust.

Metal contaminants: Aluminium, iron filings, lead chromate, nickel.

Fungi: Fungal toxin, ergot, aflatoxin

Insect infestation: Weevilled grains

Residues: Pesticide residues, veterinary drug residues, acetylene.

5.7 How to ensure food safety?

The most important key actions to ensure safety of food relate to cleanliness in handling, processing and consuming food, handling, processing and storing of raw and cooked foods, quality of food and water used for cooking, thoroughness of cooking, and above all awareness of the importance of maintaining hygiene and quality in the preparation of food.

Simple ways of checking quality of food items during their purchase: Purchasing from reliable sources having a high turnover ensures their freshness. Certifications given by food safety authorities on packaged foods for example fruit products, oils, jams, soft drinks, food colours aid in checking quality of purchased foods. Sometimes 'best before' and date of expiry labels are also helpful particularly for perishable foods. Quality checks can be done visually at the time of purchase. For example,

- Food grains should be free from infestation and foreign matter like rodent excreta and insect remnants
- They should be of uniform size and should not be shrivelled, shrunken or mouldy
- Foodstuffs should be free from artificial colors
- Risk of adulteration is higher in fats/oils purchased loose from unsealed containers

  Purchase pasteurized milk in sachets from a reputed dairy or a reliable vendor to avoid the risk of adulteration and contamination.
- Avoid purchase of fruits and vegetables that show patches, physical damage with bruises or wilted and decayed with visible evidence of insects and moulds.
- Eggs should be fresh and free from cracks. Meat or poultry must be examined for characteristic color, odor and texture and should be purchased fresh or frozen. Freshness of fresh-water fish is indicated by a stiff body, bright, clear and bulging eyes, reddish gills, tight scales and absence of stale odor or discoloration. Fresh fish will not show any pitting on finger pressure.

5.8 Who sets safety and quality standards for foods?

The Food Safety and Standards Authority of India is the main authority in India that sets standards to ensure safety of various foods such as grains, spices, fats and oils, dairy products, animal derived foods, packaged foods, ready to eat foods, food additives. The FSSAI's aim is to regulate food manufacture, storage, distribution, sale and import to ensure availability of safe and wholesome food for human consumption. Food safety authorities collect food samples at defined intervals from various food are collected by food safety personnel and analysed in specific laboratories to assess the compliance to safety and quality parameters.

Key points in food safety

- Safe and nutritious food is vital for sustaining life and good health
- Food safety hazards constitute one of the major public health concerns
- Food-borne diseases increasing at an alarming rate- consumption of contaminated food major cause
- Increase in the potential risk of consuming unsafe food through improper post-harvest processing, inadequate storage and transport facilities, and insufficient knowledge and awareness of the hazards associated with poor quality food
- Food-borne diseases are often associated with poverty, and lack of access to adequate, good quality and nutritious foods.
- Ensuring the wholesomeness of food will contribute both to the promotion of health and nutrition and ensure its adequacy and nutritive value.

Chapter 6.0
Conclusions

The concepts of nutrition and balanced diet together with the importance of food safety presented above need to be viewed in the context of the current changing life style and dietary consumption patterns particularly in children. It is important that children are educated about the disease risks of consuming high amounts of processed foods and be motivated to develop healthy diet/food options. The ancient wisdom regarding food habits, balanced diet, health and nutrition are very relevant to minimizing/preventing current lifestyle diseases and every effort must be made to preserve our traditional food culture and dietary habits.

7.0 Literature resources referred in the article

1. Dietary Guidelines for Indians-A Manual. ICMR-National Institute of Nutrition 2010
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CEREALS & PULSES

ओम् यन्तु नदयोः वर्षन्तु पर्जंया सुपिप्पला ओषधयोः भवन्तुः ।
अन्नवताम् ओदनवताम् मामिक्षवताम् एशाम् राजा भूयासन् ।।
ओदन् मुब्रुवते परमेष्ठीवा एषः यदोदनः ।
परमामेवैनम् श्रियंगमयति ।।1।।

May the rivers flow and the clouds give rain. May the plants yield good harvest. May I become the king of all those having plenty of food, boiled rice, curd and milk. Food ispraiseworthy.
This food is verily Brahma the creator. This will lead to the greatest prosperityin the form of health and wealth.

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