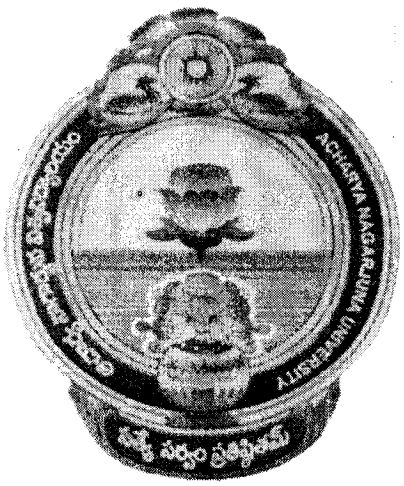
NUTRITION & FOOD HYGIENCE

PGDHM



Director

Prof. P. Sankara Pitchaiah,

M.Sc., Ph.D., M.A., Ph.D., (Psy.), PGDHRM

CENTRE FOR DISTANCE EDUCATION
ACHARAYA NAGARJUNA UNIVERSITY
NAGARJUNA NAGAR – 522 510

Ph: 0863-2293299, 2293356, 08645-211023, Cell:98482 85518
08645 - 211024, 0863 - 2346259 (Study Material)
Website : www.anucde.ac.in or www.anucde.info
e-mail : info@ anucde.ac.in

NUTRITION & FOOD HYGIENCE, PGDHM

Edition: 2016
No. of Copies : 5

Second Edition : 2017
No. Of Copies : 200

This book is exclusively prepared for the use of students of PGDHM., Centre for Distance Education, Acharya Nagarjuna University and this book is meant for limited circulation only.

Published by :
Prof. P. Sankara Pitchaiah ,
Director,
Centre for Distance Education,
Acharya Nagarjuna University

Prof. P. Vara Prasada Murthy,
Deputy Director,
Centre for Distance Education,
Acharya Nagarjuna University

Dr. V. Venkata Ratnamma,
Deputy Director,
Centre for Distance Education,
Acharya Nagarjuna University

Printed at :
M/s.Romith Technologies
Guntur

FOREWORD

Acharya Nagarjuna University, since its establishment in 1976, has been moving ahead in the path of academic excellence, offering a variety of courses and research contributions. The University achieved recognition as one of the eminent universities in the country by gaining A grade from the NAAC 2016. At present Acharya Nagarjuna University is offering educational opportunities at the UG, PG levels to students of 447 affiliated colleges spread over the two districts of Guntur and Prakasam.

The University had started the Centre for Distance Education in 2003-04 with the aim to bring Higher education within the reach of all. The Centre has been extending services to those who cannot join in colleges, cannot afford the exorbitant fees as regular students, and to housewives desirous of pursuing higher studies to study B.A., B.Com, and B.Sc., Courses at the Degree level and M.A., M.Com., M.Sc, M.B.A. and LL.M. courses at the PG level.

For better understanding by students, self-instruction materials have been prepared by eminent and experienced teachers. The lessons have been prepared with care and expertise. However constructive ideas and scholarly suggestions are welcome from students and teachers. Such ideas will be incorporated for the greater efficacy of the distance mode of education. For clarification of doubts and feedback, Weekly classes and contact classes are arranged at UG and PG levels respectively.

I wish the students who pursue higher education through Centre for Distance Education will not only be personally benefited by improving their qualifications but also strive for nation's growth by being a member in Knowledge society I hope that in the years to come, the Centre for Distance Education will grow in strength by introducing new courses, catering to the needs of people. I congratulate all the Directors, Academic coordinators, Editors, Lesson - Writers, and Academic Counsellors and Non-teaching staff of the Centre who have been extending their services in these endeavours.

Prof. A. Rajendraprasad
Vice - Chancellor
Acharya Nagarjuna University

PGDHM: Syllabus

PAPER – III: NUTRITION & FOOD HYGIENCE

THEORY:

HYGIENE:

1. Definition of Hygiene – importance of hygiene in catering industry.
2. Personal hygiene – care of skin, hair, hands, feet, teetch and use of cosmetics.
3. Food borne diseases causative organisms – contamination – control measures – precaution to be taken by food handlers.
4. Safe and correct disposal of garbage.
5. Pest Control
6. Care of premises and equipment
7. Storage of food
8. Correct handling and storage temperatures of different commodities to prevent contamination and spoilage.

NUTRITION

1. Study of different nutrients – proteins, carbohydrates, fats, vitamins, and minerals – water.
2. Balance diet – menu planning.

Recommended Books:

Nutrition - Proudfit and Robinson

Food Science - By Mudambi Shalini and M.Rao

Fundamental of Food & Nutrition by Sumathi R. Mudambi & M.V.Rajagopal

Total No. of Questions : 10] **[Total No. of Pages : 01**

PG DIPLOMA EXAMINATION, MAY – 2015
HOTEL MANAGEMENT
Nutrition & Food Hygiene (Paper - IV)

Time : 3 Hours **Maximum Marks : 75**

Answer any Five questions. *(5 x 15 = 75)*

All questions carry equal marks.

Q1) Bring out the significance of hygiene in catering industry.

Q2) Explain the use of cosmetics in personal hygiene.

Q3) Suggest measures to control food contamination.

Q4) Give an account of safe disposal of garbage.

Q5) State the precautions that the food handlers should take.

Q6) Give an account of food borne diseases.

Q7) How do you prevent spoilage commodities?

Q8) What are the features of balance diet?

Q9) State the nutritive value of food.

Q10) Describe the care required for hotel premises and equipment.

Content

Lesson - 1

HEALTH

1.0 OBJECTIVE :

The objective of this lesson is to explain how health plays a vital role in individual as well as the community. Further, it also provides the dimension of health, and explains about positive health.

STRUCTURE :

1.1 Introduction

Good health is a vital part of the great experience of living. The truth of this has been known from early times. Every age has made new discoveries about health, thereby providing man with new weapons to fight diseases. Today steady progress is being made in the fields of education, medicine and surgery as well as public health. Attempts are being made to give every one a fair chance to lead a healthier and fuller life.

1.2 Health

Health is a matter which affects not only each one of us as individuals, but also the community in which we live. Unless an individual keeps fit, he cannot make full use of this life, nor can an ailing community play its proper role in the world.

Hence health is vitally important to all of us and perfect health for all is the final aim of every community. Adequate food of the right type is the foremost necessity for achieving good health.

What do we understand by the word "Health"? Day and night the different parts of our body are working. If these go on working smoothly, attuned to their surrounding conditions, then the body is said to be healthy. If, however, this natural or normal state is upset or something goes wrong with any of the functions of the body, then one becomes ill.

The World Health Organization (WHO) defines health as " a state of complete physical, mental and social well- being and not merely the absence of disease or infirmity." There are various conditions that can affect health, they are as follows.

1.3 The Dimensions of Health

There are various conditions that can affect health, and both the individual and community must learn to control them. If this is done successfully, ill health and the unhappiness it causes can be controlled and also prevented. The following factors affect the maintenance of good health:

1. Physical well-being
2. Mental and Emotional well-being
3. Social Well- being
4. Spiritual Well-being

1. Physical well-being:

This means the correct use of the body mechanism at every stage of life, more so in adult life; in other words, it means physical fitness. It can be brought about by eating the right kind of food in sufficient quantities, along with an adequate amount of exercise and attention to the rules of health. One should not be satisfied with the mere absence of disease, but aim at ensuring complete physical fitness and a sense of well being.

2.Mental and Emotional Well-being:

A mentally depressed person develops physical troubles too, because the mind and the body are closely associated. Mental health is also influenced by emotions such as anger, hatred, worry, love, tension and jealousy. On hearing of a sad event in the family or amongst friends, we lose appetite and interest in food. On the other hand, when the mind is happy, good food is appreciated.

3.Social well-being:

The social well-being of a community depends upon its progress, broadmindedness, thoughtfulness and sympathy towards others. It also depends upon the education, productivity, health and social security of its members. Health enables one to work more, earn more and add to the assets of the nation. The changing pattern of social life influences the physical and mental life of the people and vice versa. For example, our food habits have changed as we learn to accept the foods of other communities as well.

4.Spiritual Well-being:

Due to the stress and strains of modern life, it is very important for us to consider this dimension of health as well. An individual has to be at peace with himself before he can be at peace with the world. Attention to moral values, ethics, exercises and meditation are some ways to attaining spiritual well-being.

1.4 Positive Health:

A person who enjoys the four dimensions of health described above is in a state of complete or positive health. This is possible only if a person is able to live healthily in his environment and depends on the family and community as well.

1.5 Conclusion

Various social services have been developed to look after the health of the community. Among these are child guidance clinics, health education centers and child and maternal welfare centers. In all of these, importance is given to food and nutrition at every stage of life, especially for pregnant women, lactating mothers and growing children. Food is one of the important factors towards maintaining optimum positive health. Lack of proper food causes deficiency diseases; medicines are needed to cure or promote health and prevent disease.

1.6 Self Assessment Questions

1. Give the definition of Health according to the WHO. Explain the various dimensions of health.
2. What is the necessity of having Optimum Health?

1.7 Key Words

1. Health: It is a state of complete physical , mental and social well being and not merely the absence of disease or infirmity.

1.8 Further Readings

1. Physical well-being
1. Parke J.& Parke K: Social and preventive Medicines
2. Bedi J.S: Public Health
3. Dr. A.K Jain& Dr. Vipin Gupta: Basic health Education
4. Health : N.C.E.R.T

- Sasmita Mohanty

Lesson - 2

NUTRIENTS

2.0 OBJECTIVE :

The objective of this lesson is to explain about Nutrition, Nutritional status, Nutritional care and good Nutrition. Further it explains the classification and various functions of nutrients.

STRUCTURE :

2.1 Introduction

Food is the prime necessity of life. The food we eat is digested and assimilated in the body and used for its maintenance and growth. Food also provides energy for doing work. Man has exhibited much thought and foresight in cultivating a variety of grains, fruits, vegetables, nuts and oilseeds and in rearing birds and animals for use as food. The selection of foods best suited for promoting good health has been found out by trial and error by continued use. Use of milk of different mammals as food for infants has been practiced from very early times. A considerable amount of information is now available on the nutritive value of foods and nutritional requirements.

2.2 Nutrition

Nutrition is the science of Foods, the nutrients and other substances therein; their action, their interaction and balance in relationship to health and disease. It can be defined as the process by which the organisms ingests, digests, absorbs, transports and utilizes nutrients and disposes of their end products. It can also be defined as "food at work in the body". Nutrition must perforce be concerned with the social, economic, cultural and psychological implications of food and eating.

Nutritional Status:

It is the condition of health of an individual as influenced by the utilization of nutrients in his body. This can only be found out only by a careful medical and dietary history, a thorough physical examination and appropriate laboratory investigations. It can be defined as level of nourishment in an individual.

Nutritional Care:

It is the application of science and art of Human nutrition in helping people to select and obtain food for the primary purpose of nourishing their bodies in health or in disease throughout their lives.

Good Nutrition:

Good, adequate and optimum are the terms applied to that quality of nutrition in which the essential nutrients in the correct amounts and balance are utilized to promote the highest level of physical and mental health throughout one's life .

Nutrients:

Nutrients are the constituents in food that must be supplied to the body in suitable amounts. These are proteins, carbohydrates, fats, minerals, vitamins, water and roughage.

Proteins:

Proteins are required for growth in children and maintenance of body weight in adults. Protein also provides energy to a small extent. Proteins constitute about 20% of the body weight. Body proteins are derived from dietary proteins. The body loses continuously some quantity of proteins and this loss has to be made up by dietary proteins. Proteins are made up of simpler chemical substances known as amino acids. The amino acid contents of protein have been found to differ from one protein to another. The nutritional value of proteins depends on their amino-acids contents.

Carbohydrates:

Carbohydrates are the main sources of energy for doing work. The carbohydrates commonly occurring in foods are starch, cane sugar, glucose, fructose and milk sugar. About 50-70 percent of energy value in the average diet is provided by carbohydrates. They are the cheapest source of energy. Glucose derived from the digestion of carbohydrate is used as the main source of energy in the body.

Fats:

Oils and fats serve mainly as the source of energy and they contain some essential nutrients like essential fatty acids and fat soluble vitamins. Fat is essential for maintaining good health, as absence of fat leads to the development of a deficiency disease affecting the skin known as phrynoderma.

Minerals:

The body contains about 24 minerals all of which are derived from the diet. The important minerals are calcium, phosphorus, potassium, sodium, chloride, magnesium, iron, copper, iodine, cobalt, fluorine and zinc. The minerals are essential for various body functions e.g. 1. Calcium and phosphorus for the formation of bones and teeth 2. Sodium, potassium, chloride and phosphorous for maintaining water balance in the body. 3. iron and copper for the formation of hemoglobin and 4 iodine for the normal functioning of thyroid glands. Diets should, therefore provide adequate amounts of all the minerals.

Vitamins:

Studies carried out by several pioneers have shown that foods contain certain chemical substances n small amounts which are now called vitamins. About 17 different vitamins have so

far been discovered. All of them are essential for normal functioning of the human body. Inadequate intake of vitamins will lead to the development of deficiency diseases. Vitamins have been grouped under two heads: 1. fat soluble vitamins such as vitamins A, D, E and K and 2. Water soluble vitamins e.g. vitamin B_1, riboflavin, vitamin B_6, niacin, pantothenic acid, folic acid, biotin, vitamin C and vitamin P. A large amount of information is available on the functions of vitamins, vitamin content of foods and vitamin requirements.

2.3 Classification of Nutrients

Since foods vary widely in their contents of various nutrients, they have been broadly grouped under three heads from the nutritional point of view.

1. Energy yielding foods
2. Body building foods
3. Protective foods

2.4 Functions of Nutrients

Energy yielding foods:

Foods rich in carbohydrates and fats are called energy yielding foods. Cereals, roots and tubers, dried fruits, sugars and fats are included in this group. They are the main sources of energy for doing work.

Body building foods:

Foods rich in proteins are called body building foods. Milk, meat, fish, eggs, pulses, oilseeds and nuts and low fat oilseeds and flours are included in the group of body building foods. Proteins are required for growth in children and maintenance of body weight in adults.

Protective foods:

Foods rich in proteins, vitamins and minerals are termed as protective foods. Milk, eggs, liver, green leafy vegetables and fruits are included in two groups. A) Foods rich in vitamins, minerals and proteins of high biological value e.g. milk eggs and liver. B) Foods rich in certain vitamins and minerals only e.g. green leafy vegetables and fruits. All the vitamins are essential for normal functioning of the human body. Lack of vitamins will lead to the development of deficiency diseases.

2.5 Conclusion

The problem of overcoming malnutrition and improving the nutritional status of the vulnerable sections of the population has been engaging the attention of nutritionist, governments of different countries and U.N agencies. Studies carried out in several nutrition research laboratories in India and other countries, have shown that supplementation of the diets with extra cereals, legumes and green leafy vegetables or with processed food supplements based on cereals, oilseeds meals and fortified with essential vitamins and minerals can help effectively to overcome malnutrition and improve the health and nutritional status of the population. By the application of the available knowledge, it is possible to eradicate malnutrition and under nutrition in the developing countries.

2.6 Self Assessment Questions

1. What do you understand by the term nutrition and the nutritional care of an individual?
2. Classify Nutrients according to their functions.
3. Discuss in brief the function of Nutrients.

2.7 Key Words

1. Nutrition: Is the science of Foods, the nutrients and other substances therein; their action, interaction and balance in relationship to health and disease.
2. Nutrients: are the constituents in food that must be supplied to the body in suitable amount.

2.8 Further Readings

1. Hand book of Food and Nutrition by M. Swaminathan.

- Sasmita Mohanty

Lesson - 3

FOOD

3.0 OBJECTIVE :

The objective of this lesson is to explain about various foods and their functions on the human body.

STRUCTURE :

3.1 Introduction

Like air and water, food is also basic to our existence. In fact, food is the primary concern of Man in his physical environment. Throughout all recorded history. Food or the lack of it has greatly influenced the destines of Man. One must eat to live and what ones eats affects to a high degree one's ability to keep healthy, to work, to be happy and to live well. Food can be obtained from the animal as well as the plant kingdom, from organic as well as inorganic sources.

3.2 Definition of Food

Food can be defined as anything solid or liquid which when swallowed, digested and assimilated in the body keeps it well.

3.3 The Functions of Food

a)Physiological Functions Food provides materials for tissue building, growth and body repair mainly through proteins and minerals. Different parts of the human body like the muscles, bones and organs are built up and maintained by the proteins supplied by the food. Minerals like iron, calcium and phosphorus affect the formation of the blood and skeletal tissue. A lack of any one of the various types of building nutrients leads to weakening of the body structure.

Food provides energy to the body through nutrients like carbohydrates and fats. The human body is never at rest. Energy is required constantly for the voluntary and involuntary activities of the body. Even while sleeping the heart beats, digestion and respiration go on and the body temperature remains constant.

Protective foods are essential for safe guarding the body against diseases. Vitamins play a vital role in regulating body processes like growth, eyesight, health of the skin, formation of proper

teeth and good digestion, excretion, maintenance of body temperature and the electrolyte balance. They also protect the general health of the individual. Minerals control some of the physiological process of the body. The absence of iodine can lead to a disease of the thyroid gland called goiter.

Regulatory foods are needed for the normal working of the body. Water is required in large amounts to regulate body processes such as digestion, excretion, maintenance of the body temperature. And the electrolyte balance. Roughage helps normal bowel movements.

b) Psychological Functions Food satisfies certain emotional needs of the human being. Food which is nutritionally adequate may not always give a sense of genuine satisfaction to the consumer.

People traveling to new lands have to adjust themselves to the unfamiliar food customs. It is well known fact that eating provides an outlet for the stresses and strains of life.

A difficult examination in school may cause a child to eat less or not at all. An adolescent with no friends may try to compensate by eating more, thereby satisfying his needs.

Food is also a sign of security to many. A baby feels secure in the arms of its mother when it drinks milk. Food is used as a weapon when an insecure child refuses to eat and causes concern to its mother. Children who are ill and lonely may make demands for food upon those caring for them, just to gain attention.

c)Socio Cultural Functions Food habits which have existed among a given racial group for centuries may be the reason for their reluctance to accept any suggested changes. The social structure, economy, religion, beliefs and attitudes affect the meal patterns of the family. Today, many changes in food pattern are being accepted because of the influence of other cultures. This has led to the enriching of their diets while not doing away with the older traditions. Food plays an important role during social meetings, both formal and informal. At such gatherings food serves as an instrument for developing social relationships.

Families meet at various mealtimes. Such everyday occasions provide opportunities for the development of the sound family relationships and good food habits. Food is often used to express one's feelings. The sharing of food is a token of friendship, the serving of special and favorite dishes is an expression of attention and recognition, while the withholding of desired food may be a means of punishment.

3.4 Conclusion

The food consumed by an individual should be wholesome and should fulfill the physiological, physiological and social needs of a human being. Faulty diets lead to ill health and disease. What a person eats has a lot to do with how he or she feels. Good physical strength can be made possible by good eating. This also promotes emotional stability and personality wellbeing. Custom, habit and appetite have served as the chief guides in the selection of food in the past. The food consumed should provide energy for work voluntary and involuntary. It should promote growth or built the body and repair the wear and tear; finally it should protect the body against ill health, maintain and regulate the body processes.

3.5 Self Assessment Questions

1.Define food and explain its function.

3.6 Key Word

1.Food: Food can be defined as anything solid or liquid which when swallowed, digested and assimilated in the body keeps it well.

3.7Further Readings

1.Rajalakshmi R.; Applied Nutrition; Oxford and IBH Publishing Company.

- Sasmita Mohanty

Lesson - 4

ENERGY

4.0 OBJECTIVE :

The objective of the lesson is to know about the various energy values of foods and energy requirements. It further explain about the Basal Metabolic Rate, factors affecting basal metabolic rate and the specific dynamic action of food.

STRUCTURE :

4.1 Introduction

Lavosier is rightly considered as the pioneer in studies on energy metabolism. He along with Laplace, carried out during 18th century, experiments with guinea pigs and found a relationship between heat produced and carbon dioxide output. Later, Lavosier measured the oxygen consumed by men and found that exercise increased oxygen consumption. In 1866 Pettenkofer and Voit measured the heat output and oxygen consumed and carbon dioxide output in human body.

4.2 The Energy Yielding Food Factor:

The energy yielding food factors are

1. Carbohydrates
2. Fats
3. Proteins

With in the body, these are oxidized in the cell. The process is one of the Continuous utilization of oxygen and production of carbon dioxide, water and heat.

4.3 Energy Units:

The energy value of foods can be expressed in terms of kilo calories (Kcal) or Mega joules (MJ).

Kilo Calorie: One kilogram calorie is the quantity of heat required to raise the temperature of 1 kg of water through 1. it is one thousand times the small calorie used in physics.

Mega joule: One kilo calorie equals 4.186 kilo joules.

4.4 Determination of Energy Value of Foods:

The energy value of foods is usually determined using the instrument called bomb calorimeter. A weighed amount of the food sample is placed inside the calorimeter, in a crucible. It is filled with oxygen under pressure. The calorimeter is immersed in a known amount of water. The sample is ignited by means of electric fuse and heat liberated is measured by the rise in temperature.

Example:

Weight of Wheat taken	=	2g
Weight of water in the outside vessel	=	3000 g
Water equivalent of the calorimeter	=	500g
Initial temperature of water	=	24° C
Final temperature of water	=	26° C
Rise in temperature	=	2° C
Heat gained by water and calorimeter	=	3500x 2= 7000

Small calories or 7 kilo cal

2 g wheat produces 7 K Cal

1g wheat produces 3.5 K Cal

Calorific value of 100 g of wheat = 350 K Cal

4.5 Physiological Energy Value of Foods:

In the utilization of carbohydrates, fats and proteins in the body, a certain percentage of the above nutrients is lost in digestion and the nitrogen of protein is excreted in urine as urea which still contains some energy value. The average losses in digestion in human subjects have been estimated to be 2.0 per cent for carbohydrates, 5.0 percent for fats and 8.0 per cent for proteins. The loss of energy in urea has been estimated to be 1.2 K Cal per gram of protein oxidized.

4.6 Energy Requirements:

Energy or calorie requirement is greatly affected by age, sex, climate and activity superimposed upon the body are such factors as voluntary muscular activity, the effect of the food and the maintenance of the body temperature.

Energy Requirements

	Particulars	Kcal
Man (55kg)	Sedentary worker	2400
	Moderate Work	2800
	Heavy Worker	3900
Woman (45kg)	Sedentary worker	1900
	Moderate Worker	2200
	Heavy Worker	3000

4.7 Basal Metabolism:

The energy metabolism of a subject at complete physical and mental rest and having normal body temperature and in the post-absorptive state is known as Basal metabolism.

4.8 Determination of Basal Metabolism:

Basal metabolism is usually determined using the apparatus of Benedict and Roth. The apparatus is a closed circuit system in which the subject breathes in oxygen from a metal cylinder of about 6 liter capacity and carbon dioxide produced is absorbed by soda lime present in the tower. The basal metabolism of the individual for 24 hours = 1,267 Kcal.

BMR:

The amount of energy required to carry on the involuntary work of the body. It includes the functional activities of the various organs such as the brain, heart, liver, kidneys, lungs, secretary activities of glands etc. This is measured by indirect calorimeter under the following specific condition.

1. Post absorptive i.e. 12-16 hrs after the last meal.
2. Reclining, but awake- 11/2 to one hour of rest before the test.
3. Relaxed and free from emotional upsets.
4. Normal body temperature
5. Comfortable environmental conditions

4.9 Factors Affecting Basal Metabolic Rate (B.M.R)

BMR is greatly affected by age, sex, body surface, sleep, body temperature, race, endocrine gland and state of nutritional standards.

Body size: The BMR is closely related to the body surface area.

Age: The BMR is higher in infants and young children than in adults.

Sex: Females have slightly lower rate of BMR than males.

Body consumption: The BMR is directly related to the lean body mass. Persons with well- developed muscles will have a higher BMR than obese persons whose higher body weight is due to adipose tissue.

Climate: In persons living in tropical climates, the BMR is about 10% less than those living in temperate zones.

4.10 SDA (Specific Dynamic Action)

Food has a stimulating effect on BMR. If a person in post absorptive is given food, the BMR has been found to increase by about 8%. This is known as the **Specific Dynamic Action** of Food. Rubner observed that carbohydrates, fats and proteins fed to a fasting dog, stimulated the energy metabolism over the basal level to varying extents. The extra heat produced is obtained by the oxidation of the tissue constituents and the animal will be in negative energy balance. This stimulating effect of carbohydrates, fats and proteins on energy metabolism is called Specific Dynamic Action. The SDA of proteins is (30%) the highest while that of carbohydrates and fats is only 6% and 4% respectively.

4.11 Classification of Activities

1. **Under nutrition and starvation:** Prolonged under nutrition or starvation causes a reduction about 10-20% in the BMR.
2. **Sleep:** The BMR in sleep is about 5% less than in the Basal Metabolic rate.
3. **Fever:** Fever increases the BMR for every 1^0 F rise in body temperature, B.M.R increases by about 7%.
4. **Physical activities** : If an individual takes physical exercise about an hour before the determination of BMR, appreciable increase in the BMR is observed.
5. **Fear and nervous tension:** Fear and nervous tension during the test increase the BMR.
6. **Thyroid:** Hypothyroidism decreases BMR up to 30% and hyperthyroidism may cause an increase in BMR up to 100% depending on the severity of the condition.
7. **Adrenaline:** Injection of 1 gm of adrenaline increases the BMR by about 20% for few hours.
8. **Anterior Pituitary :** The anterior pituitary influences B.M.R.,through its thyrotrophic hormone, The B.M.R being low in hypo activity and high in hyper- activity of the glands.

4.12 Conclusion

The body is said to be in energy balance when the calories supplied by the food are exactly equal to the energy needed for the involuntary and voluntary activities of body. Weight is neither gained nor lost. Another important factor is the source of calories provided.

4.13 Self Assessment Questions

1. What do you understand by B.M.R? What are the various factors that affect the Basal metabolic rate?
2. What is Specific Dynamic Action of food?
3. What are the various factors that determine the energy requirements?

4.14 Key Words

1. **Kilo Calorie:** One kilogram calorie is the quantity of heat required to raise the temperature of 1 kg of water through 1° C.
2. **Basal Metabolism:** The energy metabolism of a subject at complete physical and mental rest and having normal body temperature and in the post-absorptive state is known as Basal metabolism.
3. **Specific dynamic action of food:** Food has a stimulating effect on BMR. If a person in post absorptive is given food, the BMR has been found to increase by about 8%. This is known as the Specific Dynamic Action of Food.

4.14 Further Reading

1. Hand book of Food and Nutrition- M. Swaminathan

- Sasmita Mohanty

Lesson - 5

CARBOHYDRATES

5.0 OBJECTIVE :

The objective of the lesson is to know about the classification of carbohydrates, their metabolism and requirements in diet. It further explains about the functions of carbohydrate, digestion and absorption of carbohydrate, its sources and the deficiency and excess in the diet.

STRUCTURE :

5.1 Introduction

Carbohydrates, the most abundant organic compounds in nature are the chief source of energy. Plants produce carbohydrates through a process called "photosynthesis", wherein the chlorophyll of the plant uses sunlight to synthesize carbohydrates from carbon dioxide and water. Carbohydrates are made up of carbon, hydrogen and oxygen. They may be simple sugars of polymers such as starch.

5.2 Classification of Carbohydrates

Carbohydrates are classified into the following categories.

a) Monosaccharide or simple sugar: Compounds with one carbohydrate unit.

b) Disaccharides or double sugar: Compounds with two carbohydrate units.

c) Compounds with more than two carbohydrates units called pollysaccharides

a) **The Monosaccharide** : They are simple carbohydrates that cannot be hydrolyzed into simpler compound. Glucose, fructose and galactose are three nutritionally important carbohydrates in this category. This is the absorbable form of carbohydrate in our body.

i) **Glucose** : It serves as the main source of energy in the body. Glucose is known as grape sugar. Normal human blood contains about 80-100 mg of Glucose per 100ml of blood. The level is maintained constant in healthy subjects. In persons suffering from diabetes mellitus the glucose content of blood increases to high levels. Glucose occurs in the free state in many fruit and in honey. It is a white crystalline substance easily soluble in water with a sweet taste. Glucose is readily absorbed from the stomach. Glucose is the form of carbohydrate circulation in the blood.

ii) **Fructose (fruit sugar)** It occurs in the free state along with glucose in many fruits and in honey. It is sweeter than glucose. Honey is the richest source of Glucose. It is readily utilized by the body as a source of energy.

iii) **Galactose** : It doesn't occur in free state but occurs as a constituent of lactose present in milk. On hydrolysis lactose yields galactose and glucose.

b) The Disaccharides : They are double sugar, on hydrolysis they split into monosaccharide units. Sucrose, maltose and lactose are three nutritionally important disaccharides contained in our food.

i) Sucrose:

It is the white or brown sugar we use everyday. It is also known as invert sugar. Sucrose is simplified into glucose and fructose by hydrolysis or by enzyme action. It is produced from sugarcane and beetroots. Many fruits and vegetables also contain small amount of sucrose.

ii) Maltose or malt sugar:

Maltose contains two molecules of glucose. It doesn't occur in the average diet. It occurs in sprouting grain, malted cereals (barley, jawar, ragi etc.) and malted milk. Among sweetening agents this is found in corn syrup and corn sugar. Starch is converted into maltose before breaking down tnto glucose.

iii) Lactose or Milk sugar:

Lactose contains glucose and galactose It is early digestible and is not as sweet as cane sugar. It occurs in the milk of all mammals but has not so far been found in plant foods.

d) The Polysaccharides :

These are complex carbohydrates with a relatively high molecular weight. They may contain as many as 2000 simple carbohydrate units arranged in long chains of either straight or branched structure. Polysaccharides which are important in nutrition are starch, dextrin, glycogen and cellulose. Starch is the most important carbohydrate in the human diet. Certain varieties of roots, seed and tubers contain starch in abundance. These seeds of plants like corn, millet rice, rye and wheat are richest store houses of starch.

i) Starch :

Plants store carbohydrates in the form of starch. Cereals, grains, seeds, roots like potato, tapioca, yam and plantain contain considerable amount of starch. On cooking starch absorbs water and it swells and ruptures. This thickening quality of starch is used in cookery to

produce variety of dishes. Maize starch and corn flour are better thickening agents than rice or wheat starch. Some starch paste, for e.g. cornstarch become rigid and form a gel when cooled. All starches are broken down to glucose in the digestive system.

ii) Dextrin:

When the starch is partially broken down into fragments either by digestion or by acid they are called dextrin.

iii) Glycogen:

It is known as animal starch as it is in the form animal store carbohydrate in the body. Glycogen is stored in liver and muscles. This is the form of immediate energy for the body.

iv) Cellulose:

It is an insoluble polysaccharide. Cattle can digest cellulose but human cannot. Though it is not of much food value it provides bulk to the diet and helps movements in the large intestines of prevents constipation and to extent cancer of bowel. It reduced cholesterol level in the blood.

5.3 Functions of Carbohydrates

Carbohydrates have variety of functions. The most important of these is to supply energy for the body processes.

1. As a source of energy:

Each gram of carbohydrate when oxidized yields approximately 4 cal. of energy. Some carbohydrates in the form of glucose are used for immediate tissue energy needs. Glucose is the sole form of energy for the brain and nervous tissues.

2. Protein sparing Action :

Carbohydrate is used as a source of energy thus sparing protein for tissue building. The function of carbohydrates spare protein for its primary purpose of body building and repair of tissues is an important one.

3. Regulation of fat metabolism:

For the normal oxidation of fats some carbohydrate is necessary. When carbohydrate is severely restricted in diet, fats will be metabolized faster than the body can take of the intermediate products.

4. Role in gastro Intestinal function:

Carbohydrate serve as a source of energy for the micro-organisms that synthesizes some B-Complex vitamins in the intestinal tract and the cellulose provides fiber and bulk that promote healthy intestinal hygiene.

5. Indispensability for nervous system:

The main source of energy for central nervous system is glucose. Prolonged hypoglycemia can lead to irreversible damage to the brain tissue.

6. Role in muscle:

Carbohydrates are the major source of energy for muscular work. During muscular contraction, glycogen is broken down to lactic acid through glycolysis.

7. Role in liver:

These include detoxifying action and regulating influence of protein and fat metabolism. Liver is rich in glycogen and is more resistant to certain poisons such as carbon tetrachloride,

alcohol, arsenic and toxins of bacteria. The rate of oxidation of amino acids in liver is diminished if abundant supplies of carbohydrates are available.

8. Source of energy for heart muscle:

The heart muscle mainly uses glucose as source of energy. In hypoglycemia a definite adverse change in the working of the heart has been observed.

9. Conversion of fat:

Excess of calories fed in the form of carbohydrate is stored as fat in the adipose tissue. When body is in need of energy it can be released from the adipose tissue.

10. Contribution of dietary fibre:

Dietary fibre gives no nutrients to the body. It stimulates the peristaltic movement. It helps in preventing many degenerative diseases.

5.4 Digestion and Absorption of Carbohydrates:

The first stage in the digestion of the carbohydrates takes place in the mouth when the food is chewed. The saliva contains an alpha-amylase called Ptyalin. This enzyme acts on starch splitting it into dextrin and maltose. As soon as the food reaches the stomach, it mixes with the acidic gastric juice and amylase activity is inhibited.

The digestion of carbohydrates is mainly accomplished in the small intestines where they are subjected to the action of pancreatic amylases and intestinal amylases and intestinal amylase, sucrase, lactase, maltase and isomaltase present in the intestinal juice. The ultimate products of digestion of carbohydrates are glucose, fructose and galactose. These are absorbed in the intestines. The non-digestible carbohydrates present in the food, like cellulose, hemicelluloses, pentosans, galactans, fructosans, etc. are not acted upon by the digestive juices. They add bulk to the contents of large intestines and are excreted I the faeces. Some of these are fermented by bacteria present in the large intestines.

5.5 Metabolism of Carbohydrates:

Glucose, galctose and fructose absorbed in the intestines pass through the portal circulation to the liver. In the liver, a part of the glucose and the entire galactose and fructose are converted into glycogen. A part of the glucose passes into the general circulation and to the various tissues for being oxidized and used as energy. A small part of glucose is stored in liver and muscle as glycogen and some portion of the glucose is converted into fat and stored in adipose tissue.

5.6 Glucose Formation From Non- Carbohydrate Sources:

Glucose can be formed from the metabolism of proteins and from the glycerol of fat. It has been estimated that the glycerol present in 100gm of fat can give rise to 12 g glucose and metabolism of 100g of protein can give rise to 50-60g glucose. Lactate which is formed from glucose can be reconverted into glucose in the liver.

5.7 Sources of Carbohydrates:

The richest sources of Carbohydrates in food are sugars, cereals, grains, legumes and dried fruits. White sugar is almost pure carbohydrates. Some processed foods like noodles, dried non fat milk products, jams, jellies, pastries, breads, cakes and candies have appreciable

quantities of carbohydrates. Bananas, dates, potatoes and sweet potatoes are also rich in carbohydrates.

5.8 Recommended Allowances:

As much as 60% of the total daily calorie needs in a balance diet should be furnished by the carbohydrates.

5.9 Excess

In the fasting state, the blood of normal persons contains about 80mg-100mg of glucose per 100ml. After a meal, the glucose level steadily rises and may reach a level of 130-150mg/ 100ml. If the blood glucose level reaches above 180mg/ 100ml, glucose is excreted in urine. This condition is known as diabetes mellitus.

5.10 Diabetes Mellitus

Diabetes mellitus is a chronic disease in which blood glucose level is raised above 180 mg per 100 ml of blood glucose is excreted in urine. This disease is primarily due to the insufficient production of the hormone insulin by beta cells of the islets of Lager Hans of the pancreas.

5.11 Deficiency

In the absence of adequate carbohydrate large amount of ketone bodies are produced. The accumulation of Ketone bodies increases the acidity of blood. This condition is called as "Ketosis" may result in coma if the alkalinity of blood is reduced considerably. Sucrose"

5.12 Conclusion

The body has a specific need for carbohydrates as a source of energy for the brain and other tissue cells, for the synthesis of lactose of milk and galactose and other sugar present in the cerebrosides etc. Carbohydrate is essential for oxidation of fat, and for the synthesis of certain non-essential amino acids. The carbohydrate calories should be at least 40% in well balanced diets.

5.13 Self Assessment Questions

1. What are the various classifications of carbohydrate?
2. Discuss the various functions of carbohydrate.
3. How does the digestion and absorption of carbohydrates takes place in the body?
4. Mention the various sources of carbohydrates.

5.14 Key Words

1. Diabetes Mellitus: Diabetes mellitus is a chronic disease in which blood glucose level is raised above 180 mg per 100 ml of blood glucose is excreted in urine. This disease is primarily due to the insufficient production of the hormone insulin by beta cells of the islets of Lager Hans of the pancreas.

2. Carbohydrates: Carbohydrates are made up of carbon, hydrogen and oxygen. They may be simple sugars of polymers such as starch.

5.15 Further Readings

1. Hand book of Food and Nutrition- M. Swaminathan
2. Robinson Corrine H ; Normal and Therapeutic Nutrition

- Sasmita Mohanty

Lesson - 6

PROTEIN

6.0 OBJECTIVE :

The objective of this lesson is to study the chemical composition and structure and protein. Further it explains about various amino acid content of the protein, their digestion and absorption, functions and protein metabolism. It also explains about the protein requirement in the body, its deficiency and excess.

STRUCTURE :

6.1 Introduction

Protein is derived from a Greek word "Proteo" meaning " to take first place". A famous Dutch chemist named Mulder proposed use of the term because he believed that proteins were unquestionably the most important of all known substances in the organic kingdom. Proteins constitute about one fifth of the animal body on the fresh weight basis. They are essential for life processes.

6.2 Chemical Composition

All proteins contain carbon, hydrogen and nitrogen. Proteins are large molecules formed from the combination of a number of simpler substances called amino acids. The nitrogen content of proteins varies from about 14 to 20 per cent in most of the proteins, the value is about 16 per cent Vitamins such as thiamine and panthothenic acid combine with protein to form enzymes.

Amino acids are combined in various ways to form different proteins. There are 22 amino acids widely distributed in proteins.

6.3 Structure of Protein

Proteins are large molecules formed by the combination of a number of amino acids. About 21 amino acids have been found to occur in proteins. They are listed below:

1. Monoamino- monocarboxylic acids: These include glycerine, alanine, valine, leucine, isoleucine, norleucine, serine and threonone.
2. Monoamino- dicarboxylic acids: These are aspartic acid and glutamic acid.
3. Diamino-monocarboxylic acids: Arginine and lysine belong to this group.
4. Sulphur containing amino- acids: These are cystine, cysteine and methionine.
5. Aromatic and heterocyclic amino-acids: These include phenylalanine, tyrosine, histidine, tryptophan, praline and hydroxyproline.

The main type of linkage between the amino-acids in the protein molecule is the peptide bond. In this linkage, the carboxyl group of one amino acid reacts with the amino group of another amino acid with the elimination of one molecule of water.

6.4Properties

Proteins are colloids. They act both as weak acids and bases. They are, in general, soluble in sodium hydroxide and when the alkaline solutions of proteins are acidified, the proteins are precipitated. When proteins are acidified, the proteins are precipitated. When proteins are heated, a decrease in their solubility is observed. This is known as denaturation.

6.5 Classification

Proteins may be classified on the basis of their physical and chemical properties, their amino-acids structure or according to their nutritional qualities.

a) Physical and Chemical Properties

1. Simple Proteins: Simple protein consists of amino-acids only. Albumins of egg and globulins of Hemoglobin are examples of simple proteins.
2. Conjugated proteins: They are simple proteins combined with a non-protein substance. Eg. Phospho-proteins, casein in milk, nucleoprotein such as hemoglobin.
3. Derived proteins: These are substances like peptones, peptides and proteoses resulting from the action of enzymes on simple and conjugated protein. E.g. Peptones, poly peptide.

6.6 Amino acids Content of Protein

There are 22 amino acids commonly found in dietary proteins. The body can synthesize only some of these 22 amino acids by mutual interconversions among them. These are called non-essential amino acids. However 10 amino acids cannot be synthesized by the body and these have to be supplied through the diet. These are called as essential amino-acids.

1. Incomplete Proteins: They neither maintain life for support growth. Most vegetables proteins are incomplete.
2. Complete proteins: They maintain life and provide for normal growth. Animal proteins are mostly of this type. E.g. of meat, fish, egg, glycinin in soybeans.
3. Partially complete protein: They maintain life but fail to support normal growth. E.g. Gliadin of wheat prolamin of Rye.

6.7 Digestion and Absorption

The digestion of proteins takes place in the stomach and intestines. As a result of digestion, the proteins are broken down to amino acids and absorbed.

1. Gastric digestion: The proteolytic enzyme present in gastric juice is called pepsin. It acts on proteins in an acid medium and hydrolyses them to simpler compounds known as polypeptides.
2. Intestinal digestion: The digestion of proteins is further carried on in the intestines by the action of proteolytic enzymes present in the pancreatic and intestinal juices. The polypeptides produced by gastric digestion are hydrolyzed to free amino acids by the above enzymes. The amino acids are absorbed in the small intestines and enter the blood circulation through the portal vein.

6.8 Functions of Protein

1. **Maintenance and growth**:
   It is necessary for tissue synthesis as it is the chief solid matter of all body tissues. So the most important function is to supply the materials for the building and the continuous replacement of the cell protein throughout life.
2. **Regulation of body processes**:
   Many body processes are regulated by certain proteins. Hemoglobin, an iron bearing protein that is the chief constituent of RBC, performs a vital role in carrying oxygen to the tissues. The body's resistance to disease is maintained in part by antibodies which are protein in nature. Some enzymes and hormones like insulin and thyroid are also protein in nature.
3. **Protein as source of energy**:
   Protein yield 4 calories per gram if oxidized in the body to provide energy. It helps in building and repairing body tissues. Excess of Protein is converted into fat and stored in the body.
4. **Transport of nutrients**:
   Proteins play an essential role in the transport of nutrients from the intestine across the intestinal wall to the blood, from the blood to the tissues of the body and across the membranes of the cells of the tissues.
5. **Regulation of water balance**:
   Fluid in the body distributed in intercellular compartments. The extra cellular is divided into the intercellular and intravascular compartments. The balance between the compartments is achieved by dissolved proteins and dissolved ions primarily sodium and potassium ions. Protein molecules in the blood that are too large to pass out of the blood into the intercellular space exert an oncotic pressure, drawing water from the

intercellular space back onto the blood. A hydrostatic pressure, pushing fluid in the opposite direction out of the blood and into the intercellular space is also always present because of the pumping action of the heart. When the level of protein in the blood is low, the hydrostatic pressure dominates and pushes fluid out of the blood. This causes accumulation of fluid within the tissues resulting in oedema.

6. **Defense and detoxification:**
The body's ability to fight off infection depends on its immune system which has defensive proteins known as antibodies. Specific anti body is required for specific antigen. Whenever required, the body produces antibodies quickly.

6.9 Protein Metabolism:

The metabolism of protein may be conveniently discussed under the following heads.

1) Breakdown and synthesis of tissue proteins
2) Nitrogen Balance
3) Oxidation of amino acids

1. **Breakdown and synthesis of tissue proteins:** Recent studies have shown that breakdown and synthesis of tissue proteins proceed simultaneously. A part of the tissue proteins is broken down continuously and is replaced by the formation of new tissue proteins from the amino acids supplied by the diet. The breakdown of tissue proteins is called catabolism and the formation of new tissue proteins is called anabolism.
2. **Nitrogen balance:** When a subject is on a protein- free diet, the tissue proteins are broken down and the resulting amino acids are oxidized and the nitrogen is excreted in urine. The nitrogen lost in urine and faeces on a protein free diet is called endogenous nitrogen, i.e. derived from the body.

6.10 Complementary Value of Proteins:

If the protein of the diet is seriously deficient in one or more of the essential amino acids, nitrogen equilibrium cannot be sustained, no matter how complete and excellent the diet may be in other respects. If, however another protein containing the missing amino acid in adequate amounts is added to the diet, nitrogen equilibrium and normal nutrition can be established. This capacity of proteins to make good one another's deficiencies is known as their complementary or supplementary value. Lappe, 1971, described methods to ensure that vegetable proteins with different chemical scores complement each other to provide complete proteins.

Combinations of foods to improve quality of protein

Excellent Combination	Example
Cereals + legumes	Idli, dosa, khichidi, chapatti
Cereals + milk and milk products	Payasam, paneer pulao, cheese sandwich, curd rice, pasta and cheese
Legumes + nuts and oil seeds	Gingelly seeds or groundnut or coconut chutney with roasted Bengal gram dal.

6.11 Sources of Protein:

Meats, fish and poultry, and baked beans are excellent sources of proteins. Other good sources of Proteins are foods like milk, cheese, eggs, soybeans and sausages. Peanuts, green beans, green peas, legumes different types of pulses and cereals contribute an appreciable amount of protein by virtue of the amounts that are consumed in a day. Foods like potatoes, vegetables, fruits and fruit juices, fats and oils, sugar and jaggery contribute a very merge percentage of proteins for the daily diets.

6.12 Dietary Requirements:

The ICMR(Indian Council of Medical Research) has recommended 1.0 gm of protein per kg of body weight for a healthy adult.

6.13 Deficiency of Protein

1. Shortage of Proteins leads to retardation of growth and in extreme cases failure of growth. This is manifested as Marasmus Kwashiorkor among infant and children. The important symptoms of the disease are growth failure, Oedema, muscle wasting, fatty liver, loss of appetite and diarrhoea, changes in skin and color of hair and anemia
2. Protein deficiency affects the intestinal mucosa, this results in failure to digest and absorb the food, consequently leading to diarrhoea.
3. The normal structure and function of liver is disturbed leading to fat accumulation and fatty livers thus leading to Oedema.
4. Muscle wasting and anemia due to shortage of hemoglobin
5. In case there is a deficiency of Protein in early life, the possibility of Mental malfunction increases

Left : A child suffering from kwasahiorkor showing oedema of legs, ahand and crazy pavement dermatosis.

Right : Same child after treatment with processed protein food.

6.14 Conclusion

Dietary protein performs all three functions of nutrients. It is needed for growth, maintenance and repair of body tissue; it regulates key processes with in the body and any excess protein can be used as source of energy. Proteins furnish 10-12 per cent of the calories required daily. However the major part of proteins is essentially for body building purposes only.

6.15 Self Assessment Questions

1. Give the classification of proteins
2. Discuss the functions of proteins.
3. What is the complementary value of proteins? How can you achieve this through diet?
4. Write the deficiency of protein

6.16 Key Words

1. Simple protein: Albumins, globulins, glutelins
2. Conjugated protein: nucleoproteins, glycoproteins
3. Derived proteins: proteans, metaproteins, coagulated proteins, peptoned and peptides

6.17 Further Reading

1. Nutrition science by B. Srilakshmi
2. Hand book of food and nutrition by M. Swaminathan

- Sasmita Mohanty

Lesson - 7

LIPIDS

7.0 OBJECTIVE :

The objective of the lesson is to explain about the various classifications of lipids, chemical composition, fats in body and fats in food. It further describes the role of fats in body function, its digestion and absorption, essential fatty acids and deficiency in the diet.

STRUCTURE :

7.1 Introduction

The term Lipids is applied to a group of naturally occurring substances characterized by their insolubility in water, greasy feel and solubility in some organic solvents. Lipids are organic compounds which are made of carbon, hydrogen and oxygen. Besides these essential components, certain other elements like phosphorus and nitrogen may be present. They occur in plant and animal kingdom. The word lipid is used when discussing the metabolism of fats in the body whereas the term fat is used the fatty component of foods and diets

7.2 Chemical Composition

1. Triglycerides: Trigkycerdides or triacylglycerols are the main form of fats both in foodstuffs and in the storage depots of most animals. There are asters of glycerol and fatty acids.
2. Three classes of fatty acids are described according to the number of double bonds between the carbon atoms. In a saturated fatty acid there may be one or two or more double bonds.
3. The unsaturated fatty acids found in both plants and animals are in the cis form. Trans forms are not incorporated into structural lipids and cannot function as essential fatty acids, but they are oxidized and serve as fuels for the tissues.

7.3 Classification of Lipids

Lipids may be classified as follows:

a) Simple lipids (Oils and Fats): These are ester of fatty acids and glycerol.

b) Compound Lipids: The compound lipid contain in addition to fatty acids and glycerol, some other organic compounds.

i) Phospholipids: These contain phosphoric acid and a nitrogenous base in addition to fatty acids and glycerol.

ii) Glycolipids: Complex lipids containing carbohydrates in combination with fatty acids and alcohols.

c) Derived Lipids: These include sterols, fatty acids and alcohols.

7.4 Fats in the Body

What is Specific Dynamic Action of food?

1.Phosphplipids

As the name implies, lipids belonging to this class contain phosphate as a common component. They also posses one or more fatty acid residues. Phospholipids are categorized into one of two groups called glycerophosphatides and sphingophosphattides, depending on whether their core structure is glycerol or the amino alcohol sphingosine respectively.

a.Glycerophosphatides:

The building block is phosphatidic acid. Phosphatidic acids from a number of derivatives with compounds such as choline, ethanolamine, serine and inositol.

b.Sphingophosphatides:

Are sphingophosphatides occur in plasma membranes of animal cells are found in particularly large amounts in the amide linkage to the amino group of the sphingosine.

2.Cholesterol:

It occurs in free state and as a asters with fatty acids. Sterols are classified as:

a. Animal sterols e.g. cholesterol, b. Plant sterols e.g. phytosterol c. Mycosterol e.g. ergosterol.

Cholesterol occurs in all animal and human tissues. The white matter of the brain contains about 14 percent Cholesterol are also present in sebum secreted by the sebaceous glands.

Cholesterol serves as a precursor for the formation of bile acids. It is present in cell membranes and essential for maintaining the membranes in good conditions. It serves as a precursor for the formation of some steroid hormones such as oestrogens, androgens and progesterone. It is also essential for the synthesis of adrenocortical hormones. It is present in large amounts in the nervous tissue.

3.Ketone bodies:

In normal human subjects, the degradation of fatty acids to acetyl and the oxidation of acetyl and water take place without appreciable accumulation of the intermediate products. Ketosis is a condition in which large amounts of ketone bodies are produced in the liver and circulate in blood when the diet contains less than 100 gm of carbohydrates.

4.Brown adipose tissue:

It is involved in metabolism particularly at times when heat generation is necessary. It is active in normal human beings but absent from the obese. In most new born mammals, brown adipose tissue is responsible tissue is responsible for controlling body temperature in a cold weather.

7.5 Fats in Food

1. Isoprenoids: These are activated derivatives of isoprene, are an extraordinarily large and diverse groups of lipids built from one or more five- carbon units. As a group, isoprenoids include essential oils of plants: turpentine from trees and limonene from lemons. This group contains lycopene (red pigment in tomatoes) carotenoids (yellow and orange pigment in pumpkins)

2.Visible and invisible fats Visible fats are mainly triacylglycerols. Hidden fats, present in the membranes of plant and amimal tissues are mainly phospholipids, glycolipids and cholesterol. Products like butter, ghee, vanaspati and various edible oils such as gingelly oil or groundnut oil are visible fats.

3. Animal Fat :Butter and lard from pig, beef, sheep etc.

4.Vegetable fat : Cotton seeds, corn, soybeans, peanuts, olives, sunflower

7.6 Functions of Fat

1. Fats are richest source of energy yielding more than twice the energy supplied by carbohydrate per unit weight.
2. The layer of fat just under the skin helps in maintaining the body temperature. Losses of body height are presented with the help of this subcutaneous layer of fat.
3. Vital organ s like kidneys have a thin layer of fat around them which protects them from shocks and physical injury.
4. Fats help in lubricating the gastrointestinal tract and a diet rich in fat has a higher satiety value.
5. Some of the fat soluble vitamins like A, D, E & K needs fats for their proper utilization in the body. The body suffer from deficiency of these vitamins if enough fat is not present in the diet.

7.7 Digestion and Absorption

The digestion of fat in initiated by the lingual lipase enzyme. This enzyme mixes with chewed food and hydrolyses fatty acids from triglycerides to form diglycerides as the food travels down the oesophagus to the stomach. After entering the stomach, the gastric lipase too hydrolyses short and medium chain triglycerides more quickly than it does long chain triglycerides.

From the stomach the food mass passes into the small intestine, where the presence of fat stimulates the release of the hormones cholecystokinin and secritin. These hormones in turn stimulates the secretion of pancreatic juice from the pancreas and release of bile, which is synthesizes in the liver and stored in and released from the gallbladder. As the food mass mixes with bile, the lipid becomes bound within emulsified droplets that are coated in bile salts and bile phospholipids. Pancreatic juice is secreted and it raises the pH value from 5.6.6.5 in which pancreatic lipase becomes active. Once absorbed into the intestinal cell, the longer chain fatty acids and monoglycerides and are combined back in the intestinal lumen.

7.8 Sources

Fats are obtained from vegetables as well as animal sources.

Vegetable source:

Some seeds like mustard and sesame are rich in oils which can be extracted from them. Nuts like peanuts, coconut and almonds also contain a considerable amount of fat

Animal source:

Milk, egg yolk and animal fat like butter, lard are some of the fats of animal origin.

7.9: Daily Allowances

According to the balanced diets studies by ICMR, 30% of the daily calorie needs are met by the fats.

7.10: Deficiency of Fats

Deficient fat diet cause perennial irritation and skin changes such as dryness. Lack of energy, this leads to underweight, tiredness and reduced working efficiency.

7.11: Excess of Fats in Diet

1. Obesity
2. Digestive disturbances particularly in children
3. Accumulation of excessive amounts of cholesterol in the gall bladder may cause stones in the gall bladder.
4. In diabetic patient, consumption of excess fat may produce excessive amount of acetone bodies which may lead to serious consequences like acidosis and coma, resulting in death.

7.12 Mono Saturated Fatty Acid

MUFA are better replacement of saturated fatty acids than polyunsaturated fatty acids because they are less susceptible to oxidation. Olive oil extensively used in the Mediterranean region in rich in monosaturated.

7.13 Poly Saturated Fatty Acid (PUFA)

The very low prevalence of CHD (Coronary heart disease) among Eskimos in spite of high fat diet has drawn the attention of researchers from the early days of systematic epidemiologic studies. Experimental studies revealed that excess intake of n-6 PUFA is associated with increase in insulin resistance in muscles, adipose tissue and liver. Linoleic acid, the principal n-6 PUFA in vegetable oils (corn safflower, sunflower, peanuts and sesame) is converted into arachidonic acid which is utilized as a constituent of cell membranes.

7.14 Rancidity

The development of off-flavor in fats is known as rancidity. There are two main types of rancidity.

a.Hydrolytic rancidity:

When fat is hydrolyzed by lipase, free fatty acids are formed. The odours of low molecular weight fatty acids contribute to the rancidity.

b.Oxidative rancidity:

The oxidation takes place at the unsaturated linkage. The addition of oxygen to the unsaturated linkage results in the formation of peroxide which, on decomposition, yields aldehydes and ketones having pronounced off-odour.

7.15 Hydrogenation

During the process of hydrogenation, hydrogen is added to the unsaturated linkages. The liquid fat becomes a solid fat and the unsaturated fatty acid contents decrease as a result of hydrogenation has helped to alleviate the shortage of solid fat in the world food market. By means of this process, a hardened fat product can be matured that will meet the needs, when the climate imposes.

7.16 Conclusion

Oils and fats include vegetable oils, animal fats and manufactured fats used in human dietary. They are composed of carbon, hydrogen and oxygen, they are built by linking fatty acids and glycerol.

7.18 Key Words

1. **Hydrogenation**

Hydrogen is added to the unsaturated linkages. The liquid fat becomes a solid fat and the unsaturated fatty acid contents decrease as a result of hydrogenation has helped to alleviate the shortage of solid fat in the world food market. By means of this process, a hardened fat product can be matured that will meet the needs, when the climate imposes.

2. **Rancidity:** The development of off-flavor in fats is known as rancidity.

7.17 Self Assessment Questions

1. Explain the function of fats.
2. How are fat digested and absorbed
3. Give the sources of fats
4. What happens when there is excess of fat in the body?

7.19 Further Reading

1. Nutrition Science- B. Srilakshmi
2. Hand book of Food and Nutrition- M. Swaminathan

- Sasmita Mohanty

Lesson - 8

FAT SOLUBLE VITAMINS

8.0 OBJECTIVE :

The objective of this lesson is to explain the various functions of fat soluble vitamins, food sources, daily requirements and effects of the deficiency of vitamin.

STRUCTURE :

8.1 Introduction

Apart from protein, carbohydrates and fats there are certain other substances present in minute amounts in most food stuffs and are necessary for growth and health. They are called vitamins.

Vitamins are defined as organic compounds occurring in small quantities in the different natural food and necessary for growth and maintenance of good health in human beings.

Vitamins are necessary for metabolic reactions in the body. Vitamins are generally classified into fat soluble and water soluble ones. Fat soluble vitamins i.e. vitamins soluble in fats and fat solvents but insoluble in water. Water soluble vitamins i.e. vitamins soluble in water but insoluble in fats or fat solvents.

8.2 Vitamin A:

Vitamin A was discovered in the early nineteenth century by Dr. E. Mc McCollum and Davis observed that a fat soluble substance was necessary for the growth of animals. Its chemical name is retinol. Vitamin A occurs only in foods of animal origin. It occurs naturally in most animal fats.

8.3 Composition:

It consists of carbon, hydrogen and oxygen. It is a yellow crystalline substance and occurs in many forms. It occurs in the acid form as retinoic acid, in the alcohol form, in the aldehyde form. Carotenes are the ultimate source of all vitamin A. Vitamin A does not dissolve in water but it is fat soluble. It doesn't get destroyed at ordinary levels of heat.

i) Vitamin A_2- Vitamin A_2 occurs in the livers of fresh water fish. It differs from vitamin A in having one more double bond.

ii) Vitamin A aldehyde (Retinal, Retinene) - Vitamin A aldehyde occurs in the rod and cones in the retina of the eyes.

8.4 Functions

1. Vitamin A & Vision- Vitamin A is essential for vision in dim light. Vitamin A deficient subjects cannot see objects in dim light.

2. Vitamin A and epithelial tissue- In vitamin A deficiency the epithelial tissues are Keratinized. The tissues affected are salivary gland, respiratory tract, eyes, skin and sex organs.

3. Vitamin A and bone: Vitamin A is essential for proper growth and normal skeletal development of the body. It is essential for healthy teeth structure and the proper activity of the sweat glands.

8.5 Absorption, Transport and Metabolism

Retinol and retinyl esters account for virtually all of the performed vitamin A available in the diet obtained exclusively from foods of animal origin. Retinol can be absorbed from food directly into the intestinal wall cells. Before retinyl esters can be absorbed, they must first be hydrolyzed to free retinal and an organic acid. This hydrolysis is catalyzed by enzymes within pancreatic juice and the organic acid released is usually palmitic acid because retinyl palmitate is the predominant retinyl ester within food absorbed vitamin A in the form of retinal, retinyl esters or the retinal is transported from intestine within chylomicrons. The chylomicrons are released are released into the lymphatic system, which transports them to the blood. Most of the retinal and retinyl esters are transported to the liver and some enter adipose tissue and other tissues. When vitamin A is required by the rest of the body, it is released from the liver and transported to target tissues in the form of retinal.

8.6 Sources of Vitamin A

Vitamin A is present in animal foods like butter, ghee, whole milk, curd, egg yolk and liver, cod liver oil. Leafy vegetables such as spinach, amaranth, coriander leaves, curry leaves, drumsticks, ripe fruits such as mangoes, papaya and tomatoes are rich in carotene. Carrots and yellow pumpkin are also good sources.

8.7 Deficiency

1. Night blindness: In advanced deficiency, the subjects cannot see objects in dim light. Difficulty in reading in dim light is experienced.

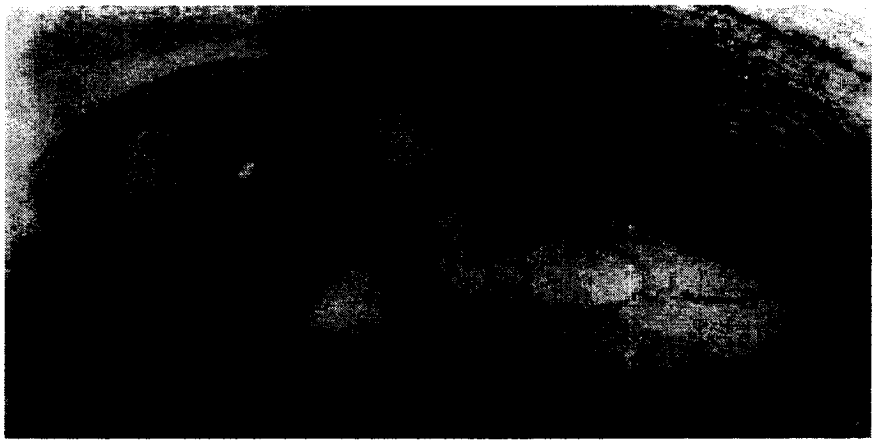
2. Xerosis conjunctivae- The conjunctivae are dry, thickened, wrinkled and pigmented. This is due to the Keratinisation of the epithelial cells. The pigmentation gives the conjunctiva a smoky appearance.

3. Xerosis Cornea: When dryness spreads to cornea, it takes on a dull, hazy and lusterless appearance.

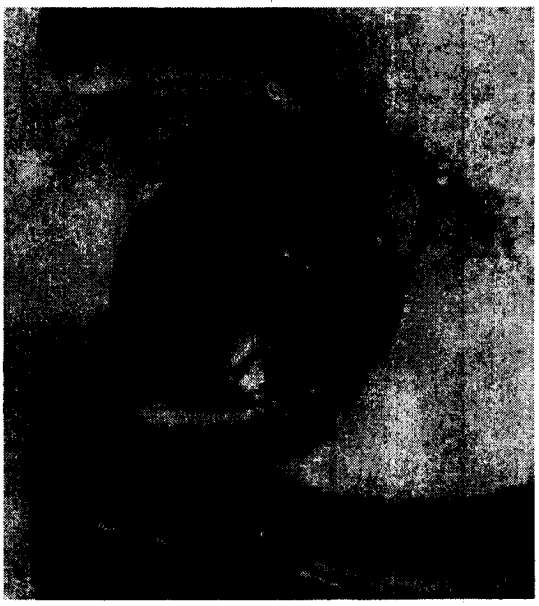
4. Keratomalacia: When Xerosis of the conjunctivae and cornea is not treated, it may develop into the condition known as Keratomalacia. The corneal epithelium becomes opaque and ulceration and bacterial invasion of the cornea bring about its destruction resulting in blindness.

5. Bitot's spot: Grayish or glistening white plaques formed of thickened conjunctival epithelium, usually triangular in shape and firmly adhering to the conjunctiva are frequently found in children.

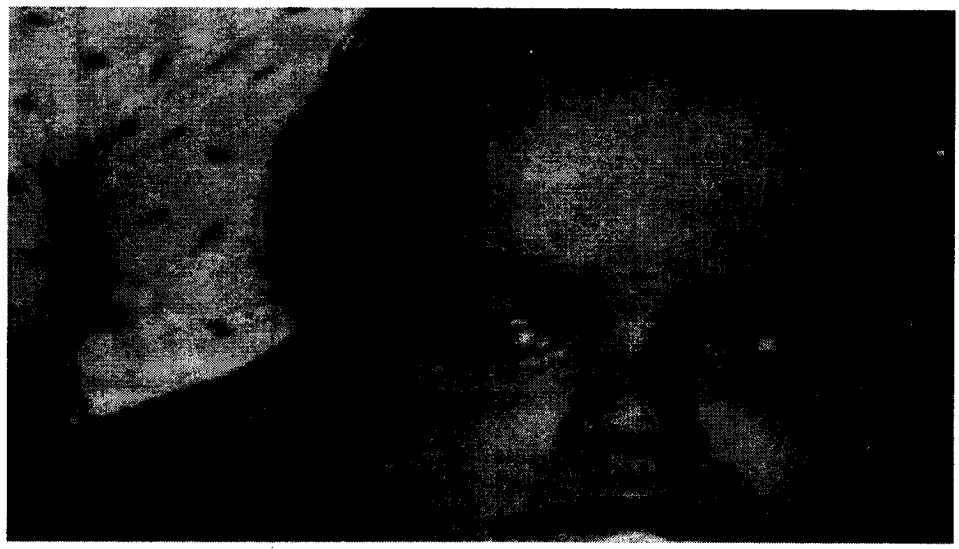
6. Follicular hyperkeratosis: These include dryness, wrinkle slate gray discoloration and thickening of the other layer. The hair may loose lusture.The skin becomes rough and dry and papules of various sizes are observed.



Bitot'sa Spot



Keratomalacia.



Both eyes blind due to Vitamin A deficiency.

8.8 Effect of Processing, Cooking and Storage

Minimal losses in ß- carotene occur when vegetables are washed before cutting. Approximately, 30-40 percent loss of ß- carotene occurs during cooking process. Steaming/ pressure-cooking retains more ß carotene in foods than cooking without lid. The use of microwave oven for cooking is nor superior to pressure-cooking for retaining ß- carotene in foods. Cooking green also with tomato help in better retention of ß- carotene because of the protection from lycopene. Cooking with lid is advisable for better retention of vitamin A activity in foods.

8.9 Excess :

Excess intake of vitamin A causes many disorders like the skin becomes scaly and rough. The bone becomes soft and fragile.

8.10 Recommended Dietary Allowances

ICMR recommended Dietary allowance of retinal and ß- carotene

Group	Retinol	ß- carotene
Man	600	2400
Woman	600	2400
Pregnant woman	600	2400
Lactation	950	3800
Infants	350	1400
Children		
1-6 years	400	1600
7-9 years	600	2400
Boys and girls		

VITAMIN D

Mellanby in 1919, discovered that cord liver oil can cure or prevent experimentally produced rickets in dogs. Reerink and Van Wijk in 1931, isolated a crystalline vitamin D preparation from activated ergosterol. Schenck in 1937, obtained a crystalline vitamin D preparation from activated 7- dehydrocholesterol.

Composition:

Vitamin D is a compound of carbon, hydrogen and oxygen. It is odourless and soluble in fat but insoluble in water. Vitamin D exists in two forms, Vitamin D_3 of the animal origin and Vitamin D_2 of plant origin.

Functions:

1. Vitamins D is required for normal growth in mammals.
2. It promotes the absorption of calcium and phosphorus from the small intestines.
3. It acts in some more direct manner on the bones promoting calcification.

Absorption, transportation and metabolism

Dietary vitamin is absorbed from jejunum with the aid of bile salts and is incorporated within chylomicrons, which take it through the lymph and then into the blood. An average of 80 percent of dietary vitamin D is absorbed by both infants and adults. On release from lymph into the blood the vitamin D is removed from the chylomicrons and becomed bound to specific vitamin D binding protein, called alpha globulin and gets transported to liver.

Sources

Food sources rich in Vitamin D include liver oils, egg yolk, milk and milk fat, butter, ghee. Exposure to sunlight provides a cheap way of permitting the production of vitamin D in the body itself.

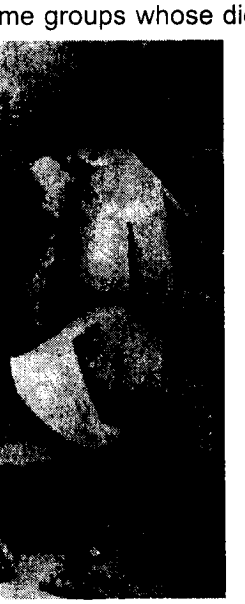
Deficiency

1.Rickets: The disease is characterized by bone deformities. The early signs are the formation of small round unossified areas in the bones of the skull and a beading of the osteochondal junctions of ribs. Later features are the development of bone deformities such as pigeon breast, bow legs and knock knees.

2.Osteomalacia: It occurs generally in pregnant women of low income groups whose diets are

A child suffering from rickets showing marked bony deformities.

A case of advanced Osteomalaciaa showing marked deformities affecting the spine, pelavis and lower extermities.



lacking in vitamin D. Bone deformities due to the weight of the body occur in pelvis, legs and ribs.

Excess

Vitamin D in excess produces toxic symptoms. These include loss of appetite, nausea, vomiting and calcification of soft tissues such as arteries, kidneys and lungs.

Recommended allowances

Vitamin D is now considered more as a prohormone than a vitamin. It can be synthesized in the body in adequate amounts by simple exposure to sunlight even for 5 mts per day. A specific recommendation of a daily supplement of 400 µg is made by ICMR.

VITAMIN E

Vitamin E was first recognized in1922 by Evans and Bishop as a dietary factor obtained from plant based foods that were essential for normal reproduction of rats.In 1933 it was identified as essential for humans and found to compromise a range of substances known as tocopherols and tocotrienols. Vitamin E is essential for normal reproduction in animal and man.

Composition

They are soluble in fats and fat solvents and insoluble in water. They are destroyed by oxidation. Vitamin E is a generic term that includes all compounds that exibit the biological compounds that exhibit the biological activity of ?- tocopherol. Eight compounds with vitamin E activity are found in nature, four are tocopherols and the other four are tocotrienols. The various forms of vitamin E differ only slightly from one another. These slight chemical differences make differences in biological activity? tocopherol is the most active form. Much of vitamin E used in supplements is naturally occurring a-tocopherol concentrated from vegetable oils.

Functions

1. It prevents per oxidation of polysaturated fatty acids in tissues and cell membranes.
2. It protects Red Blood Corpuscles cells from haemolysis by oxidizing agents.
3. It offers protection to liver injury caused by carbon tetrachloride poisoning.
4. The main function of Vitamin E within the body is to act as an antioxidant.
5. A WHO study found that improved vitamin E status was strongly correlated with reduced death rates from coronary vascular diseases.

Absorption and metabolism.

Absorption of vitamin E is similar to that of the other fat soluble vitamins. Absorption is facilitated by bile salts. Tocopherol predominantly enters blood via lymph, in which it is associated with chylomicrons and very low density lipoproteins. When vitamin E reaches the blood plasma, it becomes associated with lipoproteins LDL. It is exchanged rapidly between the LDL particles and lipid membranes, especially the membranes of red blood cells. Although most tissues store vitamin E, adipose tissue is the site of maximal vitamin E storage.

Deficiency

1. Vitamin E deficiency results in increased haemolysis of Red blood cells leading to Hemolytic anemia.

2. In some species of animals vitamin E deficiency is known to cause reproductive failure
3. Muscular dystrophy.
4. A pure form of vitamin E deficiency in humans is caused by an inborn error of metabolism known as isolated vitamin E deficiency. This produces neurological disorders similar to those found in people with vitamin E deficiency for other reasons, such as impaired absorption of fat.
5. Defective functioning of the retina of the eye (retinopathy), which can often cause permanent blindness is a danger in premature infants.
6. Vitamin E deficiency in children with severe liver disease or cystic fibrosis of the pancreas has been associated with increased aggregation of platelets in the blood.

Sources

Cereal germ oils i.e. wheat germ oil and corn germ oil are the richest natural sources. Vegetables and fats are also good sources.

Recommended dietary allowances

The requirement of vitamin E suggested by ICMR is 0.8 mg/g of essential fatty acid

VITAMIN K

Vitamin K was first discovered in 1934 by a Danish scientist named Dam. He found that bleeding in chickens can be prevented by giving lucerene and decayed fish meal. The active principle in these materials could be extracted with ether and thus a new fat soluble vitamin was discovered. Dam named it vitaminK (Koagulation vitamin) and isolated it in 1939 along with Swiss chemist Karrer and his colleagues.

Composition

The vitamin, a napthoquinone exists in nature in two forms. Vitamin K_1 originally isolated form Lucerne, occurs in plants as phylloquinone or phytylmenaquinone. Vitamin K_2 originally isolated from putrid fish meal is one of a family of homologous produced by bacteria, with 4 to 13 isoprenyl units. Menadione is synthetic vitamin K_3.

Functions

1. The only known function of vitamin K is its use by the liver in the synthesis of various substances needed for blood clotting. Vitamin K appears to be necessary to catalyse the conversion of the pprecursor of prothrombin to prothrombin in the liver; it does this by helping to convert the glutamic acid of the protein to a new amini acid, gamma-carboxyglutamate acid. In turn, prothrombin in the blood catalyses the conversion of fibrinogen, another factor involved in blood coagulation, into fibrin. Prothrombin levels in blood determine the rate at which the blood will clot. For blood to clot, fibrinogen, a soluble protein must be converted into fibrin Thrombin catalyses the proteolysis of fibrinogen to yield fibrin.

Absorption

The absorption of vitamin K is affected by the same factors as those that affect fat absorption. Absorption from the intestine into the lymphatic system requires bile and pancreatic secretions. The absorption efficiency of vitamin K ranges from 40% to 70%. An obstruction of the bile duct,

which limits the secretion of fat emulsifying bile salts, reduces absorption of vitamin K. Fat soluble forms of vitamin K are excreted in both the bile and urine, where as water soluble forms are excreted rapidly, primarily in urine.

Deficiency

1. Inadequate intake of vitamin K : Inadequate intake of Vitamin K by mother may cause the hemorrhagic disease of the new born. The infants have a low prothrombin level and they recover rapidly when Vitamin K is administered by injection.

2. Inadequate intestinal absorption: Inadequate intestinal absorption of Vitamin K may result from :

a) Lack of bile in the intestine due to defective secretion of bile as in liver disorders.

b) Pyloric or intestinal obstructions

c) Poor absorption due to diarhhoea or dysentery.

Sources

Vitamin K mainly occurs in plants. Green leaves of plants such as spinach and also cabbage, cauliflower, soybean and vegetable oils are good sources of Vitamin K. Alfalfa is a specially rich source. Pork liver is also good source of Vitamin K.

Recommended Dietary allowances

The ICMR committee considered that no recommendation need be made for this vitamin, since deficiency in India is seen only occasionally in premature newborn infants. A dose of 0.5-1.0 mg of vitamin K administered by the intramuscular route to deficient infants is suggested.

8.11 Conclusion

People living in high altitudes and cold regions also have increased vitamin requirements. Daily diet should provide required amounts of vitamins ans minerals. Inadequate intake causes deficiency diseases. Excessive intake of vitamins has toxic effects on the body.

8.12 Key Words

Night blindness: In advanced deficiency, the subjects cannot see objects in dim light. Difficulty in reading in dim light is experienced.

Rickets : The disease is characterised by bone deformities, such as bowed legs, beaded ribs, enlarged joints and skull deformation. The teeth of the children may fail to develop normally because of poor calcification and may have pits and cracks which render them prone to decay.

8.13 Self Assessment Questions

1. Discuss the functions of vitamin A
2. Name 5 best sources of vitamin A
3. Explain the deficiency of vitamin A
4. Explain deficiency of vitamin D in children and adults.
5. Discuss the metabolism of vitamin D

6. Give the deficiency vitamin E
7. Give the important sources of vitamin E and K.

8.14 Further Readings

1. Nutrition Science- B. Srilakshmi
2. Hand book of Food and Nutrition- M. Swaminathan

- Sasmita Mohanty

Lesson - 9

FAT SOLUBLE VITAMINS

9.0 OBJECTIVE :

The objective of this lesson is to explain the various functions of water soluble vitamins, food sources, daily requirements and effects of the deficiency of vitamin.

STRUCTURE :

9.1 Introduction

The discoveries of the water soluble vitamins began at the turn of the last century with the recognition by Christian Eijkman, a Dutch physician of Java. He observed neurological abnormalities in chickens which were fed on a highly polished rice diet which disappeared on feeding bran. That discovery revolutionized the physiology of the day- giving birth to the field of nutrition

Water-soluble vitamins include vitamin B-complex and vitamin C. B complex include Vitamin B_1, riboflavin, niacin, pyridoxine, panthothenic acid, folic acid, biotin, choline, p-amino benzoic acid, inositol and vitamin B_{12}. They are soluble in water but insoluble in fats or fat solvents.

Vitamins are necessary for metabolic reactions in the body. Vitamins are generally

9.2 Vitamins

9.2.1 Thiamin

Introduction: Thiamin also known as B_1 is widely known for its role in preventing the deficiency disease beriberi. The Philippino word beriberi means" I can't, I can't" and probably refers to the lack of neuromotor coordination in persons with the disease. The countries most affected by the disease were those in which cereals, such as rice, provided as much as 80 per cent of energy in diet.

In1855, Takaki had cured beriberi in the Japanese navy by using meat and milk to supplement the men's regular diet. Physicians in Philippines and Indonesia recognized that consuming the rice bran extract brought about full recovery. It became obvious that a deficiency of some substance within rice bran which was removed during milling, was the cause of beriberi. In 1936 the chemical structure of thiamin was fully established and chemists learned how to synthesize it.

Chemistry and Properties: Thiamine contains a pyrimidine ring and thiazole ring. It is readily soluble in water and slightly soluble in alcohol. It is stable in acid medium. It is destroyed when a neutral solution of thiamine is autoclaved at 20° C for 30 minutes. It is destroyed even at room temperature in alkaline medium.

Functions

1. Thiamine pyrophosphate plays an important part in carbohydrate metabolism. It is essential for the oxidation of pyruvic acid which is an intermediate product in carbohydrate metabolism
2. It is essential to maintain the nerves in healthy condition.
3. Thiamin is also known to be involved in the conversion of the amino acid tryptophan to the vitamin niacin and the metabolism of the branched- chain amino acids leucine, isoleucine and valine.

Absorption and Metabolism: Most absorption of thiamin occurs in the jejunum and ileum of the small intestine. If only small amounts of thiamin are consumed, the vitamin is absorbed by a sodium dependant active transport mechanism. If large amounts are consumed, passive diffusion can account for a substantial proportion of the absorption.

The body contains no specific storage site for thiamin, but the normal levels in the muscles, brain, liver and kidneys can be doubled by thiamin therapy. Thiamin is excreted from the body as thiamin-acetic and as various other metabolites produced by its degradation.

Sources

1. Rich sources: Dried yeast, rice polishing and wheat germ
2. Good sources: Whole cereals, legumes, oilseeds and buts are good sources
3. Fair sources: Milled cereals, vegetables, fruits, milk, meat and fish.

Deficiency: Thiamine deficiency causes the disease 'beriberi' in human beings. Two forms of beriberi namely, 1) wet beriberi and 2) Dry beriberi occur in adults. Another form of beriberi which affects infants is called infantile beriberi.

1. **Loss of Appetite or Anorexia**: This is accompanied by vomiting and it is first sign of thiamin deficiency. Increased intake of thiamin restores the appetite but it doesn't stimulate appetite beyond a normal level.
2. **Decreased Muscle tone:** In the wall of the gastrointestinal tract, decreased muscle tone results in decreased gastric motility, a distended colon and constipation
3. **Mental Depression and Confusion:** Thiamin is called morale vitamin. Deficiency causes mood changes, vague feelings of uneasiness, fear, disorderly thinking and other signs of mental depression, instability, fatigue and headache. Thiamine excreted in urine drops dramatically. The most acute symptom of thiamine deficiency is the mental confusion that precedes coma.
4. **Neurological Changes:** Thiamin levels in the brain can be reduced by 50 per cent without any noticeable symptoms. Severe disturbance of posture and equilibrium occur, and neuro muscular coordination in general becomes impaired leading to deterioration in speed of movements and hand eye coordination.
5. **Infantile Beriberi:** It occurs in infants between 2 and 5 months of age. The affected baby develops cyanosis, in which the lack of oxygen or accumulation of carbon dioxide in the blood causes the skin to turn blue, tachcardia and loud, piercing cry that changes to a thin, weak and almost inaudible one. The symptoms are sometimes accompanied by vomiting and convulsions. The early symptoms are restlessness, sleeplessness and loss of appetite. Palpitation and breathlessness and loss of appetite develop, as the disease advances, due to the enlargement of the heart.
6. **Wet Beriberi:** Oriental beriberi is usually caused by eating diets in which most of the calories are derived from polished, highly milled rice. The disorder is often precipitated by infections, hard physical labour or pregnancy and lactation. The symptoms includes oedema in the legs, enlargement of the heart and palpitation and breathlessness
7. **Dry Beriberi:** This is essentially a peripheral neuropathy. The sings and symptoms are loss of appetite, tingling and numbness of the legs and hands, wasting of muscle and difficulty in walking.
8. **Wernicke's Encephalopathy:** This cerebral form of thiamin deficiency often presents acutely usually in an alcoholic. The patient is quite confused, symmetrical opthalmoplegia- paralysis of eye muscles. If it is not treated, it can lead to death.

Treatment: Treatment of thiamin deficiency is simple and the response is dramatic. It can be treated by 10-20 mg of thiamin given parenterally twice or thrice a day. Chronic beriberi requires prolonged therapy.

Recommended dietary allowance : Nutrition Expert group of ICMR suggested an allowance of 0.5 mg per 1000 Kcal, which applies to adults, pregnant women, lactating women and children. For infants 0.3 mg/1000Kcal is suggested.

9.2.2 Riboflavin

Introduction: Riboflavin was the first component of the B_2 complex to be isolated in 1933. It promotes growth of rats when added to a vitamin B_2 deficient diet.

Chemistry and Properties: It contains an iso alloxazine nucleus and ribose. It is slightly soluble in water. It is stable in acid medium, but it is destroyed slowly in alkaline medium at room temperature. Riboflavin in acid or neutral medium is stable to heat but in alkaline medium it is rapidly destroyed. It is also rapidly destroyed when the solution is exposed to bright light.

Functions: Riboflavin is used to produce two co-enzymes, Flavin Nucleotide(FMN) and Flavin Adenine Dinucleotide (FAD). These co-enzymes function primarily in oxidation reduction reactions in electron transport chain link cycle because of their ability to accept and transfer hydrogen atoms. The proteins to which they become attached are known as flavoproteins.

1. The release of energy from glucose, fatty acids and amino acids.
2. The conversion of amino acid tryptophan into the active form of the vitamin niacin.
3. The conversion of vitamin B_6 and folate into their active coenzyme and storage forms.
4. Riboflavin plays an important role in many enzyme systems involved in the metabolism of carbohydrates, fats and proteins.

Absorption, Transport and Metabolism: Riboflavin occurs in food in three forms: riboflavin itself, FMN, FAD coenzyme forms of the vitamin. All three forms can be used to meet the body's need. In the intestinal lumen, FMN and FAD are converted into free riboflavin before absorption. The riboflavin is then absorbed by a regulated active transport mechanism largely in the upper portion of the gastro-intestinal tract. Once inside the intestinal cells the riboflavin is combined with phosphate to form FMN. Both FMN and any unphosphorylated riboflavin are released into the circulation where they largely become bound to the albumin protein and are transported to the body's cells.

Sources: Diets based on whole wheat, any of the millets, raw hand pounded rice or parboiled rice, Liver, dried yeast, egg powder, skim milk powder and whole milk powder, usually supply adequate amounts of thiamin

Deficiency: Riboflavin deficiency is widely prevalent among the low income groups of the population in all age groups particularly in vulnerable groups and geriatric group. Cereal based diets without the protective pulses and milk lead to riboflavin deficiency. Riboflavin deficiency is seen associated with tuberculosis, prolonged fevers, malabsorption, hyperthyroidism and malignancy. In fact, riboflavin deficiency can occur whenever there are chronic infections, trauma and negative nitrogen balance.

Left : Pellagrous dermatiaties in forearms and arms.

Right : Pellagrous dermatiaties on face and neck

1. **Oral and Facial Lesions**
   Angular stomatitis / glossitis, cheilosis and nasolabialse seborrhea. Early symptoms of ariboflavinosis are sorenessand burning of mouth and tongue. The lesion sat the angles of mouth are termed as angular stomatitis. The tongue in general is acutely inflamed called glossitis. Dry chopped appearance of the lips with superficial ulcers terms as cheilosis is one of the classical features of severe riboflavin deficiency.

2. **Dermal Lesions**
   Seborrhoeic dermatitis involving the facial and scrotal skin is common in riboflavin deficiency.

3. **Ocular Manifestations**
   In humans, visual symptoms photophobia, lacrimation, burning, visual fatigue are reported in riboflavin deficiency.

4. **Neurological Manifestations**
   Reaction time, hand grip strength and steadiness and motor coordination have been reported to be affected and respond to riboflavin supplement.

5. **Haematological Manifestations**
   Normocytic anemia has been reported in riboflavin deficiency.

Treatment
Riboflavin in doses of 5 and 10 mg is adequate for curing oral and dermal lesions. Riboflavin needs to be supplemented to preterm infants.

Recommended Dietary Allowances
Riboflavin requirement is related to energy intake – 0.6mg/1000 Kcal.

9.2.3 Niacin

Introduction: Niacin, formerly known as nicotinic acid was originally obtained by the oxidation of nicotine. In 1937 it was recognized as the nutrient able to prevent or cure pellagra in humans and black tongue in dogs. Niacin is used as a generic term, to include derivatives such as nicotinamide.

Chemistry and Properties: Nicotinic acid contains a pyridine nucleus. It is sparingly soluble in water. Nicotinamide is highly soluble in water. Both are stable to heat and not destroyed by autoclaving at 120° C for 20 minutes.

Functions

1. Nicotinic acid is essential for the normal functioning of the skin, intestinal tract and the nervous system.
2. Nicotinamide is a component of two coenzymes which are essential for the metabolism of carbohydrates, fats and proteins

Absorption and Metabolism: Niacin is readily absorbed from the stomach and small intestine. It is converted into the coenzymes NAD Nicotinamide Adenine Dinucleotide) and NADP (Nicotinamide Adenine Dinucleotide Phosphate). Within the cells and limited stores of these coenzymes are held in the kidneys, liver and brain. Any excess niacin is excreted in urine in the forms of methyl nocotinamide and methyl carboxamido- pyridone

Functions

1. Nicotinic acid is essential for the normal functioning of the skin, intestinal tract and the nervous system.

2. Nicotinamide is a component of two coenzymes which are essential for the metabolism of carbohydrates, fats and proteins

Absorption and Metabolism: Niacin is readily absorbed from the stomach and small intestine. It is converted into the coenzymes NAD Nicotinamide Adenine Dinucleotide) and NADP (Nicotinamide Adenine Dinucleotide Phosphate). Within the cells and limited stores of these coenzymes are held in the kidneys, liver and brain. Any excess niacin is excreted in urine in the forms of methyl nocotinamide and methyl carboxamido- pyridone.

Sources

1. Rich sources: Dried yeast, liver, rice polishing, peanut, peanut flour.
2. Good sources: Whole cereals, legumes, meat, fish
3. Fair sources: Milled cereals, maize, roots and tubers, other vegetables.
4. Milk, egg etc.

Deficiency

1.Nicotinic acid deficiency causes the disease Pellagra in human beings. The disease is characterized by three D's – dermatitis, diarhhoea and dementia. The skin symptoms of pellagra are aggravated by exposure to sunlight which led to the belief that it resulted from sun poisoning.

2. Dermal lesions
   These are photo sensitive rash and seen on exposed extensor surface of the body like the upper and lower extremities, face and neck. The lesions are precipitated by exposure to sunlight, fire and radiant heat. On the neck, the lesions appear in the form of a necklace called Casal's necklace. .
3. Gastrointestinal changes
   The mucous membrane is inflammed resulting in severe glossitis, stomatitis, oesophagitis, gastritis and enteritis. The inflammation can produce bloody diarhhoea.
4. Neurological manifestation
   Higher mental functions are deranged in pellagra. Insomnia occurs. Acute encephalopathy characterized by clouding of consciousness occurs.

Treatment

Pellagra can be cured by a good diet containing adequate amounts of protein, tryptophan or niacin as well as other members of B- complex group of vitamins

Recommended Dietary Allowances

Niacin requirement is related to energy intake- 6.6 mg/ 1000 Kcal.

9.2.4 Folic Acid

Introduction: In 1931 Dr. Lucy Wills in Mumbai drew attention to the importance of nutritional megaloblastic anaemia in pregnant women. This anemia was cured by yeast which contained anti anemic principle - the 'Wills factor' which was later termed as folic acid.

Chemistry and Properties

Folic acid contains a pteridine group linked to p- aminobenzoic acid and L- glutamic acid. It is slightly soluble in water. It is stable to heat at neutral Ph 1.0, a solution of folic acid loses about 70-100 percent of the activity when autoclaved at 20° C for 30 minutes. When aqueous solution of folic acid is exposed to light, it is rapidly destroyed.

Functions

Folate is now known to be required for the normal growth and division of all cells.

1. Along with vitamin B_2 folic acid helps in the transmethylation of homocysteine to methionine, ethanolamine to choline and uracil to thymine.
2. It is essential for the maturation of red blood cells.
3. The formation of the vitamin likes compound choline from ethanolamine.

Absorption, Transport and Metabolism

About three quarters of the folate in foods is in polyglutamyl forms. These are normally hydrolyzed to free folate by a conjugases present in small intestinal epithelium. Free folate is actively absorbed from the upper small intestine. Once absorbed into the intestinal cell walls, folate is transported in the blood to all cells of the body. Any excess is stored in the liver. The main form in which folate is transported around the body is methyl tetrahydrofolate.

Sources

Dried yeast, hen's egg and liver are rich sources. Whole cereals, legumes and green leafy vegetables are good sources.

Deficiency

1. **Nutritional Megaloblastic Anaemia in Adults**: The classical studies of Wills in India showed that the megaloblastic anaemia prevalent in pregnant women of the low income groups subsisting on poor vegetarian diets, could be cured by autolysed yeast extract. The haemoglobin content of the blood may range from 6-9 percent and RBC counts from 2-3 million per mm^3 in typical cases. It is evident that the primary deficiency in nutritional macrocytic anaemia is folic acid, even though iron deficiency or vitamin $\mathbf{B_{12}}$ deficiency may also be associated with the above condition.
2. **Megaloblastic Anaemia of Sprue and other Malabsorption Syndromes:** Megaloblastic anaemia is commonly seen in subjects suffering from malabsorption syndromes. In this condition, folic acid and vitamin $\mathbf{B_{12}}$ present in the diet are poorly absorbed. Malabsorption occurs widely among the low income groups in South India. A majority of these patients suffer from megaloblastic anaemia due to deficiency of folic acid and $\mathbf{B_{12}}$. The haemoglobin content ranges from 5-8 g/100 ml and RBC count between 2.5 and 3 million per mm^3.
3. **Megaloblastic Anaemia in Infants and Children**

Megaloblastic anaemia has been reported to occur among malnourished children in the developing countries. It has been reported occasionally in U.S.A in children fed on proprietary infant foods and also in Italy among infants fed exclusively on goat's milk.. The haemoglobin content is usually low 5-8g/ 100 ml blood and RBC count 2.5-3 million per mm.

Treatment

1. **Nutritional Megaloblastic Anaemia in Adults**:
   Studies carried out by various workers in India have shown that in a majority of cases, the anemia could be cured by the administration of 5 mg of folic acid daily.
2. **Megaloblastic Anaemia of Sprue and other Malabsorption Syndromes :**
   The treatment consists in the administration of 5-10 mg folic acid and 5 grains ferrous sulphate daily by the oral route and 500 micrograms of vitamin B_{12} intramuscularly once a week.
3. **Megaloblastic Anaemia in Infants and Children:**
   The treatment consists in the oral administration of folic acid (1-2 mg daily), iron salts and vitamin B_{12} (100 micrograms once a week) intramuscularly.

Recommended Dietary Allowances

ICMR Recommended Dietary Allowances of folic acid

Group	Folic acid µg/day
Man	100
Woman	100
Pregnancy	400
Lactation	150
Infants	25

9.2.5 Vitamin B_{12}

Introduction: Until 1926, pernicious anaemia was a fatal disease of unknown origin with an unknown cure. In 1926 Minot and Murphy found that pernicious anaemia could be cured by feeding a patient at least 0.3 kg raw liver per day.

Chemistry and Properties

Vitamin B_{12} contains cobalt (4-5 per cent). It has a molecular weight of 1355 and an empirical formula **C63H88N14O14** PCO. It is sparingly soluble in water and stable to heat at 100° C for 30 minutes.

Functions

1. Vitamin B_{12} promotes the maturation of red blood cells.
2. It acts on the narrow elements and is involved in the formation of white blood cells and blood platelets.

3. It cures neurological symptoms of pernicious anaemia.
4. It acts as a coenzyme in the synthesis of methionine.

Absorption, Transport and Metabolism Vitamin B_{12} is absorbed primarily in the terminal ileum. The absorption of vitamin B_{12} is mediated by the intrinsic factor, which is a heat labile mucoprotein secreted from parietal cells in the walls of the stomach. If intrinsic factor is deficient, intramuscular injection of B_{12} should be given. The proportion of dietary vitamin B_{12} that is absorbed decreases as the amount consumed increases. Absorption declines with age.

After absorption, vitamin B_{12} passes into the circulation where it becomes bound to one of three transport proteins known as transcobalamins I.II.and III. These proteins carry vitamin B_{12} to the various tissues of the body, particularly liver and bone marrow.

Excess vitamin B_{12} is stored in liver, largely bound within B_{12} protein complex.

Sources

1. Rich sources: Goat liver, Ox liver, Pig liver, Sheep liver
2. Good sources: Goat meat, Sheep meat, Fish, Egg
3. Fair sources: Whole milk powder, skimmed milk powder, cow's milk, fresh etc.

Deficiency

Deficiency of vitamin B_{12} causes pernicious anaemia. Patient with pernicious anaemia have lemon yellow or pale skin. Anorexia, glossitis, achlorhydria, abdominal discomfort, frequent diarrhoea, weight loss and general weakness can also occur. The surface of the tongue is usually smooth and atrophic but sometimes it is red and inflammed. Numbness of limbs, coldness of extremities and difficulty in walking are manifestations of neurologic changes. The causes are as follows:

1. **Inadequate Ingestion**
   A poor diet lacking in micro organisms and animal foods which are the sole source of vitamin B_{12} can lead to pernicious anaemia. Chronic alcoholism, poverty, religious taboos and dietary fads can cause B_{12} deficiency.
2. **Inadequate Absorption and Utilization**
   Inadequate or absence of secretion of intrinsic factor due to heredity or congenital production of defective intrinsic factor gastric atrophy, endocrine disorders associated with gastric damage or due to gastrectomy pernicious anaemia can occur.
3. **Increased Requirements**
   During infancy and pregnancy there is an increased requirement of vitamin B_{12} as it is essential for nucleic acid synthesis.

Treatment

If the haemoglobin level is under 4 g/dl blood transfusion should always be given. Physical activity should be at a minimum until the haemoglobin is above 7g/dl. Vitamin B_{12}should be given in doses of 1000 mcg intramuscularly twice during the first week, then 250 mcg weekly until the blood count is normal.

Recommended dietary allowances

ICMR Recommended Dietary Allowances of Vitamin B_{12}

Group	Vitamin B_{12} µg/day
Man	1.0
Woman	1.0
Pregnancy	1.0
Lactation	1.5
Infants	0.2

9.2.6 Vitamin B_6

Introduction: Vitamin B_6 is one of the vitamins of the B_2 complex, which prevents and cures dermatitis in rats fed on a vitamin B_2 deficient diet. It was isolated in 1938 in a pure form by different groups of workers and named "Pyridoxine ".

Chemistry and properties: Pyridoxine contains the pyridine nucleus. In addition pyridoxine, two other closely related compounds, pyridoxal and pyridoxamine occur in animal and human body. These two compounds posses the same vitamin activity as pyridoxine. It is readily soluble in water. When pyridoxine in neutral or alkaline solution is exposed to light, it is slowly destroyed.

Functions

1. **Decarboxylation**
   Converts glutamic acid to gamma- amino butyric acid, a substance found in grey matter in the brain.
2. **Deamination:**
   Renders carbon residues available for energy by removing the amino groups from amino acids.
3. **Transamination**
   Removes the amino acid group and transfers it to a new carbon skeleton forming a new amino acid cysteine.
4. **Amino acid transport**
   Actively transports amino acid glycine and succinate, a glucose metabolite in the citric acid cycle into haeme, the essential nonprotein core of haemoglobin.
5. **Nicotinic Acid Formation**
   Participates in nicotinic acid formation from tryptophan.
6. Pyridoxine is essential for maintaining the nerves in normal condition.

Sources

1. Rich sources: Dried yeast, rice polishings, wheat germs and liver are rich Sources.
2. Good sources: Whole cereals, legumes, oilseeds and nuts, eggs, milk, meat and fish and green leafy vegetables are good sources.
3. Fair sources: Milled cereals and their products, roots and tubers, other vegetables and fruits are fair sources.

Deficiency

1. Rich sources: Dried yeast, rice polishings, wheat germs and liver are rich Sources.

1. **Anaemia**
   A hypochromic, microcytic anaemia occurs even in presesnce of a high serum iron level in some persons.
2. **Central nervous system disturbances**
   In infants deprived of the vitamin, there is increased hyper-irritability that progresses to convulsive seizures.
2. **Oral and Dermal Lesions**
   Oral lesions like angular stomatitis, glossitis and cheilosis in pregnant and lactating mothers have been described in pyridoxine deficiency.

Treatment

Oral lesions and peripheral neuritis due to dietary deficiency can be treated with 10-20 mg of vitamin given orally or by parenteral route.

Recommended Dietary Allowances

ICMR Recommended Dietary Allowances of Vitamin B_{12}

Group	Pyridoxine mg/day
Man	2.0
Woman	2.0
Pregnancy	2.5
Lactation	2.5

9.2.7 Pantothenic Acid

Introduction : Pantothenic acid one of the vitamins of the vitamin B_2 Complex, which can prevent or cure a specific type of dermatitis in chicks, fed on vitamin B_2 deficient diet. It was isolated by Williams and co- workers (1938) in a pure form as its calcium salts.

Chemistry and Properties : Pantothenic acid exists both in the free form and in combination with ß- mercapto- ethylamine, adenine, ribose and phosphoric acid.The later form is known as coenzyme A. Pantothenic acid is highly soluble in water. It s stable to autoclaving at 120° C for 30 minutes in neutral solution but is destroyed rapidly in acid or alkaline medium.

Functions : Pantothenic acid in the form of a coenzyme A takes part in the metabolism of carbohydrates and fats. It is essential for the oxidation of pyruvic acid.

Sources

1. Rich sources: Dried yeast, liver (ox, sheep and goat), rice polishing, wheat germ.
2. Good sources: Whole cereals, legumes, nuts and oil seeds, eggs, meat, milk, fish.
3. Fair sources: Milled cereals, vegetables, fruits.

Deficiency

1. The visible signs of deficiency included nausea, vomiting, tremor of the outstretched hand and irritability.
2. Burning feet syndrome: A condition known as burning feet syndrome was observed in

prisoners of war during World War II in Japan and Burma. This syndrome was also associated with neurological and mental disturbances.

Treatment

Gopalan (1946) found that "burning feet" syndrome observed in Indian subjects responded to treatment with Ca- pantothenate (20-40 mg) administered intramuscularly.

Recommended dietary allowances

ICMR Recommended Dietary Allowances of Vitamin B_{12}

Group	Pyridoxine mg/day
Infants	1.5 - 2.5
Children	5 - 8
Adolescents	8 - 10
Pregnant and Lactating	2.5
Women	10 - 15

9.2.7 Biotin

Introduction: In 1927, Boas made an important observation that when raw egg white was incorporated as the main source of protein in the diets of rats, they developed deficiency symptoms characterized by dermatitis, loss of hair and muscular in coordination.

Chemistry and Properties: Biotin is sparingly soluble in cold water and is freely soluble in hot eater. It forms salts with alkali hydroxides. It is sparingly soluble in alcohol but insoluble in fat solvents. It is stable to autoclaving at 120° C for 30 minutes in acqueous medium in neutral pH.

Functions

1. Biotin is essential for normal gestation and lactation in experimental Animals.
2. It helps to maintain the skin and the nervous system in sound condition.
3. It is essential for the synthesis of malonyl COA from acetyl COA and oxaloacetic acid from pyruvic acid.

Sources

1. Rich sources: Dried yeast, rice poilishings, wheat germ, liver, peanuts, soybean.
2. Good sources: Whole cereals, legumes, mutton, eggs, and cow's milk.
3. Fair sources: Milled cereals and cereals flour, vegetables, fruits.

Deficiency:

Biotin deficiency in humans is characterized by depression, hallucinations, muscle pain, localized paresthesia, anorexia, nausea, alopecia and scaly dermatitis.

Recommended Dietary Allowances:

The minimum daily requirements for biotin are not known. Since biotin deficiency has not so far been reported in normal human subjects, it may be presumed that the customary diets provide adequate amounts of biotin.

9.2.8 Vitamin C

Introduction: The chemical name for vitamin C is ascorbic acid and it is known as hexuronic acid and antiscorbutic nutrient. Scurvy was classically a disease of sailors. In 1947, the British physician Lind demonstrated that oranges and lemon could cure scurvy.

Chemistry and Properties: Ascorbic acid is optically active. Only L-ascorbic acid occurring in foods possesses vitamin activity. Ascorbic acid has strong reducing properties. When its solution is exposed to air, it undergoes oxidation rapidly to dehydro-ascorbic acid. The oxidation is catalyzed by copper ions and is faster at higher temperature, e.g. during cooking of foods.

Functions: Vitamin C is a biological reducing agent especially during hydroxylation reactions and it is an antioxidant that protects the body against damaging oxidizing agents.

1.Collagen Formation:

Collagen is a major structural protein of connective tissue, bone, teeth, cartilage, skin and scar tissue. Vitamin C is specifically required by the fibroblast cells of connective tissue and the bone forming osteoblasts within bone. It is estimated that collagen constitutes about one quarter of all the protein in the body. Collagen is formed from a precursor protein known as tropocollagen by the hydroxylation of the amino acids proline and lysine within tropocollagen. Vitamin C is required to allow these essential hydroxylation reactions to proceed.

Any deficiency in vitamin C results in defective collagen synthesis, associated with impaired wound healing, disruption of capillaries and faulty bone and tooth formation. One of the first effects of any impairment of collagen synthesis are small pin point hemorrhages which result from weakness in the membranes that line the blood capillaries and in the fibers that hold cells together under the surface of the skin. These weaknesses allow blood to escape into the enlarged intercellular spaces, accounting for the capillary bleeding associated with scurvy. These subcutaneous hemorrhages appear most often in areas subjected to mechanical stress. Such as gums, which become soft, spongy and prone to bleeding.

If collagen synthesis is impaired, the matrix formation is defective and it becomes less able to accumulate the calcium and phosphorus required for proper bone materialization. AS a result the bone becomes weakened and sometimes distored. Bones sometimes become displaced from their joints when supporting cartilage, which is also mainly collagen, becomes weakened.

The dentin layer of tooth does not form normally during vitamin C deficiency. This results in teeth that are structurally weak and more prone to mechanical injury and decay. Skin grafts to repair burned tissue have been found to heal more quickly when adequate vitamin C is present.

2.Carnitine synthesis

Vitamin C is required for synthesis of carnitine. Carnitine is a small nitrogen- containing organic compound involved in the transport of fatty acids into mitochondria to be oxidized to release energy for use by cells.

3.Activation of hormones
Many peptide hormones and hormone releasing factors are synthesized as precursor molecules that are enzymatically modified into their active forms. Vitamin C is essential for the activation of gastrin and growth hormone releasing factor.

4.Drug detoxification
Vitamin C is required for the optimal activity of various drug detoxifying metabolic systems within the body.

5.General Antioxidant
Vitamin C is known to be involved in regulating cholesterol metabolism and maintaining the structure of blood vessels and the antioxidant effects of the vitamin might prevent tissue damage that leads to cardiovascular disease.

6.Iron metabolism
Ascorbic acid reduces the ferric iron to ferrous iron and thus helps in the absorption of iron.

Sources
Citrus fruits - oranges, grape fruit, lemons and limes, berries, melon, pineapples, guava, pears, bananas, leafy green vegetables, green pepper, cabbage, chilies, mangoes, alma, tomatoes.

Absorption, Transport and Metabolism Ascorbic acid is absorbed in the jejunum, principally by a sodium dependent active transport mechanism. Dehydroascorbic acid is passively absorbed. As intake increases, the efficiency of absorption falls. While vitamin C is filtered through the kidney, enough is reabsorbed to maintain a plasma concentration of 1.2 to 1.5-mg/ dl and a total body pool of 1.2 to 2.0 g. All vitamin C in excess of the amounts needed to maintain these plasma and body levels, is excreted in urine.

Deficiency

1. Infantile scurvy: The early symptoms of disease are: Loss of appetite, lightlessness, the infant cries when its legs and arms are moved. Swelling is observed at the ends of long bones. Hemorrhages occur under the skin. Gums are swollen. Convulsions may occur resulting in death of the infant.

2. Scurvy in adults: The disease in characterized by general weakness, spongy bleeding gums, loose teeth with desorbed dentine, swollen tender joints and hemorrhages in various tissues and under the skins.

Treatment : For the treatment of scurvy in adults, 100 mg ascorbic acid twice daily should be administered intramuscularly for a week, followed by oral administration of 500 mg daily for one month.

Recommended dietary allowances

ICMR Recommended Dietary Allowances of Vitamin B_{12}

Group	Vitamin mg/day
Man	40
Woman	40
Pregnant	40
Lactating	80

9.3 Conclusion:

Vitamins are organic compounds occurring in small quantities in natural food s and are necessary for growth and maintenance of good health. Some vitamins (B- complex) are synthesized in the body itself by intestinal micro-organisms, Antibiotics and sulfa- drugs may destroyed these organisms resulting in decreased vitamin synthesis.

9.4Key words

1. **Dry beriberi:** Thiamine deficiency causes the disease-dry beriberi. The symptoms of this disease include loss of appetite, tingling and numbness of legs and hands, wasting of muscle and difficulty in walking.
2. **Wet beriberi:** Thiamine deficiency causes the disease wet beriberi. The symptoms of this disease include oedema in legs, enlargement of heart, palpitation and breathlessness.
3. **Pellagra:** Niacin deficiency causes the disease the disease pellagra in human beings.
4. **Dermatitis:** It's a skin disease cause due to the deficiency of Niacin occurs on feet, hands and neck. The skin, especially the exposed parts to sun, itches and burns.
5. **Scurvy:** Deficiency of vitamin C causes the disease called scurvy. The disease is characterized by general weakness, spongy bleeding gums, loose teeth with desorbed dentine, swollen tender joints and hemorrhages in various tissues and under the skin.

9.5 Self-Assessment Questions

1. Give 5 sources of riboflavin.
2. Explain the deficiency of thiamin.
3. Give the deficiency of Niacin
4. Give 5 sources of folic acid
5. Write the recommended dietary allowances of vitamin B_{12}.
6. Explain in detail the deficiency of vitamin C.

9.6 Further Readings

1. Nutrition Science – B. Srilaxmi
2. Hand book of Food and Nutrition – M. Swaminathan

- Sasmita Mohanty

Lesson - 10

MINERALS

10.0 OBJECTIVE :

Objective of this lesson is to discuss the functions of various minerals in the body, their daily requirements, food sources and effects of deficiency.

STRUCTURE :

10.1 Introduction

Minerals are essential for various body functions. They are required by the body in small quantities. Inadequate intake of minerals will lead to the development of deficiency disease. The largest concentration of minerals is found in bones and teeth. Minerals are found in soft tissues such as nerves and muscles and in blood and other body fluids.

The body contains about 24 minerals, all of which must be provided by the diet. These include calcium, phosphorus, potassium, sodium, chlorine, magnesium, iron, manganese, copper, iodine, cobalt, zinc, aluminium, arsenic, bromine, fluorine, nickel, chromium, cadmium, selenium, silicon, vanadium and molybdenum.

10.2 Minerals

10.2.1 Calcium

Introduction: Among the different minerals, calcium occurs in the highest amounts in the body. About 99 percent of the calcium is present in the skeleton and the remaining 1 percent in soft tissues. The body of the infant at birth contains about 27.5 g calcium while the adult human body contains about 1,000- 12,00 g. All this calcium is deposited in the bone during the growth of the body.

Functions:

1. Bone formation: It is essential for formations of bones.

2.Tooth formation: The calcification of deciduous teeth begins by the time a foetus is about 20 weeks and is completed only shortly before they erupt at about 6 months. Permanent teeth begin to calcify when the child is between 3 months and 3 years while they are still buried in the gums below the deciduous teeth. The wisdom teeth, which are the last to erupt, may not begin to calcify until a child is between 8 and 10 years.

3.Growth: Calcium is obviously required for growth because it forms such an important part of bones and teeth and is required in much smaller amounts for the proper functioning of every cells.

4.Cofactor and regulator of biochemical reactions

a)Blood clotting: When a tissue has been injured by a cut, the enzyme thromboplastin is released from affected cells or blood platelets. Thromboplastin, catalyses the conversion of the protein prothrombin into thrombin, a process that requires the presence of calcium ions. Thrombin is an enzyme that converts a soluble blood protein called fibrinogen into fibrin, which forms the insoluble network of fibrous protein that composes the basic structure of a blood clot.

b)Contraction of muscle: Calcium ions are readily bound by electrostatic forces to proteins inside and outside the cells and to cell membranes. Protein, which bind calcium include albumin, myosin, troponin C, modulator and transport proteins, extra cellular hydrolytic enzymes and prothrombin. The binding alters the shape and configuration of the protein molecules and this determines their biological activity. Calcium is involved in the absorption of vitamin B_{12} in the action of the fat digesting enzyme, pancreatic lipase and in the secretion of insulin from the pancreas.

Sources: The important sources of calcium in the diet are milk and milk products, sesame seeds and green leafy vegetables. Milk is the best natural source and skim milk powder is very rich source. (1.37 % calcium). Ragi is the cheapest natural source of calcium, containing about 0.3 to 0.36 %.

Though sesame seeds are rich in calcium, (1.45%), the calcium is present as calcium oxalate mostly in the skin.. The skin is usually removed before consumption. The dehusked sesame seed is only fair source of calcium (0.15%). Green leafy vegetables are one of the cheapest natural sources of calcium containing about 0.44 to 1.33 %.Small fish eaten along with bones is an excellent source of calcium.

Absorption: Calcium is absorbed by two distinct mechanism, passive diffusion and active transport. The active process requires the expenditure of energy stored within adenosine troposphere (ATP). It is mediated by a carrier protein, calbindin and is saturable. It means it can occur no faster than at a maximal rate corresponding to the rate when all of the carrier molecules are carrying calcium all of the time. The active process also requires the presence of vitamin D. The passive process relies on simple nonsaturable diffusion of calcium down its concentration gradient with no requirement for energy expenditure to make it happen. In normal adult, 95 percent of calcium from a low calcium diet is absorbed by the active process. On an average 30-40 percent of the dietary calcium is absorbed in adults. Growing children, pregnant and lactating woman absorb 50-60 percent of calcium.

Factors Affecting Calcium Absorption: The various factors affecting calcium absorption from the diets are:

a. Vitamin D : Vitamin D is essential for the absorption of calcium.

b. Phosphates and phytic acids: Excess of phosphates lowers calcium absorption. Phytic acid forms insoluble calcium salts and interferes with the absorption of calcium.

c. Reaction of the intestinal contents: Calcium is well absorbed at the normal pH of the intestines. If the contents become alkaline, calcium absorption is lowered due to the formation of insoluble tricalcium phosphate.

d. Fats and fatty acids: Faulty absorption of fats leading to the presence of large amounts of fatty acids in the stools interferes with calcium absorption, as insoluble calcium salts of fatty acids are formed and excreted in the faeces.

e. Proteins: Higher levels of proteins in the diet help to increase the absorption of calcium.

f. Fibre: Presence of excess of fibre in the diet interferes with the absorption of calcium.

g. Oxalic acid: Oxalic acid present in certain foods forms insoluble calcium, which is excreted in the faeces, thus lowering calcium absorption.

h. Citric acid: A number of earlier publications indicated the beneficial effect of citric acid and citrates in rickets.

i. Lactose: Lactose increases the absorption of calcium. The beneficial effect of lactose is due to increased acidity of the intestinal contents, which leads to increased calcium absorption.

Deficiency:The various factors affecting calcium absorption from the diets are:

a)Osteoporosis: It is condition associated with a loss in bone density and bone mass and is primarily found in middle age and elderly women. Its major symptoms is an increased vulnerability to bone fractures. The bones of the skeleton are " remodeled" throughout life, a process involving the breakdown of existing bone and formation of new bone is a perpetual cycle that affects 10 % of the skeleton at any one time.

Fractures of the brittle bones occur even after minor accidents. Pain due to fractured of vertebrae may radiate round the trunk, to the buttocks or down the legs. Healing of fractures is not impaired in osteoporosis and pain subsides as soon as the fractures are healed.

b)Hypocalcaemia: Hypocalcaemia in clinical conditions is rarely caused by inadequate calcium ingestion. This may occur after operations on the thyroid gland, if too much parathyroid tissue is removed, or due to impaired alimentary absorption. It may also occur in patients with the malabsorption syndrome. When plasma ionic calcium is reduced, nerve and muscle become more readily excitable. Sensation of tingling and numbness may be present and on the motorside twitching of muscles, known as tetany, which may be followed by spasm, involuntary muscle contraction.

The face, hands and feet are mainly affected. The larynx may be affected and this causes a coarse stridor, harsh sound. Parestesia of lips, tongue, fingers and feet may occur in hypocalcaemia. There is generalized muscle ache.

Recommended Daily allowances

ICMR Recommended Dietary Allowances of Calicium

Group	Calicium mg/day
Man	400
Woman	400
Pregnant Woman	1000
Lactating Woman	1000
Infants 0-12 Months	500

Children 1-9 Years	400
Boys and Girls 10-15 Years	600
Boys and Girls 16-18 Years	500

10.2.2 Phosphorus

Introduction: An adult human body contains about 400 to 700 g of phosphorus as phosphates. A greater part of this is present in the bone teeth and the rest in other tissues. Phosphorus is present in the body as organic salts of phosphoric acid or in combination with organic compounds.

Inorganic Phosphorus: Phosphorus is present as calcium phosphate in bones and as phosphates of sodium and potassium in soft tissues and body fluids.

Organic Phosphorus: The important organic compounds containing phosphorus are phospholipids and nucleoproteins and creatine phosphate and hexose phosphates, triosephosphates and glycerophosphate.

Functions:

1. **Bone formation:** It is essential for formations of bones.

1) Phosphorus is necessary for formation of bone and teeth.
2) It is necessary for the formation of phospholipids- lecithin and cephalin, which are integral parts of cell structure and also act as intermediated in fat transport and metabolism.
3) It is essential for carbohydrate metabolism as phosphorylation of glycogen requires inorganic phosphorus andphosphoric easters like adenylic acid, adenylpyrophosphate and creatine phosphate.
4) It is a constituent of a coenzymes e.g. Coenzyme 1, and Co- carboxylase which take part in the enzyme systems concerned in the oxidation of carbohydrates, fats and proteins
5) It is an essential constituent of nucleic acid and nucleoproteins, which are integral parts of the cells.

Sources : The important food sources are milk, eggs meat and fish. Vegetables are fair sources. A greater part of the phosphorus present in cereals, pulses, nuts and oilseeds exists in the form of pyhtic acid or phytin.

Metabolism : Phosphorus is absorbed in the small intestines as inorganic phosphates. Phosphorus present in organic combination, e.g.. phytic acid, should be hydrolysed to inorganic phosphate before absorption. Since the enzyme phytase is not present in human digestive juices, phytin phosphorus is absorbed only to a very slight extent in human beings. Phosphorus present in animal foods such as milk, meat and eggs is absorbed to a greater extent than that present in cereals and legumes as the later exists mostly in the form of phytic acid. The kidney is the major pathway of excretion of the phosphorus absorbed.

Deficiency : Because of the wide spread distribution of phosphorus in foods, deficiency is hardly found in humans. However, people who consume large amount of antacids people who suffer excessive losses in urine and prematurely born infants may suffer from deficiency of phosphorus. Vitamin D deficiency and prolonged parental nutrition can cause phosphorus deficiency.

Recommended Daily allowances

ICMR Recommended Dietary Allowances of Calicium

Group	Calicium mg/day
Man	400
Woman	400
Pregnancy and Lactation	1000
Infants	750
Children	
1-9 Years	400
10-15 Years	600
16-18 Years	500

10.2.3 Magnesium

Introduction: The adult human body contains about 25 g of magnesium. About half this quantity is present in the bones in combination with phosphate and carbonate and about one-fifth of the total magnesium in the body is present in the soft tissues.

Functions:

1. Magnesium is found in certain enzymes e.g. co-carboxylase which decarbolates pyruvic acid.
2. It acts as an activator of several enzymes, e.g. alkaline phosphatase, all phosphorylating enzymes.
3. It is required as a co-factor for oxidative phosphorylation.

Sources : Particularly all foods contain significant amounts of phosphorus, although it is particularly abundant in protein rich foods. Meat, fish, poultry, eggs, dairy products and cereals products like rice are primary sources of phosphorus in the average diet.

Metabolism : The average intake from the diet by adults is about 300-400 mg. A greater part of this (40-50 percent) is not absorbed and hence excreted in the stools. About one-third of the amount ingested is excreted in urine. The magnesium content of normal human serum is about 2-3 mg/100 ml and of whole blood 1.6 mg per 100ml.

Effects of magnesium deficiency : Magnesium deficiency was produced in three patients on low magnesium diet. The principal clinical features were depression, muscular weakness, vertigo and liability to convulsions.

Recommended dietary allowances Adults- 200-300 mg/day.Older children- 150-200 mg/day Infants and preschool children- 100-150 mg/day.

10.2.4 Sodium Chloride

Introduction: All minerals except Sodium Chloride (NaCl) are usually present in sufficient amounts in a well- balanced diet. Sodium chloride is the only mineral, which is taken in more or less pure forming addition to the amount present in natural foods.

NaCl intake and excretion : A healthy adult excretes daily in urine about 10 to 15g of NaCl. All this is derived from the salt taken in food. Sodium chloride is also excreted in sweat. During excessive sweating in hot climates, while doing hard work, the loss of NaCl in sweat may vary from 10 to 20 g daily.

Sources:salt sodium compounds in baking and processing milk, cheese meat, egg, carrots, beats, spinach, celery.

Deficiency: Men doing hard work in hot humid climates, e.g. in mines suffer from heat cramps, i.e. intense and painful contractions of skeletal muscle. This is due to NaCl deficiency caused by loss of NaCl from the body by excessive sweating.

Recommended Daily allowances

I CMR Recommended Dietary Allowances of Sodium Chloride

Group	Calicium mg/day
Adults	
Light Work	10 - 15
Hard Work	15 - 20
Children	5 - 10
Adolesscent Boys and Girls	10 - 25
Infants 0-12 Months	600

10.2.5 Sodium

Introduction: The adult human body contains about 100 g of sodium ion. It is distributed entirely in the extra cellular fluid of the body.

Functions:

1. It acts as a major cation in extra cellular fluid.
2. It maintains water balance and acid base balance.
3. It helps in absorption of glucose.

Excretion: On an average diet about 3 to 5 gm of sodium is excreted in urine. On a low salt diet and in starvation, urinary excretion may fall to very low levels.

10.2.6 Potassium

Introduction: The adult human body contains about 250 g potassium which is present almost entirely in the cells of different tissues, muscle etc. Only small quantities are present in extra cellular fluid. While plasma contain large amounts of potassium ion. Potassium is the major basic ion of the body cells and apparently serves in the cells the same functions as sodium in the extra

cellular fluids. Potassium occurs in abundance in foods and so potassium deficiency seldom occurs in normal human beings.

Functions: The important functions of potassium are :

1. Regulations of pH of cell contents
2. Regulation of the osmotic pressure of cell

3.Potassium ion increases the relaxation of heart muscle, which is antagonized by Calcium ion.

Sources : Fruits, vegetables, legumes, nuts, whole grains, meat

Deficiency : Potassium deficiency causes weakness and muscular paralysis.

10.2.7 Iron

Introduction: The total iron content of the normal adult man (70 kg wt) is estimated to be about 4-5 g. A greater part of the iron in the body is present as haemoglobin. Most of the body iron exists in complex forms bound to protein either as porphyrin or heme compounds or as ferritin and transferring. Free inorganic iron occurs in the body only in very small amounts. The hemo protein and flavo- protein enzymes also contain iron.

Functions:

1.Transport and storage of Oxygen: Each gram of haemoglobin contains about 3.34 mg of iron. Iron within the metalloproteins haemoglobin and myoglobin can bind to oxygen molecules and transport them through the blood or store them within muscles. The iron in a haeme group itself is bound to the protein chain. Myoglobin is found only in muscle, where it serves as a reservoir of oxygen. The oxygen is needed to combine with nutrient molecules to release the energy to power muscular contraction.

2.Cofactor of Enzymes and other proteins: The iron containing haeme group is also a part of several proteins involved in the release of energy during the oxidation of nutrients. Also iron on its own is a cofactor bound to several nonhaeme enzymes required for the proper functioning of cells.

3.Formation of Red Blood Cells: Bone marrow produces immature cells known as erythroblasts. As erythroblasts mature in the bone marrow, many synthesize the iron containing haeme group in a process requiring the help of vitamin B_{12} and copper. The haeme group becomes bound to globin molecules, also synthesized by erythroblasts, to form completed haemoglobin molecules. The haemoglobin containing cells are known as reticulocytes and are released from the bone marrow into the blood. Within 24 to 36 hours after their release the nuclei of the reticulocytes disintegrate and the cells become mature erythrocytes ready to begin the transport of oxygen to the tissues and that of carbon dioxide away from the tissues.

Because a red blood cell has no nucleus, it cannot produce the enzyme and proteins necessary for long-term survival. The life of RBC is 120 days. When RBC die, they are removed from the blood by cells of the liver, bone marrow and spleen which are part of the reticuloendothelial system. In the spleen, the iron and amino acids derived from haemoglobin are salvaged and recycled. The iron is stored as haemosiderin and ferritin in the liver and spleen salvaged and recycled. The iron is stored as haemosiderin and ferritin in liver and spleen or is returned to the bone marrow for incorporation into new haemoglobin molecules. In this way, iron effectively conserved and reused. The amino acids are released to the blood, where they are available to all cells for the synthesis of new proteins or for the oxidative release of energy. The remaining portion

of haemoglobin molecule, its haeme group are converted to bilirubin, which is transported to the liver and then excreted in bile

Sources: Rich sources of iron are cereals, millets, pulses and green leafy vegetables. Of the cereal grains and millets, bajra and ragi are very good source of iron. Iron from animal foods is better absorbed than from plant foods. Iron content of food can be increased by cooking in iron vessels.

Absorption : In monogastric species, it is known that iron is absorbed principally in the ferrous state in the duodenum. In man ferrous salts have been shown to be more effective for haemoglobin formation than ferric salts. The rate of absorption of iron is also affected by the magnitude of iron store in the body and the rate of erythropoiesis.

Factors affecting iron absorption:

1.Iron absorbed from the intestines in the ferrous state .Iron in the ferric form will have to be reduced to ferrous state before absorption.

2.Vitamin C enhances the absorption of iron in the intestinal tract.

3.Excess of calcium interferes in the absorption of iron.

4.Excess of phosphates and phytates lowers the absorption of iron by forming insoluble iron salts.

5.Oxalic acid present in some foods interferes in the absorption of iron by forming insoluble oxalates.

Deficiency : Iron deficiency anaemia is widely prevalent among children, adolescent girls and expectant and nursing mothers in the developing countries.

1.Signs and symptoms of anaemia: The clinical features are the results of diminished oxygen carrying power of the blood due to low haemoglobin content (5 to 9 g/100 ml blood)

2.Women of child bearing age: The clinical features are general fatigue and lassitude, breathlessness on exertion, giddiness and pallor of the skin. In severe cases, there may be some oedema of the ankles. The haemoglobin levels commonly range between 5 and 9-g/100 ml blood and the RBC count.

3.Weaned infants and young children: Iron deficiency anaemia is widely prevalent among weaned infants and young children in India and other developing countries. The haemoglobin levels in severe and moderately severe and moderately severe anaemia cases, may range from 5-9 g/100 ml. The children are dull' and inactive and show pallor of the skin. The appetite is poor and growth and development of children are retarded due to low food intake. There is a tendency for children below 3 years to eat mud.

Recommended Daily allowances

Group	Calicium mg/day
Man	28
Women	30
Pregnancy	38
Lactating	30

10.2.7 Iodine

Introduction: Iodine is one of the essential micronutrients required for normal growth and development of the human brain and body. The thyroid gland, weighing about 25 g in a normal adult, contains only about 10 mg of iodine. The adult body as a whole contains about 10 mg of iodine. Over 75 percent of this is present in thyroid gland. The rest is distributed in salivary, mammary and gastric glands and the kidneys.

Functions:

1.Iodine plays an important role in the synthesis of triioddothyonine and thyroxine. The thyroid hormones play a major role in regulating growth and developing. They can stimulate the metabolic rate by as much as 30 percent, resulting in an increased rate of oxygen use and increased generation of heat.

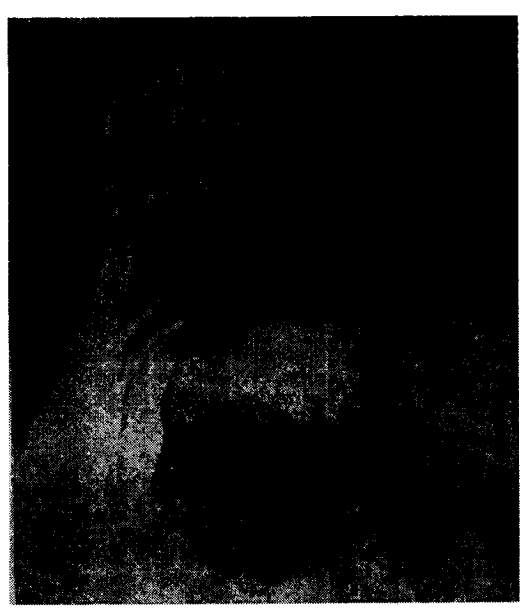
2.The activities of the thyroid hormones are critical for the normal development of the brain. They increase the proliferation of brain cells and regulate other body processes involved in brain function.

3.Thyroid hormones regulate the conversion of carotene into active vitamin A, the synthesis of protein and the absorption of carbohydrate from the intestine.

4.Thyroxine is also known to be essential for reproduction.

Sources : Iodine is present only in small amounts in common foods, the quantity of iodine present depending on the iodine content of the soil. The soil of mountainous regions usually contain less iodine than the soil of the plains near the sea. Crude common salt prepared from sea water and sea fish are good sources of iodine.

Metabolism : Iodine occurs in food as iodine ions or as free inorganic iodine. Iodine ions are absorbed rapidly primarily in the small intestine and then become distributed throughout the



A case of goitre.

extracellular fluid. Free iodine is reduced to iodide ions and absorbed. One third of iodine absorbed in taken up by the thyroid gland. The reminder is removed as it passes through the kidneys to be excreted in urine. Iodine is also lost through perspiration and faeces.

Deficiency: If sufficient iodine is not taken in the diet, enlargement of thyroid takes place, resulting in the disease called goitre. The thyroid gland of the adult which normally weighs about 25g may weigh as much as 200 to 500 g or even more in goitre. Histological examination shows diffuse overgrowth of the glandular tissue, known as general hyperplasia of the glands In children, severe iodine deficiency may result in serious retardation of growth. This condition is known as cretinism.

Recommended dietary allowances

The ICMR recommended Dietary Allowances of iodine

Group	Calicium mg/day
Adult	100-200
Infant	40 - 50
Children (1-10)	70 - 120

10.2.8 Copper

Introduction: Copper has been used therapeutically since at least 400 BC, when Hippocrats prescribed copper compounds for pulmonary and other diseases. Copper metabolism and wilson's disease were linked as early as 1912, long before the condition was recognized as an in born error of metabolism in 1953. The healthy human adult body contains about 100-150 mg of copper.

Functions:

1.Copper is necessary for the maintenance of normal haemoglobin status and is also part of many enzyme systems.

2.Many physiological functions in mammals such as erythropoiesis, skeletal materialization, connective tissue formation etc.

3.Copper plays an important role in the metabolism of fatty acids and in the formation of ribonucleic acid.

4.Copper in the body is capable of binding bacterial toxins and increase the activity of antibiotics.

Sources : Some of the rich sources of copper are sea foods like oysters, crab and lobsters, meat sources followed by nuts and dried legumes like almonds, sesame, sunflower and soybean contain 12-37 µg/gm.

Absorption : Typical diets provide about 1 mg of copper per day about 25-40 percent of which is absorbed. Copper is absorbed from all parts of the gastrointestinal tract including the stomach and large intestine. The total copper content of the body is estimated at 75 to 150 mg, 40 percent of which is found in muscles. The liver with 15 percent body copper is the major copper storage site.

Deficiency : Copper deficiency is rare in humans. It occurs mainly in infants resulting in psychomotor retardation, hypotonia (Low osmotic pressure of blood, hypopigmentation, anaemia, osteoporosis.

Recommended dietary allowances : The desirable intake suggested by ICMR of copper for an adult man is 2.2 mg/day.

10.2.9 Fluorine

Introduction: Fluorine occurs in the form of fluoride in nature. It is present in small but widely varying concentrations in partially all soils, water supplies, plants and animals and is a constituent of all diets.

Functions : There is now no doubt that traces of fluorine in the teeth help to protect them against decay. Fluoride imparts stability to bone and enamel tissue due to formation of highly insoluble fluoroapatite from hydroxyapatite. In view if this property, therapeutic use of fluoride has been recommended for preventing dental caries and osteoporotic fractures in elders.

Sources : The chief source is usually drinking water, which contain 1 part per million of fluoride, supplies 1-2 mg/day. Another significant source is tea.

Absorption : Fluoride can be absorbed rapidly by passive diffusion through mouth, stomach, small intestine, lungs and skin. About 86-97% of soluble fluoride can be absorbed through gastrointestinal tract and the absorption from drinking water is almost complete. Fluoride is excreted through urine faeces, sweat, saliva and milk. The main route being the urine.

Toxicity : Fluorosis occurs as an endemic disease in India in parts of Andhra Pradesh and Punjab. The heavy deposits of fluoride bearing minerals in the rock are mainly responsible for endemic fluorosis in India. Fluoride toxicity manifests in two major forms dental fluorisis and skeletal flurosis. The patient may develop stiffness, joint pain and deformities of the spine. High fluoride intakes may also interfere with iodine metabolism, causing hypothyroidism.

Excess: Where the fluoride content of the water is high mottling of permanent teeth is common. The enamel loses its luster and becomes rough. Bands of brown pigmentation separate patches as white as chalk. Small pits may be present on the surface. Incisors of the upper jaw are more affected. High fluoride intakes may also interfere with iodine metabolism, causing hypothyroidism. The hormones of bone metabolism like parathyroid hormone and growth hormones levels in serum are elevated in them compared to that in normals.

Recommended Dietary Allowances :

The fluorine requirements of the body are met by the quantity normally present in drinking water (1-2 ppm) in most of the regions.

10.3 Conclusion :

Minerals may be defined as those elements, which remain largely as ash when plant or animal tissues are burnt. Calcium and Phosphorus from three fourths of minerals present in the body. Many of the mineral elements are present in minute amounts and are known as trace elements. Minerals are required for the growth and development of the body and for the formation of bones

and teeth. Some are present in the body fluids and play a physiological role in regulation of body functions. Minerals do not act singly in their regulation of body processes but work with the help of other minerals and organic compounds.

10.5:Key Words

1.Minerals: May be defined s those elements which remain largely as ash when plant or animal tissues are burnt.

2.Hyperplasia: A diffuse over growth of parathyroid gland.

3.Osteoporosis: is a condition in which declaration of the bones occur due to calcium deficiency in the diet.

4.Cretinism: In children, severe iodine deficiency may result in serious retardation of growth. This condition ids known as cretinism.

5.Anaemia: Lack of iron results in iron deficiency anaemia. The haemoglobin levels commonly range from 5to 9-g/100 ml of blood in anaemia persons. This results in diminished oxygen carrying power of blood. General fatigue, lassitude, breathlessness on excretion, giddiness are the clinical features of anaemia.

6.Dental fluorosis: The drinking water containing excessive amounts of fluorine causes dental flurosis.

7.Skeletal fluorosis: Chronic intoxication through drinking water containing excessive amount of fluorine or among workers handling fluoride containing minerals result in pathological changes in bone.

10.4 Self Assessment Questions

1. Explain the functions of calcium.
2. Give the sources of calcium.
3. Explain the importance of sodium and potassium in diet
4. What are the principal functions of iodine?
5. Explain the functions and deficiency symptoms of iron. Suggest some foods rich in iron.
6. Mineral salts are required by our body in a very little amount but are essential for our growth and health. Explain.
7. Discuss fluorine under sources, deficiency and excess.

10.6: Further Reading

- Hand book of food and Nutrition- M swaminathan
- Nutrition Science- B. Srilakshmi

- Sasmita Mohanty

Lesson - 11

WATER BALANCE

11.0 OBJECTIVE :

The objective of this lesson is to explain the importance and function of water in human body, further it also explains the deficiency and excess water intake on water balance of the body and the treatment of deficiency of water.

STRUCTURE :

11.1: Introduction

Water is the largest constituent of the body, about 60-70 percent of the total body weight consisting of water. Water is an essential nutrient next only in importance to oxygen. Deprivation of water even for a few days can lead to death. The water content of soft tissues ranges from 70-80 per cent while that of bone about 20 percent.

Body water is distributed as follows; 1. Inside the cells of tissue- intracellular water (50 per cent); and ii. Outside the tissues cells- extra cellular water (20%). The extra cellular water is further subdivided into i) Water in blood plasma (about 4%), ii) Interstitial water- water in tissues space (9%) 111) Lymph in the lymphatic vessels (7%). Additional minor divisions of extra cellular water are cerebrospinal fluid and aqueous humour (in the anterior chamber of the eye).

11.2:Functions :

Water performs its functions within the body by acting as the following:

1.Part of structure: Water is a part of all tissues and is essential for growth. Glucogen is two-thirds water, Fat tissue is one- fifth water and muscle is close to three-fourths water.

2.Turgor: The cell water and its contents in solution provide a normal turgor or fullness to the tissues, a distension or degree of rigidity of the cells resulting from the fluid pressure of the cell contents on the cell membranes. Without this normal tissue turgor that cell water makes possible, the body from would not exist.

3.Solvent: Water is the solvent of life. In the presence of water as a solvent, many metabolic reactions of life are able to proceed and the remaining chemicals can react together to generate the integrated chemical complexity of a living body. By being dissolved in or otherwise exposed to intracellular and extracellular water, the chemistry of life gains the fluidity and flexibility that makes life possible.

When food enters the body, it is soon exposed to the watery secretions of saliva and the watery solutions in the stomach and intestine that allow the food to mix with and react with the compounds responsible for digestion. The digested nutrients are then absorbed into the blood, which contains an average of about 3 liters of water. It is this intravascular water that actually makes blood a fluid and allows absorbed nutrients to dissolve in blood and so be transported to every tissue of the body. The water of blood also acts as a solvent transporting many internally generated substances such as hormones and antibodies from their sites of manufacture in the body to the sites where they perform their function. Waste products of metabolism, such as carbon dioxide and urea also dissolve in the intravascular water to be transported to the lungs or kidneys for excretion.

The 12 liters or so of intercellular fluid found in the spaces between cells, carry nutrients from the blood capillaries to the outer membranes of the body's cells, allowing them to be transported across the membranes and into the watery intracellular fluid within the cells. Within cells the intracellular water serves as a suitable medium for nutrients to be transformed into the compounds needed to build and maintain cells.

Water is a solvent for electrolytes. It helps to regulate the electrolyte balance of the body maintains a healthy equilibrium of osmotic pressure exerted by the solutes dissolved in water. Some of the compounds of the body are not dissolved in water, such as the lipid- based cell membranes, but water plays an Important role in allowing such as the lipid based cell membranes, but water plays an important role in allowing such structures to form and maintain their structural integrity.

4. Reactant: Water is a reactant that participates directly in variety of different reactions within the body. Water is also formed as a product of many chemical reactions within the cell, such as the reversal of hydrolysis, known as condensation.

5. Lubricant: Water based fluids act as lubricants in various parts of the body, most notably within joints, where synovial fluid makes movement easier and minimizes wear and tear on cartilage and bone. The water in saliva and mucus acts as lubricant in the mouth and oesophagus.

6. Temperature Regulator: Water plays an important role in the distribution of heat throughout the body and the regulation of body temperature. Heat in the body is generated by the metabolism of the energy yielding nutrients. All of the energy released by the oxidation of these nutrients is eventually released as heat, apart from any stored within the compounds involved in net growth.

Some of this heat, is required to maintain the body's normal temperature of 98.6°. The excess heat must be released to the surrounding because any significant rise in temperature to above normal levels causes illness and eventually death. Some heat is lost by the radiation and simple conduction between the body and the air. The most effective route of heat loss from the body, however, is via the evaporation from skin is accompanied by the loss of 600 Kcal of heat energy from the body.

11.3: Water Balance :

In normal individual the maintenance of water balance is achieved by adjusting the input verses the output. The input of water as well as its loss can be highly variable due to individual habits and environmental factors. In spite of this the total body water needs to be maintained constant to achieve normal osmolality for physiological functions.

	Temperature Cliamate (ml)	Tropical Cliamate (ml)
Water intake:		
Drinking Water	1500	
In Food	1000	2000-5000
By oxidation of carbohydrates	300	300
Fats and proteins in tissues		
Total	**2800**	**3300-7300**
Water loss:		
In urine	1500	1000-1500
Via skin	800	1800 - 5200
Via lungs	400	
In faces	100	400
Total	**2800**	**3300-7300**

Water balance is achieved in two ways- regulation of fluid intake through changes in thirst sensations and regulation of fluid loss through the kidneys.

Thirst mechanism: The intake of fluid is regulated by mechanism of thirst. A deficient intake of water with continuing' obligatory losses leads to concentration of body fluids with respect to solutes and a rise in osmotic pressure. This tends to draw water from ICF, the dehydration of the cells seems to be the main stimulus for their mechanism through osmoreceptors as well as sensory nerves of mouth and pharynx, which respond to dryness of the mouth and pharynx.

Kidneys: Internal circulation of salt's is a process where the principal ECF ions enter the lumen of GI tract and renal tubules and their near complete reabsorption regulates electrolyte levels. This process constantly occurring in the kidneys, as at a much faster rate than that observed in the GI tract.

11.4: Electrolyte Balance :Electrolytes namely sodium, potassium are present in intracellular and extracellular fluids. The concentration of electrolytes is affected by water balance, sodium

chloride intake and intake of other minerals present in the diet. The body has several mechanisms by which it can keep the electrolyte balance in the intracellular fluids at a constant level. Gastrointestinal tract constantly regulates electrolyte levels. About 8 liters of fluid of different electrolytes enter GI tract every day and are reabsorbed almost completely.

When too much fluid is lost, the concentration of electrolytes, particularly sodium in the extracellular fluid increases. This increase will cause water to be absorbed from the saliva, leaving a dry sensation in the mouth that stimulates thirst then fluid intake. In addition, the hypothalamus in the brain responds to the higher sodium content of the blood in two ways; it stimulates the thirst sensation and it also signals the pituitary gland to release the antidiuretic hormone (ADH- also known as vasopressin as it elevates blood pressure) which influences the kidneys to reabsorb more water, restoring blood volume to a normal level. As water is reabsorbed, the volume of the urine decreases. Conversely, when the level of sodium in the fluid being filtered through the kidneys is low, The kidneys release a substance that triggers another hormone, aldosterone. This hormone causes the kidneys to retain more sodium. Stimulation of thirst secretion of ADH is triggered by changes in sodium concentration of as little as 1 per cent.

11.5 Sources:

Water ingested as such in the source from which maximum water is obtained by the human body. In addition to this all beverages contain water and thus contribute water to the system whenever they are consumed. Certain metabolic reactions carried on inside the body also release water and this is one of the sources.

11.6 Water Depletion :

Water can be depleted in the body due to reduced intake or increased losses. The possible reasons for these are given below:

Reduced intake

- Water unavailable : After a calamity like shipwreck, earthquake or floods.
- Inability to obtain water : Infants, elderly and debilitated patients, unconscious patients.
- Inability to swallow : Diseases of mouth and esophagus

Increased losses

- From the skin : Hot environment, excessive exercise, fever, hyperthyroidism.
- From the lungs: Hyperventilation, fever, high altitudes.
- From the alimentary tract : prolonged vomiting, diarrhea
- In the urine :Osmotic diuresis in diabetes mellitus, too concentrated food e.g. with tube feeding and infant milk powders. Drinking sea water, various kidney disorders, diabetes insipudes.

11.7: Deficiency :

Evidence of dehydration is sunken features, particularly the eyes which recede into the orbit. The skin becomes loose and lacks elasticity. On pinching, it stands away from the subcutaneous tissues. The patient is usually but not always thirsty.

Water deprivation causes a reduction in the volume of extracellular fluid and intracellular fluid. The urine output is reduced. There is a rapid decrease in body weight and a state of dehydration of the cells occur. After a few days, a decrease in plasma volume occurs which will reduce cardiac output and lead to circulatory failure.

Dehydration of the body comes about when water is not taken in adequate amounts to make up for the water loss. Dehydration occurs rapidly in severe diarrhea and vomiting in infants and children. The EFC id reduced in volume and its electrolyte content and osmotic pressure increase. Water is consequently drawn from ICF to ECF. The initial water loss is from the EFC but in later stages water is lost from the IFC.

The amount of rehydration that is needed depends on the size of the of the individual and the degree of dehydration. Rehydration is generally adequate when the person no longer feels thirsty and has normal urine output.

11.8;Treatment :

Oral rehydration therapy (ORT) is widely considered to be the best method for combating the dehydration caused by diarrhea or vomiting. It is a simple, cheap and effective treatment. It consists of a solution of salts and other substances such as glucose, sucrose, citrates or molasses, which is administered orally.

One standard remedy is the WHO/UNICEF glucose based Oral Rehydration Salts (ORS) solution. WHO/UNICEF ORS solution contains

Reduced osmolarity ORS	Grams/litre	Reduced osmolarity ORS	Mmol/ Litre
Sodium chloride	2.6	Sodium	75
Anhydrous Glucose	13.5	Anhydrous Glucose	75
Potassium chloride	1.5	Chloride	65
Trisodium citrate dihydrate	2.9	Potassium	20
		Citrate	10
		Total Osmolarity	245

11.9 Excess :

Over hydration leads to an increase in intracellular water and is a potentially dangerous and even lethal condition. There is difficulty in concentrating, downsiness and giddiness sometimes associated with headache and nausea. In severe cases there may be confusion, behavioral disturbances, convulsions and coma. Hyponatremia is commonly caused by either retention of water or loss of sodium. Loss of potassium may cause hyponatremia as sodium shifts into the cell in exchange of potassium.

11.10 Requirements :

The amount of water needed by an individual will depend on many factors such as the environmental temperature, humidity, occupation and the diet. In general, part from water obtained in the food an individual may need to drink about 1.5 to 2 liters of water per day. An athlete or a player playing a strenuous game such as football may lose several liters of water and dissolved salts during the game and would need replacement early. On the other hand, a sedentary individual would need much less water.

11.11 Conclusion :

Water is the largest and main constituent of the body. It is the universal solvent. Water has so many functions that the body can not survive even for a few days without it. There is always a proper balance maintained in the body reacts to the deficiency and excess of water immediately in order to maintain balance.

11.12: Key Words

1. Oral rehydration therapy (ORT): It is a simple, cheap and effective treatment. It consists of a solution of salts and other substances such as glucose, sucrose, citrates or molasses, which is administered orally.

2. Dehydration: Water deprivation causes a reduction in the volume of the extracellular fluid and intracellular fluid. The urine output is reduced. There is a rapid decrease in body weight and a state of dehydration of the cell occur.

11.13 : Self Assessment Questions

1. Write about requirement of water.
2. What are the ways of losing water from the body? How much water is lost every day?
3. What are the sources of water for the body?
4. What happens when the deficiency of water takes place in the body? Give the treatment for it.

11.14: Further Readings :

1. Nutrition Science by B. Srilakshm

- Sasmita Mohanty

Lesson - 12

EFFECT OF COOKING & HEAT PROCESSING ON THE NUTRITIVE VALUE OF FOODS

12.0 OBJECTIVE :

The objective of this lesson is to improve their digestibility and appearance, to develop new flavors and to destroy harmful microorganisms present.

STRUCTURE :

12.1 Introduction

Nearly all food stuffs, with the exception of fruits and some leafy vegetables used either as salads or in chutneys, are consumed after cooking. The nutritive value of any food stuff should strictly speaking, be assessed on the cooked material, the state in which it is consumed and not in its raw state. But culinary preparation practices vary from province to province, district to district and even house to house.

12.2 Effect of cooking on Various Nutrients

Carbohydrates: Cooking is essential for the proper digestion of starch which is the main source of calories in the diets of a large majority of the population in the developing countries. Cooking also helps the breaking of cell walls in vegetables and thus facilitates digestion of protein present in them. When heat is applied to moist starch, the starch granules swell and burst and the starch.

Fat: Cooking, under ordinary household conditions, has very little effect on fats; but during prolonged heating a sin frying for long periods, a part of the essential fatty acids present is destroyed and toxic polymerized products are formed.

Proteins: Application of moderate moist heat to proteins causes coagulation and shrinking. Moderately cooked proteins are more easily digested than raw proteins. But serve heat processing such as roasting, baking and frying has been reported to have adverse effect on the nutritive value of the proteins of certain cereals, oilseeds and animal foods.

The adverse effect is due to the reaction of the amino group of the essential amino acid – lysine in the intact protein with reducing sugars present in them. This reaction is known as 'Maillard

reaction'. In addition to lysine, certain other amino acids e.g. arginine, truptophan and histidine may also react with reducing sugars when the heat processing is drastic. On the other hand, the nutritive value of the proteins of legumes is improved to a considerable extent as a result of heat processing.

Vitamins

Vitamin A and carotene: As these are insoluble in water, no loss occurs by discarding cooking water. There is slight destruction of vitamin A and carotene during cooking in water due to oxidation by air. Frying or roasting of vegetables caused considerable losses of vitamin A carotene.

Thiamine: Loss of thiamine during cooking occurs in two ways: i) its destruction by heat during cooking and ii) its dissolution in the cooking water. Hence, the quantity of thiamine lost during cooking varies depending on the method of cooking. Discarding the cooking water accounts for a loss of nearly 20-50 per cent depending on the quantity of water used in cooking. If sodium bicarbonate is added to dal during cooking, most of the thiamine is destroyed. Hence cooking soda should not be added to dal for improving their cooking quality. The loss of thiamine during cooking, under pressure is greater than that occurring during steaming.

Riboflavin: Loss of riboflavin during cooking occurs in four ways: i) exposure of the food during cooking to strong light, ii) loss of riboflavin due to heat iii) loss of riboflavin due to leaching by discarding excess of cooking water and iv) loss of riboflavin due to addition of cooking soda during cooking of dal and vegetables. Bottled milk exposed to strong sunlight loses a part of riboflavin present.

Nicotinic acid: Loss of nicotinic acid occurs by leaching of the vitamin when excess cooking water is discarded.

Pantothenic acid: Loss of pantothenic acid during cooking occurs in two ways: i) by leaching of the vitamin when excess cooking water is discarded ii) by heat during toasting and frying.

Pyridoxine: Loss of pyridoxine during cooking occurs in two ways: i) by destruction due to excessive heat as in cooking under pressure and ii) by leaching of the vitamin when excess cooking water is discarded.

Folic acid and vitamin B_{12}: Losses of folic acid and vitamin B_{12} during cooking occur in two ways: i) destruction by heat as in pressure cooking, toasting or frying ii) by leaching when excess cooking water is discarded.

Ascorbic acid: Loss of ascorbic acid during cooking occurs in two ways: i) by oxidation due to exposure to air during cooking and ii) by leaching in water when excess cooking water is discarded. Contamination with copper also accelerates the rate of destruction of the vitamin. The quantity of ascorbic acid lost during cooking of vegetables may vary widely from 10 to 60 per cent depending on the vegetable cooked and the method used.

Minerals

Calcium and phosphorus: Losses of calcium and phosphorus during coking occur when excess of cooking water is discarded. When rice and vegetables are cooked in hard water, appreciable amounts of calcium present in the water are incorporated in them.

Iron: Loss of iron during cooking can occur if excess of cooking water is discarded. When vegetables are cut with iron knives, appreciable amounts of iron are incorporated in the vegetables. When foods are roasted in cast iron pans, appreciable amounts of iron are incorporated in them.

Sodium, potassium and magnesium: Losses of sodium, potassium and magnesium occur by leaching, when excess of water used in cooking is discarded. Sodium chloride used in cooking increases the sodium content of cooked foods.

Trace elements: Losses of trace elements occur by leaching when excess of water used in cooking is discarded.

Cereals: Cereals are cooked or heat processed before consumption. The effects of cooking on the nutritive value of rice and of baking on the nutritive value of wheat are discussed below. Cereals are also processes into breakfast cereals and consumed widely.

Rice: Rice is generally washed and then cooked in excess of water. The gruel present in cooked rice is usually drained off. These process cause marked losses of thiamine, nicotinic acid and other B- vitamins in case of home pounded and milled raw rice.

Wheat: The effect of baking on the nutritive value of wheat is briefly discussed below.

Bread: Pale, medium and dark baked bread retained 82.1, 80.4 and 73.8 per cent of thiamine respectively.

Breakfast cereals: Breakfast cereals are prepared on a large scale in many countries from different cereals such as corn, wheat, rice, oats etc. They are extensively consumed as they do not require any cooking. The heat processing involved in their manufacture is, however, somewhat drastic and many of the B- vitamin are likely to be destroyed to a great extent. The heat processing also is likely to affect adversely the quality of the proteins.

Legumes: Legumes are good sources of proteins and B- vitamins. They form excellent supplements to cereal diets. Many legumes suffer from the disadvantage In containing trypsin and growth inhibitors which affect adversely the nutritive value of the proteins.

Soaking and cooking: Soaking in water overnight is the first step in cooking whole legumes. The soaked legumes are then cooked for 20-30 minutes by boiling in water before consumption. The losses of nutrients in the water will be small if the sees coat is intact.

Steaming or cooking under pressure: When legumes are soaked in minimum amount of water and cooked in steam under pressure, growth and trypsin inhibitors present in them are destroyed and the nutritive value of the proteins is enhanced.

Germination: The fact that germinated or sprouted legumes will prevent and cure scurvy has been known since 18th century. On germination, the vitamin C content of legumes has been found to increase.

Toasting and puffing: Toasting improves the taste and acceptability of legumes. As a result of toasting, the trypsin and growth inhibitors present are destroyed, thus bringing about an improvement in the nutritive value of proteins. Tasting at high temperatures for prolonged periods may affect adversely the nutritive value of the proteins as the available.

Oilseeds and nuts: The effect of heat treatment on the nutritive value of peanut and cashew nut is discussed below:

Peanut (Groundnut)

Roasted peanut: Moderate roasting of peanut causes destruction of appreciable amount of thiamine. The trypsin inhibitors present in it is destroyed, resulting in an improvement in the nutritive value of proteins.

Roasted cashew nut: Roasting of cashew nut brings about appreciable loss of thiamine present.

Fat and oils: Application of heat as in frying brings about destruction of a part of the vitamins A and E and essential fatty acids present in them. In rancid fats, peroxides are formed. These will destroy a part of the vitamins A and E present in them.

Milk and milk products: Milk is processed in several ways for human consumption. The effects of various methods of processing on the nutritive value of milk and milk products are given below

Pasteurization: During pasteurization, about 20-30 percent of vitamin C is destroyed. The other vitamins are not affected to an appreciable extent.

Effect of exposure of bottled milk to sunlight: When bottled milk is exposed to sunlight or artificial light, there is considerable amount of destruction of riboflavin, vitamins A and C.

Sterilized milk: The relatively prolonged and drastic heat treatment brings about appreciable losses of several vitamins- thiamine, 30-40 per cent, vitamin C, 50-60 per cent etc.

Evaporated milk: There is destruction of vitamin C, vitamin **B6**, thiamine and vitamin **B12** to the Extent Of 50-80 Percent.

Sweetened condensed milk: The losses of vitamins in sweetened condensed milk are similar to those of evaporated milk.

Milk powder: During the preparation of milk powder, vitamin C is destroyed to the extent of 70-90 per cent. The losses in other vitamins are small. During storage of milk powder, however there is progressive destruction of vitamin A.

Egg powder: Vitamin A is slowly destroyed during storage, the loss of vitamin A at the end of 6 months storage at 15° F, 70° F and 98° F being 40, 50 and 70 per cent respectively.

Fish products: The loss of vitamin A in canned fish is negligible. The losses of vitamin B may range from 50-70 per cent.

Meat products: The losses of B- vitamins during the curing of ham amount to about 20-40 per cent. The loss of thiamine is quite high during canning of meat. The losses of other vitamins may range from 50-70 percent.

Poultry: The losses of thiamine in canned poultry meat may range from 60-70 percent and vitamin B 40-50 percent .In contrast to high sterilization temperature required for canned poultry, precooked frozen poultry can be prepared under relatively mild processing conditions.

Vegetables: Vegetables are cooked either in steam or by boiling in water. During the above processes a certain amount of vitamins present in them is lost. The losses of thiamine amount to 15-32 per cent, riboflavin 9-20 percent and of ascorbic acid 23-45 percent.

Dehydrated fruits: The losses of vitamins during dehydration will depend on the method of drying and on the stability of the vitamin to heat and air. Carotene losses are quite high (50-70 percent)

during sun drying of fruits. As in the case of vegetables, sulphuring causes losses of thiamine to the extent of 50-60 percent. Riboflavin loses are low.

Canned fruit juices: The loss of ascorbic acid during canning of fruit juices may range from 20-40 percent. The losses of B-vitamin are low.

Canned fruits: Canned fruit products lose considerable quantities of ascorbic acid and thiamine as a result of processing and storage. Higher storage temperatures accelerate these losses.

12 . 3 : Retention of Nutritive Value while Preparation

Ordinary cooking causes little loss of protein, fat and carbohydrates in cereals, pulses and meat. In vegetables, however there may be some protein loss on boiling in water, particularly when salt is used in cooking and the cooking water is discarded. If cooking water is thrown away there is considerable loss of mineral salts especially of sodium, potassium and chlorine due to leaching.

It is therefore advisable either to use the minimum amount of water or to utilize the cooking liquor in either wet or dry methods of cooking because the skin of most root vegetables prevents leaching out of the nutrients. It is, therefore, preferable to boil them with their skins. It is not advisable to cut the vegetables ling before they are ready for boiling. They may be cut in to as big piece as possible, added immediately to water which has already been brought to boil and cooked for as short a time as possible. The cooking water can be made use of in the preparation of soups. Losses due to leaching are less if vegetables are steamed.

Certain amount of minerals and vitamins are lost even during the preliminary treatment of washing prior to cooking. It is a common practice for the house wife's to wash rice three or four times with large amount of water before cooking considerable amounts of minerals pass into the water, the proportion removed being greater than that removed by subsequent cooking. The surplus liquor strained away after cooking rice, also carries wit it a small portion of the vitamin and minerals. It is a good practice to wash the rice only f necessary with the least quantity of water and cook rice by absorption method.

More than minerals, it is the vitamins, particularly the member of water soluble group, that show greater loss as a result of cooking. Vitamin A carotene is not affected when food stuffs are cooked in water. But in shallow frying or roasting there may be considerable loss of this vitamin. In the preparation of chips etc, in which vegetables are cut and tried immediately in hot deep fat for short time, the loss of vitamin A is perhaps not high.

The loss of thiamine due to cooking may be partly by destruction during cooking and partly by dissolution of the vitamin in the cooking water. If excess water is used and cooking water is discarded loss of as much as 50 percent if the vitamin can occur. If soda is added, especially while cooking dal the color of the dal can be preserved.

Conversely, a substance, like tamarind, with acidity if added to cooking water, has a preservative effect on the vitamins. It may be preferable to cook leafy vegetables wit lid on with minimum exposure to air and in minimum quality of water. The dishes must be consumed immediately after cooking.

Excessive heating of food stuffs may, however, affects the nutritive value of protein adversely by rendering source of amino acids. Contained in the protein unavailable to the body. Excessive or prolonged heating should therefore be avoided, especially when large quantities of substances like jaggery are used in the preparation.

12.4 Some Simple Rules for Retaining Nutritive Value and Flavor :

1. Wash vegetables before cutting
2. Cut vegetables just before cooling and introduced cut vegetable into boiling water, if to be cooked in water.
3. Use just enough water for cooling, if the vegetables ar other foods are to be served as such.
4. Cook food until just done and serve immediately.
5. When preparing soups, the slowest cooling ingredients should be added first, followed by addition of other ingredients, which cook in shorter time.
6. Spices and other flavor ingredients should be added in the oil used for seasoning, as the flavor compounds which are soluble in fat, are easily dispersed in the preparation with the oil or fat.
7. Vegetable salads should be prepared just before serving.
8. Use acid foods, such as lime juice, tomatoes, vinegar or yogurt as dressing in salads prevent loss of vitamin C, because it is stable in acid medium.
9. Fruits are best eaten as they have been eaten in tropics. Bananas are eaten right after peeling. Oranges are usually sucked after peeling. Grapefruit is usually peeled and eaten. Mangoes are sucked to get the juice. In this manner of eating, no loss of vitamin C occurs, as the fruit is not much exposed before eating.

12.5 Conclusion :

It is important that efforts should be made to retain the nutritive value of foods during preparation. It is also important to ensure that while retaining the nutritive value of the food, palatability is not sacrificed. We can prepare the food just before serving so that relating before service is avoided.

12.7 Key Words

Browning: It is usually observed in foodstuffs, which are stored for prolonged periods, it is also due to the complexing of amino acids with carbohydrates.

12.6 Self Assessment Questions

1. How do you retain maximum thiamine in preparation and cooking of food.
2. What are the effects of excess heat on proteins?

12.8 Further Readings

Handbook of food and nutrition- M. swaminathan

- Sasmita Mohanty

Lesson - 13

BALANCED DIET

13.0 OBJECTIVE :

The objective of the lesson is to explain about balance diet, the nutritional contribution of various food groups and how to get these nutrients in the right amounts in our daily diet.

STRUCTURE :

13.1 Introduction

Foods should be evaluated for their total contribution of nutrients and not solely in terms of one or two nutrients. Similarly, a diet is evaluated in terms of the contribution of its nutrients and how far these nutrients meet body requirements of an individual. Obviously the quantity and the quality of food stuffs in the diet of people varies according to their age, sex and occupation.

To determine the nutrient requirement of a body, it is important to understand what a balanced diet is, to realize the contribution of each food group to the total nutritional content of the diet and the basic dietary pattern laid down for an individual.

13.2: Balance Diet :

A balance diet is defined as one which contains different types of food in such quantities and proportions that the need for calories, minerals, vitamins and other nutrients is adequately met. A small provision has to be made for extra nutrients to withstand short duration of leanness.

Taking into account the foods which commonly from part of Indian diets, balanced diets have been suggested for various age groups of the population and the composition of such diets can be worked out.

13.3.The Five Food Groups :

Group I. Cereals, Roots and Tubers

All these primarily supply energy or calories. Examples of foods in this group are rice, wheat, jowar, bajra, ragi and other cereals, tapioca, potato, sweet potato, arbi, yam- roots and tubers. A significant contribution towards calories, proteins, iron and vitamins is made by this group. These foods are cheap and are taken in large amounts hence their importance in low income group diets. This food group ranks as an important source of thiamine, niacin and iron.

Group II. Protein Giving Foods

The food stuffs in this group are primarily sources of protein, through cereals also furnish protein. Dals, grains, peas, beans, ground nuts, cashew nuts, almonds, coconut milk, curd, butter milk, paneer, khoya, eggs, fish, mutton, chicken, pork and other flesh foods make up this group. It provides protein both from the vegetable and animal kingdom. Milk and dairy products are important sources of calcium and riboflavin. They are second only to the meat group for their protein contribution. Meat, fish and eggs rank first for their protein, iron and niacin content.

Group III. Fats/ Oils, Sugar/ Jaggery

All these food stuffs supply energy or calories- vegetable oils, vanaspati, ghee, butter, cream, sugar, jaggery. This group constitutes about 1/6th of the energy value of the diet, but does not add appreciably to the protein, mineral or vitamin levels. Although oils should be used sparingly in the diet they add taste and flavour to the food. In India, commonly available cooking oils include mustard oil, coconut oil, til oil, ground nut oil, palm oil and sunflower oil.

Group IV. Protective Vegetables and Fruits

These are mainly suppliers of minerals and vitamins e.g.

Class A. Green leafy vegetables, spinach, fenugreek leaves, colocasia leaves, kulfa and similar greens.

Class B. Yellow or orange fruits and vegetables- papaya, mango, carrots, yellow pumpkin

Class C. Fruits and vegetables rich in vitamin C- amla, guava, lemon, orange, phalsa.

They are mainly the suppliers of minerals and vitamins. They are the only important sources of ascorbic acid, contribute half of the vitamin A requirement, supply 1/5th of the iron required, making them just below the meat and the flour and cereal groups in importance.

Group V. Other Vegetables

These provide variety in taste and texture and furnish roughage in the diet e.g. fruits, stems, leaves and flowers and plants, lady's fingers, brinjals, bitter gourds and other gourds, cabbage, cauliflower, drumsticks. Diets containing foodstuffs drawn from each of the groups shown in the diagram supply all the essential nutrients in adequate amounts and keep a majority of the

individuals consuming them in a good state of health. It may be useful then at this state to consider in detail how each class of food stuffs suggested in the above diets supplies the daily requirement of the various nutrients.

13.4 Cereals:

In almost every country of the world cereal grains from a very important item of food. Rice is the chief dietary staple for almost as much as 80% of the calories for most of Asia's people. Wheat ranks second to rice in worldwide use, and is the principal cereal grain used in European countries. Corn is widely used in Central and South America.

The main cereals consumed in India are rice, wheat and millets. They are the cheapest sources of calories. In view of the large amount sources of nutrients an average Indian diet. The seed or the kernel of the cereal grain is divided into three parts, the bran the germ and the endosperm. Cereal grains vary some what in composition, the average percentage composition of the whole grain Is Protein 12%, Fat 2%; Carbohydrates 75%, Water 10%; minerals and vitamins 1%.

The quality of the protein of cereal grains is somewhat inferior to that of animal sources because some of the essential amino acids are present in less than the needed amounts. Lysine is a limiting amino acid in wheat, rice and corn, while tryptophan and threonine are also present in very small amounts in corn and rice respectively. Rice protein is, however, richer in lysine compared to other cereal proteins- thus rice protein is of a better quality.

The greater part of the minerals, iron and phosphorus and the B- Complex vitamins are in the bran and germ of the grain. Consequently, most of the nutrients are lost when cereals are highly milled. Thus the vitamins content of the finished product depends upon the degree of the milling and polishing given to the grain. Highly polished raw rice has very poor content of vitamins. Parboiling rice, on the other hand, contains significant amounts of thiamine.

During the course of parboiling, in which the rice is subjected to steaming in water, the vitamin seeps into the inner portions of the grain so that even on being milled and polished, the grain retains significant amounts of vitamins.

Except the yellow maize, which contains some carotene, cereal grains in general do not contain much vitamins A and C. Cereal grains themselves are poor sources of calcium and iron. However, ragi is rich in these minerals, especially calcium; and bajra is a good source of iron. Thus the In inclusion of these cereals as breakfast cereals may serve as a means by which calcium is included in the diet.

13.5 Protein Foods :

This group comprises food stuff which contain mostly proteins, but in widely varying amounts. Animal foods, such as meat, fish and eggs are rich sources of protein. Among the vegetable foods, pulses and nuts are the richest sources of protein with amounts often exceeding those present in animal foods. Soybean is unique in the respect in that it contains over 40% of protein.

Vegetable Proteins:

Pulses is a term which includes dals and grams. These are really important in the Indian diet as sources of proteins because flesh foods are consumed only in small amounts. Pulse proteins, however are of relatively low biological value because of the deficiency of an essential amino

acids, methionine. Red gram is also deficient in tryptophan. However, pulse proteins are rich in lysine and they are, therefore, of good supplementary value to cereal diets. The lysine deficit in cereals is made good by the lysine present in pulses and thus the overall biological value of the cereal pulse diet is better.

In the amounts consumed pulses cannot be considered rich sources of minerals but they are rich in vitamins of B-Group especially thiamine and folic acid. Dried peas do not contain vitamin C in significant amounts, but when they are sprouted they become rich sources of vitamin C. This is particularly true of sprouted green gram dal and sprouted Bengal gram.

Nuts and oil seeds are rich in proteins, contain fats and are good sources of calories. Most of the oil seeds produced in India are used for extraction of edible oils, but the cake left behind is richer in protein than the original seed. Till recently oilseed cakes were not being used as human food to any significant extent. Now oil cake can be used in various ways as food for human beings and 'Protein Isolates' are being produced from them.

Dried groundnuts are leguminous and are widely used in this country. Besides protein, groundnut is rich source of B- complex vitamins especially thiamine and nicotinic acid. However, groundnut protein is poor in the amino acid, methionine.

Animal Protein: Milk serves as the sole food of the young during the most critical period of life. Although the milk of various mammals is used for food, cow's milk is by far the most common. Milk products include cheese, khoya, rabri, curd.

There is no adequate substitute for milk. No food has wider acceptability or offers a greater variety of uses. Milk is a complex substance in which over 100 separate components have been identified. It s fluid in spite of the fact that it contains more solids than many solid foods. Fresh cow's milk contains 85% water and 13% solids. The essential amino acids present in milk proteins are supplied in almost ideal proportions for maximum tissue synthesis. Casein accounts for $4/5^{th}$ of the protein in milk.

Milk supplements cereal proteins in an excellent manner, to supplies the amino acids, lysine and tryptophan which are limited in the cereals. The biological value of proteins in white wheat flour is only 5% when used alone, but this is raised to 75%when milk is used with the wheat flour. The fat of milk is highly emulsified and easily digested.

Milk sugar or lactose is a carbohydrate occurring only in milk. This sugar is particularly adapted to making milk an ideal food for the young, because it is much less sweet, less soluble and more stable than sucrose and other sugars. It gives to milk a brand flavour. Lactose favours the growth of lactic acid producing bacteria which are believed to retard or prevent the growth of putrefying bacteria. Lactose probably favours the absorption of calcium and phosphorus and the synthesis of some B- complex vitamins in the small intestine.

Milk supplies several mineral elements in abundance. Milk product provides a practical basis for meeting the recommended allowances for calcium. Phosphorus occurs in correct proportions with calcium to support optimum skeletal growth. Milk contains appreciable amounts of sodium, potassium and magnesium, but it furnishes very little iron. An infant's diet must be supplemented with iron rich foods at an early age to prevent anaemia.

Milk is an outstanding dietary source of riboflavin and also supplies fair amounts of vitamin A, thiamine, vitamin B_{12} and vitamin B_{12}. It is low in niacin, but is an excellent source of tryptophan, which functions as a precursor of niacin. Milk lacks in vitamin C.

Curd: Whole milk is made into curd by the addition of curd as a starter. Curd contains lactic acid bacteria which cause fermentation and set the milk. All the good nutrients present in the milk remain in the curd. It is, however, more easily digested than milk.

Cheese: The composition of cheese depends upon the kind of milk used- whole or skimmed and the amount of water present. The proteins in cheese contain all the essential amino acids and are therefore, of high biological value. Only a trace of the lactose present in milk remains in the cheese. Depending upon the method of preparation varying amounts of calcium, thiamine and riboflavin are lost.

Eggs: May be used in many ways in breakfast, lunch or dinner dishes. They are excellent sources of protein. In addition to the protein of the highest quality, they contain a good deal of fat, a high content of vitamins A and B; iron, phosphorus and calcium in fair amounts. Only vitamin C is absent. The proteins contained in eggs are so well proportioned in their amino acid composition that egg protein is considered to be a perfect protein. Because of its high biological value and easy digestible, egg protein in other foods. Eggs of different species of birds are said to be similar in nutritive value. Raw egg white contains a protein known as avid which renders the vitamin biotin unavailable to the body. Duck's egg white contains in addition, a substance which inhibits the action of trypsin on protein. Heating egg, as for instance, in the preparation of boiled egg, destroys both avid in and trypsin inhibitor. Cooking makes egg protein easily available to the body.

Fish, meat, poultry and other flesh foods: Regardless of the spices, the amino acid composition in the flesh foods is relatively constant and of such balance and quality that meats, fish and poultry rank only slightly below eggs and milk in their ability to effect tissue synthesis. The meat group is the principal source of cholesterol in the diet. This lipid is not uniformly present in all flesh foods; and brain and shellfish are the outstanding sources.

The mineral element of special importance in the meat group is iron. Meats are also rich in phosphorus, sulphur, potassium; moderately high in sodium and poor in their calcium content. Fish, however, is a good source of calcium, especially the small varieties which can be consumed whole. Salt water fish contain an appreciable amount of iodine. All flesh foods like meat and fish are good sources of B-complex vitamins. Pork, liver and other organ meats are excellent for their thiamine content; poultry is rich in niacin. Vitamin B_{12} which is contained only in foods of animal origin and not in plant foods, is supplied well by organ meats and muscle meats. Flesh foods are generally not good sources of vitamin A, but liver is an outstanding source of vitamin A. Other organs such as kidney contain some vitamin A.

13.6 Fats and Oils

The visible fats which enter the diet are those such as butter and ghee, the various vegetable oils and also vanaspati made by hydrogenation of oils. All fats are concentrated sources of energy and give the same amount of calories per gram. Butter and margarine are the only fats that contain vitamin A. Butter, margarine and hydrogenated fats contain higher proportions of saturated fatty acids than to the vegetable oils. However, vegetable oils have necessarily to be included in the diet to the extent of 15 grams per day in order to provide the body with the essential fatty acids. Some quantity of vegetables oils rice in polyunsaturated fatty acids could also be included.

13.7 Sugar, Jaggery & Honey

Sugar and jaggery are used as sweetening agents in cold and hot beverages and they increase the acceptability of foods. They are purely carbohydrates and are mainly sources of energy. Jaggery contains some iron. Honey, a source of sugars, is also rich in iron.

13.8 Protective Vegetables and Fruits:

Green Leafy Vegetables : are extremely important sources of nutrients in the diet. These vegetables include many items like spinach, amaranth, colocasia leaves, drumstick leaves, mustard leaves and fenugreek. Most of them are rich sources of carotene, vitamin C, riboflavin, folic acid, calcium and iron. These vegetables are, therefore inexpensive sources of many nutrients which are essential for growth and the maintenance of normal health. Turnip greens and mustard0 greens are excellent sources of calcium; but most of their calcium is not nutritionally available. Their high oxalic acid content results in the production of insoluble calcium oxalate which cannot be easily absorbed.

Yellow and Orange Fruits and Vegetables : provides variety to the diet. The deep yellow vegetables and fruits are outstanding for their carotene content. The concentration of the vitamin is directly proportional to the depth of the colour. They are fair sources of the B- complex vitamins. Good examples of fruits and vegetables in this category are papaya, mango, carrots, pumpkin, tomatoes.

Fruits and Vegetables rich in Vitamin C : Fruits like amla, lemon, orange and cashew fruit contain vitamin C. it is a rich source of sugar, vitamin B_1 and B_2. Bananas, besides being rich in starch, contain some vitamin C. Among the beat contributors of ascorbic acid to the diet are the citrus fruits.

Other Vegetables : This group includes practically every part of the plant- leaves, stem, roots, tubers, bulbs, flowers and seeds. Many vegetables like brinjals, beans and peas of many kinds, gourds, pumpkin and ash gourd, snake gourd, bitter gourd, green plantain, lady's finger and drumsticks can be used in the diet. While these add variety and flavour to food, they supply some minerals and vitamins also. The skins, seeds and fibers of fruits and vegetables are also of value in the maintenance of the normal gastrointestinal motility by contributing some indigestible fibre which is useful as roughage.

13.9 Planning of balance diet :

Recommended daily allowances (RDA) and the basic 5 food groups are the basis of planning of balanced diets. RDA indicated the nutritional requirements for various age groups while the basic 5 food groups help in choosing the appropriate foods to meet these requirements.

13.10 Recommended Dietary Allowances Dietary Allowances :

To plan and calculate balanced diet there is need to know Recommended Dietary Allowances (RDA) for different age groups prescribed by Nutrition Expert Committee of ICMR.

Table-2 Recommended Dietary Allowance for Indians - 1989

Group	Particulars	Body wt	Net energy	Protein	Fat	Calcium	Iron	Vitamin A		Thiamine	Riboflavin	Nicotinic acid	Pyridoxin	Ascorbic acid	Folic acid	Vit. B_{12}
								Retinol	β-carotene							
		kg	Kcal/d	g/d	g/d	mg/d	mg/d	µg/d	µg/d	mg/d	mg/d	mg/d	mg/d	mg/d	µg/d	µg/d
Man	Sedentary work		2425							1.2	1.4	16				
	Moderate work	60	2875	60	20	400	28	600	2400	1.4	1.6	18	2.0	40	100	1
	Heavy work		3800							1.6	1.8	21				
Woman	Sedentary work		1875							0.9	1.1	12				
	Moderate work	50	2225	50	20	400	30	600	2400	1.1	1.3	14	2.0	40	100	1
	Heavy work		2925							1.2	1.5	16				
	Pregnant woman		+300	+15	30	1000	38	600	2400	+0.2	+0.2	+2	2.5	40	400	1
	Lactation															
	0-6 months	50	+550	+25	45	1000	30	950	3800	+0.3	+0.3	+4	2.5	80	150	1.5
	0-12 months		+400	+18						+0.2	+0.2	+3				
Infants	0-6 months	5.4	108/kg	2.05/kg		500				55µg/ kg	85µg/ kg	710µg/ kg	0.1	25	25	0.2
	6-12 months	8.6	98/kg	1.65/kg				350	1400	50µg/ kg	80µg/ kg	650µg/ kg	0.4			
Children	1-3 years	12.2	1240	22			12	400		0.6	0.7	8			30	
	4-6 years	19.0	1690	30	25	400	18	400	1600	0.9	1.0	11		40	0.5	40 0.2-1.0
	7-9 years	26.9	1950	41			26	600	2400	1.0	1.2	13	1.6		60	
Boys	10-12 years	35.4	2190	54			34	600	2400	1.1	1.3	15	1.8	40	70	0.2-1.0
Girls	10-12 years	31.5	1970	57	22	600	19			1.0	1.2	13				
Boys	13-15 years	47.8	2450	70			41	600	2400	1.2	1.5	16	2.0	40	100	0.2-1.0
Girls	13-15 years	46.7	2060	65	22	600	28			1.0	1.2	14				
Boys	16-18 years	57.1	2640	78			50	600	2400	1.3	1.6	17	2.0	40	100	0.2-1.0
Girls	16-18 years	49.9	2060	63	22	600	30			1.0	1.2	14				

Age : An adult required more total calories than a child due to larger size of the body and increase in activity. Growing child require more calories and proteins per kilogram of body weight than an adult.

Sex : A woman required less calories than a man as the BMR is lower and size of the body is less.

Physical Work : Sedentary worker requires less calories and vitamin B than heavy worker.

Physiological Stress : During pregnancy and lactation period the requirement of nutrients is increased.

13.12 Conclusion

It is tedious, time consuming and impractical to plan a diet with RDA. Hence nutritionists have grouped foods depending upon the nutrient content. This food groups system is convenient in formulating normal as well as therapeutic diets. The satisfaction derived by the individuals consuming the meals is a measure of successful planning.

13.14Key Words

Balanced Diet: is defined as one which contains different types of foods in such quantities and proportions that the need for calories, minerals, vitamins and other nutrients is adequately met.

RDA: Recommended daily allowances indicates the nutritional requirements for various age groups while the basic 5 food groups help in choosing the appropriate foods to meet these requirements.

13.13Self Assessment Questions

1.What do you understand by the term a balance diet? How does a knowledge of food groups contribute towards the planning of an adequate diet?

2.What are the five basic food groups and what nutrients does each contribute to the diet?

13.15Further Reading

Handbook of food and nutrition- M. swaminathan

- Sasmita Mohanty

Lesson - 14

MEAL PLANNING

14.0 OBJECTIVE :

The objective of the lesson is to plan meals based on recommended daily allowance following 5- food groups system. Further it explains about the importance of meal planning, principles of meal planning, factors affecting meal planning and examples of low budget diets.

STRUCTURE :

14.1 Introduction

Meal planning is both an art and science: an art in the skilful blending of color, texture and flavour and a science in the wise choice of food for optimum nutrition and digestion. A well planned meal is always appealing to the eye and it is rightly said that "we eat with our eye". Therefore, we should obtain adequate nutrition by including foods from all the food groups in sufficient quantity and proportion.

Meal planning means planning for adequate nutrition. It is well known that poor food habits are easily acquired. It is not always easy to remember what to eat in abundance today or what to compensate for tomorrow. A man's aim should be to eat to live and no to live to eat. Meal planning is an art which develops through inspiration and thought.

It may seem difficult as first but it is a skill which grows with practice. While planning family meals, the home maker plays an important role. Along with money available, time, energy, knowledge, skills and abilities, human and material resources, all influence the type of food prepared and the way in which it is served.

14.2 The Importance of Meal Planning

MIt is important to plan family meals in order to fulfill the nutritional requirements of the family members. This is essential to keep them strong, healthy, free from disease and deficiency of any kind.

The food planned has to be palatable and appealing to the eye before it can become nutritious. A majority of people will not eat things which they do not like, even if they have excellent nutritive value.

Meal planning is of utmost importance because it economizes on time, labour and fuel. While planning meals the methods of cooking involved can be careful thought out so that there is maximum retention of nutrients and minimum loss.

Meals can be planned according to the budget of the family. There can be maximum utilization of the money if it is spent in the best possible way. One can have a diet rich in quality and nutritive value without buying expensive foods like milk, eggs, butter, meat and a recognition of this will remove misconceptions that only expensive foods are nutritious. Meal planning therefore encourages one to plan within the family's means.

There are such a large variety of food stuffs that it becomes difficult to decide what to cook. A knowledge of the nutritive of foods is very important because it enables one to make a better choice and avoid monotony in the diet.

It is always better to plan meals before starting to cook or even to plan in advance. This will be economical as the left overs from the previous meal can be made use of instead of being wasted. Boiled rice can be used in khichri or some rice pudding. The nutritive value of some foods can also be enhanced by sprouting or fermenting the foods required in advance.

Meal planning determines the adequacy of the diet, the kind of food purchased, its quality and cost, the way it is stored, prepared and served. It is a good exercise for the housewife to record and find out how the meals she serves can be improved, their cost reduced and their nutritive value enhanced.

14.3 Factors Affecting Meal Planning :

No two individuals or families have exactly the same nutritional needs. Hence their diets differ in order to meet their physical, social and psychological needs. There are a number of factors which play an important role in meal planning.

1.Adequacy of Food :

A good menu is one which will not only provide adequate amounts of fats, calories and proteins but also minerals and vitamins essential for the physical well-being of each member of the family. Therefore, the age, sex, occupation, physiological conditions and number of family members must be kept in mind.

Patterns for meals may vary widely but an attempt must be made to provide a diet that will not lead to protein deficiency accompanied by a deficiency of iron. Sometimes deficiency of milk leads to a diet which is low in calcium. Most of the calorie requirements are met by the carbohydrates and fats. A small percentage of calories needed daily is also furnished by proteins. A desirable distribution of calories obtained from the various nutrients is as follows:

Protein	10%
Fats	30%
Carbohydrates	60%

2. **Meal Patterns must fulfill the family needs :**
While planning meals, one should consider the needs and requirements of each individual member of the family. In a family there may be a child, a hard- working man, an adolescent boy and a hard working housewife. The housewife who plans the meals has to see to their different nutritional requirements. The texture and method of cooking food for a young person is unable to digest hard foods and requires soft cooked foods. Young girls have to be given more iron in their diets as compared to boys because of blood loss during menstruation. A heavy worker requires more calories than a moderate worker and so on.

3. **Meal planning should save time and energy and result in easy to cook meals:**
This point is particularly important for the families of low income groups or where the housewife is also working. If the meal consists of too many dishes and each takes a lot of tome to prepare, then the housewife will spend far too much time in the kitchen and become frustrated as other household chores remain incomplete. The meal or diet plan should be such that it involves the minimum amount of time, energy and expenditure.

4. **Individual likes and dislikes :**
Although the recommended daily allowances for each of the classes of food must be followed, there is room for individual preferences amongst the foods in each class. Some people make personal likes and dislikes the only basis for the inclusion or exclusion of certain foods in their meals- the failure to include milk is a common practice. It is always better to change the form of the food rather than to completely omit it. For example, milk can be given in the form of curd, cheese, custard or another sweet dish; soybeans in form of soy flour chapattis mixed with wheat flour.

5. **Suitable Combinations :**
By combining the food in suitable ways, variety in meals can be obtained and variety in meals means acceptability, thus ensuring better nutrition. This can be introduced by changes in color, shape, texture. Flavour and methods of preparation. Attractive color combinations are always appealing to the eye. Texture variation is also essential. All soft or all hard foods will not be liked by an individual. Flavour plays an important role and different flavours introduce variety and meal appeal. Also all foods should not have too sharp a flavour. Various methods of cooking can also introduce variety.

6. **Foods should provide satiety value :**
Foods rich in proteins and fats have a higher satiety value compared to carbohydrates. While planning, consider the interval between the two meals and accordingly include foods. If the interval is longer, give foods rich in proteins and fats. If the interval is longer, give foods rich in proteins and fats. If the interval is short, then give carbohydrate foods.

7. **Availability of foods :**
In earlier times, the dietary habits depended mainly upon the foods produced in a particular area or community, but today with improved methods of food preservation and distribution, even the most perishable foods are available over large areas. The wide variation in dietary patterns throughout the world depends largely upon the available food supply.

8. **Economic Considerations :**
The budget of a family of moderate means cannot provide luxury foods but it can definitely offer variety and choice. Food budgets of low income groups restrict the choices still further and it may become necessary to depend largely on cereals with foods necessary for a balanced diet. Although it becomes difficult to plan, it is nevertheless possible. When the cost per day is low, it is important to have a good knowledge of less expensive foods which have high nutritive value. Such recipes and food should be included in meal preparation.

9. **Seasonal foods :**
Today the seasons play a less important role in meal planning than in former times because fresh frozen foods are available throughout the year. Still foods included in the diet plans should be seasonal because they are cheap and available in good quality and are within the reach of all people.

10. **Religion, Traditions and customs :**
This is an important factor and food habits must be kept in mind while planning meals because they differ from religion to religion. Muslims cannot eat pork where as Hindus cannot eat beef. Rice is considered an auspicious dish at festivals and marriages. Widows are generally not served fish in Bengal. Customs and traditions differ from community to community and hence should be kept in view while planning meals for the family.

14.4 Criteria for Planning the Menu :

The next step would be distribute the foods in food list to different meals like breakfast, lunch, evening tea and dinner. For planning the following points should be considered.

1. Energy derived from cereals should be not more than 75% .
2. Whole grain cereals, parboiled grains or malted grams give higher nutritive value.
3. It is better to include two cereals in one meal like rice and wheat.
4. Flour should not be sieved for chapattias it will reduce bran content.
5. One serving of cereal is 25 g (one chapatti, one katori rice or two phulkas). A day's menu, may require 12-14 servings.
6. Minimum ratio of cereal protein to pulse protein should be 4:1 in terms of the grains it will be 8 parts of cereals and one part of pulses.
7. One serving of pulse is 25gm
8. One serving of vegetable is 75g. Green leafy vegetables can be taken more than one serving if fruit is not included in the diet.
9. It is better to serve the fruit raw without much cooking or taking juice out of it. Everyday diet should contain at least one medium size fruit.
10. There should be minimum milk of 100ml per day. One to two glasses of milk or curd should be included in balanced diet.
11. Energy derived from fats or oils is 15-20% of total calories and 5% from sugar and jaggery.
12. One egg weighs 40 gm . This can be served along with cereal or pulses to improve the quality of protein. Instead, one serving poultry/fish can also be included in the diet.

13. Inclusion of salads and raita not only help in meeting the vitamins requirements but the meals would be attractive and have high satiety value, due to the fibre content.
14. Fried foods cannot be planned if oil allowance is less or in low calorie in the diet.
15. 1/3 of nutritional requirement –at least calories and proteins- should be met by lunch and dinner.
16. Ideally each meal should consist of all the five food groups.
17. Usually the number of meals would be four and for very young and diseased, number of meals can be more.

14.5 Composition of a Balance Diet Suitable for a Normal Adult :

Class of Food	Quantity in Gms
Cereals	400
Pulses, nuts and oil seeds	85
Green leafy vegetables	114
Root vegetables	85
Other vegetables	85
Fruits	85
Milk and milk products	284
Sugar and Jaggery	57
Vegetable oil, ghee etc	57
Fish and meat	85
Eggs	40

14.6 Sample Menu for Low Budget Diet

Size of Family 6
Habit Vegetarian
Status Low income group

Meal	Menu
Breakfast	Missi Roti, chutney, Tea
Lunch	Allo Curry, Cauliflower vegetable, Roti
Tea	Butter milk. Bhel puri, Tea
Dinner	Arhar Dal, Boiled Rice, Beans and carrot vegetables, chapatti, Jaggery

14.7 Conclusion :

A well informed meal planner will keep in mind certain important points, such as nutritional requirements, likes and dislikes of individuals, availability of foods, economic consideration and other resources like time , energy, skill and aptitude. Optimum nutrients can be obtained by giving variety in food, which include fresh salads and sprouts.

14.9 Key Words

1. Meal Planning: It is both an art and a science : an art in the skillful blending of colors, texture and flavour and a science in the wise choice of food for optimum nutrition and digestion. It also means planning adequate nutrition.

14.8 Self Assessment Questions

1. Give the importance of menu planning. Give a sample menu of low budget.
2. What are the criteria's to be born in mind while planning a menu.
3. What are various factors that affect meal planning?

14.10 Further Readings

Handbook of food and nutrition- M. swaminathan

- Sasmita Mohanty

Interchangeable courses appeal to many of today's guests.

However, this menu strategy has its disadvantages. It can overwork a kitchen at peak times, slow table turnover and raise labor costs because of the small, hand prepared food items and elaborate plate preparation and loss of temperature and quality control.

- **Regionalized Menus:** Building on a trend that started in the 1980s, many chain operations are regionalizing their menus to appeal to a larger number of local guests. Regional foods include Cajun cuisine with its blackened entrees', Southwestern cuisine with its liberal use of chilies and California cuisine with its fresh vegetables and goat cheese. "Nostalgic cuisine", also known "comfort food" features foods such as pot roast, meat loaf, and mashed potatoes with real lumps, as well as grilled burgers and blue plate specials. Regional cuisine enables food service operations to feature fresh, high quality local produce that often costs less than imported items. AS the number of fresh items on the menu increases, procedures at the various control points change.

The strategy of regionalizing menus is often driven solely by competition from local independent restaurants. Some national food service chains today dictate only half of the items that must be offered on the menu; the region or locality determines the other half. The goal is to attempt to position the operation as a neighborhood or community eating and drinking establishment. Some chain operations keep their menus the same, but add regional or local ingredients or seasonings to recipes

- **Lighter, Healthier Foods:** Perhaps no other trend has so dramatically affected menu planning as the consumer demand for lighter, fresher, more healthful food choices. Many people in the United States are ordering smaller portions of fresh and light food, such as meat less entrees' and grilled rather than fried items. Healthier alternatives to beef burgers include turkey, garden vegetables, and black bean burgers. Foods prepared with olive oil are perceived to be healthier. Appetizing foods with reduced sodium, cholesterol, fat, and calories are much in demand.

Some operators present nutritional information on their menus, and some use the American Heart Association symbol to highlight items with controlled fat and cholesterol. Others emphasize fresh, seasonal, wholesome food choices. Fresh menu items call for adjustments in purchasing frequencies, receiving schedules, storage procedures and production techniques. As preparation and cooking methods change, the skill levels of staff members and managers must also change.

Some food service operations are coupling their healthy cuisine with an increased emphasis on ecology. Using more recyclable products, rewarding guests who return reusable to go containers. And even replacing matchbooks with small packets of flower seeds are examples of this healthy cuisine- ecology partnership.

- **Ethnic and Exotic Foods:** The menus of most food service operations, both commercial and noncommercial, offer ethnic items from more than one ethnic cuisine. Besides Mexican and Italian, popular cuisines on U.S. menus include Chinese, Japanese and Thai. Mexican food served most in the United States is a blend of the flavors of the southwestern United States and northern Mexico. Often featured at quick service and table service chain and independent restaurants. Mexican cuisine in the United States is variously labeled Gringo Mexican. While these variations appeal to mass markets, other food service operations have decided to promote authentic, regional Mexican cooking. Authentic Mexican cuisines vary. Chilies and other spices are often incorporated

into sauces that are served as optional accompaniments to flavorful, fresh and not overly hot foods,.

Italian cuisine is known for its versatility as well as its popularity. Today, some operations are creating new types of pizzas including four cheese pizzas. Because they often have exotic flavors or unusual ingredients combinations and may require unique preparation techniques, ethnic and exotic foods should be added to a menu with care. Caution must be exercised whenever ingredients or preparation and cooking processes are altered and staff members are not familiar with them. Adding new menus items can result in sanitation and quality problems if staff members are not properly trained.

15.9 Conclusion :

The dual goal of any menu should be to satisfy guests and to meet the financial objectives of the organization. First and foremost, it is important to know the guests and their requirements. The more you know about the guests, the more likely it is that you will build a menu that will satisfy and delight them. It is equally important to keep up with trendy foods that should be considered for possible addition to the menu. In many respects, menu development is never finished; it is an ongoing process.

15.11 Key Words :

Lacto- ovo- vegetarians: An individual who does not eat meat but eats eggs and dairy products in addition to vegetables, fruits, grains and nuts.

Lacto- vegetarian – An individual who does not eat meat but eats diary products in addition to vegetables, fruits, grains and nuts.

Pesco-vegetarian- An individual who does not eat meat but eats dairy products, eggs and fish in addition to vegetables, fruits, grains and nuts.

15.10 Self Assessment Questions :

1. Explain in details how you should conserve the nutrients during purchase and storing.
2. What are some examples of menu trends.

15.11 Key Words :

Lacto- ovo- vegetarians: An individual who does not eat meat but eats eggs and dairy products in addition to vegetables, fruits, grains and nuts.

Lacto- vegetarian – An individual who does not eat meat but eats diary products in addition to vegetables, fruits, grains and nuts.

Pesco-vegetarian- An individual who does not eat meat but eats dairy products, eggs and fish in addition to vegetables, fruits, grains and nuts.

15.12 Further Readings

Managing Service in Food and Beverage Operations- Ronald F. Cichy and Paul E. Wise

Food and Beverage Management- Jack. D. Nenemeir

-Sasmitha Mohanthy

- Keep fresh items wrapped or covered to minimize exposure to air, humidity, and light.
- Minimize the storage time of partially processed fruits and vegetables, which are more susceptible to nutrient losses. Pre-preparation- for example, preparing salads the shift before they are needed- may be good for productivity but bad for preserving nutrients.
- Make sure that the proper storage temperature, humidity, and air-circulation requirements are consistently met. While different products ideally should be stored at different temperatures, this is frequently not practical. This reinforces the need to minimize the time that food products are in storage.
- Dry-storage items should be kept in a cool, dry, and well-ventilated are. An ideal storage temperature is 60 ° F (15° C).
- Fresh fruits and produce items should be stored at refrigerated temperatures and loosely packed; a relatively high humidity is preferable. The ideal refrigerated storage temperature is approximately 40°F (5°C), which is also the recommended temperature for minimizing the growth of microorganisms.
- Proper frozen storage temperatures should be at 0°F (-18°C). Even at frozen temperatures, fruits and vegetables can lose nutrients. Freezing, thawing, and re-freezing of frozen foods also destroy nutrients; these steps should be done with great caution and only when necessary, to help maximize nutritional value.

15.5 Conserving Nutrients During Food Preparation:

Mishandling during storage or preparation can diminish the nutritional content of food. To protect food's nutritional value, food service managers must make sure employees practice basic principles of food preparation designed to retain nutrients.

How Nutrients Can Be Lost: Several issues should be addressed here:

- Cleaning and trimming- Food should not be cleaned or trimmed more than necessary. Vegetables should not be heavily pared since nutrients such as minerals are located just below the skin. If the skin and some of the underskin is removed, many nutrients are lost.
- Oxidation – some nutrients are destroyed on contact with oxygen. Cutting food into small pieces, grinding it, or exposing large surfaces to air can cause vitamin loss. Storage for an excessive amount of time can also cause oxidation.
- Light- sunlight destroys some coour pigments and nutrients. Riboflavin (vitamin B_2) and pigments such keratin (yellow) are especially susceptible to damage when exposed to sunlight.
- Heat- some nutrients such vitamin C and thiamine are changed or destroyed by heat. Therefore, the longer that food is cooked, the greater the chance of destroying these nutrients. Proteins can also be damaged by heat. Toasting bread, for example, can destroy some of the bread's protein content.
- Water- a large number of vitamins and minerals dissolve in water, so you should avoid

soaking food if possible. To retain the maximum number of nutrients, foods that are soaked in water should be cooked in the same water. After the food is cooked, the water can be added to the stockpot or used to make soups, sauces, gravies, and related products.

- Misuse of ingredients- some vitamins are destroyed in an alkaline medium. For this reason, baking soda should not be used in excess when baking nor should it be added to green vegetables during cooking.

15.6 Conserving Nutrients During Food Preparation:

Standard Recipes and Nutrition: Standard recipes are at the heart of quality control processes in food preparation. Nutrition concerns should be addressed as recipes are developed. For example:

- Try to use items that are low in calories, such as fresh fruits and vegetables; carefully consider portion sizes as recipes are developed; use substitute foods such as low-calorie salad dressings and artificial sweeteners, whipping agents, etc., when possible to avoid added calories from fats.
- Recipe procedures can call for items to be sautéed and browned in a non-stick pan, allowing them to be cooked with little or no added fat; cooks can broil with foods suspended to allow fat to drain off the product during cooking.
- Chill cooking liquids to remove fat before use in sauces; trim fat from meat.
- Be careful with recipes requiring organ meats; these meats are high in cholesterol.
- When baking, try to reduce recipe fat amounts by on-third to one-half. Substitutions, such as applesauce or date paste, can often be used successfully to add moisture and texture in place of fats.
- Minimize the use of salt in recipes; substitute herbs and spices.

15.7 Contemporary Dietary Concerns :

Proper nutrition in only one factor in a healthy diet. As scientific evidence grows linking diet and disease, many consumers are making changes in their eating habits in an effort to live longer and be healthier. Contemporary dietary concerns include those relating to:

- Calories
- Fats and cholesterol
- Sodium
- Fiber
- Food allergies
- Vegetarian meals

Calories: although some people want to gain weight, most people watching their calories want to lose weight. An important concern for most diet- and health- conscious people is that food

taste good but not be fattening. Few people want to be over weight. Overweight people then to have more health problems and die younger. There is also strong social pressure to be thin.

As mentioned earlier, a calorie is a measure of energy contained in food. In general, people who consume more calories than they need gain weight; those who consume fewer than they need lose weight. If calorie intake equals the person's energy expenditure, the person's weight remains stable.

How many calories should a person consume? This varies with a person's age, sex, body type, and other variables. Calorie than men because women tend to have a higher proportion of body fat and because they seem to be more efficient users of calories. Activity is another important factor in deciding how many calories a person needs. Professionals football players need for more calories than executives who work behind desks much of the time. Other factors include:

- Body temperature – a person running a fever uses more calories.
- Environment – people in a cold environment need more calories to stay warm.
- Health – people recovering from surgery, trauma, or illness need more calories.

One rule of thumb says that, if you are at your ideal weight, you can multiply that weight by 14 if you are not very active, by 15 if you are relatively active, or by 16 if you active. The number that results is the number of calories you need to eat each to maintain you weight.

Food service managers can meet the needs of people concerned about calories by offering such low-calorie menu alternatives as fresh fruit and vegetables, diet beverages, sugar substitutes, low-fat milk, and reduced-calorie salad dressings. Menus should include information of interest to dieters, such as preparation methods, substitute ingredients, and smaller portion sizes.

Fats and Cholesterol: saturated fats are found primarily in animal foods- meats, lard, butter, whole milk, and eggs. Unsaturated fats are found mostly in foods from plants sources- olives, nuts, corn, soybeans, etc.- and oils made from these and similar foods.

Fats should be avoided by people who wish to lose weight, since fat contains more calories (nine) per gram than any other nutrient. Expert generally recommend that 30% or less of a person's daily calories should come from fats, and no more than 10% of these should be from saturated fats. Saturated fats should be avoided because they contribute to many types of cancer and to high levels of cholesterol. A high cholesterol level may lead to cardiovascular disease. Unsaturated fats are healthier and may even reduce cholesterol levels in some individual.

Cholesterol is a fatty substance found in all animal foods. Humans needs a certain amount of cholesterol to live. The human body uses cholesterol to make vitamin D, bile, and various hormones. It is an important part of brain and nerve cells. However, when a large amount of animal foods especially those high in saturated fats are consumed the body's cholesterol level can become too high. When this happens cholesterol may collect in the walls of arteries and block the flow of blood to the heart and other vital organs. Cardiovascular disease and heart attacks may result.

Food service managers can also provide alternatives to foods that are high in cholesterol- skim milk rather than whole milk, egg whites rather whole eggs. A variety of low cholesterol or so

called good cholesterol spreads are available as substitutes for butter and margarine.

Sodium: Sodium is a mineral component of table salt which is used in seasoning or preserving food. Table salt is valued because it heightens the flavour of foods. Too much of sodium in diet however can cause hypertension and may increase the risk of heart attacks and kidney disease.

Food service managers can meet the needs of people concerned with moderating their sodium intake by providing low sodium menu selection. Table service restaurants can place a salt substitute next to the salt and pepper on the table. Also foods and condiments high in sodium such as pickles , olives, ham, bacon, soy sauce must be avoided. With little planning most food service managers can rather easily meet the needs of most people on no added salt diets.

Fiber: It consists of all the indigestive cell walls of plants. Fibers aids digestion by physically separating food particles in digestive tract. It may prevent constipation and may decrease the risk of colon cancer. Food services managers can help guests meet their needs for fiber by including among their menu selections plan- cereals, fresh fruits, raw or lightly steamed vegetables, brown rice and whole grain breads. Food Allergies: Some guests may need to avoid certain foods because they have a food intolerance or a food allergy. A food allergy involves a reaction of a person's immune system to a food item. It is likely that the vast majority of all food allergy reactions are caused by relatively few foods: milk, eggs, legumes, nuts & wheat. Guest typically know the foods that create discomfort for them and will ask about ingredients before they place their orders. It is important that service personnel know ingredients in menu items.

Vegetarian Meals: An ever increasing number of guests are choosing vegetarian meals. Vegetarians can be divided into several types based on what they eat.

- Vegans: Vegetarians who eat absolutely no foods of animal origin including milk, cheese and honey.
- Lacto vegetarian: People who add dairy products to their vegetarian diets.
- Ovo vegetarians: People who add eggs to their vegetarian diets.
- Lacto-ovo vegetarians: Who add dairy products and eggs to their vegetarian diets.

When informed about what type of vegetarian the guest is, chefs can typically offer a tasty, nutritious and attractive offer a tasty nutritious and attractive meal that meets the guest needs.

15.8 Newer Trends in Restaurants :

In recent years, several menu trends have had a dramatic impact of the menu planning control points of all food service operations. These trends smaller portions; regionalized menus; lighter, healthier foods and ethnic and exotic foods are the result of restaurant manager's responses to changing consumer preferences throughout the country.

- **Smaller Portions:** Many guests are interested in sampling a variety of foods in smaller portions, as part of the more casual approach to dinning that emerged in the1980s. This approach calls for mini-meals that can be shared and offers guests a great deal of flexibility. Some restaurants feature expanded appetizer and finger food selections, half portions, and a variety of smaller desserts in response to this trend. Known variously as "grazing" or "modular" cuisine.

Interchangeable courses appeal to many of today's guests.

However, this menu strategy has its disadvantages. It can overwork a kitchen at peak times, slow table turnover and raise labor costs because of the small, hand prepared food items and elaborate plate preparation and loss of temperature and quality control.

- **Regionalized Menus:** Building on a trend that started in the 1980s, many chain operations are regionalizing their menus to appeal to a larger number of local guests. Regional foods include Cajun cuisine with its blackened entrees', Southwestern cuisine with its liberal use of chilies and California cuisine with its fresh vegetables and goat cheese. "Nostalgic cuisine", also known "comfort food" features foods such as pot roast, meat loaf, and mashed potatoes with real lumps, as well as grilled burgers and blue plate specials. Regional cuisine enables food service operations to feature fresh, high quality local produce that often costs less than imported items. AS the number of fresh items on the menu increases, procedures at the various control points change.

The strategy of regionalizing menus is often driven solely by competition from local independent restaurants. Some national food service chains today dictate only half of the items that must be offered on the menu; the region or locality determines the other half. The goal is to attempt to position the operation as a neighborhood or community eating and drinking establishment. Some chain operations keep their menus the same, but add regional or local ingredients or seasonings to recipes

- **Lighter, Healthier Foods:** Perhaps no other trend has so dramatically affected menu planning as the consumer demand for lighter, fresher, more healthful food choices. Many people in the United States are ordering smaller portions of fresh and light food, such as meat less entrees' and grilled rather than fried items. Healthier alternatives to beef burgers include turkey, garden vegetables, and black bean burgers. Foods prepared with olive oil are perceived to be healthier. Appetizing foods with reduced sodium, cholesterol, fat, and calories are much in demand.

Some operators present nutritional information on their menus, and some use the American Heart Association symbol to highlight items with controlled fat and cholesterol. Others emphasize fresh, seasonal, wholesome food choices. Fresh menu items call for adjustments in purchasing frequencies, receiving schedules, storage procedures and production techniques. As preparation and cooking methods change, the skill levels of staff members and managers must also change.

Some food service operations are coupling their healthy cuisine with an increased emphasis on ecology. Using more recyclable products, rewarding guests who return reusable to go containers. And even replacing matchbooks with small packets of flower seeds are examples of this healthy cuisine- ecology partnership.

- **Ethnic and Exotic Foods:** The menus of most food service operations, both commercial and noncommercial, offer ethnic items from more than one ethnic cuisine. Besides Mexican and Italian, popular cuisines on U.S. menus include Chinese, Japanese and Thai. Mexican food served most in the United States is a blend of the flavors of the southwestern United States and northern Mexico. Often featured at quick service and table service chain and independent restaurants. Mexican cuisine in the United States is variously labeled Gringo Mexican. While these variations appeal to mass markets, other food service operations have decided to promote authentic, regional Mexican cooking. Authentic Mexican cuisines vary. Chilies and other spices are often incorporated

into sauces that are served as optional accompaniments to flavorful, fresh and not overly hot foods,.

Italian cuisine is known for its versatility as well as its popularity. Today, some operations are creating new types of pizzas including four cheese pizzas. Because they often have exotic flavors or unusual ingredients combinations and may require unique preparation techniques, ethnic and exotic foods should be added to a menu with care. Caution must be exercised whenever ingredients or preparation and cooking processes are altered and staff members are not familiar with them. Adding new menus items can result in sanitation and quality problems if staff members are not properly trained.

15.9 Conclusion :

The dual goal of any menu should be to satisfy guests and to meet the financial objectives of the organization. First and foremost, it is important to know the guests and their requirements. The more you know about the guests, the more likely it is that you will build a menu that will satisfy and delight them. It is equally important to keep up with trendy foods that should be considered for possible addition to the menu. In many respects, menu development is never finished; it is an ongoing process.

15.11 Key Words :

Lacto- ovo- vegetarians: An individual who does not eat meat but eats eggs and dairy products in addition to vegetables, fruits, grains and nuts.

Lacto- vegetarian – An individual who does not eat meat but eats diary products in addition to vegetables, fruits, grains and nuts.

Pesco-vegetarian- An individual who does not eat meat but eats dairy products, eggs and fish in addition to vegetables, fruits, grains and nuts.

15.10 Self Assessment Questions :

1. Explain in details how you should conserve the nutrients during purchase and storing.
2. What are some examples of menu trends.

15.11 Key Words :

Lacto- ovo- vegetarians: An individual who does not eat meat but eats eggs and dairy products in addition to vegetables, fruits, grains and nuts.

Lacto- vegetarian – An individual who does not eat meat but eats diary products in addition to vegetables, fruits, grains and nuts.

Pesco-vegetarian- An individual who does not eat meat but eats dairy products, eggs and fish in addition to vegetables, fruits, grains and nuts.

15.12 Further Readings

Managing Service in Food and Beverage Operations- Ronald F. Cichy and Paul E. Wise

Food and Beverage Management- Jack. D. Nenemeir

-Sasmitha Mohanthy